HOLDING STATES ACCOUNTABLE FOR HARMFUL ALGAL BLOOMS: FLORIDA'S WATER CRISIS IN FOCUS

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Abstract

Scientists generally agree that agricultural runoff is a principal source of nutrient pollution in the United States. Intensive agricultural practices have resulted in decades of phosphorus and nitrogen accumulating in the natural system which continue to contribute substantially to nutrients entering watersheds. Coupled with failed water quality control measures, this water pollution has led to some of the worst harmful algal blooms (HABs) in recorded history. These nonpoint sources need to be addressed to restore and protect water quality.

Florida's Lake Okeechobee watershed provides an apt case study. Commonly referred to as the "liquid heart" of the Everglades, the lake has experienced a proliferation of large scale HABs, sometimes covering an area of more than 500 square miles and observable from space. These HABs wreak havoc on the lake's ecology. When the lake reaches water levels that pose a flooding risk to communities to the south, the United States Army Corps of Engineers discharges billions of gallons of algae and nutrient laden water to the Caloosahatchee and St. Lucie estuaries on the west and east coasts. These algae blooms cause additional harm and destruction to wildlife in these systems and pose a threat to human health and local economies.

This Article seeks to provide water quality advocates, lawmakers, and government agencies with a regulatory and policy framework for addressing HABs in their states, using Lake Okeechobee and its coastal estuaries as a case study.

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INTRODUCTION

States across the nation are experiencing water quality crises unlike any other in their history.[1] Harmful algal blooms (HABs), namely cyanobacteria and red tide, are making people sick,[2] killing and injuring

1. Robin Lloyd, *A Growing Drinking Water Crisis Threatens American Cities and Towns*, SCI. AM. (Sept. 9, 2022), https://www.scientificamerican.com/article/a-growing-drinking-water-crisis-threatens-american-cities-and-towns/# [https://perma.cc/K9FZ-PVEL].

2. *HABs: Harmful Algae Blooms*, FLA. HEALTH (Mar. 30, 2021), https://www.floridahealth.gov/environmental-health/aquatic-toxins/harmful-algae-blooms/index.html [https://perma.cc/73TM-S3G9]; *see* JENNIFER L. GRAHAM ET AL., U.S. GEOLOGICAL SURVEY, CYANOBACTERIAL HARMFUL ALGAL BLOOMS AND U.S. GEOLOGICAL SURVEY SCIENCE CAPABILITIES 2 (2016) (finding that cyanotoxins have been implicated in human and animal illness and death in at least 43 states).

wildlife,[3] and damaging local economies.[4] Unfortunately, the negative impacts of HABs are only expected to increase.[5] Agricultural, industrial, and municipal wastes, coupled with rising temperatures and changes in precipitation due to climate change, are contributing to the increased intensity, frequency, and magnitude of HABs as well as the production of cyanotoxins, such as microcystins and cylindrospermopsin.[6]

In Florida, the plight of the beloved Florida manatee provides a telling story of the effects of HABs. Over 1,000 manatees died in Florida in 2021,[7] more than double Florida's five-year average.[8] Nearly fifty percent of those deaths occurred in the Indian River Lagoon (IRL), where the suspected cause of mortality was starvation and malnutrition due to nutrient pollution that fueled excessive algae growth.[9] These algal blooms have killed an estimated 46,000 acres of seagrass—the manatee's primary food source—in this important warm water refuge.[10] The extreme die-off

3. Tim Stephens, *Sea Otter Deaths Linked to Toxin from Freshwater Bacteria*, U.C. SANTA CRUZ NEWSCENTER (Sept. 10, 2010), https://news.ucsc.edu/2010/09/otter-toxin.html [https://perma.cc/DW4H-4JZV]; Melissa A. Miller et al., *Evidence for a Novel Marine Harmful Algal Bloom: Cyanotoxin (Microcystin) Transfer from Land to Sea Otters*, 5 PLOS ONE 1, 1 (2015).

4. Walter K. Dodds et al., *Eutrophication of U.S. Freshwaters: Analysis of Potential Economic Damages*, 43 ENV'T SCI. & TECH. 12, 12 (2008); P. Hoagland & S. Scatasta, *The Economic Effects of Harmful Algal Blooms*, *in* 189 ECOLOGY OF HARMFUL ALGAE 391, 391–401 (Edna Granéli & Jefferson T. Turner eds., 2006).

5. Ellen P. Preece et al., *A Review of Microcystin Detections in Estuarine and Marine Waters: Environmental Implications and Human Health Risk*, 61 HARMFUL ALGAE 31, 32, 41 (2017).

6. Rajesh P. Rastogi et al., *Bloom Dynamics of Cyanobacteria and Their Toxins: Environmental Health Impacts and Mitigation Strategies*, 6 FRONTIERS MICROBIOLOGY 1254, 1254 (2015).

7. *2021 Manatee Mortalities*, FLA. FISH & WILDLIFE CONSERVATION COMM'N, https://myfwc.com/research/manatee/rescue-mortality-response/statistics/mortality/2021/ [https://perma.cc/5BLW-8RYD] (last visited Jan. 31, 2023); Jim Waymer, *Merritt Island Park Now a 'Manatee Graveyard' as Florida Sea Cows Starve to Death*, FLA. TODAY (Mar. 10, 2021, 6:52 PM), https://www.clickorlando.com/news/2021/03/09/merritt-island-park-now-a-manatee-graveyard-as-florida-sea-cows-starve-to-death/ [https://perma.cc/2ZZE-26ZL].

8. Zachary T. Sampson, *Florida Manatees Are Dying at a Worrisome Rate. Many Appear to Be Starving*, TAMPA BAY TIMES (Mar. 11, 2021), https://www.tampabay.com/news/environment/2021/03/11/florida-manatees-are-dying-at-an-alarming-rate-many-are-starving/ [https://perma.cc/JE4H-P8XA].

9. Greg Allen, *As Seagrass Habitats Decline, Florida Manatees Are Dying of Starvation*, NPR (June 21, 2021, 3:15 AM), https://www.npr.org/2021/06/21/1006332218/as-seagrass-habitats-decline-florida-manatees-are-dying-of-starvation [https://perma.cc/DJM6-D4TH].

10. Amy Green, *Manatee Die-Off in Indian River Lagoon Prompts Call for Federal Investigation*, WUSF (Mar. 15, 2021, 6:44 AM), https://wusfnews.wusf.usf.edu/environment/2021-03-15/manatee-die-off-in-indian-river-lagoon-prompts-call-for-federal-investigation [https://perma.cc/JP8A-W37L]; Dyllan Furness, *Decimated by Famine, Florida's Manatees Face an Uncertain Future*, GUARDIAN (July 31, 2021, 5:00 AM), https://www.theguardian.com/environment/2021/jul/31/florida-manatees-famine-face-uncertain-future [https://perma.cc/W8PC-T67E].

in the IRL led to the official designation of an Unusual Mortality Event under the Marine Mammal Protection Act.[11] Meanwhile, red tides claimed the lives of hundreds of manatees during significant blooms in 1996,[12] 2003,[13] 2013,[14] 2018,[15] and 2021.[16] The 2021 bloom, which killed three dozen manatees in Tampa Bay, also threatened to degrade important foraging habitat near a regional warm water refuge.[17]

While the science is less settled with respect to the impact of cyanotoxins on manatees, it is evident that cyanotoxins can have significant adverse effects on human health.[18] Exposure can result in gastrointestinal, dermatologic, respiratory, neurologic, and other symptoms.[19] Exposure from recreational water sources can occur through incidental ingestion or contact with the skin during activities like swimming, wading, and surfing as well as inhalation of aerosolized waterborne cyanotoxins.[20]

Scientists have also expressed increasing concern about the long-term health effects of cyanotoxin exposure.[21] These effects include potential exposure to waterborne β-methylamino-L-alanine (BMAA), which is derived from cyanotoxins.[22] Scientists have posited that exposure to

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11. *Manatee Mortality Event Along the East Coast: 2020-2022*, FLA. FISH & WILDLIFE CONSERVATION COMM'N, https://myfwc.com/research/manatee/rescue-mortality-response/ume/ [https://perma.cc/7N7R-49VM] (last visited Oct. 10, 2022).

12. FLA. FISH & WILDLIFE CONSERVATION COMM'N, 1996 FINAL RED TIDE MANATEE MORTALITIES 1–3 (2008), https://myfwc.com/media/11682/1996redtide_final14march08.pdf [https://perma.cc/P7RJ-WUJX].

13. FLA. FISH & WILDLIFE CONSERVATION COMM'N, 2003 FINAL MANATEE MORTALITIES 1–2 (2011), https://myfwc.com/media/11676/2003-fianl-red-tide-06-oct-2011.pdf.

14. FLA. FISH & WILDLIFE CONSERVATION, 2013 FINAL RED TIDE MANATEE MORTALITIES 1–6 (2015), https://myfwc.com/media/11667/2013redtide.pdf [https://perma.cc/3ERL-WTQ3].

15. FLA. FISH & WILDLIFE CONSERVATION COMM'N, 2018 FINAL RED TIDE MANATEE MORTALITIES, JAN 01 – DECEMBER 31 1–6 (2020), https://myfwc.com/media/24282/2018finalredtide.pdf [https://perma.cc/PY6S-FWGE].

16. FLA. FISH & WILDLIFE CONSERVATION COMM'N, 2021 PRELIMINARY RED TIDE MANATEE MORTALITIES, JAN 01 – DEC 31 1–2 (2021), https://myfwc.com/media/25649/2021preliminaryredtide.pdf [https://perma.cc/G6MF-6P89].

17. Justin Hobbs, *Seagrass Declines as Manatee Deaths Approach a Record*, WWSB (June 18, 2021, 8:37 PM), https://www.mysuncoast.com/2021/06/19/seagrass-declines-manatee-deaths-approach-record/ [https://perma.cc/YY29-NW3G].

18. *Health Effects from Cyanotoxins*, U.S. ENV'T PROT. AGENCY, https://www.epa.gov/cyanohabs/health-effects-cyanotoxins [https://perma.cc/Q6MP-QXWY] (last visited Feb. 3, 2023).

19. U.S. ENV'T PROT. AGENCY, EPA 822-P-16-002, HUMAN HEALTH RECREATIONAL AMBIENT WATER QUALITY CRITERIA OR SWIMMING ADVISORIES FOR MICROCYSTINS AND CYLINDROSPERMOPSIN (DRAFT) 4 (2016), https://www.epa.gov/sites/default/files/2016-12/documents/draft-hh-rec-ambient-water-swimming-document.pdf [https://perma.cc/JZ9L-534L].

20. *Id.* at 29–30, 35.

21. James S. Metcalf et al., *Public Health Responses to Toxic Cyanobacterial Blooms: Perspectives from the 2016 Florida Event*, 20 WATER POL'Y 919 *passim* (2018).

22. Maitham Ahmed Al-Sammak et al., *Co-Occurrence of the Cyanotoxins BMAA, DABA*

BMAA may increase one's risk of developing neurodegenerative diseases, such as Amyotrophic Lateral Sclerosis/Parkinsonism Dementia Complex (ALS/PDC).[23]

A key environmental driver influencing cyanotoxin production is nutrient pollution,[24] and nonpoint sources play a substantial role in nutrient pollution in many watersheds.[25] Among these nonpoint sources is agricultural runoff, which is an important contributor to nutrient pollution in many watersheds[26] and according to the EPA, is the leading source of water quality impacting the nation's lakes and rivers.[27]

As states are primarily responsible for regulating nonpoint source runoff under the Clean Water Act (CWA), they are also responsible for addressing HABs.[28] Despite the continuing harm HABs are inflicting on these fragile ecosystems, water-front communities, and local economies, most states have no water quality criteria specifically for cyanotoxins in surface waters, no drinking water standards specifically for cyanotoxins, and no quantitative guidelines for cyanotoxins in waters used for recreation.[29]

Further, where nonpoint source pollution is causing a violation of water quality standards, state water managers typically turn to total maximum daily loads (TMDLs).[30] TMDLs set a "pollution diet" for these

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*and Anatoxin-*a *in Nebraska Reservoirs, Fish, and Aquatic Plants*, 6 TOXINS 488, 490 (2014).

23. Sandra A. Banack et al., *The Cyanobacteria Derived Toxin Beta-N-Methylamino-L-Alanine and Amyotrophic Lateral Sclerosis*, 2 TOXINS 2837, 2837–50 (2010); P.K. Bienfang et al., *Prominent Human Health Impacts from Several Marine Microbes: History, Ecology, and Public Health Implications*, 2011 INT'L J. MICROBIOLOGY 1, 4; James S. Metcalf & Geoffrey A. Codd, *Cyanobacteria, Neurotoxins and Water Resources: Are There Implications for Human Neurodegenerative Disease?*, 10 AMYOTROPHIC LATERAL SCLEROSIS 74, 74–78 (2009); see Melanie Engstrom Newell et al., *Systematic and State-of the Science Review of the Role of Environmental Factors in Amyotrophic Lateral Sclerosis (ALS) or Lou Gehrig's Disease*, 817 SCI. OF TOTAL ENV'T 1, 2 (2022) (noting the suspected association between BMAA and ALS).

24. Hobbs, *supra* note 17.

25. Memorandum from Joel Beauvais, Deputy Assistant Adm'r, U.S. Env't Prot. Agency, to State Env't Comm'rs & State Water Dirs. 1, 2, 4 (Sept. 22, 2016) [hereinafter Memorandum from Joel Beauvais], https://www.epa.gov/sites/default/files/2016-09/documents/renewed-call-nutrient-memo-2016.pdf [https://perma.cc/M6GJ-B5MB].

26. *Id.* at 4.

27. U.S. ENV'T PROT. AGENCY, NATIONAL WATER QUALITY INVENTORY: 2000 REPORT 164 (2002), https://www.epa.gov/sites/default/files/2015-09/documents/2000_national_water_quality_inventory_report_to_congress.pdf [https://perma.cc/8QBS-TRS7].

28. 33 U.S.C. § 1342 (2019).

29. AM. WATER WORKS ASS'N, CYANOTOXINS IN US DRINKING WATER: OCCURRENCE, CASE STUDIES AND STATE APPROACHES TO REGULATION v–vii (2016), https://www.awwa.org/Portals/0/AWWA/ETS/Resources/Technical%20Reports/201609_Cyanotoxin_Occurrence_States_Approach[1].pdf?ver=2021-05-21-120259-770 [https://perma.cc/9G8X-LR3B].

30. 40 C.F.R. § 130.7(b)(5)(iv); *see* U.S. GOV'T ACCOUNTABILITY OFF., GAO-14-80, CLEAN WATER ACT: CHANGES NEEDED IF KEY EPA PROGRAM IS TO HELP FULFILL THE NATION'S WATER QUALITY GOALS 2 (2013) (describing a state's obligation under the CWA to develop

nutrients that, when followed, should reduce the occurrence of HABs.[31] To implement TMDLs, states most often rely on voluntary measures known as best management practices (BMPs) to reduce nutrient pollution from nonpoint sources.[32] Even with these measures in place, nutrient pollution continues to fuel HABs across the nation.[33]

Several legal scholars have examined the shortcomings of existing agricultural nonpoint source controls[34] and explored ways in which federal statutes and regulations could be strengthened to provide for greater federal oversight and enforcement options.[35] Further, some scholars have proposed integrated watershed planning approaches,[36] cost-sharing programs,[37] and regional treatment systems to better address these sources of pollution.[38]

TMDLs); INT'L JOINT COMM'N, A BALANCED DIET FOR LAKE ERIE: REDUCING PHOSPHORUS LOADINGS AND HARMFUL ALGAL BLOOMS 48 (2014) (describing why TMDLs are appropriate for most nonpoint sources); *see also* 33 U.S.C. § 1313(e) (2013) (noting that the CWA does not expressly require the implementation of a TMDL).

31. *See* INT'L JOINT COMM'N, *supra* note 30, at 48–49 (2014) (describing how TMDLs can be used to limit pollutants that may cause HABs).

32. Clean Water Act of 1972, 33 U.S.C. § 1288 (2018).

33. For example, Florida has relied on BMPs for more than two decades to achieve the TMDL for phosphorus in Lake Okeechobee. Yet there has been more than a three-fold average annual exceedance of Lake Okeechobee's TMDL. *See* S. FLA. WATER MGMT. DIST., 2019 SOUTH FLORIDA ENVIRONMENTAL REPORT 1459 app. 8B-1 (2019), https://apps.sfwmd.gov/sfwmd/SFER/2019_sfer_final/v1/v1.pdf [https://perma.cc/8JTM-5WSK]; WENDY D. GRAHAM ET AL., UNIV. FLA. WATER INST., OPTIONS TO REDUCE HIGH VOLUME FRESHWATER FLOWS TO THE ST. LUCIE AND CALOOSAHATCHEE ESTUARIES AND MOVE MORE WATER FROM LAKE OKEECHOBEE TO THE SOUTHERN EVERGLADES 63–64 (2015). Voluntary measures, such as BMPs, have been the hallmark of nonpoint source pollution management since 1972 even though there continues to be little empirical evidence on the relative effectiveness of such schemes. *See* Oliver A. Houck, *Cooperative Federalism, Nutrients, and the Clean Water Act: Three Cases Revisited*, 44 ENV'T L. REP. 10426, 10426 (2014).

34. Robin Rotman et al., *Realigning the Clean Water Act: Comprehensive Treatment of Nonpoint Source Pollution*, 48 ECOLOGY L.Q. 115, 115 (2021); William L. Andreen, *No Virtue Like Necessity: Dealing with Nonpoint Source Pollution and Environmental Flows in the Face of Climate Change*, 34 VA. ENV'T L.J. 255, 255 (2016); Dave Owen, *Conclusion: After the TMDLs*, 17 VT. J. ENV'T L. 845, 845 (2016); Mary Jane Angelo, *Maintaining a Healthy Water Supply While Growing a Healthy Food Supply: Legal Tools for Cleaning Up Agricultural Water Pollution*, 62 U. KAN. L. REV. 1003, 1003 (2014); Doug R. Williams, *When Voluntary, Incentive-Based Controls Fail: Structuring a Regulatory Response to Agricultural Nonpoint Source Water Pollution*, 9 WASH. U. J. L. & POL'Y 21, 21 (2002); Robert W. Adler, *Integrated Approaches to Water Pollution: Lessons from the Clean Air Act*, 23 HARV. ENV'T L. REV. 203, 203 (1999).

35. Rotman et al., *supra* note 34, at 153–58; Andreen, *supra* note 34, at 287–90; Williams, *supra* note 34, at 112–21; Adler, *supra* note 34, at 290–93.

36. Jamie Konopacky & Laurie Ristino, *The Healthy Watershed Framework: A Blueprint for Restoring Nutrient-Impaired Waterbodies Through Integrated Clean Water Act and Farm Bill Conservation Planning and Implementation at the Subwatershed Level*, 47 ENV'T L. 647 *passim* (2017).

37. Williams, *supra* note 34, at 120–21.

38. Angelo, *supra* note 34, at 1005.

While these positions are well taken (given decades of state inaction, resistance to stronger pollution reduction measures,[39] and the complexity of the problem), this Article instead focuses on recommendations for how states can improve a state's own statutory and regulatory frameworks to better manage nonpoint source runoff, achieve pollution reduction targets, and minimize the occurrence of HABs.

This Article begins with an overview of HABs, what causes them, and their environmental health impacts. Next, it examines what is driving the proliferation of HABs and the impacts they are having on local communities, economies, and ecosystems through a case study of Lake Okeechobee as well as the St. Lucie and Caloosahatchee estuaries. It follows with a discussion of the current regulatory framework in Florida and the resulting failures at the state level to control nonpoint source pollution, particularly in the Lake Okeechobee watershed. State water managers concede that, due to project delays and insufficient management strategies, nutrient load reductions in the watershed will likely not be achieved in the next twenty years.[40] This Article concludes with a set of recommended actions that Florida and other states can take to reduce nutrient pollution, improve water quality, and mitigate future HABs.

I. HARMFUL ALGAL BLOOMS

A. *Nutrient Pollution Is Fueling Harmful Algal Blooms Across the United States*

The U.S. Environmental Protection Agency (EPA) has stated:

> Nutrient pollution of water is one of America's most widespread, costly and challenging environmental problems, caused by excess nitrogen and phosphorus in the air and water. More than 100,000 miles of rivers and streams, close to 2.5 million acres of lakes, reservoirs and ponds, and more than 800 square miles of bays and estuaries in the United States have poor water quality because of nitrogen and phosphorus pollution.[41]

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39. OLIVER A. HOUCK, THE CLEAN WATER ACT TMDL PROGRAM: LAW, POLICY, AND IMPLEMENTATION 63 (2d ed. 2002).

40. FLA. DEP'T OF ENV'T PROT., 2020 LAKE OKEECHOBEE BASIN MANAGEMENT ACTION PLAN 15 (2020), https://publicfiles.dep.state.fl.us/DEAR/DEARweb/BMAP/NEEP_2020_Updates/Lake%20Okeechobee%20BMAP_01-31-20.pdf.

41. *EPA Issues Health Advisories to Protect Americans from Algal Toxins in Drinking Water*, U.S. ENV'T PROT. AGENCY (May 6, 2015), https://archive.epa.gov/epa/newsreleases/epa-issues-health-advisories-protect-americans-algal-toxins-drinking-water.html [https://perma.cc/3GJL-TAX3] [hereinafter *EPA Issues Health Advisories*].

According to a 2012 EPA study, approximately thirty-five percent of lakes have excessive levels of total nitrogen and forty percent of lakes have excessive levels of total phosphorus.[42] In 2015, EPA Administrator Gina McCarthy remarked, "Nutrient pollution and harmful algal blooms are among America's most serious and growing environmental challenges."[43]

As EPA explained in a 2016 memorandum to state environmental protection agencies and water managers, nutrient pollution is contributing to an increasing trend of HABs in surface waters across the nation.[44] According to the EPA, studies strongly suggest that "reductions in nutrient pollution are needed to stem eutrophication and cyanobacterial bloom expansion."[45] Unfortunately, states across the country have been unable or unwilling to effectively manage nutrient pollution, particularly from agriculture.[46]

Cyanobacteria are one of the world's oldest life forms.[47] Commonly referred to as "blue-green algae," they are not actually algae but rather photosynthetic bacteria that occur naturally in surface waters.[48] Under the right environmental conditions, cyanobacteria can reproduce rapidly and form cyanobacterial HABs.[49] Floating cyanobacterial cells can form a visibly colored scum on the water surface, which can be concentrated by the wind.[50]

Another type of HAB is "red tide," which is caused by the dinoflagellate *Karenia brevis*.[51] *K. brevis* can produce brevetoxins that

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42. LAURA GATZ, CONG. RSCH. SERV., FRESHWATER HARMFUL ALGAL BLOOMS: CAUSES, CHALLENGES, AND POLICY CONSIDERATIONS 7 (2018).

43. *EPA Issues Health Advisories*, *supra* note 41.

44. Memorandum from Joel Beauvais, *supra* note 25, at 2.

45. *Id.* at 18.

46. *See* James S. Shortle et al., *Reforming Agricultural Nonpoint Pollution Policy in an Increasingly Budget-Constrained Environment*, 46 ENV'T SCI. & TECH. 1316, 1316 (2012) ("It has been well established that agricultural [nonpoint source pollution] policies are not having the desired outcomes."); *see also* STATE-EPA NUTRIENT INNOVATIONS TASK GRP., AN URGENT CALL TO ACTION 1 (2009), https://www.epa.gov/sites/default/files/documents/nitgreport.pdf [https://perma.cc/VG3J-5ABH] ("Current efforts to control nutrients have been . . . collectively inadequate at both a statewide and national scale.").

47. *Fossil Record of the Cyanobacteria*, UCMP BERKELEY, https://ucmp.berkeley.edu/bacteria/cyanofr.html [https://perma.cc/V3BC-6QD5] (last visited Feb. 3, 2023).

48. U.S. ENV'T PROT. AGENCY, *supra* note 19, at 1.

49. *Id*. at 3.

50. *Id*. at 17.

51. Donald M. Anderson et al., *Harmful Algal Blooms and Eutrophication: Examining Linkages from Selected Coastal Regions of the United States*, 8 HARMFUL ALGAE 39, 44 (2008).

kill fish,[52] make filter-feeding fish extremely toxic to other animals,[53] and cause respiratory and intestinal distress in humans.[54]

Sources contributing to red tide include nutrients in runoff, iron-rich atmospheric dust, dead marine life, and nutrient rich groundwater.[55] Nutrients including phosphorus and nitrogen from discharges, as well as marine life killed by cyanobacteria and decaying in waters, can stimulate red tide.[56] Cyanobacteria are frequently dominant in waters without detectable red tide, suggesting that they may play an important role in providing fuel to initiate red tide blooms.[57]

HABs threaten communities across the nation.[58] In 2011, Lake Erie experienced one of the largest cyanobacterial blooms in decades,[59] and

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52. Anne Rolton et al., *Effects of the Red Tide Dinoflagellate*, *Karenia Brevis*, *on Early Development of the Eastern Oyster Crassostrea Virginica and Northern Quahog Mercenaria Mercenaria*, 155 AQUATIC TOXICOLOGY 199, 199 (2014) [hereinafter Rolton et al., *Effects of the Red Tide*]; Anne Rolton et al., *Susceptibility of Gametes and Embryos of the Eastern Oyster*, *Crassostrea Virginica*, *to Karenia Brevis and Its Toxins*, 99 TOXICON 6, 6 (2015) [hereinafter Rolton et al., *Susceptibility of Gametes*]; Anne Rolton et al., *Effects of Field and Laboratory Exposure to the Toxic Dinoflagellate Karenia Brevis on the Reproduction of the Eastern Oyster*, *Crassostrea Virginia*, *and Subsequent Development of Offspring*, 57 HARMFUL ALGAE 13, 13 (2016) [hereinafter Rolton et al., *Effects of Field and Laboratory Exposure*]; John J. Walsh et al., *Isotopic Evidence for Dead Fish Maintenance of Florida Red Tides, with Implications for Coastal Fisheries over Both Source Regions of the West Florida Shelf and Within Downstream Waters of the South Atlantic Bight*, 80 PROGRESS IN OCEANOGRAPHY 51, 66 (2009).

53. Sharon M. Watkins et al., *Neurotoxic Shellfish Poisoning*, 6 MARINE DRUGS 431, 443 (2008).

54. Bienfang et al., *supra* note 22; *Illness Associated with Red Tide --- Nassau County, Florida, 2007*, CDC (July 4, 2008), https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5726a1.htm [https://perma.cc/BK8Q-NWDN]; Lora E. Fleming et al., *Initial Evaluation of the Effects of Aerosolized Florida Red Tide Toxins (Brevetoxins) in Persons with Asthma*, 113 ENV'T HEALTH PERSP. 650 *passim* (2005); J. Naar et al., *Brevetoxin Depuration in Shellfish via Production of Non-Toxic Metabolites: Consequences for Seafood Safety and the Environmental Fate of Biotoxins*, 10 HARMFUL ALGAE 488, 488 (2004).

55. Bienfang et al., *supra* note 23, at 3; J.J. Walsh et al., *Red Tides in the Gulf of Mexico: Where, When, and Why?*, 111 J. GEOPHYSICAL RSCH. 1, 5 (2006); Miles Medina et al., *Seasonal Dynamics of Terrestrially Sourced Nitrogen Influenced Karenia Brevis Blooms off Florida's Southern Gulf Coast*, 98 HARMFUL ALGAE 1, 1 (2020). *See generally* NAT'L ACADEMIES OF SCIS., ENG'G, & MED., PROGRESS TOWARD RESTORING THE EVERGLADES: THE EIGHTH BIENNIAL REVIEW – 2020 *passim* (2021) (discussing the contribution of groundwater to red tide).

