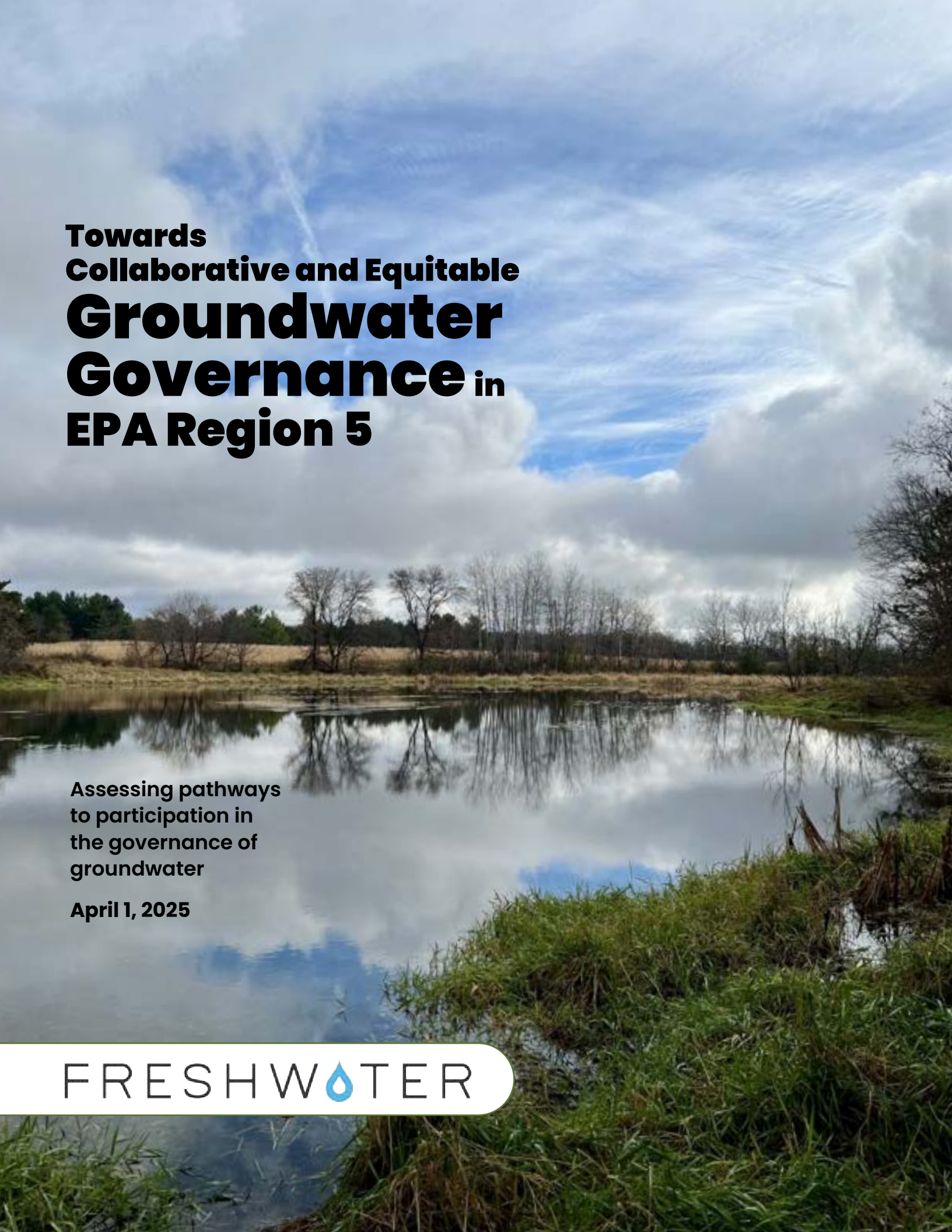

Towards Collaborative and Equitable Groundwater Governance in EPA Region 5

Assessing pathways to participation in the governance of groundwater

April 1, 2025

FRESHWATER

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Our thanks to external partners for participation, partnership, and external reviews. We'd like to express our sincere appreciation for the Tribal, federal, state, and municipal agency staff who brought their expertise, and to the local community members who brought their time and knowledge to this project. Our gratitude extends to all who attended and hosted the workshops, provided advice, and to the Joyce Foundation for making this work possible.

Note: This is not intended to constitute legal advice and only is intended as policy recommendations.

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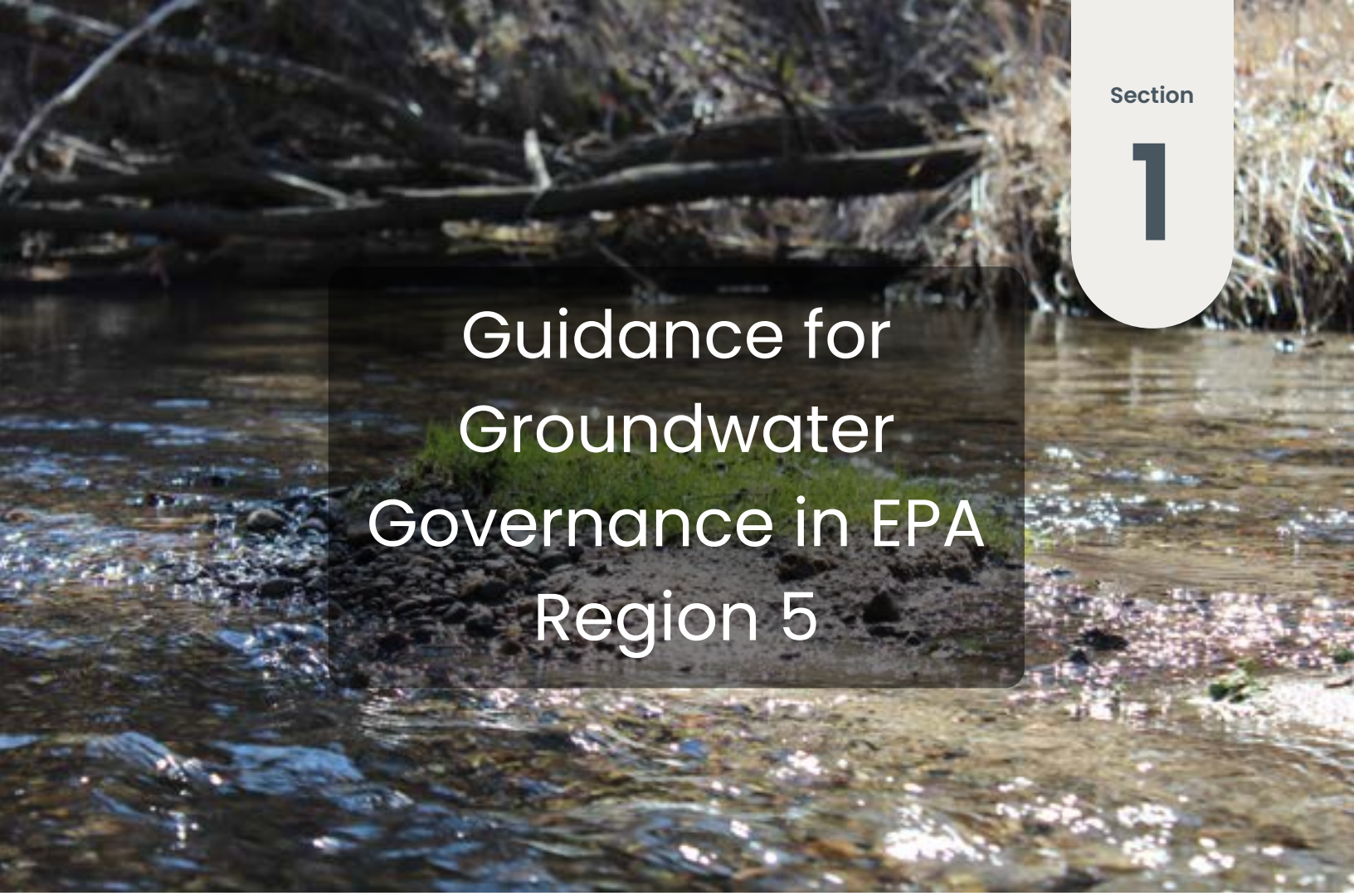

Section

1

Guidance for Groundwater Governance in EPA Region 5

Water is essential to life, and groundwater has its own unique benefits and limitations on its use. Groundwater is a hidden reservoir supporting biodiverse surface-water ecosystems, human establishments, industries, irrigated agriculture, and more.[1] New and accelerated demand for water-intensive crops, artificial intelligence powered by data centers, and sustainable aviation fuel bring industries to the region.[2] As climate shifts, towns across the United States (U.S.) that grapple with water scarcity look to this area. As the need for water increases, so does the pressure to understand how much can be used before sacrifices must be made. Some states in the region are trying to prepare for future water scenarios but there is uncertainty about how to proceed.[3]

1 Bhagwat, Vinod R. "Safety of Water Used in Food Production." Edited by Ram Lakhan Singh and Sukanta Mondal. Food Safety and Human Health, August 9, 2019, 219–47. https://doi.org/10.1016/b978-0-12-816333-7.00009-6.

2 Huang, H.W., S. Jiang, S.Y. Zhang, Y.M. Wang, J.C. Wang, X.N. Zhao, and X.R. Gao. "Agricultural and Energy Products Trade Intensified the Water Scarcity in the Grain and Energy Base in Northern China." Agricultural Water Management 307 (February 1, 2025): 109208. https://doi.org/10.1016/j.agwat.2024.109208.

3 Grumke, Kate. "Missouri and the Midwest Are Gearing up for Water Fights Fueled by Climate Change." St. Louis Public Radio, August 30, 2024. https://www.stlpr.org/health-science-environment/2024-08-30/missouri-midwest-gearing-up-water-fights-climate-change.

Executive-branch agencies and planning groups report that decision-makers need more information to weigh long-term water-use alternatives. At the local resident level, there is uncertainty over who is in charge, how to engage, and if the preferences of community members are being heard. At every level, more clarity is needed on which other jurisdictions share their groundwater and how to collaborate equitably. There is a need for cohesive regional water governance.[4]

Introduction

This project builds on previous collaborative work between Freshwater, the legal consultancy Water365, the University of Minnesota, the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), the Bureau of Indian Affairs (BIA), and their contributing partners. Referred to in this report as Phase I, it resulted in a foundational report that assessed the status of the groundwater governance framework and the potential for future policy work in Environmental Protection Agency's (EPA) Region 5 – an area that includes the six western Great Lakes states of Minnesota, Wisconsin, Michigan, Illinois, Indiana, and Ohio and 35 federally recognized Tribal nations.[5][6][7][8] The report covered groundwater institutions, governance approaches, and some of the challenges that existed. Although the report focused on groundwater quantity, groundwater of sufficient quality also impacts the quantity available.

The purpose of this second phase of work is **to help to build a regional groundwater governance system based on common understanding that fosters inclusive prosperity, ecological health, and repairs past harm, while being resilient to climate and population stresses over the next generation.** To do this, Freshwater conducted four activities during the 18-month-long project:

I. **Groundwater knowledge workshops:** Focused conversations at three groundwater workshops identified specific regional issues, promoted an understanding of current practices and challenges and management strategies for shared groundwater sources, and elevated local groundwater concerns with decision makers. Invitations went to individuals actively navigating and effecting change in groundwater policy and intended to emphasize Tribal stakeholders and community groups to reveal their lived experiences. Meeting locations were aligned with treaty territories and

4 Palermo, Fabrizio. "Water Security: How to Ensure Access to Water in a Changing World." World Economic Forum: Food and Water, January 14, 2025. https://www.weforum.org/stories/2025/01/water-security-changing-world-wef25/.

5 **Note:** This report may be referenced as Phase I, the first report, phase one, or the first phase of the project. It is the foundation upon with all following work in Phase II was built.

Mayer, Terin V, Eileen J Kirby, Linda Reid, Carrie E Jennings, Lila Franklin, and Benjamin Edelstein. "Groundwater Governance in EPA Region 5." The Joyce Foundation, May 2024. https://www.joycefdn.org/groundwater-governance-report.

6 "Region 5 Tribal Program." EPA, February 18, 2025. https://www.epa.gov/tribal/region-5-tribal-program.

7 **Note:** This does not include two pieces of trust land held by federally recognized Tribes located outside of EPA Region 5; trust land in Indiana held by the Miami Tribe of Oklahoma headquartered in Oklahoma and trust land in Illinois held by the Prairie Band of Potawatomi Nation headquartered in Kansas.

8 **Note:** Choices made in this report align with the style guide produced by Native Governance Center. Tribe, Tribal, Indigenous, Native, and similar words are intentionally capitalized. For other references, refer to Native Governance Center: Style Guide, Feb 2021.

hosted or supported by Tribal partners with participation by other political jurisdictions.

II. **Ongoing Tribal government influence amplification:** Technical support and assistance in decision-making and planning forums related to groundwater policy prioritized by Tribal partners included connecting Tribal staff with common interests and groups, providing scientific support for public comments, and assisting ongoing Tribal policy engagement in local processes.

III. **Improving intergovernmental policy and practice:** Freshwater supported the Chicago Metropolitan Agency for Planning (CMAP) as they interviewed stakeholders in the Northwest Water Planning Alliance (NWPA) to document existing groundwater management practices and developed recommendations for best practices for groundwater conservation, appropriation, and control with focus on high-capacity wells.

IV. **Cross-area comparisons:** Rural and metropolitan area comparisons provided model groundwater principles, best practices, and specific policy language to facilitate improved intergovernmental collaboration and sustainable groundwater sharing. These were compared with existing groundwater-sharing agreements both in the region and around the world.

From this project a question has emerged: **Is there a reasonable pathway to participate in the governance of groundwater?** Currently, the laws, regulations, ordinances, and policies governing the use of groundwater in Tribal, federal, state, and local jurisdictions throughout EPA Region 5 are not well-connected. This is largely intentional and a result of the distributed structure of governance in the U.S. As new interest groups vie for this region's groundwater, governance gaps create a vulnerability for communities that depend on groundwater to support their basic needs.

The analysis and results of this work are intended for citizen-residents, planners, policy makers, implementors, and any who are affected by the decision-making of groundwater governance. This work is intended to be inclusive of western science and Traditional Ecological Knowledge (TEK) and looks toward potential paths forward for collaborative and equitable groundwater governance in the region.[9]

The remainder of this chapter provides a brief overview of the current water governance landscape at the Tribal, federal, state, and local levels throughout EPA Region 5, with a continued emphasis on groundwater quantity. This chapter also provides an overview of the work conducted in Phase II. The sections that follow provide a summary of how the groundwater science workshops were conducted (Section 2); a comparison of the four focus areas where work was conducted (Section 3); an assessment of opportunities for collaborative transboundary governance (Section 4); and conclusions and recommendations for next steps toward regional groundwater governance systems rooted in inclusive prosperity, ecological health, and future generations in EPA Region 5 (Section 5). A more in-depth assessment of regional policy institutions, actors, and hydrogeology exists in the report from Phase I of this project: Groundwater Governance in EPA Region 5.

9 **Note:** There are many articles and websites on TEK as traditional ecological knowledge is both specific and regional to place. The following is one reference that provides a broad framework on TEK.

Inglis, Julian T. Traditional ecological knowledge: Concepts and cases. Ottawa: IDRC Books / Les Éditions du CRDI, 2014.

Regional Groundwater Governance Systems

Groundwater governance encompasses how people and their institutions collaborate across various jurisdictional levels to establish laws, policies, and decisions to manage the groundwater they share.

Groundwater management encompasses the practical implementation of those laws, policies, and decisions.[10]

In the U.S., approximately 38% of Americans use groundwater as their primary source of drinking water, though the numbers are higher in EPA Region 5 (see Table 1.0).[11] While surface water and groundwater are often connected, they are regulated differently, and water quality is regulated differently than water quantity. The following sections discuss the roles of the Tribal, federal, state, and local governments in the regulation of water overall (quantity and quality). This report focuses on the governance of groundwater quantity, but it is helpful to provide a brief background on other types of water law and policy for context.

Table 1.0. Population in EPA Region 5 Whose Drinking Water is Sourced From Groundwater

	MN	WI	IL	MI	IN	OH
Percentage of population whose drinking water is sourced from groundwater (water utility or private well)	75%[12]	66%[13] [14]	26%[15] *	44%[16]	60%[17] **	~42%[18]

Percentage of the population within EPA Region 5 that uses groundwater as their source of drinking water. Following the format of the Phase I report, columns move west to east and will throughout this report.

*In IL, ~65% of community water systems are also groundwater dependent.

**Data for Indiana was sourced from Phase I report. Currently there is only regional data for drinking water sourced from groundwater.

10 Lopez-Gunn, E., M. R. Llamas, A. Garrido, and D. Sanz. "Management of Water Resources." Chapter. In Treatise on Water Science 1, 1:97–127. Elsevier Science, 2011. https://doi.org/10.1016/B978-0-444-53199-5.00010-5.

11 "Groundwater: Groundwater Facts." Groundwater Facts, 2024. https://www.ngwa.org/what-is-groundwater/About-groundwater/groundwater-facts.

12 "Groundwater." Minnesota Department of Natural Resources, February 6, 2025. https://www.dnr.state.mn.us/waters/groundwater_section/index.html.

13 *Ibid.*

14 "Water: Drinking Water." Wisconsin Department of Health Services, October 24, 2023. https://www.dhs.wisconsin.gov/water/drinking.htm.

15 Annual groundwater and drinking water program review, 2023. https://epa.illinois.gov/content/dam/soi/en/web/epa/documents/compliance-enforcement/drinking-water/2023-Annual-Groundwater-and-Drinking-Water-Report.pdf.

16 "Mi Drinking Water Sources." SOM - State of Michigan. Accessed February 26, 2025. https://www.michigan.gov/mdhhs/safety-injury-prev/environmental-health/topics/care-for-mi-drinking-water/sources.

17 Mayer, Terin V, Eileen J Kirby, Linda Reid, Carrie E Jennings, Lila Franklin, and Benjamin Edelstein. "Groundwater Governance in EPA Region 5." The Joyce Foundation, May 2024. https://www.joycefdn.org/groundwater-governance-report.

18 "Groundwater Resources." https://ohiodnr.gov/discover-and-learn/safety-conservation/about-ODNR/geologic-survey/groundwater-resources, n.d. Accessed February 26, 2025.

The multi-jurisdictional groundwater governance landscape present across the region today is complex and at the same time, not comprehensive or well connected. Groundwater is managed by a combination of appropriation doctrines, pollution regulations, and land ownership rights that are set by the state. At times, a dissonance exists between the intention and effect of these systems which encompass laws, acts and statues, ordinances, regulations, and policies[19] (see Table 1.1).

Table 1.1. Policies and Regulatory Systems at Play in Governance

System	Definition	Federal	Tribal	State	Municipal
Law	A rule or system of rules passed by the legislative branch of the government that can be legally enforced.	x	x	x	x
Act / Statute / Resolution	A written law which, when passed by a legislative body, becomes enforceable as a law.	x	x	x	
Regulation / Rule	An official rule issued by an administrative agency through the executive branch of the government with the weight of a law.	x	x	x	
Ordinance / Code	A local law or decree enacted by a city, town, or other municipal-level government.		x		x
Policy	A non-legally binding guideline or directive implemented to address specific issues or to achieve specific outcomes.	x	x	x	x

This table provides clear definitions as used in governance practice, and includes which body has authority to create and implement a practice, and at what level(s) of jurisdiction the practice may be found.

Tribal Governance and Treaties

Within Indigenous culture, many stories are passed down through oral tradition. As a result, there are variations in the written versions that document Indigenous history. Different communities and dialects use different spellings for the same or similar words. The names and words used in this report are one version.

This section is intended to provide an overview of Tribal governance as it relates to groundwater quantity, the realm of environmental governance, and the jurisdictional complexities that arise when a domestic dependent nation exists within and across city and township borders, within and across county lines, within a state, and a nation. This section does not cover specifics of civil or criminal law, or specifics of state and Tribal relationships; this section does not provide in-depth knowledge or interpretation of treaties or the history of treaties. Each Tribal nation is unique and is an independent, sovereign legal and political entity. Tribal nations may also be co-signatories to treaties and may

19 Kosti, Nir, David Levi-Faur, and Guy Mor. "Legislation and Regulation: Three Analytical Distinctions." The Theory and Practice of Legislation 7, no. 3 (September 2, 2019): 169–78. https://doi.org/10.1080/20508840.2019.1736369.

share rights and relationships with other Tribal nations through ceded territories that stretch across state lines. For further knowledge, seek out information from official Tribal resources.

Tribal governance and treaties are complicated and complex. Each Tribal nation is sovereign and has the inherent authority to regulate its own land and citizens. While Tribal nations existed long before the U.S., a series of treaties led to the creation of both reservations and states. In regions where prior appropriation is followed, the creation of reservations ahead of the creation of states has implications in water law. Further treaties also explicitly reserved usufructuary rights of certain Tribes in this region. These reserved rights still exist and have been upheld through state and federal courts, including a U.S. Supreme Court decision.[20] With regards to these treaties, it can be argued that groundwater must exist in sustainable quantities to support usufructuary rights of signatory Tribes. Any withdrawals or impairment to groundwater quantity that interfere with the right to hunt, fish, gather, or otherwise travel and occupy within or across ceded territories – with court acknowledgement that the waters of the Great Lakes cannot be settled – can be an infringement of the treaties and treaty-reserved rights.[21]

The place now referred to as North America has been inhabited for over 20,000 years.[22] [23] Though part of a longer migration story, EPA Region 5 is now home to 35 federally recognized Tribal nations. Research in this report focuses mainly on Dakota and Anishinaabe nations due to the geographic scope where the workshops took place and because a majority of the Tribal participants were either Dakota or Anishinaabe nations. This section provides a brief overview of treaties in EPA Region 5, usufructuary rights, and the rights of Tribal nations in managing water today.

Tribal Governance

As sovereign nations, federally recognized Tribes hold a unique legal and political position. Formally, "American Indian" is a legal and political designation of a citizen of a tribal nation, rather than as a racial or ethnic category.[24] The Commerce Clause (U.S. Const. art I, §8, cl.1) of the U.S. Constitution vests Congress with the authority to engage in relations with the Tribes. This was upheld by a decision in the Marshall Trilogy which articulates that Tribes retain inherent powers of self-government as "domestic dependent nations" and that the Tribe is "distinct community."[25] As such, the laws of the state have no force.[26]

20 Minnesota v. Mille Lacs Band of Chippewa Indians, 526 U.S. 172 (1999).

21 Fox Opinion, 1979.

22 Becerra-Valdivia, Lorena, and Thomas Higham. "The Timing and Effect of the Earliest Human Arrivals in North America." Nature 584, no. 7819 (July 22, 2020): 93–97. https://doi.org/10.1038/s41586-020-2491-6.

23 Praetorius, Summer K., Jay R. Alder, Alan Condron, Alan C. Mix, Maureen H. Walczak, Beth E. Caissie, and Jon M. Erlandson. "Ice and Ocean Constraints on Early Human Migrations into North America along the Pacific Coast." Proceedings of the National Academy of Sciences 120, no. 7 (February 6, 2023). https://doi.org/10.1073/pnas.2208738120.

24 "Frequently Asked Questions about Native Americans." Office of Tribal Justice, August 24, 2023. https://www.justice.gov/otj/about-native-americans.

25 Cherokee Nation v. Georgia, 30 U.S. (5 Pet.) 1 (1831).

26 Worcester v. Georgia, 31 U.S. (6 Pet.) 515 (1832).

Today, Tribal sovereignty, though diminished, remains intact, and Tribal governments retain the ability to govern their citizens and lands.[27] On reservations, there is a mix of land types such as Tribal fee land, trust land, member fee land, member trust land, and nonmember fee land. Colloquially, these lands are known as "Indian Country," and include land owned by nontribal members within the bounds of the reservation.

> **Trust land** – Land title is held by the federal government for either a Tribe or by Tribal members, as allotments may be managed for the benefit of families as well as individuals. Land cannot be sold, mortgaged, leased, or otherwise encumbered without federal government approval.
>
> **Fee land** – Land on reservation not held in trust by federal government. May be owned by individual Tribal members, nontribal members, other entities, collectives, or governments.

For Tribal nations, there may be specific laws or regulations that govern water management and appropriations as set forth and enforced by the Tribal government. Tribal regulations, including water quality standards and permit requirements, may differ from the requirements set forth by the state and may be enforceable on reservations, trust lands, and fee lands.[28] Nontribal members may also be held to these standards and regulations when 1) authority is authorized by Congress – as in the case of Tribal Implementation Plans (TIPs) and the delegated authority of the EPA with the Clean Air Act (CAA) – or 2) when a Tribal regulation is necessary to protect Tribal self-interest and internal Tribal relations.[29] The U.S. Supreme Court has historically decided in favor of state and nonmember interests over Tribal interests.

Recent attempts to improve working relationships between states and Tribal nations in Minnesota, Wisconsin, and Michigan include a series of executive orders, and in some later cases state statues, establishing Tribal-state liaisons.[30] [31] [32] [33] These liaisons are positioned with state agencies with the responsibility to conduct outreach and act as a point of contact with that agency for Tribal nations.

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27 American Indians, Indian Tribes, and State Government, and Mary Davis, MN House Research § (2023). https://www.house.mn.gov/hrd/pubs/indiangb.pdf.

28 "Understanding Tribal-State Jurisdiction." Native American Rights Fund, September 12, 2023. https://narf.org/tribal-state-jurisdiction/.

29 Montana v. United States, 450 U.S. 544 (1981)

30 Government-to-Government Relationships with Tribal Governments. Minnesota Statutes. Stat. 10.65 (2021).

31 Wisconsin Executive Order 018 of April 9, 2019, Relating to an Affirmation of the Intergovernmental Relationships Among the State of Wisconsin and Tribal Nations Located Within the State.

32 Michigan Executive Order 2019-17 of February 21, 2020, Tribal Relations.

33 Office of the Legislative Liaison. Michigan Compiled Laws, act 208 § 4.791.new-4.794.new (2024).

Treaties in EPA Region 5

The long history of land stewardship and management began with the original stewards, Indigenous peoples and Tribal nations. The history of the Unites States and Tribal nations has always included treaties. According to the Supremacy Clause (U.S. Const. art VI, cl. 2), which was ratified in 1788, treaties made "under the authority of the United States remain the supreme Law of the Land."

> This Constitution, and the Laws of the United States which shall be made in Pursuance thereof; and all Treaties made, or which shall be made, under the Authority of the United States, shall be the supreme Law of the Land; and the Judges in every State shall be bound thereby, any Thing in the Constitution or Laws of any State to the Contrary notwithstanding.
>
> – Article VI, Clause 2, United States Constitution

In EPA Region 5, Tribal nations began to sign treaties with the U.S. in 1785, with the Treaty with the Wyandot, in the state now known as Ohio.[34] This treaty began the practice of annual payments from the U.S. of goods, supplies, and food in exchange for land concessions from Tribal nations and established boundaries of Tribal land. The Treaty of Greenville was signed 10 years later in the same geographic region with many of the original signatories and recognized that Tribal nations, party to the treaty, retained the right "to hunt within the territories and lands…ceded to the United States, without hindrance or molestation."[35] This established a practice of usufructuary rights for Tribal nations, or the right to use and benefit from a property while ownership belongs to another.

Throughout 1795 and 1871, the U.S. and Tribal nations signed multiple treaties, which were ratified by Congress, across the western Great Lakes region. These culminated in agreements like the Treaty of Greenville; a guarantee of goods, supplies, and food from the U.S., and expanded to include hiring, covering debts, support of education, and annual cash payments in addition to food and other goods in exchange for land concessions from Tribal nations. These treaties also established Tribal land

34 Treaty with the Wyandot, etc., U.S.-Wyandot, Delaware, Ottawa, Chippewa, Jan. 21, 1785.

35 Treaty with the Wyandot, etc., U.S.-Wyandot, Delaware, Ottawa, Chippewa, etc, Aug 3, art, VII ,1795. Commonly referred to as the Treaty of Greenville.

boundaries. Treaties with the Ojibwe nations in what are now Michigan, Wisconsin, and Minnesota included explicitly reserved usufructuary rights, including the retained rights to hunt, fish, gather in ceded treaty territory, and to occupy the land.[36] [37] [38] [39] [40] [41] [42]

These treaties established boundaries for lands within which Tribes could exercise sovereign authority over their members, known as reservations, and in the case of some Ojibwe nations with usufructuary rights, established land referred to as "ceded treaty territory" in which those rights could be exercised. Certain Tribes have co-management agreements with the state governments within the boundaries of these ceded territories. Co-management is supported through intertribal commissions, including Great Lakes Indian Fish and Wildlife Commission (GLIFWC), Chippewa Ottawa Resource Authority (CORA), and 1854 Treaty Authority, which have delegated authority to regulate those rights and support Tribal enforcement.

The sustainability of groundwater is crucial for upholding treaty-reserved usufructuary rights.[43] Beyond 1871, court cases at the state and federal level upheld the rights of treaty holders. In 1905, a U.S. Supreme Court Case concluded that Tribal nations retained any rights not expressly surrendered in the treaty, including the rights to fish, hunt, and other privileges.[44] In 1908, Tribal water rights were

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36 **Note:** This does not encompass all treaties signed by parties within the region but focuses on treaties that include usufructuary rights, establish specific boundaries. or named parties who were within Phase II of this project. For further references, check the Library of Congress or Oklahoma State University's Tribal Treaties Database.

37 Treaty with the Chippewa, U.S. -Chippewa, 1819, art. V. Commonly referred to as the Treaty of Saginaw. Reserved the right to hunt upon land ceded, and "and the Indians shall, for the same term, enjoy the privilege of making sugar upon the same land, committing no unnecessary waste upon the trees."

38 Treaty with the Ottawa, U.S.-Ottawa, Chippewa, art. XIII, 1836. Commonly referred to as the Treaty of Washington. Reserved the right to hunt and "the other usual privileges of occupancy, until the land is required for settlement."

39 Treaty with the Chippewa, U.S.-Chippewa, art. V, 1837. Commonly referred to as the Treaty of St. Peters or the White Pine Treaty. Guaranteed the privilege "of hunting, fishing, and gathering the wild rice, upon the lands, the rivers and the lakes included in the territory ceded."

40 Treaty with the Chippewa, U.S.-Chippewa of Lake Superior, Chippewa of the Mississippi, art. II-III, 1842. Commonly referred to as the Treaty of La Pointe. Reserved the right to hunt on the ceded territory, "with the usual other privileges of occupancy" and established "all the unceded lands belonging to the Indians of Fond du Lac, Sandy Lake, and Mississippi bands, shall be the common property and home of all Indians, party to this treaty."

41 Treaty with the Chippewa, U.S.-Chippewa of Lake Superior, Chippewa of the Mississippi, art. VIII, art. XIII, 1854. Commonly referred to as the Treaty of 1854. Treaty established reservation boundaries (art. III) and confirmed benefits of former treaties prior to 1847 (art. VIII), and acknowledge the signatories, with the exception of the Chippewa of the Mississippi, as the Chippewa of Lake Superior (art. XII).

42 Treaty with the Ottawa and Chippewa, U.S.-Ottawa, Chippewa, art. III, 1855. Commonly referred to as the Treaty of Detroit. Renewed the reserved right by the Chippewa of Sault Ste. Marie to fish and occupy ceded territory as established by previous treaty of 1820.

43 **Note:** Courts are still hearing and upholding the rights of Tribes and treaties today. In 2018, a case commonly known as the Culverts Case, or U.S. v. Washington, No. 13-35474 (9th Cir. 2017), affirmed the reserved rights of Tribes in the Pacific Northwest. The U.S. Supreme Court amended its previous opinion and affirmed a Washington state district court's order issuing an injunction against the state. SCOTUS concluded that the state violated and continued to violate its obligation to the Tribes under the fishing clause of the treaties.

44 United States v. Winans, 198 U.S. 371 (1905).

acknowledged, particularly related to the survival and self-sufficiency of Indigenous peoples.[45] In 1983, the Winters Doctrine was extended by holding that water rights are reserved sufficient to support hunting and fishing rights as part of the purpose of the treaty.[46]

Federal Governance

At the federal level, groundwater governance is managed by administrative agencies through the executive branch of the government. The federal government and all administrative agencies hold a legal trust obligation to Tribal nations, and as a signatory to many treaties, arguably have an additional responsibility to ensure the sustainability of treaty resources. Federal administrative oversight largely pertains to water pollution levels, the discharge of pollutants, and other water quality standards, including minimum safe drinking water standards. The federal government also retains the right to regulate all navigable waters. As a result, federal agencies largely focus on the enforcement, implementation, and research of cohesive water management policies that concentrate on water quality. Some of the federal administrative agencies' ability to regulate groundwater has changed since the Chevron Doctrine was overturned by the U.S. Supreme Court in June 2024.[47] [48] The Chevron Doctrine previously required courts to defer to agency interpretations of ambiguous statutes.[49] Loper Bright Enterprises v. Raimondo reasserted the judiciary's role in interpreting statute.

Most federal acts are intended to improve drinking water quality and apply to groundwater and surface water used as a source of drinking water. At this time, there are no federal programs that regulate or manage water quantity. Some of these federal rules and acts require the states to design and implement a program, with EPA oversight. The EPA oversees several federal programs that regulate water quality including the 1972 Clean Water Act (CWA), the 1974 Safe Drinking Water Act (SDWA), and the 2006 Ground Water Rule (GWR).[50] [51] [52] The 1986 amendment to the SDWA expanded the EPA's authority to include wellhead protection and required each state to develop and submit a wellhead protection program for EPA approval.

45 Winters v. United States, 207 U.S. 564 (1908).

46 Adair v. United States, 723 F.2d 1394 (9th Cir. 1983).

47 Rodman, Rachel, and Alec Albright. "U.S. Supreme Court Strikes down Chevron Doctrine-What You Need to Know." White & Case LLP, July 8, 2024. https://www.whitecase.com/insight-alert/us-supreme-court-strikes-down-chevron-doctrine-what-you-need-know.

48 Loper Bright Enterprises v. Raimondo, 603 U.S. 2024.

49 Chevron U.S.A., Inc. v. NRDC, 467 U.S. 837 (1984).

50 The basis of the CWA was established in 1948 as the Federal Water Pollution Control Act but was reorganized and expanded in 1972. the official text can be found in the United States Code. 33 U.S.C. §1251 et seq. (1972).

51 SDWA was originally passed in 1986 and amended in 1986 and 1996. It does not regulate private wells which serve fewer than 25 individuals. 42 U.S.C. Ch. 6A, Sub. XII; 40 CFR 141.

52 40 CFR Parts 9, 141, 142 Subpart S.

In other cases, the federal government delegates authority to the state, and allows the state to administer programs, such as state authority to issue CWA Sec. 402 and Sec. 404 permits which regulate direct discharge as part of the National Pollutant Discharge Elimination System (NPDES).[53] A federally recognized Tribe may apply to the EPA for Treatment as a State (TAS) status with regards to the CWA.[54] This status expressly provides authority for Tribal nations to have the same delegated authority within reservations boundaries and allows Tribal governments to adopt, implement, and manage federal CWA programs as states do.[55] As obtaining TAS status is reported to be strenuous, many Tribal water suppliers instead participate in the Tribal Public Water System Supervision Program (TPWSSP) which is administered by the EPA and fulfills the same functions as the SDWA.[56] [57]

In EPA Region 5, the EPA Water Quality Standards (WQS) program allows states and Tribes with TAS approval for the WQS program to set specific water quality standards under the CWA.[58] For more in-depth information on water quality standards and interactions with Tribal rights, see Appendix A.

State Governance

The U.S. federal government is one of limited power when it comes to groundwater quantity. While the federal government retains authority to regulate pollution and discharge to groundwater, individual states are responsible for the governance and appropriation of surface water and groundwater within their borders. States utilize a series of management systems to regulate and permit water allocations. In many cases, a state may use one system for surface water and another system for groundwater. As surface water and groundwater may be connected, and as water ignores geopolitical borders, equitable and sustainable use in regulatory practice requires technical mapping, scientific understanding, and cooperative management agreements across jurisdictions.

53 CWA, Sec. 404 broadly establishes a program to regulate the discharge of dredged or fill materials into the waters of the U.S., including wetlands. CWA, Section 402 relates to the permits for discharge of pollutants. Subsection 1314 discusses state administration of permit programs for discharges into navigable waters within its jurisdiction. Certain activities and sectors are excused.

54 **Note:** In Indian country, TAS may be known as Treatment as a Sovereign.

55 Beyond the CWA, Tribes may also apply for TAS with the Clean Air Act (CAA), the Toxic Substance Control Act (TSCA), and the SDWA.

56 The purpose of the Public Water System Supervision (PWSS) program is to establish, implement, and enforce health protection standards for drinking water systems that serve the public. 1986 amendments allow Tribes to assume PWSS if they meet necessary standards.

57 "Tribal Public Water System Supervision Program | US EPA." 2015. US EPA. January 12, 2015. https://www.epa.gov/tribaldrinkingwater/tribal-public-water-system-supervision-program.

58 US EPA. 2019. "Water Quality Standards Handbook | US EPA." US EPA. October 4, 2019. https://www.epa.gov/wqs-tech/water-quality-standards-handbook.

As the law has evolved, so have the systems. State courts have generally followed one of these common law "rules" (doctrines) to regulate their surface and groundwater:

I. **Riparian Rights.** Rights are rooted in the English common law system and based on property rights and ownership of shoreland adjacent to a waterway. The expectation is rights will be exercised reasonably and will not interfere with the riparian rights of others.

II. **Prior Appropriation.** The first landowner to put a water source to beneficial use or divert water is granted a priority right.

III. **Absolute Ownership Rule.** Also called the Absolute Dominion Rule, the oldest and simplest doctrine gives landowners an unlimited right to withdraw any water beneath their land for any purpose.

IV. **Correlative Rights.** This requires that groundwater shared among overlying landowners, in times of shortage, must limit withdraws to a "fair and just proportion" of the supply.

V. **Reasonable Use.** Groundwater must be put to reasonable use and used on the overlying land. Also referred to as the "American Rule."

VI. **Public Trust Management.** Groundwater is considered to be public property, and the state administers permits for groundwater use. Authority for state regulation of groundwater is established from the Police Power of the U.S. Constitution, which allows states to take action to protect the safety, health, and general welfare of citizens.

VII. **Restatement (Second) of Torts Rule.** A hybrid of Absolute Ownership Rule and Reasonable Use Rule, it uses a combination of factors to determine if water use is appropriate including but not limited to purpose of use, suitability of waterway, economic and social value of use, harm caused, practicality of avoiding harm by adjusting method or use of a party, quantity of use, protection of investments. This approach is utilized in Ohio (1990) and Wisconsin (1974). [59] [60]

The eastern U.S. tends to use riparian rights to regulate surface water, while the western U.S. either follows the rule of prior appropriation or a hybrid system of both riparian law and prior appropriation. Today, most riparian right states have shifted toward a regulated riparian system which requires a permit for the allocation of surface water used for consumptive purposes, including diversions and withdrawals from waterways.[61]

States that follow riparian water law for surface water regulation usually follow the public trust doctrine for groundwater regulation, though both Ohio and Wisconsin practice the Restatement (Second) of Torts Act. The public trust doctrine establishes certain natural and cultural resources are preserved for public use, with the public as the owner and the state responsible for protection and maintenance of these resources. Traditionally, the public trust doctrine has applied to the beds and banks of streams, tidelands, and navigable waters and these natural resources are held in trust.

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59 "Section 1521.17 - Ohio Revised Code | Ohio Laws." 2025. Ohio.gov. 2025. https://codes.ohio.gov/ohio-revised-code/section-1521.17.

60 "Wisconsin Legislature: 281.31." 2025. Wisconsin.gov. 2025. https://docs.legis.wisconsin.gov/statutes/statutes/281/iii/31.

61 The National Agricultural Law Center. 2013. "Water Law Overview - National Agricultural Law Center." National Agricultural Law Center. 2013. https://nationalaglawcenter.org/overview/water-law/.

Since the 1990s, courts have used state constitutions and constitutional amendments to extend state government control over natural resources, including groundwater.[62] However, because the public trust doctrine has its origins in navigability, attempts to expand the doctrine to cover groundwater have largely been rejected by states.[63] As of 2025, no state has extended the public trust doctrine to groundwater.[64] However, all six states impose restrictions on groundwater use.

State agencies, such as departments of environmental quality or natural resources, set regulations through rulemaking, and implement and enforce groundwater protection programs, including permitting, monitoring, and remediation. States may implement policies aimed at ensuring the sustainable use of groundwater, such as limits on withdrawals and measures for aquifer recharge. These policies are supported through technical assistance, mapping, and modeling of available groundwater in an area. Some states have developed comprehensive groundwater management plans to address specific challenges, such as overdraft or contamination.

Overall, groundwater governance across EPA Region 5 is fragmented. As such, states' legal frameworks for groundwater governance often do not reflect the current state of hydrologic knowledge. However, certain states have implemented laws, regulations, and policies which address the evolving understanding of groundwater and its sustainable use. The table below compares key aspects of existing groundwater withdrawal regulation in EPA Region 5 (Table 1.2). State summaries from Phase I of this project include more detail about state agencies and specific management practices.

Table 1.2. Comparison of Existing Groundwater Withdrawal Regulation in EPA Region 5

Policy or Regulation	MN	WI	IL	MI	IN	OH
Defines what a high-capacity well is		X	X	X	X	
Includes special groundwater districts	X	X			X	X
Considers the cumulative impact of withdrawals	X	X		X	X	X
Recognizes the groundwater-surface water connection*	X*	X		X		
Considers other states' water use	X	X		X	X	

A breakdown of groundwater regulation and the practicing states in EPA Region 5.[65]
*Minnesota recognizes groundwater-surface water connections in limited cases; specifically, fens and trout streams.

62 Williams, Kirsten. 2021. "Fundamental Environmental Rights: State Constitutions as a Vehicle of Change." Www.jurist.org. November 1, 2021. https://www.jurist.org/commentary/2021/11/kirsten-williams-environmental-rights-amendments/.

63 Mich Citizens v. Nestle Waters, 709 N.W.2d 174, (2005).

64 "State Bar of Michigan." 2022. Michbar.org. 2022. https://www.michbar.org/journal/Details/Michigans-groundwater-and-the-public-trust-doctrine?ArticleID=4451.

65 Minnesota's Water Supply: Natural Conditions and Human Impacts, September 2000, 4.

Local Governance

Local legislation deals with a wide variety of local government units (LGUs). These include regional, county, and hyper-local governments and may also be referred to as municipal governments, which include cities and townships.[66] Local government units also may contain nested jurisdictions. A piece of land may be under the jurisdiction of the hyper-local township or municipality, and under the jurisdiction of the local county, and may also be part of a special district government. Because of the varied nature, varied size, and varied terms used for LGUs, work at the local level is complex and can be confusing for non-locals.

At the county and regional level, authorities may be involved in managing local groundwater, particularly in states where groundwater management districts are established. Counties can influence groundwater use indirectly through zoning and land-use regulations, which can impact the location and amount of groundwater extraction.[67] Counties may enact ordinances that further regulate groundwater use, particularly in areas facing scarcity or contamination issues. For example, Eau Claire County, Wisconsin has a groundwater advisory committee that oversees the management of their groundwater resources.[68] Two cities and eight counties in Minnesota have their own well management programs, delegated from the State.[69]

At the municipal level, municipal governments may have their own regulations regarding groundwater extraction, particularly for municipal water supply purposes. These can include building and construction codes outlining requirements for well construction and maintenance within city or town boundaries. This can also include land-use planning, where decisions related to economic development and infrastructure can impact groundwater resources and are often regulated at the municipal level. Most LGUs plan their land use and infrastructure needs every 10 years in a comprehensive planning document and use these plans to guide interim decisions until the plan is updated.

The Role of Governance in EPA Region 5

This report is intended to gather initial recommendations regarding regional groundwater governance. Most of the recommendations start with trust building, knowledge sharing, and education between entities in shared jurisdictions, shared aquifers, and shared watersheds. Primary mechanisms for these recommendations are legislation, workshops, and conferences to further legally enforceable frameworks and to intentionally create spaces to share knowledge and to build trust among knowledge holders and community members. This is a lot easier said than done. Governance is complicated.

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66 Griffin, Chelsea, and MN House Research. 2024. "Terms Used in Local Government Law." https://www.house.mn.gov/hrd/pubs/ss/sslgterms.pdf.

67 "Groundwater Management Districts Association." 2022. Gmdausa.org. 2022. https://www.gmdausa.org/.

68 "Groundwater Advisory | Eau Claire County." 2025. Eauclairecounty.gov. 2025. https://www.eauclairecounty.gov/our-government/county-board/boards-commissions-and-councils/groundwater-advisory/-folder-1447.

69 "Delegated Well Programs - MN Dept. Of Health." 2025. State.mn.us. 2025. https://www.health.state.mn.us/communities/environment/water/wells/delegated.html.

Section

2

Methods: What Did We Do and How Did We Do It?

Overview

There are many ways to understand governance – the law, the policy, the culture – and the impact on society. This project, by its nature, is a mapping project. Its objective has been to identify key actors and institutions, and to establish their knowledge of existing regional issues. The methods used to identify actors, institutions, and issues have also mapped the connection between these people, places, and things. The first phase of this work aimed to provide an overview of existing institutions, approaches, and a survey of current governance challenges.[1] Phase II of this work aims to provide depth through a sampling of place-based workshops which highlight the complexities of how jurisdictions intersect, and how knowledge is developed and shared between people and communities, to map the patterns that emerge when people are gathered. The goal has been to understand and explain how all this information fits and flows together.

1 Mayer, Terin V, Eileen J Kirby, Linda Reid, Carrie E Jennings, Lila Franklin, and Benjamin Edelstein. "Groundwater Governance in EPA Region 5." The Joyce Foundation, May 2024. https://www.joycefdn.org/groundwater-governance-report.

This project focused on four aquifer areas where Freshwater either led or supported workshops: 1) northeast Illinois, in the northwest suburbs of Chicago, overseen by Chicago Metropolitan Agency for Planning; 2) southwest metro Minnesota, one of the seven subregional water supply planning areas in the Twin Cities Metropolitan Council's Imagine 2050 Metro Area Water Supply Plan; 3) the Michindoh Aquifer, a 12-county, tri-state area across Michigan, Indiana, and Ohio with a workshop hosted at the Native American Indian Association in Detroit and facilitated by Minnesota-based nonprofit Freshwater, and 4) North Central Wisconsin, a five-county region with shared geology in a workshop hosted at the Lac du Flambeau Band of Lake Superior Chippewa Indians and facilitated by Minnesota-based nonprofit Freshwater (Figure 2.0).

The methods section of this report focuses on workshops led and facilitated by Freshwater and provides an overview of methods used by organizational partners on workshops Freshwater supported.

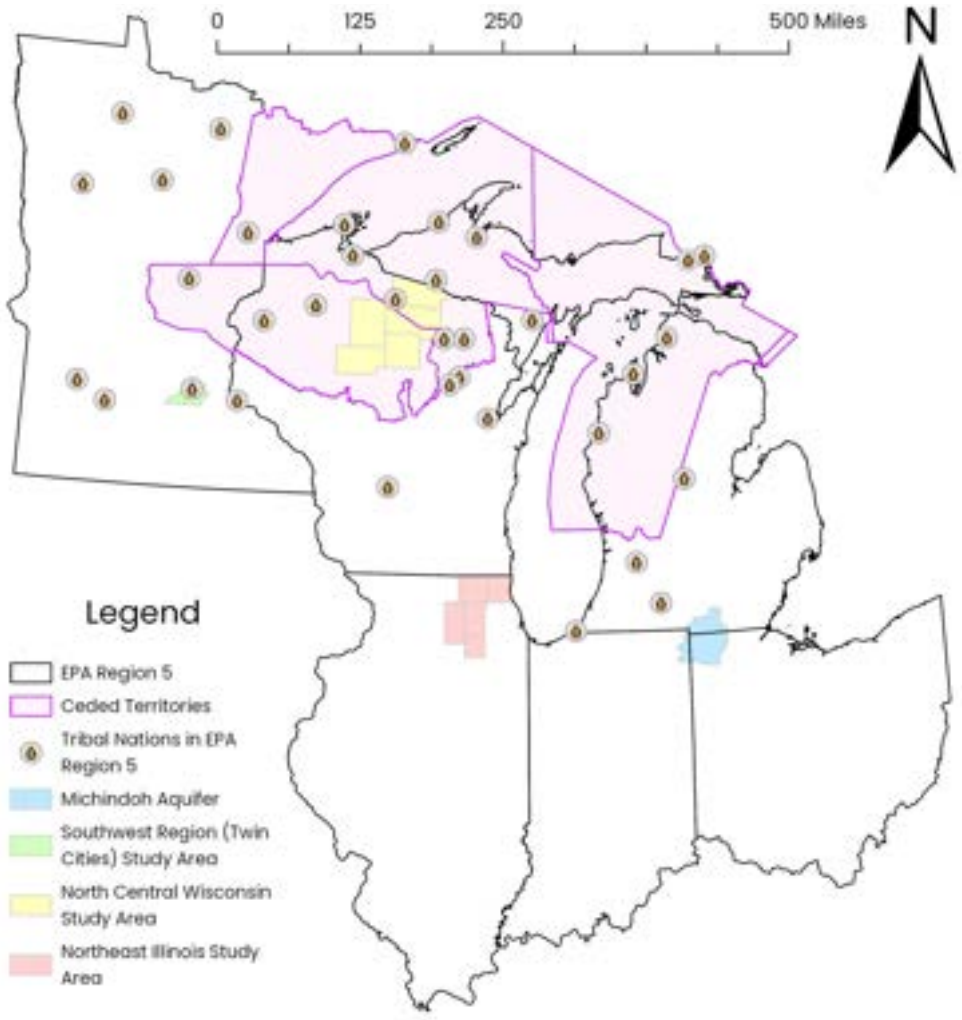

Figure 2.0. EPA Region 5 Study Areas

EPA Region 5 case study areas including 35 federally recognized tribal nations. Point locations shown on map are approximate and do not include trust land. The boundaries of the Michindoh Aquifer are not precisely known. Data from Environmental Systems Research Institute (ESRI), Great Lakes Indian Fish and Wildlife Commission (GLIFWC), the Metropolitan Council, the City of Bryan, Ohio, and the U.S. Census.

Geography and Organizational Partners

The workshops in northeast Illinois and southwest metro Minnesota were urban or suburban areas, and the workshops for the Michindoh Aquifer region and North Central Wisconsin focused on primarily rural communities with small towns. The two rural workshops were planned and facilitated by out-of-state nonprofit Freshwater.

While the entire project emphasized elevating tribal voices and perspectives, the workshops in North Central Wisconsin and southwest Metro Minnesota included tribal members as part of the advisory and planning committees, and the Michindoh Aquifer workshop agenda was developed with a tribal-specific focus and hosted at a local Native American community center.

