

Great Lakes Horizon Scanning Pilot Workshop

(October 7-8, 2025)

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Great Lakes Horizon Scanning Pilot Workshop

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OVERVIEW

The U-M Water Center convened this workshop to launch the Great Lakes Horizon Scan process. The goal was to identify “weak signals” of environmental strain before they become the blinking red lights of crises.

Over time, the Great Lakes community has been caught off guard by emergent threats—from invasive species to persistent toxic chemicals, excess nutrients, and the Flint Water Crisis. Too often, management, governance, and stewardship organizations have had to respond reactively. The horizon scanning process is a proactive approach designed to surface potential socio-economic and ecological issues well in advance and determine, together, how to avoid or mitigate them. At a time when federal institutions and funding are facing significant declines, this process supports a forward-looking, collaborative, and resilient future for the Great Lakes and the institutions that steward them.

The University of Michigan Water Center is committed to facilitating a trusted Great Lakes horizon scan, with this workshop as a key first step. We also recognize that horizon-scanning is not new; Indigenous communities have been planning for the seventh generation for millennia and have long built resilience into their systems and relationships. Yet in periods of disturbance and uncertainty, it is especially important to draw on the “wisdom of the crowds” to scan the horizon and plan for a more sustainable future.

Horizon Scanning Pilot Meeting Objectives

The workshop was convened by the University of Michigan Water Center at the Graduate Hotel in Ann Arbor, MI, USA, on October 7–8, 2025, with the following objectives:

- Develop a shared understanding of what horizon scanning is and its potential benefits to individual practice and the Great Lakes region.
- Identify Great Lakes–specific opportunities for conducting horizon scanning.
- Identify potential general and Great Lakes–specific obstacles to horizon scanning.
- Identify key elements necessary for a trusted Great Lakes horizon scanning process.
- Identify up to six emergent issues and pilot components of the horizon scanning process.

The Great Lakes Horizon Scanning workshop brought together a carefully selected group of scientists, policymakers, and community leaders to identify emerging issues, opportunities, and barriers shaping the future of the region (see Appendix A for the attendee list and Appendix B for the agenda).

Horizon Scanning Process

Horizon scanning is a systematic, forward-looking process used to identify and assess emerging environmental, technological, and socio-economic issues that could shape the future of a particular system, organization, or region. Its goal is to detect early signals of change, often weak or nascent, and analyze their potential implications before they fully materialize. In doing so, horizon scanning enables policymakers, scientists, and decision-makers to anticipate risks, capitalize on opportunities, and prepare strategic responses to possible future scenarios (Bengston, 2013; Hines et al., 2019).

A successful horizon scanning process is built on trust, transparency, and inclusivity. Sound science from credible experts is essential, but developing a common language and shared purpose among diverse stakeholders can be equally important. To be effective, the process must clearly articulate how input will be gathered, evaluated, and incorporated, with multiple opportunities for engagement.

The process typically begins by defining the scope and objectives of the scan—one of the major accomplishments on the first day of this workshop. Establishing a clear problem statement at the outset provides focus and accountability, while iterative feedback ensures adaptability as new insights emerge. Defining scope includes clarifying the area of focus, determining key issues of concern, and establishing desired outcomes, such as identifying emerging threats, opportunities, or research priorities.

Once the scope is set, the information-gathering phase begins, drawing on a wide array of sources, including academic and grey literature, regulatory documents, media, expert interviews, and even social media and online data platforms (Schindler & Baena, 2023). This information is analyzed through a combination of qualitative and quantitative techniques, such as trend analysis, the Delphi method, scenario planning, and environmental scanning, which are often supported by automation-based tools like text mining to manage large datasets (Veenhoff et al., 2025).