56. Lynn Killberg-Thoreson et al., *Nutrients Released from Decaying Fish Support Microbial Growth in the Eastern Gulf of Mexico*, 38 HARMFUL ALGAE 40, 40 (2014); M.R. Mulholland et al., *Contribution of Diazotrophy to Nitrogen Inputs Supporting Karenia Brevis Blooms in the Gulf of Mexico*, 38 HARMFUL ALGAE 20, 20 (2014).

57. Kelly L. Jones et al., *Comparative Analysis of Bacterioplankton Assemblages from Karenia Brevis Bloom and Nonbloom Water on the West Florida Shelf (Gulf of Mexico, USA) Using 16S rRNA Gene Clone Libraries*, 73 FEMS MICROBIOLOGY ECOLOGY 468, 476 (2010).

58. GRAHAM ET AL., *supra* note 2, at 7.

59. *Toxic Algae Bloom in Lake Erie*, NASA EARTH OBSERVATORY (Oct. 14, 2011), https://earthobservatory.nasa.gov/images/76127/toxic-algae-bloom-in-lake-erie [https://perma.cc/6BNH-7MYU].

another bloom three years later caused the city of Toledo, Ohio, to issue a "do not drink" order for tap water that impacted more than half-a-million people for two days.[60] Both algal blooms could be seen from space.[61] In 2015, a 650-mile bloom in the Ohio River affected the drinking water supply of five million people and impacted recreational activities in five states.[62] In 2016, the city of Ingleside, Texas, issued a 13-day do-not-drink advisory for cyanotoxins in its drinking water.[63] In 2017, Lake Erie experienced yet another HAB, covering more than 700 square miles.[64] There were 169 reported algal blooms in the United States in 2017 alone.[65] In 2018, cyanotoxins from algal blooms in Oregon's Detroit Lake made it past the city of Salem's filtration plant and into the tap water, prompting the governor to declare a state of emergency and the Oregon National Guard to provide potable water to residents.[66] The State Health Department later issued an administrative order requiring nearly 100 water systems around the state to conduct bi-weekly testing for cyanotoxins.[67] In 2021, the city of West Palm Beach, Florida, issued a water advisory for vulnerable populations when cylindrospermopsin levels exceeded EPA health advisory levels.[68]

Making matters worse, climate change "will severely affect our ability to control blooms, and in some cases could make it near impossible."[69]

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60. GRAHAM ET AL., *supra* note 2, at 2.

61. *Toxic Algae Bloom in Lake Erie*, *supra* note 59; Douglas Main, *This Is Lake Erie's Toxic Algal Bloom as Seen from Space*, POPULAR SCI. (Aug. 5, 2019), https://www.popsci.com/article/science/lake-eries-toxic-algal-bloom-seen-space [https://perma.cc/C7M8-FQGA].

62. GRAHAM ET AL., *supra* note 2, at 2.

63. Memorandum from Joel Beauvais, *supra* note 25, at 2.

64. Jugal K. Patel & Yuliya Parshina-Kottas, *Miles of Algae Covering Lake Erie*, N.Y. TIMES (Oct. 3, 2017), https://www.nytimes.com/interactive/2017/10/03/science/earth/lake-erie.html [https://perma.cc/WHQ4-AY97].

65. Bill Walker & Emily Wathen, *Across U.S., Toxic Blooms Pollute Lakes*, ENV'T WORKING GRP. (May 15, 2018), https://www.ewg.org/toxicalgalblooms/ [https://perma.cc/2JHV-UKRP].

66. Dirk VanderHart, *Report: Salem Knew for Years that Algae Could Threaten Water*, NW. PUB. BROAD. (Sept. 17, 2018), https://www.nwpb.org/2018/09/17/report-salem-knew-for-years-that-algae-could-threaten-water/ [https://perma.cc/4MNS-5XDN].

67. Dirk VanderHart, *Nearly 100 Oregon Water Systems Will Test for Toxins Plaguing Salem's Water*, OPB (June 29, 2018, 5:50 PM), https://www.opb.org/news/article/oregon-algae-toxins-salem-water/ [https://perma.cc/6YUZ-GGU2].

68. *Drinking Water Advisory*, W. PALM BEACH (May 28, 2021, 10:18 AM), https://www.wpb.org/Home/Components/News/News/1699/16 [https://perma.cc/9TXC-ZHXX].

69. Karl E. Havens & Hans W. Paerl, *Climate Change at a Crossroad for Control of Harmful Algal Blooms*, 49 ENV'T SCI. & TECH. 12605, 12605 (2015); U.S. ENV'T PROT. AGENCY, IMPACTS OF CLIMATE CHANGE ON THE OCCURRENCE OF HARMFUL ALGAL BLOOMS 1–2 (May 2013), https://www.epa.gov/sites/default/files/documents/climatehabs.pdf [https://perma.cc/N8XH-E8N3]; Karl E. Havens, *Climate Change and the Occurrence of Harmful Microorganisms in Florida's Ocean and Coastal Waters*, UNIV. FLA. IFAS EXTENSION (Mar. 7, 2018), https://edis.ifas.ufl.edu/publication/sg136 [https://perma.cc/7ERB-NKTZ]; Karl E. Havens, *The*

Favorable conditions for blooms include warm waters, changes in salinity, increases in atmospheric carbon dioxide concentrations, changes in rainfall patterns that intensify coastal upwelling, sea level rise, and high nutrient levels—all issues exacerbated by climate change.[70]

B. *Harmful Agal Blooms Can Have Significant Impacts on Human Health*

Cyanobacteria have been known to have adverse impacts on human health for more than 100 years.[71] Exposure can occur through various recreational and non-recreational pathways.[72] Recreational activities are responsible for about half of reported cyanotoxin poisonings in people.[73] Nonrecreational exposure can occur through the consumption of cyanotoxin-contaminated drinking water and food and during bathing or showering.[74] According to the EPA, exposures can result in gastrointestinal, dermatologic, respiratory, neurologic, and other symptoms.[75]

The non-protein amino acid β-methylamino-L-alanine (BMAA) is a cyanobacteria-derived toxin that has been linked to Amyotrophic Lateral Sclerosis/Parkinsonism Dementia Complex (ALS/PDC).[76] BMAA has been documented in recreational waters throughout the world[77] and can bioaccumulate in different organisms up the food chain, presenting an increased risk to human health.[78]

Future of Harmful Algal Blooms in Florida Inland and Coastal Waters, UNIV. FLA. IFAS EXTENSION (Feb. 25, 2018), https://edis.ifas.ufl.edu/publication/SG153 [https://perma.cc/7DX2-MWNQ]; Brian Moss et al., *Allied Attack: Climate Change and Eutrophication*, 1 INLAND WATERS 101, 101 (2011); Hans W. Paerl & Jef Huisman, *Blooms Like It Hot*, 320 SCI. MAG. 57 (2008) [hereinafter Paerl & Huisman, *Blooms*]; Hans W. Paerl & Jef Huisman, *Climate Change: A Catalyst for Global Expansion of Harmful Cyanobacterial Blooms*, 1 ENV'T MICROBIOLOGY REPS. 27, 27 (2009) [hereinafter Paerl & Huisman, *Climate Change*]; LAURA GATZ, CONG. RSCH. SERV., R44871, FRESHWATER HARMFUL ALGAL BLOOMS: CAUSES, CHALLENGES, AND POLICY CONSIDERATIONS *passim* (2018).

70. U.S. ENV'T PROT. AGENCY, *supra* note 69.

71. WORLD HEALTH ORG., GUIDELINES FOR DRINKING-WATER QUALITY 95 (2d ed. 1998).

72. *Harmful Algal Bloom (HAB)-Associated Illness, Exposure*, CDC (2022), https://www.cdc.gov/habs/exposure-sources.html#:~:text=Harmful%20algal%20blooms%20caused%20by,or%20use%20contaminated%20drinking%20water [https://perma.cc/Q8VV-TVWW].

73. *Id.*

74. U.S. ENV'T PROT. AGENCY, *supra* note 19, at 1.

75. *Id.* at 4.

76. Banack et al., *supra* note 23, at 2838; Bienfang et al., *supra* note 23, at 4.

77. Banack et al., *supra* note 23, at 2840.

78. Larry E. Brand, *Human Exposure to Cyanobacteria and BMAA*, 10 AMYOTROPHIC LATERAL SCLEROSIS 85, 87 (2009).

People generally do not become aware of the presence of red tide until it results in fish kills,[79] shellfish toxicity, and respiratory distress.[80] The brevetoxins can also become aerosolized, causing respiratory distress when inhaled.[81]

C. *Harmful Algal Blooms Harm Fish and Wildlife*

HABs may have both direct and indirect impacts to fish and wildlife at all levels of the food chain.[82] In 2010, a team of researchers led by scientists at the California Department of Fish and Game and the University of California, Santa Cruz, published a study on the harmful effects of microcystin on sea otters.[83] It was the first study to establish a connection between freshwater contamination by microcystin and marine mammal mortality.[84] The team reported the deaths of at least twenty-one California sea otters (a federally listed threatened species) linked to microcystin intoxication.[85] Contaminated marine bivalves were implicated as the most likely source of hepatotoxins for wild otters that were recovered near river mouths and harbors.[86]

Mass mortality events from HABs have been reported on almost every continent.[87] A 2018 study examined dolphins in Florida's St. Johns River watershed that became stranded and died.[88] The researchers found that

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79. Philip M Gravinese et al., *The Effects of Red Tide (Karenia Brevis) on Reflex Impairment and Mortality of Sublegal Florida Stone Crabs, Menippe Mercenaria*, 137 MARINE ENV'T RSCH. 145, 145–47 (2018).

80. Bienfang et al., *supra* note 23; Richard H. Pierce et al., *Compositional Changes in Neurotoxins and Their Oxidative Derivatives from the Dinoflagellate, Karenia Brevis, in Seawater and Marine Aerosol*, 33 J. PLANKTON RSCH. 343, 343–44 (2011).

81. Kirkpatrick et al., *Aerosolized Red Tide Toxins (Brevetoxins) and Asthma: Continued Health Effects After 1 Hour Beach Exposure*, 10 HARMFUL ALGAE 138, 138 (2011).

82. Elizabeth D. Hillborn & Val R. Beasley, *One Health and Cyanobacteria in Freshwater Systems: Animal Illnesses and Deaths are Sentinel Events for Human Health Risks*, 7 TOXINS 1374 *passim* (2015).

83. Stephens, *supra* note 3; Miller et al., *supra* note 3.

84. Miller et al., *supra* note 3, at 8.

85. *Id*. at 10.

86. *Id*.

87. Hillborn & Beasley, *supra* note 82, at 1379; *see* Rastogi et al., *supra* note 6, at 1255 (discussing mass wildlife mortalities in Kenya, Tanzania, and Spain); *see also* Michele Burford, *Here's What Causes Algal Blooms, and How We Can Stop Them*, THE INERTIA (Jan. 26, 2019), https://www.theinertia.com/environment/heres-what-causes-algal-blooms-and-how-we-can-stop-them/ [https://perma.cc/AD2A-W872] (describing a HAB impacting a 1,700-kilometer stretch of the Murray River in Australia in 2016, and a one-million fish kill in the Murray Darling Basin in 2019).

88. Amber Brown et al., *Detection of Cyanotoxins (Microcystins/Nodularins) in Livers from Estuarine and Coastal Bottlenose Dolphins (Tursiops Truncatus) from Northeast Florida*, 76 HARMFUL ALGAE 22, 22 (2018).

both estuarine and coastal dolphins were exposed to microcystins, with potential toxic and immune health impacts.[89]

BMAA concentrations in animals exposed to cyanobacteria have also been observed in Florida, including high concentrations in fish in the Caloosahatchee River.[90] In a recently published study, researchers at the University of Miami were the first to show detectable levels of BMAA in bottlenose dolphin brains that also displayed degenerative damage similar to Alzheimer's, ALS, and Parkinson's disease in humans.[91]

Red tide has also been linked to land mammal and bird mortality[92] and can bioaccumulate.[93] Exposed fish and seagrasses can accumulate high concentrations of brevetoxins and act as toxin vectors to dolphins and manatees.[94]

D. *Harmful Algal Blooms Threaten Livestock and Pets*

George Francis first documented the toxic effects of a cyanobacteria bloom in an 1878 study of livestock deaths in Lake Alexandria, Australia.[95] Every inhabited continent continues to report deaths related to cyanobacteria,[96] and large numbers of livestock die every year in southern Africa from ingesting cyanotoxins.[97]

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89. *Id*.

90. Larry E. Brand et al., *Cyanobacteria Blooms and the Occurrence of the Neurotoxin beta-N-methylamino-L-alanine (BMAA) in South Florida Aquatic Food Webs*, 9 HARMFUL ALGAE 620, 629 (2010).

91. Jenny Staletovich, *Dolphins Poisoned by Algae Also Showed Signs of Alzheimer's-Like Brain Disease*, MIA. HERALD (Mar. 20, 2019), https://www.miamiherald.com/news/local/environment/article228126094.html; David A. Davis et al., *Cyanobacterial Neurotoxin BMAA and Brain Pathology in Stranded Dolphins*, 14 PLOS ONE 1, 7 (2019).

92. Kevin T. Castle et al., *Coyote (Canis Latrans) and Domestic Dog (Canis Familiaris) Mortality and Morbidity Due to a Karenia Brevis Red Tide in the Gulf of Mexico*, 49 J. WILDLIFE DISEASES 955, 955 (2013); Christine Kreuder et al., *Clinicopathologic Features of Suspected Brevetoxicosis in Double-Crested Cormorants (Phalacrocorax Auritus) Along the Florida Gulf Coast*, 33 J. ZOO & WILDLIFE MED. 8, 8 (2002).

93. Michael Echevarria et al., *Effects of Karenia Brevis on Clearance Rates and Bioaccumulation of Brevetoxins in Benthic Suspension Feeding Invertebrates*, 106–07 AQUATIC TOXICOLOGY 85 (2012).

94. Leanne J. Flewelling et al., *Red Tides and Marine Mammal Mortalities: Unexpected Brevetoxin Vectors May Account for Deaths Long After or Remote from an Algal Bloom*, 435 NATURE 755, 755 (2005).

95. Ian Stewart et al., *Cyanobacterial Poisoning in Livestock, Wild Mammals and Birds – An Overview*, *in* 619 CYANOBACTERIAL HARMFUL ALGAL BLOOMS: STATE OF THE SCIENCE AND RESEARCH NEEDS, ADVANCES IN EXPERIMENTAL MEDICINE AND BIOLOGY 614 (H. Kenneth Hudell ed., 2008); Brand, *supra* note 78.

96. Stewart et al., *supra* note 95.

97. Mxolisi G. Masango et al., *Assessment of Microcystis Bloom Toxicity Associated with Wildlife Mortality in the Kruger National Park, South Africa*, 46 J. WILDLIFE DISEASES 95, 95 (2010).

Pets can be exposed to higher concentrations of cyanotoxins than humans because they are known to consume cyanobacterial scum and drink contaminated water.[98] Dogs are particularly at risk because they may lick cyanobacterial cells from their fur after swimming in water impacted by a HAB,[99] and a number of dogs die each year from cyanotoxin poisoning.[100] The EPA believes the impacts on domestic and companion animals are likely under-recognized because many cases are misdiagnosed, few cases are biochemically confirmed, and even fewer are reported in scientific literature.[101] In 2016, the Centers for Disease Control and Prevention launched the One Health Harmful Algal Bloom System as part of its National Outbreak Reporting System, which allows states to report animal cases in addition to human illnesses.[102]

E. *Harmful Algal Blooms Cause Significant Economic Impacts*

Nutrient pollution and HABs can have significant impacts to state and local economies, including loss of recreational revenue; impacts to commercial fisheries, recreational fishing, and tourism; decreased property values, and increased drinking-water treatment costs.[103] A 2009 study estimated 2.2 billion dollars of annual losses in recreational water usage, waterfront real estate, and spending on recovery of threatened and endangered species as a result of eutrophication in U.S. freshwaters.[104] As the EPA explains, "[f]ishing and shellfish industries are hurt by harmful algal blooms that kill fish and contaminate shellfish. Annual losses to these industries from nutrient pollution are estimated to be in the tens of millions of dollars."[105]

Lake Erie serves as a telling example of the crippling economic impact cyanobacteria blooms can have on local communities. A preliminary study on the economic impacts of a 2014 HAB in Lake Erie estimates losses of forty-three million dollars in recreation and tourism, eighteen

98. U.S. ENV'T PROT. AGENCY, *supra* note 19, at 77.

99. *Id.*

100. Lorraine C. Backer et al., *Canine Cyanotoxin Poisonings in the United States (1920s-2012): Review of Suspected and Confirmed Cases from Three Data Sources*, 5 TOXINS 1597, 1597 (2013).

101. U.S. ENV'T PROT. AGENCY, *supra* note 19, at 75.

102. R. Scott Nolen, *A One-Health Solution to the Toxic Algae Problem*, JAVMA NEWS (Apr. 15, 2018), https://www.avma.org/javma-news/2018-04-15/one-health-solution-toxic-algae-problem [https://perma.cc/C735-HZXW].

103. GRAHAM ET AL., *supra* note 2; Dodds et al., *supra* note 4.

104. Wayne W. Carmichael & Gregory L. Boyer, *Health Impacts from Cyanobacteria Harmful Algae Blooms: Implications for the North American Great Lakes*, 54 HARMFUL ALGAE 194, 207–12 (2016).

105. *Nutrient Pollution, The Effects: Economy*, U.S. ENV'T PROT. AGENCY, https://www.epa.gov/nutrientpollution/effects-economy [https://perma.cc/LT59-X5GB] (last visited Feb. 4, 2023).

million dollars in property values, and four million dollars in costs associated with treating drinking water.[106] Large, summer-long blooms resulted in 3,600 fewer fishing licenses being issued and cost counties adjacent to Lake Erie an estimated 5.58 million dollars in lost fishing expenditures.[107] Researchers have estimated that there would be over 2 million dollars in economic losses if sixty-seven Lake Erie beaches were closed for just one day.[108] There was "up to a $2,025 . . . increase" in individual home prices when algal levels were reduced."[109]

Red tide can also have debilitating economic impacts. In 2000, Galveston County, Texas, experienced a 21.3 to 24.6 million dollar economic impact from red tide due to fishery closures, loss tourism, and the costs of beach cleanup.[110] Red tide contributed to nearly 50 million dollars of loss in income in Maine in 2005.[111] In 2011, oyster landings dropped by more than 10.3 million dollars in Texas due to red tide.[112] Five million dollars in federal disaster relief was appropriated by the U.S. Commerce Department to address red tide impacts in Maine, New Hampshire, and Massachusetts.[113]

II. FLORIDA'S HARMFUL ALGAL BLOOMS: A CASE STUDY

Some of the largest and most destructive HABs in the United States have occurred in Florida's Lake Okeechobee.[114] These blooms have increased in their frequency, intensity, and duration over the last decade.[115] The lake's shallow depth, along with nutrient runoff and warm

106. GRAHAM ET AL., *supra* note 2, at 3.

107. *Hitting Us Where It Hurts: The Untold Story of Harmful Algal Blooms*, NOAA, https://noaa.maps.arcgis.com/apps/Cascade/index.html?appid=9e6fca29791b428e827f7e9ec095a3d7 [https://perma.cc/WA25-JUFN] (last visited Feb. 4, 2023).

108. *Id*.

109. *Id.*

110. *Id.*

111. *Id*

112. *Id.*

113. *Hitting Us Where It Hurts*, *supra* note 107.

114. Cynthia Ann Heil & Amanda Lorraine Muni-Morgan, *Florida's Harmful Algal Bloom (HAB) Problem: Escalating Risks to Human, Environmental and Economic Health with Climate Change*, 9 FRONTIERS ECOLOGY & EVOLUTION 3, 5, 16 (2021).

115. S. FLA. WATER MGMT. DIST., CENTRAL EVERGLADES PLANNING PROJECT POST AUTHORIZATION CHANGE REPORT: FEASIBILITY STUDY AND DRAFT ENVIRONMENTAL IMPACT STATEMENT 2-3 (2018); Karl Havens, *What Is Causing Florida's Algae Crisis? 5 Questions Answered*, UNIV. FLA. NEWS: SCI. & WELLNESS (Aug. 10, 2018), https://news.ufl.edu/articles/2018/08/what-is-causing-floridas-algae-crisis-5-questions-answered.html [https://perma.cc/95A6-68A7]; Joyce Zhang & Zach Welch, *Lake Okeechobee Watershed Research and Water Quality Monitoring Results and Activities*, *in* 2018 SOUTH FLORIDA ENVIRONMENTAL REPORT 8B-1 (2018).

water temperatures, provide ideal conditions for HABs.[116] Water management decisions have further exacerbated the problems by sending algae-laden water to sensitive coastal estuaries.[117] These discharges have had a significant impact on the ecology of these estuaries and inflicted significant economic losses upon regional commercial fishing, recreation, tourism, and the real estate sectors.[118] The proliferation of HABs in the region also threatens the multi-billion dollar federal and state plan to restore America's Everglades.[119]

A. *Water Management Decisions Have Compromised the Ecological Health of the Greater Everglades Ecosystem*

Encompassing 730 square miles, Lake Okeechobee is the largest lake in the southeastern United States.[120] The lake is home to sport and commercial fisheries[121] and serves as a critical habitat for the federally endangered snail kite.[122]

To the west is the Caloosahatchee River, which flows for seventy miles from Lake Okeechobee to the Gulf of Mexico.[123] The river and estuary are home to the only known pupping grounds of the federally endangered smalltooth sawfish.[124] The area is an important warm water refuge for the federally threatened Florida manatee, and four species of sea turtles listed under the Endangered Species Act, which frequent the

116. Karl Havens, *Deep Problems in Shallow Lakes: Why Controlling Phosphorus Inputs May Not Restore Water Quality*, 2013 EDIS 1, 1–4 (Jan. 2013), https://journals.flvc.org/edis/article/view/120491/118903 [https://perma.cc/PP77-Q7DM]; Karl E. Havens et al., *Natural Climate Variability Can Influence Cyanobacteria Blooms in Florida Lakes and Reservoirs*, UNIV. FLA. IFAS EXTENSION (Dec. 10, 2019), https://edis.ifas.ufl.edu/publication/SG142 [https://perma.cc/E4Y7-RHWZ].

117. Havens, *supra* note 115; Zhang & Welch, *supra* note 115.

118. *Nutrient Pollution, The Effects: Economy*, *supra* note 105.

119. NAT'L ACADEMIES OF SCIS., ENG'G, & MED., PROGRESS TOWARD RESTORING THE EVERGLADES: THE FOURTH BIENNIAL REVIEW – 2012 xi (2012), http://www.nap.edu/catalog/13422/progress-toward-restoring-the-everglades-the-fourth-biennial-review-2012 [https://perma.cc/CV84-EZGL].

120. *Lake Okeechobee*, S. FLA. WATER MGMT. DIST., https://www.sfwmd.gov/our-work/lake-okeechobee [https://perma.cc/X22G-GKQL] (last visited Feb. 4, 2023).

121. *Id.*

122. 50 C.F.R. § 17.95(b) (2022).

123. FLA. DEP'T OF ENV'T PROT., WATER QUALITY ASSESSMENT REPORT: CALOOSAHATCHEE 230 (2005), https://www.sfwmd.gov/sites/default/files/documents/06-Caloos%20River%20Basin%20Report%20FDEP.pdf [https://perma.cc/P56N-YXRB].

124. NAT'L MARINE FISHERIES SERV., NAT'L OCEANIC & ATMOSPHERIC ADMIN., SMALLTOOTH SAWFISH RECOVERY PLAN (PRISTIS PECTINATE) I-19 (2009), https://www.floridamuseum.ufl.edu/wp-content/uploads/sites/80/2017/05/STSRecovery_Plan_Final_011309.pdf.

estuary and the nearby Gulf of Mexico.[125] Five national wildlife refuges also lie within the Caloosahatchee River and Estuary.[126]

To the east is the thirty-five milelong St. Lucie River.[127] Historically, the river was a freshwater stream that flowed into the IRL, but in 1892, residents dredged an inlet to establish a more permanent connection to the Atlantic Ocean.[128] In 1928, the state completed construction of the C-44 canal to connect Lake Okeechobee to the South Fork of the River.[129] Water from Lake Okeechobee flows through the C-44 canal and east into the St. Lucie River, which flows into the IRL.[130] The IRL is recognized as one of the most diverse estuaries in North America with more than 4,300 plants and animals.[131] Sea turtles, smalltooth sawfish, and manatees rely on these waters for warm water refuge, fresh water, and other essential habitat functions.[132] Boulder star, elkhorn, and staghorn coral are found off the coast near the estuary's outlet.[133] The lagoon also supports productive fisheries, tourism, and some of the only bioluminescent waters in the continental United States.[134]

Lake Okeechobee and the coastal estuaries are part of the Greater Everglades ecosystem, a system that stretches from Shingle Creek (just

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125. U.S. FISH & WILDLIFE SERV., CALOOSAHATCHEE NATIONAL WILDLIFE REFUGE 1 (2021), https://web.archive.org/web/20210502092307/https://www.fws.gov/southeast/pdf/fact-sheet/caloosahatchee-national-wildlife-refuge.pdf [https://perma.cc/5BA9-L7YV]; *Sea Turtle FAQ*, SANIBEL-CAPTIVA CONSERVATION FOUND. (Apr. 11, 2017), http://www.sccf.org/our-work/sea-turtles/sea-turtle-faq [https://perma.cc/LM9F-7WJD]. The four sea turtle species include the loggerhead, green, Kemp's ridley, and leatherback. *Sea Turtle FAQ*, *supra*.

126. These refuges are the J.N. "Ding" Darling National Wildlife Refuge, Pine Island National Wildlife Refuge, Matlacha Pass National Wildlife Refuge, Island Bay National Wildlife Refuge, and Caloosahatchee National Wildlife Refuge.

127. S. FLA. WATER MGMT. DIST., FOCUS ON THE ST. LUCIE RIVER 2, https://www.sfwmd.gov/sites/default/files/documents/stlucie.pdf [https://perma.cc/4Y5S-Z7LR].

128. *Id.*

129. *Id.* at 4.

130. FLA. DEP'T OF TRANSP., 2015 FLORIDA WATERWAYS SYSTEM PLAN 2-43, 2-53 (2016), https://www.fdot.gov/docs/default-source/seaport/pdfs/2015-Florida-Waterways-System-Plan_Final.pdf [https://perma.cc/LQ87-ZB8H].

131. Cheryl Lyn Dybas, *Florida's Indian River Lagoon: An Estuary in Transition*, 52 BIOSCIENCE 554–59 (2002); *Ecology of the Indian River Lagoon*, FLA. STATE PARKS, https://www.floridastateparks.org/learn/ecology-indian-river-lagoon [https://perma.cc/49HM-9XBW] (last visited Feb. 4, 2023).

132. David W. Laist, *Influence of Power Plants and Other Warm-Water Refuges on Florida Manatees*, 21 MARINE MAMMAL SCI. 739, 764 (2005); T. DeLene Beeland, *Conserving Florida's Smalltooth Sawfish*, FLA. MUSEUM SCI. (Oct. 1, 2008), https://www.floridamuseum.ufl.edu/science/conserving-floridas-smalltooth-sawfish/ [https://perma.cc/S5QU-3T35]; *About the Area*, SEA TURTLE PRES. SOC'Y, https://seaturtlespacecoast.org/about-us/about-the-area/ [https://perma.cc/R857-RYU8] (last visited Feb. 4, 2023).

133. *SAJ-2017-02459 (SP-JLC)*, U.S. ARMY CORPS OF ENG'RS (Sept. 18, 2017), https://www.saj.usace.army.mil/DesktopModules/ArticleCS/Print.aspx?PortalId=44&ModuleId=16633&Article=1315263 [https://perma.cc/LZV5-962Y].