Northeast Illinois – CMAP-led Workshop

The Chicago Metropolitan Agency for Planning (CMAP) is the comprehensive planning organization for a seven-county region within northeast Illinois around Chicago: Cook, DuPage, Kane, Kendall, Lake, McHenry, Will, and the townships of Aux Sable in Grundy County and Sandwich and Somonauk in DeKalb County.

An evaluation of the high-capacity well review process was conducted by CMAP as part of the water sustainability forecast and future water demand estimate included in the regional comprehensive plan, ONTO 2050.[2] This evaluation included developing a stakeholder list, conducting interviews, and reviewing of existing statues and regulations within the state and neighboring states in EPA Region 5.

The stakeholder list included water-focused and water-adjacent state agencies such as the Office of Water Resources, the Office of Mines and Minerals, the Illinois State Water Survey, the Illinois Water Resource Center, the Illinois State Geological Survey, and programs and divisions within the Bureau of Water. There was also a focus on local government units within the geographic region of the Northwest Water Planning Alliance (NWPA), the five counties of DeKalb, Kane, Kendall, Lake, and McHenry.

As Kane County in northeast Illinois contains the highest number of private wells per capita in the state, the area was the focus as CMAP staff reviewed current statutes, regulations, and municipal ordinances for high-capacity wells and groundwater use. CMAP staff conducted interviews with agency and municipal staff over several months. These interviews helped to shape the resulting policy memo Securing Illinois' groundwater future which builds on Illinois' 2022 State Water Plan and evaluates Illinois' 1983 Water Use Act.[3]

2 "Coordinate and Conserve Shared Water Supply Resources." 2024. Chicago Metropolitan Agency for Planning. June 10, 2024. https://cmap.illinois.gov/regional-plan/goals/recommendation/coordinate-and-conserve-shared-water-supply-resources/.

3 Beck, Nora. 2025. "Securing Illinois' groundwater future." Chicago Metropolitan Agency for Planning. January 21, 2025. https://cmap.illinois.gov/news-updates/securing-illinois-groundwater-future/.

Southwest Metro Minnesota – Met Council-led Workshops

The Metropolitan Council, locally referred to as Met Council, is the regional policy-making body for the seven-county Twin Cities metropolitan area with planning services focused on transportation, water use and land use. The Metro Area Water Supply Plan, a subplan within the larger Imagine 2050 Water Policy Plan, included the southwest metro as one of the subregional focus areas where workshops were held.[4] The Southwest Metro Workgroup included members from the six municipalities of the City of Burnsville, Credit River Township, City of Lakeville, City of Prior Lake, City of Savage, City of Shakopee, and as well as the federally recognized sovereign Dakota tribal government of the Shakopee Mdewakanton Sioux Community which is located in Scott County.

A year-long series of participatory meetings developed a subregional workgroup of local leaders who collaboratively designed the two iterative subregional workshops that were held for water-adjacent professionals and experts from utilities, watersheds, state agencies, large-volume water users, nonprofits, and community-based organizations.[5] The participants worked through subregional-specific issues and implementation challenges with their peers, with input and comments collected and added to regional subplans between meetings. A final meeting was held with all subregional participants to explain the overall regional water supply plan. Participants were able to discuss and comment on subregional plans and the area water plan before the plan was publicly posted for comment. Public comments were then reviewed and integrated into Met Council's final plan water policy plan.[6]

Freshwater-developed and Facilitated Workshops

Freshwater Society is a nonprofit based in Minnesota that works on water education, research, and policy in order to inspire and empower people to value and preserve water. Great Lakes Indian Fish and Wildlife Commission (GLIFWC) is an organization that provides expertise in natural resource management, policy and legal analysis, conservation enforcement, and provides information services in support to the eleven Ojibwe tribes across Minnesota, Wisconsin, and Michigan who reserved hunting, fishing, and gathering rights in the 1836, 1837, 1842, and 1854 Treaties with the U.S. government.

In coordination with GLIFWC, Freshwater developed and facilitated two workshops for this project: North Central Wisconsin and the Michindoh Aquifer, hosted at the Native American Indian Association of Detroit, outside the aquifer area, for convenience. The North Central Wisconsin workshop focused on the five-county area of Lincoln, Taylor, Price, Oneida, and Vilas, but included technical presentations relevant to the Lake Superior Basin and Wisconsin state laws. The Michindoh Aquifer region covered the nine-county, tri-state area with Branch, Hillsdale, and Lenawee in Michigan, Steuben, DeKalb, and Allen in Indiana, and Defiance, Williams, and Fulton in Ohio. A key component of this project was the design, development, and recruitment of the participant lists.

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4 Imagine 2050 Water Policy Plan: Metro Area Water Supply Plan, 3-71. 2025. Metropolitan Council. https://metrocouncil.org/Council-Meetings/Committees/Metropolitan-Council/2025/2-12-25/Policy-files-Water-Policy-Plan.aspx.

5 "Southwest Metro - Metropolitan Council." 2023. Metropolitan Council. 2023. https://metrocouncil.org/Wastewater-Water/Planning/Water-Supply-Planning/Workgroups/Southwest-Metro.aspx.

6 Imagine 2050 Water Policy Plan. 2025. Metropolitan Council. https://metrocouncil.org/Council-Meetings/Committees/Metropolitan-Council/2025/2-12-25/Policy-files-Water-Policy-Plan.aspx.

In Freshwater-led workshops, stakeholder selection focused on identifying key actors from different sectors but the same region, in order to develop a nuanced understanding of regional issues. To identify gaps and barriers in governance, actors from different sectors were invited to regional workshops to discuss how the availability and governance of groundwater impacted their work. The goal was to build a group who had a breadth of expertise, as well as a depth of knowledge.

What Did We Do?

Stakeholder mapping is a project management tool used to identify interested and impacted parties and to map the power, influence, interest, and engagement people hold over a project. Traditional stakeholder mapping is a simplified model that uses a matrix to compare the level of interest internal and external parties have against the level of influence or engagement those people have in a project, topic, or area (Figure 2.1).

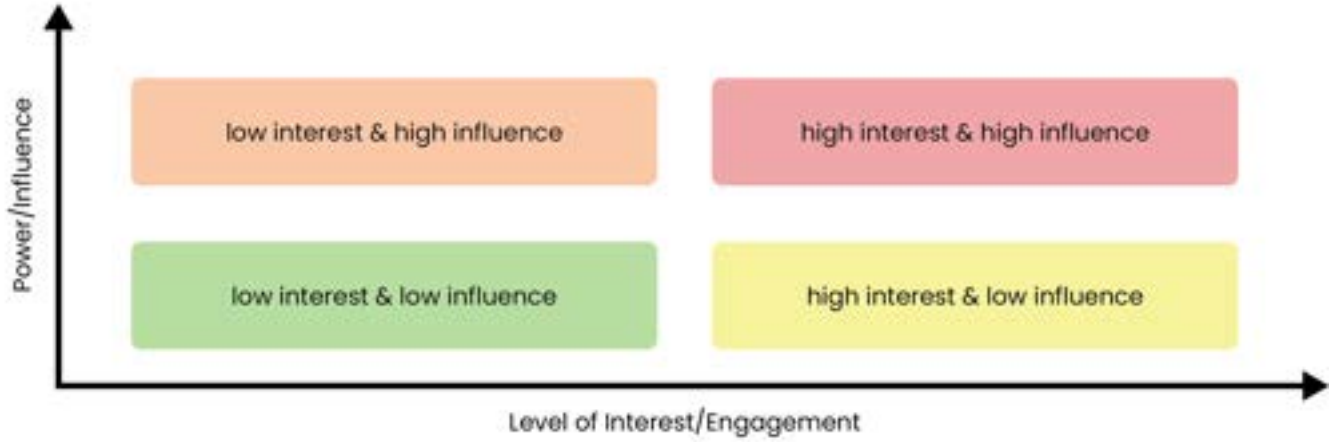

Figure 2.1. Stakeholder Matrix Model

Stakeholder Matrix Model shows the level of power or influence on the x-axis and level of interest of engagement on the y-axis.

To identify key interested and impacted parties in the region, the methodology required something beyond traditional stakeholder mapping. Instead of mapping power and influence over a project, topic, or region, the focus was on identifying people who held specific knowledge (e.g. academics and scientists, policy makers, lawyers, traditional Indigenous knowledge, well drillers) and people who were considered community nodes or good dispersers of information (e.g. community advocates, elders, positive social media engagement, long-term residents with strong social involvement). By identifying and inviting specific knowledge holders and community nodes from different sectors, the workshop participant list would achieve two things: 1) people would know one or two invitees but would be able to make mostly new connections; 2) people would gain new knowledge and disperse that knowledge to their different, varied communities.

Participants were identified using an iterative research process, and the portfolio of potential invitees was developed using visualization mapping techniques, including social network analysis. Iterative methods is a reflexive process that extracts specific information from large datasets and transforms

it into a structured dataset and builds on itself as knowledge is added to it.[7] Social network analysis was also used to gather data on people and events and locations, and to normalize the datasets.[8] A model applied to the datasets and visualizations explained relationships between nodes, including the degree of connections, the frequency of connections, and strength of connections. The visualization highlighted geographic, social and professional, and jurisdictional commonalities and gaps.[9]

Workshop constraints included 1) a limit of no more than 40 people per workshop, 2) a two-day time constraint per workshop, 3) addressing concerns from tribal members about participation, including benefit of attendance to participants. Additional information on these workshop outcomes and the attending participants can be found in the appendices.

Why Did We Do It This Way?

The participant invite list was designed to build safeguards for invitees who would be able to check with their known and trusted communities. By issuing invitations to a closed workshop, the hope was to keep participants comfortable by creating chains of trust within the space. If every participant knew someone, then everyone in the room could reasonably assume good intentions until individual trust could be built. It was the job of the facilitators to build that trust.

Water touches many realms, and a hydrogeologist has a very different perspective than that of a regulatory lawyer who has a very different expertise than that of a small farmer whose private well draws solely from the local aquifer. It takes all these different perspectives and more to understand the governance needs of a community and a region. In designing the workshop lists so that one person could fulfill many roles, the hope was to enrich conversations despite the small number of participants. When possible, we invited the lawyer who was also a small farmer; the geohydrologist who practiced traditional Indigenous medicine; the university historian who was also the tribe's Tribal Historic Preservation Officer (THPO).[10]

This method was also used with the awareness that policy decisions are repeatedly informed and made by the same subset of people. Those people are typically academically credentialled and accredited by institutions with rigorous requirements and require knowledge to navigate bureaucratic processes and access to financial resources. Those who do not participate by these specific standards, which include a four-year tertiary education degree at minimum, publication credits, and conference attendance and presentations, are usually excluded from the decision-making process. The methodology used in this research was intended to identify knowledge holders or others who followed alternative education pathways but were considered knowledgeable about their communities, their water, and who acted as community nodes. The intention was to ensure broader knowledge access, to establish stronger regional networks among communities, and to identify what barriers may have not been considered when developing regional frameworks for groundwater governance.

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7 Srivastava, Prachi, and Nick Hopwood. 2009. "A Practical Iterative Framework for Qualitative Data Analysis." International Journal of Qualitative Methods 8 (1): 76–84. https://doi.org/10.1177/160940690900800107.

8 Camacho, David, Ángel Panizo-LLedot, Gema Bello-Orgaz, Antonio Gonzalez-Pardo, and Erik Cambria. 2020. "The Four Dimensions of Social Network Analysis: An Overview of Research Methods, Applications, and Software Tools." Information Fusion 63 (2): 88–120. https://doi.org/10.1016/j.inffus.2020.05.009.

9 https://visiblenetworklabs.com/guides/social-network-analysis-101/

10 "Social Network Analysis 101: Ultimate Guide." Visible Network Labs, September 14, 2023. https://visiblenetworklabs.com/guides/social-network-analysis-101/.

How Did We Do This?

Based on previous interest indicated during Phase I, the decision was made to focus the initial workshop areas around the Michindoh Aquifer which are included in the ancestral homelands of the Potawatomi, and near the Lac du Flambeau Band of Ojibwe in the Northwoods of the North Central Wisconsin region which is in the ceded territory of 1842.

Initial knowledge discovery included identifying all original participants from the first phase of this work and confirming their current geographic locations, places of work, and job titles. The original dataset was built around people who were confirmed water professionals and who had already contributed to this project. To build on this dataset, an investigative approach was used to explore the place of work; others with similar job titles in the regional area; papers published and those who contributed, were cited, or were otherwise mentioned; activities or hobbies that were publicly available. Refining the dataset included identifying people's organizational affiliation, primary and secondary sector, and the rationale for including them in the dataset moving forward (Table 2.0). As the dataset expanded, this was refined to element, relationship, sector, geography, jurisdiction, and knowledge (Table 2.1).

Table 2.0. Initial Dataset Parameters

Job Title	Organization	Primary Sector	Secondary Sector	Rationale
	Federal, state agency, LGU, Tribe, academia, community organization, nonprofit, other.	Primary social role. Usually a person's work role.	Secondary role socially or professionally. Usually academia, tribal, nonprofit.	Perspective or knowledge is represented. A connection to or through person or place.
Criteria for determining first round of potential participants.				

Table 2.1. Refined Dataset Parameters

Element	Relationship	Sector	Geography	Jurisdiction	Knowledge
Person, place event, or item.	How are these elements connected? Strength, directionality, frequency of connection.	What space does this person affiliate with?	Where are elements based or occuring	The legal or Tribal jurisdiction of element. Tracked cross-or multi-jurisdictional elements.	What specific knowledge is held? What relevance is there to the project?
Criteria for refining potential participant list.					

To build the expanded dataset, a geographic area of scope was determined for each workshop and initial research was conducted using a broad research comb which focused on individual counties and a series of search terms ("groundwater," "water governance," "water policy," "water availability") and then refined based on news articles that were found in the previous 36 months. The news articles were used to build an initial understanding of water issues, institutions, and actors in the region. In the Michindoh Aquifer region, the nine counties served by the aquifer were considered the areas of focus. In the North Central Wisconsin region, the area of scope was confined to five counties that had shared geologic and hydrogeologic features.

Once a reasonable dataset of elements, including institutions and actors, was established and refined by topic and issue, additional data were added using social media and other public sources to identify prior contacts between elements. The objective was to identify people who 1) occupied multiple social and professional realms, 2) were both producers and distributors of knowledge, 3) knew at least one other person on the invitee list, and who 4) provided a different perspective or knowledge or expertise. Finally, participant invitees were asked if they would like to suggest or recommend anyone for the workshop.

A visualization map was used to explore how elements were related and how different geographies and jurisdictions were overlaid with sectors and knowledge. The visualization map explained gaps in knowledge spaces, specific sectors, and jurisdictions that were not represented. With this information, an effort was made to locate and recruit participants to fill those gaps. Link analysis was applied to the dataset to build an understanding of where people were located geographically, how they were connected socially and professionally, and how information travelled between geographies, communities, and jurisdictions.

Tribal members in the geographic region were communicated with and invited to the workshop. Initial outreach was conducted by both Freshwater staff and by members of GLIFWC and other tribal partners. Both workshops required an adjusted outreach approach.

In the Michindoh Aquifer region, outreach was conducted with Potawatomi tribes including the environmental departments and THPOs for Nottaweseppi Huron Band (NHBP), Pokagon Band, and the Match-E-Be-Nash-She-Wish Band also known as the Gun Lake Band. The United Tribes of Michigan and the Environmental Justice and Tribal Liaison at the Michigan Department of Environment, Great Lakes, and Energy (EGLE) were also contacted. Personal outreach was also conducted by Freshwater's Tribal Liaison to contact local tribal elders in the Detroit metro area.

In response to the original planning issue communicated by tribal staff in the North Central Wisconsin region, a planning committee was formed which included members of Lac du Flambeau's Natural Resource Department, the Great Lakes Fish and Wildlife Commission (GLIFWC), and the Bureau of Indian Affairs (BIA) who all helped to suggest and contact potential invitees. A longer planning period was accommodated, specific recruitment methods, and organizational outreach were conducted as recommended. More on this adjusted outreach process can be found in the North Central Wisconsin Workshop Summary (Appendix D).

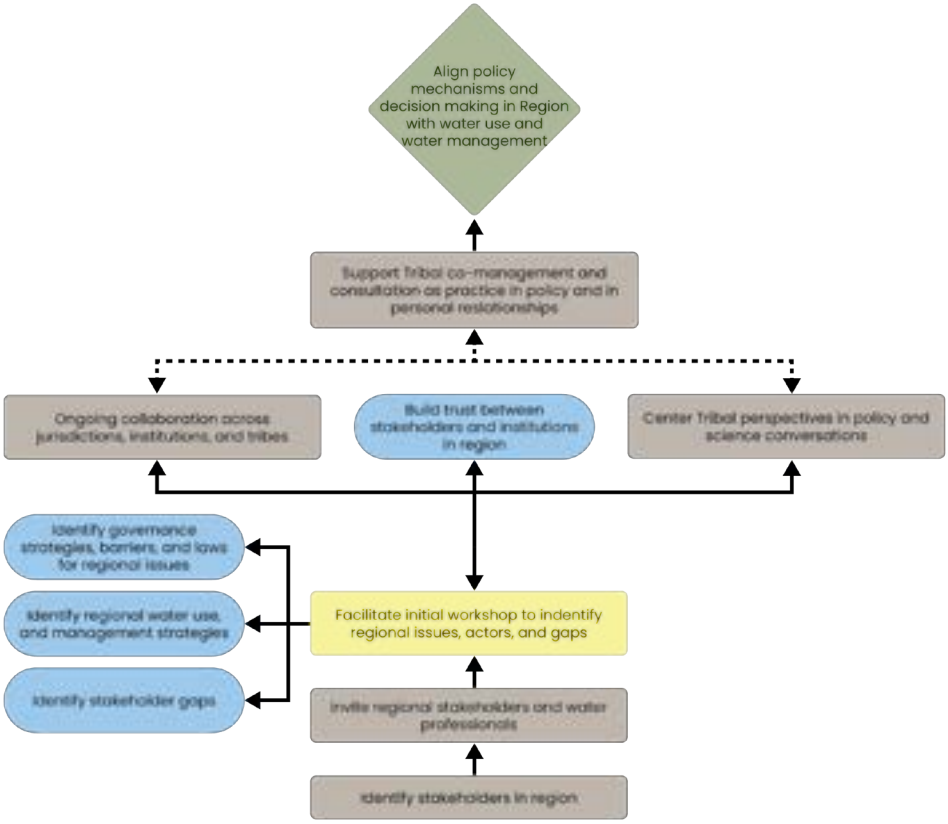
How Did This Achieve the Objective?

The objective for this project was to identify next steps toward regional groundwater governance systems. This process was an assessment which identified key actors beyond established institutions, mapped jurisdictional and communication barriers and gaps, and located potential leverage points for future action. These workshops also mapped key regional issues and allowed participants to reach a shared understanding of how those issues connect and might be addressed collaboratively.

In this phase of work, the project built off the relationships established with individual actors and institutions identified and interviewed during the original project. By necessity, the scope narrowed to focus on four action areas: northeast Illinois, southwest metro Minnesota, the North Central region of Wisconsin, and the Michindoh Aquifer area which spans southwest Michigan, northeast Indiana, and northwest Ohio. The ultimate objective in this work is to align policy mechanics with groundwater management while also supporting multi-jurisdictional collaboration and tribal co-management.

To achieve these, actors must build trust over time, identify similar regional problems from different perspectives, and understand how sector systems create gaps and barriers to existing governance practices for different institutions (Figure 2.2).

Figure 2.2. Process Map



Process map moves from bottom to top, with initial planning as the lowest box. Yellow box indicates current point in process. Blue ovals indicate process outcomes that occur as a result of activities. Green diamond indicates objective process is designed to achieve. Dotted lines between events indicate secondary events or results from primary activities.

Future Work and Recommendations

During this workshop series, members of industry were not included on the stakeholder list. This exclusion was intentional. An initial awareness was that groundwater management has long been siloed from land-use planning and economic development conversations, and while those behaviors are beginning to shift, most water management and governance research did not include industrial water users. Additionally, many of the large-scale industrial water users in the regions of focus were staffed by non-local contacts. A final and deciding factor was a concern from participants about how information provided in the workshop would be utilized.

In future work, with an understanding of regional water management, water users, and tensions, the recommendation would be to invite three new sectors: 1) industrial and other large water users, 2) municipal economic development planning teams, 3) land-use planning teams. Depending on the type of industry, energy producers should also be invited as water and energy use may be intwined for facilities like data centers and hospitals.

Section

3

Comparison Across Workshop Areas

This comparison reveals synergies and disparities of interested and impacted groups navigating groundwater policy across four geographic areas within EPA Region 5, each selected for their distinct groundwater limitations. Metropolitan water supply (centralized) and rural water supply (distributed) were the two types of groundwater systems compared. The metropolitan comparison evaluates a report by the Chicago Metropolitan Agency for Planning (CMAP) in northeastern Illinois and the updated regional water supply plan for the southwest metro area produced by the Metropolitan Council of Minnesota. The rural comparison evaluates the Michindoh Aquifer shared by three states and two Tribal nations, and a 5-county area in North Central Wisconsin (Table 3.0, Figure 3.0). These regions are defined in more detail in their respective sections below.

The aquifers within these areas vary from deep bedrock to shallow glacial deposits. There are a mix of urban and rural water demands, and different sets of public sector entities involved in groundwater management.

The governance circumstances within these distinct areas cannot be revealed without participant engagement and input. Different groups and sectors maintain distinct priorities and values, and the challenges each face span the hyperlocal to multi-regional scale. A technical expert from a state agency may focus on improvements in state-wide groundwater communications with access to better data, while a Tribal natural resource staff member may hold a culturally expansive perspective about which data are required to inform decisions with long-term consequences.

Regional case studies provide the context to understand these operational differences in a tangible way. Their intent is to explain the complex innerworkings of groundwater policy in practice to the broader audience of regional policymakers and natural-resource-management professionals.

Table 3.0. Comparison of Metropolitan and Rural Groundwater Systems

Comparison	Workshop Area	Geographic Scope	Groundwater Characteristics
Metropolitan	Northeastern Illinois	DeKalb, Kane, Kendall, Lake, and McHenry counties in Illinois	Large cone of depression in underlying aquifers, competing demands for groundwater and Lake Michigan water.
	Southwest metro water supply planning area	Scott County, western Dakota county, the Shakopee Mdewakanton Sioux Community in Minnesota	Bedrock aquifer shared across the region with limited alternate supply; significant cones of depression projected based on current use.
Rural	Michindoh Aquifer	Southern Michigan, northwestern Ohio, northeastern Indiana, and the ancestral homelands of the Potowatomi	Buried glacial aquifer in an area with no bedrock aquifers, independently managed by multiple jurisdictions.
	North Central Wisconsin	Taylor, Lincoln, Price, Vilas, and Oneida counties in Wisconsin, and Lac du Flambeau band of Lake Superior Chippewa	Lowest groundwater yields in the state and significant groundwater-surface water connections.

Description of the four workshop areas and the associated groundwater characteristics.

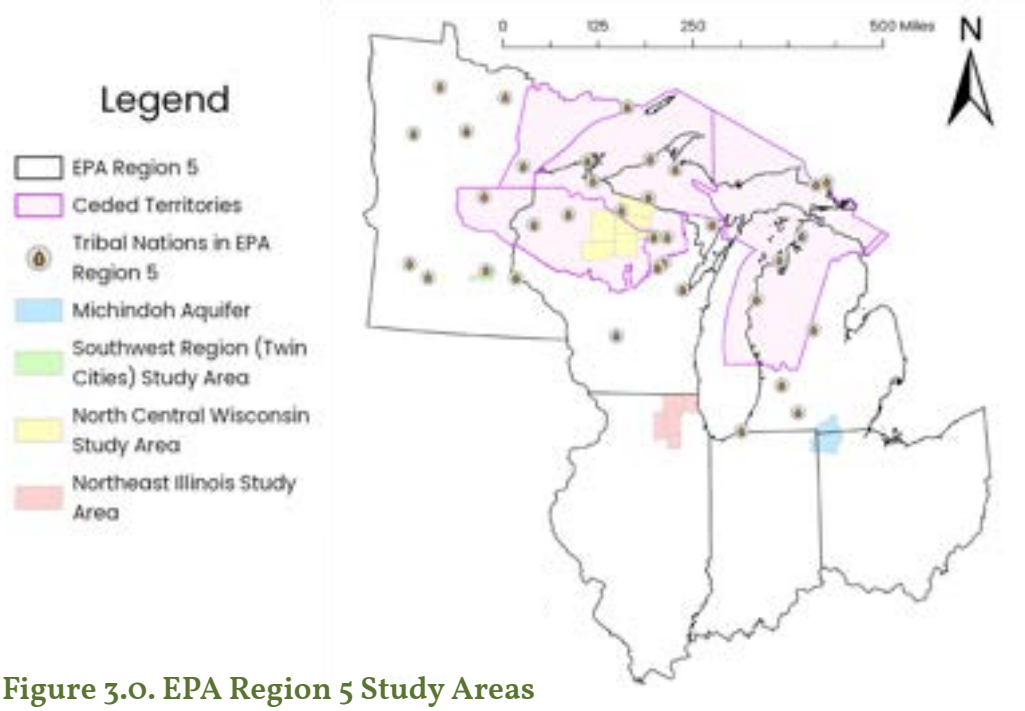


Figure 3.0. EPA Region 5 Study Areas

EPA Region 5 case study areas including 35 federally recognized tribal nations. Point locations shown on map are approximate and do not include trust land. The boundaries of the Michindoh Aquifer are not precisely known. Data from Environmental Systems Research Institute (ESRI), Great Lakes Indian Fish and Wildlife Commission (GLIFWC), the Metropolitan Council, the City of Bryan, Ohio, and the U.S. Census.

Metropolitan Area Comparison

Metropolitan areas in EPA Region 5 are facing complex, multi-jurisdictional groundwater challenges. New climate and development forecasts are revealing the long-term consequences of unchecked growth. Northeastern Illinois and southwest metro Minnesota face specific regional development pressures including competing demand for residential supply and economic development.

A significant cone of depression exists in northeastern Illinois due to heavy pumping in deep wells, withdrawal rates which exceeded recharge rates. Due to regional groundwater pressures, northeastern Illinois diverts water from Lake Michigan for domestic water supply and distributes some of the supply to nearby suburbs that lie outside the watershed of Lake Michigan.[1] However, suburban communities that do not currently receive Lake Michigan water must rely on groundwater and other surface water sources like the Kankakee and Fox rivers.

The southwest metro region in Minnesota has a bedrock aquifer shared across the region. There are significant cones of depression projected based on current use. The Twin Cities primarily use surface water for drinking water in the urban core, but as suburbs extend away from river and lake sources, private domestic wells and public municipal water suppliers increasingly rely on groundwater. Participants discussed priority issues in each of these two workshop areas (Table 3.1).

Table 3.1. Summary Comparison of the Chicago and Minneapolis-St. Paul Study Areas

	Southwest Metro Minnesota	Northeast Illinois
Participants engaged	Water utilities, watershed districts, Shakopee Mdewakanton Sioux Community (SMSC), United States Fish and Wildlife Service (USFWS)	County Soil & Water Conservation Districts, county public health departments, state agencies
Priority groundwater issues	Partnerships, educational engagement, evaluation, management of water supply system capacity, efficiency, plan alignment, and wetlands groundwater recharge	High-capacity well review process
Case Study	Niagara bottling: private well owners dispute water bottling plant due to quantity and quality concerns.	Kane County: multi-aquifer wells in area of depleted groundwater.

A comparison of participants, water issues, and case study topics between the southwest Metro Minnesota and northeast Illinois study areas.

1 Strifling, David. "Chicago and the Great Lakes Compact." Marquette University Law School Faculty Blog, May 30, 2023. https://law.marquette.edu/facultyblog/2023/05/chicago-and-the-great-lakes-compact/.

Illinois: Northeastern Illinois

CMAP is the state-authorized planning agency for Chicago and its seven-county region. In 2018, the agency produced its comprehensive 30-year regional plan, and a plan update was adopted in October 2022. This comprehensive road map also incorporated regional water demand forecasts, sustainable supply values, and water supply sustainability plans. Building on what was learned from Phase I, the Chicago Metropolitan Agency for Planning (CMAP) consulted with other planning agencies, research institutes, and municipal bodies to identify anticipated areas with water supply challenges and worked with regional partners to proposed potential solutions to barriers. As a result of this work and previous work during Phase I of this project, CMAP developed a report on the implementation of the Illinois Water Use Act of 1983.[2] The report focused on the current notification and review process for high-capacity wells which are defined in the Water Use Act as a well that can withdraw at least 100,000 gallons of water per day.[3]

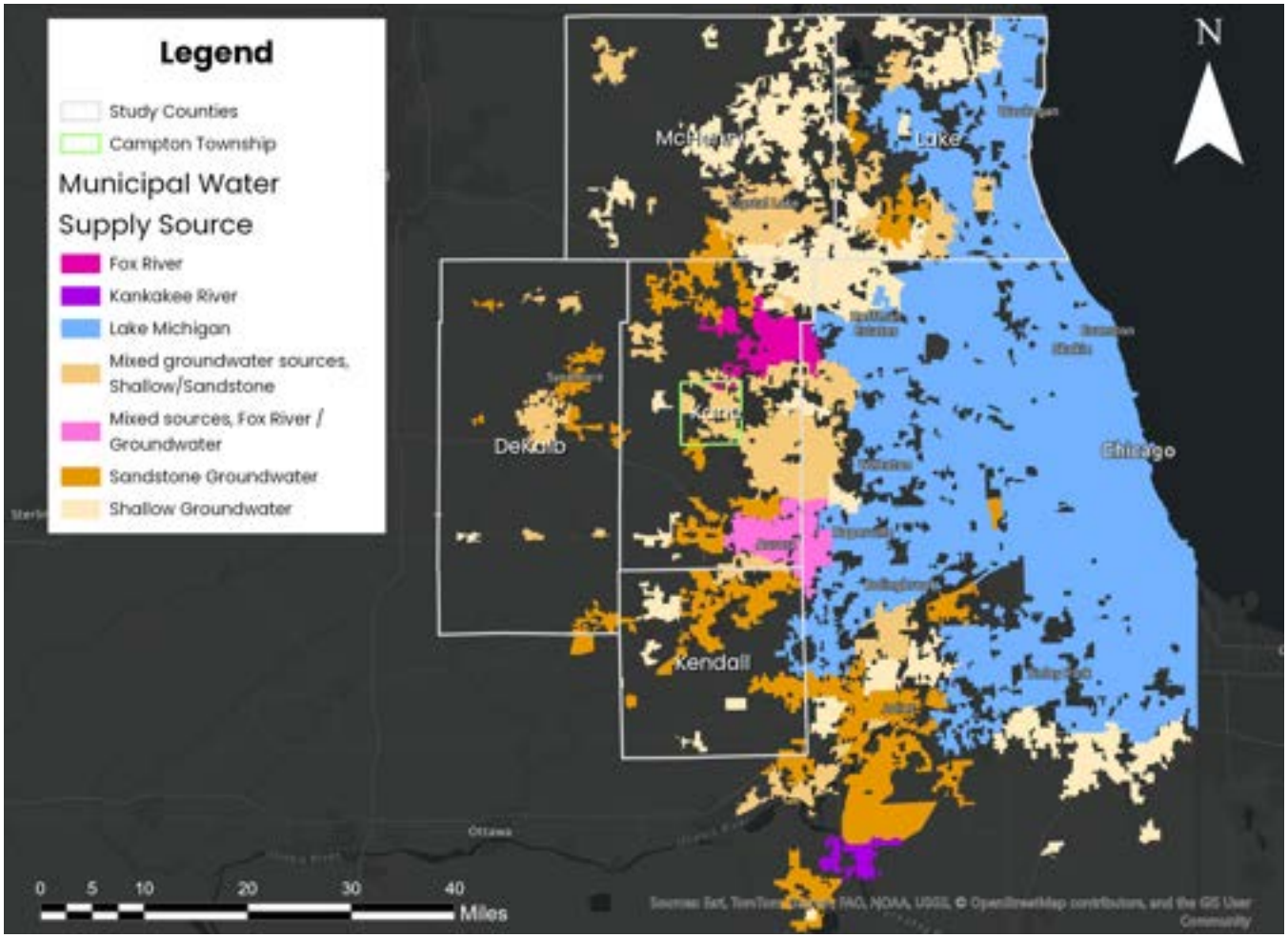


Figure 3.1. Municipal Water Sources in Northeastern Illinois

Source of municipal water, as reported by CMAP, with the study counties and Campton Township highlighted. Data sourced from ESRI, Chicago Metropolitan Area Planning (CMAP), and DeKalb County.

2 Illinois Water Use Act of 1983 § 3(c) (1973).

3 *Ibid.*

Geologic Context

The major aquifers in use in northeastern Illinois, from oldest (deepest, Cambrian) to youngest (shallowest, Ordovician) are the (Figure 3.2):

I. Elmhurst-Mt. Simon aquifer

II. Ironton-Galesville aquifer

III. Ancell aquifer in the St. Peter Sandstone[4]

Figure 3.2. Northern Illinois Geologic Units

Idealized stratigraphy and hydrostratigraphy in northern Illinois. Aquifers in blue; lower permeability units or confining units in white. Adapted from Visocky, A.P., et al, 1985.[5]

These layers host both fresh and salty water as well as oil and gas. Water communicates across bedrock strata, so aquifers are commonly referred to as "Cambrian-Ordovician" or the "deep sandstone aquifers" (Figure 3.3). Wells are also constructed in a way that allows communication of water across bedrock strata, a practice that is not allowed in some other states in EPA Region 5. Freshwater is limited to the upper 1,500 feet in the northern part of the state; below that, dissolved solids make the water unusable. Hydraulic heads, or the level that water will rise to in a well, have declined over 1,000 feet in the Chicago area since pumping began in the late 1800s prompting some communities to switch to surface water sources.

Of particular concern is the St. Peter Sandstone, a deep aquifer in the Chicago area that is recharged in central Illinois. It continues to decline under pumping centers and portions are dewatered (Figure 3.4).

4 Young, H.L. 1992 Hydrogeology of the Cambrian-Ordovician aquifer system in the northern Midwest, United States with a section on ground-water quality by D.I. Siegel. Regional aquifer-system analysis-northern Midwest, United States. U.S. Geological Survey professional paper 1405-B. https://pubs.usgs.gov/pp/1405b/report.pdf

5 Visocky, A.P., Sherrill, M.G., and Cartwright, Keros, 136, 1985. Geology, hydrology, and water quality of the Cambrian and Ordovician systems in northern Illinois: Illinois State Geological Survey Cooperative Groundwater Report 10.

Note: Original image modified for this report by Patrick Steury, 2025.

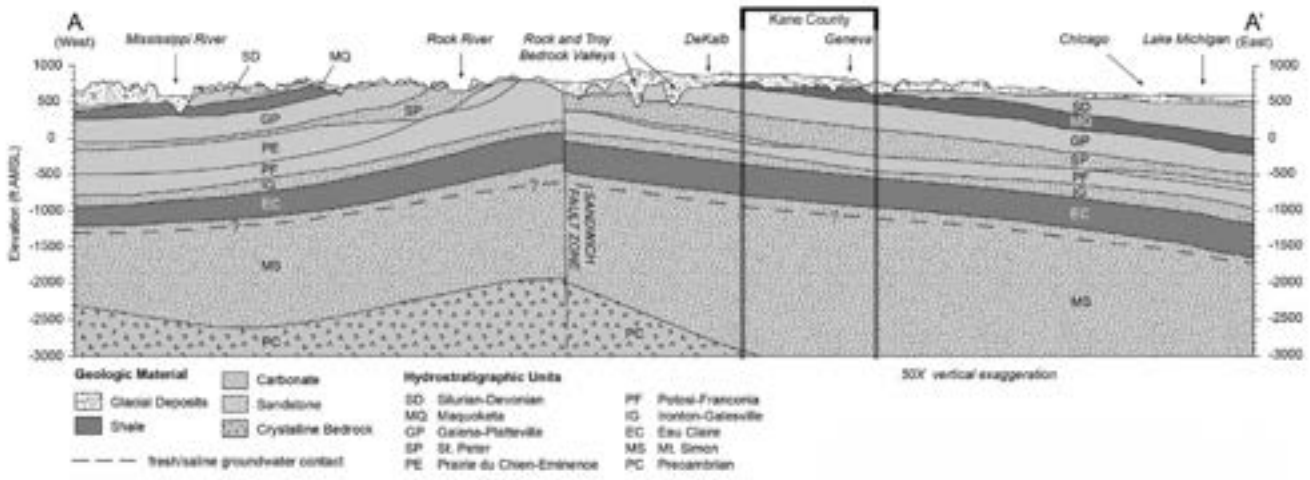


Figure 3.3. Cross Sectional Image of Geologic Units Across Northern Illinois

Kane County, highlighted, is east of DeKalb County and west of downtown Chicago. Modified from Illinois State Water Survey, Illinois Department of Natural Resources, and Hadley et al, 2015.[6] [7]

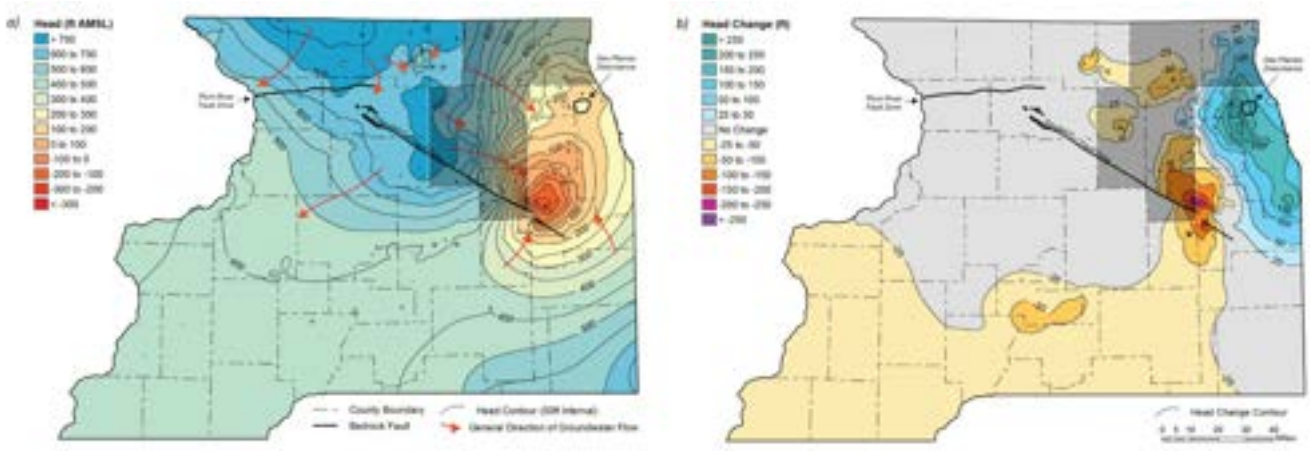


Figure 3.4. Cambrian-Ordovician Sandstone Potentiometric Surface Contours in Northern Illinois

(a) Head or potentiometric surface contours, (the elevation that groundwater would rise to if unconfined by overlying layers) for the Cambrian-Ordovician sandstones in 2014 in feet above mean seal level (ft AMSL) and (b) head changes in Cambrian-Ordovician sandstone wells between 1980 and 2014. A depression in the potentiometric surface is commonly centered on a high-pumping area and referred to as a cone of depression. Study counties in northeast Illinois overlain. Adapted from the Illinois State Water Survey, Hadley et al, 2014.

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6 Abrams, Daniel B., Daniel R. Hadley, Devin H. Mannix, George S. Roadcap, Scott C. Meyer, Kenneth J. Hlinka, Kevin L. Rennels, Kenneth R. Bradbury, Peter M. Chase, and Jacob J. Krause. Rep. Changing Groundwater Levels in the Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply. Illinois State Water Survey, September 16, 102, 2015. https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2015-02.pdf.

Note: Original image modified for this report by Patrick Steury, 2025.

7 Hadley, Daniel R., Daniel B. Abrams, and Devin H. Mannix. 2023. Changing Groundwater Levels in the Sandstone Aquifers. https://storymaps.arcgis.com/stories/6a8ff45c39134e168da93b45626fef36.

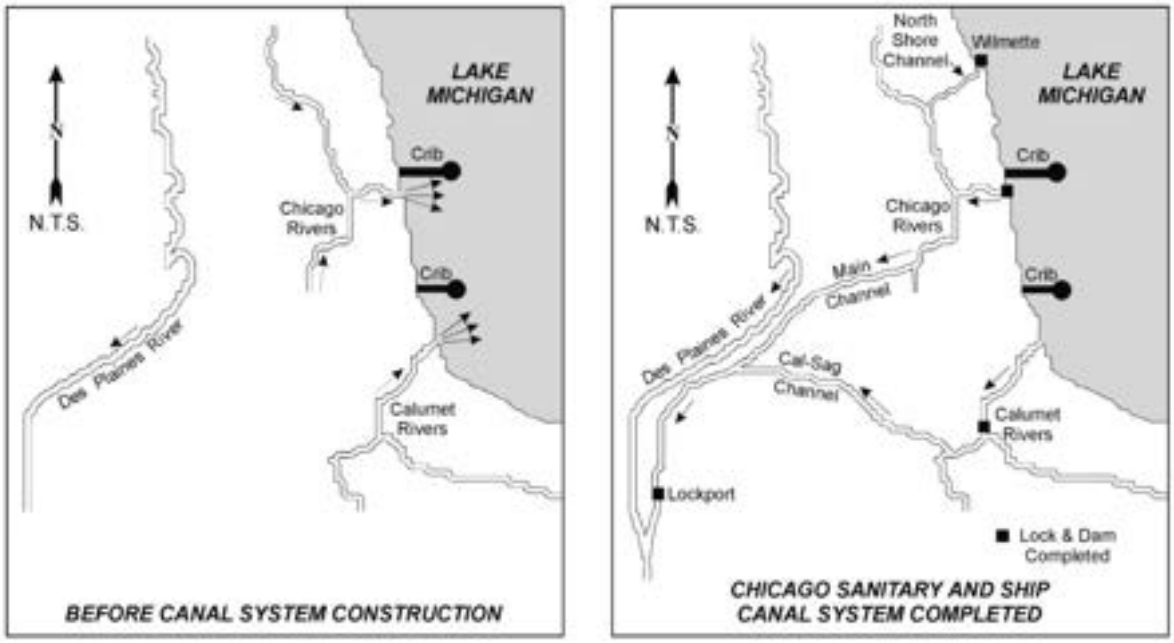

Figure 3.5. Diversion of Chicago's Rivers

Original configuration of rivers near Lake Michigan (left) and reversal of flow in the Chicago and Calumet rivers, sending water to the Des Plaines River through canals (right) [8]

By international agreement, only municipalities located within a Great Lake's watershed are approved to use it for drinking water.[9] Illinois is an exception dating back to the 1800s when the Chicago River was reversed to protect lake water quality.[10] Chicago gained access to billions of gallons of Lake Michigan water at this time to dilute the pollution diverted from the Lake (Figure 3.5). This decree has been challenged over the years (e.g. Wisconsin in the 1920s over lake-level lowering and Michigan in 2010 over the introduction of invasive species) and the Court retains jurisdiction.[11] [12] However, the 1967 Supreme Court ruling allows Chicago, and now several nearby suburbs, to use 2.1 billion gallons of lake water per day.[13] [14] Recently, the city of Chicago agreed to sell roughly 0.05% of its diversion allocation to Joliet, a suburb 35 miles to the southwest.[15] [16]

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8 Injerd, Daniel. "Illinois' Lake Michigan Water Allocation/Diversion." Northwest Water Planning Alliance, February 28, 2025. https://www.nwpa.us/uploads/1/2/9/8/129889926/lake-michigan-allocation-idnr-09082011.pdf.

9 Great Lakes-St. Lawrence River Basin Water Resources Compact, Public Law 342, 122 Stat. 3739.

10 "A Short History of the Chicago Diversion." The Climate Change and Public Health Law Site. Accessed February 18, 2025. https://biotech.law.lsu.edu/cases/environment/ChicagoDiversionHistoryMarch5.pdf.

11 Strifling, David. "Chicago and the Great Lakes Compact." Marquette University Law School Faculty Blog, May 30, 2023. https://law.marquette.edu/facultyblog/2023/05/chicago-and-the-great-lakes-compact/.

12 Wisconsin v. Illinois, 278 U.S. 367 (1929).

13 "An Overview of Great Lakes Diversions." International Joint Commission. Accessed February 20, 2025. https://www.ijc.org/en/lsbc/watershed/great-lakes-diversions.

14 Strifling, David. "Chicago and the Great Lakes Compact." Marquette University Law School Faculty Blog, May 30, 2023. https://law.marquette.edu/facultyblog/2023/05/chicago-and-the-great-lakes-compact/.

15 *Ibid*.

16 Elkadi, Nina. "Joliet, Illinois, Plans to Source Its Future Drinking Water from Lake Michigan. Will Other Cities Follow?" Great Lakes Now, October 4, 2024. https://www.greatlakesnow.org/2024/10/joliet-illinois-lake-michigan-drinking-water/.

The comprehensive regional report, ONTO 2050, notes that northeast Illinois highlights three water areas of attention for the region: water use versus water demand, conservation and efficiency efforts, and existing groundwater supply.[17] Currently, water use is expected to exceed available supply in some areas, but overall water use is expected to decline due to conservation and efficiency measures which are trending to outpace both population and employment growth. The existing water supply is mapped to show where demand may exceed availability at the county level and how much water can be pumped without causing further desaturation of deep aquifers or harm to groundwater-dependent ecosystems.[18] Northeast Illinois includes Kane County, home to the highest number of private wells per capita in the state. Campton Township in Kane County also has many multi-aquifer wells. As the region experiences groundwater sustainability concerns, this report included a case study on the concentration of private wells and the impact of multi-aquifer wells in a concentrated area.

Existing policies address some of these issues on paper but are not always as effective in practice. A recent water demand forecast study for Chicago's metropolitan area estimates that Kane County will need to reduce demand by 12 million gallons per day (MGD) to align with shallow and sandstone aquifer sustainable supply estimates.[19] To support conservation and efficiency efforts, Kane County plans to have monitoring wells in the entire county by 2026. However, with limited data being reported on high-capacity wells, reducing this demand will present challenges.

Governance Gaps, Best Practices, & Barriers

As a result of these challenges, CMAP investigated how the Water Use Act of 1983 is being implemented to promote sustainable use. CMAP worked to identify specific challenges in compliance with the current groundwater policy landscape and suggested strategies for mitigating disparities. The focus was on high-capacity wells and their potential impact on available supply (Table 3.2). The report also reviewed the processes by which Soil and Water Conservation Districts (SWCDs) are involved and made recommendations for improving the intergovernmental processes.

17 ON TO 2050 - Chicago Metropolitan Agency for Planning, October 2022. https://cmap.illinois.gov/wp-content/uploads/dlm_uploads/ON-TO-2050-Comprehensive-Regional-Plan-FINAL.pdf.

18 Beck, Nora. "New Water Demand Forecast Highlights Need for Sustainable Water Management." Chicago Metropolitan Agency for Planning, January 30, 2025. https://cmap.illinois.gov/news-updates/new-water-demand-forecast-highlights-need-for-sustainable-water-management/.

19 Beck, Nora."New Water Demand Forecast Highlights Need for Sustainable Water Management." Chicago Metropolitan Agency for Planning, January 30, 2025. https://cmap.illinois.gov/news-updates/new-water-demand-forecast-highlights-need-for-sustainable-water-management/.

Table 3.2. Governance Gap and Driving Question from Securing Illinois' Groundwater Future

Governance Gap	Driving Question
High-capacity well review	How effective is the Water Use Act of 1983 at generating a cohesive and systematic process for sustainably managing high-capacity wells?

A summary of this governance gap and the best practices and barriers identified are described below, and more information is available in Securing Illinois' Groundwater Future, the final report published by CMAP as a component of Phase II of this project.[20]

High-Capacity Well Review

According to CMAP's report, the Water Use Act of 1983 was a reaction to historic population increases and development patterns that were causing conflicts among communities with interconnected groundwater systems. This concerned farmers and the Illinois Farm Bureau, among others, and prompted the Illinois legislature to pass this act, which replaced the absolute ownership doctrine with a reasonable use doctrine (see Section 1 for more information on common law doctrines). Other key components of the act established a way to restrict groundwater withdrawals during emergencies in limited areas of the state, and to provide public notice and review of new withdrawals that are both planned and deemed substantial (i.e., greater 100,000 gallons of water per day). In 2010, the act was amended to require water-use reporting among commercial, industrial, and irrigation high-capacity well users. Prior to publication the effectiveness of generating water-use data for the users had not been thoroughly explored. The report identified many misalignments in water-use reporting and indicated that the policy may not be effectively administered and may contribute to data gaps in the future. (Table 3.3).[21]

Table 3.3. Best Practices and Barriers of High Capacity Well Review

Best Practices	Barriers

• Groundwater management objectives should include quantity
• Resource the high-capacity well review process
  ◦ Harness synergies and improve available information
  ◦ Improve administrative funding and capacity
  ◦ Connect well-review process to decision making
  ◦ Align review criteria with groundwater management goals
• Improve the water-use reporting process
	• Notices for water quality and high-capacity well reviews are duplicative
	  ◦ Require more staff time than available
	• Little guidance provided to define the scope of the review needed
	• No dedicated revenue stream for the high-capacity well review process

20 Beck, Nora. "Securing Illinois' Groundwater Future." Chicago Metropolitan Agency for Planning, January 21, 2025. https://cmap.illinois.gov/news-updates/securing-illinois-groundwater-future/.

21 Elkadi, Nina. "Joliet, Illinois, Plans to Source Its Future Drinking Water from Lake Michigan. Will Other Cities Follow?" Great Lakes Now, October 4, 2024. https://www.greatlakesnow.org/2024/10/joliet-illinois-lake-michigan-drinking-water/.

