Article

Catching Nutrients in a Net: Collective Action, Institutional Impediments, and the Mississippi River Watershed

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Thousands of local governments in the Mississippi River watershed possess regulatory land use authority. From a narrow law and economics standpoint, when these entities extract from, add to, or pollute the watershed, it may appear as a classic tragedy of the commons problem. The tragedy sounds something like this: local governments act "rationally" to avoid regulating in a way that reduces pollution in the waterway because such regulation would increase costs. Further, local governments avoid paying the costs associated with treating or reducing the level of contaminants in the water before ushering them downstream. While this analysis might partially explain local actions, it ignores the existing federal and state regulatory framework in which local governments operate. Local governments' ability to act in "irrational" ways to protect the Mississippi River watershed is significantly constrained by federal and state regulation.

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† Associate Dean, Albany Law School, and Executive Director, Sustainable Development Code, www.sustainablecitycode.org. Some articles simply take longer than others. This one took a long time. Thank you to Dean Blake Hudson for inviting me to present this topic when he was a professor of law at Louisiana State University Law School way back in 2015. Thank you also to Professors Adel Amos and Mims Woods and Heather Britan from University of Oregon Law School who allowed me to present on this topic in 2016. A special thanks to my colleague Edward De Barbieri, who organized an opportunity for me to present the topic at Albany Law School in 2022. Given the long lead time, I also have several students to thank most of whom are wonderful attorneys today, including Catherina Narigon, Teagan Dolan, Zachary R. Mueller, and Mitchell Whittaker. Much appreciated to you all. Copyright © 2025 by Jonathan Rosenbloom.

This Article begins with an overview of the Mississippi River watershed, highlighting its natural resources, increased flooding, and elevated nutrient pollution (such as nitrates) stemming from agricultural runoff. Then, it delves into the role of local governments in the watershed, focusing on their utilization of the resources to supply essential services such as potable water. The Article next examines the federal and state regulations that unintentionally drive local governments toward contributing to a tragedy of the commons, resulting in exacerbating flooding and damaging nutrient overloads within the watershed. This part of the Article scrutinizes the existing jurisprudence governing local governments and the watershed. Considering the Supreme Court's decisions in West Virginia v. EPA *and* Sackett v. EPA*, which significantly narrowed the scope of federal protection of the environment, and in particular wetland protection, local governments are increasingly tasked with taking proactive measures to address environmental concerns.*

The Article concludes by highlighting how local governments can and have effectively bypassed preemption concerns to serve as the primary actor protecting, rehabilitating, and restoring watersheds from nutrient pollution, notwithstanding federal and state legal constraints. The Article provides numerous examples of local land use laws that can be used to safeguard watersheds and protect the health of all species.

INTRODUCTION

> Thousands have lived without love; not one without water.
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> -W.H. Auden

Potable water infrastructure in Des Moines, Iowa is under constant assault.[1] In 2012 to 2013, Iowa experienced severe, extreme, and exceptional drought conditions.[2] The drought put immense pressure on infrastructure pertaining to energy, transportation, emergency services, and—most relevant to this Article—water.[3]

During the 2012 to 2013 drought, the Des Moines Water Works, which provides potable water to over 500,000 people in central Iowa (the region in and around Des Moines and Ames,

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1. *See, e.g.*, Editorial, *Progress Towards Regional Water Utility Gains Steam in a Victory for Central Iowa*, DES MOINES REG. (Mar. 27, 2022), https://www.desmoinesregister.com/story/opinion/editorials/2022/03/27/regional-water-utility-central-iowa-water-works-des-moines/7157851001 [https://perma.cc/L22P-UUT2] ("The most obvious challenge in Iowa: River and well water almost always requires intensive and expensive treatment to be safe to drink, mostly because of pollution caused by nutrient runoff from farms. Treatment equipment is a large up-front investment for Des Moines and the other utilities.").

2. *See, e.g.*, *Historical Drought Conditions in Iowa*, NAT'L INTEGRATED DROUGHT INFO. SYS., https://www.drought.gov/states/iowa#historical-conditions [https://perma.cc/H8WW-3YW4] (depicting the intensity of drought in Iowa from 2000 to the present); Mahdi M. Al-Kaisi et al., *Drought Impact on Crop Production and the Soil Environment: 2012 Experiences from Iowa,* 68 J. SOIL & WATER CONSERVATION, Jan./Feb. 2013, at 19A, 19A (noting that all of Iowa experienced severe drought in 2012).

3. *See, e.g.*, Suzanne McGee, Opinion, *Could the Midwestern Drought Cause a Global Crisis?*, FISCAL TIMES (July 31, 2021), https://www.thefiscaltimes.com/Columns/2012/07/31/Could-the-Midwestern-Drought-Cause-a-Global-Crisis [https://perma.cc/FDT7-42GZ] (noting that the drought would have a significant impact on government finances); Steve Hargreaves, *Drought May Cost Billions in U.S. Food Exports*, CNN MONEY (Aug. 2, 2012), https://money.cnn.com/2012/08/02/news/economy/drought-food-exports/index.htm [https://perma.cc/RF99-Y7B9] (noting that the drought would likely cost the U.S. food export industry billions in lost revenue); Greg Botelho, *From Dry Rivers to Dead Deer, Drought's Impact Felt Everywhere*, CNN (Sept. 16, 2012), https://www.cnn.com/2012/09/15/us/drought-impact [https://perma.cc/69LY-2WCF] (noting that outdoor activities, commercial transportation, and wildlife were impacted by the drought); David A. Swenson & Liesl Eathington, *Anticipating Economic Impacts of the 2012 Drought in Iowa*, IOWA ST. UNIV. DEP'T OF ECON. (Aug. 2012), https://www.legis.iowa.gov/docs/publications/SD/15857.pdf [https://perma.cc/M4EC-YHFG] (noting that the initial impact of a drought is a sharp reduction in water supply, which in turn has immediate impacts on agricultural productivity and commercial activities, as well as "ripple" effects on the wider economy).

Iowa), struggled to keep up with demand.[4] The drought ended with devastating floods that included nineteen inches of spring rainfall,[5] marking the most spring rain recorded since 1892.[6] Like droughts, floods are sporadically frequent now in Iowa. In the five-year span from 2008 to 2013, central Iowa experienced the "100-year flood"[7] at least four times, including in '08, '10, '12, and '13.[8] The 2008 flood was "roughly" a "500-year flood."[9]

In addition to bringing overwhelming volumes of water, the quick shift in moisture in spring 2013 stressed infrastructure by adding an influx of nutrients, such as nitrates and phosphates,

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4. *See* Donnelle Eller, *With Drought Concerns Growing, Des Moines Water Works Asks Its 500,000 Customers to Cut Back on Watering Lawns*, DES MOINES REG. (June 15, 2021), https://www.desmoinesregister.com/story/money/agriculture/2021/06/14/iowa-drought-des-moines-water-works-lawn-watering-reduction/7683498002 [https://perma.cc/G6QW-2N44] (reporting that the Des Moines Water Works called on central Iowa residents to cut lawn watering by twenty-five percent in response to the drought).

5. *See Iowa Statewide Precipitation: July–September, 1895–2013,* NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://www.ncdc.noaa.gov/monitoring-content/sotc/drought/2013/13/ia-Reg013Dv00Elem01_07092013_pg.gif [https://perma.cc/4357-257L] (charting statewide precipitation from 1895 to 2013).

6. *See id.*

7. *See* Water Sci. Sch.*, The 100-Year Flood*, U.S. GEOLOGICAL SURV. (June 7, 2018), https://www.usgs.gov/special-topics/water-science-school/science/100-year-flood [https://perma.cc/HGT6-DMTK] ("The term '100-year flood' is used . . . to simplify the definition of a flood that statistically has a 1-percent chance of occurring in any given year. Likewise, the term '100-year storm' is used to define a rainfall event that statistically has this same 1-percent chance of occurring.").

8. *See Higher Standards Following 2008 Flooding—Iowa City, Iowa*, ASS'N OF STATE FLOODPLAIN MANAGERS [hereinafter *Higher Standards*], https://floodsciencecenter.org/products/elected-officials-flood-risk-guide/success-stories/higher-standards-following-2008-flooding-iowa-city-iowa [https://perma.cc/8QBN-8TLK] (describing the devastating consequences of the 2008 flood in Iowa City); Kimberlee K. Barnes & David A. Eash, *Flood of August 11–16, 2010, in the South Skunk River Basin, Central & Southeast Iowa*, U.S. GEOLOGICAL SURV. 1 (2012), https://pubs.usgs.gov/of/2012/1202/of2012-1202.pdf [https://perma.cc/6DRN-7RUM] (describing major flooding in Iowa in 2010); *see also* Donnelle Eller, *Flooding Has Slammed Every Iowa County Since 1988, Some as Many as 17 Times*, DES MOINES REG. (Mar. 20, 2019), https://www.desmoinesregister.com/story/money/agriculture/2018/04/29/iowa-flood-center-ranks-disaster-damages-billions-wapsipinicon-river/422336002 [https://perma.cc/T4JX-YDB7] (reporting that Iowa ranks fourth nationally in number of floods since 1988).

9. *Higher Standards, supra* note 8 ("The [2008] flood was 4 feet higher than the 100-year flood elevation, reaching roughly the mapped 500-year flood elevation.").

to the watershed, changing the ecology.[10] Nutrients on agricultural land, while naturally existing in the soil, are added to the ecological system, including the soil and water cycles, through the application of fertilizer. When nutrients wash off agricultural lands, they can make water unsafe for drinking and recreating.[11] In addition, nutrient runoff, such as nitrates from fertilizer, can have devastating impacts on biodiversity.[12]

Figure 1 below tracks the nitrate levels in the two primary water sources for central Iowa during spring 2015. Both the Raccoon and Des Moines Rivers tested above the U.S. Environmental Protection Agency's maximum ten parts-per-million limit.[13]

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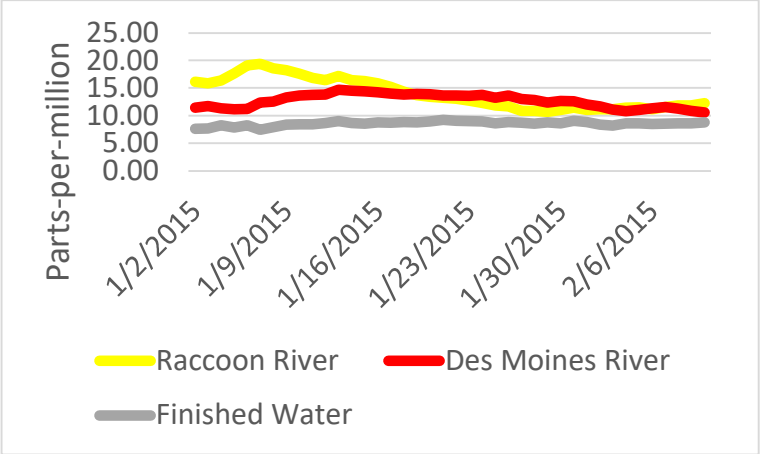
10. *See* Press Release, U.S. Geological Surv., Highest Concentrations Found in Iowa, Minnesota and Illinois (June 6, 2016), https://www.usgs.gov/news/state-news-release/rainfall-following-drought-linked-historic-nitrate-levels-some-midwest [https://perma.cc/2WMZ-R4TQ] ("Drought conditions in 2012 allowed excess nitrogen to build up in the soils until spring rains in 2013 flushed the nitrate into streams, leading to unusually high levels."). "Large amounts of nitrate can be detrimental to aquatic ecosystems." *Id.*

11. *See infra* Part I (describing the deleterious effects of agricultural runoff).

12. *See infra* Part I (describing the impacts of agricultural runoff on biodiversity).

13. Data was collected from the Des Moines Water Works, which regularly monitored nitrate concentrations in the Raccoon River at Van Meter (USGS Station 05484500) and the Des Moines River at 2nd Avenue in Des Moines (USGS station 05482000). *See Raccoon River at Van Meter, IA—05484500*, U.S. GEOLOGICAL SURV. (last updated Feb. 7, 2025), https://waterdata.usgs.gov/monitoring-location/05484500/#dataTypeId=continuous-99133-0&showMedian=false&startDT=2015-01-02&endDT=2015-02-06 [https://perma.cc/YKF5-LYTC] (measuring nitrate concentrations in the Raccoon River); *Des Moines River at 2nd Avenue at Des Moines, IA—05482000*, U.S. GEOLOGICAL SURV. (last updated Feb. 7, 2025), https://waterdata.usgs.gov/monitoring-location/05482000/#showMedian=false&dataTypeId=continuous-99133-0&startDT=2015-01-02&endDT=2015-02-06 [https://perma.cc/8B4L-VS9Y] (measuring nitrate concentrations in the Des Moines River).

Figure 1: Nitrate Levels in Des Moines and Raccoon Rivers



Like droughts and floods, these kinds of spikes in nitrates occur with regular frequency now.[14] They also reflect the challenges of trying to provide a critical service—potable water—in the face of multiple, intense, and unexpected disturbances. The situation in Iowa is not unique but emblematic of broader challenges across the Mississippi River watershed, where agricultural practices and changing precipitation patterns contribute to nutrient runoff. Communities along the Mississippi face similar struggles with nitrate contamination, algal blooms, and declining water quality, jeopardizing drinking water supplies and ecosystems throughout the region.[15] These trends raise the question: Why do local governments in the Mississippi River watershed allow a critical resource to be deteriorated to a point where people can no longer swim in it, use it, or consume it? Almost all life on Earth, including humans, need water to survive. So, why are we making it less safe and more costly to utilize this resource?

14. *See, e.g.*, Jared Strong, *Rainfall Runoff After Long Drought Leaves Many Iowa Rivers Brimming with Nitrate*, DES. MOINES REG. (May 13, 2024), https://www.desmoinesregister.com/story/news/local/2024/05/13/spike-in-iowa-rivers-nitrate-levels-recorded-as-rainfall-returns-des-moines-water-works/73672465007 [https://perma.cc/JZW9-6DQR] (highlighting one nitrate spike in four Iowa rivers after heavy a rainfall).

15. *See infra* Part I.

In this Article, I explore these questions with a particular focus on local governments and nutrient loads in the Mississippi River watershed. I look at what role local governments play in allowing nutrients to deteriorate the Mississippi River watershed and what role local governments *could* play in protecting and regenerating the quality of the watershed.

Understanding the dynamics surrounding local governments and nutrient loads in the watershed is facilitated by an exploration of the theoretical game framing local governments in the watershed. Through a narrow law and economics lens, the idea that thousands of local governments are making decisions to extract, add, or pollute the watershed could be characterized as a classic tragedy of the commons problem.[16] The analysis goes something like this: Local governments act "rationally" to avoid paying the costs associated with treating or reducing the level of contaminants in the water (in this case nutrients) before ushering them downstream.[17]

However, local governments are part of a larger institutional framework. That framework includes federal and state laws that preempt local governments and limit their authority.[18] Theoretically, and as an extension advocated by Garret Hardin in *The Tragedy of the Commons*, federal and state laws can help avoid a tragedy by compelling local governments to act

16. *See* Brett M. Frischmann et al., *Retrospectives: Tragedy of the Commons After 50 Years*, 33 J. ECON. PERSPS. 211, 214 (2019) (describing Garrett Hardin's sheepherder allegory as a classic illustration of the tragedy of the commons). Throughout the Article, I mention that local governments consume or appropriate common pool resources. This is intended to mean only the indirect appropriation of those resources "through a failure or inability to sustainably manage private appropriation of the resources." Jonathan Rosenbloom, *Local Governments and Global Commons*, 2014 BYU L. REV. 1489, 1490 n.2 (2014). For a discussion of direct appropriation, see *id.*

17. *See* Rosenbloom, *supra* note 16, at 1493 (noting that a local government's decision may be "rational" if it lures agricultural farming and investment by permitting farming up to a river's edge, and that while this decision may enhance local development, it also may result in nutrient and pesticide run-off that damages water resources downstream).

18. *See* Lauren E. Phillips, *Impeding Innovation: State Preemption of Progressive Local Regulations*, 117 COLUM. L. REV. 2225, 2231 (2017) ("Judicial assessment of local power has traditionally been guided by 'Dillon's Rule,' 'a canon of construction and a rule of limited power' that focuses on the subservient nature of the city relative to the state." (quoting Richard Briffault, *Our Localism: Part I-The Structure of Local Government Law*, 90 COLUM. L. REV. 1, 1 (1990))).

"irrationally."[19] However, as shown in Part III, when it comes to nutrients in the watershed, the federal and state regulatory framework encourages, if not compels, local governments to act "rationally," resulting in deterioration of the watershed.

In the article *Local Governments and Global Commons*, I challenged the assumption that local governments can be equated with rational actors.[20] Specifically, I noted that the international and national regulatory framework preempting local action skews a typical commons analysis.[21] Further, in *Uncommon Approaches to Commons Problems: Nested Governance Commons and Climate Change*, Dean Blake Hudson and I explored the various ways in which laws at different levels of government can impact a commons analysis.[22] Finally, in *New Day at the Pool: State Preemption, Common Pool Resources, and Non-Place Based Municipal Collaborations*, I explored how state government legal principles, such as home rule and preemption laws, restrict local government behavior and decision making.[23]

In this Article, I look to advance the research in the prior three articles in important ways. First, this Article looks to test the concepts laid out in the prior articles by applying the theories therein to a specific area of law (land use law) and specific

19. *See* Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243, 1248 (1968). It is worth noting that Hardin's famous tragedy of the commons theory is partially rooted in theories of eugenics and population control. *See, e.g.*, Gregory M. Stein, *Environmental Justice and the Tragedy of the Commons*, 13 CALIF. L. REV. ONLINE 11–12 (2022) (noting that Hardin's theories have been applied to "eugenics, anti-immigration policies, and even white nationalism" (citations omitted)). This Article seizes Hardin's theory solely as applied to local governments and environmental resources.

20. *See generally* Rosenbloom, *supra* note 16 (questioning whether local governments' actions can be explained by a straightforward tragedy of the commons analysis in which cities act "rationally" as wealth maximizers).

21. *Id.* (identifying the legal restrictions on local governments that encourage using resources in a way that negatively impacts those resources and other local governments).

22. *See generally* Blake Hudson & Jonathan Rosenbloom, *Uncommon Approaches to Commons Problems: Nested Governance Commons and Climate Change*, 64 HASTINGS L.J. 1273 (2013) (describing how laws at different levels of government can affect a commons analysis).

23. *See generally* Jonathan Rosenbloom, *New Day at the Pool: State Preemption, Common Pool Resources, and Non-Place Based Municipal Collaborations*, 36 HARV. ENV'T L. REV. 445 (2012) (arguing that the juxtaposition of limited local government authority and multi-jurisdictional local challenges has the potential to create inefficiencies and discourage local governments from seeking innovative solutions to the challenges they face).

resource (clean water in the Mississippi River watershed). Second, the prior articles focused mostly on international and national regimes and common pool resources.[24] This Article is hyper-focused on national and state legal regimes and how they impact local actors on regional resources. Third, given the confines in which the law of preemption limits local action, this Article looks to push the envelope to identify solutions—solutions in which local governments exercise their land use authority in ways to sustainably manage the Mississippi River watershed in light of federal and state failures. Here, I explore individual local governments' existing authority to act notwithstanding preemption laws. In this way, this Article seeks to bridge the gap between theory and practice.

It has become increasingly important for local governments to proactively address environmental issues. The Supreme Court's 2022 decision in *West Virginia v. EPA* and 2023 decision in *Sackett v. EPA* have made two things clear: that federal regulatory action is going to be increasingly difficult to implement under existing environmental legislation, such as the Clean Water Act, and that new environmental legislation will be necessary.[25] Given the current state of acrimony in Congress, federal legislation taking up nutrient loads in the watershed is highly unlikely. Further, as illustrated in Part IV, even if Congress were to act, local governments have existing legal authority to act in a way that avoids preemption and could have a positive impact on the damage nutrients are doing to the watershed.