134. *Ecology of the Indian River Lagoon*, *supra* note 131.

south of Orlando) to Florida Bay, comprising a mosaic of sawgrass marshes, freshwater ponds and sloughs, prairies, and forested uplands.[135]

More than a century ago, efforts were made to drain the region for development, agricultural production, and subsequent flood control.[136] Beginning in the 1940s, the U.S. Army Corps of Engineers constructed a series of canals, levees, and other structures that forever changed the natural flow of the Everglades.[137] In 1948, Congress created the Central and South Florida Project, the largest civil works project in the country, to protect agricultural interests and communities from flooding south of Lake Okeechobee.[138]

This network of canals, levees, and water control structures has fundamentally altered the ecosystem, and today the Everglades is half the size it was a hundred years ago.[139] Historically, water traveling through the system would take six to eight months to travel from the northern part of the system to Lake Okeechobee,[140] but due to the channelization of the system and upstream agriculture, water now arrives at the lake in one month.[141] This channelization, coupled with the diking of the south side of the lake, which cuts off natural flow to the Everglades, causes lake levels to rise rapidly and forces the Corps to release large volumes of water into the Caloosahatchee and St. Lucie estuaries and ultimately out to sea, instead of letting those waters flow naturally over the south rim of the lake into the southern Everglades.[142] When there is a drought, water managers hold water in Lake Okeechobee and cut off the natural flow into the Caloosahatchee River.[143]

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135. *Everglades*, S. FLA. WATER MGMT. DIST., https://www.sfwmd.gov/our-work/everglades [https://perma.cc/CEV9-3MMY] (last visited Feb. 6, 2023).

136. *History*, S. FLA. WATER MGMT. DIST., https://www.sfwmd.gov/who-we-are/history [https://perma.cc/6NCL-TNCP] (last visited Feb. 6, 2023).

137. *Id.*

138. *Id.*

139. *Everglades*, *supra* note 135.

140. FLA. OCEANOGRAPHIC SOC'Y, THE EVERGLADES & NORTHERN ESTUARIES; ST. LUCIE RIVER ESTUARY, INDIAN RIVER LAGOON & CALOOSAHATCHEE ESTUARY: WATER FLOWS & CURRENT ISSUES 2 (Aug. 20, 2013), https://www.floridaocean.org/sites/default/files/documents/PDFS/gov-scott-8-20-13.pdf [https://perma.cc/C37K-8P8S].

141. AUDUBON FLA., THE LAKE OKEECHOBEE ECOSYSTEM: A DELICATE BALANCE OF WATER 1 (June 2014), https://fl.audubon.org/sites/default/files/audubon_lakeokeechobee_factsheet_june2014_0.pdf [https://perma.cc/V3VK-KFHA].

142. GRAHAM ET AL., *supra* note 33, at 111.

143. *E.g.*, Chad Gillis, *Lake Okeechobee Levels Continue to Drop as Corps Slows Flows to Caloosahatchee River*, NEWS-PRESS (Apr. 9, 2020, 4:50 PM), https://www.news-press.com/story/tech/science/environment/2020/04/09/water-managers-cut-flows-caloosahatchee-lake-o-levels-continue-drop/5120888002/ [https://perma.cc/96X4-B2Z2] (describing how Lake Okeechobee dropped to 11.6 feet above sea level in April 2020, which prompted agencies to cut flows to the Caloosahatchee River).

The Corps' discharges of water from Lake Okeechobee are governed by the Lake Okeechobee Regulation Schedule (LORS).[144] LORS directs the Corps to maintain lake levels between 12.5 and 15.5 feet surface elevation to protect communities and agricultural fields to the south from flooding, provide agricultural and municipal water supplies during the dryer months, and protect the lake's ecology.[145] LORS is expected to be in effect until at least early 2023, and then a new regulation schedule known as the Lake Okeechobee System Operations Manual (LOSOM) will go into effect.[146]

B. *Nonpoint Source Pollution Has Degraded the Water Quality of the Northern Everglades*

In addition to the plumbing problem, the water entering Lake Okeechobee is dirty. Contaminants from agriculture, industry, and urban areas have polluted historically pristine waters with phosphorous, nitrogen, and mercury.[147] For the past several decades, phosphorus imported into the basin, primarily to improve agricultural production as a fertilizer, has largely accumulated in soils and sediments.[148] This "legacy phosphorus" has become a constant source of additional phosphorus loading to the lake and estuaries.[149]

Between water years 2014 and 2018, the five-year average annual load of total phosphorus to Lake Okeechobee was 633 metric tons per year, which is 493 metric tons more than the water quality goal of 140 metric tons per year.[150] The majority of these nutrients entered the watershed from agricultural and urban sources.[151] There have been no significant reductions in phosphorus loading into the Lake Okeechobee

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144. U.S. ARMY CORPS OF ENG'RS, FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT: LAKE OKEECHOBEE REGULATION SCHEDULE *passim* (2007), https://www.saj.usace.army.mil/Portals/44/docs/h2omgmt/LORSdocs/ACOE_STATEMENT_APPENDICES_A-G.pdf [https://perma.cc/ 86HE-2BCU].

145. GRAHAM ET AL., *supra* note 33, at 17.

146. *Lake Okeechobee System Operating Manual (LOSOM)*, MARTIN CNTY. FLA., https://www.martin.fl.us/LOSOM [https://perma.cc/32C3-CK26] (last visited Feb. 6, 2023); *Breaking Down: L.O.S.O.M.*, EVERGLADES FOUND., https://www.evergladesfoundation.org/post/breaking-down-losom [https://perma.cc/8X59-BF2C] (last visited Feb. 6, 2023); *see* Damon Scott, *Release of Lake Okeechobee Draft Plan Delayed, Seminole Tribune* (May 13, 2022), https://seminoletribune.org/release-of-lake-okeechobee-draft-plan-delayed/ [https://perma.cc/Y9MY-MLLY] ("A final plan expected to go into effect late this year is now set to be in place in early 2023.").

147. NAT'L ACADEMIES OF SCIS., ENG'G, & MED., *supra* note 119.

148. GRAHAM ET AL., *supra* note 33, at 63.

149. *Id.*

150. S. FLA. WATER MGMT. DIST., *supra* note 33, at 147, 1339, 1392 tbl.8B-8.

151. *Id.*

sub-watersheds,[152] despite several phosphorus reduction projects.[153] Lake Okeechobee has been a net sink, with more phosphorus entering the lake than leaving it.[154]

In addition to phosphorus, nitrogen is being delivered to Lake Okeechobee.[155] Increased usage of nitrogen fertilizers, urban and agricultural nitrogen wastes, and atmospheric nitrogen deposition has caused an increase in bioavailable nitrogen in receiving waters.[156] In Lake Okeechobee, the five-year rolling average total nitrogen load for water years 2014 to 2018 was 6,772 tons—a 470-ton increase from the 2013 to 2017 water year average.[157]

C. *Nutrient Pollution Has Fueled the Spread of HABs in Lake Okeechobee and the Northern Estuaries*

All the phosphorus and nitrogen entering the lake has helped fuel the spread of HABs.[158] The nutrient-rich water from Lake Okeechobee, coupled with high water temperatures, fuels the formation of algal blooms, which are then sent through canals and into the estuaries.[159]

The State of Florida has long been aware of the problem of nonpoint source pollution and the increasing threats posed by HABs. In 2008, the Florida Department of Environmental Protection (FDEP) remarked:

> Freshwater harmful algal blooms (HABs) are increasing in frequency, duration, and magnitude and therefore may be a significant threat to surface drinking water resources and recreational areas. Abundant populations of blue-green algae, some of them potentially toxigenic, have been found statewide in numerous lakes and rivers. In addition, measured concentrations of cyanotoxins—a few of them of above the suggested guideline levels—have been reported in finished water from some drinking water facilities.[160]

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152. FLA. DEP'T OF ENV'T. PROT., *supra* note 40.

153. NAT'L ACADEMIES OF SCIS., ENG'G, & MED., PROGRESS TOWARD RESTORING THE EVERGLADES: THE SIXTH BIENNIAL REVIEW – 2016 113 (2016).

154. *Id.* at 116.

155. GRAHAM ET AL., *supra* note 33, at 63.

156. Hans W. Paerl et al., *Algal Blooms: Noteworthy Nitrogen*, 346 SCI. 175, 175 (2014).

157. *See* S. FLA. WATER MGMT. DIST., *supra* note 33, at 1382 (documenting a seven percent increase in TN loading for water years 2014 to 2018).

158. *Id. passim*.

159. U.S. ENV'T PROT. AGENCY, *supra* note 19, at 28–29.

160. FLA. DEP'T OF ENV'T PROT., INTEGRATED WATER QUALITY ASSESSMENT FOR FLORIDA: 2008 305(B) REPORT AND 303(D) LIST UPDATE 37 (2008), http://publicfiles.dep.state.fl.us/DEAR/DEARweb/WAS/Integrated_Report/2008_Integrated_Report.pdf [https://perma.cc/47CL-D9K6] (italics omitted).

In 2010, FDEP similarly stated:

> [N]utrient loading and the resulting harmful algal blooms continue to be an issue. While the occurrence of blue-green algae is natural and has occurred throughout history, algal blooms caused by . . . nutrient loading from fertilizer use, together with a growing population and the resulting increase in residential landscapes, are an ongoing concern.[161]

Unsurprisingly, nutrient pollution, especially phosphorus and nitrogen, continues to plague Florida's waters. According to a 2018 FDEP report, of the 4,393 waterbody segments assessed in the state, 2,440 were impaired.[162] Of these impaired waters, 1,893 segments required a TMDL.[163] According to FDEP, "[t]he most frequently identified causes of impairment include [dissolved oxygen], fecal coliform, and nutrients."[164] The major sources of nitrogen and phosphorus pollution are generally the same as those found nationally: urban and suburban stormwater runoff, wastewater discharges, row crop agriculture, livestock production, and atmospheric deposition.[165] This pollution is fueled by an ever-increasing population.[166]

In 2005, following several strong tropical storms, toxic *Microcystis aeruginosa* (*M. aeruginosa*) blooms formed in Lake Okeechobee and were discharged downstream into the St. Lucie Estuary.[167] In June 2008, a toxic blue-green algal bloom occurred north of the Franklin Lock on the Caloosahatchee River and forced the temporary shut-down of the Olga Water Treatment Plant, which obtains its source water from the Caloosahatchee and provides drinking water for 30,000 people.[168] In 2013, after additional tropical storms, the Corps once again discharged *M. aeruginosa* blooms from Lake Okeechobee into the St. Lucie

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161. FLA. DEP'T OF ENV'T PROT., INTEGRATED WATER QUALITY ASSESSMENT FOR FLORIDA: 2010 305(B) REPORT AND 303(D) LIST UPDATE 24 (2010), http://publicfiles.dep.state.fl.us/DEAR/DEARweb/WAS/Integrated_Report/2010_Integrated_Report.pdf [https://perma.cc/Q29X-F5HB] (italics omitted).

162. FLA. DEP'T OF ENV'T PROT., FINAL INTEGRATED WATER QUALITY ASSESSMENT FOR FLORIDA: 2018 SECTIONS 303(D), 305(B), AND 314 REPORT AND LISTING UPDATE 17 (2018), https://floridadep.gov/sites/default/files/2018_integrated_report_master%20final_revised_3-12-19.pdf [https://perma.cc/978J-2QH3].

163. *Id.* at 18.

164. *Id.*

165. Water Quality Standards for the State of Florida's Estuaries, Coastal Waters, and South Florida Inland Flowing Waters, 77 Fed. Reg. 74924, 74930 (Dec. 18, 2012) (codified at 40 C.F.R. 131).

166. *Id.*

167. Preece et al., s*upra* note 5.

168. Water Quality Standards for the State of Florida's Estuaries, Coastal Waters, and South Florida Inland Flowing Waters, 77 Fed. Reg. 75762, 75769 (Dec. 18, 2012) (codified at 40 C.F.R. 131).

Estuary.[169] In 2016, a 239-square mile HAB occurred in Lake Okeechobee, during an almost year-long period of releases to the St. Lucie and the Caloosahatchee.[170] Beaches were closed, and the Florida Governor declared a state of emergency in Martin, St. Lucie, Palm Beach, and Lee Counties.[171] Heavy rain from Hurricane Irma in 2017, combined with above-average rainfall in May 2018, then set the stage for the 2018 Lake Okeechobee algal bloom, which was possibly the largest summer algal bloom in the lake's history.[172] During the 2018 bloom, the Corps discharged toxic algae-filled water into the St. Lucie and Caloosahatchee Estuaries.[173] Finding that the "release of water from Lake Okeechobee and increase in algae blooms, including overwhelming amounts of cyanobacteria (blue-green algae) which can produce hazardous toxins, has unreasonably interfered with the health, safety, and welfare of the State of Florida and its residents" in July 2018, the Governor again issued a state of emergency, this time in Glades, Hendry, Lee, Martin, Okeechobee, Palm Beach, and St. Lucie Counties.[174]

These nutrient-rich waters and cyanobacteria blooms may have a synergistic effect with red tide, amplifying the harm caused to marine life along Florida's coasts.[175] The cyanobacteria *synechococcus* is a potential prey source in nutrient-poor environments for red tide, and it has been detected in the Lake Okeechobee system.[176] Moreover, an ecosystem impacted by red tide is less resilient to cyanobacteria, and vice versa.[177]

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169. Preece et al., *supra* note 5.

170. U.S. ENV'T PROT. AGENCY, *supra* note 19, at 20, 28.

171. *Id*. at 28–29.

172. Lisa Krimsky et al., *A Response to Frequently Asked Questions About the 2018 Lake Okeechobee, Caloosahatchee and St. Lucie Rivers and Estuaries Algal Blooms*, UNIV. FLA. IFAS BLOGS, http://blogs.ifas.ufl.edu/extension/2018/07/10/algal-blooms-faq/ [https://perma.cc/5R87-YPNE] (last visited Feb. 8, 2023).

173. *Id.*; *Water Res. Dev. Acts: Status of Implementation & Assessing Future Needs: Hearing on Water Res. & Env't Before the H. Subcomm. on Transp. & Infrastructure*, 116th Cong. 29 (2019) (statement of Major Gen. Scott A. Spellmon, Deputy Commanding Gen. for Civ. & Emergency Operations, U.S. Army Corps of Eng'rs), https://www.congress.gov/116/chrg/CHRG-116hhrg40659/CHRG-116hhrg40659.pdf [https://perma.cc/H3JK-P2DA].

174. Fla. Exec. Order No. 18-191 (Emergency Management-Lake Okeechobee Discharge/Algae Blooms) (July 9, 2018), https://www.flgov.com/wp-content/uploads/2018/07/EO-18-191.pdf [https://perma.cc/ZQ7N-3VKX].

175. Patricia M. Glibert et al., *Grazing by Karenia Brevis on Synechococcus Enhances Its Growth Rate and May Help to Sustain Blooms*, 55 AQUATIC MICROBIAL ECOLOGY 17–30, (2009).

176. BARRY H. ROSEN ET AL., U.S. DEP'T OF THE INTERIOR, U.S. GEOLOGICAL SURV., CYANOBACTERIA OF THE 2016 LAKE OKEECHOBEE WATERWAY HARMFUL ALGAL BLOOM: OPEN-FILE REPORT 2017-1054 34 (2017), https://pubs.usgs.gov/of/2017/1054/ofr20171054.pdf [https://perma.cc/34GU-ZU2Z].

177. Medina et al., *supra* note 55.

Studies have detected a connection between nitrogen pollution flowing from the Caloosahatchee River to nearshore red tide in Florida.[178] In 2018, Florida experienced one of the worst red tides in a decade.[179] The bloom and resulting fish kills reached the Florida Panhandle and wrapped around the southern tip of Florida and up the Atlantic coast.[180] The Florida Fish and Wildlife Conservation Commission (FWC) reported in January 2019 that 589 sea turtles had died since red tide blooms started spreading across the Gulf Coast in 2017—the largest number of stranded sea turtles ever attributed to a single red tide event.[181] FWC also reported that red tide contributed to the deaths of 288 Florida manatees in 2018.[182]

III. REGULATORY FRAMEWORK FOR MANAGING HARMFUL ALGAL BLOOMS

A. *The Clean Water Act*

Fifty years ago, the nation was facing a water quality crisis: drinking water contained chemicals exceeding recommended limits, pollution forced the closure of shellfish beds, the discharge of polluted water was causing massive fish kills, and bacteria levels made waters unsafe to swim in.[183] Water pollution was costing the country billions of dollars every year.[184]

In 1972, Congress passed the Clean Water Act (CWA) "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[185] The CWA provides a comprehensive framework for protecting the nation's water quality from both "point source" and "nonpoint source" pollution.[186]

A point source is "any discernable, confined, and discrete conveyance . . . from which pollutants are or may be discharged."[187] The

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178. *Id.*; Miles Medina et al., *Nitrogen-Enriched Discharges from a Highly Managed Watershed Intensify Red Tide (Karenia Brevis) Blooms in Southwest Florida*, 827 SCI. OF TOTAL ENV'T 1, 1 (2022).

179. *See* Robert H. Weisberg et al., *The Coastal Ocean Circulation Influence on the 2018 West Florida Shelf K. Brevis Red Tide Bloom*, 124 J. GEOPHYSICAL RSCH.: OCEANS 2501, 2501 (2019) (attributing the intensity of the 2017 to 2018 red tide to ocean circulation).

180. Paul P. Murphy, *Red Tide is Spreading in Florida. Hurricane Michael Didn't Stop It.*, CNN (Oct. 20, 2018), https://www.cnn.com/2018/10/18/us/red-tide-florida-hurricane-michael-trnd/index.html [https://perma.cc/JUY3-AVP4].

181. Jessica Meszaros, *Most Sea Turtle Deaths for Single Red Tide Event*, WLRN (Jan. 21, 2019), https://www.wlrn.org/post/most-sea-turtle-deaths-single-red-tide-event [https://perma.cc/RHR9-8UM8].

182. FLA. FISH & WILDLIFE CONSERVATION COMM'N, *supra* note 15, at 6.

183. ROBERT W. ADLER ET AL., THE CLEAN WATER ACT 20 YEARS LATER 5–6 (1993).

184. *Id.*

185. 33 U.S.C. § 1251(a) (1972).

186. *Id.*

187. *Id.* § 1362(14).

CWA prohibits the "discharge of any pollutant by any person" unless authorized by a permit.[188] A discharge is "any addition of any pollutant to navigable waters from any point source."[189] Point source pollution is controlled through permits issued under Section 402 of the CWA through the National Pollution Discharge Elimination System (NPDES) program.[190]

Nonpoint source pollution is "the type of pollution that arises from many dispersed activities or large areas, and is not traceable to any single discrete source."[191] These diffuse sources of pollution (like farms and roadways) are sources from which runoff drains into a watershed.[192] Nonpoint source pollution is the largest contributor to water quality degradation in the United States.[193] The EPA has determined that agricultural nonpoint discharges are the leading source of water quality impacts on the nation's lakes and rivers,[194] and the Agency has stated that "the vast majority of our nation's impaired waters have no possibility of being restored unless the nonpoint sources affecting those waters are effectively remediated."[195] Nonpoint source pollution is not subject to permitting like point source discharges, and the EPA plays a limited role in nonpoint source pollution.[196] Instead, under EPA oversight, the states manage nonpoint source pollution under Section 303 of the CWA.[197]

B. *The Florida Water Pollution Control Act*

States have statutory frameworks in place to help protect their waters from pollution and HABs and to implement the provisions of the CWA. In Florida, the state legislature passed the Florida Water Pollution Control Act in 1967 after finding that "[t]he pollution of the air and waters of this state constitutes a menace to public health and welfare; creates public nuisances; is harmful to wildlife and fish and other aquatic life; and impairs domestic, agricultural, industrial, recreational and other beneficial uses of air and water."[198] The State further declared that

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188. *Id.* §§ 1311(a), 1342.

189. *Id.* § 1362(12).

190. *Id.* § 1342.

191. Nw. Env't Def. Ctr. v. Brown, 640 F.3d 1063, 1080 (9th Cir. 2011).

192. Am. Farm Bureau Fed'n v. U.S. Env't Prot. Agency, 792 F.3d 281, 289 (3d Cir. 2015).

193. U.S. ENV'T PROT. AGENCY, A NATIONAL EVALUATION OF THE CLEAN WATER ACT SECTION 319 PROGRAM 1, 4 (2011); HOUCK, *supra* note 39, at 60.

194. U.S. ENV'T PROT. AGENCY, *supra* note 26, at ES-3.

195. U.S. ENV'T PROT. AGENCY, *supra* note 193; HOUCK, *supra* note 39, at 4 (explaining that, while point source controls have helped reduce many sources of pollution from degrading the nation's waters, nonpoint sources of pollution "have bloomed like algae to swallow the gains" of the CWA over the years).

196. U.S. ENV'T PROT. AGENCY, *supra* note 193.

197. *Id.*; *Am. Farm Bureau Fed'n*, 792 F.3d at 289.

198. FLA. STAT. § 403.021(1) (2020).

"[c]ontrol, regulation, and abatement of the activities which are causing or may cause pollution of the air or water resources in the state . . . *be increased*" to protect human health and the natural environment.[199]

Following its enactment in 1967, the Florida Water Pollution Act was amended to implement the state's water quality responsibilities under the CWA.[200] Under Section 403.061 of the Florida Statutes, the Florida Department of Environmental Protection "has the power and the duty to control and prohibit pollution of air and water in accordance with the law and rules adopted and promulgated by it."[201] Section 403.061(9) directs the Department to "adopt a comprehensive program for the prevention, control, and abatement of pollution of the air and waters of the state, and from time-to-time review and modify such program as necessary."[202] This program includes the establishment of water quality standards.[203]

C. *Protecting Water Quality Under a Cooperative Federalism Approach*

Since the passage of the CWA, states have managed the quality of surface waters within their boundaries principally through what is often described as a "cooperative federalism" approach with the EPA.[204] Within this framework, each state sets water quality standards that define its water quality goals, identifies impaired waters that have water quality problems, and establishes TMDLs that serve as water pollution reduction targets.[205] These standards, lists, and TMDLs are subject to review and approval by the EPA.[206]

The "cooperative federalism" framework may be more of an experiment than anything, as the states' relationship with the EPA under this approach has varied widely.[207] As Professor Oliver Houck aptly put, the Florida experience has been "a very reluctant dance" where the state has resisted and dragged its feet for decades to address nonpoint source pollution.[208]

199. *Id.* § 403.021(6) (emphasis added).

200. MICHAEL T. OLEXA ET AL., UNIV. FLA. IFAS EXTENSION, 2021 HANDBOOK OF FLORIDA WATER REGULATION: FLORIDA AIR AND WATER POLLUTION CONTROL ACT 1 (2021).

201. FLA. STAT. § 403.061 (2020).

202. *Id*. § 403.061(9).

203. *Id.* § 403.061(11).

204. Am. Farm Bureau Fed'n v. U.S. Env't Prot. Agency, 792 F.3d 281, 288 (3d Cir. 2015).

205. *Id.* at 288–90.

206. *Id.*

207. HOUCK, *supra* note 39. Houck contends that when Congress enacted Section 303(d), it was "equally suspicious both of state enthusiasm for the hard work of pollution control and of the water quality standards method of regulation. But it was willing to give them a shot." *Id.*

208. Houck, *supra* note 33, at 10442.

1. Water Quality Standards Define Water Quality Goals

Control of both point source and nonpoint source pollution turns in large part on the implementation of programs designed to achieve water quality standards. To that end, Section 303 of the CWA requires each state, subject to EPA approval, to develop and enforce comprehensive water quality standards and goals for all intrastate waters.[209] These standards must "protect public health or welfare, enhance the quality of water and serve the purposes of the [CWA]."[210]

Water quality standards are central to the design and plan of the CWA and are at the heart of each strategy of pollution control under the Act. A water quality standard "defines the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water and by setting criteria that protect the designated uses."[211] Uses are typically specified as part of a classification system, with the highest class consisting of potable water supplies.[212] The CWA requires that the classification system "provide water quality for the protection and propagation of fish, shellfish and wildlife and provide for recreation in and on the water" where attainable.[213] Any existing use, and the water quality necessary to continue supporting that use, must also be protected and maintained.[214] Criteria then build on these "uses," fleshing out state water quality standards.[215] These criteria may be expressed as numerical constituent concentrations, narrative statements, or both,[216] and represent a quality of water that supports a particular use.[217] States are encouraged to adopt numeric values based on EPA guidance,[218] and water quality criteria must "accurately reflect[] the latest scientific knowledge."[219]

In addition to identifying designated uses and establishing criteria to protect these designated uses, states must also develop and adopt a statewide antidegradation policy and identify the methods for implementing such a policy as part of their state water quality

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209. PUD No. 1 v. Wash. Dep't of Ecology, 511 U.S. 700, 704 (1994).

210. 40 C.F.R. § 131.2 (2015); 33 U.S.C. § 1313(c)(2)(A) (2018).

211. 40 C.F.R. § 131.2 (2015).

212. *See* FLA. ADMIN. CODE ANN. r. 62-302.400 (2016) (listing seven classes of water with associated designated uses).

213. 40 C.F.R. § 130.3 (2022).

214. *See id.* § 131.10(h)(1) (stating that a state may not remove an existing use unless it replaces it with more stringent criteria).

215. *Id.* § 131.3(i).

216. *Id.* § 131.11(b).

217. *Id.* § 131.11(a); *see* PUD No. 1 v. Wash. Dep't of Ecology, 511 U.S. 715, 718–19 (1994) (explaining that water quality criteria can include various types of parameters to support both a designated and existing use, including, for example, minimum water flows).

218. 40 C.F.R. § 131.6 (2022).

219. 33 U.S.C. § 1314(a)(1) (2022).

standards.[220] Pursuant to Florida's antidegradation policy, "[e]xisting instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected."[221]

When criteria are met, water quality will generally protect the designated use.[222] EPA regulations require states to "adopt those water quality criteria that protect the designated use" and that such criteria "must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use."[223] "In designating uses of a waterbody and the appropriate criteria for those uses, the State shall take into consideration the water quality standards of downstream waters and shall ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of downstream waters."[224] States are required to review their water quality standards at least once every three years and, if appropriate, revise or adopt new standards.[225]

Any new or revised water quality standards must be submitted to the EPA for review and approval or denial.[226] The EPA may determine, even in the absence of a state submission, that a new or revised standard is needed to meet the requirements of the CWA.[227] "Water quality standards play an important role in maintaining and improving the cleanliness and safety of the nation's waterbodies, because they are designed to determine which waterbodies are safe enough to support their designated uses."[228]

Water quality standards are also used by states to implement source controls to manage the pollutant loadings into impaired waters.[229] These actions include point source controls, through the NPDES permitting process, and nonpoint source controls, most often through "best management practices."[230] For point sources, water quality standards form the basis for water quality-based effluent limits, which are placed in NPDES permits for projects that would discharge into the same water "so

220. 40 C.F.R. § 131.12(a) (2022).

221. *Id.* § 131.2(a)(2); FLA. ADMIN. CODE ANN. r. 62-302.300(14) (2016).

222. 40 C.F.R. § 131.3(b).

223. *Id.* § 131.11(a)(1).

224. *Id.* § 131.10(b); *see* 40 C.F.R. § 131.12(a) (2022) (dictating that states must develop and adopt a statewide antidegradation policy and identify the methods for implementing such a policy as part of their state water quality standards).

225. 33 U.S.C. § 1313(c)(1).

226. *Id.* § 1313(c)(2)(A).

227. *Id.* § 1313(c)(4)(B).