Minnesota: Southwest Metro

In the Twin Cities, regional water supply planning is the responsibility of the Metropolitan Council (Met Council), a policy-making body serving the seven-county metro area. The water planning team was created in 2005, with the publication of the first regional Water Policy Plan in 2015. During this project, the Met Council was in the process of their first Water Policy Plan update.[22] Seven subregional workgroups, including the Southwest Metro, were tasked with identifying the activities and barriers necessary to address current and anticipated water supply challenges over the next 25 years (Figure 3.6).[23] [24]

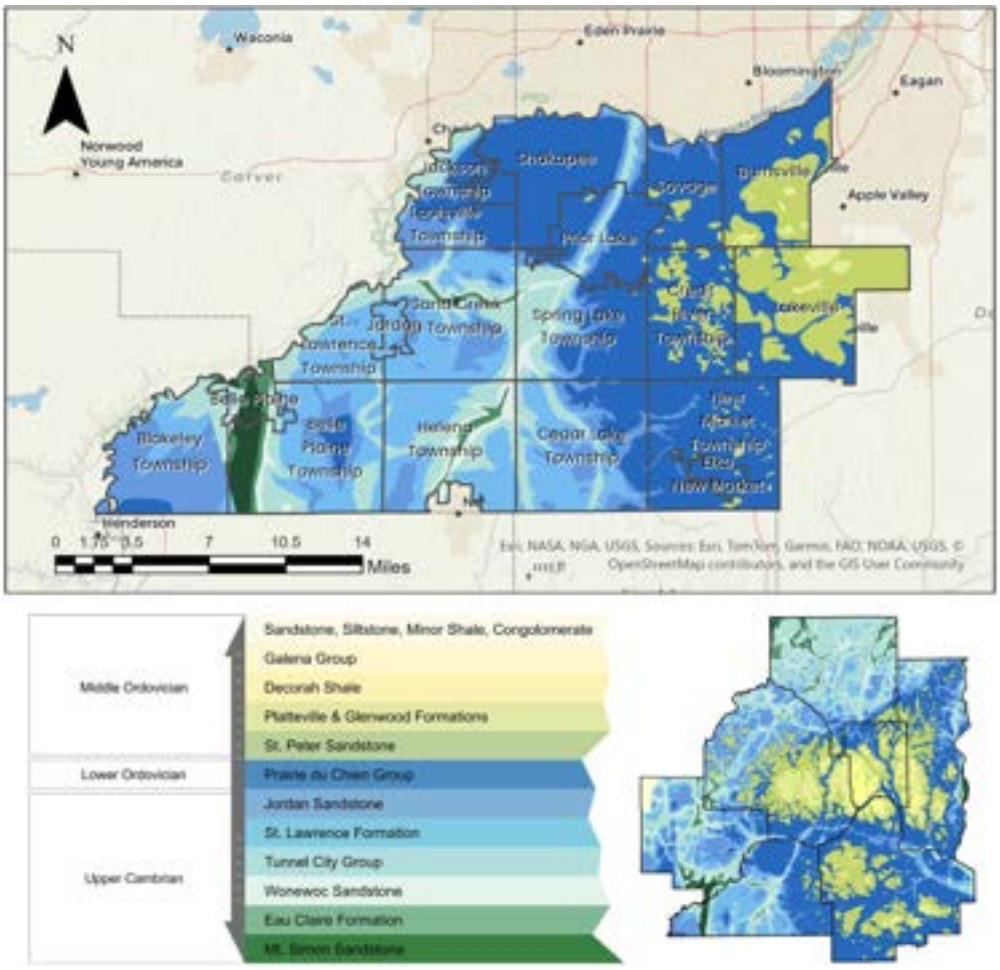

Figure 3.6. Southwest Metro Bedrock Geology

Bedrock geology of the Metropolitan Council's Southwest Metro Water Supply Planning Area, with an inset map showing the full metropolitan extent. Legend subfigure and color key from the Metropolitan Council. Data from the Minnesota Geological Survey and the Metropolitan Council.

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22 "Planning." Metropolitan Council. Accessed February 26, 2025. https://metrocouncil.org/Wastewater-Water/Planning/Water-Supply-Planning/Planners.aspx.

23 "Subregional Water Supply Workgroups." Metropolitan Council, 2025. https://metrocouncil.org/Wastewater-Water/Planning/Water-Supply-Planning/Workgroups.aspx.

24 "Water Policy Plan." Metropolitan Council. February 9, 2025. https://metrocouncil.org/Wastewater-Water/Planning/2050-Water-Policy-Plan.aspx.

The southwest metro is the only subregion with a Tribal nation, Shakopee Mdewakanton Sioux Community (SMSC) (Figure 3.7). SMSC is a well-resourced tribal government with a long history of collaborating with local governments on water supply, including most recently in participating in the planning for the Southwest Metro Workgroup supported by the Metropolitan Council. The major focus of this effort has been on fostering a sustainable regional water supply.[25]

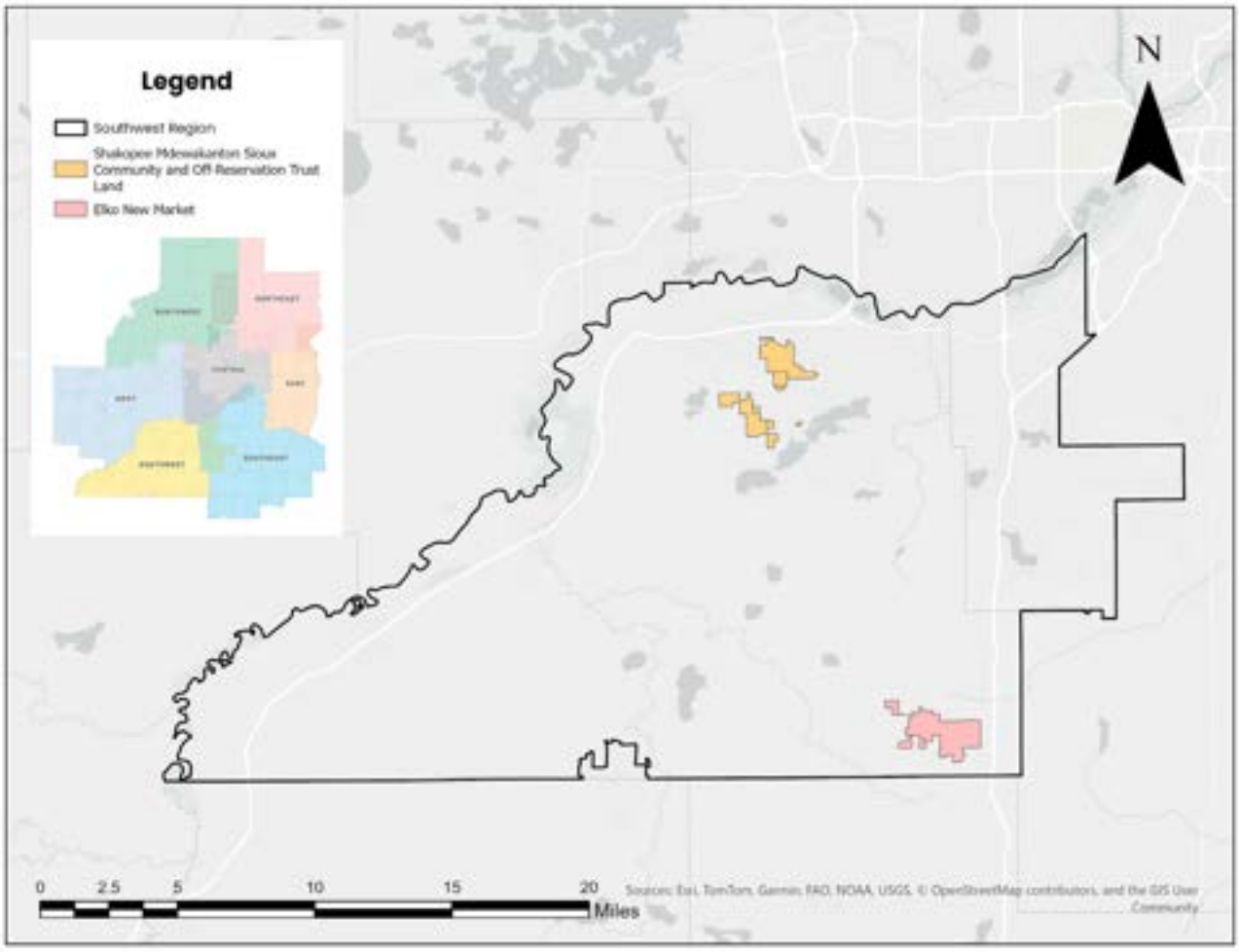

Figure 3.7. Southwest Metro, Shakopee Mdewakanton Sioux Community (SMSC) and Elko New Market

The Metropolitan Council's Southwest Metro Water Supply Planning Area with the location of the SMSC, SMSC off-reservation trust land, and city of Elko New Market. Data sourced and adapted from ESRI, U.S. Census, and Metropolitan Council.

25 *Ibid.*

The Met Council began updating their regional Water Policy Plan in 2023. This policy plan includes comprehensive water supply plan updates through planning year 2050, water demand projections, groundwater model projections, and groundwater optimization modeling. To better align regional planning with local and subregional water supply needs, the Met Council engaged water professionals who impact and are impacted by water supply. Two workshops were held in each subregion to harvest local experience and insights, ultimately shaping the content of the updated Metro Area Water Supply Plan. Freshwater participated in these workshops rather than host redundant gatherings. The Water Policy Plan includes a shared vision for water supply in the entire metro, prioritizing issues and opportunities, and developing a shared high-level action plan to address them. [26]

Geologic Context

According to the Water Policy Plan update,

> *Communities in the Southwest Metro subregion rely on a variety of drinking water sources. The majority of communities in this subregion do not have municipal community public water supply systems. In those communities, residents operate privately-owned wells to get their drinking water. In rural centers and denser, more suburban areas of the subregion, communities operate municipal community public water supply systems that provide water services to residents and businesses. Communities with these municipal supplies primarily have groundwater as their source. In the north and east parts of the subregion, they can access the Prairie du Chien and Jordan aquifers. In the south and west parts, they may rely on the Tunnel City-Wonewoc and deeper aquifers.*[27]

Governance Gaps, Best Practices, and Barriers

Five primary focus areas were identified by the stakeholders participating in the Southwest Metro water supply planning process: partnerships, education and engagement, evaluating and managing water supply system capacity, efficiency, and plan alignment (Table 3.4).

Federal participation in the Met Council process only occurred in the final, all-region planning session and was not focused on within the Southwest Metro subregion. Because a vast amount of land along the Minnesota River in the southwest metro is managed by the U.S. Fish and Wildlife Service, the regional office was contacted for an additional interview. Freshwater met with a staff member from the Minnesota Valley National Wildlife Refuge to discuss groundwater, impacts to the area, and the agency's scope of responsibility in groundwater governance. The primary gap identified in the interview was the connection between wetlands and groundwater recharge (Table 3.4).

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26 Imagine 2050 Water Policy Plan: Metro Area Water Supply Plan, 3-145 - 3-157. 2025. Metropolitan Council. https://metrocouncil.org/Council-Meetings/Committees/Metropolitan-Council/2025/2-12-25/Policy-files-Water-Policy-Plan.aspx.

27 "Water Policy Plan." Metropolitan Council. https://metrocouncil.org/Wastewater-Water/Planning/2050-Water-Policy-Plan.aspx.

Table 3.4. Governance Gaps and Driving Questions from the Southwest Metro Water Supply Planning Effort

Governance Gap	Driving Question
Partnerships	How can ongoing regional communication and cooperation among communities, conservationists, watersheds, and businesses be improved in the southwest metro?
Education and engagement	How can water-supply information and resources be understood, wanted, and trusted by citizens and their local governments?
Evaluating and managing water supply system capacity	What tools and information are needed to understand the most significant impacts to water supply and mitigate those impacts?
Efficiency	How can public water supply systems work to reduce extremes between winter and summer use?
Plan alignment	What plan alignments will generate more funding and accelerate progress in sustainable groundwater supply?
Wetlands and groundwater recharge	How should wetlands in the Minnesota River floodplain be considered for groundwater supply in the southwest metro?

Governance gaps identified in the Southwest Metro water supply planning effort and the driving questions developed by Met Council to address those gaps.

There is no one entity that oversees groundwater sustainability in the southwest metro of the Twin Cities. Water governance is fragmented. There are multiple state agencies, Tribal nations, and community members who participate in the process. Collaboration is needed to reduce siloed decision-making, address regulatory barriers to new approaches, and support communities' abilities to enact local controls that support sustainable water supplies. At the subregional water supply planning meetings, interested and impacted parties identified practices and barriers suggested to address these governance gaps (Table 3.5).[28]

Table 3.5. Best Practices and Barriers to Improved Partnerships in the Southwest Metro

Best Practices	Barriers

• Leverage partnerships between local water supply leaders, regional and state agencies
  ◦ Include economic development teams
• Coordinate efforts and prioritize issues among regional water supply leaders
• Regionalize water supply and distribution for cities with limited financial and staffing resources
• Engage community members in water supply planning
  ◦ Increase transparency of water management strategies and costs
	• Cross-jurisdictional partnerships take more time, cause tension, and reduce political desire to work together
	  ◦ Differing supply needs, perceived loss of control, and lack of a strong reason for and value of partnerships
	• Cities are not interested in regional water supply efforts
	• Local units of government lack capacity to support community engagement partnerships
	• Siloed decision-making
	• Regulatory barriers to new approaches
	  ◦ Water reuse, water circularity
	• Limited access for communities to enact local controls that support sustainable water supplies

28 *Ibid.*

Education and Engagement

Ongoing resources, including funding and staffing, are needed for education and engagement at the state, regional, and local levels for efforts like shifting to more ambitious water efficiency and getting local information back to the community. The Met Council subregional groups are a success story because water supply leaders valued attending and sharing their feedback. These leaders felt heard and able to coordinate on a regional level. However, private well owners need access to more information to ensure safe and sustainable supplies of water. Participants suggested best practices and barriers to address this governance gap (Table 3.6).

Table 3.6. Best Practices and Barriers to Education and Engagement in the Southwest Metro

Best Practices	Barriers

• Plan and budget for ongoing engagement in each region
• Allow participants to engage with partners and share information
• Invite water supply planners across sectors
  ◦ Include local government, regional planners, state government, tribal government, and community organizations
• Design meetings led by trained facilitators with support from technical water professionals
• Incorporate Traditional Ecological Knowledge (TEK) and include TEK teachers and knowledge holders
	• Current approaches to outreach and education are not hands-on or conversational
	• Need for trained facilitators is understated
	  ◦ Meetings are not engaging or accessible
	• Community connections are not utilized when inviting community members to participate, including Indigenous partners
	• Lack of state support for rural well owners
	• Credentialed individuals are targeted in engagement efforts

Evaluating and Managing Water Supply System Capacity

There is a need to better understand the demand of new economic development including high volume water users and commercial water users – both those who have been in the area a long time and new high volume water users who are looking to move to the area. However, uncertainty and gaps in information on factors like changes in climate, geology in buried bedrock valleys, and emerging anthropogenic and geologic contaminants make evaluation and management of groundwater supply challenging. Gaps in monitoring networks also exist. Effectively protecting resources like fens and springs is also a challenge. All these factors impact regional knowledge about water supply and the decisions that sustain that supply (Table 3.7).

Table 3.7. Best Practices and Barriers to Evaluating and Managing Water Supply System Capacity in the Southwest Metro

Best Practices	Barriers

• Coordinate data sharing on a regional level
  ◦ Groundwater models
  ◦ Economic development opportunities
• Recruit new water users to areas that can support their water use proactively
  ◦ Use municipal water plans to coordinate development against available water supplies
• Fund water systems to operate and maintain their water supply
  ◦ Economic development should support new infrastructure
	• Current water supply business models are not equipped to address emerging water supply challenges
	  ◦ Water reuse and recharge opportunities are not supported
	• Land use changes
	  ◦ May lead to increased water use and water quality risks which increased water treatment
	  ◦ Include urban and suburban growth, agricultural irrigation and fertilizer, manufacturing and industry, and illicit discharge
	• Weather changes
	  ◦ Multi-year droughts or flooding events strain water supplies and distribution systems
	• Utility water rates may not cover system operation and maintenance costs requiring economic development revenue to supplement

Efficiency

Many programs are in place to incentivize efficient use of water resources, but there is a knowledge gap among water users about how to access those programs. Changing weather patterns impact when these efficiency programs can and should be implemented, and many communities are still behind on implementing efficiency programs (Table 3.8).

Table 3.8. Best Practices and Barriers to Improved Efficiency in the Southwest Metro

Best Practices	Barriers
• Incentivize water efficiency and conservation for all residential, commercial and industrial water users • Share best practices for implementing water efficiency across State and local governments	• Increased water efficiency results in less revenue for water utilities • Lack of training to manage community engagement or behavior change strategies to encourage water efficiency

Plan Alignment

Align regional planning efforts with local planning efforts to increase engagement with and implementation of these plans. During the final workshop convening, the Met Council inquired about what role they should play for the different entities navigating these challenges and how they could support them moving forward (Table 3.9).[29]

Table 3.9. Best Practices and Barriers to Plan Alignment in the Southwest Metro

Best Practices	Barriers

• Design planning schedules based on what the commaunity needs
• Convene agencies and water users as a regional planning entity
	• Financial resources hinder the full scope of water supply planning work
	• Funding mechanisms
	  ◦ Are dependent on the legislature or regulations
	  ◦ Inhibit the ability or interest to engage in implementation

29 *Ibid.*

Wetlands and Groundwater Recharge

This section includes information gathered during an interview with a staff member of the US Fish and Wildlife Service (USFW) who manages the Minnesota Valley National Wildlife Refuge (Refuge) to fill a gap in federal participation. The best practices and barriers suggested are directly a result of this conversation. This employee's work pertained to managing floodwater, the original intent when citizens petitioned for the Refuge in the 1970s. The Minnesota Department of Natural Resources (DNR) and USFW co-manage the wetlands that provide floodwater protection but must follow specific rules to not impede economic or recreational uses. The work has expanded and now includes protection of features like calcareous fens. The work is very floodwater- and flood-focused, and there is opportunity for more work with groundwater.

Three primary parcels managed by the Refuge fall within the southwest metro. The Refuge is legally allowed to acquire more parcels within broader designated boundaries along the Minnesota River. The Refuge used to own Savage Fen, but it was traded to the DNR in 2011 for more floodplain area.[30] The Refuge does not currently weigh in on high-capacity wells or permitting in the area, but it is aware that these wells impact the wetlands and that there is potential to be more engaged about the area aquitards and the groundwater impacts on Savage Fen (Table 3.10).

Table 3.10. Best Practices and Barriers to Wetlands and Groundwater Recharge in Southwest Metro

Best Practices	Barriers

• Hire or consult with technical experts in groundwater-fed ecosystems
  ◦ Refuge staff have a positive and ongoing relationship working with DNR's calcareous fen expert, who has assessed the quality of their wetlands
• Expand the Refuge's programs to include groundwater management
  ◦ Anticipated impacts include increase impervious surfaces, surface runoff, and drawdown from high-capacity wells
  ◦ Impacted by groundwater governance and land-use decisions by surrounding entities.
• Educate the public through outreach and capacity building
  ◦ Opportunity for collaborative educational opportunities
  ◦ Visitor services and outreach program focuses on nature accessibility in the form of fee-free uses
  ◦ The Wilke Unit near Blue Lake allows for some wild rice harvesting by the Shakopee Mdewakanton Sioux Community (SMSC)
  ◦ Continued work with the American Indian Education Program to increase visibility and awareness of the ecosystems managed
• Partner with interested parties to provide technical assistance
• Working with SMSC on oak savanna restoration
	• Lack of participation in land-use planning, water-supply planning, and permitting decisions
	• Water supply decisions have potential impacts to downstream wetland systems and regional floodwater management
	• Staff capacity and financial limitations for hiring a groundwater-focused position

30 Schuster, Christine. "Savage Fen a 'success Story,' Officials Say Efforts Not Enough." Pioneer Press, February 8, 2025. https://www.twincities.com/2018/08/30/savage-fen-a-success-story-officials-say-efforts-not-enough/.

Rural Workshop Area Comparison

Rural communities face many similar challenges to metropolitan areas, but as urban centers expand and demands grow, rural communities have become targets for the perceived vast quantities of undeveloped land and untapped natural resources. Arriving interests require rural communities to creatively plan for a sustainable future. The COVID-19 pandemic put pressure on rural areas as many urban residents chose to either relocate full-time to existing rural vacation homes or build new ones. Planning for this sort of expansion is especially challenging with the limited financial resources available to rural municipal governments. Noncomprehensive policies, inconsistent awareness of groundwater availability and groundwater use can lead rural communities to make decisions based on local-only needs.

The two focus areas for this comparison were the Michindoh Aquifer and a 5-county region in north central Wisconsin. The Michindoh Aquifer is a multi-jurisdictional groundwater source shared by the ceded territories of the Potowatomi, and the states of Ohio, Indiana, and Michigan. The 5-county region in Wisconsin included the Lac du Flambeau Band of Lake Superior Chippewa, and Taylor, Lincoln, Price, Vilas, and Oneida counties. Both regions had unique challenges and priorities, but there remained a consistent throughline in ecosystem protection, particularly where groundwater and surface water are connected (Table 3.11).

Table 3.11. Rural Area Comparison

	Michindoh Aquifer	North Central Wisconsin
Participants engaged	Tribal water departments, Tribal community groups, state agencies, federal agencies, nonprofits, community organizers, academic professionals, legal experts	Tribal water departments, state agencies, federal agencies, nonprofits, county commissioners, academic professionals, legal experts
Priority groundwater issues	Wetlands, Rights of Nature, and data	Ecosystems, legal structure, communication and consultation, data, and emerging externalities
Case Study	AquaBounty: aquaculture fish farm threatens communities and ecosystems dependent on the water source.	Cranberry growers: cranberry farms with grandfathered wells manage water levels for frost protection and harvest and impact fish spawning beds in lakes.

Summary of the workshop areas for the rural comparison including participants engaged, groundwater issues, and the case study.

Michindoh Aquifer: Michigan, Indiana, Ohio

The Michindoh Aquifer has been the focal point of policy attention for nearly two decades (Figure 3.8). In 2007, a now-stalled effort by the city of Bryan, Ohio sought to have the Michindoh designated a "sole-source aquifer" by the EPA.[31] [32] More recently, an aquaculture operation sought a withdrawal

31 "Sole Source Aquifer Petition - Michindoh Glacial Aquifer." TritiumInc.net, October 2007. https://www.epa.gov/sites/default/files/2016-02/documents/michindoh-sole-source-aquifer-petition-2007-69pp.pdf.

32 "Michindoh Aquifer." EPA. Accessed February 15, 2025. https://www.epa.gov/oh/michindoh-aquifer.

permit of 5.25 million gallons per day (MGD) from the Ohio Department of Natural Resources, a quantity for which the cone of depression was projected to extend into Michigan and the ceded territories of the Potawatomi.[33] Both the state of Michigan and the Pokagon Band of Potawatomi, a Tribal nation headquartered in Michigan, weighed in on this process through the one mechanism available: the Ohio DNR's public comment period. Though the permit in question was ultimately granted, the project was later closed due to financial complications. A broader procedural question remains: what is the best way to jointly manage this aquifer?

Figure 3.8. Michindoh Tri-State Area Map

The Michindoh Tri-State region, with the approximate Michindoh Aquifer boundaries, Tribal nations, and select municipal governments. Data sourced and adapted from ESRI, GLIWFC, and the City of Bryan, Ohio.

33 "AquaBounty Water Withdrawal and Consumptive Use Permit - East Well Field." Ohio Department of Natural Resources. Accessed February 15, 2025. https://ohiodnr.gov/discover-and-learn/safety-conservation/about-odnr/water-resources/water-inventory-planning/ab1-public-comments.

Geologic Context

The Michindoh Aquifer is an ill-defined buried glacial sand and gravel aquifer spanning the tri-state area of Ohio, Michigan, and Indiana that coincides with ancestral Potawatomi homelands. Recent efforts by the USGS to define the flow characteristics of this aquifer have improved general knowledge about aquifer properties, ultimately clarifying the available water budget.[34] Both Ohio and Michigan have drilled or proposed to drill monitoring wells within the aquifer.[35]

The sediments overlying the bedrock in the area are more than 200 feet thick and were deposited by glacial ice, meltwater streams, and glacial lakes. The first bedrock beneath the sediment is shale that has no aquifer potential; a small area of sandstone found only in northern Hillsdale County, Michigan is the exception. Other potential bedrock aquifers are 400 to 600 feet deep, thin, and have water of questionable quality. Thus the region relies on buried glacial sand and gravel of the Michindoh aquifer.

The sequence and lateral extent of sedimentary layers is complex because it formed at the junction of former ice lobes. The Michindoh aquifer is most likely hosted in meltwater stream deposits associated with fluctuating ice margins and was subsequently buried by the advance of one or more of these lobes or by lake sediment.[36] [37] [38] [39] The sand and gravel layers of the aquifer are typically less than 40 feet thick and at depths ranging from 25 to more than 150 feet and are physically and hydraulically connected.[40] The layers are shallowest in the north, deepening to the south, which is also the inferred groundwater flow direction.

Recharge is primarily from precipitation in Hillsdale County, Michiga, the headwaters of the St. Joseph (east) and Tiffin Rivers, and along the St. Joseph River valley in Ohio. A secondary source of recharge is the lateral movement of groundwater into the aquifer from areas further upgradient. Some suggest that about half of the total recharge comes from groundwater flowing in from the northwest.[41] A few municipal wastewater treatment plants discharge polished water to the surface water drainage

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34 Ohio-Kentucky-Indiana Water Science Center. "Hydrogeologic Mapping, Data Collection, and Geologic Framework of Glacial Deposits in a Multi-County Area of Northwest Ohio, Northeast Indiana, and South Michigan." USGS, September 4, 2020. https://www.usgs.gov/centers/ohio-kentucky-indiana-water-science-center/science/hydrogeologic-mapping-data-collection.

35 Henry, Tom. "Ohio DNR Drilling 10 Water-Research Wells to Learn More about a Mysterious Tri-State Aquifer." The Blade, January 11, 2025. https://www.toledoblade.com/local/environment/2025/01/11/ohio-dnr-drilling-10-new-water-research-wells-tri-state-aquifer.

36 Eschman, D.F. Summary of the Quaternary History of Michigan, Ohio and Indiana. Journal of Geological Education, 33, no. 3, (1985): 161 – 167.

37 Dyke, A.S., J.T. Andrews, P.U. Clark, J.H. England, G.H. Miller, J. Shaw, and J.J. Veilette. The Laurentide and Innuitian Ice Sheets during the Last Glacial Maximum. Quaternary Science Reviews, 21 (2002): 9–31.

38 White, G.W. Pleistocene Deposits of the Northwestern Allegheny Plateau, U.S.A. Quarterly Journal of the Geological Society of London, 124, (1968). 131–151.

39 Frolking, T.A., and J.P. Szabo. Quaternary Geology along the Eastern Margin of the Scioto Lobe in Central Ohio. Ohio Geological Survey, Guidebook no. 16 (1988).

40 Thomas, M.A. Ground-Water Quality and Vulnerability to Contamination in Selected Agricultural Areas of Southeastern Michigan, Northwestern Ohio, and Northeastern Indiana. Water-Resources Investigations Report 00-4146 (2000) https://pubs.usgs.gov/wri/2000/4146/wri20004146.pdf.

41 Coen, Alban W. III. Groundwater Resources of Williams County, Ohio, 1984- 1986 USGS, Water Resources Inventory Report. (1989) 89-4020. https://pubs.usgs.gov/publication/wri894020

systems and streams recharge the aquifer in losing reaches. Anthropogenic constituents in wells screened at intervals between 60 and 120 feet confirm that surface water recharges the aquifer and that the overlying layers do not protect it from contamination.[42]

Governance Gaps, Best Practices, and Barriers

Three issues were explored during the in-person workshop May 9-10, 2024. These included concerns about wetlands impacted by the potential lowering of the water table from pumping, the accuracy of data used to inform and answer groundwater-related decisions, and the challenges in advocating for the rights of nature (Table 3.12).

Table 3.12. Michindoh Aquifer Workshop Focus Areas

Governance Gap	Driving Question
Wetlands and water table	How can wetlands be better protected, managed, and directly tied to water table changes that are correlated to groundwater use?
Data accuracy	What data should be collected to more accurately predict and assess the availability of groundwater and the holistic impacts of its use?
Rights of Nature	Why are the rights of nature poorly accounted for in policy decisions and who is legally able to advocate for nature's rights?

Governance gaps and driving questions from the Michindoh Aquifer workshop.

A summary of these governance gaps and the best practices and barriers identified are described below, but more details can be found in Appendix E.

Wetlands and Water Table

Concerns about the impacts of pumping to wetlands and recharge loss resulting from poor groundwater management were discussed. Participants agreed that current governance practices do not sufficiently account for the groundwater that development requires, and which can compete with wetlands, and many wetlands and rivers have been lost throughout the region. In Indiana, where a portion of the Michindoh Aquifer is located, over 85% of the original wetlands have been lost to development and agriculture.[43] This loss of wetlands alters how the water table is being expressed and where recharge is taking place.[44] Wetland loss also means loss of water storage and potential loss of groundwater recharge.[45] The remaining wetlands continue to be threatened by state legislation, such as the Senate Enrolled Act 389.[46] Not all participants understood the connection between wetlands

42 "Michindoh Aquifer." EPA. Accessed February 15, 2025. https://www.epa.gov/oh/michindoh-aquifer.

43 Sandweiss, Ethan. "A New Indiana Bill Will Weaken Protections over Wetlands." NPR, February 20, 2024. https://www.npr.org/2024/02/20/1232769595/a-new-indiana-bill-will-weaken-protections-over-wetland.

44 Vigue, Brian, and April 30. "What One Indiana Community Can Tell Us about Wetlands Loss." Audubon Great Lakes, April 30, 2024. https://gl.audubon.org/news/what-one-indiana-community-can-tell-us-about-wetlands-loss.

45 Smith, Casey. "More than 260 Acres of Indiana Wetlands Lost since 2021 Law Took Effect, Advocates Say." Indiana Capital Chronicle, September 6, 2023. https://indianacapitalchronicle.com/2023/09/06/more-than-260-acres-of-indiana-wetlands-lost-since-2021-law-took-effect-advocates-say/.

46 Indiana Senate Enrolled Act 389, 2021. Wetlands.

and groundwater as some wetlands are discharge areas and others are recharge areas.

Workshop participants expressed concern over this trend, not just in Indiana, but across the region. Wetland loss has threatened the existence of traditional medicines that are found within these wetlands and the availability of sacred wild rice which brought the Anishinaabe people to the Great Lakes region. Most data collected about wetlands does not explicitly pertain to things like traditional medicines or wild rice. Stakeholders discussed best practices and barriers to address these governance gaps (Table 3.13).

Table 3.13. Best Practices and Barriers for Wetlands in the Michindoh Aquifer

Best Practices	Barriers

• Collect and evaluate data in partnership with the community
  ◦ Tribes and community members should be consulted about where data should (and should not) be collected
• Study wetlands to evaluate recharge more comprehensively across the region
• Provide decision makers with more accessible data to inform policy decisions
• Present data, maps, and models in a clear and easy to understand manner
• Shift the perceived value of wetlands
• Promote better consultation with Tribal governments
  ◦ Consult United Tribes of Michigan to understand how wetlands are viewed culturally and to understand current Tribal protections for wetlands
• Consultation should be done early, often, and respectfully
	• Public meetings have been closed to grassroots organization and individuals
	• Legal and political barriers across each jurisdiction, including state and Tribal jurisdiction
	• Decisions are made quickly and with incomplete data
	• Disparate data collecting and collections
	• No public or social value placed on wetlands
	• Difficult to determine how the water table will be impacted by a well

Data Accuracy

Data accuracy was identified as a groundwater governance issue because of the gaps in information that inform decisions about groundwater use. These include unaccounted for withdrawals, unverifiable assumptions in groundwater models, and the limited data at certain depths in monitoring wells. However, it is not possible to know all the variables because natural systems are so complex. Accurate data can be difficult to gather, model, interpret, and verify. Both scientists and community members desire accurate predictions for decision making, all of which require accurate data (Table 3.14).

Table 3.14. Best Practices and Barriers for Data Accuracy in the Michindoh Aquifer

Best Practices	Barriers
• Increase the public's confidence in science and data • Cross-state coordination to bridge knowledge gaps and build a transparent and collaborative platform for data sharing and comparison • Build confidence through community-based research • Produce more trained science professionals • Support current science professionals to design, execute, and communicate projects and project results to the public • Fund the installation of new monitoring wells in areas where data are limited or where potential concerns exist • Increase funding to support additional staffing capacity	• Data required for permitting is not always available • Limited transparency in how assumptions are made • Limited knowledge of the complexity of geologic layering in the Michindoh aquifer • Limited tools are available for measurement • Limited funding for data collection and processing • Limited staff capacity and technical education available to some communities • Monitoring well network is restricted in extent, length of time of observation and time of year that data is collected • Interdisciplinary translation barriers between science disciplines, law, policy • Lack of political will ◦ Increased funding requires political will which relies on the ability to communicate the importance of the work and the need for the funding from the research community

Rights of Nature

The group discussed how recent Rights of Nature movements have been silenced through policy and legal structures, ultimately preventing advocacy. For example, legal personhood has been assigned to corporations while legislation that grants lakes, rivers, watersheds, and rivers the rights of personhood have been blocked or reversed (e.g., Ohio budget bill).[47] Participants expressed a feeling that politics favor the economy over ecology, and people shared personal experiences where physical attempts were made by law enforcement to silence water advocacy. For example, a local government in Ohio barred community advocates from listening to a presentation of research about the Michindoh aquifer. These are examples of blocking a feedback loop between community and decisions makers. This communication is important because it ensures that people have a stake in the decisions being made about the communities in which they live.

Furthermore, the lack of knowledge about, and respect for Indigenous knowledge systems and treaty rights neglect this perspective in decisions about the rights of nature. Treaties are the "supreme law of the Land" according to the U.S. Constitution. Consultation with Tribal entities should take place first, but Tribal perspectives are too often neglected or unknown. Having more Indigenous voices in these conversations would promote the rights of nature. Stakeholders present at this workshop shared barriers and hoped for governance practices (Table 3.15).

47 "Ohio Legislature Moves to Ban Rights of Nature Enforcement." Community Environmental Legal Defense Fund, July 8, 2021. https://celdf.org/2019/07/rights-of-nature-ban/.

Table 3.15. Best Practices and Barriers for Rights of Nature in the Michindoh Aquifer

Best Practices	Barriers

• Priority-of-use laws to protect domestic water users against unsustainable consumptive uses
  ◦ Minnesota Statute 103G.261 sets water allocation priorities for the consumptive appropriation and use of water[48]
• Foster cultural shifts through community education and engagement
  ◦ Link the interdependence of the natural world with human existence
• Honor Traditional Indigenous Knowledge (TEK) as valid, permissible data
  ◦ Humans do not just live in nature, they are nature.
	• Nature is seen as property aligned with the concept of land ownership
	• Nature tends to be invisible under the law
	• Political landscape is always changing
	• Limitations of English language
	  ◦ Lack of connection to nature unlike some Indigenous languages
	• Monetization of resources is normalized and prioritized above other needs
	• Unsustainable uses of water are prevalent
	• Lack of western scientific education among community members
	  ◦ Barred from decision making due to lack of scholastic or academic credentials
	• Differing values among citizens and decision makers
	• Lack of clear mechanism for cooperative governance
	• Strategic Lawsuits Against Public Participation (SLAPP suits) limit public participation.[49]

North Central Wisconsin

The five counties of Taylor, Lincoln, Price, Vilas, and Oneida were defined as "North Central Wisconsin" for the purpose of this project. These counties, along with the Lac du Flambeau band of Lake Superior Chippewa, share similar geologic and groundwater features, where thin glacial sediment overlies the fractured crystalline bedrock resulting in the lowest groundwater yields in the state (Figure 3.9). The North Central Wisconsin workshop was hosted on the Lac du Flambeau reservation, whose 1842 ceded lands form much of what is now the Chequamegon Nicolet National Forest.

The general findings presented in this section are outcomes of the two-day workshop held at the Lake of the Torches Conference Center on October 22-23, 2024. The full workshop summary is available in Appendix D.

48 Minnesota Statute 103G.261

49 "A Brief History of Slapp Suits." ACLU of Ohio, May 15, 2014. https://www.acluohio.org/en/brief-history-slapp-suits.

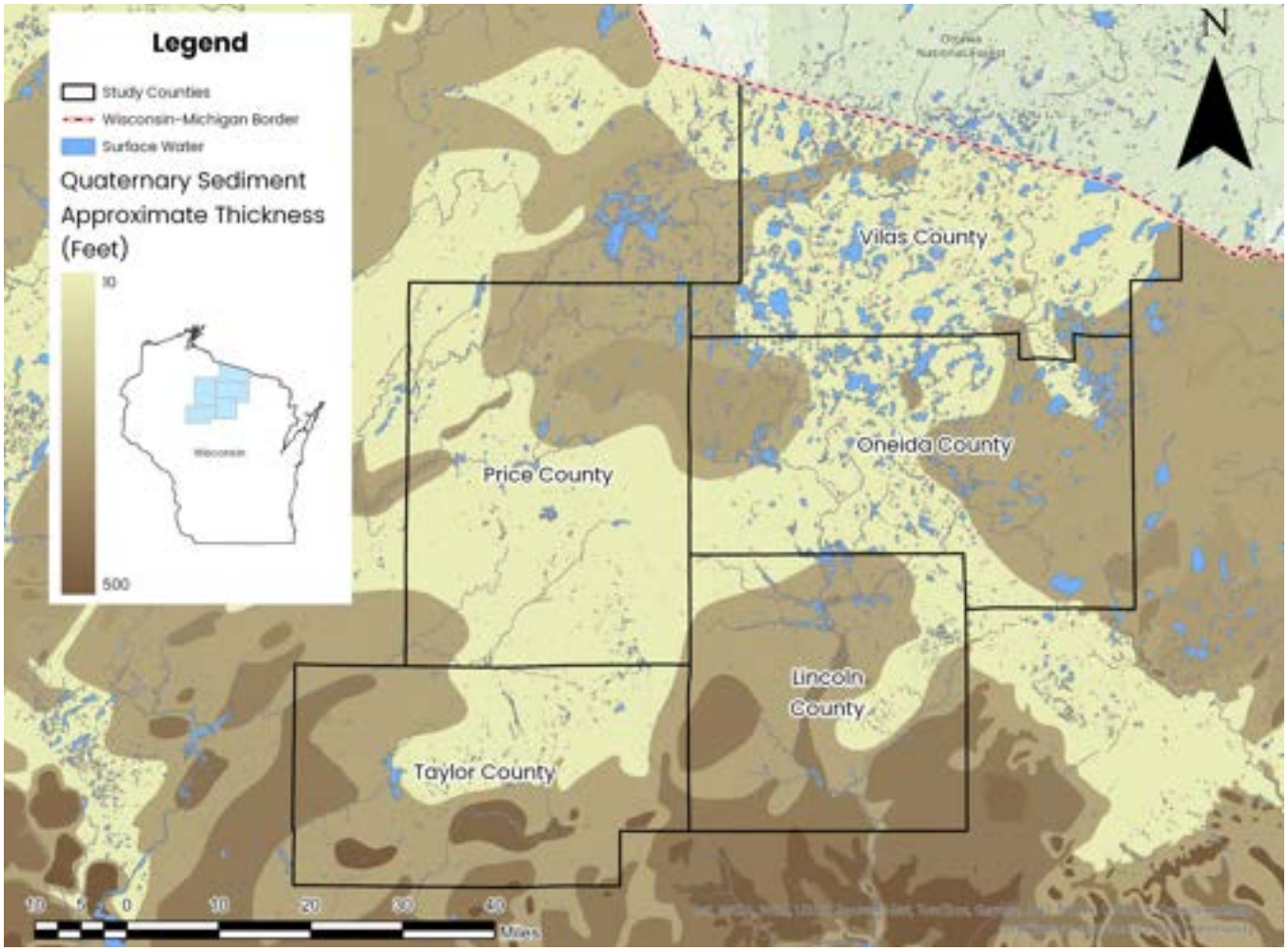

Figure 3.9. Thickness of Quaternary Sediment

Sediment layers of glacial origin overlie fractured crystalline bedrock across the study area counties (black outlines). These are among the lowest-yielding aquifers in the state and are highly connected to the many surface water features. Data sourced and adapted from ESRI and the Wisconsin DNR.

Geologic Context

Coarse-textured glacial stream sediment is the primary groundwater source. The upper, fractured layer of the bedrock can also be used for water supply, but it is an order of magnitude less transmissive than the glacial sediment. Groundwater connection to surface water is high and modeled groundwater flow fields are local, controlled mainly by topography with recharge at highs and discharge to local lows that are commonly occupied by water table or "seepage" lakes, wetlands, and streams. Groundwater levels fluctuate with precipitation and can be influenced by land-use practices such as forest management. The regional glacial groundwater flow system recharges in the northeast (Oneida and Lincoln counties) and flows to the southwest (Rusk and Taylor counties). [50] There are currently no high-capacity wells in the area in part because of the limited ability of the aquifers to support high-capacity pumping. Vilas County within this area has the lowest groundwater yields in the state.

50 Bradbury, K.R., Leaf, A.T., Hunt, R.J., Juckem, P.F., Fehling, A.C., Mauel, S.W., and Schoephoester, P.R., 2018, Characterization of groundwater resources in the Chequamegon-Nicolet National Forest, Wisconsin: Medford Unit: Wisconsin Geological and Natural History Survey Technical Report 004-1, 50 p., 10 plates.

Major land uses include forest management, mining, cranberry growing, fisheries, and rural residential including seasonal lake homes (Figure 3.10). Agriculture is mostly limited to small farms and larger-scale cranberry growing, in which many operations periodically manipulate water levels using surface water and high-capacity wells to prevent frost and to float the berries for harvest (Figure 3.11). The bedrock hosts economic deposits of ferrous and non-ferrous metals and non-metallic minerals. Sand, gravel, and peat are mined from glacial and younger deposits.[51]

The Lac du Flambeau Band of Lake Superior Chippewa has a large landholding and income-generating businesses in the area. Portions of the former reservation lost to tax forfeiture are privately owned parcels interspersed with Tribal lands.[52] Beyond their borders, water and wastewater are decentralized with private wells, on-site-sewage-treatment systems, and land-spreading of septage in the area.[53] Rhinelander is the largest population center in the region.

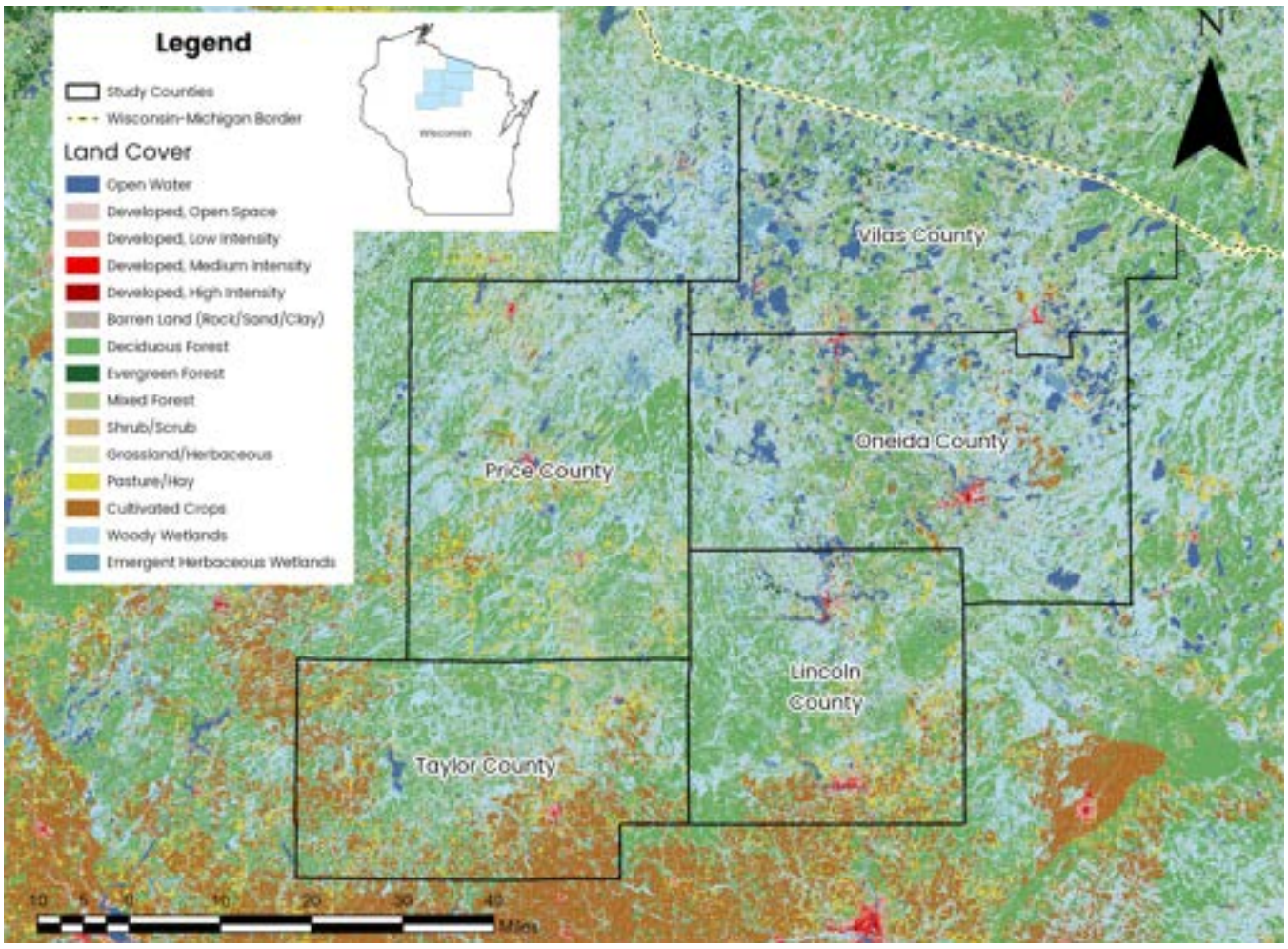

Figure 3.10. Land Cover in the North Central Wisconsin Study Area

As generated by the National Land Cover Database in 2023.

51 Recent and potential metallic mining projects in Wisconsin. Accessed March 3, 2025. https://dnr.wisconsin.gov/topic/Mines/Projects.html.

52 Hanson, Kristen. In-person conversation at North Central Wisconsin workshop, Lac du Flambeau, June 2025.

53 *Ibid*.

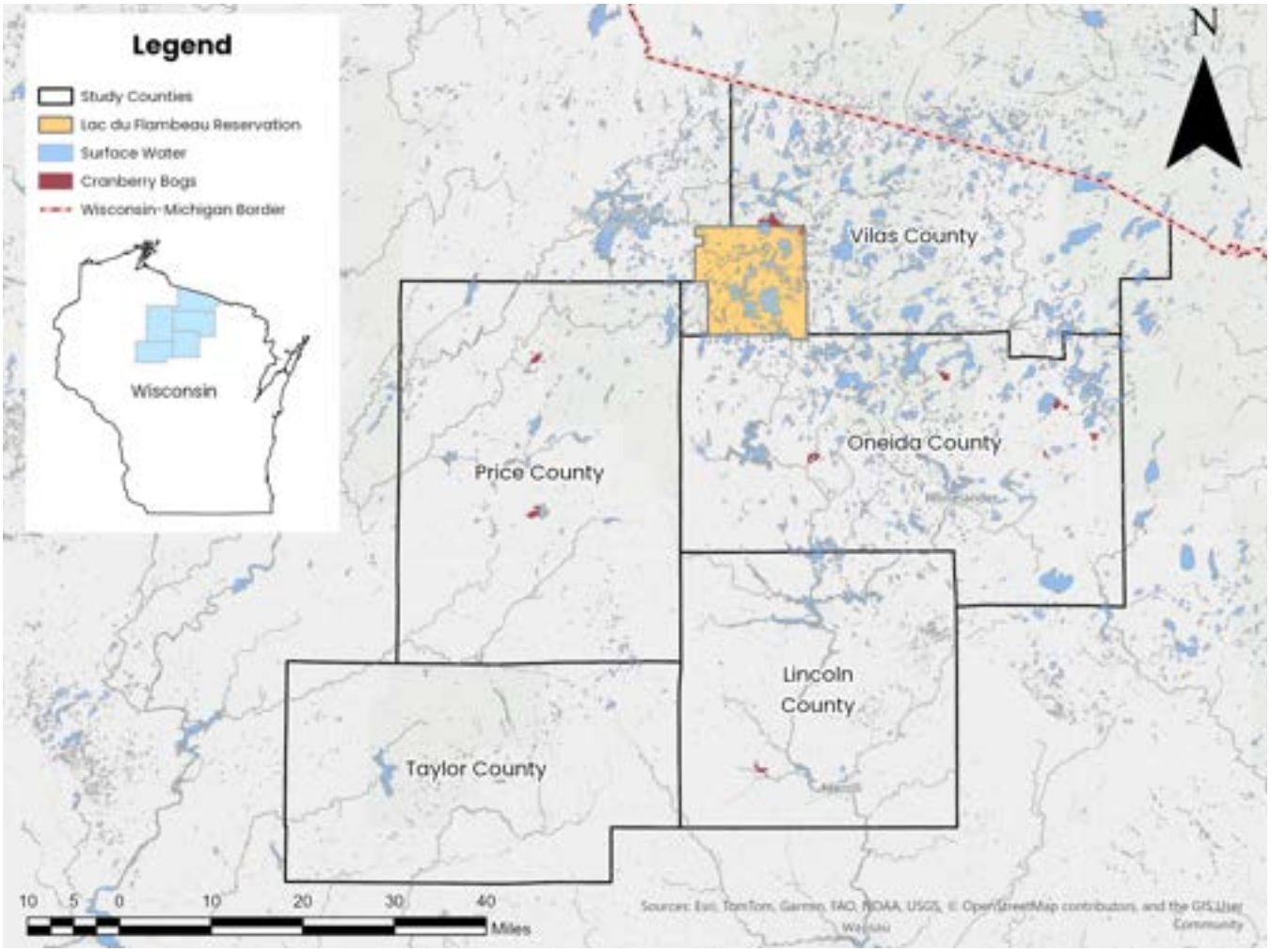

Figure 3.11. The Lac du Flambeau Reservation, Cranberry Bogs, and Surface Water in the Study Area

Data sourced from ESRI, the Wisconsin DNR, Wisconsin Statewide Parcel Map Initiative, Wisconsin State Cranberry Growers Association.

Governance Gaps, Best Practices, and Barriers

During the workshop, five regional groundwater issues were identified by the multi-jurisdictional group of workshop participants (Table 3.16).

Table 3.16. Governance Gaps and Driving Questions from the North Central Wisconsin

Governance Gap	Driving Question
Data	What data are needed to generate a holistic knowledge base of available groundwater that enables effective source-water assessment and assesses potential extents of contamination?
Communication and consultation	Why is communication siloed and uncoordinated, and what should respectful and honest consultation look like?
Legal structure	Which legal entities oversee the equitable management of groundwater and how do they work together?
Ecosystem needs	How are ecosystems and their needs impacted by the manipulation and management of groundwater?
Emerging externalities	What proactive measures are needed in anticipation of emerging externalities like climate change, PFAS contamination, and population growth?