To achieve its objectives, the Article begins with an overview of the Mississippi River watershed, the natural resources therein, and the elevated levels of nutrients flowing through the watershed from agricultural runoff. In Part II, it explores local governments and collective action challenges in the watershed.

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24. *See, e.g.*, Rosenbloom, *supra* note 16, at 1493–94 ("[T]he Article focuses on international and national restrictions local governments confront when facing global commons resource challenges.").

25. *See* West Virginia v. EPA, 142 S. Ct. 2587, 2614–16 (2022) (reinvigorating the major questions doctrine and applying it to the EPA's Clean Power Plan under the Clean Air Act, striking down the agency's generation-shifting approach to setting emissions caps for lack of "clear congressional authorization"); Sackett v. EPA, 143 S. Ct. 1322, 679 (2023) (declining to defer to the EPA's interpretation of the Clean Water Act, and requiring "exceedingly clear language" from Congress when federal authority over private property—potentially much of the "waters of the United States"—is involved).

In Part III, the Article describes some of the federal and state laws encouraging, if not compelling, local governments into a tragedy of the commons, resulting in nutrient overloads and damage to the watershed described in Part I. Part IV concludes with a closer look at existing local actions exercising sustainable management of the watershed. This final Part provides a roadmap for local governments to avoid preemption, and proactively protect, heal, and regenerate the watershed, notwithstanding federal and state laws.

I. THE MISSISSIPPI RIVER WATERSHED AND NITRATE RUNOFF

The Mississippi River watershed encompasses forty-one percent of the continental United States.[26] It is the fourth largest watershed in the world.[27] It touches thirty-one states and comprises varying geographies.[28] In the middle of the watershed are plains and prairies which are surrounded on both sides by mountains—the Appalachian and Allegheny Mountains to the East and the Rocky Mountains to the West. To the South lies the Gulf of Mexico, where the watershed discharges (see Figure 2 below for a map of the watershed).

26. *See Mississippi River: A Cultural Treasure*, AM. RIVERS, https://www.americanrivers.org/river/mississippi-river [https://perma.cc/82GW-WGAR] (noting that the Mississippi River "drains 41 percent of the continental United States").

27. *See Mississippi River Facts*, NAT'L PARK SERV. (last updated Feb. 15, 2025), https://www.nps.gov/miss/riverfacts.htm [https://perma.cc/X8Q6-TKF4] ("The Mississippi River watershed is the fourth largest in the world, extending from the Allegheny Mountains in the east to the Rocky Mountains in the West.").

28. *See Mississippi River: A Cultural Treasure*, *supra* note 26 ("The Mississippi's watershed drains all or parts of 31 U.S. states and 2 Canadian provinces between the Rocky Mountains and Appalachian Mountains.").

Figure 2: Map of Mississippi River Watershed[29]

Within this vast area are great diversities, including dense urban areas, such as St. Louis, Columbus, Louisville, Nashville, Cincinnati, Denver, New Orleans, Minneapolis, and Memphis, large rural and agricultural areas across the Midwest plains, and a variety of industrial, residential, and commercial uses, including environmental justice/disaster areas such as "Cancer Alley."[30]

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29. *Map of Mississippi River Watershed*, *in* WIKIMEDIA COMMONS (Nov. 16, 2013), https://commons.wikimedia.org/wiki/File:Mississippirivermapnew.jpg [https://perma.cc/7T62-6QMP].

30. *See id.* (depicting the Mississippi Watershed). "Cancer Alley" refers to a 130-mile stretch along the Mississippi River in Louisiana known for having a high concentration of industrial plants and high rates of cancer for local residents. *See, e.g.*, James Bruggers, *"Cancer Alley" Residents' Zoning Lawsuit Cites "Racial Cleansing,"* MOTHER JONES (Mar. 26, 2023), https://www.motherjones.com/politics/2023/03/cancer-alley-zoning-lawsuit-environmental-justice-race [https://perma.cc/EVG8-FPRH] ("Cancer alley is a 130-mile stretch along the Mississippi River from New Orleans to Baton Rouge that is dotted with more than 200 industrial facilities including oil refineries, plastics plants, chemical plants and other factories that emit significant amounts of harmful air pollution."); Trisha Gopal, *'We Are Being Poisoned': Black Residents Living in*

There are also many vital natural resources and critical ecosystems that local governments and many Americans rely on.[31] Unfortunately, these ecosystems are continuously at risk of depletion as the water level of the Mississippi continues to drop and the watershed becomes more polluted.[32]

Understanding the benefit of some of the ecosystems found in the watershed is informed by a look at "ecosystem services." The term "ecosystem services" helps to assign and evaluate the monetary value we get from ecosystems.[33] It focuses on the benefits *humans* receive from ecosystem production.[34] Ecosystem services attempt to capture a value that is not recognized in traditional markets.[35] While ecosystem services do not account for

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Louisiana's 'Cancer Alley' Say the State Is Guilty of 'Genocide' and Environmental Racism, BUS. INSIDER (Aug. 3, 2023), https://www.businessinsider.com/cancer-alley-louisiana-epa-environmental-racism-pollution-2023-7 [https://perma.cc/E3WU-S5T9] ("The lawsuit says that [St. James] parish has granted nearly every request by industrial corporations to build facilities in majority-Black neighborhoods, while no new facilities have been allowed in majority-white neighborhoods in over 46 years. 'The land-use plan that was finally adopted is a racial-cleansing plan because it actually said that these residential areas were designated future industrial,' [Center for Constitutional Rights Senior Staff Attorney Pamela] Spees said, referring to a 2014 plan that changed the fifth district from 'residential' to 'existing residential/future industrial.'").

31. *See, e.g.*, *How We Use Water*, U.S. ENV'T PROT. AGENCY (last updated Sept. 12, 2024), https://www.epa.gov/watersense/how-we-use-water [https://perma.cc/NLV7-ZUFY] (highlighting the demand on freshwater resources); Mary Reilly & Kurt H. Schindler, *Local Government Has an Important Role for Water Quality Protection: Part 1*, MICH. ST. UNIV. EXTENSION (Apr. 13, 2023), https://www.canr.msu.edu/news/local_government_has_an_important_role_HTTfor_water_quality_protection [https://perma.cc/8C69-HPB6] (highlighting the importance of protecting surface water, ground water, drinking water, and wetlands).

32. Ritu Prasad et al., *The Mississippi River Has Dropped to a Historic Low for the Second Consecutive Year*, CNN (Oct. 11, 2023), https://www.cnn.com/2023/10/11/us/mississippi-river-low-level-record-memphis-climate/index.html [https://perma.cc/3833-7EFD] (reporting that the Mississippi River had dropped to historic lows as a result of exceptional drought in parts of the South and Midwest).

33. *See Ecosystem Services*, NAT'L WILDLIFE FED'N, https://www.nwf.org/Educational-Resources/Wildlife-Guide/Understanding-Conservation/Ecosystem-Services [https://perma.cc/5VGR-DMKL] ("The value of nature to people has long been recognized, but in recent years, the concept of ecosystem services has been developed to describe these various benefits. An ecosystem service is any positive benefit that wildlife or ecosystems provide to people.").

34. Keith H. Hirokawa & Linnea E. Riegel, *An Ecosystem Services Approach to Cultural Resource Protection*, 50 ENV'T L. 665, 667–68 (2020).

35. *Id.* at 687.

non-anthropogenic benefits, such as the value a sentient being has to it and its species,[36] they can serve as a starting point to understand some of the value embedded in the Mississippi River watershed.

To help obtain ecosystem values, ecosystem services have been categorized in at least four ways: provisioning services, regulating services, cultural services, and supporting services.[37]

> Provisioning services generally include the production of goods, such as the wetlands processes that filter contaminants from water and produce goods that we use as food, fuel, and other consumables. Regulating services include the benefits stemming from the processes that regulate ecosystem interactions and other processes, including the regulation of air and water quality, erosion, climate, waste treatment, disease, pests, pollination, and natural hazards. Supporting services are essential for the manner in which they facilitate other ecosystem services. Supporting services provide indirect and sustained benefits, in contrast to the direct and short-term impacts caused by other types of ecosystem services. Finally, cultural services benefit people in nonmaterial ways, such as by providing opportunities to build on a sense of self and place, for reflection and spiritual enrichment, and for cognitive development.[38]

Some, but not all, of the services the ecosystems in the Mississippi River watershed provides are set forth in the chart below.[39]

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36. *See* N. Small et al., *The Challenge of Valuing Ecosystem Services that Have No Material Benefits*, 44 GLOB. ENV'T CHANGE 57, 60 (2017) (finding that ecosystem services have also been noted for failing to account for less direct or indirect human benefits, such as "spiritual enrichment, cognitive development, recreation and aesthetic experiences").

37. Hirokawa & Riegel, *supra* note 34, at 688 (citing Stephen Farber et al., *Linking Ecology and Economics for Ecosystem Management*, 56 BIOSCIENCE 121, 123 (2006)).

38. *Id.* (footnotes omitted).

39. *See Ecosystems*, UPPER MISS. RIVER BASIN ASS'N (2021), https://umrba.org/focus-area/ecosystems [https://perma.cc/W76S-LPX9] (describing the Mississippi River's economic and social benefits).

Table 1: Sample of Ecosystem Services in the Mississippi River Watershed

Provisioning Goods or Products	Regulating Services	Cultural Services	Supporting Services
Potable water Edible food (fish, wildlife, grains, fruits, vegetables) Raw materials Power generation	Nutrient reduction Purification of water Wetland climate regulation Enhanced resilience (protection of infrastructure, reduction in property loss) Regulation of water volume (floods) Soil retention	Accessible water for recreational purposes Accessible water for educational purposes Accessible water for health purposes Connection between community and natural resources	Thriving habitat (enhanced biodiversity)[40] Pollination Clean soil formation

Tapping into these services are millions of people living in thousands of local governments. The eleven states listed in the left column below are completely or almost completely encompassed in the Mississippi River watershed. According to the U.S. Census, these eleven states have over 26,000 local governments.[41]

40. *See Mississippi River Facts*, NAT'L PARK SERV., https://www.nps.gov/miss/riverfacts.htm [https://perma.cc/7938-G7EP] ("Sixty percent of all North American birds (326 species) use the Mississippi River Basin as their migratory flyway.").

41. *See generally 2022 Census of Governments—Organization*, U.S. CENSUS BUREAU, https://www.census.gov/data/tables/2022/econ/gus/2022-governments

Table 2: Sample Number of Local Governments by State in the Mississippi River Watershed

State	General Purpose (city, town, county)	Special Purpose (ex. sch. dist., water dist.)	Total
Arkansas	575	987	1,562
Illinois	2,822	4,108	6,930
Iowa	1,039	787	1,826
Kansas	1,994	1,774	3,768
Kentucky	535	772	1,307
Louisiana	364	170	534
Missouri	1,340	2,456	3,796
Nebraska	971	1,570	2,541
Oklahoma	669	1,171	1,840
South Dakota	1,273	627	1,900
Tennessee	437	465	902
TOTAL	**11,969**	**14,887**	**26,856**

.html [https://perma.cc/UBW2-VCT8] (select "Table 2. Local Governments by Type and State: 2022 [CG2200ORG02]" to download the dataset; then select "COG2022_CG2200ORG02_Data") (listing "Total Local Government Units" for the nation and each of the fifty states, broken down between General Purpose and Special Purpose units).

Each of these local governments have some regulatory authority in the watershed. Like their environments and watershed, the local governments have different needs, geographies, infrastructure assets, natural resource assets, challenges, financial resources, politics, and opportunities. They also exhibit variations in their approach to interacting with the watershed.

Some of the ways in which local governments directly impact the watershed include extracting volume from it. Approximately sixty percent of Americans' water use comes from the watershed.[42] Illustrations of local governments extracting from the watershed include the provision of potable water and irrigation for agricultural land. The Des Moines Water Works (mentioned in the Introduction), for example, withdraws millions of gallons from the Raccoon and Des Moines Rivers which flow directly to the Mississippi River.[43] Of particular importance in the Mississippi River watershed is the extraction of water for agricultural purposes. Agriculture accounts for a significant amount of ground and surface water use in the United States, with irrigation accounting for nearly half of the nation's total freshwater withdrawals.[44]

A second way local governments impact the watershed is by adding water to it. This is done through several land use practices contributing to stormwater runoff or direct discharges that would normally be absorbed in soil and not directly into tributaries or the Mississippi River. For example, large parking lots in urban areas, combined sewerage outfalls, and tiling on agricultural lands all add water volume to the Mississippi River.[45]

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42. Sally Deneen, *Raiding the Bread Basket: The Use and Abuse of the Mississippi River Basin*, NAT'L GEOGRAPHIC (Jan. 24, 2012), https://www.nationalgeographic.com/science/article/120123-mississippi-river-basin [https://perma.cc/4CRB-2C6R].

43. *See Watershed*, DES MOINES WATER WORKS, https://www.dmww.com/water_quality/watershed.php [https://perma.cc/NJ8Y-CYL3] ("The Raccoon and Des Moines Rivers are used to provide drinking water to more than 500,000 Central Iowans.").

44. *Irrigation & Water Use*, U.S. DEP'T OF AGRIC. ECON. RSCH. SERV. (last updated Jan. 8, 2025), https://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use [https://perma.cc/V8C5-RTWY].

45. *See Urbanization and Stormwater Runoff*, U.S. ENV'T PROT. AGENCY (last updated Jan. 16, 2025), https://www.epa.gov/sourcewaterprotection/urbanization-and-stormwater-runoff [https://perma.cc/9JBS-29QL] (describing stormwater runoff that flows over land or impervious services such as paved streets and parking lots and deposits harmful pollutants into streams, lakes,

"Tiling" is a sophisticated means of plumbing in which plastic piping is often set about five feet under agricultural land to expedite the removal of water off agricultural land and directed to a stream or river in the watershed.[46] In Iowa, approximately 46% of farmland is tiled.[47] That is essentially similar to the paving over of Connecticut, Rhode Island, and Massachusetts, and pushing that water downstream, instead of absorbing it into the ground. In the United States, approximately one acre in every nine acres is unnaturally drained by either tiling or drainage ditches.[48] Throughout the Upper Mississippi River Basin, tiling and ditches drain approximately 34% and 13%, respectively, of cultivated cropland.[49]

Local governments can influence the watershed in a third way by introducing pollutants. Such pollutants can harm water quality and have far-reaching consequences on ecosystems.[50] Various sources of pollution found in both urban and rural areas contribute to this problem. For instance, many industrial cities

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and groundwater); *see also Nutrient Pollution: Sources and Solutions*, U.S. ENV'T PROT. AGENCY (last updated Nov. 15, 2024), https://www.epa.gov/nutrientpollution/sources-and-solutions [https://perma.cc/3KEN-PLXW] (describing how the nitrogen and phosphorus in animal manure and chemical fertilizers can negatively impact downstream water quality).

46. *See* Avat Shekoofa & Brian Leib, *Tile Drainage Systems*, UNIV. OF TENN. INST. OF AGRIC. (2018), https://irrigation.tennessee.edu/wp-content/uploads/sites/176/2020/08/Tile-Drainage-Systems-W778.pdf [https://perma.cc/Q88N-B8LZ] (describing tile drainage systems); L.M. Ahiablame et al., *Effect of Tile Effluent on Nutrient Concentration and Retention Efficiency in Agricultural Drainage Ditches*, 98 AGRIC. WATER MGMT. 1271, 1271 (2011) (describing the impacts of tile drainage).

47. *See* U.S. DEP'T OF AGRIC., AC-17-A-51, 2017 CENSUS OF AGRICULTURE 646 (2019) (noting that of the thirty million acres of farmland in Iowa, fourteen million were drained by tile).

48. *Id*. at 643 (noting that of the 900 million acres of farmland in the United States, roughly 55.6 million acres were drained by tile, and roughly 43.9 million acres were drained by ditches).

49. Lara Bryant & Jan Goldman-Carter, *Options to Address Nutrient Pollution from Agricultural Drainage*, NAT'L WILDLIFE FED'N 1 (Mar. 2016), https://www.nwf.org/~/media/PDFs/Wildlife/Options-to-Address-Pollution-from-Agricultural-Drainage_rev-3-7-16.ashx [https://perma.cc/FW5N-8QYQ].

50. *See* Melissa Denchak, *Water Pollution: Everything You Need to Know*, NAT'L RES. DEF. COUNCIL (Jan. 11, 2023), https://www.nrdc.org/stories/water-pollution-everything-you-need-know#whatis [https://perma.cc/P59Z-D5WA] (describing the harms of water pollution).

have combined sewer outflows (CSOs).[51] If it rains a certain amount, the stormwater system found in these cities is overburdened.[52] To alleviate the system, the CSOs release untreated runoff or raw sewage into rivers.[53] This practice is prevalent in over 700 U.S. cities,[54] including St. Louis, where dozens of outfalls directly affect the watershed.[55] As the Metropolitan St. Louis Sewer District notes:

> During wet weather, especially heavy rains, the volume of the combined sewage and rainwater can overwhelm the capacity of our sewers, causing a mixture of sewage and rainwater to bypass the treatment facility and discharge directly into local rivers. Known as Combined Sewer Overflows (CSOs), these events increase the level of pollutants and disease-causing pathogens (viruses, bacteria, and parasites) in our rivers.[56]

Additionally, agricultural runoff, involving the draining of fertilizers and pesticides from farmlands into nearby water sources, is a significant contributor to pollution. To achieve higher yields, industrial fertilizers play a crucial role in

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51. For a general description and information on CSOs, see *Combined Sewer Overflows (CSOs)*, U.S. ENV'T PROT. AGENCY (last updated Sept. 16, 2024), https://www.epa.gov/npdes/combined-sewer-overflows-csos [https://perma.cc/BV7S-MZMW].

52. *Combined Sewer Overflow Basics*, U.S. ENV'T PROT. AGENCY (last updated Sept. 16, 2024), https://www.epa.gov/npdes/combined-sewer-overflow-basics [https://perma.cc/FMN6-JMDZ].

53. *See Combined Sewer Overflows (CSOs)*, *supra* note 51 ("Sometimes the amount of runoff exceeds the capacity of the system. When that happens, untreated stormwater and wastewater flows into nearby waterbodies.").

54. *Where Combined Sewer Overflow Outfalls Are Located*, U.S. ENV'T PROT. AGENCY (last updated June 10, 2024), https://www.epa.gov/npdes/where-combined-sewer-overflow-outfalls-are-located [https://perma.cc/J3E8-ZJL9].

55. *See* Erick Trickey, *How a Sewer Will Save St. Louis*, POLITICO (Apr. 20, 2017), https://www.politico.com/magazine/story/2017/04/20/st-louis-infrastructure-sewer-tunnel-water-system-215056 [https://perma.cc/RRY4-HY77]; *see also* Mary Anna Evans, *Flushing the Toilet Has Never Been Riskier*, ATLANTIC (Sept. 17, 2015), https://www.theatlantic.com/technology/archive/2015/09/americas-sewage-crisis-public-health/405541 [https://perma.cc/82XQ-G69M] ("The EPA has called overflows from combined sewer systems 'the largest category of our Nation's wastewater infrastructure that still need to be addressed,' affecting Americans in 32 states, including the District of Columbia.").

56. *Managing a Complex System*, METRO. ST. LOUIS SEWER DIST. PROJECT CLEAR, https://msdprojectclear.org/what-we-do/two-utilities-in-one/how-our-sewer-system-works [https://perma.cc/8F67-65D3].

supporting the growth of agricultural commodities.[57] However, the excessive use of nitrogen and phosphorus in fertilizers disrupts natural nutrient cycles, leading to nutrient runoff and water pollution.[58] Agricultural runoff stands as the primary cause of water pollution and impairment in U.S. rivers, as well as a major factor in the degradation of wetlands and lakes.[59] As one study found, the application of fertilizer to the main commodity crops including soybean and corn create a "vulnerability to nutrient loss, have a lower capacity for capturing and holding nitrogen . . . during wet conditions, and lack surface cover to prevent soil erosion and phosphorus . . . loss during heavy rain events."[60] "In reality . . . nutrients in fertilisers do not all end up in the plant; up to 20–80 % of nutrients in fertilisers may be lost to the environment or temporarily accumulate in the soil due to several complex soil chemistries that preclude their immediate availability to the plant."[61] The map in Figure 3 shows the

57. *See* INT'L FOOD POL'Y RSCH. INST., GREEN REVOLUTION: CURSE OR BLESSING? 2 (2002) [hereinafter IFPRI], https://ageconsearch.umn.edu/record/15888?ln=en&v=pdf [https://perma.cc/L5E9-B3CA] (noting that the development of inorganic fertilizers and modern pesticides fueled dramatic agricultural yield breakthroughs).