228. Fla. Pub. Int. Rsch. Grp. Citizen Lobby, Inc. v. U.S. Env't Prot. Agency, 386 F.3d 1070, 1074 (11th Cir. 2004).

229. U.S. ENV'T PROT. AGENCY, EPA 820-B-15-001, WATER QUALITY STANDARDS HANDBOOK CHAPTER 7: WATER QUALITY STANDARDS AND THE WATER QUALITY-BASED APPROACH TO POLLUTION CONTROL 7 (2015).

230. *Id.* at 8.

that numerous point sources . . . may be further regulated to prevent water quality from falling below acceptable levels."[231]

To a similar effect, water quality standards serve as the basis for the issuance of state water quality certifications under Section 401 of the CWA.[232] These state certifications are required before a federal agency can issue a license or permit for activities that may result in any discharge into navigable waters.[233]

In establishing Florida water quality standards, FDEP found "excessive nutrients (total nitrogen and total phosphorus) constitute one of the most severe water quality problems facing the State. It shall be the Department's policy to limit the introduction of man-induced nutrients into waters of the State."[234]

2. Impaired Waters Indicate Water Quality Problems

After a state adopts EPA-approved water quality standards, it conducts monitoring to assess whether state waters are meeting those standards.[235] Waters that are unable to meet the water quality standard for their identified uses—such as potable water supply, fishing, and recreation—are deemed "impaired" by states, pursuant to Section 303 of the CWA.[236] The Act requires states to develop a comprehensive list of these "impaired" waters.[237]

Every two years, states must submit their lists of impaired waters to the EPA.[238] This information can be incorporated into the state's "integrated report" and submitted to the EPA.[239] The EPA must approve or disapprove these lists of impaired waters before they go into effect[240]

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231. U.S. Env't Prot. Agency v. Cal. *ex rel.* State Water Res. Control Bd., 426 U.S. 200, 205 n.12 (1976); 33 U.S.C. § 1312(a) (2018); 40 C.F.R. § 122.44(d).

232. *Overview of CWA Section 401 Certification*, U.S. ENV'T PROT. AGENCY (Apr. 22, 2022), https://www.epa.gov/cwa-401/overview-cwa-section-401-certification [https://perma.cc/B4BB-ZQET].

233. 33 U.S.C. § 1341 (2018).

234. FLA. ADMIN. CODE ANN. r. 62-302.300(13) (2022).

235. U.S. ENV'T PROT. AGENCY, *supra* note 229, at 2–4.

236. *Overview of Identifying and Restoring Impaired Waters Under Section 303(d) of the CWA*, U.S. ENV'T PROT. AGENCY (Aug. 31, 2022), https://www.epa.gov/tmdl/overview-identifying-and-restoring-impaired-waters-under-section-303d-cwa [https://perma.cc/742L-7L7J].

237. 33 U.S.C. § 1313(d)(1)(A) (2022).

238. *Id.* § 1313(d)(1); *Statute and Regulations Addressing Impaired Waters and TMDLs*, U.S. ENV'T PROT. AGENCY (Aug. 31, 2022), https://www.epa.gov/tmdl/statute-and-regulations-addressing-impaired-waters-and-tmdls#:~:text=Every%20two%20years%2C%20states%20are, fish%20propagation%20or%20human%20recreation [https://perma.cc/HA66-92RC].

239. 33 U.S.C. § 1315(b)(1) (2022); Memorandum from Robert H. Wayland III, Dir., Off. of Wetlands, Oceans, & Watersheds, & James A. Hanlon, Dir., Off. of Wastewater Mgmt., to Water Div. Dirs. (Nov. 22, 2002), https://www3.epa.gov/npdes/pubs/final-wwtmdl.pdf [https://perma.cc/4ZUT-LDWX].

240. 40 C.F.R. § 130.7(d)(2) (2022).

and only if they are consistent with the requirements of 40 C.F.R. § 130.7.[241]

3. Total Maximum Daily Loads are Water Pollutant Reduction Targets

After the state establishes its list of impaired waters and establishes priority rankings for these impaired waters,[242] the state must establish total maximum daily loads (TMDLs).[243] A TMDL is the amount of a pollutant that can enter a particular waterbody without violating state water quality standards.[244] Federal regulations define a TMDL as "the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background."[245] The goal of the TMDL program is to restore the quality of these impaired waters to the point of achieving water quality standards.[246]

When a TMDL is developed for waters that are impaired by point and nonpoint sources, EPA guidance directs states to provide "reasonable assurance" that nonpoint source load reductions can be attained.[247] These assurances help the EPA ensure that load allocations "are not based on overly generous assumptions regarding the amount of nonpoint source pollution reductions that will occur."[248] EPA guidance details that a "reasonable assurance that the TMDL's load allocations (LAs) will be achieved could include whether practices capable of reducing the specified pollutant load: (1) exist; (2) are technically feasible at a level required to meet allocations; and (3) have a high likelihood of implementation."[249]

241. *Id.*

242. 33 U.S.C. § 1313(d)(1)(A), (C) (2018).

243. *Id.*

244. *Id.*

245. 40 C.F.R. § 130.2(i) (2022).

246. 33 U.S.C. §§ 1313(c), (d); Am. Farm Bureau Fed'n v. U.S. Env't Prot. Agency, 792 F.3d 281, 299 (3d Cir. 2015) ("TMDLs are central to the Clean Water Act's water quality scheme because . . . they tie together point-source and nonpoint-source pollution issues in a manner that addresses the whole health of the water.").

247. U.S. ENV'T PROT. AGENCY, GUIDELINES FOR REVIEWING TMDLS UNDER EXISTING REGULATIONS ISSUED IN 1992 (2002), https://www.epa.gov/sites/production/files/2015-10/documents/2002_06_04_tmdl_guidance_final52002.pdf [https://perma.cc/X84K-855Z]. EPA guidance further directs EPA regional offices to work with states to achieve TMDL load allocations where waters are only impaired by nonpoint sources. It is the EPA's position, however, that when a state cannot demonstrate reasonable assurance that load allocations will be achieved, the EPA cannot disapprove a TMDL for waters impaired only by nonpoint sources because current regulations do not require such a showing. *Id.*

248. U.S. ENV'T PROT. AGENCY, CHESAPEAKE BAY TMDL SECTION 7. REASONABLE ASSURANCE AND ACCOUNTABILITY FRAMEWORK 7-1 (2010), https://www.epa.gov/sites/default/files/2014-12/documents/cbay_final_tmdl_section_7_final_0.pdf [https://perma.cc/NB3M-VVLL].

249. *Id.*

Although the EPA proposed rules in 1999 to strengthen the TMDL program and require states to prepare watershed implementation plans (WIPs) to achieve TMDLs and provide reasonable assurances that the load allocations will be met, the Agency later withdrew the rule in 2003.[250] The statute's failure to require states to implement TMDLs may be one reason why the program has not led to wide-spread pollution reductions across the nation.[251] Nevertheless, some states have prepared implementation plans[252] and a few require them under state law.[253]

4. Basin Management Action Plans are the Roadmaps for Implementing TMDLs in Florida

In Florida, basin management action plans (BMAPs) serve as the State's "roadmap" for implementing TMDLs.[254] BMAPs must include management strategies for achieving the TMDL, establish a schedule for implementing the management strategies, establish a basis for evaluating the plan's effectiveness, and identify feasible funding mechanisms for implementing the management strategies.[255] A BMAP must equitably allocate pollutant reductions to individual basins, as a whole to all basins, or to each point source or category of nonpoint sources.[256]

BMAPs are further required to include milestones for implementation and water quality improvement, as well as a water quality monitoring component "to evaluate whether reasonable progress in pollutant load reductions is being achieved over time."[257] FDEP must assess the progress towards these milestones every five years, and revisions to the plan "shall be made as appropriate" by FDEP "in cooperation with basin stakeholders."[258] The statute also requires FDEP, in conjunction with the water management districts, to submit annual progress reports to the Florida Governor, the President of the Florida Senate, and the Speaker of the Florida House of Representatives on the status of each TMDL and BMAP.[259] If the report indicates that any of the five-year milestones for

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250. CLAUDIA COPELAND, CONG. RSCH. SERV., R42752, CLEAN WATER ACT AND POLLUTANT TOTAL MAXIMUM DAILY LOADS (TMDLS) 4 (2014), https://crsreports.congress.gov/ product/pdf/R/R42752 [https://perma.cc/V2JT-X55P].

251. Owen, *supra* note 34, at 851.

252. *Effectively Implementing TMDLs*, U.S. ENV'T PROT. AGENCY (Aug. 31, 2022), https://www.epa.gov/tmdl/effectively-implementing-tmdls [https://perma.cc/6TDV-BH5A].

253. COPELAND, *supra* note 250, at 17.

254. *Basin Management Action Plans (BMAPs)*, FLA. DEP'T ENV'T PROT. (July 21, 2022), https://floridadep.gov/dear/water-quality-restoration/content/basin-management-action-plans-bmaps [https://perma.cc/XN85-LCWE].

255. FLA. STAT. § 403.067(7)(a)(1) (2022).

256. *Id.* § 403.067(7)(a)(2).

257. *Id.* § 403.067(7)(a)(6).

258. *Id.*

259. *Id.* § 403.0675(1).

achieving a TMDL will not be met, it must explain the possible causes and potential solutions.[260] FDEP is the lead agency in coordinating the implementation of TMDLs through water quality protection programs.[261] BMAPs are enforceable orders.[262] Although the EPA has the authority to review TMDLs under the CWA,[263] BMAPs and similar implementation plans are not subject to EPA approval.[264] Regardless, states must still engage in a continuing planning process subject to EPA review and approval that includes "adequate implementation" of water quality standards[265] as well as the preparation and submission of state assessment reports and management plans for nonpoint source pollution.[266]

IV. Regulatory Failures Contributing to Florida's HAB Crisis: Lake Okeechobee in Focus

Despite the passage of the CWA nearly five decades ago and subsequent amendments that required states to adopt water quality criteria, list impaired waters, and establish TMDLs, algal blooms remain a pervasive threat across the nation.[267] Some of the most widespread and damaging blooms have occurred in Florida's Lake Okeechobee and coastal estuaries.[268]

This Article examines some of the regulatory failures contributing to the HAB crisis through the lens of Lake Okeechobee, which faces extremely complex problems. Much of the ecological harm facing the Greater Everglades ecosystem has resulted from more than a thousand miles of canals, ditches, levees, and other structures that have compartmentalized and delivered pollutants into the system for more than a century.[269] In turn, water management decisions have been constrained by engineering limitations, flooding and seepage concerns, and even a federal consent decree.[270] Moreover, there is enough legacy phosphorus

260. *Id.*

261. Fla. Stat. § 403.067(7)(b)(1).

262. *Id.* § 403.067(7)(a)(5).

263. 33 U.S.C. § 1313(d) (2018); 40 C.F.R. 130.7 (2022).

264. U.S. Env't Prot. Agency, *supra* note 247.

265. 33 U.S.C. § 1313(e) (2018).

266. *Id.* § 1329.

267. U.S. Env't Prot. Agency, *supra* note 19, at 3–4.

268. *As New Algae Bloom Spreads Across Lake Okeechobee, Florida Urged to Set Standards Critical to Protecting People, Wildlife from Harmful Toxins*, Ctr. for Biological Diversity (May 19, 2021), https://biologicaldiversity.org/w/news/press-releases/as-new-algae-bloom-spreads-across-lake-okeechobee-florida-urged-to-set-standards-critical-to-protecting-people-wildlife-from-harmful-toxins-2021-05-19/ [https://perma.cc/7QH9-PKXM].

269. Kristin Shade-Poole & Gregory Miller, *Impact and Mitigation of Nutrient Pollution and Overland Water Flow Change on the Florida Everglades, USA*, 8 Sustainability 1, 6 (2016).

270. Tyler Treadway, *SFWMD Attorneys: Consent Decree Merely a Security Blanket for Environmentalists*, TCPalm (Feb. 1, 2019), https://www.tcpalm.com/story/news/local/indian-river-lagoon/health/2019/02/01/sfwmd-we-dont-need-federal-oversight-everglades-projects/

in the system to sustain the exceedance of the TMDL for decades even if all new inputs were eliminated tomorrow.[271]

Notwithstanding these complexities, there are aspects of the Lake Okeechobee experience that are straightforward and not unlike the issues facing imperiled watersheds across the nation. For one, the pollution entering the lake is mostly from agricultural nonpoint sources, and there are no permitted point sources discharging directly into the lake.[272] Most of the pollution comes from the north, east, and west, rather than from the south, where the system is much more engineered.[273] This runoff is not unlike that found in many other regions in the United States, from the farm fields along the Mississippi River to those neighboring the Chesapeake Bay.[274] The lake also provides a jarring illustration of the damage that can occur when years of regulatory neglect are followed by legislation that prioritizes voluntary approaches over quantifiable performance standards, strict deadlines, and enforcement actions.

It is with these considerations in mind that the Lake Okeechobee experience is instructive. It provides an opportune case study of the regulatory failures that have dogged so many nonpoint source control programs throughout the country as well as the opportunities that lie within state law to better address HABs.

A. *Florida Failed to Timely List Lake Okeechobee as Impaired and Establish a TMDL*

In many ways, the HAB crisis in South Florida is the product of a legacy of extensive, historic efforts to intensely drain the Greater Everglades region, the State's failure to take swift action to protect its surface waters upon passage of the CWA, and ongoing regulatory failures to effectively manage nonpoint source pollution.

2742746002/ [https://perma.cc/D82W-FDD2].

271. Krimsky et al., *supra* note 171.

272. STEPHANIE BAZAN ET AL., ENVIRONMENTAL PLAN FOR KISSIMMEE OKEECHOBEE EVERGLADES TRIBUTARIES (EPKOET) 14 (2020), https://www.wrc.udel.edu/wp-content/uploads/2020/05/EPKOET%20Report.pdf [https://perma.cc/FA29-ZHQ5]; AUDUBON FLA., EXCESSIVE NUTRIENTS THREATEN HEALTH OF LAKE OKEECHOBEE ECOSYSTEM 1 (2014), https://fl.audubon.org/sites/default/files/audubon_lakeokeechobee_nutrient_factsheet_august2014.pdf [https://perma.cc/YCV2-D94R].

273. G. GOFORTH, A BRIEF DISCUSSION OF LAKE OKEECHOBEE POLLUTION 6 (2018), http://garygoforth.net/Lake%20Okeechobee%20Pollution%20Summary%20-%20Draft%208%2021%202018.pdf [https://perma.cc/H9B2-BPPN].

274. *Agricultural Runoff*, CHESAPEAKE BAY PROGRAM, https://www.chesapeakebay.net/issues/threats-to-the-bay/agricultural-runoff [https://perma.cc/CP7M-LMBG] (last visited Feb. 11, 2023); *How Agriculture Affects the Mississippi River*, MISS. RIVER COLLABORATIVE, https://www.msrivercollab.org/focus-areas/agriculture/ [https://perma.cc/TVX5-P6L8] (last visited Feb. 11, 2023).

In the early years of the CWA, states were far from expeditious in carrying out their duties.[275] This was perhaps most evident in the states' resistance to timely identifying which of their waters were impaired and establishing TMDLs for these waters.[276] While the EPA was initially to blame for not identifying the pollutants to which TMDLs applied, pollutants were eventually identified and the states were required to submit TMDLs by June 1979.[277] Yet the states failed to establish these TMDLs, even as waters became more polluted.[278] It took lawsuits filed by citizen groups to compel action.[279] The courts reached a consensus view that a state's failure to submit a TMDL should be deemed a "constructive submission" by the state that no TMDL is needed, triggering the EPA's duty to accept that conclusion or promulgate its own TMDL.[280] Even then, action was not immediate.[281] By the mid-1990s, courts became frustrated and directed states and the EPA to develop TMDLs.[282] More suits were filed, and thousands of TMDLs were drafted.[283]

One of these lawsuits included an action filed by environmental groups in 1998 against the EPA for not compelling Florida to establish TMDLs for the State's water bodies, including Lake Okeechobee.[284] To explain: "The following year, the parties entered a consent decree, which required the EPA to establish TMDLs for more than 500 water bodies due to the state's failure. The consent decree established a priority schedule for TMDLs for waters throughout the state."[285] The consent decree established a priority schedule for TMDLs for waters throughout the state.[286] The Florida Legislature later enacted the Watershed Restoration Act in 1999, codifying Florida's TMDL program—more than a quarter century after the passage of the CWA.[287] Even with the

275. Am. Farm Bureau Fed'n v. U.S. Env't Prot. Agency, 792 F.3d 281, 291 (3d Cir. 2015).

276. HOUCK, *supra* note 39, at 49–64.

277. *Am. Farm Bureau Fed'n*, 792 F.3d at 290.

278. HOUCK, *supra* note 39, at 49–64.

279. *Id.*

280. *Am. Farm Bureau Fed'n*, 792 F.3d at 290.

281. *Id.*

282. *Id.* at 290–91.

283. *Id.* at 291.

284. Petition for Rulemaking from Ctr. for Biological Diversity et al. to Fla. Dep't of Env't Prot. & Env't Regul. Comm'n 88 n.474 (May 23, 2019) [hereinafter Petition for Rulemaking], https://www.biologicaldiversity.org/programs/environmental_health/pdfs/Cyanotoxin-Petition.pdf [https://perma.cc/PJ3D-9V5B].

285. *Id.*

286. *Id.*

287. FLA. STAT. § 403.067 (1999); *see* HOUCK, *supra* note 39, at 56 (noting that it was twenty-five years after the passage of Section 303(d) of the CWA that all but a few states and territories had lists of water quality limited segments and the TMDL process "had actually begun").

establishment of a TMDL program, the state delayed establishing numeric criteria for nutrients for more than a decade, which further impeded the state's progress in addressing nonpoint source pollution.[288] The Florida experience has been an example of a phenomenon that commentators have characterized as "uncooperative federalism."[289]

Once the TMDL program was finally established in Florida, in 2001, the state adopted a TMDL for Lake Okeechobee setting a phosphorous target of 140 metric tons per year.[290] The Lake Okeechobee Protection Plan listed a target year of 2015 to meet the phosphorous TMDL.[291] By 2015, the state was far from meeting the TMDL.[292] Consequently, the Florida Legislature amended the law in 2016, adopting a BMAP that delayed the deadline for achieving the TMDL by twenty years.[293] If achieving the TMDL within twenty years is "not practicable," additional five-year milestones can be established.[294]

Unfortunately, it has been two decades since the legislature established the TMDL for Lake Okeechobee, and the state is not even close to meeting the 140 metric tons per year pollution standard for phosphorus.[295] According to a 2015 report issued by the University of Florida Water Institute, since 1974, annual total phosphorus loads to Lake Okeechobee have exceeded 500 metric tons nearly fifty percent of the time.[296] Averaged over the forty-one-year period of record, the annual phosphorus load is approximately 3.6 times the annualized TMDL.[297] The majority of these nutrients enter the watershed from agricultural and urban sources.[298]

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288. Houck, *supra* note 33, at 10437–42.

289. *Id.* at 10442 n.211.

290. FLA. ADMIN. CODE ANN. r. 62-304.700 (2001).

291. FLA. STAT. § 373.4595(4)(c)(3) (2000).

292. Daniel E. Canfield Jr. et al., *Restoration of Lake Okeechobee, Florida: Mission Impossible?*, 37 LAKE & RESERVOIR MGMT. 95, 95–96 (2021).

293. FLA. STAT. § 373.4595(3)(b) (2016).

294. FLA. DEP'T OF ENV'T PROT., FLORIDA STATEWIDE ANNUAL REPORT ON TOTAL MAXIMUM DAILY LOADS, BASIN MANAGEMENT ACTION PLANS, MINIMUM FLOWS OR MINIMUM WATER LEVELS, AND RECOVERY OR PREVENTION STRATEGIES 8 (June 2018), https://floridadep.gov/sites/default/files/2017STAR_MainReport_WithCoverLetter_062718.pdf [https://perma.cc/ZCB7-BAEE]. Unfortunately, the state legislature's practice of extending deadlines when water pollution reduction targets are not met is not without precedent. For example, when it became apparent that the state would miss a 2006 deadline for phosphorus pollution cleanup as established under the Everglades Forever Act, the Act was amended to extend the deadline another ten years. *See* Houck, *supra* note 33, at 10436.

295. Jenny Staletovich, *Florida Tops List for the Most Polluted Lakes in the U.S., Study Finds*, WUSF (Mar. 18, 2022), https://wusfnews.wusf.usf.edu/environment/2022-03-18/florida-tops-list-for-the-most-polluted-lakes-in-the-u-s-study-finds [https://perma.cc/ZUJ6-QRHK].

296. GRAHAM ET AL., *supra* note 33, at 63.

297. *Id.* at 63–64.

298. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 24–25.

Given the decades of delays in establishing a TMDL for the lake and the state's failure to achieve the TMDL in the years that followed, it should not come as a surprise that a significant amount of this pollution is in the form of legacy phosphorus.[299] Scientists have estimated that even if all phosphorus pollution stopped entering the lake tomorrow, the phosphorus levels would exceed the TMDL due to the amount of legacy phosphorus in the basin's soil.[300] This would sustain approximately 500 metric tons per year of total phosphorus loading for several decades.[301] Phosphorus-enriched settlements in the lake "are also likely to sustain" high total phosphorus concentrations for "decades beyond the basin legacy phosphorus removal timeline."[302]

B. *The Lake Okeechobee TMDL Failed to Provide Reasonable Assurances that Pollution Reduction Measures Would be Implemented*

The state's inability to reduce nutrient loadings stems in large part from the state's failure to adequately implement the pollution reduction measures necessary to achieve the TMDL.[303] Although the Lake Okeechobee TMDL recognized the connection between phosphorus pollution and HABs, as well as the harm caused by HABs,[304] for more than a decade there was no plan in place to implement the TMDL and address these harms.[305] When the BMAP was finally established in

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299. *See* K. Ramesh Reddy et al., *Phosphorous Cycling in the Greater Everglades Ecosystem: Legacy Phosphorous Implications for Management and Restoration*, 41 CRITICAL REVS. ENV'T REV. SCI. & TECH. 149, 179 (2011) (explaining that "[e]ven very conservative estimates" indicate that legacy phosphorous in the Everglades could sustain phosphorous loads for many decades).

300. *Id.* at 178.

301. *Id.* at 150, 178–79.

302. Yogesh Khare et al., *A Phased Assessment of Restoration Alternatives to Achieve Phosphorus Water Quality Targets for Lake Okeechobee, Florida, USA*, 11 WATER 1, 17 (2019).

303. Sydney Czyzon & Max Chesnes, *Look at the Water for Evidence. Data Proves Florida Prevention Not Working*, TCPALM (May 6, 2022, 4:00 PM), https://www.tcpalm.com/in-depth/news/local/indian-river-lagoon/2022/01/05/florida-bmaps-lake-okeechobee-water-pollution-environment-bmp-fdep-fdacs-desantis-farming-regulation/6392489001/ [https://perma.cc/NB6X-LKCY].

304. *See* FLA. DEP'T OF ENV'T PROT., TOTAL MAXIMUM DAILY LOAD FOR TOTAL PHOSPHORUS LAKE OKEECHOBEE, FLORIDA 9–10, 30–32 (2001) (finding the TMDL sets a target forty parts per billion concentration of phosphorous, which if achieved would significantly reduce the number of blooms from occurring).

305. *See* S. FLA. WATER MGMT. DIST. ET AL., LAKE OKEECHOBEE PROTECTION PLAN UPDATE 16 (2011), https://www.sfwmd.gov/sites/default/files/documents/lopp_update_2011.pdf [https://perma.cc/6ASS-Y5T5] (explaining that a BMAP *may* be created to meet the TMDL but that the Lake Okeechobee Protection Plan already "fulfills the role of a BMAP for Lake Okeechobee").

2014,[306] it lacked an adequate framework to protect Lake Okeechobee and the coastal estuaries from excessive nutrient loads and HABs.[307]

The initial BMAP assumed that all agricultural lands were enrolled in the Florida Department of Agriculture and Consumer Services' (FDACS) BMP program and that these BMPs were being implemented,[308] despite a 2014 report by FDACS revealing that, of the more than four million acres enrolled under the BMP program, FDACS had only conducted 329 implementation site visits for 257,285 enrolled acres.[309] The BMAP also lacked allocations to categories of nonpoint source pollution.[310] The lack of allocations undermined the statutory mandate that these plans equitably allocate pollutant reductions between or *among* point and *nonpoint sources* to meet the TMDL.[311] Instead, it allocated the entire load to all nonpoint sources in the aggregate.[312] The adaptive management process also lacked procedures for corrective measures if BMPs were underperforming.[313] Further, the BMAP identified "potential" funding sources but provided few details about whether these funds would be obtained and applied toward reducing total phosphorus in the watershed.[314]

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306. FLA. DEP'T OF ENV'T PROT., FINAL 2015 PROGRESS REPORT FOR THE LAKE OKEECHOBEE BASIN MANAGEMENT ACTION PLAN 10–11 (2016).

307. *See generally* WENDY D. GRAHAM ET AL., SCIENTIFIC SYNTHESIS TO INFORM DEVELOPMENT OF THE NEW LAKE OKEECHOBEE SYSTEM OPERATING MANUAL 27 (2020), https://waterinstitute.ufl.edu/wp-content/uploads/UF-Water-Institute-Final-LOSOM-Synthesis-Report.pdf [https://perma.cc/YU86-Y564] ("[T]he Total Maximum Daily Load (TMDL) for total phosphorus was set at a level equivalent to 140 metric tons/year with the goal of reducing in-lake total phosphorus (TP) concentrations . . . . Annual TP inputs to the lake, however, have typically remained 3-4 times larger than the target value.").

308. FLA. DEP'T OF ENV'T PROT., BASIN MANAGEMENT ACTION PLAN FOR THE IMPLEMENTATION OF TOTAL MAXIMUM DAILY LOADS FOR TOTAL PHOSPHORUS BY THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION IN LAKE OKEECHOBEE 42 (2014), https://floridadep.gov/sites/default/files/LakeOkeechobeeBMAP.pdf [https://perma.cc/NM74-9LBX].

309. Douglas H. MacLaughlin, *Will Basin Management Action Plans Restore Florida's Impaired Waters?*, 89 Fla. Bar J. 31, 37 (2015).

310. The 140 metric ton per year total phosphorous standard was allocated to the entire Lake Okeechobee watershed. *See* FLA. DEP'T OF ENV'T PROT., *supra* note 306, at xiv–xvi.

311. FLA. STAT. § 403.067(6)(b) (2022); *see* MacLaughlin, *supra* note 309, at 31–33 (explaining the statutory requirement in Section 403.067(6)(b)).

312. FLA. DEP'T OF ENV'T PROT., *supra* note 306, at 17.

313. *Id.* at 72.

314. *Id.* at 139.

C. *Executive Orders and Legislation Have Not Resulted in Stronger Agricultural Nonpoint Source Pollution Controls*

1. The State Has Not Fully Implemented the Recommendations of the Florida Blue Green Algae Task Force

Following what may have been the most devastating HABs in Florida's history in 2018, Florida Governor Ron DeSantis issued an executive order aimed at addressing the crisis.[315]

Perhaps the most noteworthy aspect of Executive Order 19-12 was the creation of a Blue Green Algae Task Force "charged with focusing on expediting progress toward reducing the adverse impacts of blue-green algae blooms now and over the next five years."[316] This followed the nearly two-decade absence of the Harmful Algal Bloom Task Force, which was established in 1997 after two major HABs in Florida in 1996.[317] The state disbanded the force in 2002 due to a lack of funding.[318] Executive Order 19-12 stated:

> [The Blue Green Algae Task Force] should support key funding and restoration initiatives to expedite nutrient reductions in Lake Okeechobee and the downstream estuaries. This task force should identify priority projects for funding that are based on scientific-data and built upon Basin Management Action Plans to provide the largest and most meaningful nutrient reductions in key waterbodies, as well as make recommendations for regulatory changes.[319]

The Blue Green Algae Task Force is comprised of five scientists who have expertise in aquatic ecology, oceanography, environmental engineering, and marine biology.[320] The task force has met on several occasions to examine the sources of nutrient over-enrichment and the measures in place for monitoring, reducing, and remediating them.[321] In October 2019, the task force issued its first "consensus document," which

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315. Fla. Exec. Order No. 19-12 (Achieving More Now for Florida's Environment) 1 (Jan. 10, 2019) [hereinafter Fla. Exec. Order No. 19-12], https://www.flgov.com/wp-content/uploads/orders/2019/EO_19-12.pdf [https://perma.cc/XY7G-LA6P].