Governance gaps identified in the North Central Wisconsin water supply planning effort and the driving questions developed by Freshwater to address those gaps.

A summary of these governance gaps and the best practices and barriers identified are described below, but more detail can be found in Appendix D.

Ecosystems

Ecosystems and the lifeways they support are not sufficiently protected by the federal, state, and local laws governing groundwater management. This is perceived to lead to biodiversity decline, impacts to aquatic organism communities, invasive species invasions, warming stream temperatures, reduced drinking water, diminished recreation opportunities, and water stress in the ecosystem.

In this region, specific concerns were shared regarding land spreading of septage, potentially hosting PFAS and human pharmaceuticals, impacting water quality and leading to a degraded groundwater ecosystem and wildlife impact; dewatering for mining and the potential impact to the water table and connected surface waters; and increased development pressures on limited groundwater, especially where connected to seepage lakes and wetlands. These activities potentially threaten crucial lifeways of human and non-human ecosystems living in the North Central Wisconsin planning area (Table 3.17).

Legal Structure

There are numerous issues associated with government entities having varying foci, needs, capacities, and available funding. This results in a variety of outcomes and a lack of cohesive frameworks and structures. One example where legal structure does not respect existing environmental conditions is cranberry growing. There are a number of cranberry operations in the area, but cranberry growers are exempt from Clean Water Act regulations through the irrigation return flow exemption. This means that cranberry growers' discharges to surface water are unregulated, posing a potential threat to groundwater in locations where surface water recharges the groundwater aquifer. Workshop participants identified these and other hyper-local barriers and best practices (Table. 3.18).

Table 3.17. Best Practices and Barriers for Ecosystem Protection in North Central Wisconsin

Best Practices	Barriers

• Implement or explore science-driven policy and actions
  ◦ Groundwater in this region could be designated as "treaty reserved" or "Waters of the United States"
  ◦ Sole Source Aquifer designation through the Safe Drinking Water Act for groundwater quantity management
• Exercise self-determination
  ◦ The Sokaogon Band of Lake Superior Chippewa were formally approved by the EPA in 1996 to set their own water quality standards, by way of the Treatment–As-A-State (TAS) legislation, allowing the ability to classify all of their water bodies as Outstanding National Resource Waters (ONRW), which ultimately protected their waters from the impacts of mining. [54] [55]
• Acquire land to protect groundwater-dependent ecosystems
  ◦ Under public or Tribal ownership, ecosystems can be protected more directly may limit the development pressures on seepage lakes and wetlands
• Establish a regional groundwater collaborative based on natural boundaries
  ◦ Workshop-based collaboratives, and more grassroots project-driven work
	• Lack of clarity around private land regulation within reservation boundaries
	• Inconsistent regulatory structure for groundwater quantity
	• Research timelines may be long and funding restrictive
	• Grandfathered-in activities (e.g., cranberry high-capacity wells) persist even with changing circumstances

Table 3.18. Best Practices and Barriers of the Legal Structure in North Central Wisconsin

Best Practices	Barriers
• Prioritize immediate mandates with significant impact for groundwater issues • Build relationships between agencies ◦ Memorandum of Understanding (MOU) may be developed to find solutions to common issues and identify shared priorities • Build relationships locally • Allocate resources based on need rather than political climate • Develop a regional planning tool for groundwater use it to coordinate, manage complexity, and share data across agency and government efforts	• Lack of available, cohesive information across disciplines • Short-term priorities are emphasized due to political and legal conflicts, stagnating change • Building trust, funding, and capacity requires political will and an investment in relationships • Lawsuits are cost-prohibitive for those who do not have the means to go through litigation

54 Van Zile, Tina, and Ferdinand, Roman. "Case Studies in Tribal Water Quality Standards Program: The Sokaogon Chippewa Community." EPA, November 2014. https://www.epa.gov/sites/default/files/2014-11/documents/casestudy-sokaogon.pdf.

55 Van Zile, Tina. "Crandon Mine Purchase Anniversary Celebration Held Last Saturday." Sokaogon Chippewa Community: Mole Lake Band, November 2, 2023. https://sokaogonchippewa.com/crandon-mine-purchase-anniversary-celebration-held-last-saturday/.

Communication and Consultation

Inadequate communication and consultation can create conflict or challenges. While many recommended best practices for communication exist, they are often not followed. This leads to a gap in awareness and engagement between those making decisions and those impacted by the decisions. For example, one workshop participant was unaware of multiple research projects about wild rice happening on their reservation, despite being the technical expert for wild rice. This lack of communication led to many questions and concerns about what data was being collected and how it was being used, ultimately furthering the distrust of research institutions. In response to these scenarios, those present suggested best practices to overcome barriers (Table 3.19).

Table 3.19. Best Practices and Barriers to Communication and Consultation in North Central Wisconsin

Best Practices	Barriers
• Create informational content to effectively outline key water issues[56] • Mobilize volunteers to create awareness and educate their communities through grassroots efforts • Recruit marketing professionals to expertly share messages of importance • Prioritize early relationship building and regular consultation with regional actors, including Tribes, shareholders, and legal experts • Evaluate and regulate high-capacity wells	• Knowledge gap regarding issues of water quality and quantity for many citizens • Lack of understanding around the importance of Tribal consultation • Lack of political will to make changes because of the nature of politics and unknown financial interests • Lack of financial resources to pay for help, organization, legal support, or implementation of improvements

Data

Data availability for source-water assessments and the general knowledge base was thought by this group to be lacking. This was complicated by the past and current restrictions by which state and federal agencies operate, and the specific restrictions placed upon state and federal employees (Table 3.20).

56 **Note:** In a 2023 report on rural resident perceptions of Wisconsin's waters, 60% of residents report seeing little to no information about water in their community. note: While their most used source of information was local news, friends, family, and neighbors, they reported that they have the highest levels of trust in private well testers and staff at state and federal regulatory agencies, county conservation departments, and the University of Wisconsin system.

Christenson, Catherine, Michael Cardiff, Ken Genskow, and Bret Shaw. Publication. Rural Resident Perception of Wisconsin's Waters, 2023. https://www.wri.wisc.edu/wp-content/uploads/WaterSurvey-Report2023Finalized.pdf.

Table 3.20. Best Practices and Barriers of Data Management in North Central Wisconsin

Best Practices	Barriers
• Provide access and increase awareness of groundwater studies and models to assist county and municipal planners in developing groundwater protection and management plans • Conduct an inventory of studies and existing data to identify data gaps in consultation with the Tribes • Ensure staff and organizational contacts are current to facilitate communication between jurisdictions • Amplify and provide more funding for the Wisconsin Groundwater Coordinating Council, an existing state-level structure that requires support for federal and Tribal participation	• Unsure if data are updated or available to answer emerging questions • Lack of technical and institutional knowledge, funding, and capacity impact data access and availability • Capacity constraints make it difficult to explain the need, produce results, and navigate the bureaucracy to pursue funding

Emerging Externalities

Emerging externalities included population growth, climate change, PFAS, and increased development. While the workshop was intended to focus on water-supply, not water-quality challenges, the group maintained that PFAS directly impacts supply due to the difficulty of remediating. This was reinforced throughout the workshop, as participants inquired about the impacts of PFAS contamination on the safe consumption of drinking water, and potential impacts to locally sourced foods like maple syrup and wild game. They also expressed concerns about the lack of regulations that exist to protect groundwater from untested and potentially contaminated biosolids that were being land-spread as a disposal solution (Table 3.21).

Table 3.21. Best Practices and Barriers of Emerging Externalities in North Central Wisconsin

Best Practices	Barriers
• Improve land-use planning to avoid expensive treatment where possible ◦ Zoning ordinances may restrict land-spreading in areas of groundwater recharge • Mitigate PFAS contamination through establishing and enforcing water quality standards for PFAS, testing biosolids before land application, and working in collaboration with airports to co-design best management practices	• Remediation is costly, particularly regarding PFAS • Limited staff capacity to monitor and enforce rules • Lack of protection and awareness around PFAS in consumer products • Federal and state policy makers lack the technical or issue understanding to implement policy-based solutions

Section

4

Collaborative Transboundary Governance in EPA Region 5

During the project period, Freshwater explored opportunities for collaboration across jurisdictions, including municipalities, states and Tribal nations in EPA Region 5 for improved groundwater governance through the following activities:

- meeting with EPA on the new ruling to protect treaty-reserved rights in ceded territories;
- working with the Minnesota Groundwater Association (MGWA) to feature groundwater specialists from the Region at their conference on sustainable groundwater management;
- co-hosting an interstate meeting with the Minnesota Department of Natural Resources (DNR) for groundwater technical staff from across Region 5;
- reviewing groundwater ordinance language;
- reviewing existing transboundary agreements and identifying best practices;
- discussing site-selection and design considerations for high-volume water users with engineering firms;
- meeting with citizen groups about their ability to engage in groundwater governance.

Description of Geographic Challenge

Every person, agricultural enterprise, and industry uses water. Yet water, a shared, common-pool resource, is often an afterthought in site selection and planning processes. The Great Lakes region is perceived as being water-rich and states promote this asset to attract water-intensive industries.[1] While it is true that the region hosts usable groundwater, the supply is not limitless, evenly distributed, and in places it is being depleted in decades. Use is clearly not sustainable in areas with large cones of depression or where streams, wetlands, and lakes are seasonally impacted. Areas that lack bedrock aquifers and rely on glacial sediment for groundwater are less likely to support large population centers and water-intensive industry long-term. Where glacial aquifers are at the surface, the need for irrigation can stress connected surface waters.[2] There are other unique local challenges from over-pumping such as salt intrusion, [3] PFAS and pollutant plume migration, and mobilization of geogenic contaminants like arsenic, manganese, and radon.

The adequacy of groundwater to sustain existing and new users requires evaluation on a case-by-case basis using an appropriate level of detail to describe local hydrogeologic conditions; a comprehensive summary of current use; a groundwater monitoring network; and future-scenario modeling that includes climate impacts.

This section reviews the results of the activities listed above as they apply to existing gaps, best practices, and barriers for management, conservation, and sustainable use of groundwater.

Applying Groundwater Quantity to EPA's Rule on Water Quality Standards to Protect Treaty-Reserved Rights: A Discussion with the EPA

Freshwater and Great Lakes Indian Fish and Wildlife Commission (GLIFWC) staff requested a meeting with those who worked on the rule on water quality standards (WQS) to protect treaty-reserved rights (TRR Rule).[4] Region 5 staff close to the topic also attended (supervisors, tribal coordinators, water quality standards coordinator, and tribal water standards specialists). The objective was to better understand how the EPA's TRR Rule might play out in practice, especially in surface waters with a strong

1 Davis, Jon. "Big Data Centers, Big Rewards for States?" CSG Midwest, November 18, 2024. https://csgmidwest.org/2024/11/18/big-data-centers-big-rewards/.

2 "Central Sands Lakes Study." Central Sands Lakes Study | Wisconsin DNR, May 2021. https://dnr.wisconsin.gov/topic/Wells/HighCap/CSLStudy.html

3 Walters, Alex. "Salt Level Rising in Michigan Groundwaters, Endangering Crops, Homes." Bridge Michigan, April 15, 2024. https://www.bridgemi.com/michigan-environment-watch/salt-level-rising-michigan-groundwaters-endangering-crops-homes.

4 Water Quality Standards Regulatory Revisions To Protect Tribal Reserved Rights, EPA-HQ-OW-2021-0791; FRL-8599-02-OW § (2024).

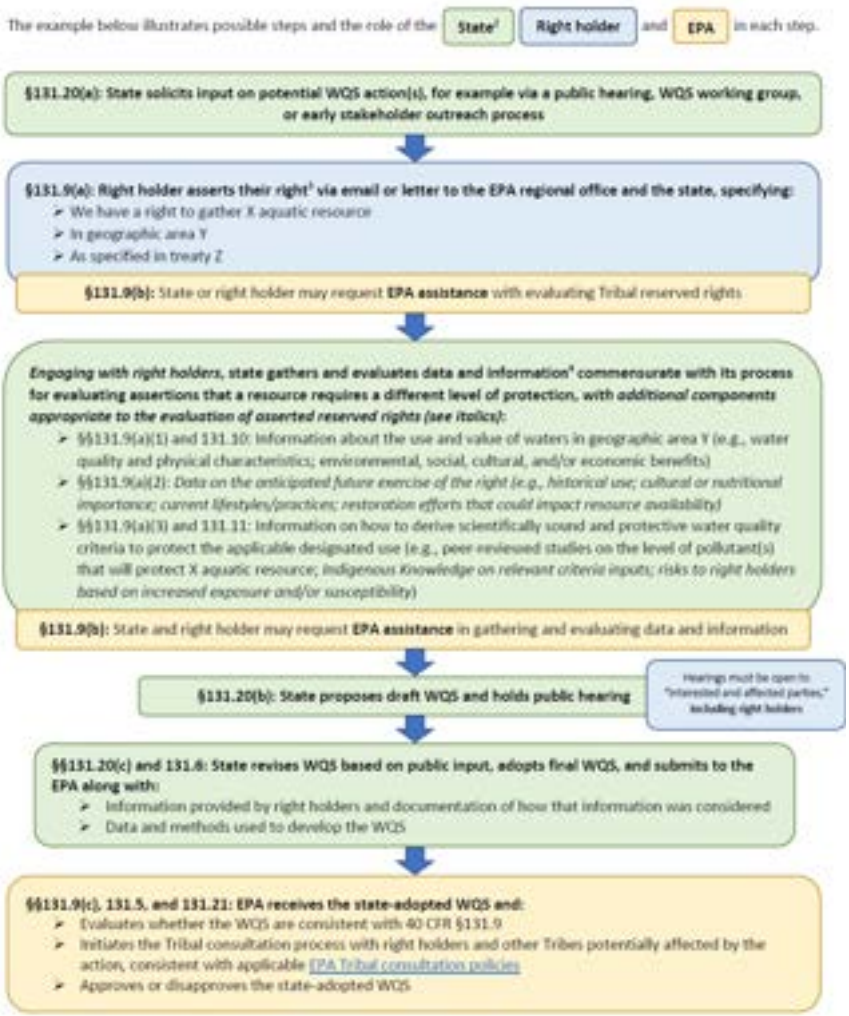

Figure 4.1. EPA Regulatory Revisions for TRR Rule with an Example Implementation Scenario

1 - This example implementation scenario does not impose legally binding requirements on the U.S. Environmental Protection Agency (EPA), states, Tribes, or the regulated community, nor does it confer legal rights or impose legal obligations upon any member of the public. The EPA regulations referenced in this document contain legally binding requirements. This example implementation scenario does not change or substitute for any Clean Water Act (CWA) provision or EPA regulation. The example provided here may not apply to a particular situation based upon the circumstances. This document is not intended to bind any EPA decisionmakers as they review WQS under CWA section 303(c). Notwithstanding anything in this document, each WQS action must be evaluated on a case-by-case basis in accordance with the CWA and the EPA's implementing regulation at 40 CFR part 131.

2 - Pursuant to 40 CFR 131.3(j), "states" include the 50 states, the District of Columbia, Guam, the Commonwealth of Puerto Rico, Virgin Islands, American Samoa, the Commonwealth of the Northern Mariana Islands, and Indian tribes that the EPA determines to be eligible for purposes of the WQS program.

3 - A decision not to raise a right in a specific WQS context does not amount to a general waiver or disclaimer of that right in the WQS context or in other contexts, including with respect to other state or federal actions that may impact Tribal reserved rights. Additionally, a decision not to raise a right during a specific state WQS development process does not preclude the right holder from raising that reserved right during another WQS development process or during another process addressing expressed Tribal interests, as long as the assertion relates specifically to WQS.

4 - There may be circumstances where data and information are not available in a specific state WQS development process, such as where additional time is needed to gather data and evaluate the results. In such cases, the triennial review process exists to ensure that any new information that was not previously addressed is considered and incorporated in a future WQS revision, as appropriate. In the interim, the state, the right holder, and the EPA should discuss next steps for a future WQS revision to address the new information, as needed, as well as how the right could be protected until that future WQS revision occurs.

groundwater connection. The intent was to explore the applicability of the TRR Rule to the following scenarios, especially where treaty territories cross state boundaries.

I. Groundwater-fed streams and springs have cooler, more stable temperatures and differing water chemistry from surface water. Cold-water fish and the organisms they depend on are potentially at risk if groundwater is depleted. Could the TRR Rule be used if enough groundwater was extracted to warm groundwater-fed streams?

II. Healthy wild rice beds have been linked to areas of groundwater upwelling. Could the TRR Rule be deployed if groundwater withdrawal impacted wild rice viability?

III. In a reverse scenario – where shallow aquifers have been breached by pipeline emplacement- cold upwelling groundwater into tannic (acidic) surface-water bodies has the potential to change pH and temperature creating unfavorable habitat for bog plants and life. Could the TRR Rule be used to protect those waters from harmful groundwater discharge?

The process for implementation of the TRR Rule as outlined by the EPA is portrayed in Figure 4.1.[5]

Every three years, states take part in the triennial review process where current WQS are assessed, developed, updated, and revised, and the state solicits comments.[6] [7] Tribes with TAS status are authorized to establish and enforce WQS within reservation boundaries. There is also potential for Tribal WQS to have occasional upstream, off the reservation impact if the point source could compromise those standards.[8] As such, the TRR Rule is intended for Tribes without TAS or for areas where Tribal WQS are not currently in place. The proposed implementation scenario would likely take multiple years. As of this report, questions remain about the level of consultation with Tribes that will be exercised by each state. According to this proposed process, consultation with Tribes will not happen early or frequently. Instead, states will follow the status quo in conjunction with public comment periods and formal review processes.

Treaty-Reserved Rights Rule's Application to Groundwater

The TRR Rule was designed to apply to surface water, not groundwater and to clarify EPA's role in assisting tribes with surface-water-quality standards. A surface-water standard can be quantity-, quality-, temperature-, or contaminant-based. Surface water can be protected for the use of recharging groundwater used as a drinking-water source or in support of a treaty-reserved right. EPA staff acknowledge that surface water and groundwater connections have not been explored thoroughly in Region 5 compared to other water-scarce parts of the country. The TRR Rule would allow Tribes to assert rights for consideration to the EPA related to surface water interaction with groundwater.

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5 U.S. Environmental Protection Agency. WQS Regulatory Revisions to Protect Tribal Reserved Rights: Example Implementation Scenario, April 2024. https://www.epa.gov/system/files/documents/2024-05/tribal-reserved-rights-final-rule_fact-sheet_508.pdf.

6 "Triennial Review." Illinois Environmental Protection Agency, 2025. https://epa.illinois.gov/topics/water-quality/standards/triennial-review.html.

7 **Note:** The triennial review process is every three years for each state. Not every state conducts its triennial review on the same year.

8 "TAS for the Water Quality Standards Program, EPA 820-F-17-019." EPA Office and Science and Technology, September 2017. https://www.epa.gov/.

Implementation of the TRR Rule could require designating the use of a surface-water feature by using a criterion that would ensure protection if interaction with groundwater occurs. An assertion could also focus on a use impacted by surface-water impairments that require groundwater recharge. For example, there are designated uses for surface water that involve treaty-reserved rights to gather manoomin or fish. Changes in groundwater quantity can impact aspects of surface-water chemistry like dissolved oxygen, salinity, or temperature. To the extent that waters under review with the TRR Rule are supported by adequate groundwater, they could be subject to an updated standard. The volume of cold water needed to maintain an existing thermal standard is dependent on the air temperature as well as groundwater temperature and volume. Citing a thermal standard could require documentation of any change in temperature to a cold-water stream that was a result of climate versus groundwater volume or temperature change.

Tribal Rights for Interstate Ceded Territories

States receive delegated authority from the EPA to administer federal environmental programs, like the Clean Water Act's WQS program, which sets standards within the state borders. Tribes who have applied for and been approved for Treatment as a State (TAS) also have that same delegated authority, similar to a state, to manage and implement federal environmental programs for their Tribe within their reservation boundaries.[9] A Tribe must apply for and be approved for TAS status for each environmental program separately.[10] States have assumed delegated authority and have the individual authority to set WQS and submit revisions to the EPA.

The general practice in Region 5 has been to extend consultation to all of those in the treaty area. For example, consultation in the 1837 Treaty Territory would include Wisconsin and Minnesota Tribes. There has not been formal interstate coordination in Region 5, but members of state agencies discuss border-spanning issues frequently. Parties can request EPA engagement to negotiate a solution across states and Tribes if needed, but ultimately the authority lies in the state's process.

The TRR Rule has already faced legal challenges. As of summer 2024, a group of twelve western states has alleged the TRR Rule exceeds EPA's Clean Water Act authority.[11] The initial lawsuit was answered with a motion to intervene served by 12 Tribes, including seven Tribes from Region 5 and accompanied by comments from Great Lakes Indian Fish and Wildlife. Despite the EPA's assurances otherwise, the TRR Rule may further be challenged for effectively limiting existing water rights. The geographic extent of Tribal reserved water rights for fishing may have significant effects on water quality standards and the granting or denial of pollutant discharge permits throughout the U.S.; particularly in states where multiple federally recognized Tribes hold reserved rights to aquatic or aquatic-dependent resources.

For additional details, including a potential scenario for how the TRR Rule may be used during a state triennial review, see Appendix A.

9 Treatment as a State is also known as Treatment as a Sovereign in Indian Country.

10 U.S. Environmental Protection Agency. "Tribal Assumption of Federal Laws - Treatment as a State (TAS)." EPA, January 14, 2025. https://www.epa.gov/tribal/tribal-assumption-federal-laws-treatment-state-tas.

11 State of Idaho v. EPA. Case 1:24-cv-00100-DLH-CRH (https://www.epa.gov/system/files/documents/2024-06/complaint-idaho-et-al-v-epa-tribal-reserved-rights-rule-5.28.24.pdf May 28, 2024).

Summary of MGWA Conference Impact

The Minnesota Ground Water Association (MGWA) is a non-profit, volunteer organization which promotes public policy and scientific education about groundwater. The organization sponsors two conferences each year on timely issues concerning policy and the scientific aspects of groundwater that are attended by approximately 400 water professionals. The theme of the conference in the fall of 2024 was groundwater sustainability. Freshwater worked with the MGWA Board to extend speaker invitations to groundwater specialists in the western Great Lakes region, including Minnesota, Wisconsin, and Illinois. This resulted in useful information exchange at the meeting and during the small-group technical staff meeting described in more detail later.

Minnesota

It is within the statutory authority of the Minnesota DNR to permit groundwater allocations based on the availability of water for future generations, the support of ecosystems, the protection of drinking water sources and to preserve water quality. There is a great difference in groundwater availability across Minnesota and the DNR models its groundwater management approach based on those groundwater provinces (Fig. 4.2).[12]

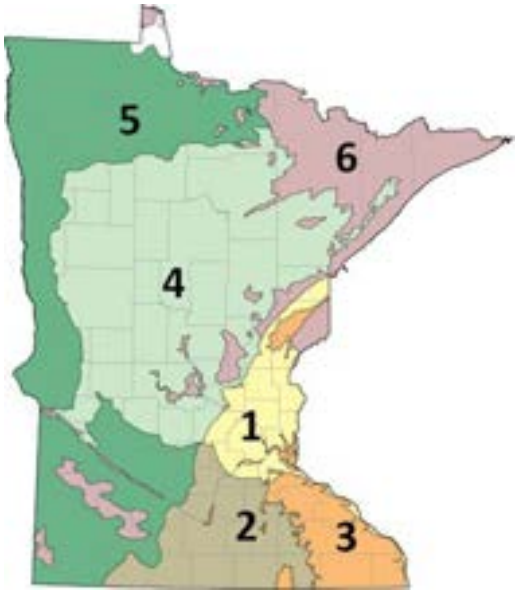

Figure 4.2. Groundwater Provinces of Minnesota

A qualitative, geology-based assessment of groundwater availability from high (1) to low (6). Source: Minnesota Department of Natural Resources[13]

In Groundwater Province 5, the western edge of Minnesota with portions of the northwest and southwest regions, livestock watering accounts for 10% of water use, consuming on average 100 million gallons per year and that number doubled between 2021 and 2023. Clustered animal operations can lead to groundwater decline. The DNR requires monitoring and modeling in places where aquifer knowledge and water was scant. In some scenarios, a 25% decline was determined to be too great.[14] It may take longer to determine the availability of groundwater in Groundwater Province 5 because there is less information about the distribution and volume of available water.

12 "Minnesota Groundwater Provinces 2021." Minnesota Department of Natural Resources, February 6, 2025. https://www.dnr.state.mn.us/waters/groundwater_section/mapping/provinces.html.

13 *Ibid*

14 Considine, Ellen, Jennifer Rose, and Amanda Yourd. "MGWA: Groundwater Resilience in the Upper Midwest: Sustainability Vision 2050." Brooklyn Center, MN, 9:30-10:27, 2024. https://www.mgwa.org/conferences/mgwa-2024-fall-conference-wrap-up/

Another management approach is a Water Allocation Plan that establishes a maximum yearly volume and leaves the specifics of water sharing up to the high-capacity users in the area.[15] If end users cannot agree, then the DNR gets involved. In Groundwater Province 5, that volume is approximately 200 MG/yr.[16] DNR can help identify where there may be potential for conflict and if a decline in public water supply occurs, can work with communities and appropriators to limit pumping. However, it takes time to develop such a plan.

In the Twin Cities metropolitan area (Groundwater Province 1), there is more groundwater and hydrogeologic information available. However, there is greater potential for well interference between high-capacity users and the numerous domestic wells on the urban edge. For example, pumping by the City of Blaine, a northwest suburb, caused interferences for 47 private wells in Blaine and the nearby City of Ham Lake from 2021 to 2023, a period of significant drought.[17] During 2022, the city used 1.7 billion gallons of water, five times more than all the other high-volume water users in the area combined.[18] During periods of drought, when water levels are already low, people tend to increase water usage (e.g. watering the lawn). It was people's reaction to drought during a time of already low water levels that created the conditions for well interference in this scenario.[19]

The Minnesota DNR has the responsibility to protect ecosystems that rely on groundwater discharge[20], including wetlands. Calcareous fens rely on constantly upwelling groundwater to support the calcium-loving plants and have special protections in Minnesota statute, so the DNR takes a cautious approach with permit applicants within two to three miles of fens.[21] Water levels in sentinel wells near one fen in Groundwater Province 1 showed a drawdown of 0.2 feet during a pump test and that amount of water-level change would have degraded the fen, so an appropriation permit was denied.[22] The determination of impact of a wells near calcareous fen may take two to three years.[23]

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15 "Guidelines for Suspension of Surface Water Appropriation …" Guidelines for Suspension of Surface Water Appropriation Permits, 18, June 2019. https://files.dnr.state.mn.us/natural_resources/climate/drought/drought_permit_suspension.pdf.

16 Considine, Ellen, Jennifer Rose, and Amanda Yourd. "MGWA: Groundwater Resilience in the Upper Midwest: Sustainability Vision 2050." Brooklyn Center, MN, 2024. https://www.mgwa.org/conferences/mgwa-2024-fall-conference-wrap-up/

17 "Blaine-Ham Lake Area Well Interference Investigation." Minnesota Department of Natural Resources, June 2023. https://www.dnr.state.mn.us/waters/watermgmt_section/blaine-ham-lake-well-interference.html.

18 Yourd, Amanda. "Fact Sheet: Blaine-Ham Lake Area Well Interference." Minnesota Department of Natural Resources, June 2023. https://files.dnr.state.mn.us/waters/watermgmt_section/appropriations/2023-06-21-blaine-ham-lake-gw-fact-sheet.pdf.

19 Considine, Ellen, Jennifer Rose, and Amanda Yourd. "MGWA: Groundwater Resilience in the Upper Midwest: Sustainability Vision 2050." Brooklyn Center, MN, 2024. https://www.mgwa.org/conferences/mgwa-2024-fall-conference-wrap-up/

20 Minnesota Statute 103G.223.

21 Minnesota Administrative Rules, 8420.0935 STANDARDS AND CRITERIA FOR IDENTIFICATION, PROTECTION, AND MANAGEMENT OF CALCAREOUS FENS.

22 Considine, Ellen, Jennifer Rose, and Amanda Yourd. "MGWA: Groundwater Resilience in the Upper Midwest: Sustainability Vision 2050." Brooklyn Center, MN, 2024. https://www.mgwa.org/conferences/mgwa-2024-fall-conference-wrap-up/

23 *Ibid*.

Metropolitan Council for 7 Counties Surrounding Minneapolis and Saint Paul

The Metropolitan Council (Met Council) has a water supply-planning process that provides access to data and context to assist in the local groundwater management and planning. In the Twin Cities metro area, The Met Council controls wastewater treatment for the metropolitan area, which includes both surface water and groundwater. Though a majority of the drinking water in the Minneapolis-Saint Paul center is surface water sourced from the Mississippi, groundwater from municipal wells is more common in suburban water supplies.[24] In the metropolitan area, water use in the summer is higher than in the winter and there is room for improvement in water-use efficiency and conservation.[25] By considering current supply and demands, Met Council can be more proactive than individual projects and cities where issues may arise from cumulative impacts.

Wisconsin

There are groundwater sustainability challenges in Wisconsin that include the presence of grandfathered-in, high-capacity wells in proximity to groundwater-dependent lakes, the variability of water availability and quality with geology, and quantity issues arising from recent drought conditions. Regulatory challenges have included uncertainty in the decision-making process, and the high number of requests for permits (the Wisconsin DNR receives 200 to 300 high-capacity well applications per year).[26]

The Wisconsin Geological and Natural History Survey (WGNHS) collaboratively co-manages a groundwater-level monitoring network with the U.S. Geological Survey (USGS) Upper Midwest Water Science Center, which can help identify long-term trends and distinguish pumping from climate impacts to help establish thresholds to avoid harm to ecosystems.[27] Monitoring wells and other field data are used in groundwater flow models to help build better conceptual understanding of groundwater-surface water connections. The modeled impact varies with pumping rate, aquifer properties, the presence of fractures, and general uncertainties about the conditions. Shallow lakes respond differently from deep lakes and streams tend to experience more impact than lakes.

Opportunities include working at the appropriate scale to manage an aquifer and proactively collaborating with agencies, institutions, and planning commissions at various levels of government; working with agricultural interests on irrigation planning to reduce stress on the system; focusing on cumulative impacts when reviewing water use and approving wells with conditions; making a water quality and groundwater database readily available, and developing a well interference process.

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24 "Wells & Drinking Water." Wells & Drinking Water | Scott County, MN, 2025. https://www.scottcountymn.gov/711/Wells-Drinking-Water.

25 "Water Supply Now and for the Future: Steps toward Sustainable Water Supplies." REPORT OF THE METROPOLITAN AREA WATER SUPPLY ADVISORY COMMITTEE TO THE MINNESOTA LEGISLATURE, 2017. https://metrocouncil.org/Wastewater-Water/Publications-And-Resources/WATER-SUPPLY-PLANNING/Water-Supply-Now-and-for-the-Future.aspx.

26 **Note:** State agencies are under the executive branch of the state government (the governor), but are bound by state statutes, administrative rules, and other legislative decisions enacted by the state legislature. State agencies are also bound to the decisions made by the judicial courts. As elections occur, the political opinions of the government branches may shift and sway. Civil servants in state agency positions must adjust certain behaviors and decisions with every election cycle to ensure compliance with statutes, court decisions, and other legalities.

27 "Groundwater-Level Monitoring Network." Wisconsin Geological and Natural History Survey, 2025. https://home.wgnhs.wisc.edu/water/groundwater-level-monitoring-network/.

Illinois

The Illinois State Water Survey (ISWS) is guided by the 2022 state water plan, a 7-year management strategy that includes surface water, groundwater, and public water-supply sources.[28] However, oversight of groundwater withdrawals has not been prioritized despite challenges with water supply in some regions. There is no statutory authority to limit usage of groundwater.[29] The current approach gives more control to local and regional planning groups to manage resource allocation. Ecosystem impacts are not being evaluated evenly.

The ISWS has developed predictive models of deep groundwater systems. The St. Peter is at risk of further drawdown and dewatering in the northwest suburbs of Chicago. This is driving some suburban communities to request connections to Lake Michigan water. Others seek that water because of PFAS contamination and the cost of treatment.

Local governments want to retain authority over water planning decisions and manage water locally. Planners are optimistic and have a strong belief in technological improvements that solve water scarcity problems or may be reading individual data points and not projecting far into the future. Lessons learned from participant engagement are that diverse kinds of engagement are needed early in the process to navigate questions and tradeoffs because by the time water concerns are evident, hydrogeologists often must deliver difficult news.

Some emerging focus areas in Illinois include water reuse in big infrastructure projects, building pipelines to store carbon in sedimentary rocks, and potable reuse of treated wastewater for irrigation. The state is also working to attract data centers, which can be large water consumers. Winter deicers are increasingly impacting water quality in shallow aquifers.

Groundwater Technical Staff Meeting Discussion

A group of water professionals from Minnesota, Wisconsin, and Illinois met the day after the MGWA conference to discuss their successes and challenges. Attendees included geologists, hydrologists, members of the Minnesota DNR, the Wisconsin DNR, the ISWS, the White Earth Division of Natural Resources, Minnesota's regional Met Council, the MGWA, and Freshwater staff. Guiding questions and group discussion are summarized below.

28 2022 Illinois State Water Plan. Illinois State Water Plan Task Force, December 2022. https://iwrc.illinois.edu/wp-content/uploads/2023/01/SWPTF_Report_Dec2022.pdf.

29 Securing Illinois' Groundwater Future: A Review of the 1983 Water Use Act and High-Capacity Well Review Process. Chicago Metropolitan Agency for Planning, December 2024. https://cmap.illinois.gov/wp-content/uploads/dlm_uploads/Securing-Illinois-Groundwater-Future.pdf.

What Groundwater Successes Have You Had and How Have They Been Achieved?

Illinois, Minnesota, and Wisconsin share information about existing wells publicly. Education and outreach are used to communicate technical information to the public and explain groundwater models with varying levels of success. Iterative engagement with stakeholders proved successful at generating local buy-in. This was contrasted with technical presentations given by modelers with little to no prior engagement which was more commonly met with confusion or resistance. People trained to communicate and facilitate are good to have on the team.

Partnerships which involve state agencies and local organizations generate real understanding about groundwater limitations, especially if the initial focus is on building relationships, deepening the understanding of problems, and incorporating locally based solutions. The groundwater technical staff meeting helped to disperse local knowledge, build trust, and resulted in new tools.

State agencies have been able to work with federal agencies to leverage technical tools that are not always available locally due to funding or the political climate. Sharing peer-reviewed technical tools for the region through the USGS publications series is a best practice for regional technical information dispersal.

What Groundwater Supply Challenges Have You Had?

Technical Capacity Challenges

Management challenges included a lack of trained professionals to fill staff openings, funding and budgetary constraints, and siloed approaches to groundwater management. Even if fully staffed, agencies simply cannot afford to run a groundwater model for every permit request. Minnesota receives about 400 groundwater appropriation permits to review annually and the groundwater technical team reviews 100 of these requests. Wisconsin and Michigan have models that are additive, so new wells are added to an existing model to assess their impact on surface water features and surrounding wells. Despite these models, it can be difficult to assess impact without a full-blown pump test and monitoring wells. The potential for stream depletion is really only assessing water table aquifers and cannot evaluate the sustainability of pumping from a confined aquifer. Attendees were looking for additional tools to conduct these assessments.

Water appropriation permit review took from 2-to-3-year across Minnesota, Wisconsin, and Illinois. Limited resources and technical staff contributed to the long review period but so did the internal structure of a department. Splitting the review and approval teams added time. The Wisconsin process has hydrogeologists in one department that meets weekly to make group decisions. Permit review can still take months to years; some permits have been in process for 10 years. Consultants have been used to perform technical reviews for permit applications; sometimes this is helpful but other times the work has to be redone so it does not end up saving time. Reviews may need to include considerations of water quality, from either introduced or geologic contaminants and this can also increase the timeline.

Funding for groundwater technical units is perceived as being inadequate and this contributes to staff shortages. Programs are typically funded by permit revenue with a typical high-capacity well application fee ranging from $125 to $500. This does not support more than a couple hours of a

professional's time. Some have a sliding scale within the Great Lakes Basin with a cap of $10,000. Fees are likely to increase as two conservative courts recently agreed on the importance of water.

State agencies are increasingly wary of lawsuits, and of issuing a permit which may result in a later lawsuit. Modeling teams are largely sheltered from political considerations, but they may be introduced unwittingly by which permits are elevated for review.

Water Supply Challenges

Groundwater supply challenges included declining aquifers, agricultural impacts, and encouraging water users to transition away from groundwater as a primary water source and toward surface water.

Declining aquifers and the geologic realities that limited groundwater availability were not always understood by water users, and their aversion to loss plays a role in their behavior. No one wants to give up what they have, and some go so far as to say that if some of the streams must go, then so be it. However, some states are seeing people move toward surface water because groundwater permits are too hard to obtain. Ideally people would be encouraged to see groundwater as a backup rather than the main supply.

Intensively irrigated areas in central Minnesota, central Wisconsin and along the Illinois River in Illinois are seeing seasonal impacts to surface waters and declining water quality. There is a lack of regulations for agricultural practices yet fear of future regulations. Even if a requirement to not harm a resource through groundwater withdrawal exists, this is not well defined by courts and every resource is different and must be considered in context of every application.

In areas with groundwater shortages, managed aquifer recharge might help with sustainability. However, recharge and reuse are complicated and have diverse actors influencing decisions and incomplete regulations. It is not a common tool used in the Midwest.

A more holistic One Water approach (surface water and groundwater considered as one) would help unify some processes. Unifying land-use planning and water-use planning and aligning them with population projections would lead to a more sustainable future. Different levels of the government may offer contradictory messages; cities complain that "you told us to grow" but now they are hearing "there's no water here to expand". This may result from different planning timelines and priorities of various groups. Within infrastructure spaces, most are focused on a 10- to 20-year water plan and the long-term life of infrastructure (100+ years).

Suburban expansion creates the potential for more well interference between high-capacity municipal wells and private wells. It may also result in development in the recharge areas for regional aquifers.

What Tools and Strategies Are Used Regularly to Complete Groundwater Work?

Attendees highlighted science education and iterative engagement as both strategy and tool in ongoing work. They also emphasized the need for diverse skill sets on teams including data visualization and science communicators. You must do the engagement first and then build the model that is asked for. Conversations with multiple stakeholders to resolve issues in problem areas are always going to be a challenge. The time and energy spent bringing the right people to the table is worth it and much better than convening them when a problem feels intractable.

Other tools included reuse and recharge, withdrawals from Lake Michigan, and utilizing grant funding creatively. There was discussion of management systems utilized by other states and the benefits to those systems, including groundwater management districts based around watersheds and permit and allocation systems with finite water budgets. Groundwater management districts based around surface watersheds are used in western states. An allocation system has been put in place and people in the region must work things out amongst themselves.

Some teams were able to utilize technology to be transparent about the timeline for permit review. A dashboard in Teams can allow a group to track all requested work including who is working on what permit.

Recommended Next Steps By and For the Assembled Group

- Aim for another meeting ahead of the Great Lakes Compact meeting on the technical day that precedes the meeting (late spring/early summer 2025).
- Engage with counterparts in states and tribes that were not able to be present.
- Collaborate where possible at the department level and build connections between agencies and departments.
- Just pick up the phone.

What Questions Do We Have For One Another?

- How do we effectively bring all those involved together for a concentrated conversation on a gnarly topic?
    - A Charette model was used for Minnesota's East Metro Area with the PFAS working group[30]
- Does the PFAS ban in Minnesota include unintentional PFAS?
    - Process- vs Product-sources of PFAS are treated differently in the current legislative language
- Are climate-change impacts on water treatment systems being considered?
- Are environmental justice impacts considered in your work?
- Where do our granular activated carbon (GAC) remains end up? What community handles disposal? What are the secondary and tertiary impacts?
- How do you negotiate appropriations between water users in a region that have already been permitted but are now facing insufficient water availability or water scarcity due to over withdrawal, well interference or drought?
- Are we trying to solve problems before they happen? Or do we just assume these things will occur in the future and plan to address problems after-the-fact? This shapes organizational response and organizational plan. For example:

30 "Public Participation Guide: Charrettes." EPA International Cooperation, October 29, 2024. https://www.epa.gov/international-cooperation/public-participation-guide-charrettes.

    - Existing land and existing water use?
    - Do environmental impact reviews simply get okayed?
    - Do developers ever get denied?
- Are we charging enough for water?
- Do people value their water appropriately?
- Who is missing or not in the room?
- Are we reinventing the wheel with these meetings? Should there be more of these meetings? How can they occur without tons of logistics burden?
    - Add-on to existing meetings and rotate states
    - These types of meetings are usually held at director or manager level rather than among technical staff; it is beneficial to have technical staff participate in these types of meetings to build understanding and collaboration

Model Ordinance Review

Drafting a model groundwater ordinance for a cluster of municipalities involves creating a comprehensive document that addresses the specific groundwater management needs and challenges of these areas. Considering the importance of groundwater for domestic supply (private and municipal wells), agriculture, industry, and the protection of natural resources, the ordinance should be designed to ensure sustainable use and protection of groundwater supported ecosystems. The framework can be adapted to the particular conditions and needs of specific areas. The involvement of local stakeholders, including residents, businesses, agricultural representatives, and environmental groups, is crucial in developing and implementing effective groundwater policies. Additionally, coordination with state and federal water management policies and regulations will ensure that local efforts are complementary, informed by current datasets, and aligned with broader water resource management goals.

A suggested structure with section headings and content outlines follows.

I. Preamble

    A. Explanation of the ordinance's purpose, its legal basis, and the importance of sustainable groundwater management.

II. Definitions

    A. Clear definitions of key terms used in the ordinance, such as "aquifer," "groundwater," "sustainable yield," "withdrawal," "contamination," and "conservation measures."

III. Groundwater Management Authority

A. Designation of the responsible local authority or authorities.

B. Description of their powers and duties in relation to groundwater management.

IV. Groundwater Use Permitting

A. Requirements for obtaining permits for new and existing wells.

B. Criteria for permit approval, including consideration of sustainable yield and existing water rights.

C. Process for reviewing and renewing permits.

D. Permitting may refer to existing county or state regulations.

V. Well Construction and Maintenance Standards

A. Specifications for well construction to prevent contamination.

B. Requirements for regular maintenance and inspection of wells.

VI. Groundwater Priority of Uses and Withdrawal Limits

A. Establishment of withdrawal limits based on aquifer characteristics, recharge rates, and sustainable yield assessments.

B. Special provisions for critical periods, such as droughts.

VII. Water Conservation Measures

A. Mandatory conservation practices for residential, agricultural, and industrial users.

B. Incentives for water-saving technologies and practices.

VIII. Monitoring and Reporting

A. Requirements for groundwater users to monitor and report their water use.

B. Provisions for the installation and maintenance of water meters.

IX. Protection of Groundwater Quality

A. Regulations to prevent contamination from industrial, agricultural, and other sources.

B. Requirements for the proper handling, storage, and disposal of hazardous substances.

X. Dispute Resolution

A. Procedures for resolving disputes related to groundwater use, permitting, and conservation measures.

XI. Penalties and Enforcement

A. Penalties for non-compliance with the ordinance.

B. Description of enforcement mechanisms.

XII. Amendments and Reviews

A. Process for amending the ordinance.

B. Schedule for regular reviews of the ordinance's effectiveness and the need for updates.

XIII. Severability

A. Statement that if any part of the ordinance is held invalid, the rest remains in effect.

XIV. Effective Date

A. The date when the ordinance comes into force.

Review of Existing Transboundary Agreements

The following are best practices from the international agreements reviewed in Appendix B: Legal Frameworks for Transboundary Groundwater Governance.

Transboundary agreements are both critical and necessary for groundwater governance to be effective but they are difficult to establish. There are preexisting laws and policies pertaining to the various regions involved, competing sociopolitical priorities and needs, and potentially differing hydrogeology and groundwater-dependent ecosystems. Within international legal frameworks there have emerged similar foundations, and it is these which provide recommendations for what should be included in a transboundary groundwater governance agreement.

A successful legal framework for groundwater governance typically includes the following:

- A definition of the terms used in the agreement for shared understanding and for future agreements
- Clarification of which waters and dependent systems are included, and which waters and dependent systems are not included in the agreement
- A clear geopolitical scope of agreement boundaries
- Establishment of a governance mechanism
- Establishment of a dispute resolution mechanism
- A mutual assurance and responsibilities including:
    - Agreement members are entitled to fair uses of agreement waters
    - Agreement members are obligated to prevent harm to agreement waters, including through preventive measures
    - Agreement members are responsible for shared management and protection
- Encouragement of cooperation between agreement members through the exchange of relevant

data and information, including planned activities with potential impact on agreement waters

Of the existing international legal agreements for transboundary water groundwater governance currently in use, some of the joint management frameworks utilized by those agreements include frameworks like integrated water resources management, agreements for shared waters, and regionally appropriate management for shared waters.

The Global Environment Facility Transboundary Waters Assessment Programme (GEF TWAP) is an indicator-based framework developed to identify and evaluate changes in water systems caused by human activities and natural processes are shared by two or more nations.[31] An indicator-based approach allows for a flexible framework that can be adapted to different water systems including groundwater, surface water, and large marine ecosystems. The GEF TWAP uses three different broad indicators to capture pressures and impacts: biophysical, socioeconomic, and governance. These are then categorized into lowest risk, low risk, moderate risk, high risk, and highest risk. These risk categories are used to address integrated areas with updated governance strategies.

In EPA Region 5, a similar joint management approach might include 1) share geological and hydrogeological knowledge and other technical monitoring data of groundwater between participating partners to support governance decision-making; 2) develop shared models based on relevant technical data; 3) establish efficient recharge systems or other adaptative management strategies for the ecosystem; 4) increase environmental education, social communication, and inclusive public and stakeholder participation practices.

Smaller jurisdictions, like municipalities or watershed districts, would benefit from a joint management practice that distributes the burden of gathering, monitoring, and maintaining data records. This would allow costs, infrastructure development, and upkeep to be disbursed between multiple units, as well as create a broader information network. When groundwater features cross geopolitical boundaries, members of a transboundary governance agreement should mutually benefit from participation.

Discussions with Infrastructure Planners About Data Centers and Other Large Industrial Groundwater Users

Developers balance trade-offs when citing and designing large industrial facilities including manufacturing, technology, industrial agriculture, or food and beverage facilities. The trade-offs include costs, early morning and late-night schedules, noise, energy, and then commonly lastly, water use. The key factors that influence siting and resource decisions are the dependability of the resource and the timeline and ease of getting permits balanced against their need to move fast and get systems online so they can start making revenue. Above all, industries need a water supply that they can depend on to maintain process water quantity and quality to reduce the risks of downtime. Whether the water is used in the final product or for cooling or irrigation, companies are looking for low water risk to their operations. They may want to be water efficient but have to balance this with the

31 "Transboundary Waters Assessment Programme (TWAP)." GEF TWAP, January 8, 2014. http://geftwap.org/twap-project.

speed of getting a permit and overall capital and maintenance costs of the alternative. Many times, groundwater is the default supply due to faster permits and better water quality, followed by surface water, and then water reuse. The cost of reusing wastewater is prohibitive in some places and the timelines for planning and getting permits are commonly long. Smaller wastewater utilities might not have a consistent volume of treated wastewater to reliably supply a large water user.

Technology is moving towards low- to no-water-use cooling systems, and it is helpful if companies are incentivized for this. Irrigation systems and industrial processes are more water efficient than they used to be. Often times, the specific process technology is a black box to the engineering design firm citing the facility; the designs are proprietary, and new technology and processes are constantly evolving. Designers try to accommodate future industrial processes that might reduce water demand.

Revenue that comes from new economic development projects and property tax income are a huge economic driver for a community and the state to attract new industries. Each deal is different depending on the company, internal goals, budgets, and timelines. Some developers will 'pay their own way' for infrastructure upgrades to sweeten a deal and build out infrastructure to other parts of the city.

In terms of siting facilities for long-term water supply, the engineering design firms interviewed were well versed in infrastructure design but were not fully aware of the local water supply picture. States know that some regions have excess water supply, some scarcity issues, and others water supply alternatives. Infrastructure designers are unaware of the detailed hydrogeologic setting or how this information might be used early on to help them site their facilities and reduce permit timelines. If there is a change in the water-supply source after the facility is operational, they need to match existing inputs with the extra costs and incur possible shutdowns.

State regulatory agencies are most frequently involved in siting of new industrial facilities during approval of water appropriation permits or in the review of an environmental impact statement if one is required. State agencies are typically not involved if a large water user is a power and water customer of the city. In these instances, businesses may not have detailed knowledge from state agencies in order to make the best long-term design decisions for their proposed site.