58. *See* Water Sci. Sch., *Nitrogen and Water*, U.S. GEOLOGICAL SURV. (May 21, 2018), https://www.usgs.gov/special-topics/water-science-school/science/nitrogen-and-water [https://perma.cc/JKT6-VVHW] ("Nutrients, such as nitrogen and phosphorus, are essential for plant and animal growth and nourishment, but the overabundance of certain nutrients in water can cause a number of adverse health and ecological effects . . . . If excess nitrogen is found in the crop fields, the drainage water can introduce it into streams like these, which will drain into other larger rivers and might end up in the Gulf of Mexico, where excess nitrogen can lead to hypoxic conditions (lack of oxygen).").

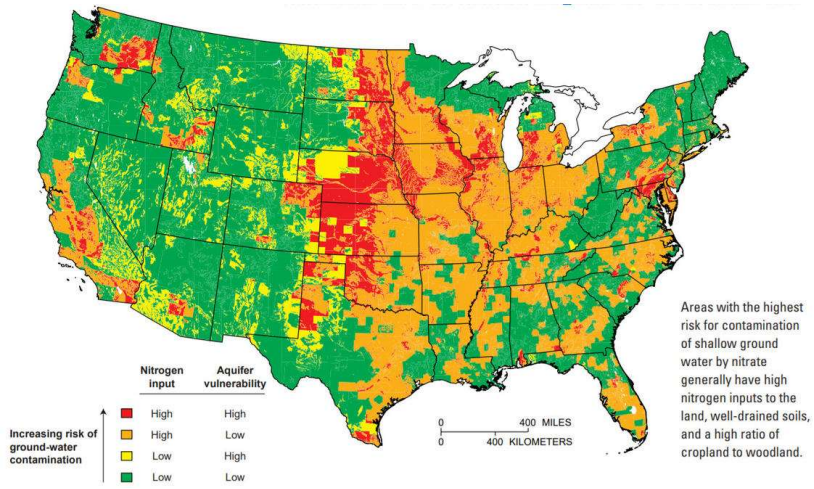
59. Javier Mateo-Sagasta et al., *More People, More Food, Less Water? A Global Review of Water Pollution from Agriculture*, FOOD & AGRIC. ORG. OF THE U.N. 4 (2018), https://openknowledge.fao.org/server/api/core/bitstreams/686ea465-7847-428e-b599-b236f2240e47/content [https://perma.cc/8KT8-JWTZ] ("In the United States of America, agriculture is the main source of pollution in rivers and streams, the second main source in wetlands and the third main source in lakes."(internal citation omitted)).

60. Laurie Nowatzke & Jamie Benning, *Measuring Conservation and Nutrient Reduction in Iowa Agriculture*, IOWA STATE UNIV. EXTENSION & OUTREACH (July 9, 2020), https://crops.extension.iastate.edu/cropnews/2020/07measuring-conservation-and-nutrient-reduction-iowa-agriculture [https://perma.cc/LHB8-YU5W].

61. Prem S. Brindraban et al., *Revisiting Fertilisers and Fertilisation Strategies for Improved Nutrient Uptake by Plants*, 51 BIOLOGY & FERTILITY SOILS 897, 898 (2015); *see also Tracking the Iowa Nutrient Reduction Strategy*, IOWA

location of the highest levels of nitrogen in the United States, which are concentrated in the heart of the Mississippi River watershed. In fact, the map of nitrogen below forms an almost identical shape to the Mississippi River watershed.

Figure 3: Nitrogen Contamination in the United States[62]



Fertilizer runoff from farms can lead to numerous water-based challenges. Locally, toxic algae outbreaks can occur affecting recreational swimming and the potability of water.[63] It is estimated that about half of the waters in the United States are

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ST. UNIV., https://nrstracking.cals.iastate.edu/tracking-iowa-nutrient-reduction-strategy [https://perma.cc/N996-KRR9] (describing a science-and technology-based approach to assessing and reducing nutrients delivered to Iowa waterways and the Gulf of Mexico).

62. *The Quality of Our Nation's Waters: Nutrients*, U.S. GEOLOGICAL SURV. 51 (1999), https://pubs.usgs.gov/circ/circ1225/pdf/nutrients.pdf [https://perma.cc/34LL-CCS2].

63. *See* Emma Cotton, *Farm Management or Climate Change? Vorsteveld Trial Wraps Up in Addison County*, VTDIGGER (Jan. 11, 2022), https://vtdigger.org/2022/01/11/farm-management-or-climate-change-vorsteveld-trial-wraps-up-in-addison-county [https://perma.cc/B4L2-VQAQ] (reporting on a trial resulting from an allegation that a dairy farmer's tile drainage system dumped pollutants into Lake Champlain).

too contaminated for basic uses such as fishing and swimming.[64] Further, the cumulative impact of agricultural activities in the Mississippi River watershed has created a vast 3,058 square mile "dead zone" in the Gulf of Mexico.[65] This form of pollution is caused chiefly by the widespread use of nitrogen and phosphorus-rich fertilizers, which run off agricultural properties during certain rain events.[66] The overuse of industrial fertilizers has led to well-documented cases of oceanic "dead zones"—areas of water deprived of oxygen, causing extensive harm to environmental, socio-ecological, and economic systems.[67] The highest

64. *See* Shirin Ali, *About Half of US Water 'Too Polluted' for Swimming, Fishing or Drinking, Report Finds*, HILL (Mar. 28, 2022), https://thehill.com/changing-america/sustainability/environment/600070-about-half-of-us-water-too-polluted-for-swimming [https://perma.cc/H4L3-4DWB] ("Agriculture runoff is another area that needs to be addressed, as [the Environmental Integrity Project] believes that is by far one of the largest sources of impairments in waterways across the U.S.").

65. *NOAA and Partners Announce Below-Average 'Dead Zone' Measured in Gulf of Mexico*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Aug. 2, 2023), https://www.noaa.gov/news-release/noaa-and-partners-announce-below-average-dead-zone-measured-in-gulf-of-mexico [https://perma.cc/5H5R-PBUH]. The National Oceanic and Atmospheric Organization reported that the dead zone that occurred in the northern Gulf of Mexico in 2021 was the equivalent of more than four million acres of potentially unavailable habitat. *Happening Now: Dead Zone in the Gulf 2021*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://oceantoday.noaa.gov/deadzonegulf-2021 [https://perma.cc/U3CS-9VZM]; *see also* J.B. Ruhl & James Salzman, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: A Guide for Whittling Away*, 98 CALIF. L. REV. 59, 87 (2010) (describing the sources and causes of Gulf hypoxia).

66. *See* Robert M. Hughes & Robert L. Vadas, Jr., *Agricultural Effects on Streams and Rivers: A Western USA Focus*, WATER, July 2, 2021, at 1, 2 (noting that agriculture was deemed the cause of forty-eight percent of water-quality impairment in U.S. surface waters); U.S. GOV'T ACCOUNTABILITY OFF., GAO-08-944, CONCENTRATED ANIMAL FEEDING OPERATIONS: EPA NEEDS MORE INFORMATION AND A CLEARLY DEFINED STRATEGY TO PROTECT AIR AND WATER QUALITY FROM POLLUTANTS OF CONCERN 6 (2008) ("Most of the water studies found that nutrients or hormones released from animal feeding operations were causing environmental harm, such as reproductive disorders in fish and degraded water quality.").

67. *See What is a Dead Zone?*, NAT'L OCEANIC & ATMOSPHERIC ADMIN., https://oceanservice.noaa.gov/facts/deadzone.html [https://perma.cc/KE4N-MBEQ] ("Excess nutrients that run off land or are piped as wastewater into rivers and coasts can stimulate an overgrowth of algae, which then sinks and decomposes in the water. The decomposition process consumes oxygen and depletes the supply available to healthy marine life."); Hannah Seo, *What Is the 'Dead Zone' in the Gulf of Mexico, and Why Is It Super-Sized This Year?*, POPULAR SCI. (Aug. 4, 2021), https://www.popsci.com/science/gulf-of-mexico-dead

percentages of nitrates and phosphates working their way to the Gulf originate from Arkansas, Illinois, Indiana, Iowa, Kentucky, Mississippi, Missouri, Ohio, and Tennessee.[68] Recent studies reveal substantial negative effects, amounting to billions of dollars, on fisheries and ecosystems.[69] Similar dead zones and associated issues are observed across the United States, affecting regions like the Great Lakes, the Chesapeake Bay, and the Pacific Northwest.[70]

-zone [https://perma.cc/Z3QS-FHFB] ("The Gulf of Mexico's dead zone is a product of . . . the Mississippi River watershed . . . . As freshwater moves southward, it accumulates nitrogen and phosphorous from Midwest agriculture . . . . [F]uel[ing] algal blooms . . . their decomposition . . . deplete [sic] the oxygen there, creating the dead zone.").

68. *See* Richard B. Alexander et al., *Differences in Phosphorous and Nitrogen Delivery to the Gulf*, 42 ENV'T SCI. & TECH. 822, 828–29 (2008) (showing that these nine states collectively account for seventy-five percent of the nitrogen and phosphorous delivery to the Gulf).

69. *See* J.B. Ruhl, *Farms, Their Environmental Harms, and Environmental Law*, 27 ECOLOGY L.Q. 263, 288 n.143 (2000). ("Federal government efforts to control agricultural nonpoint source runoff have proven costly. For example, since fiscal year 1994, the federal government has spent $3 billion annually to address nonpoint source runoff. USDA spent a total of $11 billion in that period . . . .").

70. Tyler Marshall, *Ever Increasing Algae Blooms & Dead Zones Threaten U.S. Waters & Aquatic Life*, WASTEWATER DIGEST (Dec. 7, 2020), https://www.wwdmag.com/wastewater-treatment/article/10938430/ever-increasing-algae-blooms-dead-zones-threaten-us-waters-aquatic-life [https://perma.cc/AD6X-Y6MV] (containing a map of recent harmful algae blooms throughout the United States). The origins of the current agricultural pollution crisis in the watershed can in part be traced back to the response to impending global famines in the 1950s and 60s. IFPRI, *supra* note 57, at 2–3. The term "carrying capacity" was developed by Thomas Malthus, an eighteenth century social scientist who posited that population growth rapidly outpaces food production in each area, leading to catastrophe unless population growth is slowed. Jorg Friedrichs, *Who's Afraid of Thomas Malthus?*, *in* UNDERSTANDING SOCIETY & NATURAL RESOURCES 68–69 (Michael J. Manfredo et al. eds., 2014). In the 1950s and 1950s, industrialized nations, spurred by technological advancements from World War II, implemented the "green revolution" to increase food production without significantly expanding arable land. William S. Eubanks II, *A Rotten System: Subsidizing Environmental Degradation and Poor Public Health with Our Nation's Tax Dollars*, 28 STAN. ENV'T L.J., 213, 222 (2009). This revolution relied on intensive agricultural practices, chemical inputs, monoculture cropping, and mechanization, particularly for low-nutrition commodity crops such as wheat, rice, and corn. *Id.*; *see also* Richard Manning, *The Oil We Eat*, RESILIENCE (May 23, 2004), https://www.resilience.org/stories/2004-05-23/oil-we-eat-following-food-chain-back-iraq [https://perma.cc/B7XV-8RXS] ("The accepted term for this strange turn of events is the green revolution, though it would be

It is also important to note that fertilizer use in agriculture contributes to greenhouse gas emissions.[71] The globalization of agricultural systems has led to significant increases in greenhouse gas emissions, with industrial agriculture accounting for over ten percent of total emissions in the United States, releasing approximately six hundred million tons of CO_2 equivalent annually.[72]

Synthetic pesticides, while potentially beneficial for protecting crops from pests,[73] also runoff from agricultural lands as well as suburban and urbans properties, such as lawns, contributing to the deterioration of the watershed. Pesticides and their breakdown products can drift through the air, runoff into water bodies, and leach into groundwater, affecting aquatic life and water quality.[74] In one study, pesticides were detected in 97 percent of sampled streams and 61 percent of shallow groundwater areas in U.S. agricultural regions.[75] Furthermore, 92 percent of fish tissue samples reveal the persistence of organochlorine, a pesticide compound that has largely been discontinued.[76]

Pesticides applied to crops may have a significant adverse impact on pollinating insects, which are critical for agriculture.[77]

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more properly labeled the amber revolution, because it applied exclusively to grain–wheat, rice, and corn. Plant breeders tinkered with the architecture of these three grains so that they could be hypercharged with irrigation water and chemical fertilizers, especially nitrogen.").

71. *See* Karthish Manthiram & Elizabeth Gribkoff, *Fertilizer & Climate Change*, MIT CLIMATE PORTAL (July 15, 2021), https://climate.mit.edu/explainers/fertilizer-and-climate-change [https://perma.cc/QHD6-8B2E] ("Fertilizers also produce greenhouse gases after farmers apply them to their fields. Crops only take up, on average, about half of the nitrogen they get from fertilizers.").

72. *Sources of Greenhouse Gas Emissions*, U.S. ENV'T PROT. AGENCY (last updated Jan. 16, 2025), https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions [perma.cc/M9MT-2DBS].

73. INST. OF MED. & NAT'L RSCH. COUNCIL, A FRAMEWORK FOR ASSESSING EFFECTS OF THE FOOD SYSTEM 249 (Malden C. Nesheim et al. eds., 2015) (ebook) ("Just as farmers react to market price incentives by changing what or when or how they produce food, insect pests respond to repeated use of the same pest control method by evolving modes of resistance.").

74. *Id*. at 4.

75. *Id*. at 134.

76. *Id*.

77. *Pollinator Health Concerns*, U.S. ENV'T PROT. AGENCY (last updated Nov. 4, 2024), https://www.epa.gov/pollinator-protection/pollinator-health-concerns [https://perma.cc/YCF4-DD8G] (listing multiple factors putting pollinator health at risk including, *inter alia*, pesticide exposure).

The loss of pollinators affects wild plant populations as well as yields of crops such as fruits and nuts.[78] There has been a seventy-five percent decline over thirty years in flying insect biomass.[79] Insect pollinators such as bees contributed twenty-nine billion dollars to U.S. farm income in 2010.[80] The loss of pollinating insects could be devastating for agriculture. Additionally, at least sixty percent of global terrestrial biodiversity loss is related to food production.[81]

In addition to nutrient and pesticide runoff from agricultural and suburban lands, soil and silt also flow from many agricultural lands into the watershed. The cost of erosion resulting from agriculture in the United States is estimated at forty-four billion dollars annually.[82] This erosion has caused crop yields in the Midwest to decline by 20–40% for row crops (traditional annual commodities like corn, soybeans, rice, and cotton, are considered row crops).[83]

As discussed in this Part, local governments play a significant role in impacting watersheds through various direct interventions. Firstly, they influence the watershed by extracting a considerable volume from it. Secondly, local governments contribute to the watershed by adding water through diverse land use practices, such as stormwater runoff, tiling, and direct discharges. Thirdly, local governments introduce and allow the introduction of pollutants into the watershed, affecting water quality and ecosystems. These multifaceted impacts collectively

78. *Id.* ("Many types of plants, including fruit and vegetable crops, depend on animals for pollination.").

79. Caspar A. Hallmann et al., *More than 75 Percent Decline over 27 Years in Total Flying Insect Biomass in Protected Areas*, PLOS ONE, Oct. 18, 2017, at 1, 2–4.

80. Krishna Ramanujan, *Insect Pollinators Contribute $29 Billion to U.S. Farm Income*, CORNELL CHRON. (May 22, 2012), https://news.cornell.edu/stories/2012/05/insect-pollinators-contribute-29b-us-farm-income [https://perma.cc/BJ2E-LJGW].

81. Marcel Kok et al., *How Sectors Can Contribute to Sustainable Use & Conservation of Biodiversity*, PBL NETH. ENV'T ASSESSMENT AGENCY 11 (2014), https://sustainabledevelopment.un.org/content/documents/1981cbd-ts-79-en.pdf [https://perma.cc/GD4K-B8JU] ("Food production is the economic sector with the largest negative impact on biodiversity, contributing 60-70% to date of total biodiversity loss . . . .").

82. H. Eswaran et al., *Land Degradation: An Overview*, *in* RESPONSE TO LAND DEGRADATION 20, 20 (E. Michael Bridges et al. eds., 2001).

83. *Id.* at 21.

underscore the crucial role local governments have in shaping the health and sustainability of watersheds.

II. LOCAL GOVERNMENTS AND TRAGEDY IN THE MISSISSIPPI RIVER WATERSHED

Collective action hurdles and the tragedy of the commons have been exhaustively documented.[84] In this Part, I aim only to highlight some of the scholarship and traditional understanding of local governments' place in the tragedy of the commons narrative.

The exploration in this Part reveals the dual roles local governments can assume: one as regulators overseeing the use of resources to prevent potential problems caused by private entities that are using the resource, and the other as direct or indirect users of those resources. This Part emphasizes the occasional overlap where local governments perform both roles simultaneously. In such instances, a local government not only sets regulations to govern resource utilization but also aims to utilize the resource itself, either directly or indirectly, before other local governments can lay claim to it. This dual engagement highlights the critical role local authorities play in resource utilization.

The tragedy of the commons, as conceptualized by Garrett Hardin, examines how laws and behaviors can impact some resource consumption.[85] Hardin's premise, illustrated with herdsmen and a pasture, highlights resources that are depletable and non-excludable.[86] When such a resource falls under Hardin's

84. A Google search, or a simple search on Westlaw for "Tragedy of the Commons," reveals thousands of law review articles.

85. Hardin, *supra* note 19, at 1244 (The "tragedy" Hardin refers to "resides in the solemnity of the remorseless working of things" (quoting A.N. WHITEHEAD, SCIENCE AND THE MODERN WORLD 15 (15th prtg. 1960)).

86. From the *Tragedy of the Commons*:

> [T]he rational herdsman concludes that the only sensible course . . . is to add another animal to his herd. And another; and another. . . . But this is the conclusion reached by each and every rational herdsman sharing the commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit — in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons.

analysis as a common pool resource, individual users (appropriators) acting as "independent, rational, free-enterprisers" are predicted to prioritize short-term gains over long-term consequences.[87] The assumption is that each user benefits from resource consumption while sharing the cost of overuse among all users.[88] This individualistic competition for the resource, in the absence of internal coordination or external regulation,

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Hardin, *supra* note 19, at 1244. *But see* ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 6 (reprt. 1993) (arguing that people often figured out ways to manage depletable and non-excludable resources at the community level); *see also* Carol M. Rose, *The Tragedy of the Commons at 50: Context, Precedents, and Afterlife: Commons and Cognition*, 19 THEORETICAL INQ. L. 587, 589–90 (2018) (arguing that the scale of the commons can affect the interests and information that the 'herders' in the commons will have, leading to more collaboration at a smaller scale). For a similar perspective to Hardin that is particularly relevant to cities in 1965, see generally MANCUR OLSON, THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS (1965). Olson differs in one significant aspect from Hardin. Olson noted that the costs of collaborating, monitoring, and enforcing agreements among the participants may be reduced enough in small groups to make collaboration more efficient. *Id.* at 2, 43–45. *But see* Edella Schlager, *Common-Pool Resource Theory* (stating that research on common pool resources has not found a significant relationship between the likelihood of collaborative action and group numbers or area size), *in* ENVIRONMENTAL GOVERNANCE RECONSIDERED: CHALLENGES, CHOICES, AND OPPORTUNITIES 145, 162–63 (Robert F. Durant et al. eds., 2004). For discussion on how the tragedy of the commons is generally viewed by scholars today, see generally Carol M. Rose, *Thinking About the Commons*, 14 INT'L J. COMMONS 557 (2018) [hereinafter *Thinking About the Commons*].