316. *Id.* at 2.

317. *History of Florida's Harmful Algal Bloom Task Force*, FLA. FISH & WILDLIFE CONSERVATION COMM'N, https://myfwc.com/research/redtide/taskforce/history/ [https://perma.cc/FQ9D-SS4Q] (last visited Feb. 17, 2023).

318. *Id.* In 2019, the Harmful Algal Bloom Task Force was reconvened at the Florida Governor's direction. *Id.*

319. Fla. Exec. Order No. 19-12, *supra* note 315, at 2.

320. *State Task Force Efforts: Blue-Green Algae Task Force*, PROTECTING FLA. TOGETHER, https://protectingfloridatogether.gov/state-action/blue-green-algae-task-force [https://perma.cc/HC5U-A2BZ] (last visited Feb. 17, 2023).

321. *Id.*

contains a set of recommendations aimed at informing policy decisions and regulatory actions as well as filling in information gaps.[322] The consensus document "highlights areas where additional study and/or policy and regulatory reform are warranted,"[323] including BMAPs, BMPs, onsite sewage treatment and disposal systems, sanitary sewer overflows, storm water treatment systems, innovative technologies and applications, public health, and monitoring programs.[324]

The establishment of the Blue Green Algae Task Force is a significant first step toward addressing the algae crisis. It elevates science over politics, the latter of which has stymied the state's development and implementation of pollution reduction measures for decades.[325]

Unfortunately, the status quo has remained, as little regulatory and legislative progress has been made since the task force was established. The state legislature took a few steps toward implementing some of the task force's recommendations when it passed the Clean Waterways Act in 2020, such as allowing DEP to proactively inspect wastewater treatment systems and requiring FDACS to inspect agricultural operations every two years to verify BMP compliance.[326] Yet the Clean Waterways Act does not directly address the ways in which agricultural pollution can be better managed at the source, what more needs to be done to achieve the pollution reduction targets set forth in the TMDLs, and how state agencies can better monitor for cyanotoxins and notify the public when HABs pose a threat to human health.[327]

2. The Governor's Executive Order Has Not Led to Significant Improvements in the Implementation of TMDLs

Executive Order 19-12 further directed FDEP to update and secure all restoration plans within one year for waterbodies impacting South Florida communities.[328] In 2020, FDEP performed five-year reviews for the Lake Okeechobee, St. Lucie, and Caloosahatchee BMAPs and updated the

322. FLA. DEP'T OF ENV'T PROT., BLUE-GREEN ALGAE TASK FORCE CONSENSUS DOCUMENT #1 *passim* (Oct. 11, 2019), https://floridadep.gov/sites/default/files/Final%20Consensus%20%231_0.pdf [https://perma.cc/FK63-Y26K].

323. *Id.* at 2.

324. *Id.* at 2–10.

325. Houck, *supra* note 33, at 10442; Greg Allen, *'A Government-Sponsored Disaster': Florida Asks for Federal Help with Toxic Algae*, NPR (July 9, 2016, 12:58 PM), https://www.npr.org/2016/07/09/485367388/a-government-sponsored-disaster-florida-asks-for-federal-help-with-toxic-algae [https://perma.cc/X2UA-L3H3].

326. Renzo Downey, *Gov. DeSantis Signs Clean Waterways Act*, FLA. POLS. (June 30, 2020), https://floridapolitics.com/archives/345170-gov-desantis-signs-clean-waterways-act/ [https://perma.cc/A5UB-NQ8D]; Clean Waterways Act, 2020 Fla. Laws 150 (2020).

327. Clean Waterways Act, 2020 Fla. Laws 150 (2020).

328. Fla. Exec. Order No. 19-12, *supra* note 315, at 2.

BMAPs.[329] Although the Lake Okeechobee BMAP now includes sub-watershed load allocations, milestones for achieving load reductions, and more frequent reporting,[330] it still falls short of providing an adequate framework for the state to effectively manage nutrient loads.

Many of the same deficiencies in the initial Lake Okeechobee BMAP remain in the updated BMAP. The current BMAP still does not acknowledge that high phosphorus levels are one of the principal drivers of HABs in the lake and estuaries and does not address why meeting the TMDL is critical if the state hopes to reduce HABs. The BMAP also does not assign load allocations among the various types of nonpoint sources, particularly those within certain pollution hotspots. This is despite the fact that certain types of land uses and operations, such as intensive pastures and dairies, contribute a larger percentage of nutrients into the system than others, like unimproved pastures, groves, and orchards.[331] The BMAP continues to rely predominantly on the implementation of agricultural BMPs to achieve load reductions.[332] But after more than two decades, there is "insufficient" BMP enrollment, according to FDEP.[333] Even where FDACS makes a site visit and finds a landowner or producer not in compliance, it remains unclear under the Florida statute what specific enforcement procedures are in place after corrective ("first touch") and remedial ("second touch") measures fail to achieve compliance.[334] Where BMPs are being implemented, questions remain about whether they can achieve the desired load reductions.[335]

Aside from the five-year review process, the Lake Okeechobee BMAP does not include a platform for the public to review the state's progress toward meeting the TMDL or opportunities for continuing stakeholder engagement. It also does not provide opportunities for more frequent revisions if FDEP learns through adaptive management and the yearly reporting process that the load reduction strategies (principally

329. FLA. DEP'T OF ENV'T PROT., *supra* note 40, *passim*; FLA. DEP'T OF ENV'T PROT., CALOOSAHATCHEE RIVER AND ESTUARY BASIN MANAGEMENT ACTION PLAN *passim* (2020) [hereinafter CALOOSAHATCHEE 2020 BMAP], https://publicfiles.dep.state.fl.us/DEAR/DEARweb/BMAP/NEEP_2020_Updates/CaloosahatcheC%20BMAP_01-31-2020.pdf; FLA. DEP'T OF ENV'T PROT., ST. LUCIE RIVER AND ESTUARY BASIN MANAGEMENT ACTION PLAN *passim* (2020) [hereinafter ST. LUCIE 2020 BMAP], https://publicfiles.dep.state.fl.us/DEAR/DEARweb/BMAP/NEEP_2020_Updates/St_Lucie_BMAP_01-31-20.pdf [https://perma.cc/6UDL-FDY9].

330. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 24, 53, 45.

331. Khare et al., *supra* note 302, at 4 tbl.1.

332. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 25–27.

333. *Id.* at 15.

334. Catherine Awasthi & Ralph A. DeMeo, *Marine Canary in the Coal Mine: The Latest Threats to Manatee Survival and Efforts to Save Them*, 95 FLA. BAR. J. 52, 55 (2021).

335. *7/1/19 Department of Environmental Protection Blue-Green Algae Task Force Part 1*, FLA. CHANNEL (July 1, 2019) [hereinafter *7/1/19 Department of Environmental Protection*], https://thefloridachannel.org/videos/7-1-19-Department-of-environmental-protection-blue-green-algae-task-force-part-1 [https://perma.cc/H5XB-ZCS2]/.

BMPs) are not performing as expected. Additionally, the BMAP lacks backstops if milestones are not met. The latter issue is particularly troubling given FDEP's statement that "[d]ue to the fact that necessary local and regional nutrient reduction projects are still being identified, and as a result of insufficient agricultural BMP enrollment, BMP implementation verification, and other management strategies, it does not seem practicable to achieve reductions sufficient to meet the TMDL within 20 years."[336]

3. There Needs to be Greater Investment Toward Addressing the Pollution at the Source

Lastly, the Executive Order calls for additional investment in Everglades restoration and addressing nonagricultural sources of pollution.[337] These water storage and treatment projects are certainly needed to address the historic "plumbing problem" plaguing the lake and reduce the harmful discharges to the estuaries. The construction of large reservoirs and storage treatment areas, however, will neither address the pollution at the source nor prevent HABs from occurring in the future.[338] Further, although there are additional sources of pollution that the Executive Order does seek to address through increased investment in water treatment and funding programs, such as storm water and leaking septic tanks,[339] these other sources contribute a smaller percentage of the total phosphorus and nitrogen entering the lake than agricultural operations.[340] Moreover, while this Article proposes some statutory and regulatory reforms to better address these other sources, the infrastructure improvements and upgrades needed to reduce nonagricultural nonpoint source pollution (such as replacing old, broken, or leaking sewer lines and converting properties with onsite sewage treatment and disposal

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336. FLA. DEP'T OF ENV'T PROT., *supra* note 40.

337. Fla. Exec. Order No. 19-12, *supra* note 315, at 2–4.

338. NAT'L ACADEMIES OF SCIS., ENG'G, & MED., *supra* note 55, at 6. As a report from the National Academies of Sciences, Engineering, and Medicine explains, "CERP ecological restoration goals, particularly in the northern estuaries and Biscayne Bay, cannot be met if water quality and associated algal blooms, which are outside of the direct purview of the CERP, are not addressed." *Id.* at 9. The report further notes that

> Some CERP projects are expected to reduce nutrient loads, but the water quality components of CERP projects represent only minor aspects of the steps needed to meet water quality criteria in the estuaries. Requirements for compliance with the Clean Water Act to address pollution and water quality fall to the state and not to CERP.

Id. at 10. The report also states that public expectations for improved estuarine conditions extend beyond what CERP alone can achieve and require non-CERP efforts as well. *Id.*

339. Fla. Exec. Order No. 19-12, *supra* note 315, at 2–3.

340. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 24–25 tbl.3.

systems to central sewer systems) depend largely on significantly more capital investment by state and local governments.

V. Recommendations to Address Harmful Algal Blooms

The State of Florida should embrace its primary role under the CWA and take bold steps towards reducing nonpoint source pollution and restoring water quality. To this end, it should adopt specific water quality criteria for cyanotoxins, retool the BMP programs, adopt BMAP approaches that embrace accountability frameworks pioneered by the Chesapeake Bay TMDL, and adapt to the compounding effects of climate change. While the recommendations below use Florida as an example, many of the recommendations can be broadly applied to any state suffering from HABs.

A. *Florida Should Adopt Water Quality Criteria for Cyanotoxins and Improve Monitoring and Notification Systems*

The first step toward addressing HABs should be to identify, establish, and enforce water quality standards for cyanotoxins. Currently, there are no federal standards for cyanobacteria or cyanobacterial toxins in drinking water under the Safe Drinking Water Act (SDWA).[341] Since states are primarily responsible for establishing water quality standards for surface waters, there are also no federal limits on cyanotoxins in lakes, rivers, estuaries, and other water bodies.[342] The EPA, however, has published recommendations for states to protect people from cyanotoxins in drinking water and recreational waters.[343] Florida should use the EPA's recommendations to establish its own drinking water and surface water standards. These standards, coupled with improvements to the state's water quality monitoring and notification systems, would better protect people, pets, and wildlife from HABs.

341. U.S. ENV'T PROT. AGENCY, EPA-810F11001, CYANOBACTERIA AND CYANOTOXINS: INFORMATION FOR DRINKING WATER SYSTEMS 1 (2019) [hereinafter EPA-810F11001], https://www.epa.gov/sites/default/files/2019-07/documents/cyanobacteria_and_cyanotoxins_fact_sheet_for_pws_final_06282019. pdf [https://perma.cc/V58L-95M9].

342. *See id.* (stating that there are no federal guidelines for cyanobacteria and their toxins in recreational waters).

343. U.S. ENV'T PROT. AGENCY, *supra* note 19, *passim*. In 2019, the EPA published final recommendations that significantly increased the allowable levels of exposure. *See* U.S. ENV'T PROT. AGENCY, EPA 823-R-19-001, RECOMMENDATIONS FOR CYANOBACTERIA AND CYANOTOXIN MONITORING IN RECREATIONAL WATERS *passim* (2019) [hereinafter EPA 823-R-19-001], https://www.epa.gov/sites/production/files/2019-09/documents/recommend-cyano-rec-water-2019-update.pdf [https://perma.cc/4SEK-GY8M].

1. There Should Be Drinking Water Standards for Cyanotoxins

The SDWA authorizes the EPA to set national drinking water standards to protect the public against both naturally-occurring and man-made contaminants.[344] The SDWA requires the EPA to publish a maximum contaminant level goal and promulgate a national primary drinking water regulation (NPDWR) for a contaminant if it determines that (1) the contaminant may have adverse health effects; (2) the contaminant known to occur (or there is a substantial likelihood that it occurs) frequently in public water systems at levels of public health concern; and (3) there is a meaningful opportunity for health risk reduction for people served by public water systems.[345] The EPA has established drinking water standards for more than ninety contaminants.[346]

The EPA has placed cyanobacteria and their toxins on its Contaminant Candidate Lists, which identify contaminants that are not subject to any proposed or promulgated NPDWR but are known or anticipated to occur in public water systems and may need to be regulated under the SDWA.[347]

In 2015, the EPA released health advisory values for algal toxins in drinking water.[348] Health advisory values identify the concentration of a contaminant in drinking water at which adverse health effects are not expected to occur over specific exposure deadlines (for example, ten days).[349] They serve as informational technical guidance for federal, state, and local governments and water system managers in protecting public health when emergency spills or contamination events occur.[350] Health advisory values provide information on environmental properties, health

344. *Overview of the Safe Drinking Water Act*, U.S. ENV'T PROT. AGENCY (Feb. 15, 2022), https://www.epa.gov/sdwa/overview-safe-drinking-water-act [https://perma.cc/GB6X-9RJE]; Safe Drinking Water Act, 42 U.S.C. §§ 300f–300j-27.

345. Safe Drinking Water Act, 42 U.S.C. § 300g-1(b)(1)(A)(i)–(iii).

346. *Safe Drinking Water Act*, U.S. ENV'T PROT. AGENCY (July 14, 2022), https://www.epa.gov/sdwa [https://perma.cc/KT2U-STQG].

347. U.S. ENV'T PROT. AGENCY, 2015 DRINKING WATER HEALTH ADVISORIES FOR TWO CYANOBACTERIAL TOXINS 1 (2015), www.epa.gov/sites/default/files/2017-06/documents/cyanotoxins-fact_sheet-2015.pdf; EPA-810F11001, *supra* note 341.

348. *EPA Issues Health Advisories to Protect Americans from Algal Toxins in Drinking Water*, U.S. ENV'T PROT. AGENCY (May 6, 2015), https://archive.epa.gov/epa/newsreleases/epa-issues-health-advisories-protect-americans-algal-toxins-drinking-water.html [https://perma.cc/SUA9-TZ68]; U.S. ENV'T PROT. AGENCY, EPA-820R15100, DRINKING WATER HEALTH ADVISORIES FOR THE CYANOBACTERIAL MICROCYSTIN TOXINS *passim* (2015) [hereinafter EPA-820R15100], https://www.epa.gov/sites/default/files/2017-06/documents/microcystins-report-2015.pdf [https://perma.cc/KD48-LFE4]; U.S. ENV'T PROT. AGENCY, EPA-820R15101, DRINKING WATER HEALTH ADVISORY FOR THE CYANOBACTERIAL TOXIN CYLINDROSPERMOPSIN *passim* (2015) [hereinafter EPA-820R15101], https://www.epa.gov/sites/default/files/2017-06/documents/cylindrospermopsin-report-2015.pdf [https://perma.cc/H99G-546J].

349. U.S. ENV'T PROT. AGENCY, *supra* note 347.

350. *Id.*

effects, analytical methodology, and treatment for removal of drinking water contaminants.[351] There are health advisory values for more than 200 contaminants.[352] Some states have published guidance values for cyanotoxins in drinking water, and Ohio has established a "do not drink" level for children and sensitive populations.[353]

Currently, there is no program in place to monitor for the occurrence of cyanotoxins (including microcystins and cylindrospermopsin) at surface water treatment plants for drinking water in the United States.[354] The majority of states also do not require cyanotoxin monitoring in drinking water.[355] In Florida, although some cities may proactively test for cyanotoxins, testing is not required routinely for treatment facilities,[356] and it appears there is no state guidance for public water systems.[357]

Federal action may, however, be on the horizon. Following the EPA's issuance of health advisories (HAs) for algae toxins in drinking water, the Agency published its Fourth Unregulated Contaminant Monitoring Rule (UCMR 4) for public water systems in 2016.[358] Pursuant to the SDWA,[359] the EPA is required once every five years to issue a new list of no more than thirty unregulated contaminants to be monitored by public water systems.[360] UCMR 4 was intended to provide the EPA and others with data on the occurrence and levels of contaminants in drinking water.[361] Under UCMR 4, thirty chemical contaminants were monitored and surveyed from 2018 to 2020.[362] This national survey is one of the primary

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351. *Id.* at 2.

352. *Drinking Water Health Advisories*, U.S. ENV'T PROT. AGENCY (June 15, 2022), https://www.epa.gov/sdwa/drinking-water-health-advisories-has [https://perma.cc/L39K-9CQJ].

353. *Guidelines and Recommendations*, U.S. ENV'T PROT. AGENCY, https://19january2017snapshot.epa.gov/nutrient-policy-data/guidelines-and-recommendations_.html [https://perma.cc/TD6C-FPTK] (last visited Feb. 18, 2023).

354. EPA-810F11001, *supra* note 341.

355. AM. WATER WORKS ASS'N, *supra* note 29, at vi.

356. *Update on Vulnerable Populations Water Advisory*, W. PALM BEACH (June 3, 2021, 5:12 PM), https://www.wpb.org/Home/Components/News/News/1722/16 [https://perma.cc/L7JK-SVLQ].

357. AM. WATER WORKS ASS'N, *supra* note 29, at 5 tbl.3.

358. *Fourth Unregulated Containment Monitoring Rule*, U.S. ENV'T PROT. AGENCY (Dec. 16, 2022), https://www.epa.gov/dwucmr/fourth-unregulated-contaminant-monitoring-rule [https://perma.cc/3V5L-QMH9].

359. Revisions to the Unregulated Contaminant Monitoring Rule (UCMR 4) for Public Water Systems and Announcement of Public Meeting, 81 Fed. Reg. 92666 (Dec. 20, 2016) (codified at 40 C.F.R. § 141).

360. U.S. ENV'T PROT. AGENCY, THE FOURTH UNREGULATED CONTAMINANT MONITORING RULE (UCMR 4) GENERAL INFORMATION 1 (2016), https://www.epa.gov/sites/production/files/2017-03/documents/ucmr4-fact-sheet-general.pdf [https://perma.cc/P2T7-W6UZ].

361. *Id.*

362. U.S. ENV'T PROT. AGENCY, EPA 815-S-22-001, THE FOURTH UNREGULATED CONTAMINANT MONITORING RULE (UCMR 4): DATA SUMMARY, JANUARY 2022 1 (2022), https://www.epa.gov/sites/default/files/2018-10/documents/ucmr4-data-summary.pdf [https://

sources of information on occurrence and levels of exposure that the EPA will use to develop regulatory decisions for contaminants in the public drinking water supply.[363] Of the thirty chemicals monitored under UCMR 4, nine were cyanotoxins, and one was a cyanotoxin group.[364]

Under the SDWA, the EPA will consider the data from UCMR 4 and other sources, including peer-reviewed literature, to make a regulatory determination on whether to initiate the process to develop NPDWR for these contaminants.[365] The NPDWR are "legally enforceable primary standards and treatment techniques that apply to public water systems" and that protect human health by limiting contaminant levels in drinking water.[366] FDEP implements the SDWA in Florida and has adopted EPA regulations and rules.[367] UCMR 4 reporting is complete, and collection under the Fifth Unregulated Contaminant Monitoring Rule (UCMR 5) is now underway.[368]

With the increase in HABs in Florida, cyanotoxins continue to pose a threat to the State's drinking water. In May 2021, the City of West Palm Beach collected raw water samples from Clear Lake (a source of its drinking water) and finished water at its treatment plant, which showed cylindrospermopsin in the drinking water at levels above the EPA's 0.7-micrograms-per-liter HA.[369] The city issued a water advisory for vulnerable populations and established a point of distribution for the dissemination of bottled water to residents affected by the advisory.[370] Clear Lake receives its water in part from Lake Okeechobee.[371]

Florida should consider establishing its own values even if the EPA does not ultimately adopt NPDWR for cyanotoxins under the SDWA.

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perma.cc/JB8B-42LM].

363. *Id.*

364. U.S. ENV'T PROT. AGENCY, *supra* note 360.

365. *Id.*

366. *National Primary Drinking Water Regulations*, U.S. ENV'T PROT. AGENCY (Jan. 9, 2023), https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations [https://perma.cc/MKT6-2P7L].

367. *Regulated Drinking Water Contaminants and Contaminants of Emerging Concern*, FLA. DEP'T ENV'T PROT. (July 1, 2022, 12:14 PM), https://floridadep.gov/comm/press-office/content/regulated-drinking-water-contaminants-and-contaminants-emerging-concern [https://perma.cc/PQ6J-ADL9]; *Drinking Water Standards and Facts*, FLA. DEP'T ENV'T PROT., https://floridadep.gov/sites/default/files/drinking-water-standards-facts.pdf [https://perma.cc/Y5ZC-NUR2] (last visited Jan. 12, 2023).

368. *Occurrence Data from the Unregulated Contaminant Monitoring Rule (UCMR)*, U.S. ENV'T PROT. AGENCY (Feb. 17, 2023), https://www.epa.gov/dwucmr/occurrence-data-unregulated-contaminant-monitoring-rule [https://perma.cc/9XZ2-CJCW].

369. *Update on Vulnerable Populations Water Advisory*, *supra* note 356.

370. *Id.*

371. Kimberly Miller, *Look at This Lake: Is West Palm's Drinking Water Supply in Danger?*, PALM BEACH POST (July 23, 2019), https://www.palmbeachpost.com/news/20190723/ look-at-this-lake-is-west-palms-drinking-water-supply-in-danger [https://perma.cc/ZA53-BNDG].

While the federal government establishes NPDWR that the states follow, states can establish their own drinking water standards that are no less stringent than the NPDWR.[372] States have also adopted standards for contaminants not regulated under the NPDWR.[373] Under the Florida Safe Drinking Water Act, FDEP appears to have the authority to develop state standards for contaminants otherwise not regulated by the EPA.[374]

Florida's residents and visitors would be well served if the state were to follow the lead of Ohio and other states and develop guidance values, including "do not drink" levels for cyanotoxins. Doing so would lead to consistent and uniform monitoring and tracking of cyanotoxins in the state's drinking water supply and would enable local authorities to obtain clear guidance and instructions from FDEP and the Florida Department of Health (FDOH) about what specific reporting and other protective measures must be taken to protect public health—particularly vulnerable populations. This would also help ensure that there are no significant delays between the time that sampling reveals cyanotoxin levels are at levels that pose a risk to human health and the time that drinking water advisories are issued by county health departments.[375]

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372. 40 C.F.R. § 142.10(a) (1996); *see, e.g.*, FLA. STAT. § 403.853(1)(a)1. (2022) (stating that FDEP shall adopt and enforce "[s]tate primary drinking water regulations that shall be no less stringent at any given time than the complete interim or revised national primary drinking water regulations in effect at such time").

373. For example, several states have promulgated standards for per- and polyfluoroalkyl substances (PFAS) in the absence of national primary drinking water standards. *See, e.g.*, *Contaminant Levels (MCLs)*, MICHIGAN PFAS ACTION RESPONSE TEAM, https://www.michigan.gov/pfasresponse/0,9038,7-365-95571_99970---,00.html [https://perma.cc/Z54P-TLW9] (last visited Feb. 19, 2023). Michigan cited the lack of enforceable federal standards for PFAS chemicals during the development of its state drinking water standards. *See Drinking Water Rule Promulgation*, MICH. DEP'T OF ENV'T, GREAT LAKES, & ENERGY, https://www.michigan.gov/egle/0,9429,7-135-3313_3675_3691-9647--,00.html [https://perma.cc/YMG7-8ZA3] (last visited Feb. 19, 2023).

374. Florida implements SDWA drinking water standards under Florida Administrative Code Rule 62-550 (2022). Florida's regulations state that the scheme of the federal Safe Drinking Water Act "was to give primary responsibility for public water systems programs to states to implement a public water system program." FLA. ADMIN. CODE ANN. r. 62-550.102 (2022). The Florida Legislature enacted the Florida Safe Drinking Water Act, Sections 403.850 to 403.864, Florida Statutes (2022), and FDEP promulgated regulations to implement the requirements of the Act "and to acquire and maintain primacy for Florida under the Federal Act." FLA. ADMIN. CODE ANN. r. 62-550.102 (2022). Florida's rules adopt national primary and secondary drinking water standards of the federal government where possible "and otherwise create additional rules to fulfill state and Federal requirements." *Id.*

375. In the case of the May 2021 water advisory in West Palm Beach, Florida, it appears the city did not receive guidance from FDOH until nine days after the sampling results indicated elevated levels of cylindrospermopsin. *See* Danielle Waugh, *City of West Palm Beach Defends Waiting 10 Days to Alert Public About Toxic Water*, CBS 12 NEWS (June 1, 2021), https://cbs12.com/news/local/city-of-west-palm-beach-defends-waiting-10-days-to-alert-public-about-toxic-water-06-01-2021 [https://perma.cc/F8B8-5H65].

2. Florida Should Establish Water Quality Criteria for Microcystins and Cylindrospermopsin in Recreational Waters

In consideration of the human health effects of cyanotoxins resulting from recreational exposure, in 2016, the EPA published draft recommended values for microcystins and cylindrospermopsin under Section 304(a) of the CWA "for states to consider as the basis for swimming advisories for notification purposes in recreational waters to protect the public."[376] In developing these recommended values, the EPA noted that states may also consider using these values when adopting new or revised water quality standards.[377] If adopted as water quality standards and approved by the Agency under Section 303(c) of the CWA, the recommended values could be used for all CWA purposes.[378] States can also use the values as swimming advisory values.[379] The EPA envisioned that if states decided to use the values as swimming advisory values, they would do so in a manner similar to their current recreational water advisory programs.[380] On May 22, 2019, the EPA issued its final Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin.[381]

Although a state is not required to adopt new or revised criteria for parameters for which the EPA has published new or updated CWA Section 304(a) criteria recommendations, the state must provide an explanation when it submits the results of its triennial review to the Regional Administrator of the EPA consistent with Section 303(c)(1) of the CWA and the requirements of 40 C.F.R. § 131.20(c).[382]

Some states severely impacted by HABs are acting to protect their residents and visitors from cyanotoxins. For example, Ohio produced a response strategy with the EPA to establish a recreational use standard and advisory protocol for cyanotoxins.[383] Twenty-two states have

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376. U.S. ENV'T PROT. AGENCY, *supra* note 19, at 1. The EPA recommended values protective of primary contact recreation for microcystins at four micrograms per liter and for cylindrospermopsin at eight micrograms per liter. *Id.* at 2.

377. *Id.* at 1.

378. *Id.*

379. *Id.*

380. *Id.* at 1–2.