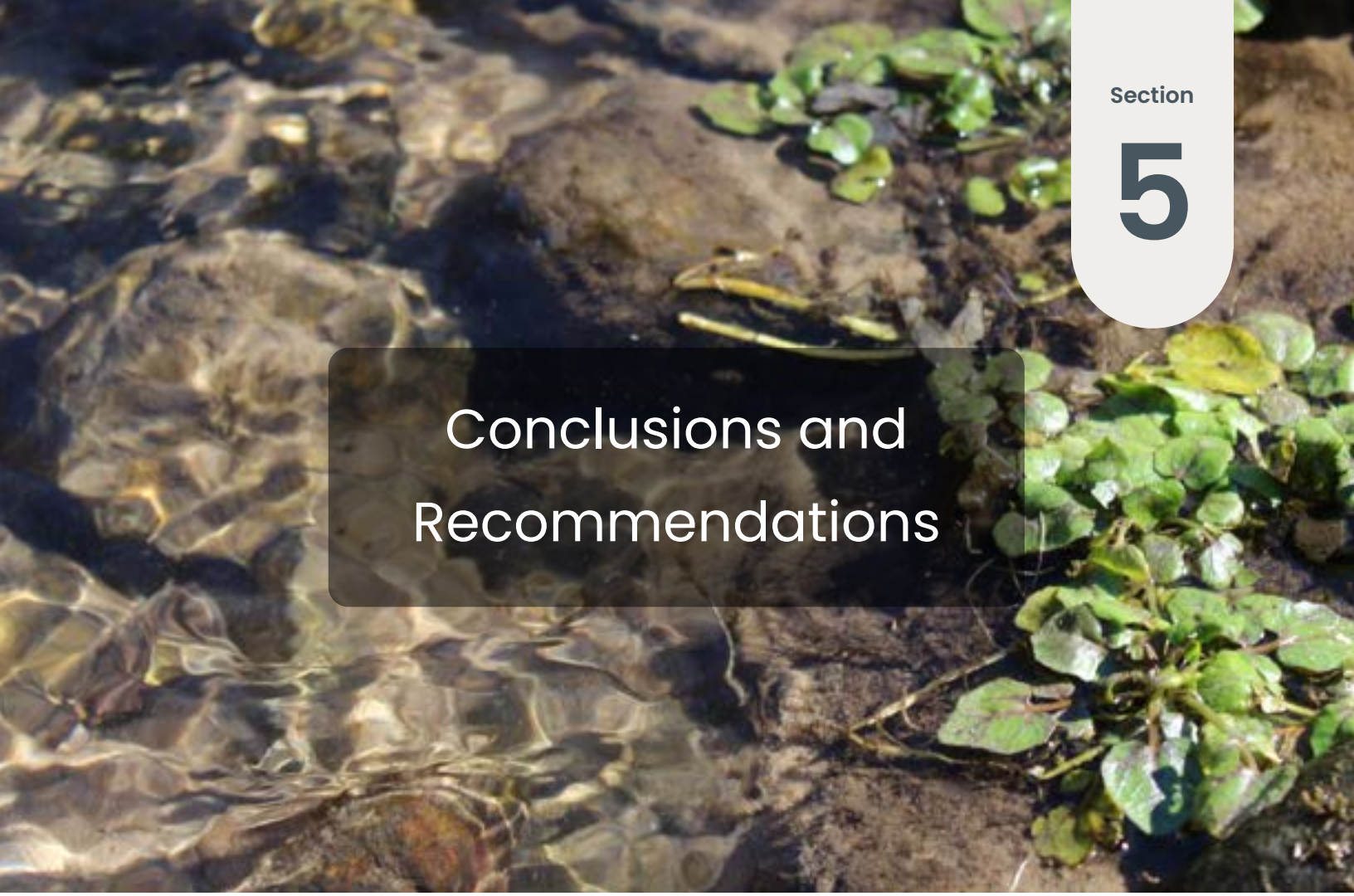
Ideally a state would proactively help cities identify good locations for large water users that local units of government and economic development teams could designate in their planning processes. States could do this by compiling helpful data on the water supply availability per region, across groundwater, surface water, or water-reuse sources. They might also work to create a generic review process for cities to consider when citing large-volume water users and provide more certainty with permitting. Finally, offering incentives for sustainability, co-location of industries with complementary inputs and outputs, and efficient permitting of circular water design features would result in better outcomes for both business costs and resource management.

Citizen Group Concerns

When and where stakeholder engagement is not prioritized, the city's planning process is not transparent, and the entry of a large water user into the area creates fear and distrust. Groups may form and engage in various ways that are somewhat dependent on the resources of the community members. This can perpetuate environmental injustices for under-resourced and rural communities. It also increases distrust in government institutions at all levels. For a business or local government, it adds extra time and costs to the development process.

When the course of action is not clear, and governance pathways not established, groups take varying routes to voice their feedback: through the legal system, by seeking media attention, by seeking attention from their elected officials, through a formal environmental review process, or by public protest. Frustration can lead to changes like new people running for local offices or systems being put in place. However, more commonly it leads to wasted effort, unnecessary anxiety, and unhappy residents.

Ideally the connection between a city's water authority and its role in sustainable regional planning would be understood by the community. There would also be transparency around the state's role in providing clear direction through laws and rules, in developing geologic and hydrogeologic knowledge, and delivering it in a timely manner to the city water supplier, economic development team, and Tribes where applicable, so they understand and use the information for sustainable development.



Section

5

Conclusions and Recommendations

Although in its early stages, a groundwater governance system has progressed in EPA Region 5 as evidenced by the increased sharing of information and strategies against the latest groundwater pressures. State, Tribal, and municipal staff, residents, and the media in targeted areas are paying attention to how decisions about groundwater are being made. As recent threats to community water supply coincide with a weakening of federal oversight, it highlights the policy gaps that state legislators are hurriedly trying to identify and fill, all while respecting the ability of city governments and Tribes to determine their own futures.

Although there are many differences across the region, there are shared values that prioritize groundwater for future use for human consumption and to support ecosystems. The challenge is how to include groundwater to support the economy of a region whether it is based in agriculture, industry, or is shifting to high-tech industries.

This effort created a platform for technical experts, community groups, government employees, and those with knowledge of groundwater to voice their concerns and experiences dealing with the existing governance structure around groundwater. With their input, a greater understanding of the physical limits of groundwater and the current water users sharing an aquifer was achieved. In the most focused conversations among peers, interstate groundwater specialists came together for a productive, solutions-oriented session that dealt with knowledge production and delivery. Broadening

the conversations to those on the receiving end of the data occurred in each of the aquifer area workshops where gaps and best practices were identified.

Local Engagement

Local engagement is a critical component of a project where decisions impact people. Both Tribes and members of hyperlocal organizations are often the first to see and feel the impacts of decisions and are commonly not part of the decision-making process. Front-line communities are not regarded as experts or included in decision-making spaces. In governance practice, shifting the perspective about who holds knowledge and decentering hierarchical credentials can help create a more inclusive process. If governance starts with inclusive, bottom-up practices, there is less need to revise or amend the frameworks of those plans later.

Tribes

Initial outreach to Tribal contacts had varied responses. The goal was to include Tribal participants without placing additional pressures upon Tribal natural resource staff, to maintain a mutually beneficial relationship. The Michindoh Aquifer area required multiple rounds of outreach with the identified potential Tribal participants and organizations. Direct recruitment was necessary to receive a response from local Tribal participants in some cases, and in other cases a more hierarchical form of contact where a direct work supervisor was contacted first was necessary. Overall, more time was needed between notice of invitation and the workshop than originally anticipated. Participants also required the agenda far in advance of the workshop. Tribal natural resource staff members needed the agenda to demonstrate how attendance would show direct benefits to their work, an important process for receiving departmental approval.

Both workshops included an opening with a ceremony and keynote talks which explained the importance of traditional knowledge and an Indigenous worldview. This provided framing for how Traditional Ecological Knowledge fits alongside western scientific knowledge. The goal was to center and uplift Tribal perspectives, without asking Tribal participants to do additional educational work for non-Tribal participants outside of their work roles. This was to assist Tribal and non-Tribal participants in building working relationships during less formal situations where the jurisdictions may not otherwise cross at the same time – federal agencies (US Geological Survey, US Forest Service), state agencies and entities (department of natural resources and state surveys), county-level planners, and conservation staff.

Next Steps and Recommendations

Establish Working Partnerships with Known Tribal Organizations Early

Practically, this means developing a working relationship with a Tribal organization that shares mutual goals and desired outcomes. Ask for assistance from Tribal partners in reaching out to Tribal communities if no reply or response is received during initial outreach attempts. If email isn't sufficient, then call by phone, and if the phone isn't sufficient, then show up in person (with notice) and talk face-to-face.

Provide notice of events far ahead of time, and plan for multiple modes of communication and outreach: different social media platforms, radio, newspaper, and flyers. Plan for responses to take longer than expected. Expect to reach out to new organizations and committees and expect to work around different cultural calendars.

Establish Consultation Practices with Tribes and Tribal Contacts Upfront

Do not decide on or develop a plan and ask for Tribal participation as a last step. Tribal officials, Tribal department staff, and Tribal members should be part of the planning process that decides on goals, objectives, and implementation design. Culturally relevant needs should be accounted for and accommodated during the development process. Ensure the work shows benefit to the community, as decided by the community.

Work with Grassroots Organizations to Gain Local Authoritative Input

The definition of who is an authority is always a question. Hyperlocal organizations are spaces of informal authority in the realm of groundwater governance. These are spaces occupied by locals, by community members, by those who are impacted. In the case of governance, it is easy to turn to experts – policy experts, legal experts, science experts. It is easy to look to those with credentials, degrees, and other recognized forms of professional authority. It is also easy to ignore that authority and knowledge and expertise can come from experience, and experience may grant no degrees beyond wisdom.

In the case of this project, stakeholders were identified through a variety of means – previously contacted participants from previous project phases, regional experts in niche subject matter, word of mouth. Participants were also located through social media and newspaper articles. The Williams County Alliance and No to Niagara are examples from this project of hyperlocal, grassroots organizations that act as watchdogs by monitoring environmental impacts after large-scale, water-intensive industries arrive in the community. These participants were identified because members were consistent in organizing water-monitoring and educational events, speaking to news organizations, and posting on social media pages. Physically, socially, and economically, the people in these organizations bear the risk from both being a front-line community and speaking out.

It is almost impossible to know when an area will become a hot spot of activity, and a grassroots group will shift from being a group of locals to a group with hyper-specific local knowledge and expertise. However, these front-line groups are usually the first to recognize a change in their ecosystems and the first to sound an alarm. At times it is easier to identify a hyperlocal, grassroots group than a hot spot location.

Stay Engaged with Information Being Shared in Your Focus Area

Keep an eye on local news stories in ever vanishing small-town newspapers in water-rich areas. Be willing to educate those who show up in bureaucratic processes and explain technical language. Be willing to listen to and hear the local experience and how the impact is felt despite the intention of the action. Be willing to act in partnership with local knowledge and energy, and to invest in the process.

Who Was Not Included

The workshops in this project did not include businesses and industry, elected representatives, or many water supply operators. Future conversations would benefit from their eventual inclusion. One regular and consistent risk in relationship building is competing priorities and a lack of time.

Industry

Industries are important participants because they are invested in planning and policy decisions which may impact their ability to grow. Industries may have a more regional presence and familiarity navigating different governance structures, restrictions, standards, and incentives. Water-intensive industries have historically used legal pressure against front-line communities as a means of quieting dissent. Other tactics have involved offering future economic incentives like infrastructure development in the form of roads and investment in schools and new jobs in return for tax write-offs, bulk rate offers on water purchases, and permit evasions through ordinance loopholes. These future incentives may fall through if the water-intensive industry never moves beyond the exploratory phase or closes before making a profit. Legal and social pressure has been leveraged against front-line community members who hold expert knowledge of the local ecosystem and monitor impacts from industry activities. Some Tribal members and local community groups expressed hesitance at participating until assured that the participant lists did not include industry groups.

Elected Officials

Policies and legislation are not passed without the endorsement of elected officials. Therefore, it is important to keep them in the loop and educated on matters of groundwater supply. The geographically focused conversations did not specifically include elected officials (e.g. county commissioners, legislators). These omissions did allow government staff present to propose solutions and air concerns freely. However, it is critical that legislators, Tribal leaders, commissioners, city and township administrators and other officials be briefed on the outcomes of engagement and provided with information. The right time to do that may be when specific approaches to close governance gaps can be translated into resolutions, bill or ordinance language. For example, upon completion of the CMAP memo on their workshop result, the organization engaged with an Illinois legislator early in the legislative session when change could be implemented.

Water Supply Operators

Some of the aquifer area conversations included those involved in water supply, but water plant operators and rural water suppliers were notably missing in other conversations. In the southwest metro, water-supply professionals who were present reported being left out or included late in their city's planning process. Land decisions and electrical supply drove planning conversations with the assumption that water would always be available. Water supply professionals hold critical information regarding changing demands on infrastructure and can readily engage with other groundwater managers.

Next Steps and Recommendations

Prioritize Building Trust at Every Stage of Engagement

To build trust, power differentials among individuals must be recognized and acknowledged. All the actors across the different sectors need to understand how past actions may have contributed to present inequities and commit to a shared future in a shared geology and geographic space. The initial trust-building meetings should also be used to identify high priority industry representatives, relevant elected officials, and water supply operators in a region to include in future conversations.

Where issues have become contentious or entered into a litigation phase, it may impact the ability of those in the room to build trust and speak freely. A way to navigate problematic relationships around shared groundwater may be to work with a neutral third party. For example, engineering firms hired to design water-intensive businesses or academics studying a particular water sector might be able to speak generally about site-selection processes, industrial processes, and alternate water sources in a more general way to help a conversation move forward.

Present Information Across Siloes to Break Down Communication Barriers

As water-intensive industries are driven by financial pressures, there is potential for conflict with grassroots priorities and domestic water users. Information transparency will help to mitigate tensions. With sufficient scientific data to support risk and cost-benefit analyses, land-use and economic development planners will be able to work with utility operators to balance local energy and water supply growth with environmental impacts.

Exercise Timely Engagement of Elected Officials

It may be sensible for time reasons to include the staff of an elected official earlier on in the planning process. While the exclusion of elected officials allows government staff the ability to speak freely, early inclusion of political staffers may help to build trust and to ensure there is someone to take part in the practical discussions and hear all the concerns raised in the workshop.

Across Jurisdictions: Challenges and Recommendations

Host Webinars

Hosting easy-to-attend webinars that are recorded and can be disseminated afterward is an inexpensive and effective way to reach diverse and large audiences. Examples that occurred during Phase II of this project included a lunchtime webinar for continuing legal education credit that summarized the lack of existing law around groundwater quantity and a seminar held for regional policy makers by the Council of State Governments, Midwest (CSG Midwest) and the Legislative Conference Energy & Environment Committee and the Great Lakes-St. Lawrence Legislative Caucus. The topic was Data Centers in the Midwest: Their Expected Growth and Potential Impacts on Water Use and Management.

Hyperlocal Coordination

In the absence of statutory authority, it is still possible to convene groups at all levels of decision making. Examples include the kinds of workshops hosted for this project to bring together Tribal, national, state, local, and private stakeholders to discuss challenges and best practices. Regional groundwater planning conversations based on natural boundaries can happen even where planning groups do not exist and may come together around a specific need or topic. For example, a cluster of small towns around a larger municipality approached by large water users are reluctant to engage with the larger city. An independent academic or non-profit entity with groundwater knowledge could facilitate a planning conversation in the shared aquifer area to help balance the otherwise outsized influence of the larger city.

Getting well owners and residents to discuss groundwater can be achieved by organizing local events that are helpful to well owners like well-maintenance and -testing clinics. These can be done in partnership with non-profits and local community groups. The No to Niagara group co-hosted two well-testing clinics with the Minnesota Well Owners' Organization and the Minnesota Groundwater Association, supported by staff and funding from participating counties and volunteers.

Knowledge, Sharing, and Data Transparency

Transparency and coordination of technical data and knowledge production across a region promotes confidence in planning efforts. For example, making results from an ecological monitoring program or well network public can demonstrate good intentions even if other entities do not have the capacity to independently analyze those data sets. Independent, cross-jurisdictional groups like the USGS Upper Midwest Water Science Center commonly serve in this capacity. Data sharing is facilitated through the National Groundwater Monitoring Network that aggregates data from federal, state, Tribal, and local groundwater monitoring networks. Groundwater models could similarly be shared across these jurisdictions.

Although communication barriers between states were cited, there is no lack of existing convenings around groundwater. These meetings can serve as a platform for information exchange among practitioners and include:

I. The twice-yearly Minnesota Groundwater Association meeting

II. Wisconsin's annual meeting of the American Water Resources Association

III. The technical day that occurs prior to the Great Lakes Compact meeting

IV. The Illinois Groundwater Association meeting

The Fall 2024 MGWA conference was intentionally orchestrated to feature speakers from across the Region on the topic of groundwater sustainability. Setting the agenda of the day-long conference required a champion to create a cohesive series of talks and then host a more targeted, small group discussion the following day. The number of groundwater technical managers in the region is not large and many have existing professional connections, making a cohesive network possible.

Expanding groundwater conversations beyond the technical managers and to a State or Tribe's economic development agency is an efficient way to ensure that business development and growth are mindful of groundwater availability. Currently, a business-friendly, global water risk atlas steers water-intensive industry to locations with water security.[1] There is an opportunity for local governments to create a shared, collaborative, and higher-resolution version of this atlas. In addition to higher resolution geospatial data, local versions could reference specific state statutes protecting streams, wetlands, or rare species. The global Aqueduct Atlas is a useful tool for corporations and insurers looking to compare and screen sites, but it "certainly does not replace local data and knowledge". [2]

Communication

Communication is a complex and multi-faceted solution. Policy, science, and law must all be synthesized and translated for a non-technical audience. The needs of the community must also be explored, synthesized, and explained to decision makers. Breaking down communication barriers can help make all other solutions possible.

In conversations with city administrators who have limited staff, it was indicated that groundwater was not something anyone had time to address or that was well understood. Staff and administrators did not know what or whom to ask. Individuals in those roles requested templates or lists of questions and model ordinance language. Direct outreach with specific regional information from the state, county, an NGO, or academic partner could help under-resourced municipalities put groundwater sustainability issues in context. Trust in that relationship has to predate the conversation for it to be well received.

Communication with community members will also lead to increased awareness of processes, planned events, and industry partnerships. Direct communication and ongoing relationship building with Tribes in the form of Tribal consultation will improve other coordination efforts. Overall, transparency where possible will improve trust and working relationships in the community at large.

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1 "Aqueduct Water Risk Atlas." Map. World Resources Institute. Accessed 2025. https://www.wri.org/applications/aqueduct/water-risk-atlas/.

2 Samantha Kuzma of World Resources Institute, personal communication with Dr. Carrie Jennings, March 7, 2025.

Legal

Laws and statutes, rules, ordinances, and policies are all codified mechanisms that can be decided upon and then enforced by a community. When a group agrees on an action, a system of rules is set into place which includes expectations, accountability measures, and consequences. To agree on the appropriate mechanisms, people ideally understand enough about a subject to make those decisions. Through education, collaboration, and knowledge sharing, communities can come together to enact rules to support those decisions.

Currently, there are robust legal protections for groundwater quality. Groundwater is a major source of drinking water in EPA Region 5 and serves an average of 52% of residents.[3] Most of this drinking water serves private domestic wells and public municipal water supplies. There are options like a progressive public trust doctrine, which expands upon the traditional notion of navigable waterways as a natural resource for government use and asserts that the government owns and manages a broader range of water, including groundwater, for the benefit of the public. This has not gained real traction in any EPA Region 5 state. The EPA Treaty Reserved Rights Rule has offered more protection for Tribal sovereignty but focuses on surface water and, as of writing this report, has not yet been tested.

Regional laws and local ordinances establishing priority use for domestic residents offer a way to allow economic development while ensuring current communities are not casualties of extractive practices. Crucially, practical options that are robust, durable, and avoid litigation are preferred.

Implementation and Enforcement

Enforcement of existing regulations is a first step, but enforcement is not simple. Leak detection, other conservation efforts, and reporting requirements may take staff or data that are not readily available. Periodically reviewing permitting processes for their consistent application or any unintentional loopholes is a best practice. Agency review is critical if sustainability goals articulated in statute are to be upheld.

A recent example in Minnesota can shed light on unintentional policy gaps. Large industrial groundwater users approached cities directly for a share of the groundwater appropriations. This did not trigger a review for a new high-capacity well by the Minnesota DNR. In Minnesota statute, industrial users are lower priority than domestic users, energy production, agricultural and small appropriators. By connecting to a municipal water supply system, the priority-of-use distinction is muddied and the illegality of guaranteeing water to the industry in times of drought is not clear to the city. Review, clarify, and propose revisions to existing statute and ordinance language to close similar policy gaps.

Where it is not possible to simply enforce the current rules and achieve sustainable and equitable groundwater use, technical approaches like managed aquifer recharge may come into play. A state may need to incentivize more circular water practices or at the very least, not incentivize wasteful ones. This requires some awareness of how large appropriators are using water and alternatives to that consumptive use. For example, there are other ways to move heat than to consume groundwater, and wastewater can be reused by co-locating water-intensive industries. In some areas, conversations

3 **Note:** This number found by Table 1.0 from Section 1, and averaging percentage of population whose drinking water is sourced from groundwater.

about regionalization of water supply systems are needed, especially as population centers move away from surface water sources or face expensive treatment options.

Shift Sources

Encourage people to move away from groundwater as their primary water supply and shift to surface water. Encourage water circularity and other sustainable options where possible. Encourage infrastructure, legal support, a permitting path and research for water reuse.

Section

6

Workshop Area Case Studies

Throughout Phase II, a collective of organizations provided an overview of existing groundwater institutions and actors, governance approaches, and challenges. These case studies highlight specific groundwater issues within the workshop focus areas.

Case Study

Michindoh AquaBounty

The AquaBounty aquaculture operation in Pioneer, Ohio was a point of discussion at the Michindoh Aquifer Groundwater Governance workshop because of its proposal to make regular large withdrawals from the Michindoh aquifer. In 2022, the proposed operation was approved by Ohio's Department of Natural Resources to withdraw 5.25 million gallons daily (MGD) from the Michindoh aquifer.[1]

Figure 1. The Michindoh Tri-State Region

With the approximate Michindoh Aquifer boundaries, Tribal stakeholders, and select municipal stakeholders. Data sourced and adapted from ESRI, GLIFWC, and the City of Bryan, Ohio.

1 "AquaBounty Water Withdrawal and Consumptive Use Permit - East Well Field." Ohio Department of Natural Resources. Accessed February 15, 2025. https://ohiodnr.gov/discover-and-learn/safety-conservation/about-odnr/water-resources/water-inventory-planning/ab1-public-comments.

Economic development opportunities were a driving force of this operation, as over 100 jobs were to be created. Incentives were generated from public dollars to assist in this development. For example, the Toledo Lucas County Port Authority authorized up to $425 million in revenue bonds to help AquaBounty finance the project.[2] While the project gained the backing of the village of Pioneer, Williams County, the state of Ohio, JobsOhio, and the regional growth partnership, others protested the move for such a large draw from the Michindoh aquifer.

The Williams County Alliance raised concerns about the capacity of the aquifer to sustainably supply residents with drinking water. In 2007, the nearby town of Bryan, Ohio had petitioned the EPA for sole source designation of the Michindoh Aquifer.[3] In response to comments received in 2010, a scoping study was conducted to assess available geologic information. However, EPA determined the necessary data to make this designation was not available and requested further information from the City of Bryan. The city did not have the means to collect this data, so it was determined that until this information was received, EPA would indefinitely suspend the petition. In 2019, citizens of Williams County petitioned to have rights granted to the Michindoh Aquifer,[4] but this was denied by the County and the State of Ohio. Furthermore, a ruling by the State of Ohio banned the enforcement of Rights of Nature.[5] These issues created a challenging context for the Williams County Alliance as they advocated their concerns about AquaBounty's proposal.

One Tribal Nation with ceded territory within the aquifer's extent, the Pokagon Band of Potawatomi, wrote a letter during Ohio DNR's public comment process for the permit. This letter outlined concerns about threats to wetlands in the projected 13,000 acre cone of depression, as these wetlands are a source of traditional medicines and ecosystem health in the region. AquaBounty responded, "It was determined…that the glacial till layer exists consistently at varying thickness throughout the modeled area between the shallow and deep aquifer zones, providing a "barrier" to impact from the effects of pumping the production wells on surface water resources".[6]

In 2022, the Ohio DNR approved the permit for the aquaculture operation's water use of 5.25 MGD. Despite concerns raised by community groups and the Pokagon Band of the Potawatomi, no monitoring of wetlands was included in the Groundwater and Surface Water Monitoring Plan.[7]

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2 Henry, Tom. "Ohio DNR Drilling 10 Water-Research Wells to Learn More about a Mysterious Tri-State Aquifer." The Blade, January 11, 2025. https://www.toledoblade.com/local/environment/2025/01/11/ohio-dnr-drilling-10-new-water-research-wells-tri-state-aquifer.

3 Sole Source Aquifer Petition: Michindoh Glacial Aquifer. Bryan, Ohio, 2007. https://www.epa.gov/sites/default/files/2016-02/documents/michindoh-sole-source-aquifer-petition-2007-69pp.pdf.

4 "Ohio Group Submits Signatures to Recognize Rights for Michindoh Aquifer." Community Environmental Legal Defense Fund, June 26, 2019. https://celdf.org/2019/06/media-statement-ohio-group-submits-signatures-to-recognize-rights-for-michindoh-aquifer/.

5 "Ohio Legislature Bans Rights of Nature Enforcement." Community Environmental Legal Defense Fund, July 18, 2019. https://celdf.org/2019/07/rights-of-nature-ban/.

6 Wulf, Sylvia, AquaBounty. Letter to Dena Barnhouse, Division of Water Resources, Ohio Department of Natural Resources. "AquaBounty's Response to Public Comments Received by the Ohio Department of Natural Resources Regarding AquaBounty's East Well Field Groundwater Withdrawal and Consumptive Use Permit Application," September 21, 2022. https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/water/aquabounty2/AquaBountyResponsetoPublicComments-AQBEastWellfield-09212022.pdf

7 Groundwater and Surface Water Monitoring Plan: AquaBounty Farms, LLC. Pioneer, Ohio: Burgess & Niple, 2023.

AquaBounty drilled wells to monitor the groundwater and respond to the requirements of the permit. This data was requested by Michigan's Department of Environment, Great Lakes, and Energy (EGLE) to support the United States Geologic Survey (USGS) in building a groundwater flow model for the Michindoh Aquifer.[8] The model was a direct response to the data gaps that prevent sound decisions about high capacity well permitting. According to EGLE, a partner on the USGS project, AquaBounty refused to share this information. Therefore 5 wells were installed at two locations within 2.5 miles of the border, and in the 5-to-10-foot projected cone of depression. They were equipped with pressure transducers to monitor water-level impacts from pumping and support the model.

AquaBounty could not meet their financial obligations, having not made a profit in 30 years and announced they would no longer be developing this site. As of February 2025, AquaBounty discontinued operation and was expected to pay the village of Pioneer millions of dollars a year for the electricity it used and reimburse it for certain costs associated with building the substation. The $5 million note matures in November 2025. The village said it will pay any debt that it owes, "even if AquaBounty should cease to exist".[9]

One community organizer involved in the dispute from the beginning reflected that this halt was not the result of more equitable groundwater policy. She says, "We seem to have dodged the "bullet" on AquaBounty, but not because of any systemic changes that would shift western perspectives of the commodification of water. We witnessed how so many people dependent upon the Michindoh aquifer understood how critical water is to all life, yet existing law doesn't reflect that value. We can only hope that indigenous knowledge and belief can guide a shift in law."

Other similar business models with larger access to investors may still present themselves in this same area again soon, with some community members hearing talk about the site being redeveloped into a potential data center or a solar farm.[10]

8 Ohio-Kentucky-Indiana Water Science Center. "Hydrogeologic Mapping, Data Collection, and Geologic Framework of Glacial Deposits in a Multi-County Area of Northwest Ohio, Northeast Indiana, and South Michigan." USGS, September 4, 2020. https://www.usgs.gov/centers/ohio-kentucky-indiana-water-science-center/science/hydrogeologic-mapping-data-collection.

9 Clark, Anna. "The One That Got Away: This Small Town Is Left in Limbo After Betting Big on GMO Salmon." ProPublica, February 18, 2025. https://www.propublica.org/article/aquabounty-pioneer-ohio-gmo-salmon-fish.

10 Henry, Tom. "Ohio DNR Drilling 10 Water-Research Wells to Learn More about a Mysterious Tri-State Aquifer." The Blade, January 11, 2025. https://www.toledoblade.com/local/environment/2025/01/11/ohio-dnr-drilling-10-new-water-research-wells-tri-state-aquifer.

Case Study

Northeast Illinois and Multi-Aquifer Wells

Geographic Context

There are a variety of water sources in the Chicago metropolitan area. This case study focuses on Kane County in northeastern Illinois on the western edge of the Chicago metropolitan area (Figure 1). Drinking water for northeast Illinois is either surface water piped from Lake Michigan or sourced from the Fox and Kankakee rivers, or groundwater used by municipal public water systems and private wells.

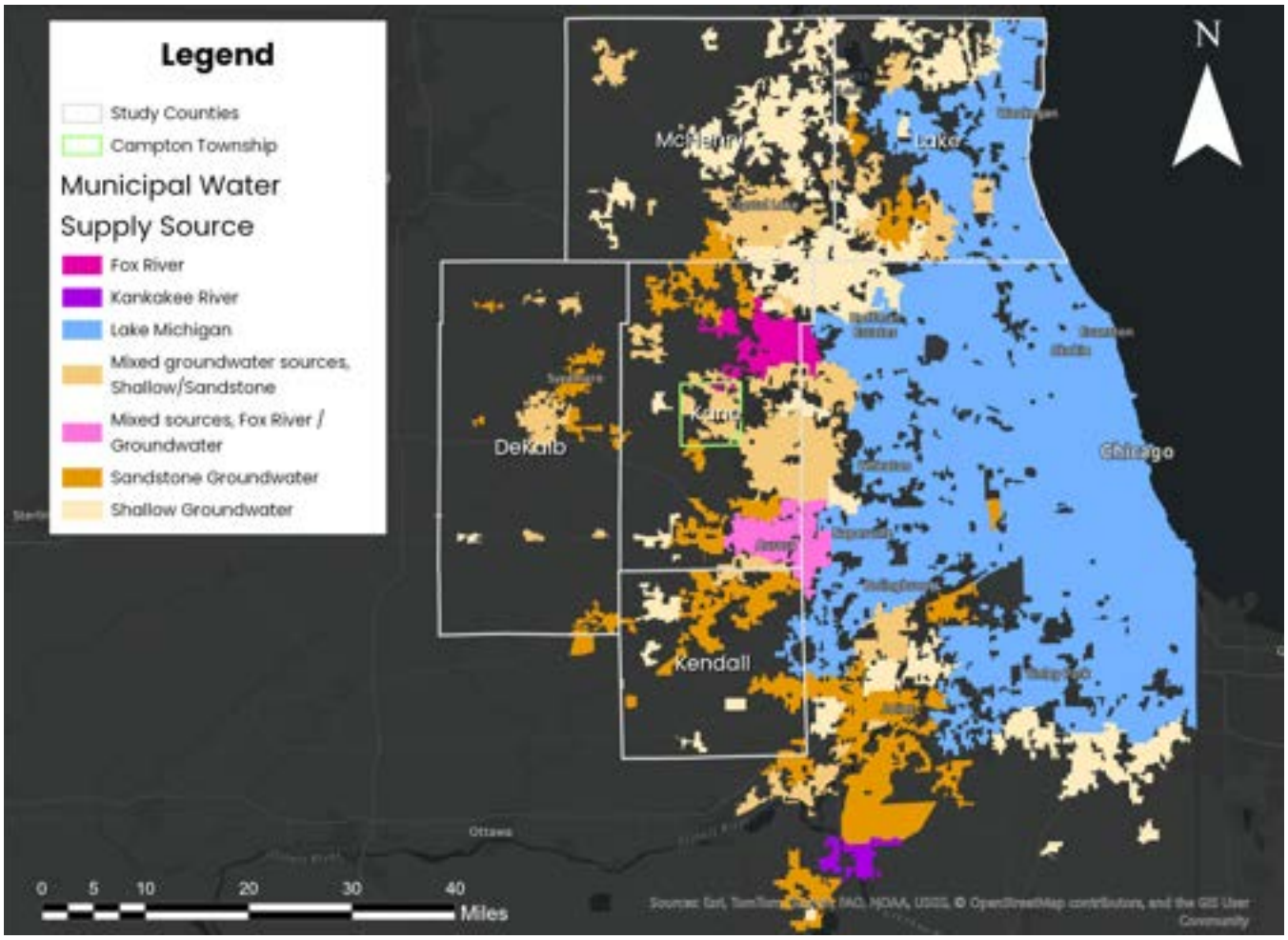

Figure 1. Northeast Illinois

Kane County is a transitional county between rural and suburban at the western fringe of metropolitan Chicago. Campton Township is highlighted in Kane County. Data sourced from ESRI, Chicago Metropolitan Area Planning (CMAP), and DeKalb County.

Residents and businesses in Kane County receive water through either community water suppliers or are self-supplied through private wells.[1] Residents may have individual private wells or share private well access with a neighbor or neighbors in their area as part of non-community water supply in a subdivision.[2] Wells in this area use groundwater from four major geologic units: 1) the unconsolidated glacial sand and gravel aquifer; 2) the Silurian-Maquoketa aquifer; 3) the Galena-Platteville aquifer; and 4) Ironton-Galesville sandstones of the Glenwood Formation and historically, the St. Peter Sandstone (the Ancell aquifer).[3] Due to collective withdrawals, the St. Peter Sandstone layer was observed to be partially desaturated and is no longer considered to be a useable aquifer in Kane County.[4]

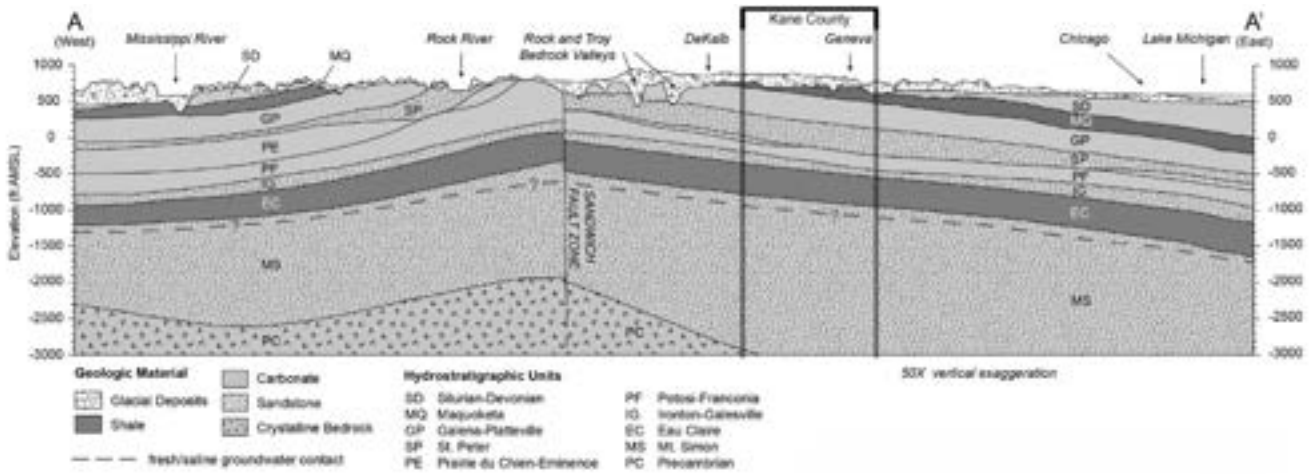

Figure 2. Cross Section of Geologic Units Across Northeast Illinois

Cross section of the geologic units across northeast Illinois with Kane County highlighted. Layers SP, IG, and MS are water-bearing sandstone aquifers; layers SD, GP, PE, and PF are water-bearing carbonate aquifers; layers MQ and EC are fine-grained (shale) confining layers that originally separated the water-bearing layers. The primary aquifers accessed in Campton Township are glacial sand and gravel (surface), the dolomite of Silurian to Devonian age, the dolomitic portion of the Galena and Platteville formations, and the St. Peter Sandstone, which is now partially dewatered locally.[5] Data adapted from Abrams et al, 2015.

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1 "Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois." University of Illinois at Urbana-Champaign. Illinois State Water Survey, May 2009, 2. https://www.isws.illinois.edu/pubmore/ISWSCR2009-07/ISWSCR2009-07.pdf.

2 Hadley, Daniel R., Daniel B. Abrams, Devin H. Mannix, and Cecilia Cullen. "Establishment of a Groundwater Monitoring Network And ..." Northwest Water Planning Alliance, August 2020. http://www.nwpa.us/uploads/1/2/9/8/129889926/campton_letter_report_final_publicversion.pdf.

3 Hadley, Daniel R., Daniel B. Abrams, Devin H. Mannix, and Cecilia Cullen. "Establishment of a Groundwater Monitoring Network And ..." Northwest Water Planning Alliance, August 2020. http://www.nwpa.us/uploads/1/2/9/8/129889926/campton_letter_report_final_publicversion.pdf.

4 Abrams, Daniel B., Daniel R. Hadley, Devin H. Mannix, George S. Roadcap, Scott C. Meyer, Kenneth J. Hlinka, Kevin L. Rennels, Kenneth R. Bradbury, Peter M. Chase, and Jacob J. Krause. Rep. Changing Groundwater Levels in the Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply. Illinois State Water Survey, September 16, 2015. https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2015-02.pdf.

5 Abrams, Daniel B., Daniel R. Hadley, Devin H. Mannix, et al. Rep. Changing Groundwater Levels in the Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply. Illinois State Water Survey, September 16, 102, 2015. https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2015-02.pdf.

Water in Kane County

Water use in Kane County has evolved over time as the population has grown. Kane County has never sourced water from Lake Michigan, unlike surrounding communities. Beginning in the late 1980s, the eastern communities of Elgin and Aurora moved to source public water from the Fox River.[6] Drinking water in the region is now sourced from three groundwater aquifers and from the Fox River as a surface water source.[7] As the western suburbs of Chicago expand, the region is attempting to manage resource allocation sustainably when demand outpaces supply.

There is a finite amount of water and land, as predetermined by geology and available recharge. Since the mid-1990s, the U.S. Geological Survey (USGS), the Illinois State Water Survey (ISWS), Northwest Planning Alliance (NWPA), and Illinois Department of Natural Resources (IDNR) have worked with Kane County to model groundwater flow, map the impacts of well density, and track the impact of multi-aquifer wells on water quality and quantity. The 2009 and 2015 ISWS studies indicate three pressures on shallow groundwater aquifers: drought, seasonal irrigation, and multi-aquifer wells. [8] [9]

During droughts and points of seasonal irrigation, groundwater models show a lowering of the water surface in shallow aquifers. Shallow aquifers also impact surface water stream flow where communities source drinking water. Multi-aquifer wells present a challenge because they allow in-ground exchange of formerly separated waters. Deep multi-aquifer wells also show impact to shallow wells as a deeper aquifer (e.g. the St. Peter Sandstones or the Galena-Platteville Sandstones) can depressurize and allow the nearby shallow aquifer (e.g. the Maquoketa and Silurian-Devonian dolomites) to drain into the deeper one. [10] [11] Shallow aquifers also impact surface stream flow where communities source drinking water.

6 Meyer, Scott C., George S. Roadcap, Yu-Feng Lin, and Douglas D. Walker. Rep. Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois. Champaign, Illinois: Illinois State Water Survey, 2009, 2.

7 *Ibid*.

8 Meyer, Scott C., George S. Roadcap, Yu-Feng Lin, and Douglas D. Walker. Rep. Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois. Champaign, Illinois: Illinois State Water Survey, 2009.

9 Abrams, Daniel B., Daniel R. Hadley, Devin H. Mannix, et al. Rep. Changing Groundwater Levels in the Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply. Illinois State Water Survey, September 16, 2015. https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2015-02.pdf.

10 Meyer, Scott C., George S. Roadcap, Yu-Feng Lin, and Douglas D. Walker. Rep. Kane County Water Resources Investigations: Simulation of Groundwater Flow in Kane County and Northeastern Illinois. Champaign, Illinois: Illinois State Water Survey, 2009.

11 Cullen, Cecelia, and Daniel R. Hadley. Rep. KANE COUNTY SHALLOW GROUNDWATER QUALITY 2023: A TWENTY-YEAR RETROSPECTIVE. Champaign, Illinois: Illinois State Water Survey, 2024.

Campton Township in Kane County has one of the highest densities of both private wells and multi-aquifer wells in Illinois.[12] [13] As of 2020, there were 2,638 domestic well records found in ISWS/ISGS databases for Campton Township, though only 2,113 of the records were had enough data to analyze if they were multi-aquifer wells.[14] Of the 2,113 domestic wells, approximately 54% of those were multi-aquifer wells.[15] Very few of the deep wells were open to only a single geologic unit, and the well records were defined by the deepest aquifer a well was open to. Approximately 18 percent of Maquoketa wells were considered multi-aquifer, approximately 84 percent of Galena-Platteville wells were considered multi-aquifer, and all the St. Peter wells were considered multi-aquifer.

What is a Multi-Aquifer Well?

In Illinois, a minimum of 40 feet of casing must be used to protect the well from surface contaminants.[16] Some states in EPA Region 5 only allow one aquifer to be screened. Historically, Illinois has allowed screened intervals to cross formerly separated aquifers.[17] These "cross-connected," multi-aquifer wells can pull groundwater from different geological units and allows the mixing of groundwater between those layers.[18] [19]

To access groundwater, a hole is drilled until water is reached and a well is constructed within that hole. A well has multiple components which include casing or the solid pipe that lines the hole and spans the sediment and rock layers that are not of interest; grout that seals the annular space between the solid pipe and the drilled hole; a screened interval near the bottom that allows water to flow in from the water-bearing layer(s) being accessed, and a gravel pack which fills the annular space around the well screen to maintain access to the groundwater while keeping sediment out of the well (Figure 3). It is believed that a properly constructed groundwater well can last between 25 to 100 years.[20]

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12 "Campton Township Monitoring, Kane County," n.d. https://www.isws.illinois.edu/groundwater-science/gs-archive/campton-township-monitoring-kane-county.

13 Hadley, Daniel R., Daniel B. Abrams, Devin H. Mannix, and Cecilia Cullen. "Establishment of a Groundwater Monitoring Network And …" Northwest Water Planning Alliance, August 2020, 24. http://www.nwpa.us/uploads/1/2/9/8/129889926/campton_letter_report_final_publicversion.pdf.

14 *Ibid*, 6.
Note: This amount and availability of data is typical for both the county and the state.

15 *Ibid*, 8.

16 Illinois Water Well Construction Code. § 920.70 (1973).

17 Abrams, Daniel B., Daniel R. Hadley, Devin H. Mannix, George S. Roadcap, Scott C. Meyer, Kenneth J. Hlinka, Kevin L. Rennels, Kenneth R. Bradbury, Peter M. Chase, and Jacob J. Krause. Rep. Changing Groundwater Levels in the Sandstone Aquifers of Northern Illinois and Southern Wisconsin: Impacts on Available Water Supply. Illinois State Water Survey, September 16, 2015, 17. https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2015-02.pdf.

18 *Ibid*, 67.

19 Hadley, Daniel R., Daniel B. Abrams, and Devin H. Mannix. Rep. Changing Groundwater Levels in the Sandstone Aquifers: Synoptic Measurement of Deep Sandstone Wells in 2021 throughout Northern Illinois, June 8, 2024. https://storymaps.arcgis.com/stories/6a8ff45c39134e168da93b45626fef36.

20 "Groundwater Monitoring Well Network," Illinois Department of Agriculture. https://agr.illinois.gov/environment/groundwater.html.

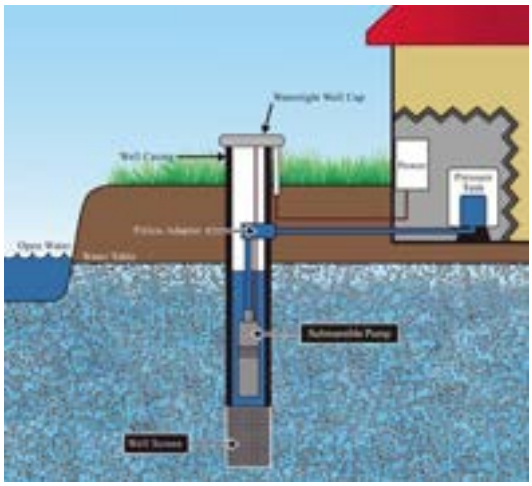

Figure 3. Single-Aquifer Well

Simplified diagram of a single-aquifer well. The casing extends from above the surface to the water-bearing layer of interest. The aquifer being accessed has a screened interval to allow water to flow into the casing and rise to its natural level which varies with topography and water pressure. A submersible pump is typically submerged below the normal water table level.[21]

At this time, private wells are required to be permitted by the local county health department, drilled by a registered well driller, and reported to the Illinois Department of Health.[22] All private wells must also be constructed according to the state well code.[23] The 1983 Water Use Act also sets forth "reasonable use" groundwater withdrawal rules for the state and requires the registration of high-capacity wells and requires data be supplied to Soil and Water Conservation districts (SWCDs) by the land occupier.[24] This data allows ISWS to conduct analysis on well conflicts and well interference. At this point, well inference analysis is not robust. This could be improved by requiring land occupiers to report data to local SCWDs, and by improving support to local SCWDs and to ISWS through funding and staffing capacity to provide data collection and management, and well interference models and reports.

A records review of domestic wells found that between 1989 and 2002, eight wells in Kane County were redrilled, with five of those eight deepened from the Galena-Platteville Dolomite to the St. Peter Sandstone.[25] Currently, Illinois allows for the construction of multi-aquifer wells under certain conditions. Well drillers are expected to evaluate which aquifer(s) will be available to satisfy the proposed well-water system.[26] If the system is designed for a shallow aquifer, and the shallow aquifer cannot provide sufficient water, the system may be in violation of the Water Well Construction Code and may need to be sealed abandoned, or a variance may be required.[27] According to the Design Factors section of the Illinois State Water Well Construction Code, if "multiple water-bearing formations of different static water levels are penetrated in the construction of a water well and the lower water-bearing formation has sufficient yield for the water well, the upper water-bearing formation shall be excluded by installing casing or a liner and properly sealing to prevent dewater of the upper water-bearing formations." [28] At this time, enforcement mechanisms for this are unclear.

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21 "Well Basics - What Is a Well? - Well Water Testing." The Groundwater Foundation, October 7, 2022. https://groundwater.org/wells/.

22 Illinois Water Well Construction Code. § 920.70 (1973).

23 *Ibid*.

24 Illinois Water Use Act of 1983 § 3(c) (1973).

25 Hadley, Daniel R., Daniel B. Abrams, Devin H. Mannix, and Cecilia Cullen. "Establishment of a Groundwater Monitoring Network And …" Northwest Water Planning Alliance, August 2020, 9. http://www.nwpa.us/uploads/1/2/9/8/129889926/campton_letter_report_final_publicversion.pdf.

26 Ilinois Department of Health. "THE 'HOW TO' MANUAL CONSTRUCTION OF WATER WELL SYSTEMS ACCORDING TO ILLINOIS CODES," 5-6. https://dph.illinois.gov/content/dam/soi/en/web/idph/files/publications/ww-contractor-studyguide-042716.pdf.

27 *Ibid*.

28 Illinois Water Well Construction Code. § 920.40.c (1973).

What is Campton Township Doing?

Municipal governments allocate and manage land, water, energy, and the distribution of residents and industries through zoning and management plans. To better understand the available resources in a region, and to more effectively distribute those resources, studies are often used by municipalities. Over the past decade, multiple studies have been conducted in the township with support from Kane County. These studies have focused on the sustainability of shallow aquifers, expanded groundwater monitoring, and examined conservation efforts.

The ongoing assessment of shallow groundwater sustainability has three components: 1) community discussions and modeling to define sustainability methodology and constrain metrics for the shallow aquifer system; 2) real-time telemetry to monitor water level throughout Kane County; 3) repeat water quality studies in Kane County wells and homeowner wells to determine if water quality has changed over time.[29] This assessment should allow for greater understanding of current water needs and community desires, while supporting community members and decision makers with the information for planning based on available groundwater in the area. This process also provides the community with knowledge of how behavior and actions impact resources, and links water quantity to water quality.

Campton Township is part of a greater effort to expand the monitoring network throughout Kane County.[30] Another nearby township, Sugar Grove, also has monitoring wells. This network supports assessments of seasonal and long-term trends that are used in county-wide water supply planning efforts.[31]

As part of broader conservation efforts and awareness of water sustainability planning, Campton Township also is receiving technical assistance through Kane County.[32] Support includes community water conservation plans, water loss audits, reviewing or updating water conservation ordinances, and other public education campaigns or programs. Technical assistance includes direct assistance with tools and technology, financial support for expert consultants, or purchase of water efficiency devices.

Campton Township has a high density of both private wells and multi-aquifer wells. Industrial, agricultural and residential users all compete for this limited water supply. As water levels in the deep aquifers decline, the question is how to move forward to manage both long-term availability of remaining deep groundwater, the shallow groundwater, and the surface water to ensure all residents have a shared sustainable future.

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29 Hadley, Daniel R., Cecelia Cullens, and Daniel B. Abrams. "Kane County Energy and Environmental Committee Agenda: Kane County Shallow Groundwater Sustainability Kickoff Meeting.", June 16, 2023. https://www.kanecountyil.gov/Lists/Events/Attachments/6627/AG%20PKT%2023-05%20Administration.pdf.

30 "ArcGIS Web Application," Illinois State Water Survey. https://univofillinois.maps.arcgis.com/apps/webappviewer/index.html?id=e364cd4c39d847f3ba4f794986a85883.

31 "Kane County Groundwater Monitoring Network," Illinois State Water Survey, 2025. https://www.isws.illinois.edu/groundwater-science/groundwater-monitoring-well-networks/kane-county.

32 "Home - Conserve Water for Kane County | Technical Assistance. " Conserve for Kane, 2025. https://conservewaterforkane.org/.

Case Study

Southwest Metro: Niagara Bottling

In 2021, Niagara Bottling approached Elko-New Market, Minnesota, a city in the southeast corner of the Southwest Metro Water Supply Planning Area, with plans to develop a water bottling facility within a 118-acre industrial park,[1] requiring an estimated 13 million gallons of city water per month (an amount exceeding the city of Elko-New Market's average water use of 9 million gallons per month). The bottling company would connect to the City's water system as a large water user. Using the City's 2025 industrial water use rate of $1.37 per 1,000 gallons, revenue to the City would be over $12,000 per month plus tax revenue. This format of approaching the City directly for an agreement effectively bypasses the MN DNR Water Appropriation Permit Program that a stand-alone water appropriator would have to file that would require regulatory review and public processes.[2] In this case, the public was made aware of this development plan when a portion of the planned construction required a conditional use permit. The public was concerned about the increase in city water use and the impact on their regional water resources and adjacent private wells.

No to Niagara, a citizens group, collected data to support concerns over water quality and quantity changes to the regional aquifer. This data was used to request environmental review, which, after a prolonged period of mounting public pressure, resulted in a lengthy aquifer pump test by the designated state agency. The citizens group hosted two clinics for screening private well water quality. Pump test results were used in conditions for the City's water permit and private litigation. In this instance, community advocates revealed policy gaps in the approval process and influenced the development of a more comprehensive permit evaluation process.

The project's timeline started in 2020, when Elko-New Market's Economic Development Board began exploring options for addressing ongoing challenges in funding the water system, and large water users were explored as a solution. Niagara Bottling was incentivized to come to Minnesota and Elko New Market by both the city and state. Minnesota's Department of Employment and Economic Development and the City of Elko-New Market offered Niagara $4.3 million in waived fees, forgivable loans, and tax rebates.

The city signed a non-disclosure agreement (NDA) with Niagara Bottling in 2022. NDAs are a common tool that provide expediency, preserve competitiveness, but limit transparency.[3] In October 2022, Bring Me The News published an article capturing the attention of the public, which resulted in a petition signed by 400 people as part of an Environmental Assessment Worksheet (EAW) submitted to Minnesota's Environmental Quality Board who assigns the appropriate agency to determine

1 "Elko New Market," Niagara bottling, accessed March 17, 2025, https://www.niagarawater.com/about-us/elkonewmarket/.