87. Hardin *supra* note 19, at 1244–45; *see also Thinking About the Commons*, *supra* note 86, at 558 ("[T]he tendency of each individual is to use the resource to maximize his own immediate interest . . . ."); Christian Iaione & Elena De Nictolis, *Urban Pooling*, 44 FORDHAM URB. L.J. 665, 691–92 (2017) ("The idea behind [Hardin's] theory is that when there is a commons with open access, a tragedy will occur and the resource will be over-exploited.").

88. Hardin, *supra* note 19, at 1244. Hardin questioned "What is the utility to me of adding one more animal to my herd?" He, then, stated:

> This utility has one negative and one positive component. 1) The positive component is a function of the increment of one animal . . . the positive utility is nearly +1. 2) The negative component is a function of the additional overgrazing created by one more animal. Since . . . the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of -1.

Id.

ultimately leads to its depletion, as per Hardin's perspective.[89] Hardin emphasizes that unless there is a departure from this independent, rational behavior—brought about by internal or external forces—the degradation of the resource remains an inevitable outcome.[90]

When local governments are viewed as appropriators, the challenges of collective action associated with these resources might unfold as follows: An independent and reasoned local government, when confronted with a finite and accessible shared resource—a common pool resource—sees itself engaged in perpetual competition with other local entities for use of that resource.[91] In this scenario, the local government may logically opt to maximize its consumption of the resource swiftly and extensively, ultimately leading to the resource's depletion and demise.

In the context of the Mississippi River watershed, the idea that thousands of local governments are making decisions that led to direct and indirect extraction, addition, or pollution to the watershed could be characterized as a classic tragedy of the commons problem. In this tragedy, local governments act "rationally" by regulating in a way that reduces landowners' and others' costs or avoiding the costs associated with treating or reducing the level of contaminants in the water before ushering them downstream. Local governments may implement politically uncontroversial measures, often sacrificing not only the resource but also fundamental principles and integrity. Alternatively, they may adopt measures designed to raise local revenue, such as increasing property tax revenues, even when these actions come at the expense of water quality. These measures might involve increasing development, permeable surfaces, and/or agriculture activities close to tributaries. The support of policies that

89. *Id.*; *see also Thinking About the Commons*, *supra* note 86, at 558 (supporting this takeaway from Hardin); Iaione & De Nictolis, *supra* note 87, at 692 (2017) (supporting this takeaway from Hardin).

90. *See* Rosenbloom, *supra* note 23, at 457 ("The result, Hardin concluded, is '[r]uin' of the [resource], as all actors will seek to optimize their position and will over consume the [resource]." (quoting *Hardin*, *supra* note 19, at 1244)).

91. *See* Rosenbloom, *supra* note 23, at 458 (describing how the tragedy of the commons explains why local governments take unsustainable actions); Rosenbloom, *supra* note 16, at 1493 ("Because thousands of local governments consume numerous global commons resources, classic tragedy problems arise in which motivations are in place for cities to act 'rationally' as wealth maximizers.").

result in increased runoff could potentially facilitate the flow of pollutants into the watershed, while simultaneously allowing landowners to capitalize on the land's advantages, shifting the pollution costs downstream.[92]

I noted elsewhere that:

> [A] local government's decision may be rational if it lures agricultural farming and investment by permitting farming up to a river's edge. While the local government's decision may enhance local development, it also may result in nutrient and pesticide run-off, damaging water resources downstream. An irrational decision may include a local policy to institute buffer zones between agricultural areas and streams. This would be irrational because it may lead to lower development—an internal cost to the city—while the benefit of the city's actions [is] externalized or shared with cities downstream.[93]

Scholarly examinations applying the tragedy of the commons to local governments can be divided into two primary camps: local governments as appropriators and local governments as regulators.[94] Professors Sheila R. Foster and Christian Iaione, for example, typify the scholarship exploring the critical role local governments play as regulators.[95] The authors have collectively and individually written several articles observing the interplay between local governments (specifically cities) and their regulation of common pool resources.[96]

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92. In *Foundations of Insider Environmental Law,* Keith Hirokawa and I countered the generalization that local governments are prone to protectionism. *See generally* Jonathan Rosenbloom & Keith H. Hirokawa, *Foundations of Insider Environmental Law*, 49 LEWIS & CLARK ENV'T L. REV. 631 (2019). In many ways, local governments are far more aggressive than national and international bodies when it comes to protecting the environment. *See, e.g.*, *infra* Part III.

93. Rosenbloom, *supra* note 16, at 1493.

94. *Compare, e.g.*, Blake Hudson, *The Natural Capital Crisis in Southern U.S. Cities*, 92 CHI.-KENT L. REV. 529, 539–40 (2017) (discussing examples of governments as appropriators), *with* Sheila R. Foster, *Collective Action and the Urban Commons*, 87 NOTRE DAME L. REV. 57, 109–13 (2011) (discussing governments as regulatory bodies).

95. *See, e.g.*, Sheila R. Foster & Christian Iaione, *The City as a Commons*, 34 YALE L. & POL'Y REV. 281, 311–23 (2016) (discussing the relationship between law and urban commons).

96. *See, e.g.*, Sheila R. Foster, *Urban Informality as a Commons Dilemma*, 40 U. MIA. INTER-AM. L. REV. 261, 267–69 (2009) (discussing regulatory slippage); Christian Iaione, *The CO-City: Sharing, Collaborating, Cooperating, and Commoning in the City*, 75 AM. J. ECON. & SOCIO. 415, 423–37 (2016) (discussing regulation and collaboration between cities); Foster & Iaione, *supra* note 95, at 311–23 (discussing the relationship between law and urban commons); *see*

Their article *The City as a Commons* exemplifies their exploration of local governments and common pool resources.[97] In this piece, the authors suggest viewing the city itself as a commons, advocating for collaborative and polycentric governance tools instead of relying solely on prevailing public regulatory regimes.[98] They express skepticism about the effectiveness of current regulatory frameworks in navigating urban politics, especially regarding economic influences on urban development.[99]

The authors analyze various examples to derive democratic design principles applicable to managing shared urban goods and resources.[100] They introduce the principles of horizontal subsidiarity and others to propose a shift from a centralized, monopolistic state control over common assets to a collaborative governance approach.[101] This approach involves the state evolving into a facilitating entity rather than a dominant center, as it is today and as discussed in Part III.

Important for these purposes, Foster's and Iaione's article does not view local governments as appropriators but recognizes that local governments' limited authority may impact their ability to regulate the commons and avoid a tragedy.[102] In Foster and Iaione's model, local governments work with the

also Iaione & De Nictolis, *supra* note 87, at 680–98 (exploring the dynamics surrounding collective action challenges, common pool resources, and the involvement of local governments). Foster's individual work, like that in her collaboration with Professor Iaione, examines the complexities of managing commons resources sustainably. She highlights the role of local governments as overseer, regulating common pool resources within their jurisdictions. *E.g.*, Foster, *supra* note 94, at 109–13.

97. Foster & Iaione, *supra* note 95, at 285–334.

98. *Id.* at 285 ("What we are interested in is the potential for the commons to provide a framework and set of tools to open up the possibility of more inclusive and equitable forms of 'city-making.'").

99. *Id.* at 290 ("There is healthy skepticism, however, about the effectiveness of the current regulatory regime to navigate the very urban politics of which progressive reformers complain . . . .").

100. *Id.* at 324–25 ("The city may also use zoning and land use tools such as performance zoning and inclusive zoning to structure incentives for sharing the city and for ensuring that a broader group of inhabitants can access and use the city commons.").

101. *Id.* at 326–34 (discussing the application of "horizontal subsidiarity" to commons problems and collaborative governance).

102. *See id.* at 290 (expressing skepticism about the current ability for local governments to effectively avoid "tragic outcomes").

appropriating actors, who are private parties.[103] The local governments themselves are viewed as dispassionate observers of the commons that could, in theory, serve as a regulatory body to help avoid a tragedy but do not have the ability to do so.[104]

Professor Kirsten H. Engel has also written extensively about common pool resources and governance challenges.[105] In *Arizona's Groundwater Management Act at Forty: Tackling Unfinished Business*, Engel, Esther Loiseleur, and Elise Drilhon examine the Arizona Groundwater Management Act of 1980, highlighting its shortcomings in effectively addressing the state's groundwater depletion concerns.[106] The Act, the authors note, left rural regions subjected to unregulated groundwater usage and likened the scenario to a tragedy of the commons.[107]

In *Arizona's Groundwater Management Act at Forty*, the authors contend that revising the legislative Act is imperative to ensure sustainable and equitable groundwater use statewide.[108] The authors propose two potential approaches for future legislation: a property-rights-based approach and a government-regulation-based approach.[109] The former suggests establishing a

103. See *id.* at 329–34 (discussing the collaborative governance model).

104. *Id.*

105. *See, e.g.*, Kirsten H. Engel, *Whither Subnational Climate Change Initiatives in the Wake of Federal Climate Legislation?*, 39 PUBLIUS 432, 433–50 (2009) (exploring the role of state and local governments as policy innovators); Kirsten H. Engel, *EPA's Clean Power Plan: An Emerging New Cooperative Federalism?*, 45 PUBLIUS 452, 455–71 (2015) (examining the bases for federal allocation among several states to comply with the EPA's Clean Power Plan); Kirsten Engel et al., *Arizona's Groundwater Management Act at Forty: Tackling Unfinished Business*, 10 ARIZ. J. ENV'T. L. & POL'Y 187, 189–214 (2020) [hereinafter Engel et al., *Arizona's Groundwater Management*] (arguing that Arizona's 1980 Groundwater Management Act is insufficient to protect against a tragedy of the commons loss).

106. Engel et al., *Arizona's Groundwater Management*, *supra* note 105, at 191–208.

107. *Id.* at 202–03 ("Current levels of excessive groundwater withdrawals might reflect a community of users that now lack the shared social norms and interdependent future that Elinor Ostrom identified as key to preventing the tragedy of the commons with respect to a common pool resource.").

108. *Id.* at 191 ("Arizona lawmakers should return to the drafting table to complete the work they started in 1980—the creation of a groundwater management code, based in science, that will ensure the equitable and sustainable use of groundwater across the entire State for current and future generations.").

109. *Id.* at 205–06 ("Arizona's rejection of a property right in uncaptured groundwater does not preclude the legislature's creation and allocation of

framework for a groundwater market, enabling users to buy and trade pumping rights.[110] The latter advocates for a cooperative localism model, wherein state-imposed groundwater protection requirements are implemented through local planning.[111] Similar to Foster and Iaione, Engel et al. view local governments acting on the commons as regulators, without an appropriator's stake in the commons and without sufficient ability to sustainably manage the commons.[112]

Like Engel et al., Professor Jennifer Harder has explored the role of local governments in regulating water as a common pool resource.[113] In the context of groundwater management in California and Texas, Harder notes that the tragedy of the commons persists.[114] Shared ownership of groundwater, tied to property rights, Harder argues, leads to claims that resist quantification, risking over-extraction and depletion.[115] Harder notes that despite its necessity for sustaining groundwater basins,

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transferable rights to capture extracted groundwater."); *id.* at 207–09 ("Alternatively, Arizona could enact a regulatory scheme that expands the coverage of the Groundwater Management Act to include the rural areas of the State.").

110. *Id.* at 206 ("The cap and trade regime . . . could serve as a model for regulation of groundwater in the areas currently left unregulated in Arizona.").

111. *Id.* at 209 ("According to this framework, the State would be charged with information-gathering and scientific research as well as the development of uniform state standards. In turn, county, or even existing local groundwater management units, would be charged with developing plans to implement the state standards . . . .").

112. *See id.* at 207 (suggesting a regulatory scheme that expands coverage of the Groundwater Management Act).

113. *See, e.g.*, Brian Gray et al., *Implementing Ecosystem-Based Management*, 31 DUKE ENV'T L. & POL'Y F. 215, 221–81 (2021) (arguing that the implementation of cooperative ecosystem-based management into the regulation of California's waterways could be accomplished through existing laws); Jennifer Harder, *Demand Offsets: Water Neutral Development in California*, 46 MCGEORGE L. REV. 103, 111–63 (2014) (discussing the benefits and considerations of water neutral programs); Jennifer L. Harder, *Unlimited Rights in a Water-Scarce World? Quantification of Dormant Rights to Common Pool Groundwater*, 48 TEX. TECH L. REV. 719, 733–54 (2016) [hereinafter Harder, *Water-Scarce World*] (arguing that unlimited rights to shard water is undesirable, and practically impossible).

114. *See* Harder, *Water-Scarce World*, *supra* note 113, at 725 (characterizing groundwater as a depletable resource).

115. *Id.* at 722 ("[W]aste and destruction of a common pool resource are not part of the land-based right, and . . . the exercise of that right may be regulated and quantified to avoid these outcomes.").

quantification faces opposition, reflecting the tragedy of individual interests overshadowing collective resource preservation.[116]

Harder's article challenges the belief that land-based rights cannot be quantified. She argues for regulated quantification as a solution to prevent the tragedy.[117] Emphasizing the role of local governments in quantifying efforts aligns with local governments as regulators.[118]

Professor Christopher Brown provides a critical perspective on local governments and common pool resources, particularly through the role of special districts, such as housing authorities, water districts, and sewer districts, in managing vital resources like groundwater.[119] Focusing on Texas, Brown emphasizes the importance of these special districts in regulating common pool resources, noting that groundwater, as a classic example, is susceptible to individual self-interest in the absence of regulations that ensure long-term preservation, which can lead to negative

116. *Id.* at 721.

117. *Id.* at 751–53.

118. *Id.* at 752 ("To ensure appropriately flexible management and responsiveness to place-based concerns, [regulation] should happen at the local level."). Professor Kenneth A. Stahl also views local governments as regulatory bodies. *See, e.g.*, Kenneth A. Stahl, *The Challenge of Inclusion*, 89 TEMP. L. REV. 487, 495 (2017) (discussing local zoning regulation as a "solution" to development externalities). In his work, Stahl focuses particularly on local policies that exacerbate local tragedies. *Id.* Stahl delves into the challenge of creating inclusive housing policies while navigating the hurdle of property rights, particularly the right of exclusion. *Id.* at 493–533. He starts by examining concentrated poverty and the desire to create diverse communities. *Id.* at 489–90. The discussion transitions into exploring the tragedy of the commons, using examples like a crowded public park or a collectively owned orchard to illustrate how shared resources, when managed individually without oversight, often lead to overuse and depletion. *Id.* at 493–94 ("A public park is a wonderful place to spend a Sunday afternoon, but if everyone else has the same idea, the park becomes crowded and unpleasant."). With these examples, the piece highlights the inherent problem: without a central authority to regulate usage, individuals prioritize their own benefit, leading to resource depletion. *Id.* at 494–97 (touching on government intervention in managing common resources, particularly through zoning laws, to address these challenges). For another interesting tragedy of the commons discussion from Professor Samantha Hepburn, see generally Samantha Hepburn, *Public Resource Ownership and Community Engagement in a Modern Energy Landscape*, 34 PACE ENV'T L. REV. 379 (2017).

119. *See generally* Christopher Brown, *Special Purpose District Reconsidered: The Fifth Circuit's Recent Declaration that the Edwards Aquifer Authority Is a Special Purpose District Under the Voting Rights Act, and the Tortured History that Led to That Decision*, 27 HASTINGS ENV'T L.J. 3 (2021) (discussing the 2019 decision that the Edwards Aquifer Authority is a special purpose district).

collective outcomes.[120] Brown further examines the Edwards Aquifer Authority, a major resource serving nearly two million people, illustrating how local governments can regulate individual or private actions in relation to common pool resources.[121] While the article highlights local governments' regulatory roles, it does not analyze them as actors on the commons, whether directly or indirectly utilizing the resource.

Finally, Dean Blake Hudson has examined a variety of ways in which local governments interact with commons resources.[122] Specifically, in *The Natural Capital Crisis in Southern U.S. Cities*, Hudson highlights how private landowners and the governing bodies overseeing them often act as self-interested appropriators, akin to the rational herders proposed by Hardin.[123] This behavior results in the depletion of natural resources that are held in common, causing environmental harm that affects the wider society.[124] According to Hudson, the absence of effective federal, state, or local regulations exacerbates this issue, allowing private landowners to exploit natural resources for their individual benefit while passing on the negative consequences to society at large.[125]

Hudson notes that the focus on short-term economic gains leads to a disregard for long-term environmental consequences, neglecting concepts like urban infill and redevelopment

120. *See id.* at 5 ("Among the special districts that exercise 'primary public oversight of land use,' none plays a more critical role than those charged with regulating common pool resources like groundwater.").

121. *Id.* at 10–14 (discussing the local regulatory authority history regarding the Edwards Aquifer Authority).

122. *See, e.g.*, Blake Hudson, *The Natural Capital Crisis in Southern U.S. Cities*, 92 CHI.-KENT L. REV. 529, 532–47 (2017) (discussing the concept of sprawl and detailing the crisis of land use in the southern United States).

123. *Id.* at 539–47.

124. *Id.* at 530 ("While all three components overlap to a degree, the first relates to characteristics of human behavior, namely, the tendency to fixate on short term gains while ignoring long term harms—effectively a tragedy of the commons in the land development context.").

125. *Id.* at 539 ("[Hardin's] work has been expanded to demonstrate that in the absence of federal, state, or local regulation in the United States, private landowners can 'appropriate' resource units of natural capital from their property to the detriment of the commonly shared environment that stretches across the nation.").

policies.[126] This shortsighted approach poses risks not only to the geographical landscape but also to future generations that will inherit the ramifications of today's unsustainable land use decisions.[127] To illustrate the point, Hudson notes a Southern culture that is resistant to government intervention in land use regulation.[128] Unlike states such as Oregon and Washington, where some state-level oversight guides local land use, most Southern states leave land use regulation entirely to local governments.[129] Only Tennessee, Hudson notes, mandates growth boundaries for municipalities, but even this seems geared more toward economic efficiency than environmental conservation.[130] Many Southern cities prioritize economic growth through the conversion of greenfields into new developments rather than embracing policies that promote redevelopment of existing urban areas.[131] Unlike some of the other articles, Hudson squarely places local governments as actors appropriating from a commons resource.

Hudson's article provides a good prompt to ask why local governments have chosen to act unsustainably in land use management—an assumption Hudson does not address—and whether local governments have the authority to act sustainably. Such questions as they arise in the Mississippi River watershed are addressed in Part III.

126. *Id.* at 540 ("The implication, of course is that . . . environmental degradation facilitates economically desirable outcomes, over the short term at least, even if at odds with the preservation of crucial global natural capital.").

127. *Id.*

128. *Id.* at 539 ("Most local governments in the region maintain extremely lax land use controls, primarily out of a cultural predilection to resist government regulation at every turn.").

129. *Id.* (describing Oregon and Washington's state and local regulatory structure).

130. *Id.* at 539–40 (describing Tennessee's state and local regulatory structure).

131. *Id.* at 540 (describing how Miami and other southern metro areas convert greenfields to new developments as a means of growing their citizenry, tax base, and economic productivity).

III. LOCAL GOVERNMENTS AND THE TRAGEDY WITH A TWIST

Implicit in many of the articles cited and discussed in Part II is that local governments have regulatory control over numerous commons resources; further, that local governments have the authority to regulate those resources. Missing from this avenue of investigation is an analysis of the diverse legal and institutional frameworks that shape actors' conduct within the commons. This oversight fails to explain why a local government may act irrationally in governing commons resources.