381. U.S. ENV'T PROT. AGENCY, RECOMMENDED HUMAN HEALTH RECREATIONAL AMBIENT WATER QUALITY CRITERIA OR SWIMMING ADVISORIES FOR MICROCYSTINS AND CYLINDROSPERMOPSIN *passim* (2019), https://www.epa.gov/sites/default/files/2019-05/documents/hh-rec-criteria-habs-document-2019.pdf [https://perma.cc/V4GD-G8J3]. The EPA's final recommended values are eight micrograms per liter for microcystins and fifteen micrograms per liter for cylindrospermopsin. *Id*. at 16–17.

382. 40 C.F.R. § 131.20(a).

383. OHIO DEP'T OF HEALTH ET AL., STATE OF OHIO HARMFUL ALGAL BLOOM RESPONSE STRATEGY FOR RECREATIONAL WATERS *passim* (2020), https://epa.ohio.gov/static/Portals/35/hab/

implemented HAB response guidelines in the event of a significant bloom in recreational waterways.[384] These include specific criteria for analyzing the severity of a bloom and the actions—public advisories, posted warnings, waterway, or beach closures, among others—that correspond to a bloom that meets a certain threshold.[385]

In Florida, following the EPA's release of its final recommended water criteria for cyanotoxins, the Center for Biological Diversity, Sanibel Captiva Conservation Foundation, and Calusa Waterkeeper petitioned FDEP to establish water quality criteria for microcystins and cylindrospermopsin.[386] FDEP indicated that it would consider adopting such criteria during its triennial review of the state's water quality standards.[387] More than two years later, however, FDEP indicated that it does not intend to adopt water quality criteria for cyanotoxins, despite the Florida Blue Green Algae Task Force recommending that it do so.[388] In declining to establish standards, FDEP had concerns regarding how the EPA's final 2019 recommended criteria were derived and determined that chlorophyll-*a* could be used as a proxy for cyanotoxins instead.[389]

While FDEP is justified in its concerns about how EPA's 2019 final recommended criteria were derived,[390] the CWA regulations do not

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HABResponseStrategy.pdf?ver=2020-10-28-164629-413#:~:text=The%20purpose%20of%20the%20Ohio,from%20cyanotoxins%20produced%20by%20cyanobacteria [https://perma.cc/HYP5-BCXV]; *see* Tom Henry, *What Will Lake Erie's Impairment Mean for Northwest Ohio?*, TOLEDO BLADE (Mar. 25, 2018), https://www.toledoblade.com/local/2018/03/24/What-will-Lake-Erie-s-impairment-mean-for-northwest-Ohio.html [https://perma.cc/FEU8-QLMD] (discussing how, following severe HABs in Lake Erie and prompted by subsequent litigation challenging EPA's review of Ohio's biennial impaired waters list, Ohio designated a sixty-mile portion of western Lake Erie as "impaired").

384. *Guidelines and Regulations*, U.S. ENV'T PROT. AGENCY, https://19january2017snapshot.epa.gov/nutrient-policy-data/guidelines-and-recommendations_.html [https://perma.cc/4MZS-V257] (last visited Feb. 19, 2023).

385. *Id.*

386. Petition for Rulemaking, *supra* note 284, at 2.

387. Order from Fla. Dep't of Env't Prot., In re: Petition for Rulemaking, No. 19-0419 (June 24, 2019) (on file with authors); Letter from Ctr. for Biological Diversity et al. to Kaitlyn Sutton, Fla. Dep't of Env't Prot. 2–3 (Nov. 18, 2019), https://www.biologicaldiversity.org/programs/environmental_health/pdfs/Comments-on-Florida-Triennial-Review.pdf [https://perma.cc/VQ9T-4FNW].

388. DIV. OF ENV'T ASSESSMENT & RESTORATION, FLA. DEP'T OF ENV'T PROT., TRIENNIAL REVIEW OF FLORIDA'S WATER QUALITY STANDARDS 81–94 (2021), http://publicfiles.dep.state.fl.us/DEAR/DEARweb/Standards/Triennial%20Review%202019-2021/May%202021%20Workshop%20Technical%20Documents/MayPublicWorkshop3_19_21_All_Slides-FINAL%20PDF.pdf; FLA. DEP'T OF ENV'T PROT., *supra* note 322, at 9.

389. DIV. OF ENV'T ASSESSMENT & RESTORATION, *supra* note 388, at 85, 89.

390. Unlike the draft criteria, the final recommended values eliminate the "relative source contribution" (RSC) and assume that all cyanotoxin exposure is from ingestion and not from inhalation, dermal absorption, or eating contaminating fish or shellfish. *Compare* U.S. ENV'T PROT. AGENCY, *supra* note 19, at 37, 44, *with* U.S. ENV'T PROT. AGENCY, *supra* note 381, at 58. The decision to drop the RSC not only seems to ignore the mounting evidence that people can be

preclude FDEP from adopting the more protective 2016 EPA draft recommendations, even if there is still some scientific uncertainty regarding acceptable levels of exposure.[391] Indeed, the precautionary principle counsels in favor of adopting the criteria now even if there is still some scientific uncertainty.[392] Despite the reliance on chlorophyll-*a*, chlorophyll-*a* is an inappropriate proxy for cyanotoxins for characterizing impairment because the conditions that promote or suppress chlorophyll-*a* in water are different than the conditions that allow for cyanotoxins, such as microcystin from cyanobacteria.[393]

The establishment of water quality criteria for cyanotoxins in Florida's surface waters would make a significant difference in controlling HABs, protecting people from the harmful effects of exposure to cyanobacteria, and preventing further damage to local communities that depend on the state's waters to support their economies. By promulgating water quality criteria for cyanotoxins, FDEP would establish clear numeric baselines for the state's waters, which are used as sources of drinking water, places to recreate, areas to propagate and harvest shellfish, and habitat for the state's abundant and diverse wildlife.

3. Florida Should Improve its HAB Monitoring and Notification Systems

Florida should also develop clearly defined procedures for notifying the public when HABs are present in recreational waters. Under Florida's qualitative guidelines, when a cyanobacteria bloom is present, the

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exposed to cyanotoxins through multiple pathways, but it also appears to deviate from longstanding EPA policy. EPA policy dating back to 2000 recommends the use of an RSC to account for multiple exposure pathways to pollutants like cyanotoxins. *See* U.S. ENV'T PROT. AGENCY, *supra* note 19, at 44 (stating that the EPA recommends using an RSC to calculate ambient water quality criteria). The EPA has indicated that "[t]he policy of considering multiple sources of exposure when deriving health-based criteria has become common in EPA's program office risk characterizations and criteria and standard-setting actions." U.S. ENV'T PROT. AGENCY, EPA-822-B-00-004, METHODOLOGY FOR DERIVING AMBIENT WATER QUALITY CRITERIA FOR THE PROTECTION OF HUMAN HEALTH 4-4 (2000) [hereinafter EPA-822-B-00-004].

391. 40 C.F.R. § 131.20 (1983) (amended 2015).

392. As the Hawaii Supreme Court explained in a case upholding the state's regulation of certain consumptive uses, the precautionary principle means that "where there are present or potential threats of serious damage, lack of full scientific certainty should not be a basis for postponing effective measures to prevent environmental degradation. 'Awaiting for certainty will often allow for only reactive, not preventive, regulatory action.'" *In re* Water Use Permit Applications, 9 P.3d 409, 466 (Haw. 2000) (quoting Ethyl Corp. v. U.S. Env't Prot. Agency, 541 F.2d 1, 25 (D.C. Cir. 1976)).

393. Letter from Ctr. for Biological Diversity et al. to Avril Wood-McGrath, Fla. Dep't of Env't Prot. 4 (May 19, 2021) [hereinafter Letter], https://www.biologicaldiversity.org/programs/environmental_health/pdfs/Triennial-Review-Comments-Cyanotoxins.pdf [https://perma.cc/8D75-85YM].

recommended action is a health advisory alerting people to avoid the bloom.[394]

These qualitative guidelines are insufficient because a visible surface scum, or other clear visual indicators, must be present *before* a health advisory is issued and before people are notified to avoid waters impacted by a HAB.[395] In the case of cyanotoxins, "cylindrospermopsin-producing cyanobacteria do not tend to form visible surface scums[,] and the highest concentrations occur below the water surface."[396] Further, "[m]icrocystins can persist even after a bloom is no longer visible[,] and cyanotoxin concentrations can be higher after the initial bloom fades."[397] Therefore, people could be exposed to cyanotoxins while recreating in waters that are not the subject of a health advisory. Quantitative guidelines, by contrast, "set levels that can be routinely monitored for and serve as clear trigger points for public health officials" to act.[398]

Unfortunately, even when a HAB is observed, state agencies have failed to promptly notify the public and close affected waters to recreation.[399] FDOH's response to HABs in 2018 sparked significant criticism from the media and the public,[400] and the Agency has struggled to address the concerns of numerous residents affected by HABs.[401]

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394. U.S. ENV'T PROT. AGENCY, *supra* note 19, at 12, B-18 tbl.B-3.

395. Letter, *supra* note 393, at 6.

396. *Id.*

397. *Id.* For example, in its 2016 draft recommended criteria, EPA cited a study that found dissolved microcystin-LA was present in waters at a concentration of twenty micrograms per liter or more for 9.5 weeks even though the bloom was not visible after five weeks. U.S. ENV'T PROT. AGENCY, *supra* note 19, at 31.

398. Letter, *supra* note 393, at 6. Florida should also restore its water quality monitoring program. Over the last decade, the number of monitoring stations dropped from 350 to 115 according to Florida International University's Southeast Environmental Research Center. These sites include, among others, Pine Island Sound and Biscayne Bay, which have suffered from several HABs over the past decade. Scientists also point out that what little monitoring is performed is not enough to understand the life and evolution of a bloom, when and where it forms, and to forecast future blooms like Ohio scientists are doing for Lake Erie. *See* Jenny Staletovich, *Florida Gutted Water Quality Monitoring Network – As Killer Algae Increased*, TAMPA BAY TIMES (Aug. 7, 2018), https://www.tampabay.com/florida-politics/buzz/2018/08/07/florida-gutted-water-quality-monitoring-as-killer-algae-increased/ [https://perma.cc/4TKV-8F7T].

399. Metcalf et al., *supra* note 21, at 919.

400. *See* Tom Hayden, *Editorial: Health Department Ignorant to Water Crisis*, NEWS-PRESS (Aug. 21, 2018, 2:19 PM), https://www.news-press.com/story/opinion/2018/08/21/toxic-algae-florida-health-Department-ignorant-water-crisis/1051336002/ [https://perma.cc/XFP2-4BC5] ("The Florida Department of Health is failing residents and tourists on many fronts when it comes to massive blue-green algal blooms and the spread of red tide.").

401. Amy Bennett Williams, *Florida Department of Health Emails Show Agency Struggled to Manage Algae Crisis*, NEWS-PRESS (Apr. 7, 2019, 6:00 AM), https://www.news-press.com/story/news/2019/04/07/florida-health-Department-emails-show-struggle-manage-toxic-algae-crisis/3275715002/ [https://perma.cc/KP63-44UE].

Additionally, scientists, researchers, and physicians have questioned FDOH's position on the health effects of cyanotoxins and its response to HABs.[402] In 2018, several researchers expressed concerns about the potential long-term implications of the state's failure to immediately notify the public of the harm caused by HABs.[403] These researchers detailed that public health authorities were slow to publish information on the toxicological risks of the 2016 HABs.[404] They expressed concern about the potential long-term health risks for individuals exposed to the 2016 HABs and explained that "closure or restriction of access to the waters should have occurred rapidly, if not immediately, with continuous monitoring to determine potential adverse health effects."[405]

FDOH and FDEP should develop a more robust plan for notifying the public about the dangers of HABs. The plan should include a public notification procedure that requires local health departments to immediately post signs whenever waters exhibit surface scum *or* exceed the state water quality criteria for cyanotoxins established by FDEP. To ensure government transparency and accountability, these signs and other communications, such as press releases, should explain what the numeric criteria mean and how human health and the environment may be impacted when these criteria are exceeded. They should also provide an Internet link to the state's BMAP program where the public can learn more about the conditions that fuel algal blooms, what specific actions are being taken to achieve the load reductions necessary to reduce or avoid algal blooms in the future, and, as explained below, how the public can track the state's progress. Non-English language versions of the communications should be available so that all of Florida's diverse population can benefit from these notifications.

B. *Florida Should Put the "Best" into Best Management Practices*

Florida, like other states, relies predominately on the use of BMPs to manage nonpoint source pollution.[406] The state defines BMP as a practice or a combination of practices determined by FDACS, FDEP, and the water management districts, based on research, field testing, and expert review, to be the most effective and practicable on-location means for

402. Amy Bennett Williams, *Florida Toxic Algae a Long-Term Health Concern, According to Scientists, Researchers*, NEWS-PRESS (Aug. 22, 2018, 6:00 AM), https://www.news-press.com/story/news/2018/08/22/toxic-algae-florida-scientists-question-health-Departments-stand/973593002/ [https://perma.cc/VT73-EP44].

403. Metcalf et al., *supra* note 21, at 926.

404. *Id.* at 921.

405. *Id.* at 926.

406. FLA. STAT. § 403.067 (2022); Robin Kundis Craig, *Local or National? The Increasing Federalization of Nonpoint Source Pollution Regulation*, 15 J. ENV'T L. & LITIG. 179, 182 (2000).

improving water quality in agricultural and urban discharges.[407] These discharges "shall reflect a balance between water quality improvements and agricultural productivity."[408]

BMPs in the northern Lake Okeechobee basins have been classified as three types. Level I BMPs primarily focus on nutrient management actions by the producer and landowner, such as fertilizer selection, application rate and timing, and recordkeeping.[409] Level II BMPs are more labor- and time-intensive and, unlike most Level I BMPs, require structural modifications such as fencing, improved irrigation systems, and wetland or storm water retention systems.[410] These are often funded through cost-share programs following the implementation of Level I BMPs.[411] Level III BMPs typically involve chemical technologies, such as aluminum and iron chloride, or edge-of-field storm water retention or detention, and are applied after Level I and II BMPs.[412] Level II and III BMPs may need to be implemented based on site-specific needs identified by assessment questions within FDACS's BMP manuals.[413]

While FDEP is responsible for developing nonagricultural BMPs, FDACS is responsible for developing and adopting by rule BMPs for nonpoint agricultural pollutant sources in consultation with FDEP, FDOH, water management districts, as well as agricultural and environmental representatives.[414] These rules must incorporate provisions for a notice of intent to implement the BMPs and a system to assure the implementation of the BMPs, including site inspection and recordkeeping requirements.[415] The Florida statute requires FDEP to verify the effectiveness of BMPs at representative sites.[416] The implementation of BMPs initially verified to be effective by FDEP "shall provide a presumption of compliance with state water quality standards."[417] The statute further requires that "[w]hen water quality problems are demonstrated, despite the appropriate implementation, operation, and maintenance of best management practices and other measures . . . [FDEP], a water management district, or [FDACS], in

407. FLA. STAT. § 373.4595(2)(a) (2022).

408. *Id.*

409. FLA. DEP'T OF AGRIC. & CONSUMER SERVS., WATER QUALITY/QUANTITY BEST MANAGEMENT PRACTICES FOR FLORIDA VEGETABLE AND AGRONOMIC CROPS 7 (2015), https://www.fdacs.gov/content/download/77230/file/vegAgCropBMP-loRes.pdf [https://perma.cc/VSW5-RLNE].

410. *Id.*

411. *Id.*

412. *Id.*

413. *Id.*

414. FLA. STAT. § 403.067(7)(c)1.–2. (2022).

415. *Id.* § 403.067(7)(c)2.

416. *Id.* § 403.067(7)(c)3.

417. *Id.*

consultation with [FDEP], shall institute a reevaluation of the best management practice or other measure."[418] If the reevaluation determines that the BMP or other measure requires modification, FDEP, a water management district, or FDACS, must revise the rule to require implementation of the modified practice within a reasonable time period as specified in the rule.[419]

At least every two years, FDACS must perform onsite inspections of each agricultural producer that enrolls in a BMP to ensure that such practice is being properly implemented.[420] This verification includes a collection and review of the BMP documentation from the previous two years, including, but not limited to, nitrogen and phosphorus fertilizer application records.[421] FDACS is further required to initially prioritize inspection of agricultural producers located in the BMAPs for Lake Okeechobee, the IRL, the Caloosahatchee River and Estuary, and Silver Springs.[422]

Despite the requirements in Florida's statutory provisions, annual total phosphorus reductions have remained essentially flat,[423] and the state must acknowledge that its reliance on the existing BMP program will not achieve phosphorus and nitrogen loading targets.[424] Progress has been hampered by the failure of many agricultural producers to enroll in the BMP program, delays in BMP implementation and verification, and the lack of monitoring to evaluate the effectiveness of BMPs.[425] As has been the case in other jurisdictions, without greater accountability, it is unlikely that water quality conditions will improve.[426] Below is a discussion of these regulatory failures and several recommendations for

418. *Id.* § 403.067(7)(c)4.

419. *Id.*

420. FLA. STAT. § 403.067(7)(d)3. (2022).

421. *Id.*

422. *Id.*

423. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 19 fig.ES-2; *see* Khare et al., *supra* note 302, at 2 (noting that, despite a long regulatory history, no reduction in total phosphorous loading to Lake Okeechobee has occurred since 1990).

424. GRAHAM ET AL., *supra* note 33, at 64; *see* John Seewer, *Plan to Fight Lake Erie's Algae Would Force Changes on Farms*, WKYC (Mar. 23, 2018, 10:26 AM), https://www.wkyc.com/article/weather/environment/plan-to-fight-lake-eries-algae-would-force-changes-on-farms/95-531284003 [https://perma.cc/FQ9S-A233] (discussing how, in Ohio, Governor Kasich's administration developed new proposals to combat algal blooms in Lake Erie).

425. GRAHAM ET AL., *supra* note 33, at 63.

426. *See* David K. Mears & Rebecca A. Blackmon, *Lessons for Lake Champlain from Chesapeake Bay: Returning Both Waters to the "Land of Living"*, 17 VT. J. ENV'T. L. 564, 569 (2016) ("To date, the effectiveness of TMDLs in achieving this goal has been mixed, largely due to the lack of an accountability mechanism to ensure that the implementation plans developed for those TMDLs were in fact implemented."); *see also* Andreen, *supra* note 34, at 271–72 (discussing how non-regulatory mechanisms have been overwhelmingly relied upon to implement TMDLs and how CWA goals will likely not be met unless something other than a voluntary approach is taken to nonpoint source pollution).

how the state legislature could strengthen the law to bring greater accountability to BMP programs.

1. The Legislature Should Accelerate BMP Implementation, Verification, Reevaluation, and Adoption Schedules

While agricultural producers must "implement" BMPs to enjoy a presumption of compliance with water quality standards, other statutory provisions and rules may be contributing to delays in implementing effective BMPs and achieving water quality standards.[427] From the start, FDACS's regulations for implementing BMP programs do not require the immediate implementation of BMPs after a producer submits a notice of intent (NOI) but rather "as soon as practicable, but no later than 18 months after submittal of the NOI."[428] Even after implementation occurs, the BMPs may not achieve the desired results because the presumption of compliance with water quality standards is triggered once FDEP makes its initial verification that BMPs are effective based on its "best professional judgment."[429] The presumption applies even if FDEP has not performed its final verification at representative sites to determine whether the BMPs being used are effective in practice.[430] Further, although water quality monitoring is one of the most important aspects of any nonpoint source control program and could help quantify the efficacy of BMPs,[431] there are no statutory provisions that expressly allow for the statutory presumption to be rebutted and for the agencies to require changes to the producer's BMPs if water quality monitoring shows that the BMPs being used at the site are ineffective.[432] Therefore, until FDEP

427. Despite the statutory requirement that producers implement BMPs to qualify under the safe harbor provision, the regulatory structure has not rigorously adhered to this requirement, as Professor Angelo has previously documented. *See* Angelo, *supra* note 34, at 1032 (examining the potential "gaping loopholes" in BMP manuals for farmers who do not want to implement BMPs).

428. FLA. ADMIN. CODE ANN. r. 5M-6.004 (2022).

429. OFF. OF AGRIC. WATER POL'Y, FLA. DEP'T OF AGRIC. & CONSUMER SERVS., STATUS OF IMPLEMENTATION OF AGRICULTURAL NONPOINT SOURCE BEST MANAGEMENT PRACTICES 5–6 (2022), https://www.fdacs.gov/ezs3download/download/104912/2726091/Media/Files/Marketing-Development-Files/09124-FDACS-OAWP-Annual-Report-2022.pdf [https://perma.cc/KDP8-KM2Z].

430. FLA. STAT. § 403.067(7)(c) (2022).

431. Angelo, *supra* note 34, at 1034.

432. Unlike in the region north of Lake Okeechobee and elsewhere in the state, water quality monitoring is a core component of the state's BMP program in the Everglades Agricultural Area (EAA), south of the lake. A federal consent order imposes a strict limit on the amount of phosphorus entering the lake from the EAA and imposes permitting requirements on agricultural producers to implement BMP and water quality monitoring plans to ensure compliance. *See* U.S. v. S. Fla. Water Mgmt. Dist., 847 F. Supp. 1567, 1570 (S.D. Fla. 1992). Agricultural producers located in the EAA or C-139 Basin implement BMPs that are governed by permits issued by the South Florida Water Management District (SFWMD) under the Florida Administrative Code. *See* FLA. ADMIN. CODE ANN. r. 40E-63 (2022). Among other requirements, SFWMD's "Works of the

makes a final determination regarding the effectiveness of these BMPs with representative site monitoring, agricultural producers can implement inferior BMPs, resulting in little progress towards reaching TMDL water quality targets. Even then, the statute does not compel immediate action if it is discovered that existing BMPs are not working. Although the statute requires the agencies to reevaluate and develop new BMPs in these instances, the only requirement is that they do it "within a reasonable time."[433]

To accelerate progress toward meeting the TMDL pollution reduction targets, the state legislature should consider amending the statutes to require more immediate implementation of BMPs, providing the relevant agencies with the express authority to overcome the presumption of compliance if water quality monitoring reveals that BMPs are not effective in reducing pollution,[434] and mandating specific deadlines for FDEP to make final BMP verifications as well as reevaluate and develop new BMPs when water quality problems are detected.

In addition, the legislature could provide FDEP and FDACS with the statutory authority to require additional recordkeeping, monitoring, and reporting for BMPs as additional backstops in future BMAPs if TMDL

District" (WOD) program requires permit applicants to submit and implement a BMP plan which includes "a monitoring plan to verify BMP implementation, operation and effectiveness." FLA. ADMIN. CODE r. 40E-63.136(1) (2022). Permit applicants must also submit "an acceptable water quality monitoring plan which provides reasonable assurance that annual water discharge and total phosphorus load are accurately documented." *Id.* r. 40E-63.136(2). FDACS does not perform site visits on these 109 producers that have enrolled in the BMP program because they are subject to site visits and permitting oversight by SFWMD. *See* OFF. OF AGRIC. WATER POL'Y, FLA. DEP'T OF AGRIC. & CONSUMER SERVS., STATUS OF IMPLEMENTATION OF AGRICULTURAL NONPOINT SOURCE BEST MANAGEMENT PRACTICES 10–11 (2021), https://www.fdacs.gov/ezs3download/download/98382/2665697/Media/Files/Agricultural-Water-Policy-Files/BMP-Implementation/2021-status-of-bmp-implementation-report.pdf [https://perma.cc/45SP-NJEQ]. Permittees are subject to monitoring and enforcement action by the SFWMD for failing to comply with an approved monitoring plan or BMP plan requirements. *See* FLA. ADMIN. CODE ANN. r. 40E-63.145 (2022). In the EAA Basin where the Everglades Forever Act mandates a twenty-five percent reduction in total phosphorus loads, there has been a sixty-three percent reduction of observed loads. *See* GRAHAM ET AL., *supra* note 33, at 70. Although the SFWMD once required most producers north of Lake Okeechobee to similarly obtain permits if their properties connected to, made use of, or altered WOD, SFWMD eliminated these requirements in its most recent rulemaking. *Compare* FLA. ADMIN. CODE ANN. r. 40E-61 (1989), *with* FLA. ADMIN. CODE ANN. r. 40E-61 (2022). The SFWMD still maintains a water quality monitoring program in the region. *See* FLA. ADMIN. CODE ANN. r. 40E-61 (2022).

433. FLA. STAT. § 403.067(7)(c)(4) (2022).

434. While the EAA is a far more homogenous and engineered system, and therefore it may not be practicable to apply the same permitting scheme north of Lake Okeechobee, more can be done in this region to ensure BMPs are effective. For example, the SFWMD's water quality program under the Florida Administrative Code could greatly inform the process for determining when BMPs are not meeting water quality standards. *See* FLA. ADMIN. CODE ANN. r. 40E-61 (2022).

pollution load reduction milestones are not being achieved. With technical assistance from FDACS and FDEP, producers opting to implement BMPs rather than engage in water quality monitoring could be required to document the measures they have chosen to implement and monitor their effectiveness. This would ensure that BMPs are indeed being implemented and then reviewed by agencies to help determine which measures are effectively reducing runoff and nutrient loads into the system and which adaptive management actions must be taken when BMPs are not performing as intended.

2. The Legislature Should Fully Fund FDACS and FDEP to Verify BMP Implementation and Effectiveness

In Florida, state law requires FDACS to verify that producers are implementing the BMPs they say they are using in their NOIs.[435] To this end, FDACS makes site visits that include a review of nutrient and irrigation management records.[436] Yet problems such as significant backlog, insufficient staff, and limited resources undermine these site visits.[437] According to FDACS's 2021 report to the Governor and state legislature, FDACS performed site visits on only twenty percent of agricultural acres "enrolled" in the program statewide.[438] Therefore, it is possible that at least in some instances, BMPs are not being fully or properly implemented because FDACS has not visited these sites to determine the status of BMP implementation.

Indeed, as FDEP explains in its 2020 update to the Lake Okeechobee BMAP, BMP enrollment "falls well short of the full enrollment requirement under law, and for those producers that have enrolled, onsite verification of BMP implementation is insufficient."[439] FDEP further explains:

> This insufficiency in agricultural BMP enrollment and implementation verification is a constraint to achieving the TMDL in 20 years, and to address this constraint it is paramount that FDACS carries out its statutory authority and fulfills its statutory obligations by more actively engaging agricultural nonpoint sources to enroll in BMPs and by adequately verifying BMP implementation.[440]

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435. FLA. STAT. § 403.067(7)(c)(2) (2022).

436. OFF. OF AGRIC. WATER POL'Y, *supra* note 432, at 10. Prior to August 2019, FDACS also relied on self-reporting through producer surveys to verify BMP implementation. *Id.* at 12.

437. *Id.* at 3.

438. *Id.* at 2, 13.

439. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 16.

440. *Id.*

According to the 2020 updates to the BMAP, "FDACS has requested funding for additional positions to enable it to ensure full BMP enrollment and implementation verification."[441] It appears progress was made in 2021, as FDACS was allocated funding to hire eight additional positions,[442] but the state legislature needs to make BMP verification a long-term priority and adequately fund FDACS to provide the staff and resources needed to develop updated BMP manuals and visit every producer and operator every two years. Moreover, the legislature needs to provide additional funding to FDEP to perform more initial and final verifications to ensure that BMPs are working and bring enforcement actions against those who do not implement the BMPs.