2 "Water Appropriation Permit Program." Minnesota Department of Natural Resources, June 13, 2024. https://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/index.html.

3 Eva Herscowitz, "Farmington Residents Couldn't Get Answer about a Proposed Data Center. Then They Saw the NDA.," MSN, January 9, 2025, https://www.msn.com/en-us/news/us/farmington-residents-couldn-t-get-answers-about-a-proposed-data-center-then-they-saw-the-nda/ar-BB1ra0RI.

if an Environmental Impact Statement is (EIS) is required.[4] In this case, the Minnesota DNR was the designated agency, and they determined that an EIS was not needed, however, they eventually did require and administer a 6-week aquifer pump test.

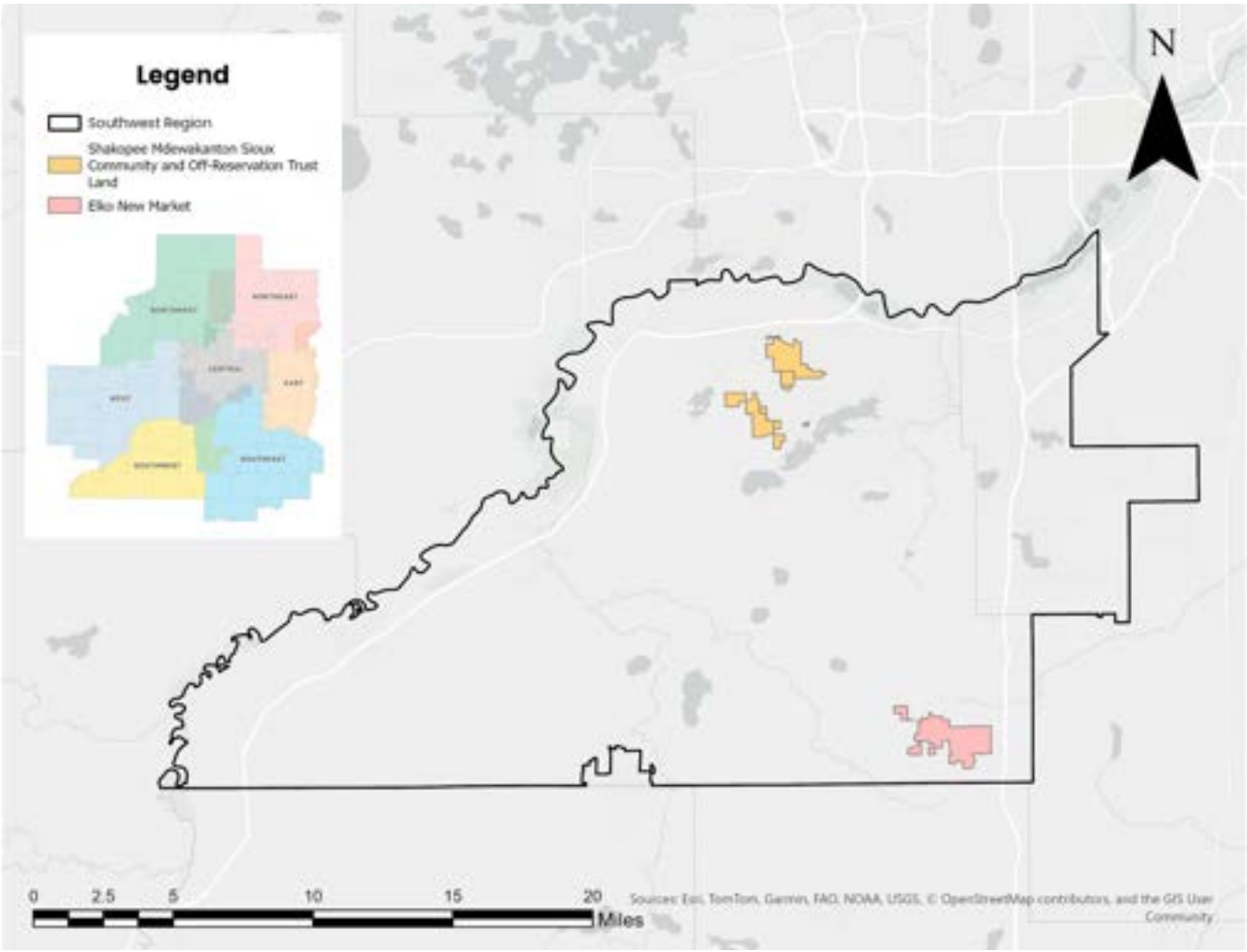

Figure 1. The Metropolitan Council's Southwest Metro Water Supply Planning Area

With the location of the SMSC, SMSC off-reservation trust land, and city of Elko New Market. Data sourced and adapted from ESRI, U.S. Census, and Metropolitan Council.

4 Schuster, Christine. "A Massive Bottling Plant Could Be Coming to the Southern Twin Cities." Bring Me The News, October 7, 2022. https://bringmethenews.com/minnesota-business/a-massive-bottling-plant-could-be-coming-to-the-southern-twin-cities.

A pump test yields critical information about the capacity of the aquifer to provide the required water without impacting surrounding wells. A number of those wells were used to monitor for water-level drawdown during the test. Broader communication about the timing, duration and potential impact of a pump test is not part of the DNR methodology. However, community members within a 5-mile radius of the test reported changes to their water quality during the test, with significant and costly impacts. Others who found out about the test after it had been completed recognized that the changes they had been experiencing were linked to the testing period; many reported ongoing issues with their private wells that persisted for up to 6 months. In all, over 75 private well owners reported water quality issues and three reported water quantity issues.

These reports raised concerns from citizens about how they would be protected if issues were to arise when Niagara started full operations, and the city increased their groundwater pumping. This also prompted questions about the practice of conducting a pump test without public awareness. In response, although the DNR proceeded to issue the permit, they did so only after significant consultation with drinking water and public health experts on what had potentially caused the mobilization of harmful geologic constituents (manganese and iron) and added conditions to the permit that would require the City of Elko New Market to create a response plan impacted well owners. Niagara Bottling built their plant in the proposed location, but the City must investigate water quality issues within two miles and water quantity issues within one mile of the City wells. Well owners experiencing problems outside of these areas need to report problems directly to the MN DNR who will decide if further investigation is warranted.

In December of 2024, at the request of the citizens group, a second well-testing clinic was hosted by the Minnesota Well Owners Organization (MNWOO) and the Minnesota Ground Water Association (MGWA) in advance of pumping by Niagara Water Bottling's completion. Volunteers staffed "ask a geologist" tables to consult with well owners. Local organizers promoted and worked at the event and supported it with independent funding. Over 220 samples were run with most people agreeing for their data to be released to establish baseline water quality values.

No to Niagara convened citizens to challenge, under law, the DNR and later the City of Elko New Market on their decision to approve the water bottling plant. As part of their efforts, No to Niagara developed a set of issues to capture their concerns. These issues are:

- **The regional approach to groundwater management is lacking** in protection of surface waters, rare fens, trout streams, wetlands and lakes that are connected to the groundwater; preservation of water for future use, prioritizing drinking water over other use; guards against emerging pollutants like PFAS, nitrates, pesticides, and other carcinogens; and equitable management of groundwater for everyone's interests in the region (i.e., multiple cities in the region exceed their water appropriation permits, agency not considering totality of water use for the region)
- **Industrial large water users requesting water from municipalities** prioritizes industrial use over municipal and private well use, avoids responsibility (i.e., municipality on the hook for issues), and offers less scrutiny by the agencies of a municipal permit.
- **Exporting water out of state in tiny bottles for profit removes water from the region**, which would be denied if it were done in bulk but appears acceptable when done as a single use. The process used requires 2.4 billion water bottles a year, of which very few are recycled.

- **State and Local subsidies being used to fund this for-profit company.**
- **An aquifer pump test that resulted in 75 private well-owner reports of water quality issues and 3 reports of water quantity issues** was completed with no notification to the wider community.
- **Investigation into the cause of manganese increases, a neurotoxin, in private domestic wells is warranted.** The permit made the city responsible for water issues that arise within a 2-mile radius rather than denying the permit, but the burden of proof is on the well owner.

Even now, so much about the legal pathway to participation remains unclear. While many local leaders and knowledge keepers were able to navigate the decision-making process, many citizens and decision makers were not aware of the consequences of a bottling plant in their region. As a result, information gaps remain and questions are unanswered about how action will be taken to repair harm if it does occur, and what will take priority if those issues do arise.

Case Study

Cranberries, Groundwater Withdrawals, and the Impact

Cranberries are the edible fruit of multiple species of cranberry shrub native to Wisconsin, and their commercial cultivation began in the state in the early 1850s near the town of Berlin.[1] They are now grown in bogs throughout the state. Wisconsin has been the largest cranberry grower in the U.S. since 1994, when its output surpassed that of Massachusetts.[2] Cranberries are now among Wisconsin's biggest cash crops generating over one billion dollars in economic impact a year and are cultivated across 18,000 acres in 19 counties as of 2007.[3] Wisconsin supplies over 50% of the world's cranberries and produces 60% of all cranberries grown in the U.S.[4]

In a 2021 Water Use Report, Wisconsin reported 358 active high-capacity well withdrawal permits specifically for cranberry production.[5] Most of this groundwater extraction is in the central part of the state, but some high-capacity wells are withdrawing large volumes in the area with the state's lowest groundwater capacity.[6] This north central region is peppered with so-called "seepage lakes" that receive water through the thin glacial sediment layer.[7] The fractured, lower-water-yielding bedrock is a few dozen feet below the surface. Wells that withdraw water in this region where groundwater and surface water are intrinsically linked present ongoing challenges for ecosystem health. The scope of this case study is the five-county region of Vilas, Oneida, Taylor, Price, and Lincoln counties in north central Wisconsin, and the Lac du Flambeau Band of Lake Superior Chippewa.

Cranberry bog flooding occurs in the spring for frost protection and to prepare for the growing season and again in the fall to facilitate harvest. Large water withdrawals have been reported to impact nearby lake levels. Withdrawals in the spring can be problematic because even a drop of a few inches can expose the shallow beds along the shore where fish spawning occurs. This disruption can negatively impact fish populations in affected lakes, leading to ecosystem imbalance and limited fish supply for local anglers.

It is unclear whether the reported lowering of lake levels on the Lac du Flambeau reservation is a result

1 "Cranberry Farming in Wisconsin." Wisconsin Historical Society, August 19, 2013. https://www.wisconsinhistory.org/Records/Article/CS3858.

2 *Ibid*.

3 Thiel, Abriela. "Wisconsin Expected to Lead U.S. in Cranberry Production." https://www.wmtv15news.com, August 16, 2022. https://www.wmtv15news.com/2022/08/16/wisconsin-expected-lead-us-cranberry-production/.

4 Deller, Steven, and Jeffrey Hadachek. "The Contribution of Agriculture to the Wisconsin Economy: Wisconsin Cranberry Industry." University of Wisconsin-Madison Extension, October 2024. https://aae.wisc.edu/wp-content/uploads/2024/11/The-Contribution-of-Agriculture-to-the-Wisconsin-Economy.pdf.

5 "Wisconsin Water Use - 2021 Withdrawal Summary." Wisconsin Department of Natural Resources, 2021. https://dnr.wisconsin.gov/sites/default/files/topic/WaterUse/WithdrawalReport/2021.pdf.

6 *Ibid*.

7 Admin. "Lake Types." Wisconsin Lakes, August 29, 2016. https://wisconsinlakes.org/lake-types/.

of groundwater withdrawal or surface water diversion but in any event, fish spawning has been negatively impacted by water-level lowering of up to two feet. Some of the high-capacity wells used for cranberry production in state are "grandfathered in," meaning they are not subject to the same permitting requirements as other irrigators because these wells were drilled before the current high-capacity well-permitting system was established. They may also not have well logs recording their depth and aquifer they draw from. The Wisconsin DNR is not authorized to regulate high-capacity wells approved prior to the creation of Wis. Stat. § 227.10(2m).[8] Therefore, regulating these withdrawals if they are shown to impact fish spawning poses a significant challenge

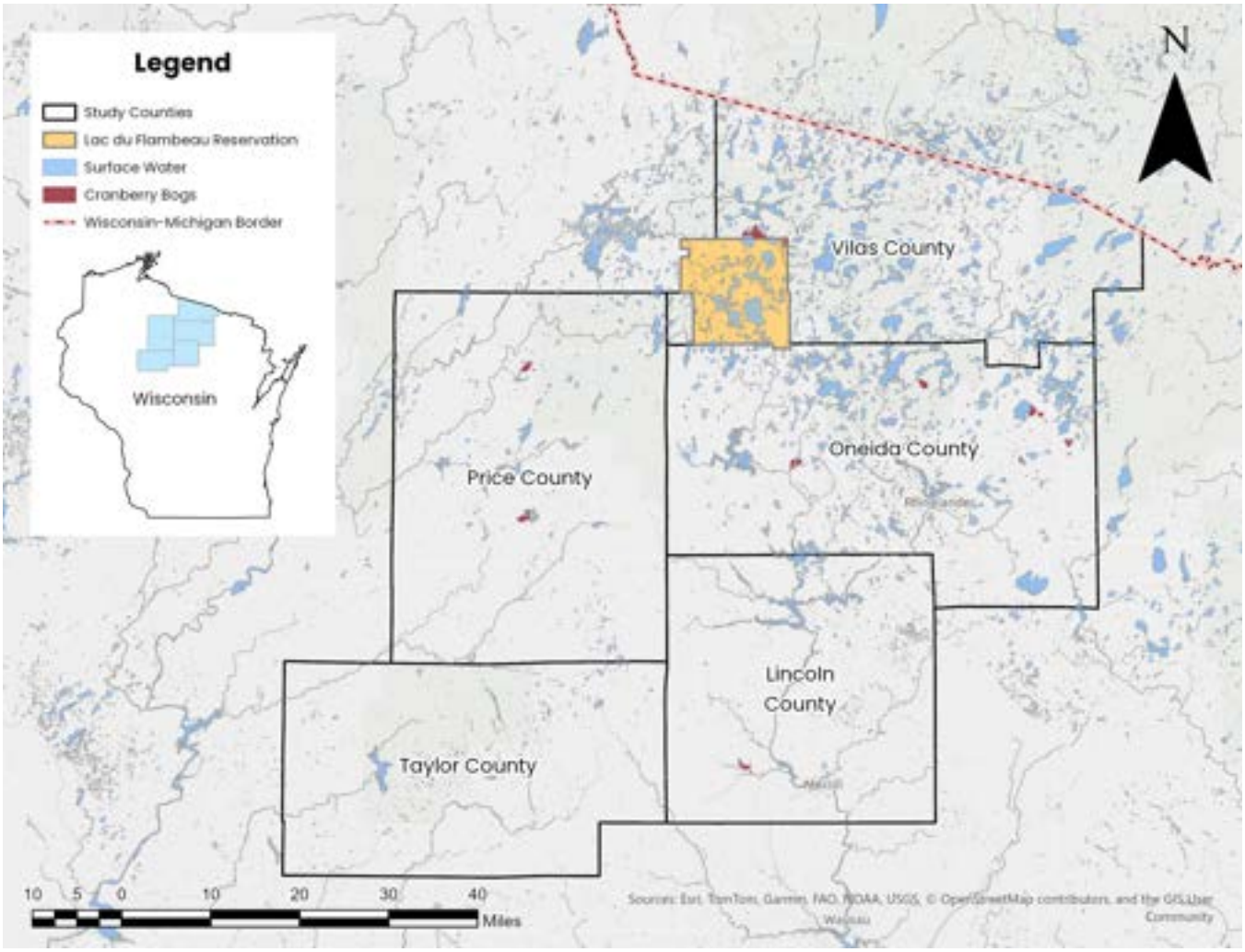

Figure 1. The Lac du Flambeau Reservation, Cranberry Bogs, and Surface Water in the Study Area

Data sourced and adapted from ESRI, Wisconsin Department of Natural Resources, Wisconsin Statewide Parcel Map Initiative, and Wisconsin State Cranberry Growers Association.

8 Koehnke, Christopher T., Andrew T. Phillips von Briesen, and Roper s.c. "Regulating High Capacity Wells in Wisconsin." Legal News Papers, June 2016. https://www.wicounties.org/wp-content/uploads/2020/03/legal-news-pages1.pdf.

During the North Central Wisconsin groundwater workshop, participants suggested that a best practice would be communicating with nearby cranberry producers. The producers typically work and manage their own lands but may be under contract with buyers who require certain practices for viable production. Having conversations with producers can lead to greater understanding of the ecosystem impacts, along with their personal financial impacts, which could lead to practices that benefit all parties.

This region is very sensitive to changes in groundwater and all those who use these resources must be considered as projected water demands grow alongside an increasingly changing climate. More work is needed to understand the effect of cranberry water management on local ecosystems.

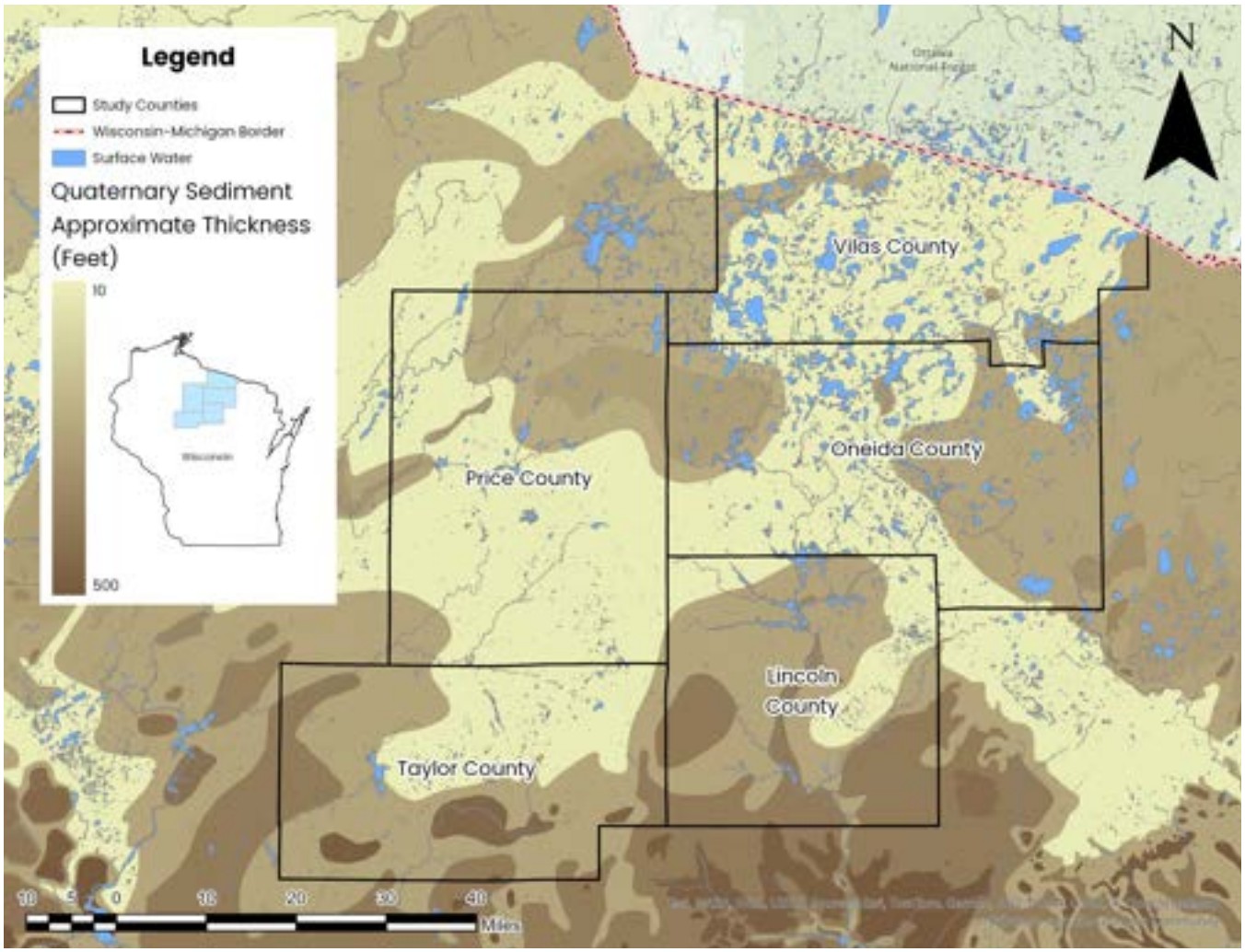

Figure 2. Thickness of Quaternary Sediment

Sediment layers of glacial origin overlie fractured crystalline bedrock across the study area counties (black outlines). These are among the lowest-yielding aquifers in the state and are highly connected to the many surface water features. Data sourced and adapted from ESRI and the Wisconsin Department of Natural Resources.

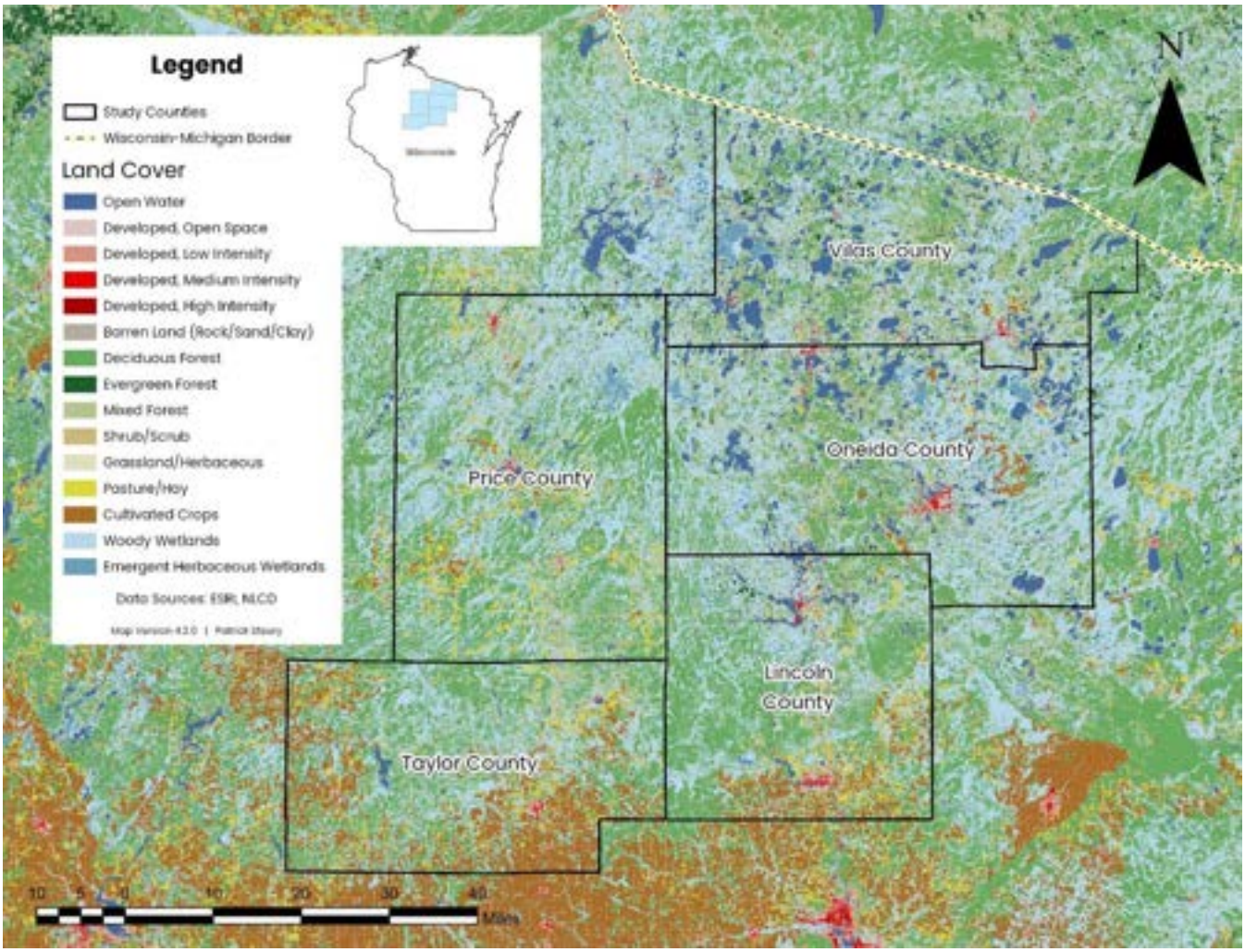

Figure 3. Land Cover in the Study Area

As generated by the National Land Cover Database in 2023.

Appendix A

Background and Implementation of the EPA Treaty Reserved Rights Rule in EPA Region 5

Author: Quinn Soltis

Background and Summary of the Clean Water Act as it Relates to the Treaty Reserved Rights (TRR) Rule

The Clean Water Act (CWA) provides the basic structure for regulating pollutant discharges into the waters of the United States (U.S.).[1] It establishes that a permit is required before any person discharges any pollutant from a point source into U.S. waters. It also provides a mechanism to delegate that authority to states and tribes, with oversight by the Environmental Protection Agency (EPA). The CWA was originally called the Federal Water Pollution Control Act, and it was enacted in 1948. In 1972, it was significantly revised and expanded and became commonly known as the Clean Water Act. Tribes, similar to states, may assume the authority to set water quality standards that apply on reservations. There are eight Tribes in Minnesota, Wisconsin, and Michigan that have EPA approved water quality standards in place.[2]

I. Fond du Lac Band of Minnesota Chippewa (MN)

II. Grand Portage Band of Minnesota Chippewa (MN)

III. Leech Lake Band of Ojibwe (MN)

IV. Red Lake Band of Chippewa (MN)

V. Lac du Flambeau Band of Lake Superior Chippewa (WI)

VI. Sokaogon Chippewa Community (Mole Lake Band) (WI)

VII. Bad River Band of Lake Superior Chippewa (WI)

VIII. Keweenaw Bay Indian Community (MI)

On May 2, 2024, the Environmental Protection Agency (EPA) published its final rule requiring state consideration of tribal reserved rights (TRR) when revising its water quality standards (WQS).[3] [4] Tribal reserved rights are defined as "any rights to CWA-protected aquatic and/or aquatic-dependent

1 33 U.S.C. §1251 et seq. (1972).

2 U.S. Environmental Protection Agency. "Tribal Assumption of Federal Laws - Treatment as a State (TAS)." EPA, January 14, 2025. https://www.epa.gov/tribal/tribal-assumption-federal-laws-treatment-state-tas.

3 **Note:** The final rule became effective on June 3, 2024, 30 days after its publication in the Federal Register.

4 Water Quality Standards Regulatory Revisions To Protect Tribal Reserved Rights, EPA-HQ-OW-2021-0791; FRL-8599-02-OW § (2024).

resources reserved by right holders, either expressly or implicitly, through Federal treaties, statutes, or executive orders." [5] Under this rule, when a tribe asserts its treaty-reserved rights to the state and to the EPA for consideration, the state must examine a number of things. The state must factor in the value and use of state waters in protecting Tribal reserved rights when it comes to adopting or revising designated uses. They must account for the anticipated future exercise of Treaty reserved rights unsuppressed by water quality when creating water quality standards. Lastly, the state must develop water quality criteria to protect Tribal reserved rights when designated uses encompass or explicitly protect those rights.

The latter requirement ensures that water quality criteria protect right holders using the same risk levels (e.g., cancer risk, illness rate, or hazard quotient) as those applied to the general population (non-rights holders), matched with exposure inputs (e.g., fish consumption rates) reflecting right holders' exercise of their reserved rights. The EPA must also follow these standards when setting federal water quality standards. This new rule commits the EPA to assist states and right holders in reviewing Tribal reserved rights upon request and initiating tribal consultations with right holders who have asserted their rights for consideration in establishing WQS.[6] The rule updates requirements for state submissions of WQS under the CWA. These updates include submissions of Tribal reserved rights information provided by right holders plus documentation on how states considered it, as well as EPA review factors to ensure state-adopted WQS comply with the rule's requirements. Lastly, the new rule includes state triennial reviews that must incorporate any new information on Tribal reserved rights.

The following case study is an example of how this rule may be used in Minnesota.

Minnesota's Water Quality Standards

Minnesota's water quality standards are comprehensive. This summary will note one place where Tribes may be initially inclined to challenge those standards as inadequate. The first is the wild rice designated use and its associated sulfate standard. One of the designated uses described in the Clean Water Act has to do with the protection of wildlife, fish, and shellfish in designated use waters, wild rice falls into this category. Wild rice is especially important for tribal communities as it has been one of their staple food sources for centuries. The state of Minnesota currently has a 10mg/L standard for sulfate in class 4A waters where wild rice is present.[7] Wild rice is especially susceptible to harm from sulfate and there are currently 32 water bodies that were added to Minnesota's 2020 Impaired Waters List due to having sulfate that exceeds the 10mg/L standard.[8]

States exercising delegated authority for water quality standards under the Clean Water Act must review standards (such as the sulfate standard) every three years. As part of this "triennial review" process, the state must hold a public hearing that is open to rights holders. (Section 131.20(b)) Over

5 *Ibid*.

6 US EPA. 2019. "Water Quality Standards Handbook | US EPA." US EPA. October 4, 2019. https://www.epa.gov/wqs-tech/water-quality-standards-handbook.

7 Weiss, Steve, Scott Kyser, Matt Lindon, Dennis Wasley, and Emily Brault. "Procedures for Implementing the Class 4A Wild Rice Sulfate ..." Procedures for implementing the Class 4A wild rice sulfate standards in NPDES wastewater permits in Minnesota, January 2024. https://www.pca.state.mn.us/sites/default/files/wq-wwprm2-109.pdf.

8 "Minnesota's Impaired Waters List." Minnesota Pollution Control Agency, April 2024. https://www.pca.state.mn.us/air-water-land-climate/minnesotas-impaired-waters-list.

the three years of the triennial review, the state revises its WQS, adopts final standards, and submits them to EPA. Accompanying the standards must be information provided by the rights holders and an explanation of how that information was considered, as well as the data and methods used to develop the water quality standards. Once the EPA receives the standards, it evaluates whether they are consistent with the protection of tribal reserved rights (40 CFR 131.9), consults with tribes under EPA's tribal consultation policy, and approves or disapproves the state's standards.

Potential Scenario – Minnesota State Triennial Review Process

Initial Approach: Would the state be willing to consider these water bodies as eligible for listing as wild rice waters under the wild rice designated use? Would there be other data that the state would want with respect to those lakes (e.g. characteristics like sediment type that would show that the lake might be able to support wild rice in the future)? Would the state limit the time frame relative to when these lakes supported wild rice (e.g. within the last 25 years)?

Secondary Questions: If the state argues that the current designated use language (that is "water used for the production of wild rice") precludes listing lakes that don't currently support wild rice: Would the state be willing to consider a change to the designated use language so that it could encompass waters where wild rice existed in the past and may again exist in the future? If so, there could be discussion about removing the wild rice designated use from the agriculture and wildlife class and moving it to the aquatic life class. What would be the consequences of such a change?

Policy Steps to Advance the Above Scenario Under the Treaty Reserved Rights Rule

I. Rights holder (a tribe or tribes) asserts its treaty reserved right to EPA's regional office and the relevant state (Minnesota, in this example). Section 131.9(a). This assertion is not intended to be onerous; it can be accomplished via email. EPA encourages rights holders to identify:

- The applicable treaty,
- The nature of the right (e.g. the right to gather wild rice), and
- The geographic location (e.g. in a particular area or waterbody).

II. EPA has urged rights holders to assert their rights at the time of a state triennial review, calling it "an ideal opportunity" (89 Fed. Reg. 35728), although that is not required.

The State or the rights holder may request the assistance of EPA with evaluating reserved rights. Section 131.9(b)]

III. The rights holder and the State (with the assistance of EPA if requested), evaluate data and information related to the rights holder's assertion that a resource is not adequately protected by the state's current water quality standard (WQS).

- In this case, the tribe(s) would be making the argument that the list of waters with the designated use "water used for the production of wild rice" should include additional waters that supported wild rice in the past and are reasonably capable of supporting wild rice in the future. [See Step V.a., below.]

IV. If the State and the Tribe(s) agree that the designated use language is too restrictive, then a new designated use would need to be developed. [See Step V.b., below.]

[Note: The State or the rights holder may request the assistance of EPA with data and information gathering. Section 131.9(b)]

Data Requirements

Assuming that EPA and/or the State agree with the Tribe(s) that the existing designated use can include additional water bodies (III.a. above), the Tribe(s) (with the assistance of Freshwater) would need to:

I. Present information that supports the use and values associated with wild rice (applicable to the specific waterbody(ies) that supported wild rice in the past if possible).

II. Present data on the anticipated future exercise of the right should rice be restored.

III. Present data on the potential for rice restoration (addressing reasons that the waterbody no longer supports wild rice).

There may be other data that would need to be presented (see Initial Questions, above) depending on interactions with the State and questions/concerns that they may raise.

Potential for the TRR Rule to be Short-Lived

As of the time of this report, there are currently 12 western states suing the EPA, making a number of arguments that the new rule is improper.[9] States argue that this new rule strips them of authority to designate water uses, imposes vague and burdensome obligations relating to permit costs, and unconstitutionally disrupts state-tribal relations. The states contend that the EPA is exceeding its statutory authority under the CWA, intruding on state water rights, and imposing significant economic and political costs without clear congressional authorization. States seek to halt implementation, block enforcement, and have the rule declared invalid.

Since then, several tribes, including the Fond du Lac Band of Minnesota Chippewa, have intervened to defend the rule.[10] [11] They have cited its recognition of tribal rights and the fact that it protects water quality at a time when climate change and environmental degradation continue to pose a threat. Because the TRR Rule is a final rule, it cannot be undone by a new administration without going through the federal rulemaking process. If the new administration does propose to withdraw the rule, it would require a notice in the federal register and a public comment period.

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9 State of Idaho v. EPA. Case 1:24-cv-00100-DLH-CRH (https://www.epa.gov/system/files/documents/2024-06/complaint-idaho-et-al-v-epa-tribal-reserved-rights-rule-5.28.24.pdf May 28, 2024).

10 State of Idaho v. EPA. Case 1:24-cv-00100-DLH-CRH (https://www.narf.org/nill/documents/20240712amended-mti-epa-rule.pdf July 12, 2024).

11 **Note:** The original motion to intervene was filed on June 18, 2024. On July 12, 2024, an amended motion to intervene was filed. As of July 12, the motion to defend the EPA's Tribal Reserved Rights Rule includes seven Tribes from Region 5: Bay Mills Indian Community (MI), Lac du Flambeau Band of Lake Superior Chippewa Indians (WI), Sokaogon Chippewa Indian Community (WI), Red Lake Nation (MN), Fond du Lac Band of Lake Superior Chippewa Indians (MN), Grand Traverse Band of Ottawa and Chippewa Indians (MI), White Earth Band of the Minnesota Chippewa Tribe (MN).

Appendix B

North Central Wisconsin Groundwater Workshop Summary

Author: Freshwater

Executive Summary

During this two-day workshop in late October of 2024, Tribal, Federal, State and local government representatives and others gathered in Lac du Flambeau, Wisconsin to discuss groundwater challenges in North Central Wisconsin. This aquifer action workshop was organized by Freshwater in partnership with the workshop host, Lac du Flambeau Band of Lake Superior Chippewa. Facilitating shared conversations like this one is part of an ongoing groundwater governance project in the Great Lakes region.

Throughout the workshop, participants were given a platform to listen and react to presentations, engage in round-table discussions, and participate in small break-out groups to evaluate a local groundwater issue of interest.

The Sokaogon Room at the Lake of the Torches Casino, where the workshop was held.

There were five breakout groups for the specific topics of concern, which were identified by the workshop participants and included:

I. The state of monitoring data and knowledge of groundwater. This became the "**data**" group, summarized in section 3.1.

II. Inequitable communication and consultation about groundwater research and data collection, especially with those disproportionately impacted by the outcomes. This became the "**Communication & Consultation**" group, summarized in section 3.2.

III. Impacts of climate, economic development and growth, and emerging contaminants on groundwater supply. This became the "**emerging externalities**" group, summarized in section 3.3.

IV. An authority structure that artificially separates the governance of water instead of viewing it as a connected system. This became the "**legal structure**" group, summarized in section 3.4.

V. Ecosystem impacts of groundwater use, including lake and wetland levels and their plant and animal communities. This became the "**ecosystem needs**" group, summarized in section 3.5.

During the break-out groups, participants used the information from the technical presentations, along with their firsthand knowledge and lived experiences, to admire the issue and identify strategies

and barriers for addressing the issue through the implementation of new or improved policies. Each group reported the outcomes of their discussions, giving the rest of the participants an opportunity to react and weigh in with their own thoughts and ideas. The multi-disciplinary and multi-cultural makeup of the room resulted in a wide range of suggestions.

The outcomes of this aquifer action cluster workshop will be used to summarize the policy tools and best practices for groundwater governance in EPA Region 5 in the upcoming report, concluding Phase II of this project. The outcomes from Phase I of this project are presented in the Groundwater Governance in EPA Region 5 report.

Introduction

From October 22nd to 23rd of 2024, a group of approximately thirty-five people including scientists, lawyers, and government staff from local, state, Tribal, and federal institutions gathered at the Lake of the Torches Convention Center in Lac du Flambeau, Wisconsin (Figure 1) to discuss groundwater in North Central Wisconsin during this two-day workshop facilitated by Freshwater. The purpose of the workshop was to identify regional issues, current practices, and sustainable groundwater governance strategies for the five-county areas of Taylor, Lincoln, Price, Vilas, and Oneida defined as "North Central Wisconsin." These counties share similar geologic and groundwater features, where thin glacial sediment overlies the fractured crystalline bedrock resulting in the lowest groundwater yields in the state. The workshop was hosted on the Lac du Flambeau reservation, whose 1842 ceded lands form much of what is now the Chequamegon Nicolet National Forest.

Figure 1. Door to Sokaogon Room, with sign to direct participants

The four questions that guided this two-day workshop included:

I. What concerns are you working on within North Central Wisconsin?

II. What current groundwater stressors are you hoping to address in a better way?

III. Do you have any input on sustainable governance practices that could be implemented multi-regionally?

IV. What other experts do you think should be a part of this process, and part of the continuing conversation?

Who Was Invited?

The prospective participant list was divided into several categories to promote cross-sectoral representation from the multiple jurisdictions and different sectors within the North Central Wisconsin workshop area. Recruitment focused on ensuring there was a specific range of regional, technical, and cultural knowledge, as well as members of community hubs and people with strong ties to their networks with the ability to distribute information. Several attendees had broader expertise or worked throughout the state of Wisconsin as well as within the narrower region.

Invitees were broadly categorized by area of work focus (county or region), organizational affiliation (Tribal, state, federal, nonprofit, community, academic, other), and knowledge or expertise (earth science and technical, cultural, regional, organizational operational, legal and policy). A selection of the water professionals who attended were interviewed during Phase 1 of the project. Other participants were identified through local news sources, active nonprofits and community organizations in the region, outreach to Tribal communities, or through research produced by their organizations. Several participants were also recruited through recommendations from other invitees or organizations.

The workshop was originally scheduled for June 2024 but was postponed due to scheduling conflicts and to allow time to increase participation from key stakeholders. After the postponement, an advisory committee was formed to focus on identifying and recruiting potential attendees. This advisory committee included a member of Lac du Flambeau's Natural Resource Department, a member of the Great Lakes Indian Fish & Wildlife Commission (GLIFWC), a member of the Bureau of Indian Affairs (BIA), and a member of Freshwater. Each of these advisory committee members was asked to undertake outreach by using their local knowledge of organizations and issues and their personal connections to maximize participation. The advisory committee developed targeted strategies specific to the culture and region.

For example, Tribal, state, and federal government agencies have restrictions on staff participation and require more notice than nonprofits and local government units to approve travel expenses. These entities also require detailed agendas to make informed decisions about who should participate and have more distinct hierarchies for approval, which determines who should be contacted first.

With this in mind, Freshwater staff refined the agenda and, with the guidance of the advisory committee, invited attendees who could give technical presentations that would be regionally relevant and of interest to target stakeholders and who could also represent their respective organizations. A Save-the-Date flyer was sent two months in advance to several organizations and department heads of organizations were requested to invite people from their staff. Information was provided describing the workshop and its intent, including a draft agenda.

Prior to attending, participants were sent a survey to gather availability over the two days of the workshop and to determine their focus areas of interest. Formal invitations, final agenda, itinerary, and information about financial assistance for tribal participants were sent a week prior to the workshop.

Tribal Nations attending the event included Lac du Flambeau Band of Lake Superior Chippewa, Sokaogon Chippewa Community, Forest County Potawatomi Community, Bad River Band of Lake Superior Chippewa, and Keweenaw Bay Indian Community. Additionally, staff from the Great Lakes Indian Fish and Wildlife Commission, US Forest Service, and US Geological Survey were on hand to discuss Tribal and Federal groundwater management. Staff from Wisconsin Department of Natural Resources, and Wisconsin Geological and Natural History Survey were on hand to discuss State-level groundwater

management and permitting. While county conservationists (from Vilas, Oneida, and Taylor counties), Wisconsin Rural Water Association, and the North Central Wisconsin Regional Planning Commission were on hand to share local and regional challenges in groundwater management. Others in the room were there to share perspectives from non-profits and organizations working in this sector.

In the survey, participants expressed an interest in networking, learning about local groundwater data needs, hearing the Tribal perspective, and gaining more momentum around local efforts in groundwater management.

Community Engagement

Community engagement is a broad name for research frameworks (also referred to as community action research, participatory research, empowerment evaluation, etc.). Its purpose is to center a community's voices, values, and understanding of issues. Community engagement brings a research problem to the people within a defined scope of focus (e.g. geographic area, demographic group, specific topic interest) and invites participation in the problem solving. It centers the people impacted and asks researchers and community members to collaborate as part of a single research team (Syed and Palermo 2010). https://doi.org/10.2105/ajph.2009.178137.

The role of community engagement is particularly important when working with marginalized communities where different cultures, values, and priorities may have to compete for consideration against dominant frameworks. This groundwater governance workshop included participants from varying cultures and asked participants to respect all knowledge brought into the workshop, including Traditional Ecological Knowledge (TEK) and lived experience.

Academic credentials and Western scientific knowledge are prioritized in policy and law-making settings due to their empirical and analytical approach (Mazzocchi 2006). TEK and lived experience are typically less common because it is difficult to evaluate the reliability of this expertise under academic or Western science rubrics of knowledge (Kadykalo et al. 2020).

Traditional Ecological Knowledge (TEK) is described as "observations, oral and written knowledge, practices, and beliefs that promotes environmental sustainability and the responsible stewardship of natural resources through relationships between humans and environmental systems" (White House Press Brief 2021).

Lived experience is firsthand knowledge, or knowledge generated by living through specific events, conditions, or occurrences. Through recollection and retrospection, this firsthand knowledge provides information by situating a problem within a particular context (O'Leary and Tsui 2022).

In recognizing these different ways of knowing as valid, workshop participants were encouraged to speak freely about their personal experiences. They were asked to listen to the wisdom of others without passing judgment, or assuming that one perspective was more credible than another. This was a way to facilitate respectful dialogue throughout the room.

Agenda and Topics Covered

The detailed agenda is included in the appendix.

Day One in Review

The first day of the workshop was October 22, 2024, where participants were greeted in the Sokaogon Room at the Lake of the Torches Casino in Lac du Flambeau, Wisconsin. Breakfast and coffee were available for all who attended, and Freshwater staff were present to facilitate the two-day event.

Opening & Introductions

Dee Allen, Tribal Administrator for Lac du Flambeau, opened the workshop with a brief greeting and introduction to the Tribal Council President John Johnson Sr., who offered warm words of welcome. This was followed by three Drum songs performed by President Johnson's grandsons, Mike Wiggins Jr., along with President Johnson himself.

Mike Wiggins Jr., director of the Madeline Island Museum, then kicked off the day with an opening talk about the cultural history of groundwater in the region. He spoke of the breadcrumbs of wisdom left by ancestors and framed the Indigenous point of view as looking through a new lens.

"When you go to the optometrist and they click a lens in front of you and ask, 'Better or worse?' You might suddenly realize you have become accustomed to bad vision." He asked non-Indigenous attendees to keep this metaphor in mind as he described issues of water through a collection of teachings that had been passed down to him. He spoke of the 700-year migration of the Anishinaabe people from the east as the glaciers retreated, guided by a prophecy to find the food that grows on water. He spoke of the many lifeways dependent on water that enrich the region, including fish, traditional medicines, and wildlife. And how the minerals deep below the Earth's surface support the abundance of water in the region. He said, "When the window of life gets small, the Great Lakes will be the place to be." The participants appeared to be attentive throughout this presentation, with many in the room expressing great appreciation throughout the workshop for gaining this new perspective.

Following this opening, participants were asked to bring chairs to the middle of the room in circular formation. Freshwater facilitator, Rosie Russell then shared a story about how she got connected to water, which kicked off the 2-hour talking circle, where each person was given the opportunity to share a story about their personal connection to water.

Everyone had a story that detailed their relationship to water, and the sharing of these stories intended to have an equalizing effect around the table. Some shared their experience living in a hunting shack with no running water, having their well collapse, or swimming in dirty mucky lakes as a child. One spoke of their fascination watching little brown bats occupy the small space above water where the bugs hang out, while others marveled at the interconnected ways that water moves through earth and how it is hard to separate surface water from groundwater in this region. The groundwater connection to surface waters had been observed by one participant who has fished, trapped and hunted these lands and waters, and had participated in scientific studies conducted with the University of Minnesota that validated their observations.

Several participants detailed the ways in which water intersected with their work, as planners, students, legal experts and scientists. One individual shared their concern about the inadequate and fragile system of water governance and expressed a belief that there was a better way forward, while another expressed interest in a world where geology was not resource extraction. One shared their passion for understanding turbulent flow, where art and science meet, while others wondered how to regulate and protect springs and well fields, especially in a region with the lowest well yields in the state.

Some spoke about the incredibly destructive power of water, like Hurricane Helene, or how wildfires impacted their ability to get clean water while at a research camp. Others expressed concerns about the changing climate, and their hope for a normal winter. Many spoke of the spiritual and grounding power of water, like the way it makes a person feel when the sunshine sparkles on it, or when throwing out a net to fish.

As participants went around the circle, heads were nodding while the sounds of agreement and surprise could be heard. At the end, people had much to talk about with one another as they took a break in preparation for the next presentations.

Technical Presentations

Rosie Russell, the facilitator, began with an introduction to the purpose of this workshop, the challenges with discussing big systems like groundwater governance, and the importance of everyone being empowered to share their expertise and lived experience. She then shared the data norms and practices used for this workshop.

This was followed by a presentation from Carrie Jennings, Research and Policy Director of Freshwater, who provided background on the groundwater governance project. She spoke of the work done during Phase I and the recommendations that followed. She shared how the aquifer action cluster areas came about, and the process being used to collect data from these specific regions while uplifting the perspective of the Tribal Nations. Following this presentation, participants inquired about the new Environmental Protection Agency (EPA) ruling to protect Tribal reserved rights in ceded territories and how that would be implemented when there is mistrust. As Mike Wiggins Jr. said earlier, "We are in ceded territory. These were created as the permanent homelands. Ceded lands are for all of us to share. It is our shared home."

Another participant expressed concerns about discussing groundwater, and said that it was all one water, and we cannot just pick it apart separately if it is a connected system. Others chimed in to share the importance of having these conversations, saying what doesn't happen here will probably happen somewhere else at some time and that we must look seven generations ahead and change the approach of how we view these resources because it helps everyone. A local county conservationist felt overwhelmed by the topic, and struggled with the many ways one can protect groundwater and felt helpless about the solutions. Another wondered, how do we engage with groups who have soft authority?

J. Elmo Rawling III, a Quaternary geologist with the Wisconsin Geological and Natural History Survey (WGNHS), followed this presentation with a description of the geologic history and characteristics of the landscape within the North Central Wisconsin region. He talked about the data being collected and the knowledge being produced through mapping. Participants responded with questions about how Tribal Nations are notified when data are collected within ceded territories. Concerns were expressed

about current Tribal consultation practices and lack of effective communication between state and Tribal project partners. Another participant shared that other states have Tribal environmental groups that are well organized and active, but because this doesn't happen in Wisconsin a more up-to-date directory of Tribal environmental staff is needed to facilitate better communication practices with Tribal entities.

John Noonan, JD, Water 365, followed this with a virtual presentation overviewing groundwater policy in the U.S. and the state of Wisconsin. John Roterman, Tribal liaison from Freshwater, then spoke about the Rights of Nature and how this world view informs how local Tribes value their waters and natural ecosystems. One participant asked how one would go about asserting sovereignty when it comes to the interpretation of Rights of Nature, citing an example from New Zealand.

The technical nature of these presentations created a foundation for the rest of the workshop. After the trust-building of the first day, the participants were aware of each other's professional backgrounds and social contexts, and this created an environment of trust where questions and clarification could be asked about even sensitive topics.

Breakout Groups: Defining the Issues

Following the presentations and brief discussion, participants were asked to brainstorm issues they are working to address in the North Central Wisconsin region, with a focus on groundwater availability. The issues that were suggested were displayed at the front of the room, and included:

- Per- and polyfluoroalkyl substances (PFAS), and their potential to be in septage that is landspread near wetlands
- The state of data and the region's groundwater knowledge base
- Source water: assessment and development
- Groundwater manipulation and management impacting lake levels and ecosystems
- Complicated and disconnected authority structure
- Water resource availability limited by geologic characteristics
- Population growth and development impacting groundwater supply
- One water, not currently seeing or managing water as a connected system.
- Groundwater with naturally occurring iron and manganese impacting drinking water quality and the potable water supply
- The need for an engaged citizenry aware of groundwater issues when they arise
- Process for communication and knowledge sharing; lack of consultation with tribes
- Climate impacts on water
- Timing of groundwater withdrawals impact on ecosystem

The group then agreed to combine and consolidate the different issues into the following categories:

- Data: PFAS, Knowledge base, source-water assessment (see section 3.1)
- Communication and Consultation: engaged citizenry, process for communication and knowledge sharing (see section 3.2)
- Legal structure: Authority structure, one water, resource limits (see section 3.3)
- Ecosystem needs: groundwater manipulation and management, timing of groundwater withdrawal on ecosystem (see section 3.4)
- Emerging externalities: PFAS, climate impacts, population growth anticipation (see section 3.5)

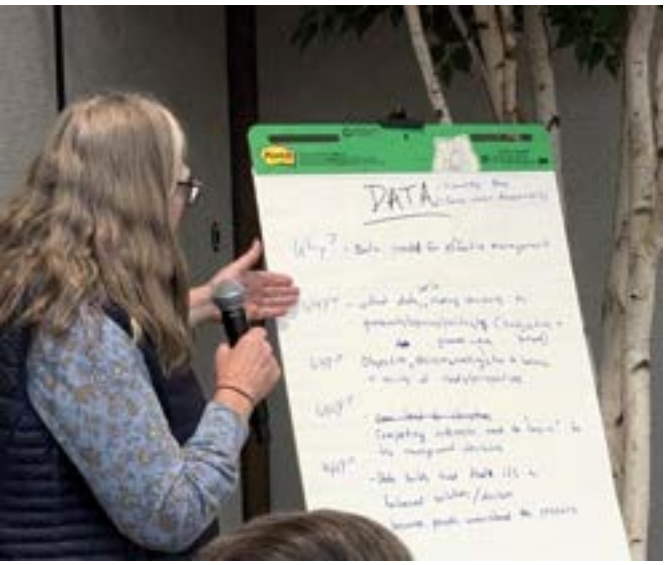

Figure 2. Data group presenting the results from their 5 Why's exercise

Attendees were given the opportunity to choose which group to join and walk through a series of exercises to discuss the issue of their choice, and to "admire the problem," as was reiterated throughout the discussion. Notes of topical points were recorded on sticky notes and posted on large flipboards to help participants find common themes and connections.