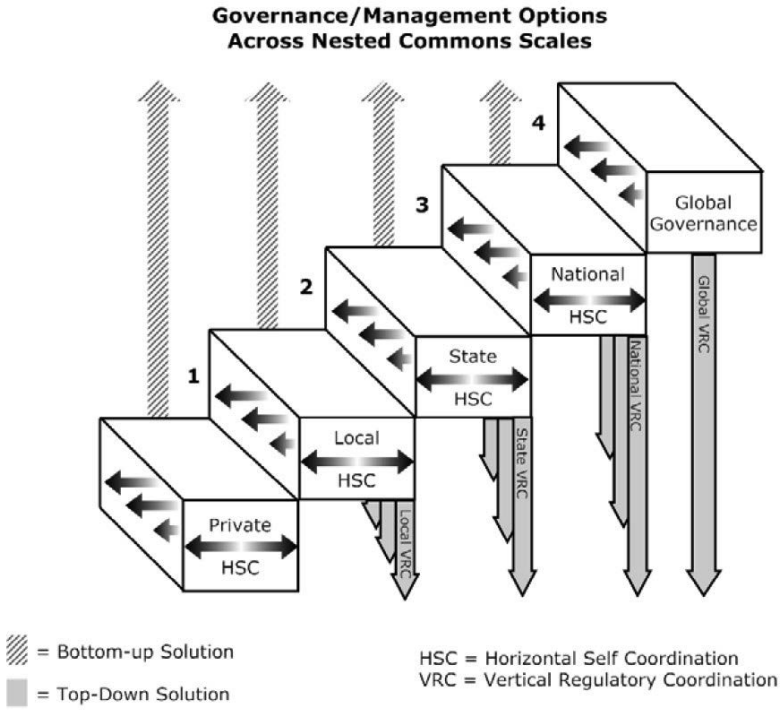
Dean Blake Hudson and I delved into the intricate dynamics of governance allocation within the federal system and its implications for commons resource management.[132] Our aim was to construct a theoretical framework unraveling the interplay between government levels and commons resource oversight. In dissecting this multi-layered governance, we uncovered two pivotal observations: one, that a single resource implicates multiple collective action challenges (both private and public), and two, those collective action challenges are influenced by multiple layers of government.[133] Through our exploration, we devised a three-dimensional model depicting this multi-layer institutional structure.[134]

132. *See generally* Hudson & Rosenbloom, *supra* note 22.

133. *Id.*

134. *Id.* at 1338.

Figure 4: Nested Commons[135]



At the local level, Dean Hudson and I observed the impact of multiple regulatory actions that supersede or influence local behaviors particularly when the commons is global.[136] For instance, different cities, such as Rome and Seattle, face distinct regulatory environments shaped by national, regional, and international policies. Moreover, subnational entities may engage in horizontal coordination, exemplified by initiatives like the Western Climate Initiative, adding yet another layer to the governance landscape.[137]

Building off this research, this Part applies the theory laid out in our prior article to the Mississippi River watershed. Local governments in the Mississippi River watershed are subject to

135. *Id.*

136. *See id.* at 1337 (noting that nesting government scales create a complex regulatory structure).

137. *Id.* at 1332 ("[T]he Western Climate Initiative has had a variety of climate change related successes through state . . . collaboration.").

both federal and state vertical regulatory power. To understand what power local governments have to "act rationally," we need to first look at federal and state law.

A. FEDERAL AND STATE NUTRIENT REGULATION IN THE WATERSHED

On the federal side, neither the Clean Water Act (CWA) nor other federal statutes regulate nutrient runoff from agricultural lands.[138] Agricultural activities resulting in nutrient runoff remain outside the purview of the CWA, thus allowing such activities to evade regulation for runoff purposes.[139]

Even though agriculture runoff is a large source of pollution in rivers, streams, and wetlands, the exemptions from the CWA mean that water pollution regulations generally do not cover

138. *See* Jan G. Laitos & Heidi Ruckriegle, *The Clean Water Act and the Challenge of Agricultural Pollution*, 37 VT. L. REV. 1033, 1033 (2013) ("Although the Clean Water Act was intended to 'restore and maintain the chemical, physical, and biological integrity of the Nation's waters[,]' this goal can never be achieved if agricultural pollution continues to contaminate America's 'waters.' Perversely, the Clean Water Act itself is in part responsible for agricultural sources remaining outside the scope of the Act's reach."); *see also* Am. Wildlands v. Browner, 260 F.3d 1192, 1197 (10th Cir. 2001) ("In the [CWA], Congress has chosen not to give the EPA authority to regulate nonpoint sources of pollution."); Laitos & Ruckriegle, *supra*, at 1035 (explaining that the CWA "provides no direct mechanism to control the agricultural-based nonpoint source pollution"). The Occupational Safety and Health Administration (OSHA), the EPA, the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), and the Department of Homeland Security have some regulations addressing fertilizer and pesticides, but those regulations are directed at manufacturing, distribution, and labeling—not use and management, which are most relevant for controlling runoff. *See* Watershed Academy Web, *Introduction to the Clean Water Act*, U.S. ENV'T PROT. AGENCY, https://cfpub.epa.gov/watertrain/moduleFrame.cfm?parent_object_id=2788 [https://perma.cc/EC2G-6M8Q] ("There is no CWA federal regulatory authority over nonpoint sources of pollution and the act does not require states to develop their own regulatory programs . . . .").

139. Emily Broad Leib et al., *Blueprint for a National Food Strategy*, FOOD STRATEGY BLUEPRINT 19 (Feb. 2017), https://foodstrategyblueprint.org/wp-content/uploads/2020/10/Food-Strategy-Blueprint.pdf [https://perma.cc/7AVS-N7WA] (stating that agricultural nonpoint pollution is largely exempted from CWA reach).

nutrient runoff.[140] This leaves much of the regulation of nutrient runoff to states and local governments.[141]

The damage and injustice associated with not regulating agricultural runoff through the CWA has been well documented.[142] Although nutrient runoff pollution often enters the watershed from a single location, seemingly undistinguishable from other point sources that are regulated pursuant to the CWA, nutrient runoff is subject to the same regulation and treatment as *diffuse surface runoffs*, and not point sources.[143] While it is true that nutrient runoff sources are not regulated pursuant to intentional exemptions under the CWA,[144] there is no validity in the argument that they are somehow substantively different from other point sources when it comes to damage to the natural resource.[145]

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140. *Id.* (arguing that despite agricultural nonpoint source pollution being the highest polluters of rivers, "water pollution regulations generally do not cover farms").

141. Peggy Kirk Hall & Ellen Essman, *State Legal Approaches to Reducing Water Quality Impacts from the Use of Agricultural Nutrients on Farmland*, NAT'L AGRIC. L. CTR. 2 (May 2019), https://farmoffice.osu.edu/sites/aglaw/files/site-library/State_Legal_Approaches_to_Agricultural_Nutrients.pdf [https://perma.cc/FVP8-K55R] ("The federal Clean Water Act [8] grants the U.S. EPA legal authority to regulate point source discharges that may contribute to nutrient pollution, such as animal feeding operations. But the states maintain primary legal authority over nonpoint sources of nutrients, such as farmland and runoff from farmland.").

142. *E.g.*, Lisa Held, *The Field Report: The Clean Water Act Has Failed to Curb Ag Pollution*, CIV. EATS (Mar. 22, 2022), https://civileats.com/2022/03/22/field-report-clean-water-act-regulations-curb-pollution-farms-cafos-runoff [https://perma.cc/BY2E-F3MX] ("[W]hile the Clean Water Act effectively targeted 'point sources' of pollution . . . it didn't include strong controls for 'nonpoint sources,' such as farms field runoff.").

143. *See* Bd. of Water Works Trs. v. Sac Cnty. Bd. of Supervisors, 890 N.W.2d 50, 64 n.6 (Iowa 2017) ("No court or agency to date has ruled agricultural drainage systems constitute point sources regulated under the CWA.").

144. 33 U.S.C. § 1342(*l*)(1) ("The Administrator shall not require a permit under this section for discharges composed entirely of return flows from irrigated agriculture . . . .").

145. Point and non-point sources are not "substantively different" because they can both involve the same kinds of pollutants, such as sediment, chemicals, nutrients, etc. The difference is simply where the pollutants are sourced from. *See* Terry Gibb, *What's the Point and Non-Point in Water Quality?*, MICH. ST. UNIV. EXTENSION (Apr. 4, 2013), https://www.canr.msu.edu/news/whats_the_point_and_non_point_in_water_quality [https://perma.cc/BXL5-ATZJ] (discussing key differences and similarities between point sources and non-point sources of pollution).

The CWA tackles agricultural pollution by regulating agricultural runoff as a non-point source, mandating states to establish best management practices and water quality classifications rooted in suitable use and standards.[146] In instances where a water body falls short of prescribed quality benchmarks owing to agricultural runoff, states are mandated to delineate pollution thresholds and devise strategic management blueprints aimed at elevating impaired waters to the specified standards.[147] Further, the CWA mandates that states undertake specific measures to tackle non-point source pollution, specifically, engaging in strategic planning endeavors to identify and mitigate impairments in water bodies caused by non-point sources.[148] Yet, these mandates ultimately operate on a voluntary basis, with the federal EPA lacking the jurisdiction to enforce compliance.[149]

Part of the states' obligation is to establish Total Maximum Daily Loads (TMDLs) outlining the maximum allowable pollution levels for identified impaired water bodies to meet acceptable water quality standards.[150] However, the CWA grants minimal enforcement authority to the EPA for these mandates, instead relying on "the 'threat and promise' of federal grants to states to accomplish this task."[151] This strategy, acting as a form of motivation and pressure, has proven largely ineffectual in compelling states to manage and curtail agricultural non-point source pollution.[152] One pivotal factor contributing to this lack of

146. 33 U.S.C. §§ 1313, 1329 (providing examples of two statutes which require state officials to review or report water quality standards in various circumstances).

147. *Id.* § 1329 (stating requirements for reporting of polluting sources and requirements for remedial state water management programs).

148. *See id.* § 1288 (requiring states to develop area wide treatment plans for areas of known water quality impairment); *id.* § 1313(d) (requiring states to identify waters which are not expected to meet water quality standards and develop load allocation plans to bring them into compliance); *id.* § 1329 (requiring states to identify impaired water and develop nutrient management plans and best management practices to improve water quality).

149. *See* Laitos & Ruckriegle, *supra* note 138, at 1042 (noting that there is a "mandatory voluntary" problem in the CWA because the EPA has no enforcement powers for inadequate state plans).

150. *Id.* at 1049 (citing 33 U.S.C. § 1313(d)(1)(C)).

151. Pronsolino v. Nastri, 291 F.3d 1123, 1126–27 (9th Cir. 2002) (quoting Or. Nat. Desert Ass'n v. Dombeck, 172 F.3d 1092, 1097 (9th Cir. 1998)).

152. *See* Laitos & Ruckriegle, *supra* note 138, at 1040 (noting states continue to suffer high pollution from agricultural sources, indicating "federal efforts to encourage effective state and local action have not been successful").

oversight stems from Congress's failure to allocate complete funding for the cost-sharing and grant initiatives designed to encourage state engagement.[153] Or, as Professor Douglas R. Williams stated, "[w]ithout assurances that the costs of attacking agricultural nonpoint source pollution will be underwritten by the federal government, most states are unwilling, or unable to attack agricultural nonpoint source pollution aggressively."[154]

While the federal Toxic Substances Control Act imposes a registration requirement on industrial fertilizer producers, and certain states oversee fertilizer sales at a county level, comprehensive data on individual purchases or application on agricultural properties remains unavailable.[155] Further, some states mandate licensure for those applying fertilizer on agricultural lands, contingent solely upon the successful completion of training programs addressing proficient and secure application methods.[156]

In short, the remarkable achievements of the CWA in combating point source pollution[157] are not replicated in the realm of

153. *Id.* at 1042–45 (noting "Congress never full appropriated the total amount of funds" for Section 319 among a host of other problems).

154. Douglas 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, 75 (2002).

155. *See, e.g.*, OHIO REV. CODE ANN. § 905.37 (LexisNexis 2023–24) (allowing the director of agriculture to distribute annual statements of fertilizer sales by county); N.Y. COMP. CODES R. & REGS. tit. 1, § 153.2 (2025) (allowing the New York Department of Agriculture to request evidence that fertilizers meet standards for including various elements); *Agriculture Nutrient Management and Fertilizer*, U.S. ENV'T PROT. AGENCY (last updated Jan. 22, 2025), https://www.epa.gov/agriculture/agriculture-nutrient-management-and-fertilizer [https://perma.cc/TJJ5-CNV8] ("In some States, the regulations on hazardous waste use in fertilizers may be more stringent than the Federal standards, since States can adopt regulations that are more stringent and/or broader in scope than the Federal regulations.").

156. *See, e.g.*, OHIO REV. CODE ANN. § 905.32 (LexisNexis 2023–24) (requiring a license for the manufacture or distribution of fertilizers); OHIO REV. CODE ANN. § 905.322 (LexisNexis 2023–24) (setting the requirements for training programs necessary to support licensure).

157. Olivia Amitay, *Five Clean Water Act Success Stories*, PBS: PERIL & PROMISE (Feb. 24, 2023), https://www.pbs.org/wnet/peril-and-promise/2023/02/five-clean-water-act-success-stories [https://perma.cc/CW3D-EUBM] (providing five examples of where the Clean Water Act almost entirely eliminated point source pollution in some of the most polluted waterways in the United States).

agricultural pollution.[158] This leads to a stark reality: Nearly all nutrient pollutants administered on agricultural lands streaming into various water sources, including vital municipal drinking water supplies, remain fundamentally unregulated by the federal government.[159] The question then falls to state governments and what, if any, regulation they have enacted and whether they have permitted local government to regulate nutrient runoff in the Mississippi River watershed.

Many states, particularly those in the Mississippi River watershed, have taken the position that local governments may not regulate nutrient runoff.[160] As discussed in Part I, fertilizer is a

158. 33 U.S.C. § 1342(*l*)(1). Congress chose to exempt non-point sources including all "return flows from irrigated agriculture" from the NPDES permitting and monitoring program. *Id.* The Department of Agriculture mandates animal feeding operations to submit comprehensive nutrient management plans to access specific cost-sharing programs, yet this requirement does not encompass crop producers abstaining from the utilization of manure-based fertilizers. *See* 16 U.S.C. § 3839aa-5(a) (setting forth the necessary information to be included in a comprehensive nutrient management plan); *see also Comprehensive Nutrient Management Planning*, U.S. DEP'T OF AGRIC., https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/maryland/comprehensive-nutrient-management-planning [https://perma.cc/Z5SH-EZSD] ("Comprehensive Nutrient Management Plans (CNMP's) are conservation plans that are unique to livestock and poultry operations.").

159. *See* Laitos & Ruckriegle, *supra* note 138, at 1035 (noting that agricultural nonpoint sources "are not subject to federal oversight or EPA-set standards").

160. Considering the substantial political influence wielded by industrial agriculture within many of the Mississippi River watershed state legislatures, endeavors undertaken by local governments to enforce nutrient management regulations are typically superseded by prevailing state statutes. *See* Alex Brown, *Environmentalists Make Long-Shot Attempt to Ban New Factory Farms*, STATELINE (Feb. 19, 2021), https://stateline.org/2021/02/19/environmentalists-make-long-shot-attempt-to-ban-new-factory-farms [https://perma.cc/5ZCF-XYG4] ("Many of the air pollutants emitted by livestock are not regulated under the Clean Air Act. Meanwhile, some state agencies tasked with enforcing those laws lack the resources or interest to crack down on pollution."); *see also* Kristina Johnson, *Twenty-Nine States Make it Illegal for Counties and Cities to Pass Seed Laws*, FOOD & ENV'T REPORTING NETWORK (Aug. 17, 2017), https://thefern.org/ag_insider/twenty-eight-states-make-illegal-counties-cities-pass-seed-laws [https://perma.cc/J8B4-ZS35] ("Farming is the largest industry in Montana, and Texas is the third-largest agricultural state in terms of production, behind California and Iowa."). Many states similarly prohibit local governments from regulating fertilizer. *See, e.g.*, IOWA CODE § 200.22 (2025) (prohibiting any "local government entity" from enacting or enforcing any local legislation "relating to the use, sale, distribution, storage, transportation, disposal, formulation, labeling, registration, or manufacture of a fertilizer or soil conditioner").

major source of nutrients in the watershed, causing immense amounts of damage throughout the watershed in the form of algae blooms (such as in Toledo, Ohio, where hundreds of thousands of people were without water because of an algae bloom) and the dead zone in the Gulf Coast.[161] Notwithstanding the prevalence of and the damage caused by these nutrients, local governments throughout the watershed are prohibited from regulating fertilizer use.[162] For example, Iowa's law states:

> A local governmental entity shall not adopt or continue in effect local legislation relating to the use, sale, distribution, storage, transportation, disposal, formulation, labeling, registration, or manufacture of a fertilizer or soil conditioner, regardless of whether a statute or rule adopted by the department applies to preempt the local legislation. Local legislation in violation of this section is void and unenforceable.[163]

Here is an example where the federal government is not regulating in the watershed and state governments have pulled local governments out of the process—disconnecting them from the ecology, even though they are responsible for critical services that depend on the watershed.

Preemption is happening in the courts too via expanded implied preemption.[164] Humboldt County, Iowa, passed Ordinance

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161. *Five Years Later: Lessons from the Toledo Water Crisis*, ALL. FOR THE GREAT LAKES (Aug. 1, 2019), https://greatlakes.org/2019/08/five-years-later-lessons-from-the-toledo-water-crisis [https://perma.cc/QF6C-WPV5] (describing a water crisis in Toledo as a result of algae blooms on Lake Erie); *The Effects: Dead Zones and Harmful Algal Blooms*, U.S. ENV'T PROT. AGENCY (last updated Feb. 5, 2025), https://www.epa.gov/nutrientpollution/effects-dead-zones-and-harmful-algal-blooms [https://perma.cc/7C2U-DSLZ] (noting the damages as a result of "dead zones" caused by algae blooms).

162. Despite its importance, pesticide runoff regulation is often off-limits to local governments in most agricultural states due to state preemption. *See generally* A. Dan Tarlock, *The Potential Role of Local Governments in Watershed Management*, 20 PACE ENV'T L. REV. 149, 162–75 (2002) (discussing preemption and the law of water rights). About a billion pounds of pesticides are applied each year. Donald Atwood & Claire Paisley-Jones, *Pesticides Industry Sales and Usage: 2008–2012 Market Estimates*, U.S. ENV'T PROT. AGENCY (2017) https://www.epa.gov/sites/default/files/2017-01/documents/pesticides-industry-sales-usage-2016_0.pdf [https://perma.cc/B62E-P3HB]. Some of this pesticide runs off agriculture lands deteriorating the watershed. *Nonpoint Source: Agriculture*, U.S. ENV'T PROT. AGENCY (last updated Feb. 27, 2025), https://www.epa.gov/nps/nonpoint-source-agriculture [https://perma.cc/GU4Q-SFUS].

163. IOWA CODE § 200.22 (2025).

164. *See* Bd. of Water Works Trs. v. Sac Cnty. Bd. of Supervisors, 890 N.W.2d 50, 64 (Iowa 2017) (providing one major state Supreme Court example where "precedents immunizing drainage districts" were considered).

24 not too long ago. It stated: "No person . . . shall . . . apply livestock manure on any land in Humboldt County that drains into an agricultural drainage well or sinkhole in a manner that results in the contamination of groundwater."[165] The County also required annual testing and required permitting under the ordinance.[166]

In striking down Ordinance 24, the Iowa Supreme Court ruled that the ordinance was preempted.[167] Specifically, the state law set a lower standard than the county ordinance for regulation of runoff. And thus, one could comply with the state law, but not the county law.[168] Here is an attempt by a local government to internalize or manage the external impacts stemming from agricultural runoff, and that ordinance is struck down because it provides *more* watershed protection than that required pursuant to state law. The combination of express and implied preemption laws prohibits or, at a minimum, discourages local governments from implementing many of the best practices to manage nutrient loads directly and sustainably in the watershed.[169]

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165. Goodell v. Humboldt County, 575 N.W.2d 486, 490 (Iowa 1998).