3. The Legislature Should Strengthen Enforcement Procedures for BMP Non-Compliance

FDACS has the authority to require landowners and producers not implementing BMPs to come into compliance through a "corrective" phase, and, if necessary, through a "remedial" phase if corrective action is not taken.[443] If remedial measures are not implemented by the scheduled date of completion, FDACS must notify FDEP within sixty days.[444] BMAPs and management strategies, including BMPs and water quality monitoring, are enforceable under the statute,[445] and FDEP has the authority to enforce these statutory requirements under its general enforcement authorities.[446] It remains unclear, however, what penalties are in place for not implementing remedial measures and when they would be enforced.[447] It is also unclear what specific enforcement measures are in place and the type of penalties that can be assessed for not implementing a water quality monitoring program.[448] Given the significant percentage of unenrolled acres in the BMAP areas,[449] there must be clear enforcement timelines and legal consequences for those not implementing BMPs or a water quality monitoring program. The legislature should amend the Florida Statutes to specify when enforcement action can be taken after FDACS informs FDEP of a person's noncompliance, what specific enforcement measures can be taken against a person who refuses to implement corrective and remedial

441. *Id.* at 53.

442. Awasthi & DeMeo, *supra* note 334, at 54.

443. FLA. ADMIN. CODE ANN. r. 5M-1.009(1)(a)–(b) (2022).

444. *Id.* r. 5M-1.009(2).

445. FLA. STAT. § 403.067(7)(d)(1) (2022).

446. FLA. STAT. §§ 403.021, .131, .141, .151, .161 (2022).

447. Awasthi & DeMeo, *supra* note 334.

448. FLA. ADMIN. CODE ANN. r. 62-307 (2022).

449. OFF. OF AGRIC. WATER POL'Y, *supra* note 432, at 2, 13. In the Caloosahatchee Estuary BMAP area, eighty-five percent of agricultural lands were enrolled in the BMP program as of 2021. *Id.* at 24.

measures, and what administrative penalties can be assessed. Currently, there is no clear regulatory process for identifying parties that have refused to enroll in the BMP program and referring them to DEP, and no notice and cure provisions or cut-off period to preclude a landowner from filing a notice of intent to implement BMPs to avoid water quality monitoring. The penalties for not implementing a water quality monitoring plan remain unclear.[450] To bring greater clarity to the enforcement process, the legislature could establish administrative penalties for failing to enroll or implement BMPs under Section 403.121, Florida Statutes (2022), which already establishes administrative penalties for various types of violations. Doing so would not only put parties on notice of the financial consequences of not enrolling in the program or performing water quality monitoring but would also likely encourage greater BMP enrollment and potentially less nutrient pollution from entering the watersheds.

4. State Agencies Should Improve BMP Effectiveness Monitoring and Information Sharing, Regularly Review BMPs and Update BMP Manuals, and Prioritize Advanced BMPs in Pollution "Hotspots"

States can take several additional steps to bring greater transparency and accountability to their BMP programs. In Florida, the legislature can provide FDACS with the direction and resources to develop pilot programs to continually study BMPs in action, rather than depending mostly on FDEP's initial verification to determine their effectiveness. The programs would provide FDACS with the resources necessary to continually evaluate BMP effectiveness across a range of agricultural uses and locations. By monitoring BMP effectiveness at representative sites, the agencies might be able to collect important information like that obtained through the SFWMD's WOD program, even if the heterogeneity of the landscape may provide different challenges or limitations. The pilot program could include certain incentives to encourage landowner participation.

There must also be greater information sharing and interagency coordination to ensure BMPs result in the water quality improvements that FDEP predicted they would have at the time of their initial verification. FDEP, FDACS, and SFWMD must act in furtherance of the legislature's intent and work together to reduce pollutants and achieve water quality standards in Lake Okeechobee, Caloosahatchee, and St. Lucie watersheds through the BMAP and TMDL programs. To this end, FDEP must consistently use the water quality data collected by the SFWMD to track the state's progress toward meeting specific sub-

450. Telephone Interview with Elizabeth Fata Carpenter, Managing Att'y, Everglades L. Ctr. (July 8, 2021); FLA. STAT. § 403.067 (2022); FLA. ADMIN. CODE ANN. r. 62-307 (2022).

watershed load allocations and achieving the TMDL. The SFWMD has an extensive and robust water quality monitoring network, which has recently expanded under Executive Order 19-12,[451] and it needs to be utilized to achieve the state's water quality goals.[452]

FDACS should also regularly review, and update as necessary, their BMP manuals to ensure BMPs are based on the best available science.[453] Presently, FDACS *intends* to update these manuals every five years.[454] The review process should be conducted more frequently and in consultation with the University of Florida Institute of Food and Agricultural Sciences and FDEP. It should also be informed by the aforementioned pilot program and SFWMD's water quality monitoring data, particularly where nutrient levels are high or trending upward. BMPs should then be revised and updated accordingly, and FDEP should update the BMAP to reflect these changes. FDEP should also conduct final BMP verifications to facilitate this process.

In addition to strengthening BMP effectiveness monitoring and information sharing between the agencies and requiring FDACS to regularly review BMPs and update BMP manuals when necessary, the legislature should prioritize funding the development and implementation of Type III BMPs in areas that have been identified as hotspots for phosphorus pollution. These newer and emerging field-verified BMPs and in-situ technologies immobilize legacy phosphorus and will likely be necessary to address legacy phosphorus and hot spots.[455] BMAPs should specifically identify the areas requiring these BMPs, establish an

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451. *See 12/8/21 Department of Environmental Protection's Blue-Green Algae Task Force*, FLA. CHANNEL (Dec. 8, 2021), https://thefloridachannel.org/videos/12-8-21-department-of-environmental-protections-blue-green-algae-task-force/ [https://perma.cc/NR46-YMZM] (discussing the agency's in-lake, basin, and upstream monitoring programs); *see also* Fla. Exec. Order No. 19-12, *supra* note 315, at 1, 3 (directing the FDEP to work with the SFWMD to address stormwater treatment).

452. *See* Gary Goforth, Founder, Gary Goforth, LLC, Presentation at the 2019 Everglades Coalition Conference: Water Quality of Lake Okeechobee and St. Lucie Estuary Watersheds – Are BMAPs Working? (Jan. 11, 2019) [hereinafter Goforth Presentation] (explaining that, rather than using measured data collected by the SFWMD, the Lake Okeechobee BMAP relies on computer models that significantly underestimate nutrient loading). The 2020 Lake Okeechobee BMAP also identifies numerous instances throughout the lake's nine sub-watersheds where FDEP cannot identify nutrient loading trends due to "insufficient data," which further underscores the need for the SFWMD's expanded water quality monitoring programs so that FDEP can accurately measure and track nutrient loads throughout the watershed. *See* FLA. DEP'T OF ENV'T PROT., *supra* note 40, *passim*.

453. FLA. DEP'T OF ENV'T PROT., *supra* note 322, at 5.

454. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 164. FDEP has indicated that it needs these manuals to be updated no more than five years from the adoption of the BMAP "[t]o expedite further reductions." *Id.* at 56.

455. GRAHAM ET AL., *supra* note 33, at 74, 76.

implementation schedule, and track the pollution load reductions achieved through these advanced technologies.

C. *Florida Should Improve the Framework for Implementing and Revising BMAPs to Provide Reasonable Assurances that Pollution Targets Will be Achieved*

The nonpoint pollution plaguing Lake Okeechobee is much like the nonpoint pollution plaguing Chesapeake Bay, where "dead zones" have diminished the health of the ecosystem.[456]

Plans to clean up Chesapeake Bay began with grassroots efforts in the 1970s, starting with a study to identify the causes of the pollution.[457] The study's results, which attributed the problems to nutrient pollution, led to the Chesapeake Bay Agreement of 1983 signed by several governors and the Mayor of the District of Columbia.[458] A subsequent agreement was produced in 1987, promising more specific ways to cut nitrogen and phosphorous loadings by 2000.[459] Steps were taken to reduce impacts from sewage treatment systems but little was done to address agricultural pollution.[460] By 2000, fifteen years of effort had reduced phosphorous loadings by only twenty-five percent—largely from detergent bans—and nitrogen by only thirteen percent.[461] Another agreement followed, which promised to remove Chesapeake Bay and its tributaries from the list of impaired waters by 2010.[462] Little progress was made and a 2006 General Accountability Office (GAO) report concluded that Chesapeake Bay would remain polluted for decades.[463] A year later, the GAO found that the bay was "actually going backwards."[464] Maryland, Pennsylvania, Virginia, the District of Columbia, Delaware, New York, and West Virginia were required to establish TMDLs for their waters.[465]

If the story were to end here, the history of efforts to clean up the Chesapeake Bay would largely mirror that of Lake Okeechobee—decades of state studies, plans, agreements, promises, and initiatives

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456. *See* K.A. McConnell, *Limits of American Farm Bureau Federation v. EPA and the Clean Water Act's TMDL Provision in the Mississippi River Basin*, 44 ECOLOGY L. Q. 468, 479 (2017) (explaining that sixty-two percent of the bay had insufficient oxygen to support aquatic life and only eighteen percent of the bay had acceptable water clarity).

457. Houck, *supra* note 33, at 10439–40.

458. *Id.* at 10440; Rachel Felver, *Celebrating 35 Years of Restoration*, CHESAPEAKE BAY PROGRAM (Oct. 11, 2018), https://www.chesapeakebay.net/news/blog/celebrating-35-years-of-restoration [https://perma.cc/5GX6-7ZTE].

459. Houck, *supra* note 33, at 10440.

460. *Id.*

461. *Id.*

462. *Id.*

463. *Id.*

464. *Id.*

465. Houck, *supra* note 33, at 10440.

(mostly spurred by citizen action and a few deeply concerned elected officials) that failed to materialize in any meaningful way to curb nutrient pollution. "[V]oluntary . . . measures[] ha[ve] been applied longer in the Chesapeake than any other ecosystem-wide restoration program in the world."[466] As one scholar has observed, the federal cost-share dollars that subsidized many of these measures are "staggering."[467] The parallels with the Florida experience up to this point are rather striking.

But things began to change for the Chesapeake about a decade ago with a "can-do attitude" that stands in sharp contrast with the "reluctant dance" observed in Florida.[468] In 2010, the EPA, with cooperation from six states, D.C., and local governments, developed a TMDL providing a framework of accountability and transparency that establishes allocations among different kinds of sources, a timetable for action, and "reasonable assurances" that it will be implemented.[469] This framework requires the states and D.C. to track progress of the TMDL goals in two-year increments.[470] "If progress is insufficient, the EPA may take 'actions to ensure pollution reductions.'"[471] These actions may include increasing the stringency of pollution limits on point sources, withholding or conditioning federal grants, increasing enforcement against polluters, and instituting greater oversight.[472] It also provides opportunities for the states to adjust their implementation plans as they learn what is or is not working in each phase of implementation.[473] The TMDL "incorporates an adaptive management approach that documents implementation actions, assesses progress, and determines the need for alternative management measures based on the feedback of the accountability framework."[474] This plan may provide the most promising steps toward recovery to date.

Since the adoption of the Chesapeake Bay TMDL, other states have adopted a similar accountability framework, as evidenced by the EPA's 2016 phosphorous TMDL for Lake Champlain.[475] Like the Chesapeake Bay TMDL, the Lake Champlain TMDL includes pollution allocations among the various sources, a timetable for achieving the required reductions in the pollutant load, and reliance upon phased implementation

466. Jamison E. Colburn, *Coercing Collaboration: The Chesapeake Bay Experience*, 40 WM. & MARY ENV'T. L. & POL'Y REV. 677, 678 (2016).

467. *Id.*

468. Houck, *supra* note 33, at 10442.

469. U.S. ENV'T PROT. AGENCY, *supra* note 248; *Chesapeake Bay TMDL Fact Sheet*, U.S. ENV'T PROT. AGENCY (July 20, 2022), https://www.epa.gov/chesapeake-bay-tmdl/chesapeake-bay-tmdl-fact-sheet [https://perma.cc/DM4T-EGYA].

470. Mears & Blackmon, *supra* note 426, at 579.

471. *Id.*

472. *Id.*

473. Mears & Blackmon, *supra* note 426, at 580.

474. U.S. ENV'T PROT. AGENCY, *supra* note 248, at 7-2.

475. Mears & Blackmon, *supra* note 426, at 567.

plans developed by the State of Vermont to address both point and nonpoint sources.[476] There are also similar milestones and backstops in the event the state does not implement the plan.[477]

It will likely take many years to achieve the reductions set forth in the Chesapeake Bay plan. At present, the health of the bay appears to be slightly improving,[478] and several states have taken substantial steps to implement the TMDL and upgrade aging wastewater treatment systems.[479] Yet when it comes to curbing agricultural and storm water pollution, there has been much less progress.[480] Many have cited the lack of BMP performance measures, overstated pollution reductions based on assumptions about the effectiveness of runoff control actions rather than empirical monitoring data, and inadequate enforcement among the reasons why nutrient pollution from agricultural operations has barely declined.[481] Still, some researchers and activists see increased funding for BMP cost-share programs and pilot projects as encouraging signs that positive steps are being taken toward reducing sediment and nutrient runoff.[482]

Despite these challenges, the Chesapeake Bay TMDL offers a useful blueprint for how Florida can provide the transparency and accountability necessary for achieving the State's TMDL targets. While the Florida Legislature took significant steps in 2015 when it established several requirements for the State's BMAPs that mirror some of the requirements set forth in the Chesapeake Bay TMDL, the statute provides few consequences when milestones are not being met and pollution reduction measures are not being implemented.[483]

State leaders serious about addressing nutrient pollution should bring much more transparency and accountability to their TMDLs. In the case of Florida, they should address the Lake Okeechobee, Caloosahatchee, and St. Lucie River TMDLs, and pick up where they left off in 2016 and amend state law to require more effective and enforceable TMDL implementation mechanisms.[484] One of these mechanisms should be the

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476. *Id.* at 585.

477. *Id.* at 567.

478. *See* Stephanie Lai, *The Chesapeake Bay's Water Quality Is Inching in the Right Direction, Scientists Say*, WASH. POST (June 22, 2021, 3:51 PM), https://www.washingtonpost.com/local/maryland-news/chesapeake-bay-report-card-2021/2021/06/22/c7ca8122-d34f-11eb-ae54-515e2f63d37d_story.html [https://perma.cc/93ZY-XWFA] ("Several key health indexes relating to the health of the Chesapeake Bay improved slightly from the previous year.").

479. John Carey, *The Complex Case of Chesapeake Bay Restoration*, 118 PNAS 2–3 (2021).

480. *Id.* at 4.

481. *Id.* at 4–5.

482. *Id.* at 5.

483. MacLaughlin, *supra* note 309, at 52.

484. In arguing that implementation plans are the most important (and most controversial) part of the entire TMDL program, Professor Houck contends that it is the absence of effective and

requirement that BMAPs contain "reasonable assurances" that the state is able to sufficiently reduce nutrient pollution.

Section 303(d) of the CWA requires a TMDL be "established at a level necessary to implement the applicable water quality standards."[485] Although not required under the CWA, the EPA has long maintained that where waters are impaired by both point and nonpoint sources, states should provide "reasonable assurances" that the load allocations established by TMDLs will be achieved.[486] "Reasonable assurances" are a hallmark of the Chesapeake Bay and Lake Champlain TMDLs.[487] As the EPA explained in the Chesapeake Bay TMDL, "determinations of reasonable assurance" that load allocations will be achieved "could include whether practices capable of reducing the specified pollutant load (1) exist; (2) are technically feasible at a level required to meet allocations; and (3) have a high likelihood of implementation."[488]

Consistent with the EPA policy, Florida's TMDLs should also provide "reasonable assurances" that the load allocations will be achieved, even where a watershed is wholly impaired by nonpoint sources. This begins with the state legislature amending the Florida statute to *require* BMAPs for all impaired waters that have TMDLs.[489] BMAPs play an integral role in implementing TMDLs, and they must include the specific strategies and backstops necessary to achieve water pollution reduction targets. There must also be mechanisms in place for the public to track the state's progress and hold decisionmakers accountable when waters remain impaired. The following subsections are a series of recommendations for legislative and regulatory steps the state legislature and FDEP should take, respectively, to create "reasonable assurances" and bring desperately needed transparency and accountability to the state's TMDL and BMAP programs.

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enforceable implementation mechanisms and the consequent absence of implementation that led to the underperformance of all previous water quality programs. *See* Houck, *supra* note 33, at 10428.

485. 33 U.S.C. § 1313(d)(1)(A) (1972).

486. *See* EPA, GUIDELINES FOR REVIEWING TMDLS UNDER EXISTING REGULATION ISSUED IN 1992 (2002), https://www.epa.gov/sites/default/files/2015-10/documents/2002_06_04_tmdl_guidance_final52002.pdf [https://perma.cc/Z3PW-YUHB] (last updated Aug. 11, 2022); *see also* EPA, GUIDANCE FOR WATER-QUALITY BASED DECISIONS: THE TMDL PROCESS 1 (Apr. 1991).

487. *See, e.g.*, U.S. Env't Prot. Agency, *supra* note 248 (detailing the reasonable assurances requirement in the Chesapeake Bay TMDL).

488. *Id.*; *see* Am. Farm Bureau Fed'n. v. U.S. Env't Prot. Agency, 792 F.3d 281, 300–01 (3rd Cir. 2015) (finding that the reasonable assurances requirement in the Chesapeake Bay TMDL did not run afoul of the CWA and was a lawful exercise of EPA authority in that instance).

489. The Florida statute uses the word "may" rather than "must," indicating that BMAPs are voluntary: "In developing and implementing the total maximum daily load for a water body, the department, or the department in conjunction with a water management district, *may* develop a basin management action plan that addresses some or all of the watersheds and basins tributary to the water body." FLA. STAT. § 403.067(7)(a)(1) (2022) (emphasis added).

1. FDEP Should Explain How Load Reduction Strategies Will Address Harmful Algal Blooms

A simple step states can take in improving BMAPs is to acknowledge how nutrient pollution is a principal driver in the formation and proliferation of cyanobacteria blooms and to explain how the BMAP's load reduction strategies will reduce HABs. While FDEP cites existing numeric nutrient criteria as one reason for not adopting water quality criteria for cyanotoxins,[490] the BMAP for the Lake Okeechobee phosphorus TMDL makes no mention of cyanobacteria, cyanotoxins, or algal blooms, much less provides a strategy for combatting them.[491]

The public would be well served if FDEP explained how load allocations, BMPs, and other management strategies (when verified and properly implemented) provide a means of not only meeting the TMDLs for these waters but also reducing HABs. The discussion should also identify the other factors contributing to the proliferation of HABs and what other measures may need to be taken to restore water quality. By explaining how the reduction of nutrients will reduce the occurrence and severity of HABs, FDEP would help the public better appreciate how these regulatory tools can be utilized to improve their everyday lives—by protecting the waters they use and enjoy.[492] This in turn could lead to greater public support for the BMAP process and greater buy-in and focus on the specific steps that need to be taken to achieve the state's water quality goals.

FDEP should also provide increased transparency by acknowledging what specific steps the Agency needs to take to achieve pollution targets and reduce HABs. For instance, the Agency should recognize that more progress needs to be made in verifying and enforcing BMPs. The public could use this information to identify what steps the state is taking (and not taking) toward reducing HABs and assess the state's progress toward achieving that goal. It could also result in greater accountability if the Agency does not meet the plan's milestones and there is a need to retool the Agency's approach in future phases of implementing the BMAP.

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490. DIV. OF ENV'T ASSESSMENT & RESTORATION, *supra* note 388, at 84.

491. FLA. DEP'T OF ENV'T PROT., *supra* note 40, *passim*.

492. For example, the Chesapeake Bay TMDL discusses the relationship between nutrients and algal blooms and explains how these blooms smother aquatic life, block sunlight needed for submerged aquatic vegetation, and result in "dead zones" where fish and shellfish cannot survive. It then discusses how nutrient load reductions are aimed at ameliorating these negative water quality conditions and restoring aquatic life in the bay. *See* U.S. ENV'T PROT. AGENCY, CHESAPEAKE BAY TMDL EXECUTIVE SUMMARY ES-3 (2010), https://www.epa.gov/sites/default/files/2014-12/documents/bay_tmdl_executive_summary_final_12.29.10_final_1.pdf [https://perma.cc/U2VJ-Z5CW].

2. BMAPs Should Identify Specific Strategies for Managing Nitrogen

To further improve the Lake Okeechobee BMAP, the FDEP should develop a more targeted approach to reducing nitrogen loads to help combat HABs. Presently, there are no TMDLs for nitrogen or other nutrients in the lake, and researchers have maintained that a greater emphasis should be placed on reducing nitrogen pollution that may be further fueling HABs.[493] The Governor's Florida Blue Green Algae Task Force also recommended that total nitrogen reductions should be identified for the lake to protect the coastal estuaries.[494]

In recent years, scientists have been contributing to a growing body of research suggesting that nitrogen may play an equally prominent, if not an even greater role, in the formation and proliferation of some HABs. HABs may proliferate in response to combined phosphorus and nitrogen additions, or in some instances, only nitrogen additions.[495] *Microcystis*, for example, cannot fix atmospheric nitrogen and require combined nitrogen sources for growth.[496] Increased usage of nitrogen fertilizers, urban and agricultural nitrogen wastes, and atmospheric nitrogen deposition have increased bioavailable nitrogen in receiving waters.[497] Nitrogen and phosphorus are being delivered to Lake Okeechobee, and the loading rates are highly correlated.[498] External nitrogen input can be "a key driver" of eutrophication and *Microcystis* can dominate in areas despite phosphorus-focused controls.[499] Thus, management of phosphorus loading alone may not be enough to control the growth or toxicity of cyanobacteria such as *Microcystis*.[500]

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493. *See* GRAHAM ET AL., *supra* note 33, at 68 ("All currently developed nutrient source control programs for the Lake Okeechobee watershed primarily focus on [phosphorus] reduction, but consideration should be given to nitrogen control as well because the ratios of these nutrients can yield variable effects on eutrophication of waterbodies and are particularly important in estuaries. Loads of [nitrogen] to Lake Okeechobee measured between [2000 and 2014] ranged from 2,500 to 8,800 metric tons [nitrogen] per year."); *see also* U.S. ENV'T PROT. AGENCY, EPA-820-S-15-001, PREVENTING EUTROPHICATION: SCIENTIFIC SUPPORT FOR DUAL NUTRIENT CRITERIA 2 (Feb. 2015), https://www.epa.gov/sites/production/files/documents/nandpfactsheet.pdf [https://perma.cc/X4NL-TGFX] (recommending the development of numeric water quality criteria for both phosphorus and nitrogen to help prevent the proliferation of HABs); Goforth Presentation, *supra* note 452 (documenting nitrogen loads in Lake Okeechobee and suggesting that FDEP establish a nitrogen TMDL for the lake).

494. FLA. DEP'T OF ENV'T PROT., *supra* note 322, at 3.

495. *Id.*

496. Paerl et al., *supra* note 156.

497. Siti Jariani Mohd Jani, Composition, Sources, and Bioavailability of Nitrogen in Urban Waters 117 (2018) (Ph.D. dissertation, University of Florida) (ProQuest).

498. GRAHAM ET AL., *supra* note 33, at 63.

499. Paerl et al., *supra* note 156.

500. Christopher J. Gobler et al., *The Dual Role of Nitrogen Supply in Controlling the Growth and Toxicity of Cyanobacterial Blooms*, 54 HARMFUL ALGAE 87–97 (2016).

Increased nitrogen loading may also be contributing to the increased frequency of red tides in Florida. Researchers at the University of Miami examined data on *K. brevis* along the southwest coast of Florida from 1954 to 2002.[501] They hypothesized that greater nutrient availability in the ecosystem is most likely the cause of an increase in *K. brevis* biomass.[502] A large increase in human population and associated activities (for example, more sewage, more disturbance of terrestrial and wetland ecosystems that sequester nutrients, and more land surface runoff) in South Florida over the past fifty years is a major factor.[503]

Accordingly, after establishing a TMDL for nitrogen, FDEP should work in consultation with FDACS and the water management districts and identify monitoring opportunities that would help zero in on the specific sources of nitrogen pollution in the system (as well as any hotspots). FDEP should then reassess the effectiveness of the mitigation strategies it relies on in the BMAP to address nutrient pollution and identify what new approaches may be needed to specifically reduce nitrogen loading. This would help bring a more targeted approach to managing both phosphorus and nitrogen throughout the system.

3. FDEP Should Establish Allocations Between or Among Nonpoint Source Categories Within Pollution Hotspots

Under Florida law, FDEP must establish:

> [R]easonable and equitable allocations of the total maximum daily load *between or among* point and nonpoint sources that will alone, or in conjunction with other management and restoration activities, provide for the attainment of the pollutant reductions . . . to achieve water quality standards for the pollutant causing impairment . . . . Allocations may also be made to individual basins or sources or as a whole to all basins and sources or categories of sources of inflow to the water body or water body segments.[504]

TMDLs may begin with an initial allocation of allowable pollutant loads among point and nonpoint sources, but in such cases, a detailed allocation to specific point sources and specific categories of nonpoint sources shall be established in the BMAP for that TMDL.[505]

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501. Larry E. Brand & Angela Compton, *Long-Term Increase in Karenia Brevis Abundance Along the Southwest Florida Coast*, 6 HARMFUL ALGAE 232–52 (2007).

502. *Id.*

503. *Id.*

504. FLA. STAT. § 403.067(6)(b) (2022) (emphasis added).

505. *Id.*; Sierra Club v. Dep't of Env't Prot., No. 1D21-1667, 2023 WL 2007945, at *2 (Fla. 1st DCA Feb. 15, 2023).

FDEP's 2020 revisions to the Lake Okeechobee TMDL include load reductions and targets for each of the nine sub-watersheds that comprise the Lake Okeechobee watershed.[506] This finer-scale approach is a substantial improvement over the 2014 BMAP, which did not include any load reductions or targets at the sub-watershed level.[507] But more needs to be done to further FDEP's statutory directive that it equitably allocate pollutant reductions between or among nonpoint sources[508] and achieve the milestones set forth in the BMAP. Setting pollution reduction targets in the sub-watersheds will likely not be granular enough to focus on the specific areas where phosphorus loading is at the highest levels in the watershed.

As researchers at the Everglades Foundation and University of Florida detail in a 2019 study, there are several phosphorus-loading "hotspot clusters" in the northern Lake Okeechobee basins, which is consistent with several prior studies of the region.[509] The land uses within these clusters consist primarily of dairies—both active and abandoned—dairy boundary pastures, intensive pastures, spray fields, sod farms, and tree nurseries.[510] Comparatively, other agricultural uses such as unimproved pasture, citrus groves, pine plantations, and row crops appear to have a much lower average annual total phosphorus load in the Lake Okeechobee watershed.[511] Despite the presence of these hotspots and differences in phosphorus loading among these operations, the Lake Okeechobee BMAP fails to identify and allocate pollution loads among the many categories of nonpoint source pollution. Rather, the BMAP lumps all nonpoint source pollution categories and land uses together across the nine sub-watersheds.[512]

The Lake Okeechobee BMAP should be revised to take an even finer-scale approach to tackling phosphorus pollution. This should consist of a phased approach that starts with allocating loadings to nonpoint source categories within these nine sub-watersheds, which would enable FDEP to zero in on the phosphorus hotspots and prioritize pollution reduction measures in these areas. By allocating load reductions among these categories, FDEP would be able to take a harder look at the root causes for these hotspots and identify pollution reduction measures that are more

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506. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 15, 23.

507. FLA. DEP'T OF ENV'T PROT., *supra* note 308, at xiv–xv.

508. FLA. STAT. § 403.067(6)(b) (2022).

509. Khare et al., *supra* note 302, at 6.

510. *Id.* at 330 tbl.1.