The first exercise in this process was the 5 Whys exercise, which encouraged participants to get to the root of the issue they were discussing while creating a starting point for each person in the group to share and debate their different perspectives. See Figure 2.

After reporting the results of their 5 Whys discussion and selecting a more narrowed focus for their topic, each group considered the various ways the issue impacts their communities. Participants were asked, "who or what does this issue impact?" After reporting their results, participants were asked, "who or what impacts the issue?" This exercise brought each group to a deeper understanding and provided the foundation to move into day two's discussion: policy and governance tools.

Day Two in Review

On Day Two, most of the invitees returned with a few additional faces to continue the dialogue regarding groundwater in North Central Wisconsin. Everyone was given an opportunity to reflect on the previous day's discussions. The diversity of industry professionals, Tribal experts, and government staff made for interesting talking points that seemed to intersect at times and blossomed into further fruitful conversation.

Opening

The group was again invited to form a circle inside the tables to share their day-one experience and what was most anticipated for day two. Many said they had a great time the previous day and looked forward to attending more meetings like this one. There was a positive reception to the format and

composition of the workshop, and an appreciation for gaining the latest information and news from other dedicated professionals.

One participant praised the brilliance of the meeting's set-up and focus—to have everyone who touches the same issue in the same room at the same time and allowing for some serendipity. They said it was a gift for them to work on the shallow, sole-source, glacial aquifer for Lac du Flambeau, where water seems to be everywhere. They said it was hard to think about groundwater and surface water separately and there are many issues of water quantity and quality. They were learning something all the time; for example, how dependent the system is on the type of tree cover. Pines hold more snow and release more water later to recharge groundwater. They asked what the impact of selectively logging pines 150 years ago might have been and how forest succession changes groundwater recharge.

Several participants were eager to hear solutions and an actionable plan, especially where Tribes were being included and heard. Concerns were expressed about the ways in which Tribes were viewed by surrounding communities, like the hatred that returned when money and services ran out after Lac du Flambeau made great efforts to extend support into the community during the COVID-19 pandemic. Given the financial and legal constraints that exist, collaboration to produce a list of priority concerns was seen as an important next step for progress to coordinate focus among organizations.

Technical Presentations

After a large group discussion on the second day, Aaron Pruitt, a hydrogeologist at the Wisconsin Department of Natural Resources, provided a high-level overview of the permitting process for high-capacity wells. John Noonan, JD, of Water 365 followed that presentation with examples of policies and policy tools used to address groundwater issues in impacted communities.

The discussion highlighted how state law dictates the scope and responsibilities of the DNR as a regulatory body and how that language has shifted and changed over time. In 2003, Wisconsin Act 310 passed as part of a bipartisan effort to expand state authority to consider environmental impacts of high-capacity wells by providing a framework for addressing water quantity issues in low-yield areas of the state. In 2007, Act 227 was proposed, and in 2008, Act 227 was passed and signed, and Wisconsin became party to the Great Lakes Compact. Under Act 227 of the state legislature, there are multiple conditions and regulations stipulated for water withdrawals (see this summary of Wisconsin's Groundwater Law for more information). In 2021, the Wisconsin Supreme Court issued a decision on about the role of the DNR and its authority in protecting Wisconsin's water resources. The impact of PFAS and other source water contaminants also came up several times in the discussion, including questions about whether PFAS is being monitored in wildlife and maple syrup.

Upper Midwest Science Center hydrologists Martha Nielsen and Megan Haserodt of the U.S. Geological Survey provided technical presentations on groundwater data in the Lake Superior Basin (Nielsen) and the Wisconsin Groundwater Monitoring Network (Haserodt).

Haserodt covered how the groundwater monitoring network can be used and has been used in the workshop region. This is included a discussion about how the Haskell Lake project – a study on a water budget, a contamination plume, the effects on the ecology of the shallow drainage lake – resulted from tribal consultation and collaboration with Lac du Flambeau.

Nielsen covered the region north of the workshop area, including the counties of Ashland, Bayfield, Douglas parts of the Chequamegon-Nicolet National Forest, the Bad River Reservation, and the ceded

lands of the 1842 treaty territory. Due to industry interests and actions in the Lake Superior Basin questions emerged related to industry's impact on groundwater, specifically mining and logging, including the impact on water budgets and watersheds and the impact of industry on water quality and quantity.

A repeated theme in the discussion highlighted how the North Central Wisconsin geology differed from the surrounding area and how in this area the surface water and the groundwater are functionally all one water. Although participants reacted to some of the presentations with skepticism, questions, and probes for deeper analysis, the trust-building on the first day allowed participants to appear more at ease in expressing questions and seeming vulnerable when asking for clarification around scientific and legal topics. The participants also appeared to be more aware of each other's backgrounds and social contexts, and this knowledge allowed people to engage in civil and open dialogue.

Breakout Groups: Policy Tools and Interventions

Between presentations, participants returned to their respective groups to brainstorm policy and governance tools. They were asked to reflect on interventions or policy tools that could be implemented by a local jurisdiction or institutions to either mitigate an existing impact discussed the previous day, or to improve an existing policy that would indirectly address an impact.

During this discussion participants were also asked to identify some barriers that might impede successful implementation. Participants focused on multi-regional approaches using the same process.

Each group presented their strategies in a different format, with a variety of specific and generalized approaches suggested. Many found the process challenging and wondered how to apply the strategies in a real-life scenario, especially given the long list of barriers that were presented.

Debrief

At the end of the workshop, participants were asked to reflect on their experience during a debrief and then again in a short post-workshop survey. Many participants expressed gratitude for being in-person to discuss these complex and multi-dimensional issues, and to be able to disconnect from screens, something that has not returned to the same level since the COVID-19 pandemic. One felt that two days as a group translated into 500 virtual meetings worth of discussions.

Some appreciated both the cultural and experiential diversity of the group and that the focus was on listening rather than the facilitator saying, "here's what we're trying to accomplish." There was thoughtful conversation with smiles and humor, and no shouting, as pointed out cheerfully by one participant.

Several people felt that the Tribal perspective and the stories that were shared were the most unique and important part of the meeting. Some expressed a need to incorporate more Traditional Ecological Knowledge into their work. One said the Tribal perspective was largely unknown to them and the hardest for them to wrap their head around, which is why it was important for them to be in the room. Another mentioned this perspective was unfamiliar to them even though working with Native Americans was a big part of their job. They were happy to be exposed to traditional songs, stories, food, and hospitality.

On the topic of who should be included in the continuing discussion, one acknowledged that everyone in the room cared about groundwater, but the challenge was communicating that to the average

person in an effective way to make them also care about the issues and help them understand their role in the solutions. Another was reminded that a lot of us engage in this academically and with distance. It is not our lifeways and lives that are threatened. They emphasized that we need to keep the end-users in mind when recruiting participants, like the impacted people and farmers. Most participants agreed that there needed to be more legislators, elected officials, industries, and community groups in the room.

When asked what data were needed moving forward, one participant shared that they appreciated the excellent small-group discussion on data needs. They said everything discussed at the workshop fell under their job title, and agreed that there need to be more data, but it should also be better organized and presented in a way that is accessible and helps people do their jobs. Several participants expressed this same concern, that more data is always a plus, but the main challenge is finding ways to consolidate it for people who need to understand and use it, like county conservationists. Another acknowledged that data are useful for regulatory work, but that a lot of the pieces and connections were in the room and work could start on a hyper-local level. Others agreed that top-down approaches may not be serving their purpose and that grassroots efforts would be the most desirable.

In the post-workshop survey, one participant shared it was a very good workshop and that they learned a lot about groundwater. They said the presenters were awesome, and the information provided was exceptional.

Groundwater Governance Issues and Strategies Discussed

Five groundwater governance issues selected by the workshop participants became the focus of this workshop. These issues were discussed using the series of exercises described in the preceding section. Following the workshop, the notes from each of the five group discussions were recorded into Miro, an online whiteboard, and analyzed and summarized by Freshwater staff. This section includes summaries from each of the five discussions: Data, communication & consultation, emerging externalities, legal structure, and ecosystem needs.

Data

Participants self-selected into the "Data" group which centered around two issues identified during the large group brainstorming session: knowledge base and source-water assessment. Data are generally defined as facts that can be analyzed to make decisions or to generate knowledge. Simply, data are assumed to be raw information, devoid of any interpretation. Knowledge base is usually used as an adjective to describe a "knowledge-base system" or a series of facts or ways of reasoning about those facts which are used to deduce new facts[1]. Source water assessments (SWAs) are used to generate information about potential contaminants and the potential for systems to be contaminated.

1 Hayes-Roth, F, Waterman, D, and Lenat, D, "Building expert systems," (1984)

The data group was made up of participants who work, manage, or conduct research in the field as or alongside hydrologists, geologists, and engineers. All the participants were comfortable with scientific jargon, and several members of the data group managed or oversaw projects that required complicated budgets, timelines and staffing.

During the 5 Whys exercise, the group tried to address the importance of "why data?" as it related to both "knowledge base" and "source-water protection."

- Data were needed for effective management
- Without data, decisions may be subjective and biased by opinions, politics, or money,
- Objective decision-making that is grounded in data still has to balance a variety of needs and perspectives,
- Competing interests need to buy in to the management decisions,
- Data build trust that it is a balanced solution or decision because people understand the resource.

The group was interested in data availability initially and highlighted how data may not be stored in accessible or consistent locations and emphasized the lack of a central warehouse and the impact that it had on accessing existing data. The group also discussed how there is not consistent data coordination, which leads to poor coordination between entities around what data have been collected, when they were collected, and when and how those data were stored.

Data availability impacted different stakeholders, including:

- Planners and resource managers as they developed economic plans for a region based on the water supply,
- Water consumers who plan to purchase homes in an area,
- Homeowners planning their activities for the season,
- Industry representatives who may be in talks with municipal representatives or state agencies before building a water-intensive plant in a community,
- Researchers who conduct studies in a wetland or area with certain geologic features.

The group discussed how lack of institutional knowledge, funding, and political objectives impacted the ability to obtain data. As people in the field retire, there are fewer people with the technical skills available to replace them, and fewer people available who possess an understanding of bureaucratic systems necessary to navigate complex jurisdictional issues. Water does not know boundaries, and funding is frequently restricted within political borders. Negotiating around those obstacles requires a specific set of skills, among those is the ability to interpret and present data, and the ability to build trust between different entities using data.

This workshop was held in Wisconsin with participants that came almost entirely from one state. Within Wisconsin, there is a single state agency to consult – the Department of Natural Resources. Tribal participants were almost entirely Ojibwe, almost entirely signatories of the Treaty of 1842, and almost entirely represented by GLIFWC. Within this group, several barriers, policy tools, and key strategies emerged during discussion.

The group worked to identify current policy tools that might help improve data availability for source-water assessments and the general knowledge base. This was complicated by the past and current restrictions by which state and federal agencies operate, and the specific restrictions placed upon state and federal employees. However, the group suggested existing knowledge, databases, and programs that might be utilized to improve data access and availability.

There are an abundance of groundwater studies and models, and a goal was to increase awareness and access to existing studies and models. The group suggested doing this through more outreach and technical assistance to county and municipalities as planners developed groundwater protection and management plans. Partnerships between organizations allowed for improved collaboration and data sharing, but the group had several questions which succinctly captured the identified barriers:

- How do people know [the data] exists?
- How can we keep [the data] updated?
- How can we use [the data] to answer emerging questions?

The participants also identified lack of technical knowledge and lack of institutional knowledge as the major barriers to data access and availability. Those barriers were compounded by limited staff time and limited funding. Funding was also deemed unlikely to increase without staff who could explain the need and also produce the results and who could navigate the bureaucracy.

The group attempted to address these questions and other barriers through their multi-regional strategies which included suggesting an inventory for studies and existing data, identifying existing data gaps, establishing a procedure for position changeover. One of the issues that was repeatedly mentioned in the larger group discussion was the lack of consultation with the Tribes.

The group also discussed the frustration experienced with attempting to reach someone only to discover their contact had retired, transferred, or quit and there was no way to get in touch with the new person in that position. A simple, but effective multi-regional strategy was updating contact lists, having procedures for how to update contacts when changing positions, and asking the Tribes for a contact list. A final strategy included using the Wisconsin Groundwater Coordinating Council, an existing state-level structure that lacked current coordination with federal agencies and the Tribes.

Communication & Consultation

This breakout group of six was tasked to "admire the problem" concerning the lack of good communication and Tribal consultation in combined efforts to sustainably manage groundwater. They began their exercise by coming up with the 5 why's of the issue, each time narrowing down the focus of the issue. They arrived at their conclusions which were as follows:

There is great complexity of the issue.

I. There is a lack of understanding and communication overall regarding groundwater.

II. Decisions are made based on how well the understanding of the issue is.

III. Trust building in Tribal/State relationships is needed for consultation to occur.

IV. Decisions are made based on limited understanding amidst broken relationships coupled with much inaction.

The group further dissected the issue by discussing the barriers and repercussions of limited understanding amidst broken relationships and inaction. Many ideas were brought forth, including the severe lack of financial resources available, different ideas of ownership of the resource, differing governance strategies and laws between jurisdictions, regularly changing political will and priorities, and perhaps ultimately, the greatest barrier to communication is the illusion that consultation has taken place, and that we have been operating as sustainably as possible in the first place.

The group looked at the repercussions if the issue is not fully addressed and resolved. They realized the importance of good strategies regarding sustainable drinking water management and how the lack thereof presents a bad situation for everyone involved. When operating in an isolationist and often hostile environment, distrust and resentment can occur. The division around what proper management should include stems from an escalation of problems in an already distrustful, "us vs. them" paradigm. Litigation is common and furthers the divide between what is currently done and what strategies could work. This results in pain for communities feeling the lack of proper management. In the worst-case scenario, this is how extinctions occur because life is dependent on daily access to clean water.

As the group spent time admiring these issues, everyone shared and contributed their thoughts and ideas freely with each other and were attentive to listening and understanding. They fully looked at the factors and identified some common barriers.

- Lack of awareness on the importance of Tribal consultation or of the issues of water quality and quantity by many citizens;
- lack of political will to make changes due mainly to the nature and red tape of politics and unknown assorted financial interests (Good old boy network);
- lack of financial resources to pay for help, organization, legal support, or implementation of improvements.

The group ended the day somewhat bewildered at the scope of negative issues surrounding improper groundwater management due to lack of coordination and communication, along with a lack of Tribal consultation. They looked forward to seeing solutions for these many diverse issues the following day

Day-2 discussions were lively and upbeat, focusing on solutions to the issues. They began with ways to better inform the public so there was more awareness of the importance of Tribal consultation and of the different water issues being faced in the region. There was a lot of conversation on ways to recruit more people to join the efforts of moving towards more sustainable and cooperative management of shared freshwater.

Ideas to grow a grassroots effort included sharing education better through community meetings like the one we were attending. When building a grassroots effort, it is hard to get the message out to everyone so there may even be a need to go door to door to broaden the reach of education to more people. It was brought up that people are more reactive than proactive, making messaging so important. Creating solid informational content to effectively outline key issues can create impetus for action.

Growing the number of volunteers in this effort is crucial and will help more people work together to create awareness and educate the public. Volunteers can have many different important skills to add. Appropriate and motivating messages would resonate with people and help bridge the gaps in awareness of local issues. Water is a subject that unites everyone due to our common ground and basic water needs.

Securing grant money is also crucial to grow efforts and recruiting movers and shakers would be a great benefit moving forward as well. Advertising and publicity are keys to creating better awareness. These advertisements take funds, making acquisition of grants even more important. Recruiting celebrities was seen as a good way to further outreach.

Tribal consultation is needed and will inform and spread the message to a broader base, strengthening awareness and support. For example, Minnesota codified the Government-to-Government Relationship With Tribal Governments into statute in 2021. It was mentioned that the Tribe needs to be involved more and earlier in a process, not after a plan had been developed. Relationship building begins even earlier. Efforts are needed to include all shareholders including Tribal, forestry, local government, state, and agencies like GLIFWC, 1854 Treaty Authority, WGNHS, as well as legal experts. It was suggested that up-to-date contact lists for the Tribes could help State agencies and other groups know who to contact.

There was additional conversation concerning the issue of cranberry bog flooding which needs to occur every spring for frost protection. The timing of the bog flooding negatively impacts fish spawning time by exposing the shallow beds along lakeshores when the lake is lowered. Further discussions will be needed regarding this issue between stakeholders. Half the world's supply of cranberries comes from Wisconsin. The high-capacity wells used for this type of farming are grandfathered in, meaning they are not subject to the same permitting requirements as other irrigators.

There are many ways to improve the overall picture of consultation and communication, and further discussion is needed. Awareness increased because of this meeting and at the very least, this roomful of participants has more information to move forward in a better way.

Emerging Externalities

Throughout the two-day workshop, participants reacted to the presentations with many questions about how PFAS contamination, population growth and development, and climate change would impact the carrying capacity of the system and ultimately the lifeways of living beings (human and non-human). This shared concern led to the formation of the "emerging externalities" breakout group. They were concerned with how these emerging externalities would stress the resources, upset the balance of ecology and chemistry of the water, and disturb the timing of natural patterns in the system.

The emerging externalities group was made up of lawyers, Tribal water professionals, and local county conservationists, all with unique perspectives on how this issue is impacting their communities and their work in protecting water sustainability in the region. Given the breadth of this topic, participants were quickly overcome with the daunting task of trying to brainstorm causes of natural patterns disturbed by climate change. They explored things like capitalism and fossil fuel emissions, but realized the list was endless. As they moved into the impacts that this issue has on the local region, the discussion narrowed. Some argued that these externalities impacted the vulnerability of seepage lakes fed by groundwater. Some advocated for impacted lifeways including the supply of potable drinking water, while others noted the decreasing snow cover and its impact on winter-based tourism and small-business revenue.

They shared a local example of this issue in which some wells in Rhinelander, Wisconsin are contaminated with PFAS. As a result, the city is required to use more expensive treatment technology and investigate the extent and sources of the contamination. A potential source was a local paper-mill's landspreading practices. While the workshop was intended to focus on water-supply challenges,

not water-quality, the group maintained that PFAS directly impacts supply due to the challenging undertaking of remediating it once it has entered the water. This was reinforced throughout the workshop, as participants inquired about the impacts of PFAS contamination on the safe consumption of drinking water, and potential impacts to maple syrup, and local wildlife. They also expressed concerns about the lack of regulations that exist to protect groundwater from untested and potentially contaminated biosolids that were being landspread as a disposal solution. The increase in land spreading biosolids is a direct result of population growth in this unsewered area.

The group brainstormed policy tools that could be implemented at a local and multi-regional level to tackle these issues. Some suggestions included better land-use planning, testing of biosolids before spreading, establishing water-quality standards for PFAS, working with airports to co-design best management practices (BMPs), and implementing zoning ordinances to restrict land spreading in areas of groundwater recharge. For example, starting in September 2025, all wastewater treatment facilities in Minnesota that land apply biosolids will be required to collect and analyze a representative sample of biosolids that are intended to be applied (MPCA, 2024). Some significant barriers were also discussed that would make these policy tools challenging to implement. These barriers included the immense costs of remediation, the limited staff available to monitor and enforce rules, the lack of consumer protection (or consumer awareness of which products contain PFAS), and the level of knowledge federal and state policy makers have about these issues.

Legal Structure

During this breakout session, participants discussed concerns regarding the lack of guiding value structures within the government when it comes to groundwater governance and regulation. The group discussed the issues associated with government structures in different regions not having a single enforceable goal. Different government entities are moving in different directions due to varying foci, needs, capacities, and available funding. This results in a variety of outcomes and a lack of cohesive frameworks and structures. One example where legal structures do not respect existing environmental conditions is cranberry growing. There are a number of cranberry operations in the area but cranberry growers are exempt from Clean Water Act regulations through the irrigation return flow exemption. This means that cranberry growers' discharges to surface water are unregulated, posing a significant threat to groundwater in locations where surface water recharges the groundwater aquifer. The group discussed a number of key questions including what impacts the legal scheme for groundwater and what does that legal scheme impact? The bulk of the time in the breakout was spent discussing why these different government agencies are operating in such disparate ways and seemingly in different directions.

The legal workshop breakout group was made up of a number of attorneys and representatives of state and federal agencies, tribal agencies, and non-governmental organizations. On the first day of the workshop the focus of the discussion centered around identifying WHY's that attempted to explain the inconsistencies between governments. The conversation explored various agencies that have a role in groundwater governance or regulation, and their mandates and goals. A few different agencies are collecting data, but those data may not always be accessible or known to local governments, posing a challenge for groundwater managers to plan There seems to be a significant gap when it comes to the purposes of different agencies and how that translates into creating legal and regulatory mandates for groundwater governance. There is also a challenge because laws tend to be narrow, and goals, broad. Different agencies have different guiding regulations and missions which makes it

difficult to determine what exactly can and needs to occur in order for the right changes to be enacted. Judiciaries can appear hostile, and legislatures are vitally important for effecting change, but they are sometimes seen by outside entities as not functioning well. At times, there can be a reluctance to advocate for change in the face of these barriers. In addition, political interests are often concentrated on specific matters and shifting that focus to an issue like groundwater can be challenging, especially when messaging from different agencies conflicts. There needs to be an incentive for employees of state agencies to take risks, but this is undermined by a lack of cohesion and faith in the government as a whole. Even so, some members of the group mentioned that communication is incredibly siloed and navigating that problem is an issue in and of itself. The group also discussed the fact that there can be competition internally within agencies for resources and attention, making it difficult to have specific issues addressed. These kinds of problems are detrimental for the process as agencies tend to fall into inaction as a result.

In terms of solutions, the group discussed prioritizing immediate mandates that will have a significant impact on groundwater issues. There also needs to be a focus on building relationships within and between agencies. These relationships need to and can be built even on the local scale. For example, as discussed by John Nooman, the city of Eau Claire was able to improve its groundwater management through increased local communication. These efforts could include starting new or building on existing Tribal-State Memoranda of Understanding or other types of agreements. For example, this workshop provided an opportunity for a Vilas County employee tasked with land-use planning, to meet representatives of the Lac Du Flambeau Tribe. Unfortunately, although this individual had reached out to someone at Lac Du Flambeau for feedback on their land- use-planning effort, that employee was no longer with the Tribe, so the outreach failed. Workshops like this one provided additional contacts between the Tribe and the County and facilitated the opportunity to begin or restart intergovernmental coordination. On a larger scale, increased focus is needed to determine where resources are actually needed versus what needs are being identified based on the political climate. One suggestion was to develop a new tool that would establish a regional water quality clearinghouse system (as a type of watershed planning for groundwater at a regional scale) and use it to then coordinate, manage complexity, and share data for agency and government efforts.

Ecosystem Needs

During the opening presentation, Mike Wiggins Jr. introduced the importance of ecosystem needs by saying, “we are so cocky to think we are in control of nature. We are at the bottom of this pyramid. Pitifulness and humility are necessary.” As he shared the different lenses in which to view the world, he said, “the first lens is functionality. Mother Earth is all sacred.” As the workshop continued, many concerns were expressed regarding how ecosystems are being threatened by groundwater manipulation and management, and the timing of groundwater withdrawals. This impetus formed the group, “ecosystem needs.”

The group was made up of a geologist, Tribal water technician, hydrologist, and groundwater modeler. Each participant shared a concern for the many lifeways that depend on water, all maintaining a different perspective on how groundwater management impacted these lifeways. As they dove into the 5 whys exercise, they discussed they want and need many ecosystem services, some being known and others being unknown. We want to increase these services, which leads to health and longevity for all. With earth in balance, human and non-human populations and communities thrive, which is important motivation for upholding the rights of nature.

When asked to describe the elements impacting ecosystem needs, they explored topics like industry, pumping, and climate change. Some questioned the impact of who places value on what service, how land conversion is governed, how different water users may have conflicts, and how ditching and draining is managed. Others talked about point and non-point source pollution, road salt, and the lack of awareness of impacts of personal choices on water (diet, daily habits, use of chemicals, consumerism).

When asked to describe the elements that ecosystem needs impact, they discussed things like biodiversity decline, impact to aquatic organism communities, invasive species invasion increase, warming stream temps because of loss of groundwater inputs, and impacts to all life. Others talked about drinking-water-supply availability, recreation opportunities, and water stress in the ecosystem.

They shared three local examples of this issue.

I. Land spreading of septage, potentially hosting PFAS and human pharmaceuticals, impacting water quality and leading to a degraded groundwater ecosystem and wildlife impact;

II. Dewatering for mining and the potential impact to the water table and connected surface waters;

III. Increased development pressures on limited groundwater, especially where connected to seepage lakes and wetlands.

The group then brainstormed local and multi-regional policy tools to tackle these issues. Some suggested science-driven policy and actions, tapping into the delegable Safe Drinking Water Act, and establishing a Tribal-led LLC to purchase lands. For multi-regional tools, a suggestion was made to establish a regional groundwater collaborative based on natural boundaries. Another mentioned that because there is no regulatory framework about groundwater quantity, it does not sit in anyone's house. This was perceived as a positive because it requires multi-regional collaboration, possibly through workshop-based collaboratives like this one, and more grassroots project-driven work. Another mentioned that groundwater needs to be designated as "treaty reserved" or "Waters of the United States", and that aquifers providing the sole source of drinking water to a community could be Federally designated as such by the EPA.

As for barriers, the group brainstormed many barriers to implementing these policy tools. This included the lack of a federal structure for managing groundwater quantity, and the lack of clarity around who the regulator is within private lands on reservation boundaries. Another mentioned that some activities are grandfathered in, even with changing circumstances, like cranberry growers' withdrawal limits. With regards to research, the research timeline can be long, and funding limited.

Overall, the group had many suggestions for how ecosystem needs could be protected through better groundwater governance. While these strategies do have significant barriers, it was thought that better collaboration would lead to more grassroots momentum around these topics of concern.

Participant List

Workshop Participants

Aaron Pruitt (presenter)

Andrew Aslesen

Andrew Gorniak

Ann McCammon Soltis

Bill Davis

Cara Faillace

Caren Ackley

Carolyn Scholl

Catherine Christenson

Darryl Landreau

Dawn White

Dee Allen

Elizabeth Cisar

J. Elmo Rawling III (presenter)

Jen Vanator

Joe Graveen

John Coleman

Justin Woodruff

Martha Neilsen (presenter)

Maureen Muldoon

Meg Haserodt (presenter)

Megan Luick

Michele Sadauskas

Mike Wiggins Jr (presenter)

Nathan Podany

Pamela Holz

Sam Carter

Steve Elmore

Tim Paul

Trent Wickman

Lac du Flambeau hosts:

Kristen Hanson

Dee Allen

John Johnson Sr.

Lake of the Torches Casino Host

Jennifer Wilcox

Freshwater

Carrie Jennings (presenter)

John Roterman (presenter)

Rosie Russell (facilitator)

Alyssa Fabia

Quinn Soltis

Water 365

John Noonan (presenter)

Apendix

Workshop Itinerary and Agenda

Workshop Topic	Groundwater Governance in the North Central WI Region
Date	Tuesday, October 22, 8am-4pm to Wednesday, October 23, 8am-4pm
Location	Lake of the Torches Convention Center, Lac du Flambeau, WI

We are looking forward to you joining us at this 2-day workshop. Below you will find some details to make your trip go more smoothly. Please contact Rosie Russell at rrussell@freshwater.org or (652) 571-2696, or Alyssa Fabia at afabia@freshwater.org or (703) 969-9020 with questions.

Arriving at the Hotel

- Hotel: Lake of the Torches Convention Center – 510 Old Abe Rd, Lac du Flambeau, WI 54538-9680
- Free parking is available in their lot.
- Check-in is after 4pm. Check-out time is at 11am. Please make arrangements if you need the hotel to hold your luggage on day 2.

Arriving Locally at Lake of the Torches Convention Center

- Please arrive between 7:45am and 8:00am.
- The meeting will be held in the Sokaogon Room at Lake of the Torches Convention Center at 510 Old Abe Rd, Lac du Flambeau, WI 54538-9680
- There is free parking available in the casino parking lot.
    - To get there from Rhinelander, travel north on WI-47 N. The drive will take approximately 45 minutes.
    - To get there from Crandon, travel west on US-8 W. At the traffic circle, at the 2nd exit onto WI-47 N. The drive will take approximately 1 hour, 15 minutes. Alternate routes are also available.

What to Expect for the Workshop

- Please dress comfortably. We will mostly be sitting but moving through the room occasionally.

- A full breakfast, coffee, and water will be served both days.
- Day 1 will begin with a welcome from Dee Allen, Lac du Flambeau Tribal Administrator and a grounding in the cultural history of water by Mike Wiggins, Jr., Madeline Island Museum Director. This will be followed by 2 hours of getting to know one another. The rest of the agenda for days 1 and 2 is focused on presentations, problem-solving exercises, and plenty of respectful sharing and listening.
- Data Sovereignty norms and expectations will be presented during the workshop kickoff. The meeting will not be live streamed or recorded. Participants are welcome to ask for any notes to be stricken from the record. If participants have specific questions, please let the facilitation team know.
- The agenda and menu can be found on the following pages.
- Optional evening activities for October 22nd will be shared during the workshop.

Workshop Description

This participatory workshop is about groundwater quantity and its shared, sustainable governance in the North Central Wisconsin region. The purpose of this workshop is to better understand the existing challenges, needs, and strategies for sustaining the groundwater of the region and the communities it supports. This is one of three aquifer-action cluster workshops organized by Freshwater Society to elevate local groundwater concerns with decision makers.

This workshop follows previous project work in EPA Region 5 that included the Groundwater Governance in EPA Region 5 Report, a GLIFWC-supported survey, interviews with tribal environmental staff from 25 of the 35 tribes, and a pilot groundwater workshop. Spanning the 1842 Treaty Territory and ceded lands, this workshop focuses on the shared geologic groundwater features across the five counties of Vilas, Oneida, Taylor, Price and Lincoln. These shared geologic features are governed by layers of institutions, organizations, and individuals that own and manage the land above it, and currently, different communities assign their own values and priorities to their management policies which may or may not align with others enjoying its many benefits.

Who is Attending and What Will We Be Doing?

A multi-jurisdictional group of professionals have been invited to attend and provide their specific regional knowledge and technical expertise on the state of groundwater quantity, regulatory needs, and potential solutions. There will be technical presentations from experts about the geology of the groundwater, the political structure by which groundwater is managed, and the tools used to pull data and knowledge together to inform decisions about who gets to use it, when they get to use it, and how they get to use it.

Throughout these presentations, there will be a focused discussion about participant-driven topic areas that highlights a regional groundwater issue.

Outcomes

The outcomes from this meeting will be compiled into a larger report about the unique challenges and opportunities for managing groundwater within the North Central Wisconsin region, and throughout the Great Lakes region. The outcomes and summary from this workshop will be shared with all who participate for feedback before being incorporated into the final report. This will be the first of many steps that will ultimately shape the foundation and future of groundwater sustainability and governance in the Great Lakes region.

The four questions that will guide this two-day workshop include:

- What concerns are you working on within the North Central Wisconsin region?
- What current groundwater stressors are you hoping to address in a better way?
- Do you have any input on sustainable governance practices moving forward that could be implemented multi-regionally?
- What other experts do you think should be a part of this process, and part of the continuing conversation?

Workshop Agenda

Day 1 – October 22, 2024 – 8am to 4pm

8:00	Welcome and breakfast	Welcome from Dee Allen, Lac du Flambeau tribal administrator and President John Johnson Sr. followed by a Drum Song. Continental breakfast catered by Lake of the Torches Casino will be available (Coffee and water served all day)
8:30	Opening	Mike Wiggins Jr., Bad River on the cultural history of groundwater
9:15	Introduction to participants	All participants will have the opportunity to share their name, region they come from, and a story or observation about water.
11:15	15-minute break	
11:30	Introduction to the workshop	A brief introduction by the facilitator, Rosie Russell, and a summary of the Groundwater Governance project from Dr. Carrie Jennings (Freshwater).
12:00	Lunch (catered)	Menu includes Indian Tacos catered by Lake of the Torches Casino. Details can be found on the final page of this document.
13:00	Project background, geologic history, and groundwater policy presentations	This series of presentations will include a brief history and geology of North Central Wisconsin (Lincoln, Price, Taylor, Oneida, and Vilas counties) by Elmo J. Rawling III (Wisconsin Natural History Geologic Survey), a summary of groundwater policy in the region and throughout the United States from John Noonan, Water 365 (legal team), and a presentation about the Rights of Nature by John Roterman, Freshwater.
14:00	Groundwater Governance issues in North Central Wisconsin region	Participants to brainstorm on groundwater issues in the region and break out into groups.
14:30	Discussion Groups	Refine groundwater issues and scenarios in community discussions and a series of systems thinking exercises.
16:00	Adjourn workshop for the day	Option to gather informally later in the evening for food and further conversation.

Day 2 – October 23, 2024 – 8am to 4:00pm

8:00	Welcome and breakfast	Continental breakfast catered by Lake of the Torches Casino will be available (Coffee and water served all day)
8:30	Large-group discussion	What's top of mind for you? What questions remain?
9:15	Permitting high-capacity water users in Wisconsin	Aaron Pruitt, Wisconsin DNR: High capacity well permitting process

9:45	Policy tools being implemented by local jurisdictions to protect groundwater	John Noonan, Water 365: Examples of policies and policy tools used to address a groundwater issue within an impacted community.
10:00	Discussion Groups	Return to a groundwater issue of your choice What groundwater stressors are you hoping to address within your own communities? What barriers might you face? Are there any tools that have worked?
11:00	Groundwater modeling and monitoring in Wisconsin, USGS	Martha Neilsen, USGS: Compilation of Groundwater Data in the Lake Superior Basin Meg Haserodt, USGS: Wisconsin Groundwater Monitoring Network
12:00	Lunch (catered)	Lunch buffet (sandwiches) catered by Lake of the Torches Casino
13:00	Presentation about policy tools being implemented regionally and multi-regionally.	John Noonan, Water 365 This presentation will include a summary of various examples of collaborative groundwater governance tools being implemented multi-regionally to maintain or conserve a valued community asset.
13:15	Discussion Groups	Return to a groundwater issue of your choice What sustainable governance practices could be implemented across jurisdictions? What barriers might we face? Are there any tools that have worked?
14:30	Debrief	What are your reactions? What data do you think is needed to move forward? What other experts do you think should be at the table/part of this process and continuing conversation?
16:00	Adjourn the workshop	

Appendix C

Transboundary Groundwater Governance Case Studies

International legal frameworks for groundwater governance offer important insights into how transboundary groundwater resources can be managed through cooperation, equitable use, and environmental protection. While these frameworks were primarily designed for international cooperation, they hold valuable lessons for managing shared water resources even within the United States, particularly in EPA Region 5, where multiple states may share critical aquifers and face similar challenges. For instance, states like Michigan and Ohio share groundwater resources that cross state lines, and international agreements provide valuable guidelines on cooperation, data-sharing, and the sustainable use of groundwater. Although the U.S. has its own legal frameworks governing water resources, such as the Clean Water Act and Safe Drinking Water Act, principles like equitable utilization and prevention of harm can inform policies in Region 5 to address issues such as over-extraction and contamination. Thus, while EPA Region 5 does not face international water governance in the traditional sense, residents can still draw on global principles to better manage its shared groundwater resources.

The Franco-Swiss Genevese Aquifer System

The Franco-Swiss Genevese Aquifer, shared by France and Switzerland, is a critical transboundary groundwater resource providing drinking water. The Swiss side operates ten wells, while the French side uses four. In the 1960s and 1970s, over pumping led to a depletion of groundwater levels by more than 7 meters, with storage dropping by about one-third. To address this, artificial recharge from a nearby river was implemented successfully (de los Cobos 2018).

Franco-Swiss Genevese Aquifer Agreement

In 1978, the Franco-Swiss Genevese Aquifer Agreement formalized groundwater management efforts. The agreement's objectives were to protect the shared aquifer and ensure its sustainable recharge.

Key Elements of the Agreement

- Bilateral Exploitation Committee
    - Composed of representatives from both countries' water authorities and water companies (SIG and SEA), it managed operational decisions, water abstraction limits, and monitoring.
- Joint Technical Committee
    - Focused on data sharing, artificial recharge, and ongoing collaboration between the two countries.
- The agreement was renewed in 2007, introducing provisions for dispute resolution under Swiss law and reinforcing water quality assessments aligned with European directives.

Keys to Success

Several factors contributed to the success of the agreement:

- Legal Framework and Institutional Structure
    - A solid legal foundation provides a governance structure, ensuring accountability.
- Monitoring and Data Sharing
    - Regular monitoring and data transparency strengthened cooperation between parties.
- Adaptive Management
    - The agreement allowed for flexible adjustments in water extraction limits.
- Local Engagement
    - Direct involvement of local authorities fostered a sense of responsibility and efficiency.
- Focus on Shared Resource Knowledge
    - An understanding of the aquifer's hydrogeology supported the successful implementation of artificial recharge systems.

The Guarani Aquifer System

The Guarani Aquifer System (GAS) spans Brazil, Argentina, Paraguay, and Uruguay, making it one of the largest transboundary groundwater reserves. Covering an area equivalent to the combined size of Texas and California, it is primarily recharged by rainfall, especially in higher-elevation regions (Foster et al. 2009).

Precursor to the Agreement: The Guarani Aquifer Project

Before formalizing the agreement, the Guarani Aquifer Project facilitated scientific research and stakeholder engagement. It identified seven core components for effective governance:

- Expanding scientific knowledge
- Developing a shared management framework
- Promoting environmental education
- Implementing monitoring and evaluation
- Exploring geothermal energy potential

The project's success in localized studies and fostering informal cooperation networks provided a strong foundation for the Guarani Aquifer System Agreement (GASA).

The Guarani Aquifer System Agreement (GASA)

Adopted in 2010 and ratified in 2018, GASA created a cooperative framework for managing and conserving the aquifer, balancing national sovereignty with shared responsibility. Key provisions

include:

- National Sovereignty and Shared Responsibility
    - Countries retain sovereign rights over their portion of the aquifer but must prevent harm to neighboring nations.
- Equitable Use
    - Water extraction must be equitable and reasonable, although specific guidelines remain flexible.
- Transparency and Information Sharing
    - States are required to share information and conduct environmental impact assessments for projects with potential transboundary consequences.
- Dispute Resolution
    - A Joint Commission oversees the agreement's implementation, with dispute resolution mechanisms including negotiation and mediation.

Keys to Success

- Scientific Foundation
    - Reliable data from the Guarani Aquifer Project strengthened the case for cooperation.
- Public Participation
    - Local communication strategies ensured the viability of the governance framework.
- Institutional Networks
    - The informal cooperation networks played a crucial role in resolving technical and operational challenges.
- Continuous Support
    - Financial and technical backing, particularly from organizations like the World Bank, helped sustain momentum.

The Nubian Sandstone Aquifer System

The Nubian Sandstone Aquifer System (NSAS) is one of the world's largest groundwater reserves, covering approximately 2 million square kilometers across Libya, Egypt, Chad, and Sudan. It is primarily recharged in the southwestern region and serves as a crucial water source in this arid region, where surface water is scarce. In response to the need for coordinated governance, the four countries established the Joint Authority for the Study and Development of the Nubian Sandstone Aquifer in 1992, with Sudan joining in 1996 and Chad in 1999 (International Water Law Project Blogspot 2013).

Joint Authority Governance Structure

The governance framework for NSAS is centered on the Joint Authority, which is headquartered in Tripoli, Libya. The main components of the governance structure include:

- Board of Directors
    - Comprising three representatives from each member state, appointed by the relevant ministries. The board oversees aquifer management.
- Administrative Secretariat
    - Includes legal, technical, and policy staff to assist in operations.
- Regional Project Steering Committee
    - Approves work plans and budgets, evaluates recommendations from the Regional Technical Review Committee.
- Nubian Project
    - Works to develop a rational and equitable management system that balances socio-economic development with environmental protection.

Key Objectives and Goals

The NSAS governance framework aims to:

I. Identify Priority Threats
    A. Focus on key transboundary threats and their root causes.

II. Improve Data and Methodologies
    A. Fill critical data gaps, especially using isotope techniques under the International Atomic Energy Agency (IAEA).

III. Develop a Strategic Action Program (SAP)
    A. Guide future cooperation and sustainable management efforts.

IV. Establish Long-Term Institutional Framework
    A. Create lasting structures for the implementation of the SAP.

Joint Authority Agreement

The Joint Authority Agreement includes several provisions to ensure effective governance:

- **Article 3**: Outlines key responsibilities, including data collection, water quality and quantity assessments, and public information dissemination.
- **Article 8**: Defines decision-making procedures, requiring a majority vote for most decisions, with a two-thirds majority for critical matters such as budget approval and international cooperation

proposals.

- **Dispute Resolution**: While no explicit dispute resolution mechanism is provided, the agreement encourages negotiation and cooperation to resolve conflicts.

Significant Achievements

One of the most significant achievements has been the Nubian Aquifer Regional Information System (NARIS). This system stores, analyzes, and displays critical aquifer data, facilitating informed management decisions. Member states share annual data on water extractions, water levels, and electrical conductivity, formalized in the 2000 Agreements on Monitoring and Data Sharing, which enhanced transparency and cooperation.

Key Lessons

Several lessons can be drawn from the governance of NSAS:

- Strong Administrative Structure
    - A well-defined governance body with authority and clear responsibilities is essential for effective management.
- Data Sharing and Transparency
    - A dedicated information center like NARIS strengthens cooperation and enhances scientific understanding of the aquifer.
- Equitable Apportionment System
    - A fair system that accounts for geographic, political, and economic factors ensures equitable and sustainable water use.

Stampriet Transboundary Aquifer System

The Stampriet Transboundary Aquifer System (STAS) is a vital groundwater resource shared by Botswana, Namibia, and South Africa, situated in the arid Kalahari Basin. This aquifer is essential for local communities, livestock, and agriculture, providing the only permanent and dependable water source in the region. It spans approximately 87,000 square kilometers, covering central Namibia, western Botswana, and South Africa's Northern Cape Province (UNESCO 2016).

Governance Framework

In 2017, the three countries agreed to establish a Multi-Country Cooperation Mechanism under the Orange-Senqu River Commission (ORASECOM). This initiative aims to integrate the management of surface water and groundwater resources, emphasizing data harmonization, transparency, equitable and reasonable use, and the prevention of significant harm to other states.

Key Initiatives

- Internationally Shared Aquifer Resources Management (ISARM):
    - This initiative supports the STAS by promoting the sustainable management of shared aquifer resources.
- Governance of Groundwater Resources in Transboundary Aquifers (GGRETA):
    - The GGRETA project plays a pivotal role in advancing the shared hydrogeological assessment of the aquifer and improving scientific understanding of its characteristics.
    - It has facilitated the development of a harmonized monitoring framework for groundwater levels, quality, and use across the three countries.
    - Additionally, capacity-building workshops for technical experts and policymakers have enhanced institutional capabilities, fostering collaboration through data sharing and dialogue among stakeholders from Botswana, Namibia, and South Africa

Assessment and Data Harmonization

A comprehensive assessment of the STAS was undertaken using a multidisciplinary methodology developed by the UNESCO International Hydrological Programme (IHP) and the International Groundwater Resources Centre (IGRAC). This approach involved the collection and processing of national data—hydrogeological, socio-economic, environmental, legal, and institutional—and the harmonization of data across all three countries to enable a joint assessment of the transboundary resource.

Challenges and Future Outlook

While significant progress has been made in establishing a cooperative framework and enhancing data sharing, the long-term success of the STAS governance initiative depends on sustained commitment from all parties. Ongoing efforts are necessary to address emerging challenges, such as climate variability, population growth, and the need for sustainable water management practices. The foundation for cooperation has been established, and there has been an increase in collaboration, particularly in data sharing and decision-making processes among the countries involved.

North-Western Sahara Aquifer System

The North-Western Sahara Aquifer System (NWSAS) is a significant transboundary groundwater resource shared by Algeria, Libya, and Tunisia, covering over 1,000,000 square kilometers. It comprises two main aquifers: the Intercalary Continental and the Terminal Complex. These aquifers are crucial for agriculture, domestic use, and livelihoods in the region (United Nations Economic Commission for Europe 2020).

Governance Framework

In 2002, the Permanent Consultation Mechanism (PCM) was established under the Observatoire du Sahara et du Sahel (OSS) to manage the NWSAS jointly. The PCM's responsibilities include:

- Managing the hydrogeological database and simulation model.
- Developing and overseeing a reference observation network.
- Processing, analyzing, and validating data related to the aquifer.
- Creating databases on socio-economic activities related to water use.
- Developing public indicators on the resource and its uses.
- Promoting joint studies and research.
- Implementing training programs.
- Regularly updating the aquifer model.
- Formulating proposals for the evolution of the Consultation Mechanism.

These efforts have led to increased cooperation among the three countries, establishment of a shared monitoring system, and development of sustainable water management policies, helping to reduce overexploitation of the aquifer.

Key Objectives

The governance framework for NWSAS aims to:

- Prevent harm to other states.
- Ensure sustainable use of the aquifer.
- Encourage collaborative management.

These objectives are guided by the principles outlined in the SDAC Protocols, which offer a legal framework emphasizing the equitable use and protection of shared water resources.

Recent Developments

In 2023, the three countries agreed to establish a consultation mechanism in Algiers to manage the shared groundwater resources of the NWSAS. This agreement outlines the creation of a consultation body to oversee the sustainable use and protection of the aquifer.

Challenges and Future Directions

Despite these collaborative efforts, the NWSAS faces challenges such as overexploitation, water scarcity, and the impacts of climate change. Ongoing cooperation and the implementation of sustainable management practices are essential to address these challenges and ensure the long-term viability of the aquifer system.

Al-Sag/Al-Disi Aquifer System

The Al-Sag/Al-Disi Aquifer System is shared by Jordan and Saudi Arabia, with both nations beginning significant groundwater extraction in the 1970s and 1980s, shortly after the aquifer's discovery. Initially, Saudi Arabia increased its extractions substantially to support wheat production, causing a reversal of flow from Jordan to the Saudi well fields. By 2008, withdrawals from the aquifer were estimated to exceed 1,000 million cubic meters (MCM). To address the shared use and sustainability of this important resource, the two countries signed a formal agreement in 2015 to manage the aquifer cooperatively (Inventory of Shared Water Resources in Western Asia 2013).

Governance Framework

The governance framework is outlined in the Al-Sag/Al-Disi Aquifer Agreement, which consists of four main articles:

- **Article One** defines key terms and concepts related to aquifer management.
- **Article Two** establishes management norms, including the creation of a "Protected Area" of approximately 400 square kilometers on each side of the border, where all groundwater extraction activities must cease within five years.
    - It also defines a broader "Management Area" of 1,000 square kilometers in each country, where extractions are only allowed for municipal purposes, and groundwater pollution is heavily restricted.
- **Article Three** outlines the formation of a Joint Saudi/Jordanian Technical Committee (JTC), which will monitor extraction quantity and quality, collect and exchange information, and submit findings to the authorities of both nations.
- **Article Four** addresses administrative provisions for implementing the agreement, ensuring proper execution and compliance.

The JTC plays a central role in overseeing the agreement's implementation, though it does not have decision-making authority.

Successes

- Formalized Cooperation
    - The 2015 agreement marks a significant step in formalizing cooperation between Jordan and Saudi Arabia for the joint management of the aquifer, particularly after decades of uncoordinated extraction.
- Protected Area
    - The establishment of a Protected Area ensures a buffer zone between the well fields of the two countries, preventing further depletion and contamination of the shared resource.
    - This demonstrates a collaborative effort to protect the aquifer from over-extraction and pollution.
- Joint Monitoring

    - The creation of the Joint Technical Committee enables effective data sharing, monitoring of extraction rates, and quality control for both countries, promoting transparency and evidence-based decision-making.

- Data Sharing
    - A critical success of the governance framework has been the commitment to data sharing between Jordan and Saudi Arabia.
    - The Joint Technical Committee is tasked with the exchange of data related to groundwater levels, quality, and extractions, which enhances transparency and facilitates better management of the resource.
    - However, the effectiveness of data sharing depends on the capacity and willingness of both countries to continuously update and analyze the information.

Challenges

- Enforcement of Management Areas
    - While the agreement establishes management norms, there are no clear numerical limits on extractions, leaving some uncertainty about long-term sustainability.
    - The Protected Area and Management Area stipulations, while important, might be challenging to enforce over the long term without strict monitoring and compliance mechanisms.
- Dispute Resolution
    - Although the agreement establishes cooperative norms, it lacks a formal dispute resolution mechanism.
    - This could be problematic if tensions arise over extraction limits or water quality concerns, particularly since both countries rely heavily on the aquifer for water supply.
- Technical and Financial Constraints
    - Implementing the monitoring framework and the broader provisions of the agreement may face challenges related to technical capacity and financial resources, especially as both countries work to develop their monitoring systems and data collection infrastructure.

Future Outlook

While the 2015 agreement laid a solid foundation for the sustainable management of the Al-Sag/Al-Disi Aquifer, the long-term success of the agreement will depend on:

- Strict enforcement of management norms, especially regarding the Protected Area and Management Area.
- Sustained collaboration and data sharing through the Joint Technical Committee to avoid over-extraction and contamination of the aquifer.
- Addressing the technical and financial challenges involved in maintaining monitoring systems and ensuring that both countries have the resources and capacity to adhere to the management plan.

Given the increasing water scarcity in the region, the agreement is a positive step toward more collaborative, sustainable water management practices. However, it will require continuous adaptation and cooperation to meet future challenges.