166. *Id.*

167. *Id.* at 505 ("Consequently, any home rule authority of the county to control the land application of manure from confinement operations has been preempted by the state. Therefore, the county did not have the power to adopt ordinance 24.").

168. *Id.* ("We hold there is a direct and irreconcilable conflict between ordinance 24 and section 455B.172(5).").

169. Local governments in Wisconsin have taken a different approach with their regulation of fertilizer. In *Croplife America, Inc. v. City of Madison*, producers and suppliers of compounds consisting of fertilizers and pesticides, or "weed-and-feed" products, sued Dane County, Wisconsin, and other local governments claiming they improperly attempted to limit these products. 432 F.3d 732, 733 (7th Cir. 2005). Producers and suppliers appealed to the Seventh Circuit, arguing that the Wisconsin state statute preempted any local legislation regarding pesticides, which included "pesticide-fertilizer mixtures." *Id.* at 734. Judge Posner disagreed, holding that "the definition of both 'pesticide' and 'fertilizer' as including a mixture of the two preserves both state regulation of pesticides and local regulation of fertilizers." *Id.* ("The state regulates the pesticide components of the mixed products, local government the fertilizer components."). The Wisconsin legislature thereafter acknowledged under § 94.701 that while the state explicitly regulates pesticides, local governments are permitted to regulate fertilizer. *See* WIS. STAT. § 94.701 cross-reference (2023–24) ("A local government is not preempted by sub. (3) (a) from regulating the phosphorous content in weed and feed products. A weed and feed product is both a

B. REVISITING DES MOINES

This Part revisits Des Moines discussed in the Introduction and the trials and tribulations of the Des Moines Water Works, one local government in the Mississippi River watershed. The City of Des Moines sits at the confluence of the Raccoon and Des Moines Rivers. The Des Moines River then continues southeast out of the city and connects with the Mississippi River about 120 miles north of St. Louis. The sub-watersheds for the Des Moines and Raccoon Rivers lie within the Mississippi River watershed and extend up to Minnesota.

The city and most of the two sub-watersheds sit in the Des Moines Lobe, which was glaciated until about 12,000 years ago.[170] As the glaciers receded, much of the area in the Lobe was a wetland.[171] Like most wetlands in the upper Midwest, the wetlands in Iowa were drained for farmland.[172] The map below shows the loss of wetlands in the United States from 1780–1980. Many of the states with high wetland losses can be found throughout the Mississippi River watershed, including Iowa, Missouri, Indiana, Illinois, and Ohio, all with wetland loss of eighty-five percent or above.

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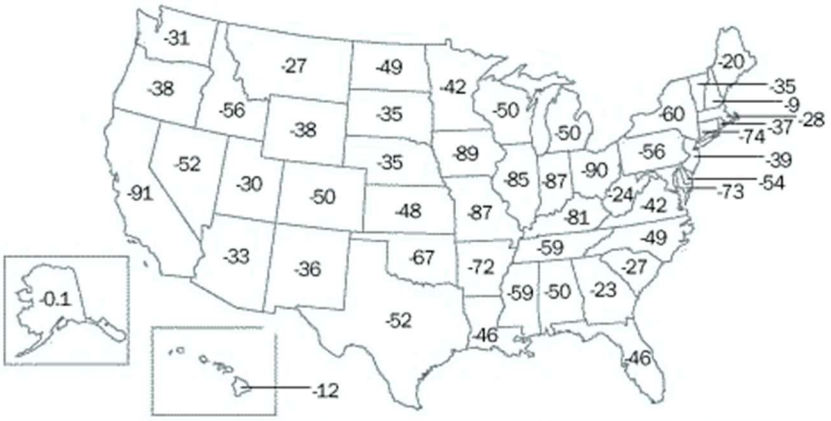
pesticide, which under sub. (3) (a), only the state can regulate, and a fertilizer, which local government can regulate. . . [t]he state regulates the pesticide components of the mixed products, local government the fertilizer components.").

170. Jean C. Prior, *Des Moines Lobe*, IOWA GEOLOGICAL SURV., https://iowageologicalsurvey.uiowa.edu/iowa-geology/landforms-iowa/des-moines-lobe [https://perma.cc/7PDG-5QKR].

171. David A. Eash et al., *Stream-Channel and Watershed Delineations and Basin-Characteristic Measurements Using Lidar Elevation Data for Small Drainage Basins Within the Des Moines Lobe Landform Region in Iowa*, U.S. GEOLOGICAL SURV. 2 (2018), https://www.semanticscholar.org/paper/Stream-channel-and-watershed-delineations-and-using-Eash-Barnes/7e65c08b31965caa387bf24c656f8aa906705155 [https://perma.cc/QN6E-J2A7] (noting that wetland basins are a characteristic of the Des Moines Lobe which are retained imprints of "recent glacial occupation").

172. *See* Prior, *supra* note 170 ("[L]aying tile lines beneath poorly drained areas have turned the Des Moines Lobe into highly productive farmland.").

Figure 5: Percentage of Lost Wetland Acreage from 1780s–1980s[173]



Twenty-two states have lost at least 50 percent of their original wetlands. Seven states—Indiana, Illinois, Missouri, Kentucky, Iowa, California, and Ohio—have lost over 80 percent of their original wetlands. Since the 1970's, the most extensive losses of wetlands have been in Louisiana, Mississippi, Arkansas, Florida, South Carolina, and North Carolina.

In Iowa, the wetlands were typically removed for agriculture. Eighty-four percent of the land base in Iowa is used for agriculture.[174] Thirty-two percent of all the nation's hogs are "raised" in Iowa.[175] In many years, Iowa is the number one producer of corn, pork, and eggs, and number two producer of

173. *Wetlands Threats and Loss*, UNIV. OF FLA. IFAS EXTENSION, https://soils.ifas.ufl.edu/wetlandextension/threats.htm [https://perma.cc/H2NB-KH6M] (referencing data compiled in WILLIAM J. MITSCH & JAMES G. GOSSELINK, WETLANDS 46–47 (2d ed. 1993)).

174. *Iowa Economic Contribution and Impact Research*, UNIV. ARK. DIV. OF AGRIC. RSCH. & EXTENSION, https://economic-impact-of-ag.uada.edu/iowa [https://perma.cc/X7L5-C6HM].

175. Decision Innovation Sols., *2020 Iowa Pork Industry Report*, IOWA PORK PRODUCERS ASS'N 6 (May 2020), https://www.iowapork.org/filesimages/Documents/Full_Iowa-Pork-Industry-Report.pdf [https://perma.cc/9Z6E-UBDW] ("The Iowa pork industry is a robust industry that continues to expand and increasingly contribute to the Iowa economy. Hog inventory numbers reached a new record high with 24.8 million hogs on Iowa farms in December 2019. Iowa holds 32% of the U.S. hog inventory.").

soybeans.[176] The agriculture industry in Iowa is about a $34.7 billion dollar a year business.[177]

To keep the moisture out of the former wetland areas and out of the soil, much of Iowa's farmland is tiled.[178] Most of the tiled systems throughout Iowa are managed by local governments, called drainage districts.[179] In the late 1800s and early 1900s, Iowa had vast amounts of poorly drained wetlands. The State passed a drainage district law that allowed two or more property owners to jointly petition for the creation of a drainage district.[180] Districts are organized by watershed and determined and mapped by an engineer.[181] Districts contain subsurface tile systems, open channels, and streams.[182] Each drainage district is governed by the Trustees of the drainage district.[183] The county's Board of Supervisors is the default Trustee, but landowners can also elect their own trustees.[184] There are more than 3,800 drainage districts across Iowa and more than nine million

176. *Target Industries*, IOWA AREA DEV. GRP. https://www.iadg.com/iowa-advantages/target-industries [https://perma.cc/QP58-L6ME].

177. *Iowa Economic Contribution and Impact Research*, *supra* note 174 ("In 2022, Iowa generated around $46.6 billion in agricultural cash receipts . . . .").

178. See *supra* Part I for a discussion of tiling in more detail. *See also* Donnelle Eller, *Farming 101: What You Need to Know About Tiling Runoff*, DES MOINES REG. (Sept. 12, 2016), https://www.desmoinesregister.com/story/money/agriculture/2015/09/14/farming-101-why-you-should-care-tiling-runoff/72266046 [https://perma.cc/47X6-6FRW] (noting that tiling has been used to quickly lower the water table in Iowa since the 1910s).

179. Eller, *supra* note 178 ("Des Moines Water Works filed a lawsuit in March against drainage districts in Sac, Calhoun and Buena Vista counties.").

180. *See* IOWA CODE § 468.6 (2025) (establishing that two or more landowners may petition for the creation of a drainage district); *see also* IOWA CONST. art. I, § 18 (constitutionalizing an avenue for private parties to establish drainage districts under management of the legislature).

181. *Engineer / Secondary Roads: Frequently Asked Questions*, BOONE CNTY. IOWA, https://boonecounty.iowa.gov/engineer/faq [https://perma.cc/R5BY-QE4W] ("When a drainage district is formed, the area of the district is determined by an Engineer and mapped.").

182. *Id.* ("Drainage districts have both underground tile systems and open channels/streams.").

183. *Id.* ("The Trustees of the drainage district govern the drainage district.").

184. *Frequently Asked Questions*, IOWA DRAINAGE DIST. ASS'N [hereinafter *Drainage FAQ*], http://www.iowadrainage.org/pages/faq [https://perma.cc/3MHY-JRJC] (noting that a board of supervisors is trustee of a drainage district by default, but that each district may opt out and elect trustees to the district).

acres of drained land.[185] The county Board of Supervisors manages the affairs of the drainage district in a representative capacity, such as determining what improvements are needed.[186] A district is considered a "political subdivision of the county in which it is located . . . [and] is a legally identifiable political instrumentality created by state statute."[187]

The tiling created by drainage districts has several impacts. First, there are flooding issues.[188] In 1993, the Des Moines Water Works was not able to provide potable water for almost three weeks to hundreds of thousands of people when the Des Moines and Raccoon Rivers flooded.[189] As noted in the Introduction, in recent years, the Des Moines and Raccoon Rivers have experienced a "100-year" flood several times.[190]

Second, the Des Moines Water Works experiences significant spikes in nitrates and phosphates from agricultural runoff. Agricultural practices are the primary source of nitrate-nitrogen

185. *Id.* (providing the relevant figures for number of districts and acres of drained land).

186. IOWA CODE § 468.126 (2025) ("The board . . . may order done whatever is necessary to restore or maintain a drainage or levee improvement in its original efficiency or capacity, and for that purpose may remove silt and debris, repair any damaged structures . . . and whatever else may be needed."); *see also* IOWA CODE §§ 468.37, .89, .231, .232, .617, 468.126(1)(a) (2025) (providing other examples of the management abilities a board of supervisors in a drainage district has).

187. *Drainage FAQ*, *supra* note 184.

188. *Subsurface Water Flow Through Agricultural Tile Drainage Systems,* U.S. ENV'T PROT. AGENCY ENVIROATLAS (Feb. 2018), https://enviroatlas.epa.gov/enviroatlas/DataFactSheets/pdf/ESN/Subsurfacewaterflowthroughagriculturaltiledrainagesystems.pdf [https://perma.cc/CV26-87R2] ("Even though tile drainage decreases surface runoff, it can . . . contribute to flooding."); *see also* Kristen L. Blann et al., *Effects of Agricultural Drainage on Aquatic Ecosystems: A Review*, 39 CRITICAL REVS. ENV'T. SCI. & TECH. 909, 924 (2009) (noting that artificial drainage increases the risk for flooding); Kevin W. King et al., *Phosphorus Transport in Agricultural Subsurface Drainage: A Review*, 44 J. ENV'T QUALITY 467, 469 (2015) (noting that tile drainage tends to increase total water yield by ten to twenty-five percent); K.W. King et al., *Effect of Subsurface Drainage on Streamflow in an Agricultural Headwater Watershed*, 519 J. HYDROLOGY 438, 438 (2014) (noting that in certain conditions subsurface drainage increases rather than decreases flooding).

189. Zane Satre, *Flood of '93: On This Day 30 Years Ago, the Water Was Shut Off in Des Moines*, KCCI DES MOINES (July 14, 2023), https://www.kcci.com/article/des-moines-iowa-flood-of-93-july-11-water-shut-off/44508917 [https://perma.cc/SE36-N99Q] (recounting a 1995 levee overflow which resulted in the City of Des Moines shutting off water for 250,000 people).

190. *See supra* notes 7–9 and accompanying text.

in the Racoon River, driven by intensive corn and soybean production across over eighty percent of the watershed and amplified by sub-surface drainage systems (tiling) that rapidly transport nitrates from fields to surface waters.[191] The chart in the Introduction shows the nitrate levels in the rivers compared to and exceeding the EPA limit for nitrates in drinking water.[192]

Third, at an additional cost of about $10,000 a day, the Des Moines Water Works can remove some of the nitrates with one of the most sophisticated nitrate removal systems in the world.[193] In 2014, the Des Moines Water Works ran the removal system for over 150 days, at a cost of over $1,000,000.[194]

Given the importance of agriculture in Iowa it is not surprising that the State has opted for a voluntary nutrient reduction strategy.[195] Further and as mentioned above, local governments in Iowa have little or no authority to directly regulate nutrient

191. J.L. Hatfield et al., *Nitrate-Nitrogen Patterns in the Racoon River Basin Related to Agricultural Practices*, J. SOIL & WATER CONSERVATION, May/June 2009, at 190.

192. *National Primary Drinking Water Regulations*, U.S. ENV'T PROT. AGENCY (last updated Dec. 12, 2024), https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations [https://perma.cc/L8C7-WCBR] (providing a table with maximum contaminant level goals for water sources). Weather whiplash events regularly cause nitrate levels to elevate above EPA maximums. *See* Terrance D. Loecke et al., *Weather Whiplash in Agricultural Regions Drives Deterioration of Water Quality*, 133 BIOGEOCHEMISTRY 7, 12 (2017) ("The faster increase in extreme events results in an increasing frequency of spring nitrate concentrations exceeding the E.P.A. drinking water standard.").

193. *Nitrate Removal Facility Fact Sheet*, DES MOINES WATER WORKS, https://cms9files.revize.com/desmoineswater/Nitrate%20Removal%20Facility.pdf [https://perma.cc/S2YN-ZZRV].

194. *Court Date Set for Des Moines Water Quality Suit*, NAT'L AGRIC. L. CTR. (July 20, 2015), https://nationalaglawcenter.org/court-date-set-for-des-moines-water-quality-suit [https://perma.cc/Z8B7-WN4P] ("Stowe said recent high nitrate levels prompted the Des Moines utility to run its nitrate removal plant for more than 150 days, longer than ever before.").

195. *See Iowa Ag Intel*, COAL. TO SUPPORT IOWA'S FARMERS, https://www.supportfarmers.com/iowaagintel [https://perma.cc/CUQ3-F6ZY] ("Iowa continues to be a national and global leader in agriculture, ranking No. 1 in production of hogs, corn, eggs and soybeans – while ranking in the top 5 for red meat production, number of farms, cattle on feed, cash receipts and total value of ag exports.").

runoff from fertilizer, and the federal and state governments have either refused or applied lax regulation to this runoff.[196]

So, can the Des Moines Water Works act "irrationally" if it wanted? What recourse, if any, does it and its citizens have to protect its water and directly regulate nutrients to stop them from damaging the water source? Sadly, under current laws, not a whole lot.

The Des Moines Water Works filed suit against three upstream counties managing ten drainage districts seeking to have the drainage districts reduce nutrient pollution flowing downstream.[197] In the complaint, the Water Works claimed that the drainage districts should internalize their impacts under the Clean Water Act and/or under several state causes of action, including trespass and nuisance.[198] The U.S. District Court for the Northern District of Iowa certified a set of questions to the Iowa Supreme Court to answer before issuing its final ruling.[199]

At the Iowa Supreme Court, the Des Moines Water Works advanced multiple arguments. Ultimately, however, the Iowa Supreme Court held in January 2017 that the drainage districts simply "lack the broad police powers exercised by counties and other political subdivisions" and thus cannot properly redress any injuries, even those they may have actualized.[200] Chief Justice Cady's partial concurrence got to the heart of the issue:

> The role of this court is not to decide the outcome of the case, but to determine if the basis of the lawsuit is supported by our state law. It is abundantly clear that Iowa's drainage district law did not originate and was not developed over time with the thought that a drainage district could be a polluter. If it had, I am convinced our law would have developed in a way that would have recognized a clear remedy.[201]

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196. For a discussion of preemption and fertilizer, see *supra* notes 162–69 and accompanying text.

197. Complaint at 1–3, Bd. of Water Works Trs. v. Sac Cnty. Bd. of Supervisors, No. 15-cv-04020, 2016 WL 7043012 (N.D. Iowa Jan. 20, 2016) (arguing in part that the various drainage districts violated the CWA and "the discharge of nitrate from drainage district infrastructure must be addressed").

198. *Id.*

199. *Bd. of Water Works Trs.*, 2016 WL 7043012, at *1–2 (holding that the federal district proceedings would be stayed as the issue was certified to the Iowa Supreme Court).

200. Bd. of Water Works Trs. v. Sac Cnty. Bd. of Supervisors, 890 N.W.2d 50, 67 (Iowa 2017).

201. *Id.* at 72–73 (Cady, C.J., concurring in part and dissenting in part).

The Des Moines Water Works argued that other states allow private persons to sue drainage districts in tort.[202] But the court noted that none of the cases cited involved claims by a water utility or other public entity and that the cases were "inapposite because the immunity afforded drainage districts in Iowa is based on special features of drainage districts under Iowa law and specific determinations of our legislature."[203]

The court ruled that pursuant to the Clean Water Act (CWA), the drainage districts were not the proper defendants.[204] But the Des Moines Water Work's strategy to sue the drainage districts was intentional; the CWA considers agricultural runoff as nonpoint source pollution, meaning that such pollution and the associated agricultural practices are largely exempt from CWA regulation unless the Des Moines Water Works was able to show that the drainage districts were the point source.[205] Unfortunately, it was not able to do so.[206]

Not satisfied with the victory, in February 2017, Iowa House Bill 316 was introduced to the legislature by Republican lawmaker and hog farmer Jarad Klein to dissolve the Des Moines

202. *Id.* at 68. The Des Moines Water Works cited the following cases in support if its argument: Roark v. Macoupin Creek Drainage Dist., 738 N.E.2d 574, 579–80 (Ill. App. Ct. 2000); Gerbers, Ltd. v. Wells Cnty. Drainage Bd., 608 N.E.2d 997, 998, 1000 (Ind. Ct. App. 1993); Dougan v. Rossville Drainage Dist., 757 P.2d 272, 279 (Kan. 1988); Lezina v. Fourth Jefferson Drainage Dist., 190 So.2d 97, 100 (La. Ct. App. 1966); Landview Landscaping, Inc. v. Minnehaha Creek Watershed Dist., 569 N.W.2d 237, 240 (Minn. Ct. App. 1997); Parriott v. Drainage Dist. No. 6, 410 N.W.2d 97, 99–100 (Neb. 1987); Kilburn v. Fort Bend Cnty. Drainage Dist., 411 S.W.3d 33, 36–37 (Tex. App. 2013); Holytz v. City of Milwaukee, 115 N.W.2d 618, 625 (Wis. 1962), *superseded by statute*, WIS. STAT. § 331.43 (1963), *as recognized in* Milwaukee Metro. Sewerage Dist. v. City of Milwaukee, 691 N.W.2d 658, 677 (Wis. 2005) (noting the adoption of the statute codifying immunity for discretionary functions); *see also* Ark. State Highway Comm'n v. Steed, 411 S.W.2d 17, 21 (Ark. 1967) (granting immunity for tort actions against "improvement districts" but allowing injunctive relief and compensation for taking private property).