511. *Id.*

512. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 20. This approach appears to be common to many BMAPs throughout the state, despite the statutory language calling for more specificity and detail. Douglas MacLaughlin points to the TMDL established for Lake Apopka, which only established an initial allocation between a single point source and all nonpoint sources adding phosphorus to the lake. MacLaughlin, *supra* note 309.

specifically tailored to these operations and to reducing these hotspots. By focusing on hotspots, the challenges of managing diffuse sources of pollution across a large landscape also appear surmountable. If FDEP later determines that a finer-scale approach is necessary in future phases to zero in on the most significant sources of pollution, it could allocate loadings to nonpoint source categories within each of the sixty-four basins that make up the Lake Okeechobee watershed.[513]

The state legislature should also consider amending the statute to provide FDEP with the express authority to allocate loadings to individual nonpoint sources in future phases of the Lake Okeechobee BMAP if allocating loadings to nonpoint source categories is not achieving pollution reduction milestones and an even more granular approach is necessary to address the pollution resulting from specific operations.[514]

4. FDEP Should Impose Backstops When Milestones are not Met

There must also be greater consequences if the state agencies responsible for administering BMAPs fail to make meaningful progress toward achieving the TMDL. While Florida law identifies five-year, ten-year, and fifteen-year milestones, and establishes reporting requirements, it does not impose any backstops if the state falls short of meeting these milestones.[515] In fact, if achieving the TMDL within twenty years is not practicable, FDEP is only required to explain the constraints that prevent achievement of the TMDL within twenty years and provide an estimate of the time needed to achieve the TMDL.[516] It can then set additional five-year milestones, as necessary.[517] The statute only contemplates FDEP revising the plan "as appropriate" and "in cooperation with basin stakeholders."[518] Without backstops or other contingencies in place, the statute incentivizes kicking the proverbial can down the road, with the goal posts being moved every couple of decades. This is becoming more of a realization after data from May 2013 to April 2017 revealed that the average annual phosphorus load remains nearly four times the target set forth in the TMDL, with basins on the northern side of Lake Okeechobee consistently contributing over ninety percent of the total phosphorus load from non-atmospheric sources.[519]

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513. *See* FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 23 (depicting the sixty-four basins).

514. The statute currently provides FDEP with authority to make allocations for "categories" of nonpoint sources in TMDLs and BMAPs. *See* FLA. STAT. §§ 403.067(6)(b), (7)(a)2 (2022).

515. *Id.* § 403.0675(1).

516. *Id.*

517. *Id.* § 403.067(7)(a)6.

518. *Id.*

519. Khare et al., *supra* note 302, at 2.

Therefore, the Florida statute should be amended to provide FDEP with opportunities to establish and implement specific regulatory backstops every five years if the state is falling short of meeting its milestones. These backstops may include: ratcheting up maximum allocation loads for sub-watersheds or the individual basins that are determined to be in identifiable hotspots for pollution, as well as specific categories of nonpoint sources within these hotspots; investing more in advanced BMP technologies to address the most significant sources of new pollution; imposing more rigorous recordkeeping requirements for agricultural producers; and conducting more frequent site visits to ensure landowners (particularly those within pollution hotspots) are properly implementing BMPs.

5. There Should be Better Communication and Collaboration Among State and Local Agencies to Address Non-Agricultural Pollution

Attainment of the Lake Okeechobee TMDL will largely depend on the state's ability to effectively manage agricultural nonpoint sources, as they are the predominant source of pollution entering the lake.[520] Local governments, however, also have an opportunity to assist the state in achieving the TMDL by addressing non-agricultural runoff and flows that are contributing sources of pollution including leaking septic tanks, sanitary sewer overflows, and storm water treatment systems.[521]

There are additional steps the state can take to address these additional pollution sources through the BMAP process by requiring additional information sharing within and between state and local governments. For urban storm water systems, FDEP should collect annual municipal

520. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 39.

521. In some parts of the Greater Everglades ecosystem, such as the IRL, leaking septic tanks may be a leading driver of nutrient pollution. *See* L.W. Herren et al., *Septic Systems Drive Nutrient Enrichment of Groundwaters and Eutrophication in the Urbanized Indian River Lagoon, Florida*, 172 MARINE POLLUTION BULL. 1, 12 (2021) ("This study illustrates that implementing more advanced wastewater treatment in key locations may allow for decreased nutrient loading and improved estuarine water quality and seagrass health in the IRL and other locations with similar conditions."); Peter J. Barile, *Widespread Sewage Pollution of the Indian River Lagoon System, Florida (USA) Resolved by Spatial Analyses of Macroalgal Biogeochemistry*, 128 MARINE POLLUTION BULL. 557, 571 (2018) ("Sewage nitrogen has been identified as a significant contributor to eutrophication in many coastal ecosystems throughout Florida, including the Indian River Lagoon."); Brian E. Lapointe et al., *Septic Systems Contribute to Nutrient Pollution and Harmful Algal Blooms in the St. Lucie Estuary, Southeast Florida, USA*, 70 HARMFUL ALGAE 1, 4 (2017) ("One emerging issue is the potential nutrient loading associated with the application of biosolids."); Brian E. Lapointe et al., *Evidence of Sewage-Driven Eutrophication and Harmful Algal Blooms in Florida's Indian River Lagoon*, 43 HARMFUL ALGAE 82, 84 (2015) ("Despite the elimination of point-source sewage inputs to the IRL through the IRL Act, non-point source sewage pollution from septic tanks . . . has continued to expand and remains a serious environmental and human health concern.").

separate storm sewer system (MS4)[522] permitting data within a BMAP area to determine expected loads, as well as net changes in loading between each implementation milestone. This would enable FDEP to evaluate the progress of MS4 permits in achieving pollution reductions in BMAP areas and, if necessary, to reexamine their adequacy in achieving waste load allocations, especially in identified hotspots.[523]

Similarly, for sanitary sewer overflows, FDEP should include data from incident reports along with loading estimates to determine where these incidents are occurring within the BMAP area every year, and to what extent they are contributing to nutrient-loading in the watershed.[524] In addition, FDEP could collect information regarding the properties that have switched from septic to sewer or have upgraded existing septic systems within a BMAP area, and the expected nutrient pollution reductions from local governments. This would help the state evaluate the effectiveness of these programs in helping meet nutrient reduction goals.

6. There Should be an Independent Advisory Committee to Perform Yearly Reviews and Incorporate New Information in Future Decision-Making

In addition to establishing more finely scaled load reductions and targets within the nine sub-watersheds, the BMAP's phased implementation approach needs to provide greater accountability and transparency. Much like the five-year milestones, the reporting

522. MS4s are stormwater systems that are not a combined sewer or part of a sewage treatment plant or publicly owned treatment works. These publicly owned systems collect or convey stormwater that discharge to waters of the United States. NPDES permits are required to prevent harmful pollutants from being washed or dumped into MS4s. Permit holders must develop stormwater management programs that describe stormwater control practices that will be implemented to minimize the discharge of pollutants. *See Stormwater Discharges from Municipal Sources*, U.S. ENV'T PROT. AGENCY (Dec. 2, 2022), https://www.epa.gov/npdes/stormwater-discharges-municipal-sources [https://perma.cc/DEJ6-ULXL].

523. Annual reporting is required under MS4 permitting rules, and it appears the FDEP could compile this information for use in BMAPs. *See* FLA. ADMIN. CODE ANN. r. 62-624.600 (2022) (setting forth annual reporting requirements for individual MS4 permits); *see also 9/24/19 Department of Environmental Protection Blue-Green Algae Task Force Part 2*, FLA. CHANNEL (Sept. 24, 2019), https://thefloridachannel.org/videos/9-24-19-Department-of-environmental-protection-blue-green-algae-task-force-part-2 [https://perma.cc/X2YQ-U65L].

524. For example, it appears there was significant loading in the Kissimmee River Basin as a result of infiltration and inflow (I&I) incidents during Hurricane Irma in 2016, which preceded massive algal blooms in the lake and estuaries. *See 8/1/19 Department of Environmental Protection Blue-Green Algae Task Force Part 2*, FLA. CHANNEL (Aug. 1, 2019), https://thefloridachannel.org/videos/8-1-19-Department-of-environmental-protection-blue-green-algae-task-force-part-2/ [https://perma.cc/8LM8-M8GC].

requirements established in 2016[525] are a significant improvement to the TMDL process. While BMAP revision is a collaborative process involving a range of stakeholders, it typically occurs every five years as FDEP reviews the progress made toward achieving the five-year milestones set forth in the BMAP.[526] Following a 2019 Executive Order by the Governor, the Lake Okeechobee BMAP was updated in 2020 to include recommendations from the first five-year review.[527] This included updates to the modeling, sub-watershed loading targets, management actions to achieve nutrient reductions, and a revised monitoring plan to track water quality trends.[528]

However, there must be more frequent progress reports and independent assessments, given the frequency of the HABs afflicting the lake and the coastal communities and the role of nutrient pollution in the formation and proliferation of HABs.[529] HABs have occurred almost every year for the past decade, and BMAPs should be continually reviewed to ensure the most accurate, up-to-date data is being used to inform decision-making and develop management approaches to respond to these events.[530] Comparatively, the Chesapeake Bay and Lake Champlain TMDLs have two-year milestones, which require the states to meet pollutant load reductions more frequently and provide for more frequent performance reviews.[531]

To this end, the Governor should establish an advisory committee to perform a yearly review of the state's progress toward achieving the TMDL and provide specific recommendations to the legislature for improvements to the BMAP process and to FDEP for future revisions to the plan. The committee could identify future projects that are needed to address the more than sixty percent of load reductions necessary to meet the TMDL.[532] The committee would convene every year following FDEP's submittal of its statewide annual report and would consist of an independent and interdisciplinary group of water quality scientists, biologists, engineers, and experts in water law. Given the significant work that needs to be done to even meet five-year milestones, it is unlikely that shorter milestones would offer the scientific scrutiny and the

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525. *See* FLA. STAT. § 403.0675 (2022) (requiring that FDEP and FDACS submit progress reports).

526. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 15.

527. *Id.*

528. *Id.*

529. *See* Goforth Presentation, *supra* note 452 (recommending annual assessments based on measured nutrient loads).

530. *Id.*

531. *Id.*

532. *See 7/1/19 Department of Environmental Protection*, *supra* note 335 (discussing the shortage of identified future projects to meet the load reduction targets in the BMAP).

opportunities for revision necessary to make substantial progress toward achieving the TMDL that an expert panel would provide.

7. There Should Be an Online Portal for the Public to Track Progress

Public transparency and accountability could be further improved by the establishment of an online platform where concerned citizens could track the progress being made toward achieving the milestones set forth in BMAPs. This should include a GIS-based mapping system depicting the various phosphorus hotspots with information about the various methods being taken to reduce pollution in the watershed. The map would identify specific BMPs, wetland restoration, dispersed water management projects, stormwater treatment areas, and other projects and include information about the projects' status, role in phosphorus reduction, and effectiveness to date. These maps could also depict the baseline identified in the 2014 BMAP and the annual load reduction progress made since then. This could be modeled after other TMDL tracking tools, such as those used for Chesapeake Bay, which include interactive maps that allow the EPA, states, and stakeholders to track progress toward implementing the bay's TMDL.[533] This information will enable the public to stay informed about the state's efforts to reduce phosphorus loading in the lake and demand greater accountability from elected officials and state agencies when milestones are not being achieved.

8. State Agencies Should Continually Adapt as Circumstances Change with Population Growth and Climate Change

Given that the Lake Okeechobee BMAP relies predominantly on the implementation of BMPs on more than 1.7 million acres of farmland in the northern Lake Okeechobee watershed to achieve load reductions to meet the TMDL in twenty years, it is imperative that the state ensure these practices really are "the best."[534]

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533. *Chesapeake Bay TMDL, Tools to Track Progress in the Chesapeake Bay Watershed*, U.S. ENV'T PROT. AGENCY (May 4, 2022), https://www.epa.gov/chesapeake-bay-tmdl/tools-track-progress-chesapeake-bay-watershed [https://perma.cc/JK4Z-ZTVZ]; *Public Reports – Compare Map*, CHESAPEAKE ASSESSMENT SCENARIO TOOL, https://cast.chesapeakebay.net/PublicReports/CompareMap [https://perma.cc/JWE9-CZ27] (last visited Feb. 25, 2023). The Chesapeake Bay Program had a Chesapeake Bay TMDL Tracking and Accounting System (BayTAS), but it was retired. *See Phase 5.3.2 Watershed Model*, CHESAPEAKE ASSESSMENT SCENARIO TOOL, https://cast.chesapeakebay.net/Documentation/Phase5/ [https://perma.cc/T7Y8-VYEV] (last visited Feb. 25, 2023).

534. S. FLA. WATER MGMT. DIST. ET AL., *supra* note 305, at 13–14 (2011). *See generally* Joyce Zhang et al., *Lake Okeechobee Watershed Protection Plan Annual Progress Report*, *in* 2022 SOUTH FLORIDA ENVIRONMENTAL REPORT – VOLUME I 8B-3 (2022) (noting that SFWMD gave its approval to expand the existing upstream and in-lake monitoring program for the Lake Okeechobee watershed).

As the state continues to experience significant growth and changing land use patterns[535]—which in turn could place an even greater demand on agricultural production, water use, and natural resources—additional conservation measures and new technologies may be required to achieve phosphorus targets.[536]

Moreover, nonpoint source pollution is predicted to increase due to increased precipitation and higher-intensity rainfall events driven by climate change.[537] Seasonal changes could further "trigger changes in cropping patterns, agricultural practices, and future land uses," thus further exacerbating nutrient pollution.[538]

To this end, BMAPs should be required to contain an adaptive management component that is specifically focused on how population growth and the resulting changes in land use—as well as climate change stressors—are affecting nonpoint source pollution, and in turn, impacting nutrient loading in the lake. Through a feedback loop, data would be used to respond to growth patterns, changing agricultural practices, and climate change-driven impacts, and provide FDEP with the information to make changes to pollution reduction measures on an as-needed basis.[539]

D. *BMAPs, Consumptive Use Permits, and Water Supply Plans Should Consider the Role Water Allocations Play in the Formation and Proliferation of HABs*

Under Florida law, water is a public resource[540] and almost all uses of water require a permit.[541] Florida's Water Resources Act authorizes water management districts to issue permits for consumptive uses, typically for twenty years.[542] Flood control and water supply demands have led water managers in the state to alter natural surface water levels and flows to

535. *See* Michael Volk et al., *Florida Land Use and Land Cover Change in the Past 100 Years*, *in* FLORIDA'S CLIMATE: CHANGES, VARIATIONS, & IMPACTS 70 (2017), https://diginole.lib.fsu.edu/islandora/object/fsu:539153/datastream/PDF/view [https://perma.cc/DZ37-PF6R] ("[T]he pre-1900 landscape of Florida has been significantly altered by agriculture and urbanization.").

536. Khare et al., *supra* note 302.

537. *Id.*

538. *Id.*

539. The GAO discusses several recommendations by the National Research Council (NRC) in 2001 for improving TMDLs. The NRC recommended a plan to monitor a TMDL's effect on water quality, including monitoring biological parameters, and a description of an adaptive approach to implementing the TMDL, whereby monitoring data will be used to periodically assess progress toward attaining water quality standards and adjusting the TMDL as necessary. *See* U.S. GOV'T ACCOUNTABILITY OFF., *supra* note 30, at 38–39 (2013).

540. FLA. STAT. § 373.016(4)(a) (2022).

541. Exceptions include domestic consumption of water by individual users and water used strictly for firefighting. *See* FLA. STAT. § 373.219 (2022); FLA. ADMIN. CODE ANN. r. 40E-2.051 (2022).

542. FLA. STAT. § 373.219(1) (2022).

manage water for agricultural, industrial, and municipal users.[543] Yet, in addition to nutrients and temperature, hydrological factors such as water flows, levels, and velocities can also influence the formation and proliferation of algal blooms.[544]

Lake Okeechobee, where water is stored during wet periods for future consumptive use in the dry season, is a striking example of how resource managers have altered the natural system to provide for water supply and flood protection.[545] These water management decisions have a profound impact on the natural system. For example, when lake stages are 15.5 feet or higher, phosphorus and sediment-rich waters from the center of the lake mix with waters in the nearshore region, harming submerged plants and worsening algal blooms.[546] When water levels are too high and pose a risk of flooding communities to the south of the lake, the Corps of Engineers discharges this nutrient-laden water to the coastal estuaries, leading to algal blooms and fish kills in the rivers and estuaries.[547] Conversely, when lake stages are low, less water flows to the Caloosahatchee, causing the river to become stagnant and hypersaline, which then results in low oxygen levels and the loss of submerged aquatic vegetation.[548]

Reducing nutrient loading and restoring hydrologic regimes are the most successful strategies to mitigate HABs.[549] BMAPs, consumptive use permits, and regional water supply plans, however, have all failed to address the extent to which water allocations—which can greatly influence water flows and levels in lakes, canals, and other waterbodies––have contributed to the formation and proliferation of HABs.[550]

543. *Water Management Districts*, FLA. DEP'T OF ENV'T PROT. (May 16, 2019, 2:18 PM), https://floridadep.gov/water-policy/water-policy/content/water-management-districts [https://perma.cc/G39P-UDCU]; *Minimum Flows and Minimum Water Levels and Reservations*, FLA. DEP'T OF ENV'T PROT. (Dec. 6, 2022, 3:08 PM), https://floridadep.gov/water-policy/water-policy/content/minimum-flows-and-minimum-water-levels-and-reservations [https://perma.cc/RS6D-5N4Q].

544. *See* UNIV. OF FLA. LEVIN COLL. OF L. CONSERVATION CLINIC, SPRING WATER VELOCITY: PROTECTING WATER QUALITY WITH WATER QUANTITY REGULATION *passim* (2018) (citing several studies finding that water quantity indicators can be as relevant to macroalgal proliferation in Florida spring-fed rivers as water quality indicators); *see also* CTR. FOR EARTH & ENV'T SCI., WHAT CAUSES ALGAL BLOOMS? 1 (2018), http://www.lakeleann.org/uploads/3/9/0/8/39088599/understanding_algae.pdf [https://perma.cc/SX94-UG2H] (explaining that algal blooms likely result from factors such as available nutrients, temperature, sunlight, ecosystem disturbance, hydrology, and water chemistry).

545. U.S. ARMY CORPS OF ENG'RS, *supra* note 144, at i.

546. GRAHAM ET AL., *supra* note 33, at 115.

547. *Id.*; U.S. ARMY CORPS OF ENG'RS, *supra* note 144, at 138.

548. NAT'L ACADEMIES OF SCIS., ENG'G, & MED., *supra* note 55, at 162.

549. *Id.* at 176.

550. *Id.*

In establishing the BMAP program, the state legislature envisioned a cooperative interagency approach to protecting water quality and reducing the spread of nutrients in state waters: BMAPs "must integrate the appropriate management strategies available to the state through existing water quality protection programs to achieve the total maximum daily loads."[551] As the lead contributor in this effort, the legislature must coordinate the implementation of TMDLs through existing water quality protection programs, which include permitting programs as well as other water quality management and restoration activities.[552]

Recent BMAPs have started to recognize the role that consumptive use permitting and other regulatory programs play in protecting water resources and reducing the impact of new development and other land uses changes as they occur.[553] However, these plans do not consider the role that consumptive uses (present and future) play in the formation and proliferation of HABs. While efforts to construct large-scale water storage and treatment projects are underway to help move water out of the lake south during the rainy season,[554] more can be done under Florida's regulatory programs to address these issues. Specifically, there needs to be a more integrated approach that bridges water use permitting and planning with BMAP pollution reduction programs. This could be achieved by FDEP adding a component to the BMAPs that specifically addresses any relationship between water levels and flows, nutrients, and HABs and how water supply allocations are influencing this relationship.

BMAPs would be a more effective tool to address the effects of water supply demands if districts more fully implemented the requirements for consumptive use permits (CUPs). State law requires districts to apply a three-prong test to determine whether a CUP should be issued.[555] This test requires: (1) that the use is a reasonable-beneficial use; (2) that it will not interfere with any existing legal use of water; and (3) that the use is consistent with the public interest.[556] The Florida statute gives the districts

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551. FLA. STAT. § 403.067(7)(a) (2022).

552. *Id.* § 403.067(7)(b).

553. FLA. DEP'T OF ENV'T PROT., *supra* note 40, at 159; FLA. DEP'T OF ENV'T PROT., SILVER SPRINGS AND UPPER SILVER RIVER AND RAINBOW SPRING GROUP AND RAINBOW RIVER BASIN MANAGEMENT ACTION PLAN 73 (2018), https://floridadep.gov/sites/default/files/Silver%20Rainbow%20Final%202018.pdf [https://perma.cc/BGJ7-R74C]; ST. LUCIE 2020 BMAP, *supra* note 329, at 158.

554. *Progress Continues on the Everglades Agricultural Area Reservoir Project*, S. FLA. WATER MGMT. DIST., https://www.sfwmd.gov/our-work/cerp-project-planning/eaa-reservoir [https://perma.cc/Z9CC-W2WX] (last visited Feb. 26, 2023).

555. Sw. Fla. Water Mgmt. Dist. v. Charlotte Cnty., 774 So. 2d 903, 908 (Fla. 2d DCA 2001).

556. *Id.*; FLA. STAT. § 373.223(1)(a)–(c) (2022). "Public interest" is not defined in the statute. *See* Christine A. Klein et al., *Modernizing Water Law: The Example of Florida*, 61 FLA. L. REV. 403, 432–41 (2009) (examining the permitting challenges resulting from not having a clearly defined "public interest" test and identifying several possible approaches to defining the public interest).

discretion in requiring information from permit applicants about the nature of the proposed withdrawal.[557] The SFWMD explains in its handbook for permit applicants that "[r]easonable assurances that the proposed water use from both an individual and cumulative basis meets this three-pronged test are provided, in part, by the applicant's compliance with the Conditions for Issuance," set forth in Florida Administrative Code Rule 40E-2.301.[558] This rule requires applicants to provide reasonable assurances that consumptive uses will not, among other things, cause harm to wetlands or other surface waters and not cause pollution of the water resource.[559] The districts could further protect the public interest by requiring applicants for CUPs to analyze the direct, indirect, and cumulative impacts of water supply allocations on the formation and proliferation of blooms. While existing permittees maintain the right to use the amount of water authorized by their permits,[560] this is not an unfettered right guaranteed in perpetuity,[561] and requiring this additional analysis for new permits and permit renewals would help guide future permitting decisions as demands on surface waters continue to increase in the future, particularly due to saltwater intrusion because of climate change.[562] This approach would implement the policy set forth in Section 373.016(2), Florida Statutes (2022), which requires FDEP and the governing boards of the districts to "take into account cumulative impacts on water resources and manage those resources in a manner to ensure their sustainability."

More broadly, regional water supply plans could help further illuminate the connections between water use and HABs by assessing the water quality impacts consumptive uses are having within watersheds across a twenty-year planning horizon. Florida Statutes direct the governing board of each district to conduct water supply planning for a specific region "where it determines that existing sources of water are not

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557. *See* FLA. STAT. § 373.229(1)(i) (2022) (indicating that all permit applications must include any information deemed necessary by the governing board or FDEP).

558. S. FLA. WATER MGMT. DIST., APPLICANT'S HANDBOOK FOR WATER USE PERMIT APPLICATIONS WITHIN THE SOUTH FLORIDA WATER MANAGEMENT DISTRICT 50 (2022). The handbook is incorporated by reference in Florida Administrative Code Rule 40E-2.091.

559. FLA. ADMIN. CODE ANN. r. 40E-2.301 (2022).

560. FLA. STAT. § 373.223 (2022); GRAHAM ET AL., *supra* note 33, at 20–21. In addition, the savings clause of the Water Resources Development Act of 2000 provides that the Corps and the SFWMD cannot eliminate or transfer existing legal sources of water in carrying out projects under the Comprehensive Everglades Restoration Plan. *See* Water Resources Development Act of 2000, Pub. L. No. 106-541, § 601(h)(5), 114 Stat. 2572, 2690 (2000).

561. *See* FLA. STAT. §§ 373.236, .243 (2022) (establishing the duration of permits as well as granting the districts the authority to require compliance reports and authorizing the revocation of permits, respectively).

562. *See* GRAHAM ET AL., *supra* note 307, at 100 ("The dependency on Lake Okeechobee for water supply during the dry season and droughts could increase as a consequence of sea level rise.").

adequate to supply water for all existing and future reasonable-beneficial uses and to sustain the water resources and related natural systems for the planning period."[563] Currently, districts do not consider how consumptive uses may influence the development of HABs, or how water being used for consumptive uses is contributing to HABs as a result of agricultural and urban runoff during high rainfall events.[564] There is also no analysis of how land acquisition and water conservation could otherwise help meet water supply needs for the natural system and provide additional protections against HABs.[565] The districts could evaluate this information to determine whether water sources are sufficient to meet supply needs and sustain natural systems, including the water quality of these systems. Further, the legislature could make it even clearer that districts must consider these impacts and possible mitigation measures in their water supply plans. This would further advance the collaborative framework established under Chapter 403 of the Florida Statutes to achieve the state's water quality goals.[566]

CONCLUSION

Many of Florida's lakes, rivers, and estuaries, like others in the nation, are facing ecological collapse due to HABs that kill wildlife, harm people and their pets, and threaten the way of life of so many coastal communities. The Fourth District Court of Appeal of Florida remarked that "[t]he Florida Legislature has taken due care to protect our water because it is among our most basic resources" and that "Florida's policy to protect and conserve our water is a matter of great public importance."[567] Governor DeSantis echoed these sentiments in Executive Order 19-12.[568]

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563. FLA. STAT. § 373.709 (2022).

564. S. FLA. WATER MGMT. DIST., UPPER EAST COAST WATER SUPPLY PLAN UPDATE *passim* (2021), https://www.sfwmd.gov/sites/default/files/2021_UEC_Plan_Chapters-final.pdf [https://perma.cc/7PYV-39NF]; CENT. FLA. WATER INITIATIVE, REGIONAL WATER SUPPLY PLAN *passim* (2020), https://cfwiwater.com/pdfs/CFWI_2020RWSP_FINAL_PlanDocRpt_12-10-2020.pdf [https://perma.cc/9P4F-8NYU]; S. FLA. WATER MGMT. DIST., LOWER KISSIMMEE BASIN WATER SUPPLY PLAN UPDATE *passim* (2019), https://www.sfwmd.gov/sites/default/files/2019_LKB_PlanAppendices_Final.pdf [https://perma.cc/Y88V-XF7V]; S. FLA. WATER MGMT. DIST., LOWER EAST COAST WATER SUPPLY PLAN UPDATE *passim* (2018), https://www.sfwmd.gov/sites/default/files/documents/2018_lec_plan_planning_doc.pdf [https://perma.cc/WSG2-8Q7M]; S. FLA. WATER MGMT. DIST., LOWER WEST COAST WATER SUPPLY PLAN UPDATE *passim* (2022), https://www.sfwmd.gov/sites/default/files/2022_LWC_Plan_Chapters_and_Appendices.pdf [https://perma.cc/NPS4-76HM].

565. *See supra* note 564.

566. *See* FLA. STAT. § 403.075 (2022) (directing government agencies to coordinate permitting and planning activities through an ecosystem management-based approach).

567. City of W. Palm Beach v. Palm Beach Cnty., 253 So. 3d 623, 626, 628 (Fla. 4th DCA 2018).

568. Fla. Exec. Order No. 19-12, *supra* note 315.

Yet existing water quality standards, nonpoint source pollution controls, TMDLs, and public health guidelines have not limited the amount of harmful cyanotoxins that can occur in Florida's waters without causing ecological damage, killing wildlife, and threatening human health. Recommendations by the state's Blue-Green Algae Task Force have largely gone unheeded, and resources have mostly been allocated toward redirecting water flows and addressing pollution sources that are dwarfed by the agricultural runoff that continues to feed HABs.

Florida and other states should take bold action and make legislative changes to effectively manage nonpoint source pollution, plan for the compounding effects of climate change and sea level rise, and restore thousands of imperiled waters. American waters, families, communities, and local economies have suffered far too long from the devastating impacts of algal blooms.