Mexico-United States Aquifer Systems

The Mexico-United States Transboundary Aquifer Systems consist of several groundwater systems that span the shared border between the two countries. These aquifers are crucial water resources for both nations, particularly in arid regions where surface water is limited. Given their transboundary nature, these aquifers face complex governance challenges, including ensuring equitable water distribution, managing water quality, and addressing cross-border environmental impacts.

The management of these shared aquifers has been facilitated through various agreements and collaborative frameworks, most notably the International Boundary and Water Commission (IBWC), established in 1889. Over time, the IBWC has expanded its scope to include groundwater governance, leading to the establishment of joint programs such as the Transboundary Aquifer Assessment Program (TAAP). This initiative focuses on research and data sharing between U.S. and Mexican agencies, with the goal of improving water management and addressing sustainability concerns for these vital water resources. The collaboration between the two countries serves as a model for addressing shared groundwater challenges in other transboundary regions (University of Arizona, Water Resources Research Center 2009).

Governance Framework

The governance of the Mexico-United States transboundary aquifer systems is primarily managed through the International Boundary and Water Commission (IBWC), established in 1889. The IBWC oversees the application of boundary and water treaties between the two nations and addresses disputes arising from their implementation.

In 2006, the U.S.-Mexico Transboundary Aquifer Assessment Act was enacted, authorizing the U.S. Geological Survey (USGS) to collaborate with Mexican agencies, including the National Water Commission (CONAGUA), universities, and local water management authorities. This collaboration focuses on joint research, data collection, and analysis of shared aquifers.

A significant milestone in this collaboration was the signing of the "Joint Report of the Principal Engineers Regarding the Joint Cooperative Process United States-Mexico for the Transboundary Aquifer Assessment Program" on August 19, 2009. This agreement established the framework for joint studies of shared aquifers, emphasizing mutual benefits, respect for each country's legal frameworks, and the non-restrictive nature of the agreement on independent actions within each country's territory.

Successes

The Transboundary Aquifer Assessment Program (TAAP) has been instrumental in enhancing the scientific understanding of shared aquifers. Notable achievements include:

- Binational Studies
    - Conducting comprehensive studies of transboundary aquifers, such as the San Pedro Aquifer, which have provided valuable data on groundwater availability and quality.

- Data Sharing
    - Facilitating the exchange of groundwater data between the U.S. and Mexico, leading to improved water management practices and policy development.
- Capacity Building
    - Organizing workshops and training sessions for technical experts and policymakers, thereby strengthening institutional capabilities in both countries.

Challenges

Despite these successes, several challenges persist:

- Data Gaps
    - There are still significant gaps in data regarding the extent and functioning of shared aquifers, which complicates effective management.
- Legal and Jurisdictional Issues
    - Differences in legal frameworks and water rights between the two countries can hinder collaborative efforts.
- Resource Allocation
    - Balancing the equitable distribution of water resources between the nations remains a complex issue, especially in times of drought or water scarcity.

Lessons Learned

The experience of the Mexico-United States transboundary aquifer systems offers several lessons for effective groundwater governance:

- Bilateral Cooperation
    - Establishing formal agreements and joint committees can facilitate collaborative research and data sharing.
- Scientific Collaboration
    - Joint scientific studies enhance mutual understanding and inform policy decisions.
- Flexibility and Adaptability
    - Agreements should be adaptable to changing circumstances, such as shifts in water availability or climate conditions.

Appendix D

Michindoh Aquifer Workshop Summary

Author: Freshwater

Introduction

In early May of 2024, a group of thirteen people including Indigenous leaders, community advocates, and scientists gathered at the North American Indian Association of Detroit (Figure 1) for a two-day workshop facilitated by Freshwater. The purpose of this workshop was to identify regional issues, current practices, and sustainable groundwater governance strategies for the Michindoh aquifer, a groundwater feature spanning the ancestral homelands of the Potowatomi and other Anishinaabe nations, the three states of Michigan, Indiana, and Ohio, and numerous local government units.

This workshop was designed to bring diverse voices together to discuss governance challenges, needs, and strategies for sustaining the Michindoh aquifer and the many communities it supports.

The four questions that guided this two-day workshop included:

I. What concerns are you working on within the Michindoh Aquifer?

II. What current groundwater stressors are you hoping to address in a better way?

III. Do you have any input on sustainable governance practices that could be implemented multi-regionally?

IV. What other experts do you think should be a part of this process, and part of the continuing conversation?

Figure 1. Front entrance to the North American Indian Association of Detroit

Who Was Invited?

The initial invitation list included water experts from Tribal governments, community activists, and hydrogeologists. The objective was to develop a contact list that was balanced and representative of affected communities within the Michigan-Indiana-Ohio tri-state area while maintaining a smaller, focused workshop group of 12-25 local and regional experts.

The prospective list of invitees was divided into several categories to promote maximum representation and to identify people who were likely to be community nodes, people with specific regional, technical, or cultural knowledge who have strong connections to their networks and are well-connected to how information could be distributed for the best effect.

Invitees were categorized by residence (state), organizational affiliation (Tribal, state, federal, nonprofit, community, academic, other), and knowledge or expertise (earth science and technical, cultural, regional, organizational operational, legal and policy). A selection of the water professionals who attended were interviewed during phase 1 of the project. Other participants were identified through local news sources, active nonprofits and community organizations in the region, outreach to Tribal communities, and recommendations from other invitees.

During this process, people were sent initial emails to alert them about the workshop and its objectives to gather participant availability and interest. Formal invitations were then sent out about a month before the workshop, and included an agenda, travel logistics, and more information about the financial support available for Tribal participants.

Before attending the workshop, each of the thirteen participants responded to a survey sharing their reasons for attending. Some were hoping to get more connected to others in the region, like one participant who wanted to meet and learn from Tribal members about their water concerns and ongoing work, while also expressing interest in furthering collaboration across state lines. Some were hoping to get more knowledge about groundwater, like one who wanted to receive education on groundwater and aquifers, or another who was seeking more regional knowledge of groundwater sources, policy restrictions, and what can be done to address the issues. Some were more interested in workshopping the issues, like one participant who wanted to work through the needs for investigation and research, or another who wanted to brainstorm for sustainable groundwater sources. Overall, people joined us to share knowledge, learn more, and work through the challenges in governing the Michindoh Aquifer equitably and sustainably across the region.

Community Engagement

Community engagement is a broad name for research frameworks (also referred to as community action research, participatory research, empowerment evaluation, etc.). Its purpose is to center a community's voices, values, and understanding of issues. Community engagement brings a research problem to the people within a defined scope of focus (e.g. geographic area, demographic group, specific topic interest) and invites participation in the problem-solving. It centers the people impacted and asks researchers and community members to collaborate as part of a single research team (Syed and Palermo 2010).

The role of community engagement is particularly important when working with marginalized communities where different cultures, values, and priorities may have to compete for consideration against dominant frameworks. This groundwater governance workshop included participants from

varying backgrounds and asked participants to respect all knowledge brought into the workshop, including Traditional Ecological Knowledge (TEK) and lived experience.

Academic credentials and Western scientific knowledge are prioritized in policy and law-making settings. TEK and lived experience are typically less common because it is difficult to evaluate the reliability of this expertise under academic or Western Science rubrics of knowledge (Kadykalo et al., 2020).

Traditional Ecological Knowledge (TEK) is described as "observations, oral and written knowledge, practices, and beliefs that promotes environmental sustainability and the responsible stewardship of natural resources through relationships between humans and environmental systems." (White House Press Brief 2021).

Lived experience is firsthand knowledge, or knowledge generated by living through specific events, conditions, or occurrences. Through recollection and retrospection, this firsthand knowledge provides information by situating a problem within a particular context (O'Leary and Tsui 2022).

In recognizing these different ways of knowing as valid, workshop participants were encouraged to speak freely about their personal experiences. They were asked to listen to the wisdom of others without passing judgment, or assuming that one perspective was more credible than another. This was a way to facilitate respectful dialogue throughout the room.

Agenda and Topics Covered

The detailed agenda is included as an appendix to this document.

Day 1 in Review

The first day of the workshop was May 9, 2024 at the North American Indian Association (NAIA) of Detroit. A Native-inspired breakfast was available for all who attended, which was catered by Rosie's Food Stand. Freshwater staff were present to facilitate the two-day event.

NAIA Director Brian Moore opened the workshop with a blessing, as is customary protocol for Native gatherings. The blessing was offered in Anishinaabemowin and translated to English for everyone's benefit. He welcomed the group and offered blessings for their mutual health and good presence in that space during the coming days of meetings. Workshop participant Andrea Pierce then offered a blessing and water ceremony, and shared a story about the consequences of mistreating the water and the power that sacred water holds in healing and nurturing communities.

Freshwater staff member, John Roterman, also welcomed the group, As the first point of contact for the invitees, John led the workshop introductions by thanking them for their interest and attendance. He stated the Freshwater goal of amplifying Native voices for this project, and shared his hopes that this initial workshop would grow into future efforts, with new allies blossoming to a formidable grass roots effort to protect our freshwater. John then relayed a story of the Anishinaabe 7th Fire Prophecy and how the Anishinaabe migration journey happened.

Freshwater staff member and facilitator, Rosie Russell then shared a story about how she got connected to water, which kicked off the 2-hour talking circle, where each person was given the opportunity to share their story about their personal connection to water.

Everyone had a story that detailed their relationship to water, and the sharing of these stories had a great equalizing effect around the table. Some came into water through childhood experiences, like one individual who said she watched the Cuyahoga River burning while growing up in Cleveland or another who wanted to watch a Power Rangers movie one day and, to his dismay, his parents brought him to see An Inconvenient Truth.

Some got connected to water later in life, like a participant who became an advocate after economic development threatened the Michindoh Aquifer, the sole source of drinking water in the region. Some formed their relationship to water through farming, like one participant who has been an organic farmer in the region for over a decade and has been a staunch advocate of local water systems and their protection from harmful chemicals applied for pest management.

Some gained an interest in water through their work and academic studies, like a participant whose interest in Tribal history and ecology led to an academic study of historical wild rice beds and detailed GIS maps that included sovereign knowledge held by local Tribes. Some actively work on environmental policies and water governance projects in the region, tackling existing barriers and struggles with multi-jurisdictional governance practices.

Others lost family members to the poor treatment of water which brought them into activist work, like one participant whose mother was lost to health-related issues from PFAS contamination in her drinking water. This led to her involvement in grass roots organizing that promoted sound water management, such as Line 5. Others were raised with a close connection to water and recounted how they observed changes in the environment throughout their life, including eating fish directly from the lake and the water quality impacts that led to health risks from consuming the same fish.

Overall, participants various connections to water brought them to this discussion about the Michindoh aquifer, which they agreed is an important community asset that gives life to all who inhabit the region.

Presentations

The 2-hour talking circle was followed by a series of presentations about the project background, the geologic history of the Michindoh aquifer (Figure 2), and the state of groundwater policy and governance in the region. The purpose of these presentations was to share information about the project's focus and to briefly summarize the information currently informing the management and governance of the Michindoh aquifer. By empowering the room with knowledge, informational barriers were minimized. Notebooks and handouts of the presentations were provided and allowed people to follow along. Following each presentation, workshop participants were given an opportunity to ask questions or reflect on the topics discussed. Some participants questioned how old the data were and the limitations they have describing the system's holistic nature, while others reflected on the existing policies and their limitations in protecting the ecosystems they set out to protect.

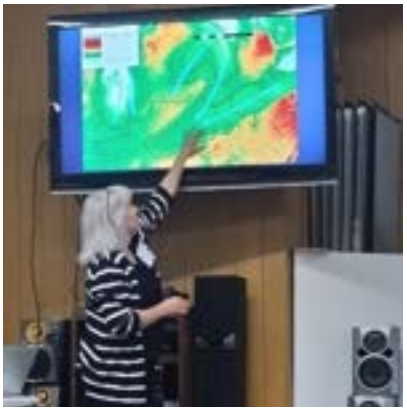

Figure 2. Dr. Carrie Jennings presenting on the geologic history

Issues and Topics of Interest

Following the presentations and brief discussion, participants were asked to brainstorm issues they are working to address in the Michindoh Aquifer, with a focus on groundwater availability. The issues that were suggested were displayed at the front of the room (see Figure 3), and included:

- impacts to wetlands
- recharge loss
- unaccounted-for withdrawals
- unverifiable assumptions in groundwater models
- monitoring wells and their levels, depth of data
- rights of the aquifer
- rights of aquatic resources
- quality of discharged water used to grow genetically modified species
- diluting discharge using groundwater

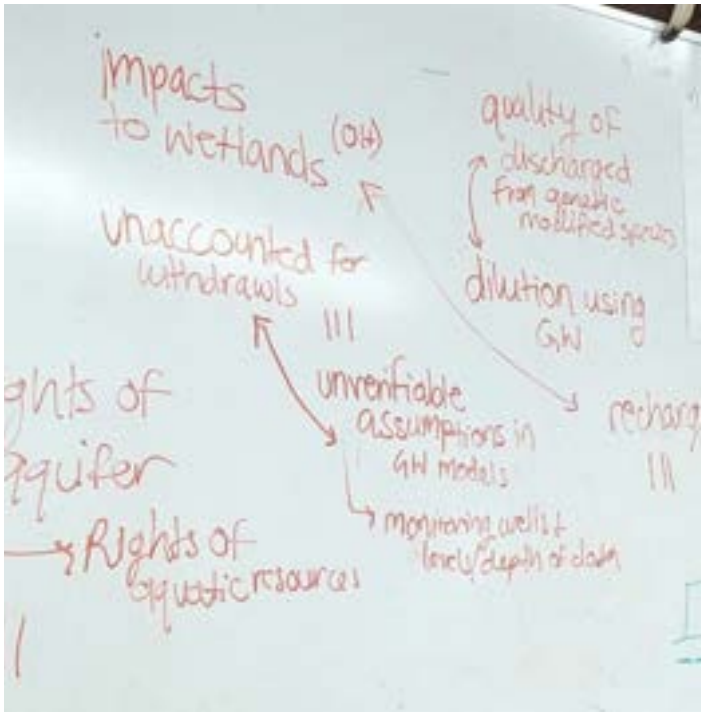

Figure 3. Whiteboard showing issues of interest in the Michindoh aquifer

The group then voted on the different issues and agreed to combine and consolidate them into three categories (as shown in Figure 3). Impacts to wetlands and recharge loss became the **wetlands and the water table** group. Unaccounted for withdrawals, unverifiable assumptions in groundwater models, and monitoring wells and their levels, depth of data became the **data assumptions** group. Rights of the aquifer and rights of aquatic resources became the **rights of nature** group. The last two topics were excluded from the discussion due to the low interest and loose connection to groundwater quantity.

Attendees were given the opportunity to choose which group to sit in with and notes of topical points were recorded on sticky notes and posted on large flipboards to help participants find common themes and connections. A series of exercises were used to discuss the issue of their choice, and to "admire the problem," as was reiterated throughout the discussion.

The first exercise in this process is called the 5 Whys exercise (Figure 4), which encourages people to get to the root of the issue they are discussing while creating a starting point for each person in the group to share and debate their different perspectives.

After reporting the results of their 5 Whys discussion and selecting a more narrowed focus for their topic, each group considered the various ways the issue impacts their communities. Participants were asked, "who or what does this issue impact?" After reporting their results, participants were asked, "who or what impacts the issue?" This exercise brought each group to a deeper understanding and provided the foundation to move into day 2's discussion: policy and governance tools.

Figure 4. Data group prepping the flipboard for the 5 Whys

Day 2 in Review

On Day 2, most of the invitees returned to continue the dialogue regarding the Michindoh Aquifer. Everyone was given an opportunity to reflect on the previous day's discussions. The diversity of industry professionals, Tribal members, and community advocates made for interesting talking points that seemed to intersect at times and that blossomed into further fruitful conversation.

Some felt apprehension during the first day and were unsure of what this workshop would require personally and professionally and were surprised by the relationship building that had taken place. Some highlighted how their academic training emphasized dispassion and black-and-white viewpoints and appreciated how this workshop allowed space for more nuance, complexity, and dissolved typical silos. Another person stated that they loved to see different perspectives coming together and how this workshop needed to happen.

Some expressed gratitude for being included, and highlighted how these discussions are normally left in the realm of "those with all the titles" and how Native communities are typically excluded from these multi-jurisdictional decision-making spaces despite being stewards of the land. Some noted their lack of interaction with Native communities but appreciated the opportunity to listen and learn from the Native people in the room. Some noted that they were still learning and were taking time to take in all the new information, and their plans included additional learning after this workshop.

Some brought up their age and how they initially felt it disqualified them from this workshop and that their lack of credentials made them nervous to speak among professionals and experts, but that had changed due to being welcomed and respected in the previous day. Some mentioned how nice it was to learn about the work being done by others and to have the chance to learn about their different perspectives.

Overall, the group relayed a feeling that there was a disconnect between governance and the community, but there was also an optimistic tone as participants discussed future opportunities to work together.

Technical Presentations

Discussions were tabled to listen to presentations from Chanse Ford, Ph.D. and Ben Edelstein, J.D. respectively. Chanse presented on the preliminary results of USGS modeling of the Michindoh aquifer but noted that the research was still in review by USGS. As a result, this work is not included in this report. Ben presented on legal tools for governing groundwater in defined jurisdictions, as well as cooperative mechanisms in place for multi-regional groundwater management. Although these talks were technical in nature, they were presented and explained in easy-to-understand language.

Figure 5. Ben Edelstein, J.D. presenting on policy tools

Although participants reacted to some of the presentations with skepticism, questions, and probes for deeper analysis, the trust-building on the first day allowed participants to be more at ease in expressing questions and being vulnerable when asking for clarification around scientific and legal topics. The participants were also more aware of each other's backgrounds and social contexts, and this knowledge allowed people to engage in civil and open dialogue.

Policy Tools and Interventions

Following this discussion, participants returned to their respective groups to brainstorm policy and governance tools. Participants were asked to reflect on interventions or policy tools that could be implemented by a local jurisdiction or institutions to either mitigate an existing impact discussed the previous day, or to improve an existing policy that would indirectly address an impact (see Figure 6). During this discussion participants were also asked to identify some barriers that might impede successful implementation. Participants focused on multi-regional approaches using the same process.

Figure 6. Wetlands and the water table group reporting out policy tools

Debrief

Workshop participants were asked to reflect on their experience during a debrief at the end of the workshop and then again in a short post-workshop survey.

During the debrief, several participants expressed interest in having more participation from legislators and State and Federal agency representatives, especially from Ohio, to better understand how decisions are getting made and why local advocacy groups are experiencing pushback. Others hoped to see traditional healing practitioners and Indigenous people who use medicine or fish the waters to have more first-hand knowledge of how these systems are changing in response to the way the groundwater is being managed.

Many agreed that so much more is needed to better understand the issues present within the Michindoh aquifer region, including getting more clarity on the stories being told with the data, getting more funding to collect meaningful real-time data, consulting more directly with Tribal stakeholders, getting more information about how animals and ecosystems are impacted, and hearing more examples of groundwater management strategies from other regions, such as the Ogalala aquifer area.

Overall, participants reflected that the workshop provided a welcoming and engaging platform to hear new perspectives, to network, and to focus on the Michindoh aquifer.

In the post-workshop surveys, participants reflected positively about their experience. Some expressed gratitude for the quality of information that was shared, including the introductory components and the more advanced education from experts in hydrogeology. Others were happy with the welcoming atmosphere, and the comfort and flexibility to share their stories among a diverse group of backgrounds and professions. Overall, people were pleased with how this workshop brought together a diverse group of people who have a shared interest in the Michindoh Aquifer. The quote below captures this in full:

> *"As someone who has also organized workshops/events bringing people of diverse backgrounds and professions together, I appreciated this workshop very much. Bringing community members, scientists, and activists together and using small group discussions all made for a thought provoking 2 days. It also provided all of us a chance to form some relationships with new people who also care deeply about water, nature and in this case the Michindoh aquifer. Well done!"*

Groundwater Governance Issues and Strategies Discussed

Three groundwater governance issues selected by the workshop participants became the focus of this workshop. These issues were discussed using the series of exercises described in the preceding section. Following the workshop, the notes from each of the three group discussions were recorded into Miro, an online whiteboard, and analyzed and summarized by Freshwater staff. This section includes summaries from each of the three discussions.

Rights of Nature

The rights of nature group formed to discuss how recognition of nature's rights would positively affect the health and wellbeing of groundwater and the environment. The importance of groundwater to participants' lives was explored and common themes were identified (see Figure 7).

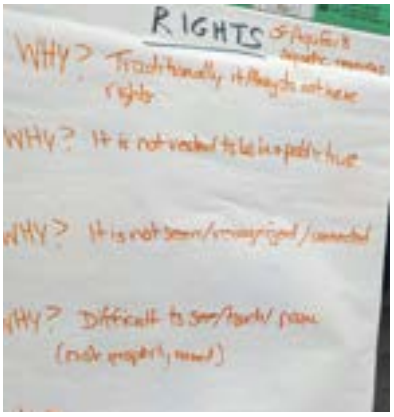

Figure 7. Rights of nature 5 Whys

Some of the ideas presented included dissatisfaction with the current paradigm, where monetary concerns always seem to outweigh best practices, and a lack of representation in stakeholder engagement. The health and quantity of the water was also identified as a main concern, but a barrier to that included policy and legal structures, some of those which include the assignment of personhood to corporations while blocking or reversing legislation that granted lakes, rivers, watersheds, and rivers the rights of personhood. Participants expressed a feeling that politics favor the economy over ecology, and people shared personal experiences where physical attempts were made by law enforcement to silence water advocacy.

A key barrier was the absence of nature's advocates in stakeholder engagement and water governance and decision-making circles. Unsustainable uses of water, lack of scientific education, lack of connection to nature, differing values, oversight failures by, and lack of cooperative governance, and legal threats like Strategic Lawsuits Against Public Participation (also known as SLAPP suits) to silence advocates were also identified as barriers to development of practices that protect nature.

As populations increase, conservation and sustainable use of groundwater are important to consider. Some states have priority-of-use laws which elevate human consumption, but with or without them end-users can use drinking-quality water for lower priority activities like lawn watering, car washing, and toilet flushing. Harvesting rainwater and graywater were identified as strategies to preserve groundwater for essential uses and reduce overuse of groundwater.

Intense cultural shifts were suggested to implement a sustainable agenda, focusing education on the interdependence of the natural world and its link to human existence. For example, freshwater health in rivers, lakes and streams is determined by surveying the macroinvertebrates present. They are the best indicator of a healthy ecosystem. One example mentioned was the truth, reckoning, and right relationships workshops put on by the Community Environmental Legal Defense Fund.

The lack of knowledge about, and respect for Indigenous knowledge systems and treaty rights is a barrier to moving forward in a more sustainable way. Treaties are the "supreme law of the Land" according to the U.S. Constitution. Consultation with Tribal entities should take place first, but Tribal perspectives are too often neglected or unknown. Having more Indigenous voices in the conversations would promote the rights of nature, but too often, these conversations fail to take place. Treaties and constitutions that incorporated the rights of nature would be specific to each bioregion and include every living entity connected within.

The capitalist system we live in favors economic development and is at cross-purposes with the rights of nature. It requires life sustaining "resources" to be consumed or destroyed to be capitalized upon. Laws are designed and carried out without inclusion or recognition of the rights of nature. Corporations

are granted personhood to have rights afforded to wholly unnecessary entities, while rights and access to clean water, air and food suffer. Limitations of the English language or even specific word choices of "shall" or "may" change everything. In the rights of nature discussion, participants offered that Nature should be considered as important as or more important than the rights of corporations and businesses. The dismissal of Traditional Indigenous Knowledge (TEK) in favor of western cultural values has caused a disconnect to our natural relatives. We don't just live in nature, we are nature.

Data Assumptions

The topic of data was proposed by participants, and became the broader topic of "Data, assumptions, and monitoring" to better encompass the process of how data are generated and used. Data are generally defined as facts that can be analyzed to make decisions or to generate knowledge. Simply, data are assumed to be raw information, devoid of any interpretation.

There was apparent reluctance to join the Data group, and the initial group was the smallest of all three working groups and split between community members and scientists who worked with and modeled data professionally. During the 5 Whys exercise, participants disagreed on the order of the initial 5 whys. It was argued that it was wrong to state that it is "not possible to know all the variables" in a model, because variables are specifically selected or ignored for a model. The counterargument was that nature is so complex, and there are many variables still unknown and undiscovered in nature, so it is impossible to incorporate all variables in model.

The group eventually agreed that the first two whys generated were reciprocal: It is not possible to know all the variables because natural systems are so complex; natural systems are so complex, and so it is therefore not possible to know all the variables (see Figure 8). Because of this, accurate data can be difficult to gather, model, interpret, and verify. However, both scientists and community members desire accurate predictions for decision making. Accurate data are needed to make accurate predictions.

The group identified people, systems, and processes that might result in having better or more accurate data or that would be impacted by having better and more accurate data. Throughout this exercise, the discussion revolved around what was meant by "better" and "more accurate" when applied to data. Did "better" mean the quality of data, or did it include the quantity of data and the data collection and data storage and data retrieval? Did "more accurate" mean robust or just precise? What is meant by data and was it only meant to reference measurements in the earth science categories? This discussion highlighted the complexities that exist in and between different disciplines and scientific fields.

As this workshop focused on the Michindoh Aquifer and this exercise focused on accurate predictions, "data" referred to precise measurements collected in the earth sciences. The group discussed themes that highlighted specific needs of the aquifer region. Later, the group arranged the identified themes as strategies which addressed identified barriers.

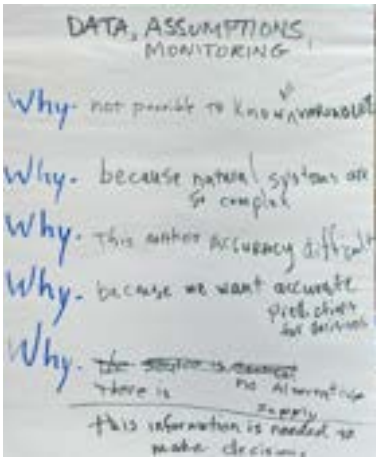

Figure 8. Data group's 5 Whys

Key strategies that emerged in these discussions included a need to increase the public's confidence in science and data; a need for additional staff with professional training in science, technology, engineering, and math (STEM) fields to expand duties and fieldwork; and a need for additional funding to support the additional staff capacity, data monitoring, and data management. For example, well drillers could have access to more training in geology to improve the accuracy of well logs, or funding could be used for installing new monitoring wells in areas where data is limited or where potential concerns exist.

Figure 9. Data group discussing what impacts the accuracy of data

One strategy was to increase funding to support additional staff and staffing capacity, and an ideal outcome would include more trained professionals who would be better able to design, execute, and communicate projects and project results to the public and build trust between the public and scientists. To support increased funding, there would need to be the political will from the legislation and the ability to communicate the need for the funding from the research community. The idealized outcome that emerged in group discussion was a public that felt educated and empowered, and youth who would eventually go into STEM-field careers to continue this cycle of trust and build more collaborative and interdisciplinary research partnerships. For example, it was suggested that the United States Geologic Survey (USGS) could coordinate work across state boundaries to bridge knowledge gaps and therefore build a transparent and collaborative platform for data sharing and comparison.

Wetlands and the Water Table

During this workshop, participants expressed concerns that there is much that remains unknown about the relationship between wetlands, the Michindoh Aquifer, and those inhabiting the land. How much water is being recharged into the aquifer through wetlands? How are wetlands impacted by high groundwater pumping rates in their local vicinity? How much traditional medicine has been lost to development throughout the region? These questions prompted a diverse group of participants to brainstorm what is happening and what can be done about it from a groundwater-governance standpoint.

The wetlands group was made up of scientists, Indigenous leaders, and community members who all had first-hand knowledge of wetlands within their communities and places of work, but with varying perspectives. Their knowledge of these systems quickly became apparent as they dove into a series of exercises. Given that each person in the group was looking at the issue from a different vantage point, the initial discussion naturally began with a refresher on the mechanics of wetlands. Some did not understand the potential connection between regional-water-table lowering and wetland loss. Some argued that the loss of wetlands impacted the quality of water for well-water consumers. Some advocated for impacted future generations and their ability to hunt and gather food and medicine that occur in wetlands, while others noted the flood-buffering capacity of a landscape with wetlands. Some shared that wetlands have been central to human's relationship with water for hundreds of thousands of years, as they provide medicine and food, filter water, buffer floods during rainstorms, and support interconnected ecosystems.

They discussed how water moves downward through some wetlands, like after a rainstorm, "recharging" the aquifer with filtered water. However, they agreed that the certainty of when and where recharge is happening remains a mystery to them. As a result, governance practices do not sufficiently protect against the development demands that can compete with these important ecosystem features, which may explain why to them it seems like so many wetlands and rivers have been lost throughout the region. Scientists shared that this loss of wetlands alters how the water table is being expressed, how pollutants are making their way into water-table aquifers, and where recharge is taking place. For example, in Indiana, where a portion of the Michindoh Aquifer is located, over 85% of the original wetlands have been lost to development and the remaining wetlands continue to be threatened by state legislation, such as the Senate Enrolled Act 381. It has been found that these changes have endangered wildlife, impacted the quality and quantity of drinking water, and increased the risk of flooding of homes and buildings.

Workshop participants expressed concern over this trend, not just in Indiana, but across the region. They expressed concerns about how wetland loss has threatened the existence of traditional medicines that are found within these wetlands and the availability of sacred wild rice which brought Indigenous people to this region. This is because the pollutants and development practices also impact the functionality of a wetland, like what can grow there. For example, healthy wild rice has been linked to areas where groundwater upwells in the system. However, most data being collected about wetlands does not explicitly pertain to things like traditional medicines or wild rice which is held sacred by Indigenous groups.

As the discussion concluded, the participants expressed a need to change how people in decision-making roles perceive the value of wetlands. For example, when trying to advocate for the protection of wetlands, some community members were blocked by Ohio legislation that prevented people from advocating on behalf of nature or ecosystems. Some local governments in Ohio have also forcibly barred community advocates from listening to conversations where science and data were being shared about the Michindoh aquifer's impact on the ecosystem. These are examples of blocking a feedback loop between community and decisions makers. Having the ability to freely communicate in a transparent manner is necessary for effective and democratic decision-making regarding how wetlands are being protected. This communication is also important because it ensures that people have a stake in the decisions being made about the communities in which they live, and there's something in it for them.

Another suggestion was to promote better consultation with Tribal governments. For example, United Tribes of Michigan are generally unified in their commitment to protect the environment. One way to increase the protection of wetlands in Michigan, or further, across EPA region 5, would be to consult United Tribes of Michigan to understand how wetlands are protected within their sovereign nations. This consultation should be done respectfully and include the people who have lived knowledge and experience of the many values that wetlands provide, especially as it pertains to Indigenous values that are often excluded from the picture when making decisions.

Figure 9. Data group discussing what impacts the accuracy of data

Others shared that decision makers need more data to understand how the aquifer is being recharged, where recharge is happening, and the role that wetlands play in recharge. The data should also look at how wetlands are impacted by the level of recharge. For example, one participant shared that some wetlands, such as marshes or fens, require that the water table be at least one foot from the surface. A groundwater recharge study of wetlands was suggested to evaluate recharge more comprehensively across the region. The group agreed that Tribes and community members should be consulted when thinking about where that data should be collected. However, data, maps, and models also need to be presented in a clear and easy to understand manner, like this groundwater story map from Michigan, so that politicians making decisions about these ecosystem features can understand the stories behind the data and become more willing to provide funds or resources to protect them, or even conduct the studies to better understand them.

Overall, the group was interested in better communication strategies to incorporate a diverse range of perspectives and values when governing groundwater through the lens of wetlands. They agreed that the largest barriers to achieving this were costs, time, who is in power, and the fact that there's not enough time to get to the point of knowing before decisions get made.

Participant List

Workshop Participants

Andrea Pierce

Chanse Ford

Debra Durall

Ginger Davis

Grant Poole

Jack Wittman

Jim Milne

Julie Dye

Rochelle (Shelby) Charette

Rosemary Hug

Sherry Fleming

Sue Franklin

Tish O'Dell

NAIA Hosts

Brian Moore, Executive Director

Travis Schuyler

Caterer

Alycia Atkinson from Rosie's Food Stand

Freshwater

Carrie Jennings

John Roterman

Rosie Russell

Alyssa Fabia

Water 365

Ben Edelstein

Appendix

Workshop Itinerary and Agenda

Workshop Topic	Groundwater Governance in the Michindoh Aquifer
Date	Thursday, May 9, 9am-4pm to Friday, May 10, 9am-3:30pm
Location	North American Indian Association (NAIA) of Detroit

We are looking forward to you joining us at this 2-day workshop. Below you will find some details to make your trip go more smoothly. Please contact Rosie Russell at rrussell@freshwater.org or (652) 571-2696, or John Roterman at jroterman@freshwater.org with questions.

Arriving at the Hotel

- Hotel: Holiday Inn Express & Suites Detroit Northwest – Livonia, 27451 Schoolcraft Rd, Livonia, MI 48150
- Free parking available in their lot.
- Check-in is after 3pm.
- Check-out time is 11am. Please make arrangements if you need the hotel to hold your luggage on day 2.

Arriving at the North American Indian Association (NAIA) of Detroit

- 22720 Plymouth Rd, Redford Charter Twp, MI 48239

  To get there from the hotel, travel south on Inkster Road. Turn left, heading east on Plymouth Road. NAIA will be on the left (north side of the road) between W Parkway Street and Beaverland Street.

- There is plenty of free parking available on the west side of the building
- Enter the building from the south. We will be meeting in the main room upstairs. Please arrive between 9:00 and 9:15.

What to Expect for the Workshop

- A full breakfast, coffee, and water will be served both days.
- Please dress comfortably.
- Day 1 will begin with an Opening Invocation and Prayer by Brian Moore, Executive Director of NAIA Detroit, and a Water Ceremony from Andrea Pierce. This will be followed by 2 hours of getting to know one another. The rest of the agenda for days 1 and 2 is focused on problem-solving exercises

and plenty of respectful sharing and listening. You can find the agenda on the next few pages.

- The menu of traditional Indigenous food from Rosie's Food Stand is at the end of this document.
- Optional evening activities for May 9th will be shared during the workshop.
- Data Sovereignty norms and expectations will be presented when we kickoff the workshop, but we want you to be aware that the meeting will not be live streamed or recorded and participants are welcome to ask for any notes to be stricken from the record. If you have any specific questions you'd like us to address, please let us know.

Workshop Description

The Michindoh Aquifer is a groundwater feature that supports many community needs and values. Spanning the ancestral homelands of the Potowatomi, three states, and numerous local government units, this shared geologic feature is governed by layers of institutions, organizations, and individuals that own and manage the land above it. Currently, the governance strategy does not acknowledge the Michindoh Aquifer as a communal feature of the landscape. Instead, different communities assign their own values and priorities to their management policies, which may or may not align with others enjoying its many benefits.

Therefore, you are among a multi-jurisdictional group of experts that has been invited to attend this workshop, with a focus on amplifying the voice and representation of Tribal Nations residing in this region. Those in attendance will discuss governance challenges, needs, and strategies for sustaining the Michindoh Aquifer and the communities it supports.

In attending this workshop, we hope you will form new alliances with like-minded individuals who are unified in their commitment to implementing strategies that sustain the Michindoh Aquifer for generations to come. Our goal is that with your contributions, this will be the first of many steps that will ultimately shape the foundation and future of groundwater governance in the Great Lakes region.

The four questions that will guide this two-day workshop include:

- What concerns are you working on within the Michindoh Aquifer?
- What current groundwater stressors are you hoping to address in a better way?
- Do you have any input on sustainable governance practices that could be implemented multi-regionally?
- What other experts do you think should be a part of this process, and part of the continuing conversation?

This area (Michindoh Aquifer) is one of three aquifer-action cluster workshops being organized by the Freshwater Society to elevate local groundwater concerns with decision makers.

Workshop Agenda

Day 1 – May 9, 9:00 to 16:00 – 9am to 4pm

9:00	Welcome	Refreshments and breakfast will be available (Coffee and water served all day)
9:15	Opening Invocation and Prayer and Water Ceremony, followed by a talking circle	Brian Moore will start us off with the opening invocation and prayer. Then, Andrea Pierce will conduct a Water Ceremony. Following this, everyone will have the opportunity to share their name, region they come from, and a story or observation about water.
11:15	Kickoff from Groundwater Governance team	This will be a presentation format and will include a background on the history and geography of the Michindoh Aquifer from Carrie Jennings, and background on groundwater policy in this region from Ben Edelstein.
12:00	Lunch (catered)	Menu includes traditional Indigenous food and can be found on the final page of this document.
13:00	Groundwater Governance issues in the Michindoh Aquifer	Participants to brainstorm groundwater governance issues in the Michindoh Aquifer and things they value and want to protect
13:30	Breakout Groups (issue 1)	Define your groundwater governance issue using a series of exercises.
14:20	15-minute break	
14:35	Breakout Groups (issue 2)	Define your groundwater governance issue using a series of exercises.
15:25	Debrief talking circle	What are your initial reactions? What do you hope to get out of tomorrow?
16:00	Adjourn for the day	We will have options for places to gather later in the evening for food and further conversation.

Day 2 – May 10, 9:00 to 15:30 – 9am to 3:30pm

9:00	Welcome	Refreshments and breakfast will be available (Coffee and water served all day)
9:15	Talking circle	Any thoughts, discussions you had the previous day/evening that you want to share with the group?
9:45	Presentation about groundwater modeling	Presentation by Chanse Ford from USGS
10:15	Background on tools being implemented by other communities	Presentation by Ben Edelstein from Water 365

10:25	Breakout Groups (issue 1)	Return to a groundwater governance issue of your choice Questions: What groundwater stressors are you hoping to address within your own communities? What barriers might you face? Are there any tools that have worked?
11:05	15-minute break	
11:20	Breakout Groups (issue 2)	Return to a groundwater governance issue of your choice Questions: What current groundwater stressors are you hoping to address within your own communities? What barriers might you face? Are there any tools that have worked?
12:00	Lunch (catered)	Menu includes traditional Indigenous food and can be found on the final page of this document.
13:00	Background on tools being implemented multi-regionally	Presentation by Ben Edelstein from Water 365
13:10	Breakout Groups (issue 1)	Return to a groundwater governance issue of your choice Questions: What sustainable governance practices could be implemented multi-regionally? What barriers might we face? Are there any tools that have worked?
13:50	15-minute break	
14:05	Breakout Groups (issue 2)	Return to a groundwater governance issue of your choice Questions: What sustainable governance practices could be implemented multi-regionally? What barriers might we face? Are there any tools that have worked?
14:45	Debrief talking circle	What are your reactions? What data do you think is needed to move forward? What other experts do you think should be at the table/part of this process and continuing conversation?
15:30	Adjourn the workshop	

Appendix E

Transboundary Groundwater Governance Legal Frameworks

Authors: John Noonan, JD, Water365

Effective groundwater governance is crucial for managing transboundary water resources, ensuring equitable access, and preventing environmental degradation. Over time, various legal frameworks have emerged to regulate shared groundwater, from early instruments like the Helsinki Rules (1967) and Seoul Rules (1986) to the more recent Draft Articles on the Law of Transboundary Aquifers (2008), all emphasizing equitable and reasonable utilization, obligation not to cause harm, and mandatory cooperation.[1] [2] Regional and basin-specific instruments, such as the European Union (EU) Water Framework Directive (2000) and the Southern African Development Community (SADC) Protocol on Shared Watercourses (2000), provide tailored approaches to governance, while multilateral environmental and human rights treaties, including the Convention on Biological Diversity (CBD) (1992) and the International Covenant on Economic, Social, and Cultural Rights (ICESCR), reinforce the connection between groundwater sustainability, ecosystem protection, and human rights.

Additionally, governance frameworks must account for both on-reservation and off-reservation tribal water rights, ensuring that treaties, federal trust responsibilities, and relevant legal principles are incorporated into groundwater management strategies. Complementing these legal frameworks, global governance initiatives like Governance of Groundwater Resources in Transboundary Aquifer (GGRETA) and Global Environmental Facility International Waters (GEF) supporting Transboundary Waters Assessment Programme (TWAP) enhance cooperation, data-sharing, and scientific assessments. Together, these mechanisms form the backbone of international groundwater governance, promoting sustainable use, preventing disputes, and ensuring the long-term viability of shared aquifers.

Foundational Legal Frameworks

I. Helsinki Rules (1967)

   A. Established the principle that international drainage basins include both surface and connected groundwater but did not cover confined aquifers.

   B. Defined an international drainage basin as a system of waters, including surface and underground sources, flowing into a common terminus.

1 The Helsinki Rules on the Uses of the Waters of International Rivers, 1966, were adopted by the 52nd International Law Association (ILA) at its meeting in Helsinki, Finland, in 1966 and subsequently published in 1967. While the official publication date is 1967, the rules are often referred to by the year of their adoption in legal and policy discussions.

2 The Seoul Rules on International Groundwaters, 1986, were adopted by the 62nd International Law Association (ILA) conference held in Seoul, Korea, in 1986. These rules supplemented the earlier Helsinki Rules on the Uses of the Waters of International Rivers, 1966, by addressing groundwater resources, particularly those that are hydraulically connected to surface waters.

C. Key Provisions:

1. Equitable and Reasonable Utilization: States are entitled to a fair share of the beneficial uses of an international water basin.

2. Obligation to Prevent Harm: States must prevent new forms of water pollution or changes that could harm other basin states.

II. Seoul Rules (1986)

A. Expanded the Helsinki Rules by incorporating confined groundwater into transboundary water governance.

B. Defined aquifers as all underground water-bearing strata capable of yielding water.

C. Clarified that aquifers intersecting state boundaries qualify as part of an international basin.

D. Key Provisions:

1. Protection of Groundwater: Stresses the need to prevent groundwater over-extraction and pollution.

2. Integrated Management: Encourages the combined governance of surface and groundwater resources.

III. Bellagio Draft Treaty (1989)

A. Focused on governance of shared aquifers and cooperation between states.

B. Key Provisions:

1. Joint Management Mechanisms: Proposed establishing joint commissions for managing transboundary groundwater resources.

2. Data Sharing: Encourages states to exchange relevant groundwater data and information.

IV. UN Watercourses Convention (1997)

A. Extended international water law to groundwater, defining watercourses to include aquifers linked to surface water.

B. Key Provisions:

1. Obligation Not to Cause Significant Harm: Article 7 requires states to take appropriate measures to prevent significant harm to other watercourse states.

2. Notification of Planned Measures: States must inform other watercourse states of planned activities that could have adverse effects.

3. Dispute Resolution: Provides mechanisms for peacefully resolving conflicts between states sharing a watercourse.

V. Draft Articles on the Law of Transboundary Aquifers (2008)

A. First global instrument specifically addressing aquifer governance.

B. Key Provisions:

1. Sovereignty of Aquifer States: Affirms that states have sovereignty over the portion of a transboundary aquifer located within their territory.

2. Equitable and Reasonable Utilization: Requires that states use groundwater in a fair and sustainable manner.

3. Obligation Not to Cause Significant Harm: Mandates that states take precautions to prevent harm to neighboring states.

4. Mandatory Cooperation: Establishes the duty of states to cooperate on aquifer management.

5. Data Exchange: Encourages states to share relevant groundwater data.

6. Recharge and Discharge Zones: Recommends that states identify and protect aquifer recharge and discharge zones.

7. Monitoring: Calls for regular assessment of aquifers to ensure sustainable use.

Regional and Basin-Specific Legal Instruments

I. EU Water Framework Directive (2000)

A. Introduced basin-based water management, groundwater quality standards, and the polluter pays principle.

B. Key Provision:

1. Mandates economic analysis of water use and monitoring and reporting on water quality.

II. Southern African Development Community (SADC) Protocol on Shared Watercourses (1995, revised 2000)

A. Provides a legal framework for regional cooperation in managing shared water resources.

B. Key provisions:

1. Requires states to protect and preserve shared water ecosystems.

2. Establishes procedures for coordinated responses to water-related emergencies.

III. African Union's Shared Watercourses Framework (2000)

A. The African Water Vision 2025 emphasizes integrated water resources management for shared watercourses across the African continent.

B. Key Provisions:

1. Focuses on sustainable management of transboundary water resources, including groundwater.

2. Encourages cooperation among member states for the equitable development and management of water resources.

IV. Water Charter for the Niger River Basin (1964)

A. Regulates the management of the Niger River and its associated groundwater resources.

B. Key Provisions:

1. Defines the cooperative framework for managing both surface and groundwater resources within the Niger River Basin.

2. Provides for the establishment of a shared water resources commission to oversee governance.

Multilateral Environmental and Human Rights Instruments

I. Convention on Biological Diversity (CBD) (1992)

A. Protects biodiversity, which indirectly supports the preservation of groundwater-dependent ecosystems.

B. Key Provisions:

1. Parties are obligated to conserve biodiversity, including groundwater-dependent ecosystems.

2. Encourages integrated management strategies that connect groundwater sustainability with broader environmental health.

II. Ramsar Convention on Wetlands (1971)

A. Protects wetlands, including those dependent on groundwater resources.

B. Key Provisions:

1. Protects wetlands, which are often dependent on groundwater, and promotes integrated water resource management.

2. Encourages transboundary cooperation to protect groundwater-fed wetland areas.

III. International Covenant on Economic, Social, and Cultural Rights (ICESCR)

A. Key Provisions:

1. States are required to ensure access to safe drinking water, including the sustainable use of groundwater resources.

2. Ensures that groundwater governance aligns with human rights principles, ensuring equity in access and sustainability.

Global Water Governance Initiatives

I. Governance of Groundwater Resources in Transboundary Aquifers (GGRETA) – UNESCO Project

   A. Aimed at improving transboundary groundwater governance through pilot studies.

   B. Key Provisions:

      1. Conducting technical, legal, and socioeconomic assessments of aquifers.

      2. Providing training and technical support to groundwater governance stakeholders.

II. The Strategic Action Programme (SAP) for International Waters (Global Environment Facility)

   A. Provides a framework for addressing transboundary water issues, including groundwater, through collaborative efforts.

   B. Key Provisions:

      1. Focuses on integrated water resources management and the promotion of joint management frameworks for shared groundwater.

      2. Supports capacity building and the development of strategic action plans for groundwater governance.

III. Global Environmental Facility International Waters (GEF) supporting Transboundary Waters Assessment Programme (TWAP)

   A. Also referred to as the Global Transboundary Water Assessment Programme (GTWAP)

   B. Assesses transboundary water systems, including groundwater, and recommends cooperative management approaches.

   C. Key Provisions:

      1. Focuses on gathering data and providing recommendations for the management of both surface and groundwater in shared basins.

      2. Promotes scientific assessments to inform governance practices and facilitate cooperation between states.

Tribal Water Rights - Foundational Legal Principles and Treaties

I. Winters Doctrine (Winters v. United States, 207 U.S. 564 (1908))

   A. Established the principle of federally reserved water rights for tribes.

   B. Affirms that tribal reservations include sufficient water to fulfill their purpose, which has been

extended to include groundwater.[3]

C. Key Principle:

1. Reservations include an implicit right to water necessary to fulfill their purpose.

II. Federal Trust Responsibility

A. The U.S. government has a fiduciary duty to protect tribal water rights.

B. Groundwater governance frameworks must respect and uphold these rights through cooperative management.

C. Key Principle:

1. Federal agencies must consider tribal water rights in decision-making, permitting, and water resource management.

III. Treaty of La Pointe (1842)[4]

A. Guaranteed Ojibwe (Chippewa) tribes the right to hunt, fish, and gather in ceded lands across present-day Wisconsin and Minnesota.

B. These rights have been interpreted to include necessary environmental protections, which may extend to groundwater.[5]

C. Key Principle:

1. Tribal water rights extend beyond reservations to ensure the viability of treaty-protected resources.

International Legal Frameworks

I. United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (2007)

A. Adopted by the UN General Assembly in 2007, this declaration affirms indigenous peoples' rights to manage and protect their natural resources, including water.

B. Emphasizes that indigenous communities must have free, prior, and informed consent in any governance framework affecting their water resources.

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3 Arizona v. California, 373 U.S. 546 (1963), is a landmark U.S. Supreme Court case solidified the Winters Doctrine, extending federal water rights to Native American tribes, ensuring that they possess adequate water, including groundwater, to fulfill the purposes of their reservations. The case emphasized the federal trust responsibility and was pivotal in establishing that water rights reserved through treaties or executive orders can include groundwater.

4 Other treaties establishing usufructuary rights of Tribes can be found in the introduction, under the section Treaties in EPA Region 5.

5 Minnesota v. Mille Lacs Band of Chippewa Indians, 526 U.S. 172 (1999), affirmed the Mille Lacs Band's usufructuary rights (hunting, fishing, and gathering) guaranteed by the 1837 treaty, rejecting Minnesota's claims that these rights were extinguished by later actions.

C. Key Provisions:

1. Article 25 recognizes indigenous peoples' rights to maintain and strengthen their spiritual relationship with water and other resources.

2. Article 26 recognizes the right to own, use, develop, and control lands, territories, and resources they have traditionally occupied or used.

II. Obligation to Prevent Harm & Equitable Use

A. Principles from international water law, including the UN Watercourses Convention (1997) and Draft Articles on the Law of Transboundary Aquifers (2008), reinforce the duty to consider tribal rights in managing shared water resources.

B. Key Principle:

1. Tribes must be considered stakeholders in transboundary water governance to prevent harm to their rights and resources.

Considerations

A broader approach to groundwater governance in EPA Region 5 must integrate both international principles and domestic frameworks to ensure sustainable and equitable management of groundwater resources. Given the region's shared aquifers and their significance for tribal nations, states, and local communities, effective transboundary groundwater governance should be a priority.

One key consideration is adopting integrated water resources management (IWRM), a concept championed by the Ramsar Convention and UN Watercourses Convention, which promotes a holistic approach to managing both surface and groundwater resources. This could involve establishing interstate cooperative agreements modeled after the Bellagio Draft Treaty's joint management mechanisms, where shared aquifers are governed collaboratively to prevent over-extraction and contamination.

Additionally, incorporating tribal co-management principles aligned with the federal trust responsibility could strengthen governance structures, ensuring that groundwater policies respect and uphold treaty-protected water rights. A data-sharing framework, inspired by the Draft Articles on Transboundary Aquifers, could enhance transparency and accountability, allowing states and tribes to monitor groundwater quality and usage collaboratively across jurisdictional boundaries.

Further, public engagement and capacity-building—as emphasized in the Global Transboundary Water Assessment Programme (GTWAP)—could enhance local participation, ensuring that all stakeholders, including tribal nations, municipalities, and industrial users, have a voice in groundwater decision-making. By incorporating these international and domestic best practices, EPA Region 5 can develop a resilient, cooperative, and adaptive groundwater governance model, preventing conflicts and ensuring long-term sustainability and equitable access to groundwater resources across state and tribal jurisdictions.