203. *Bd. of Water Works Trs.*, 890 N.W.2d at 68.

204. *Id.* at 63–64 ("Yet this proliferation of environmental laws [such as the CWA] has not led us or the legislature to revisit our precedent limiting judicial remedies against drainage districts.").

205. *See id.* at 64 n.6 (highlighting the fact the CWA expressly exempts agricultural runoff).

206, *Id.* at 63–64.

Water Works and replace it with a regional water authority.[207] Proponents of the bill stated that it would simply update an aging system, while others believe the true purpose, along with its timely House introduction, was to halt the controversial actions brought by the Des Moines Water Works against drainage districts.[208]

Before the Des Moines Water Works could react to this presumptive threat, on March 17, 2017, the federal court found that drainage districts were immune from the Des Moines Water Works' claims.[209] In citing the Iowa Supreme Court's decision, the court concluded that there was no ability to redress the alleged injuries.[210] In a sad twist of fate that highlights the failures of this system, the Water Works has little it can do with the nitrates it pulls out of the water. Thus, it has received, at times, permission to dump those nitrates back into the Des Moines River, working their way to the Mississippi and ultimately the Gulf.[211]

In short, the Des Moines Water Works cannot directly regulate the nutrient runoff that it is responsible for cleaning before

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207. H.R. 316, 87th Gen. Assemb., Reg. Sess. (Iowa 2017) (calling for the discontinuation of Iowa's current water utility and for it to be replaced by a "regional water authority").

208. Clay Masters, *Bill to Break Up Des Moines Water Works Might Also End Its Lawsuit Against Rural Counties*, IOWA PUB. RADIO (Feb. 28, 2017), https://www.iowapublicradio.org/state-government-news/2017-02-28/bill-to-break-up-des-moines-water-works-might-also-end-its-lawsuit-against-rural-counties [https://perma.cc/AA9C-TJCT] ("'At least have the courage to say this really is about our dislike for Des Moines Water Works and their clean water litigation,' says Des Moines Water Works CEO Bill Stowe.").

209. Bd. of Water Works Trs. v. Sac Cnty. Bd. of Supervisors, No. C15-4020, 2017 WL 1042072 at *6 (N.D. Iowa Mar. 17, 2017) ("[Plaintiff] seeks injunctive relief and the assessment of civil penalties against the drainage districts arising from alleged duties and powers that the districts simply do not possess under Iowa law. [Plaintiff] may well have suffered an injury, but the drainage districts lack the ability to redress that injury.").

210. *Id.* at *5–6 (finding that because drainage districts by law have limited duties and powers with respect to preventing pollution, they are unable to redress the Des Moines Water Works' alleged injuries).

211. *See* Bd. of Water Works Trs. v. Sac Cnty. Bd. of Supervisors, 890 N.W.2d 50, 66 (Iowa 2017) (noting that the most cost-effective way to remove nitrates from Des Moines drinking water may be to require action by Des Moines Water Works, "which already bears the statutory obligation to provide safe water for its customers under the Safe Drinking Water Act and its Amendments" and "at times has lawfully deposited back into the Raccoon River the very nitrates it removed").

providing potable water to hundreds of thousands of people; it cannot compel the drainage districts to take such action; the state has opted for a voluntary nutrient reduction strategy leaving the decisions in the hands of farmers; and the federal government has taken a laissez faire approach to nutrient reduction. This leaves the Des Moines Water Works and other similarly situated local governments throughout the watershed with little or no options for direct regulation of nutrients, yet they bear the cost associated with nutrient removals. But is there a way for local governments to indirectly regulate nutrients to help preserve and regenerate the Mississippi River watershed?

IV. VIEWING THE NITRATE TRAGEDY FROM A SYSTEMS PERSPECTIVE

In a prior article, I stated, "[t]o reduce the problems of resource overuse we must begin with a better understanding of the constraints limiting local government's ability to sustainably manage commons resources."[212] Parts I–III of this Article attempt to do that in the context of the Mississippi River watershed. The analysis presented above highlights a significant hindrance–local governments lack direct regulatory authority over nutrients and fertilizers in a substantial portion of the Mississippi River watershed. In other words, even if a local government wanted to prohibit fertilizers in the watershed, it could not.

Confronted by this constraint, this Part proposes strategies for local governments to navigate preemption complexities so that local governments can reduce nutrient pollution in the watershed without conflicting with state law. The recommendations put forth here originate from a systems thinking perspective,[213] recognizing the intricate interplay between nutrients and

212. Rosenbloom, *supra* note 16, at 1489.

213. Systems thinking identifies systems—which are "interconnected set[s] of elements" coherently organized for a function or purpose—and their innate "properties of resilience, self-organization, and hierarchy" that influence "long-term behavior and structure." DONELLA H. MEADOWS, THINKING IN SYSTEMS 11, 87 (Diana Wright ed., 2008). As a "paradigm that emphasizes universal interconnectivity," systems thinking provides insight the law by understanding "organizational behavior, systemic functioning, and how those factors relate to effective advocacy." Tomar Pierson-Brown, *(Systems) Thinking Like a Lawyer,* 26 CLINICAL L. REV. 515, 515 (2020). *See generally* Jeroen van der Heijden, *Systems Thinking and Regulatory Governance: A Review of the International*

the water source, and that nutrient runoff is only one input into these sophisticated natural cycles. Thus, the prohibition on directly regulating nutrient runoff can be viewed as prohibiting regulation of only one part of complicated systems. Taking a systems approach opens available regulatory avenues in different parts of the system where local governments are not preempted from regulating.

Systems thinking, in this context, involves considering the interconnected components and their relationships within the ecosystem where nutrients flow.[214] By examining the relevant systems we can identify aspects of the systems—both inputs and outputs—that local governments can regulate. The systems thinking approach here begins with a look at the key components of the nutrient cycle and the water cycle.

Nutrient Cycle. The nutrient cycle, also known as the biogeochemical cycle, explains how nutrients move between living and nonliving parts of an ecosystem.[215] As shown in the image below, nutrient cycling is the process where elements change forms and then return to their original state, depending on the amount of nutrients and other inputs.[216] Soil plays a key role in the cycle as it holds nutrients like nitrogen and phosphorus.[217] Plants, another important aspect, absorb these nutrients from

Academic Literature (State of the Art in Regul. Governance Rsch. Paper, Paper No. 2020.04, 2020), https://dx.doi.org/10.2139/ssrn.3531381 [https://perma.cc/VD6D-BMGT] (discussing the present state of systems thinking as it relates to regulatory practice and governance).

214. *See Nutrients*, U.S. ENVT. PROT. AGENCY fig.3 (last updated Feb 7, 2025), https://www.epa.gov/caddis-vol2/nutrients [https://perma.cc/8VPN-84A4] (showing the causal pathways related to nutrients).

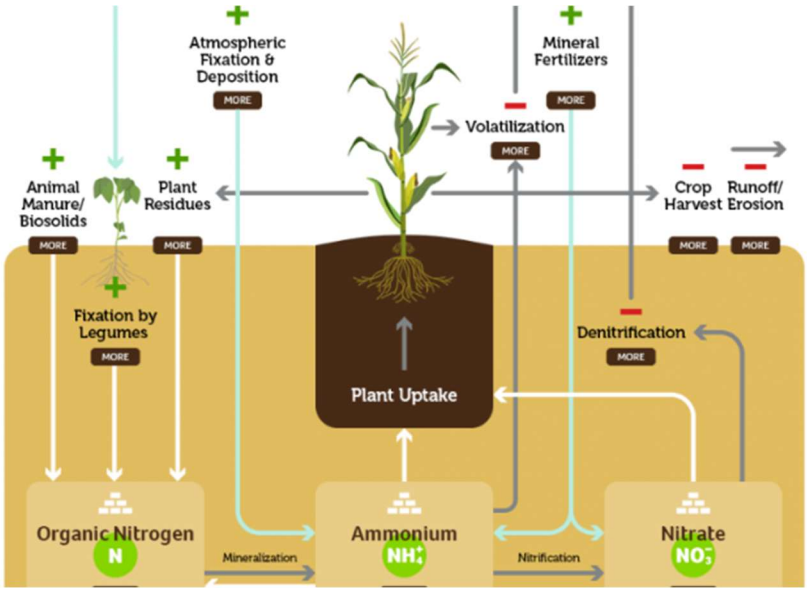
215. *See Nutrient Cycling*, CRANDALL PARK TREES, https://mdocs.skidmore.edu/crandallparktrees/ecosystem/nutrient-cycling [https://perma.cc/WZ22-8TWA] (explaining nutrient cycling).

216. *The Nitrogen Cycle, Explained*, ESN: SMART TALK BLOG, https://smartnitrogen.com/smart-talk/the-nitrogen-cycle-explained [https://perma.cc/L6NX-JJMR] (demonstrating the way nutrients, such as nitrogen, are introduced in the environment and how they interact with soil and plant life).

217. *The Impacts of Nitrogen and Phosphorus from Agriculture on Delaware's Water Quality*, UNIV. OF DEL. COLL. OF AGRIC. & NAT. RES., https://www.udel.edu/academics/colleges/canr/cooperative-extension/fact-sheets/the-impacts-of-nitrogen-and-phosphorus-from-agriculture-on-delawares-water-quality [https://perma.cc/MPJ5-KS35] ("Nitrogen (N) and phosphorus (P) are essential nutrients for all living organisms. Soil, fertilizer, and manure are all sources of N and P to growing crops.").

the soil and transform them into organic matter.[218] This organic matter serves as a conduit for passing nutrients to other parts of the ecosystem, including into the water cycle via runoff.[219] Fertilizers, containing nutrients such as nitrogen and phosphorus, are flooded into the soil and system to enhance agricultural growth, impacting the soil, plants, and the water cycle.[220]

Figure 6: Nutrient Cycle[221]



Water Cycle. The water cycle overlaps with the nutrient cycle in several ways, including through photosynthesis allowing the plant to absorb more nutrients from the soil and through runoff.[222] As shown in the image below, the water cycle, also

218. *See The Nitrogen Cycle, Explained*, *supra* note 216.

219. *See id.*

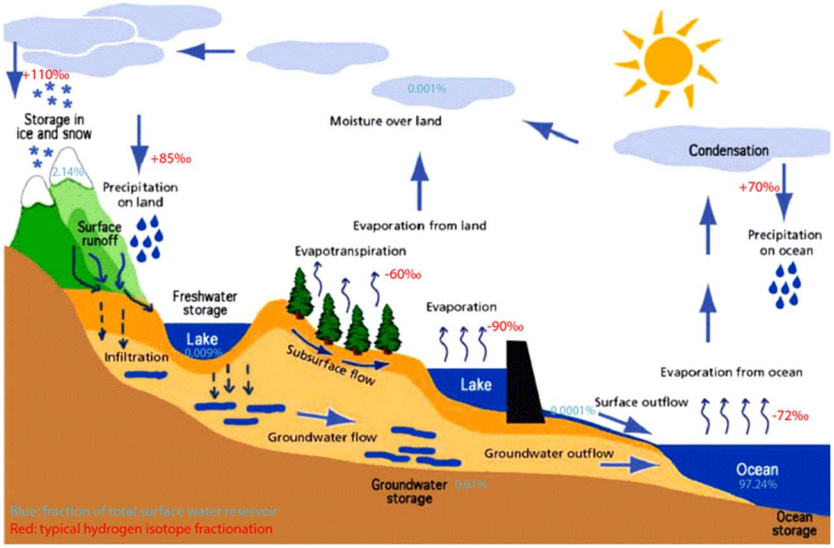
220. *Nutrients*, *supra* note 214 ("Nutrients in runoff and groundwater enter waterbodies from their terrestrial watersheds. They may enter diffusely from overland flow or groundwater discharge or at discrete locations (e.g., agricultural drainage tiles, stormwater outfalls).").

221. *The Nitrogen Cycle, Explained*, *supra* note 216.

222. *Water Cycle*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (last updated Feb. 1, 2019), https://www.noaa.gov/education/resource-collections/freshwater/water-cycle [https://perma.cc/YMD5-MYTX] ("Liquid water flows across land (runoff),

known as the hydrological cycle, describes the continuous movement of water between the soil, plants, atmosphere, and underground reservoirs.[223] It involves processes like evaporation, condensation, precipitation, and runoff, in the distribution and availability of water across different ecosystems.[224]

Figure 7: Water Cycle[225]



Three key parts of both cycles are vegetation, water flows, and soil. Below I explore the ways in which local governments have already exercised authority over the regulation of vegetation, water flows, and soil. Further, such regulations may impact the nutrient cycle, lowering nutrient pollution to help cleanse the watershed. The actions below may not be relevant in all jurisdictions and may not be permitted in some states.

The actions listed below are only meant to begin a conversation on local authority to address nutrient pollution. They are

into the ground (infiltration and percolation), and through the ground (groundwater). Groundwater moves into plants (plant uptake) and evaporates from plants into the atmosphere (transpiration).").

223. *See* Sunson08, *Illustration of Hydrological Cycle*, *in* WIKIMEDIA COMMONS (May 23, 2016), https://commons.wikimedia.org/wiki/File:F3_hydrological_cycle.png [https://perma.cc/ZPX5-9RF2] (depicting the water cycle).

224. *See id.*

225. *Id.*

not meant to be all-encompassing.[226] In addition, while an action may be listed under one heading it also affects the others. For example, a local ordinance designed to increase vegetation will also influence the purity of soil and water. Finally, many of the strategies below would work well in conjunction with others listed below in a way to systematically address nutrient pollution throughout the cycles.[227]

A. VEGETATION

The following local actions seek to lower nutrient pollution in the watershed by focusing on vegetation. Most of the actions below have additional benefits including greenhouse gas emission reductions, climate adaptation, and increasing biodiversity.[228]

Regeneration of Lost Wetlands and Vegetation. Local governments can enact ordinances to increase the growth of lost wetlands and lost trees in the watershed.[229] Wetlands, trees, and

226. For additional actions, see SUSTAINABLE DEV. CODE, www.sustainablecitycode.org [https://perma.cc/7XA4-KRDK]; *Gaining Ground Information Database*, PACE L. SCH., https://appsrv.pace.edu/gainingground [https://perma.cc/EQD9-FRK2].

227. Most of the examples below come from the SUSTAINABLE DEV. CODE, *supra* note 226.

228. For additional benefits, see *The Urban Heat Island Effect in NYC*, N.Y. ENV'T & HEALTH DATA PORTAL (Aug. 20, 2021), https://a816-dohbesp.nyc.gov/IndicatorPublic/data-stories/urban-heat-island [https://perma.cc/PFG7-L3S4]; Marlee Bird, *The Temperature of Disinvestment: Examining Urban Heat Islands and Historically Redlined Communities*, NAT'L CMTY. REINVESTMENT COAL. (July 7, 2022), https://ncrc.org/the-temperature-of-disinvestment-examining-urban-heat-islands-and-historically-redlined-communities [https://perma.cc/6QUH-5HBK] (explaining that trees and vegetation absorb heat, capture rainwater, and improve air quality, which in turn reduces respiratory illnesses). For the negative consequences associated with reduced vegetation in urban areas, see *City of Albany 2019 Community Greenhouse Gas Emissions Inventory*, CITY OF ALBANY OFF. OF SUSTAINABILITY 2 (2020), https://www.albanyny.gov/DocumentCenter/View/6960/Albany-Community-Greenhouse-Gas-Inventory-2019-PDF [https://perma.cc/SCJ3-ZL8C] (noting elevated levels of smog and respiratory illnesses in areas with heat islands); Anna Weber, *What Is Urban Flooding?*, NAT. RES. DEF. COUNCIL (Jan. 15, 2019), https://www.nrdc.org/bio/anna-weber/what-urban-flooding [https://perma.cc/V7KF-G6LN] (noting flooding and health-related issues in urban areas covered primarily by impervious surfaces).

229. *See* Alec LeSher, *Tree Canopy Cover*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/tree-canopy-cover [https://perma.cc/WQ4U-FG36] (explaining the benefits of local tree canopies and how local governments can

other vegetated areas act as natural filters, absorbing nutrients and pollutants from river systems before they can trigger algal blooms, exacerbate hypoxic conditions in dead zones, or contribute to other environmental challenges.[230] Wetlands and trees are often sacrificed during development as trees are removed and wetlands filled. We can expect this to continue or increase in the wake of the Supreme Court's decision in *Sackett v. EPA*.[231] Urban areas, for example, lost an estimated thirty-six million trees annually from 2009 to 2014, impacting public and private benefits such as reduced air pollution, enhanced property values, and improved health.[232] Local governments can enact ordinances that require developers and homeowners to increase the tree canopy cover and regenerate lost wetlands by mandating minimal coverage, reforestation standards, and offering landscaping credits for developers planting more trees. Examples include Balt., Md., Code of Ordinances sections 33-6-101 to 33-6-122 (2025)[233] and Ventura County, Cal., Code of Ordinances section 8178-7.6.1 (2024).[234]

Mitigation of Lost Vegetation during Development. Local governments increasingly require developers to offset the habitat lost by new developments.[235] Local ordinances enacting

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use ordinances to facilitate the growth of local tree canopies, and providing examples of such ordinances).

230. *See* David Biancavilla et al., *Environmental Science for Lawyers* (describing how wetlands support processes that in turn facilitate the removal of nitrogen and phosphorus from the soil), *in* MASSACHUSETTS ENVIRONMENTAL LAW §§ 26.1, 26.8.6(d) (Gregor I. McGregor ed., 2024), Westlaw ENV MA-CLE 26-1; *see also* Kenneth K. Kilbert, *Distressed Watershed: A Designation to Ease the Algae Crisis in Lake Erie and Beyond*, 124 DICK. L. REV. 1, 7 (2019) (explaining how algae blooms in Lake Erie can make local drinking water unsafe).

231. *See supra* note 25 and accompanying text (discussing *Sackett*).

232. Amy Chillag, *US Cities Are Losing 36 Million Trees a Year. Here's Why It Matters and How You Can Stop It*, CNN HEALTH (Sept. 18, 2019), https://www.cnn.com/2019/07/20/health/iyw-cities-losing-36-million-trees-how-to-help-trnd [https://perma.cc/QL3B-742K].

233. [https://perma.cc/4UQA-EQ2J].

234. [https://perma.cc/7VPN-WSUL]. For more examples, see LeSher, *supra* note 229.

235. Alec LeSher, *Mitigation of Lost Critical Habitats*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/require-mitigation-of-lost-critical-habitats-3 [https://perma.cc/NME8-22LB] ("To ensure that new developments mitigate the loss of habitat that they damage or destroy, local governments are increasingly requiring developers to offset the loss of habitat in a variety of ways, for example, by purchasing equivalent habitat elsewhere or paying for offsite creation of new habitat.").

mitigation of habitat loss prioritize on-site preservation but allow off-site mitigation, such as purchasing undeveloped land, enhancing wildlife habitat, and supporting conservation land banks that sell credits to fund additional conservation lands, aiming for no net loss or ideally a net gain in habitat area.[236] These ordinances may specify habitat types, applicable zoning districts, and the ratio of affected to preserved, replaced, or enhanced habitat.[237] Further, these can be done with an eye toward nutrient rich vegetation. Examples include Snowmass Village, Colo., Municipal Code section 16A-4-20(f)(1)(d) (2025)[238] and Camas, Wash., Code of Ordinances section 16.61 (2025).[239]

Planting Native Plants and Vegetation and Removing Invasive Plants. Local governments can help remove nutrient pollution and can protect the watershed by mandating the use of some native plant species and removing invasive plantings.[240] To counter the loss of vegetation from urban development and others, local ordinances can encourage or require native plant landscaping.[241] These ordinances can specify approved native species (especially those high in nutrient demand), maintenance criteria, and setback distances, and may include flexible requirements. Examples include Kane County, Ill., Subdivision Regulations section 19-127 (2024),[242] Sanibel, Fla., Code of Ordinances section 122-169, 191 (2025),[243] Schaumburg, Ill., Code of

236. *Id.* ("For example, a local government may require a developer to purchase undeveloped land, enhance the wildlife habitat features, and protect the land with a conservation easement.").

237. LeSher, *supra* note 229.

238. [https://perma.cc/NFJ3-JNRC].

239. [https://perma.cc/Z988-F9C3]. For more examples, see Tyler Adams & Charles Bloom, *Setbacks Protecting Sensitive Habitats and Water Quality*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/setbacks-protecting-sensitive-habitats-and-water-quality-8 [https://perma.cc/9EBU-LGNV].

240. Kyler Massner, *Native Plants/Vegetation*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/require-use-of-native-plants-vegetation-8 [https://perma.cc/2H9N-6VN5]; Tyler Adams, *Require Native Trees and Removal of Invasive Trees*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/require-native-trees-and-removal-of-invasive-trees-4 [https://perma.cc/B5ZA-VGF5].

241. Massner, *supra* note 240 ("[I]n addition, local governments can require landowners to meet specific minimums of native plant species in field borders, buffers, and other landscaping improvements, or encourage their use in landscape plans.").

242. [https://perma.cc/ZP7W-KZRH].

243. [https://perma.cc/5CH6-DZWA].

Ordinances section 154.136 (2025),[244] and Minneapolis, Minn., Code of Ordinances sections 227.90(b), 530.190, 200 (2025).[245]

Vegetation Protection Areas or Green Zones. Vegetation protection areas designate land sections for regeneration, restoration, or exclusive plant life use, often focusing on wildlife habitat areas.[246] Local governments can utilize this tool to also focus vegetation on those species that help reduce nutrient pollution.[247] Vegetation protection areas can vary in the amount of protection, such as fully protected primary zones and secondary zones with some permissible but restricted development.[248] While preventing development, these ordinances also regulate species, ensuring water filtration and maintaining essential wildlife habitats in specified areas. Examples include Wayland, Mich., Code of Ordinances section 20-520 (2025)[249] and Kenai Peninsula Borough, Alaska, Code of Ordinances sections 21.18.010 to 21.18.145 (2025).[250]

Limit Planned Unit Developments Near Sensitive Natural Areas in the Watershed. In theory, Planned Unit Developments (PUDs) offer design flexibility compared to traditional Euclidean zoning and are increasingly used due to challenges in the traditional zoning processes.[251] However, lax PUD regulations, particularly in rural areas, may result in adverse impacts to sensitive natural areas especially in the watershed.[252] To address this, local governments can revise codes to regulate

244. [https://perma.cc/LVC3-J8WU].

245. [https://perma.cc/U5YP-4ULV]. For more examples, see Massner, *supra* note 240.

246. Brandon Hanson, *Vegetation Protection Areas*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/vegetation-protection-areas-8 [https://perma.cc/8EEX-BM3U]; Brandon Hanson, *Green Zones*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/create-green-zones-2 [https://perma.cc/UMH2-JU8Q].

247. *See* Hanson, *Vegetation Protection Areas*, *supra* note 246 (explaining how native species facilitate natural filtration processes, thereby keeping watersheds healthy).

248. *See id.*

249. [https://perma.cc/EJJ8-A6K7].

250. [https://perma.cc/BRB8-7235]. For more examples, see *id. See also* Hanson, *Green Zones*, *supra* note 246.

251. *See* Kyler Massner, *Limit PUDs Near Sensitive Natural Areas*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/limit-puds-near-sensitive-natural-areas-3 [https://perma.cc/7U8U-VGUX] (explaining effects and examples of PUDs).

252. *Id.*

and restrict PUDs near such areas, incorporating environmental principles and imposing construction techniques that mitigate wildlife risks and require native plant reintroduction.[253] Restrictions on the number of approved PUDs or a complete ban near sensitive natural areas can further safeguard against watershed harm. Examples include Coon Rapids, Minn., Code of Ordinances section 11-902 (2025),[254] Kittitas County, Wash., Kittitas County Code section 17.36 (2025),[255] Kane County, Ill., Subdivision Regulations section 19-137 (2024),[256] and Kane County, Ill., Subdivision Regulations section 25-16-5-2 (2024).[257]

B. SOIL

This Section explores strategies for the preservation of soils. It underscores the importance of development restrictions that prioritize nutrient absorption in the soil, while mitigating soil compaction and pollution.

Development Restrictions to Protect Prime Soils. Limiting development based on soil quality can safeguard farmland and the watershed, especially prime soil crucial for efficient agricultural use and the absorption of nutrients.[258] Every hour, 180 acres of farm and ranch are lost to non-agricultural development, contributing to the annual loss of 1.7 billion tons of topsoil through erosion.[259] Local governments can enact ordinances that explicitly limit non-agricultural development on prime soil, preserving its integrity and nutrient reduction, while limiting urban sprawl. Examples include Whitman County, Wash., Code of Ordinances section 19.10.110 (2021),[260] Clinton County, Ind., Unified Development Ordinance sections 302.01, 513, app. A

253. *Id.*

254. [https://perma.cc/6W5N-7YB6].

255. [https://perma.cc/KDB6-FP9W].

256. [https://perma.cc/7B9A-CV7T].

257. [https://perma.cc/RP4J-68GX]. For more examples, see Massner, *supra* note 251.

258. *See* Bryce Colonia-Hughes, *Development Restrictions to Protect Prime Soils*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/development-restrictions-to-protect-prime-soils-2 [https://perma.cc/TZ52-UAU8] ("Ordinances seeking to preserve farmland based on the quality of soil can be effective measures to preserve prime soil for agricultural uses.").

259. *Id.*

260. [https://perma.cc/NMQ2-5LDJ].

(2015),[261] and Hamilton Township, N.J., Land Development Code section 550-73 (B)(14)(b)(7) (2025).[262]

Reduce Soil Compaction during Construction. Undisturbed soil in the watershed contains pores, constituting around fifty percent of its volume, but construction activities can lead to soil compaction, reducing pore size and volume.[263] Large construction equipment can cause soil volume reduction of twelve to twenty inches, resulting in adverse effects such as impenetrable soil, standing water, increased runoff, and poor vegetation health.[264] Local governments can adopt ordinances addressing soil compaction, specifying equipment use, storage of heavy materials, and rehabilitation measures, with some requiring post-construction soil tests performed by private or government-associated engineers. Examples include Bass River Township, N.J., Code of Ordinances section 13.08.260 (2022),[265] Town of Markham, Ont., By-Law 2011-232 (2021),[266] and Albert Lea, Minn., Code of Ordinances section 50.1039(2)(h) (2025).[267]

Community Septic Systems. Decentralized septic systems can help protect the watershed by ensuring that they are placed away from sensitive watershed areas.[268] Local governments, to safeguard health and the environment, can allow community septic systems, and, in doing so, should enforce rigorous inspection, mandate maintenance through homeowner associations, eliminate exemptions from groundwater standards, and demand evidence of soil suitability in the watershed.[269] Examples include Middleton, Wis., Land Development Code sections 19.01–.05

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261. [https://perma.cc/8J53-KNP5].

262. [https://perma.cc/VNV7-UCY8]. For more examples, see Colonia-Hughes, *supra* note 258.

263. Bradley Adams, *Reduce Soil Compaction During Constructions*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/reduce-soil-compaction-during-construction-3 [https://perma.cc/B4P6-TGR2].

264. *Id.*

265. [https://perma.cc/C2Q5-VH4J].

266. [https://perma.cc/6ZHE-9C72].

267. [https://perma.cc/L54F-HU7L]. For more examples, see Adams, *supra* note 263.

268. *See* Kyler Massner, *Community Septic Systems*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/community-septic-systems-2 [https://perma.cc/N8R9-5V7L] (defining a community septic system as a waste system that allows multiple users to connect to a shared septic tank or field on a smaller lot).

269. *Id.*

(2025),[270] Mason County, Wash., Code of Ordinances sections 8.52.120, 17.03.030 (2025).[271]

Cost of Services Studies for All Developments in Agricultural Areas. Expanding development into rural or agricultural areas may incur unforeseen costs, such as damage and loss to soils and wetlands, which can increase nutrient runoff.[272] Local governments can mandate Cost of Service Studies (COSS) for developments in these areas, assessing population increase, associated costs, and potential revenues.[273] Local COSS regulations can be expanded to include comprehensive analyses of environmental, social, and economic impacts, with mitigation measures enforced if costs exceed benefits, including the creation of development impact fees or requiring changes to the development plan.[274] Examples include Suffolk, Va., Unified Development Ordinance sections B-14, 31-601, B-9(m), B-13, 31-503(k), B-21 (2025),[275] Weld County, Colo., Charter and County Code chapters 20, 22 (2024),[276] and Franklin County, N.C., Code of Ordinances section 4-29(b) (2012).[277]

C. WATER

This last Section explores local strategies that focus on the rivers themselves in the watershed. These include the unprecedented appointment of legal guardians, setbacks, riparian buffer strips, watershed impact analyses, and others.

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270. [https://perma.cc/D2C5-D2PJ].

271. [https://perma.cc/6M9B-79BT]; [https://perma.cc/4953-3YX2]. For more examples, see Massner, *supra* note 268.

272. Haider Naeem & Tegan Jarchow, *Cost of Services Studies for All Developments in Agricultural Areas*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/cost-of-services-studies-for-all-developments-in-agricultural-areas-2 [https://perma.cc/2CLU-N2MM].

273. *See id.* (explaining that a COSS analyzes the fiscal impact of a new development by projecting the population increase, converting that increase into an estimate of increased costs associated with increased public services, projecting potential tax and other revenues generated, and comparing the projected costs and benefits).

274. *Id.*

275. [https://perma.cc/7E3J-54R9]; [https://perma.cc/535W-FG3W]; [https://perma.cc/3XV7-BSC5]; [https://perma.cc/7L7P-RXHF]; [https://perma.cc/A6VA-LNNJ]; [https://perma.cc/6X75-J7WR].

276. [https://perma.cc/JPF4-WXK7]; [https://perma.cc/62AM-6P8J].

277. [https://perma.cc/8QQT-NC2Q]. For more examples, see Naeem & Jarchow, *supra* note 272.

Natural Rights and the Appointment of Legal Guardians to Protect the Local Watershed. In January 2024, Nederland, Colorado appointed two legal guardians to protect a portion of the Boulder Creek and its associated watershed. As one article noted, this was the "first time humans have been appointed to act as legal guardians for nature within the United States . . . that recognized the rights of rivers, forests, animals and ecosystems."[278] The appointment of a guardian, like the appointment of guardians under the law for other purposes, does not necessarily grant any additional rights, but it insures more process for the water and watershed.[279]

Setbacks Protecting Water Quality. Setbacks, restricting or prohibiting development in certain areas, are vital for safeguarding environmentally sensitive zones like riparian areas and wetlands.[280] These requirements may prohibit development, structures, or human habitation in certain widths running parallel to a river, including large areas such as 500 feet from the river, to protect irreplaceable environmental characteristics from human impact.[281] Setbacks, such as riparian buffer strips, help mitigate polluted nutrient runoff by intercepting runoff and limiting construction activities near surface waters.[282] Examples include Fort Collins, Colo., Land Use Code section 3.4.1 (2024),[283] Maplewood, Minn., Code of Ordinances section 18-221

278. Katie Surma, *Colorado Town Appoints Legal Guardians to Implement the Rights of a Creek and a Watershed*, INSIDE CLIMATE NEWS (Jan. 12, 2024), https://insideclimatenews.org/news/12012024/rights-of-nature-boulder-creek-colorado [https://perma.cc/V5T3-WB3S].

279. Michael Booth, *Two Nederland Residents Appointed as "Guardians" of Boulder Creek, Giving It a Voice in Town Policy,* COLO. SUN (Jan. 12, 2024), https://coloradosun.com/2024/01/12/nederland-river-guardians-boulder-creek-colorado [https://perma.cc/24FQ-NWRB] (explaining that the creek guardians "see their role as logical communicators, researching concerns about the [county] watersheds and reporting to the town boards how they could impact a valuable resource").

280. *See* Adams & Bloom, *supra* note 239.

281. *Id.*

282. *See id.* ("One common type of setback requirement used by local governments are riparian buffer strips, a type of 'conservation buffer' that can mitigate the damages of polluted runoff on water quality.").

283. [https://perma.cc/3JXX-PEK4].

(2024),[284] and Hartford, Conn., Zoning Regulations section 6.11 (2025).[285]

Watershed Impact Analysis. A Watershed Impact Analysis (WIA) provides essential information to local governments about a potential development's effects on the watershed, serving as a comprehensive resource for developers, local officials, and the community.[286] Specifically focused on watersheds, this ordinance can be manipulated to require developers to provide all critical information that is relevant to the watershed, including nutrient loads.[287] Beyond WIA content, communities should consider factors such as minimum development qualifications to initiate the WIA, approval criteria and whether information in a WIA can halt a project, and the appeal process in crafting WIA ordinances. Examples include Blaine County, Idaho, County Code sections 9-19-1 to 9-19-6 (2024),[288] and Bonita Springs, Fla., Code of Ordinances section 4-348 (2025).[289]

Stormwater Management Credits for Providing Agricultural Land or Open Space. Stormwater management credits can be granted to landowners to help preserve rural and agricultural land and open space by utilizing techniques like green infrastructure, credit trading, and water absorption to manage stormwater.[290] Local governments can implement credit systems tailored to their needs, applying credits to utility fees or property taxes, and establishing review boards for efficient approval of stormwater management credits with a focus on nutrient

284. [https://perma.cc/9H2Y-PUUJ].

285. [https://perma.cc/B6NX-G7M6]. For more examples, see Adams & Bloom, *supra* note 239.

286. *See* Alec LeSher, *Wetland Habitat Impact Analysis*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/require-wetland-habitat-impact-analysis-4 [https://perma.cc/F2EW-7NZR].

287. *Id.*

288. [https://perma.cc/A68E-BB4R].

289. [https://perma.cc/PL53-GXXZ]. For more examples, see LeSher, *supra* note 286.

290. *See* Joseph Coffey, *Stormwater Management Credits for Providing Agricultural Land or Open Space*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/stormwater-management-credits-for-providing-agricultural-land-or-open-space-6 [https://perma.cc/WK2R-SWWG] (first describing green infrastructure as a form of stormwater management that soaks up and stores water and then explaining that credit trading programs are most effective when development projects have to implement runoff prevention technologies).

reduction strategies.[291] Examples include Montgomery County, Md., Code of Regulations section 19.35.01.05 (2025),[292] Springfield, Ohio, Codified Ordinances chapter 918 (2024),[293] and Greenville, S.C., Code of Ordinances section 19-7.4 (2025).[294]

Rain Gardens. Rain gardens, designed to absorb stormwater runoff from impervious surfaces, can significantly reduce runoff by up to ninety-eight percent, mitigating strain on the watershed and reducing nutrient pollution from reaching the watershed.[295] Rain garden ordinances, often defining acceptable types and incentivizing native plant use, may require compliance with local stormwater regulations, offer credits, grants, or rebates, and establish specific criteria for installation and maintenance.[296] Examples include Blaine, Minn., Code of Ordinances section 34-541 (2025),[297] Order No. 970, app. A (2022) (codified at Kennett Square, Pa., Code of Ordinances ch. 24 (2025)),[298] and Bensalem, Pa., Code of Ordinances section 196-148 app. I (2024).[299]

Limiting Septic Systems Near Sensitive Areas of the Watershed. In rural areas lacking sewage infrastructure, septic systems are commonly used, posing challenges for preserving wetlands and biodiversity, especially in subdivisions with multiple septic systems.[300] Some local regulations offer options such as local government approval or prohibition of septic systems,

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291. *Id.*

292. [https://perma.cc/H53L-Q4N8].

293. [https://perma.cc/B85G-ETZ4].

294. [https://perma.cc/UR6D-34S3]. For more examples, see Coffey, *supra* note 290.

295. Katie Gatzke & Amy Campbell, *Rain Gardens*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/rain-gardens-8 [https://perma.cc/84EC-3JWV].

296. *Id.*

297. [https://perma.cc/C4WW-P55M].

298. [https://perma.cc/696C-LQ99] (incorporating Kennett Square, Pa., Code of Ordinances ch. 24, app. A (2022), [https://perma.cc/2CZK-7MHK]).

299. [https://perma.cc/EWM3-DJ68]. For more examples, see Gatzke & Campbell, *supra* note 295.

300. *See* Alec LeSher, *Septic Systems Near Significant Wildlife Habitats*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/restrict-septic-systems-near-significant-wildlife-habitats-3 [https://perma.cc/3TUL-JALG] ("For example, instead of one septic system on a thirty-acre lot, the subdivision may consist of fifteen two-acre or thirty one-acre lots and fifteen or thirty septic systems, raising significant challenges for preserving wildlife habitat and biodiversity.").

emphasizing the need for sustainable development practices and impact analyses to reduce the number of septic systems near sensitive areas of the watershed.[301] Examples include Zoning Ordinance of the City of Lebanon, N.H., sections 401.1 to 401.6 (2025),[302] and Tuscaloosa, Ala., Municipal Code 13-51 (2025).[303]

Pervious Cover Minimums and Incentives. Some local governments are encouraging or mandating the implementation of a minimum amount of permeable pavement in certain projects.[304] Permeable pavements, which enable water infiltration, encompass various forms and technologies, such as interconnecting pavers and porous concrete.[305] Permeable pavement can help purify the water, reducing nutrient pollution, as the water flows back into the watershed.[306] Examples include L.A. County, Cal., Code of Ordinances section 22.44.1340(G) (2025),[307] San Antonio, Tex., section 35-210 (2023),[308] and Fairway, Kan., Code of Ordinances section 15-264 Zoning Districts (2024).[309]

D. PART IV SUMMARY

The policy recommendations outlined above illustrate the diverse and creative ways local governments can navigate legal constraints to mitigate nutrient pollution and improve water quality. By leveraging existing authority over vegetation, soil, and water management, localities can meaningfully influence nutrient cycles despite preemptive barriers to directly regulating fertilizers. These strategies reflect a systems-thinking approach that acknowledges the interconnectedness of land use, hydrology, and nutrient flows. However, while these local initiatives are essential, they remain only a partial solution. The watershed

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301. *Id.*

302. [https://perma.cc/4AY5-EKQM].

303. [https://perma.cc/W7BE-YSNE]. For more examples, see LeSher, *supra* note 300.

304. Kerrigan Owens, *Pervious Cover Minimums and Incentives*, SUSTAINABLE DEV. CODE, https://sustainablecitycode.org/brief/pervious-cover-minimums-and-incentives-8 [https://perma.cc/2L4K-XEF2].

305. *Id.*

306. *See id.* (explaining that local stormwater utilities that maintain drainage systems otherwise bear the costs associated with impermeable pavement).

307. [https://perma.cc/C5YJ-H3VJ].

308. [https://perma.cc/CT4Z-Y7X5].

309. [https://perma.cc/8RDE-HLZP]. For more examples, see Owens, *supra* note 304.

remains subject to many local, state, and federal laws not addressed here. While this suite of policy interventions can help local governments maneuver within the existing legal framework, it does not eliminate the need for broader systemic reforms at the state and federal levels. Local action alone cannot fully resolve the collective action problem inherent in watershed management. By embracing the tools available to them, however, local governments can play a crucial role in alleviating the pressures on shared water resources, demonstrating that even within constraints, meaningful progress is possible.

CONCLUSION

The intricate dynamics within the Mississippi River watershed, challenged by recurring nutrient spikes, underscore the urgent need for robust local governance. The tragedy of the commons appears on the surface to accurately describe local actions in the watershed. However, this Article contends that federal and state laws ostensibly compel local governments into a rational and detrimental pattern of behavior, contributing to the degradation of the watershed. However, this Article also shows that local authorities harbor untapped potential to bridge the gap between theoretical considerations and practical solutions to nutrient pollution. By strategically wielding their existing legal authority, local governments can emerge as proactive stewards, safeguarding and rejuvenating the delicate balance of the Mississippi River watershed in the face of escalating environmental threats.

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