The next critical stage involves sense-making, or the interpretation of raw information to identify patterns, clusters, and signals of change that might indicate potential disruptions or transitions (Abdelhakim et al., 2024). The sense-making portion of the horizon scan took place on the second day of the workshop. In this

phase, experts and stakeholders assess signals, cluster related risks, and evaluate their potential impacts, both positive and negative, on the defined system (Muench et al., 2024). Analysts also examine underlying driving forces, such as political, economic, or ecological trends, and use them to construct plausible future scenarios through methods like backcasting and cross-impact analysis. This stage allows for a nuanced exploration of how multiple factors may interact to produce cascading or compounded effects.

Following analysis, horizon scanning emphasizes prioritization and strategic planning. This step identifies the most critical emerging issues and assesses their urgency, severity, and potential consequences. These insights inform the development of adaptive strategies, management plans, and policy recommendations rooted in a forward-looking understanding of risk and opportunity (Bengston, 2013).

The final stage involves communication, monitoring, and iteration; sharing results with relevant stakeholders, establishing systems to track trends over time, and regularly updating the scan as new information emerges (National Academy of Sciences, 2020). Throughout, effective horizon scanning depends on diverse stakeholder engagement, flexibility, and continuous feedback to ensure the process remains relevant and responsive to changing contexts.

Overall, by identifying weak signals and early indicators of change, horizon scanning helps decision-makers anticipate risks and seize opportunities before they fully emerge. Discussions in the workshop reflected both optimism about the power of collaboration and proactivity, as well as concern about the fragility of current social, political, and ecological systems. Through shared dialogue, participants explored how horizon scanning could guide proactive action, foster trust, and strengthen resilience across the Great Lakes basin.

WORKSHOP OUTCOMES

Potential for Horizon Scanning Application in the Great Lakes

Workshop participants concluded that the Great Lakes region offers a strong foundation for horizon scanning, supported by engaged research networks, active local organizations, and deeply invested residents. Leveraging existing trust and expertise is key to sustaining engagement and expanding participation. Integrating horizon scanning into established bodies, such as the Great Lakes Advisory Board or Task Force, could help ensure that foresight becomes an ongoing, institutionalized practice.

Authentic community engagement is both a value and a necessity. Reaching beyond traditional scientific and policy circles to include underfunded agencies, grassroots organizations, Indigenous communities, and local institutions will enrich the process with lived experience and ensure emerging issues are viewed through social, cultural, and public health lenses.

Artificial intelligence tools offer the ability to scan volumes of information, identify patterns, and flag weak signals of change. Private-sector forecasting and innovative approaches such as “reverse scans,” which begin with known challenges and work backward, also represent promising models for strengthening future horizon scanning efforts.

Enabling Conditions, Opportunities, and Obstacles to Implementing Horizon Scanning

While enthusiasm for horizon scanning in the Great Lakes is high, participants identified several obstacles that must be addressed:

- **Persistent silos:** Disconnection between water quality and natural resources (e.g., fisheries) limits interdisciplinary collaboration.
- **Political and funding instability:** Federal support is fragile, and political shifts can affect information integrity and funding reliability.
- **Relevance and engagement:** Long-term foresight may be deprioritized if not linked to personal relevance and tangible benefits (e.g., public health, economic resilience).
- **Capacity constraints:** Tribal nations and smaller agencies often lack stable funding needed for long-term thinking.
- **Emerging pressures:** Rising freshwater demand from new industries, loss of winter conditions, and unequal water access signal urgent concerns.

Participants agreed that overcoming these obstacles will require challenge-based long-term funding, integrated governance structures, and clear linkages to real-world benefits to sustain engagement and trust.

Key Elements of a Trusted Process

To undertake a full horizon scan, workshop participants identified six key elements:

- **Transparency:** Clearly communicate how public and stakeholder input informs decisions.
- **Accountability:** Begin with a well-defined problem statement that guides the scan.
- **Inclusivity:** Cultivate diverse participation from research, policy, community, and underserved groups.
- **Iterative learning:** Integrate ongoing feedback to adapt the process.
- **Communication:** Use creative strategies (arts, technology) to strengthen engagement and understanding.
- **Equity and trust:** Embed these principles throughout the process so outcomes resonate across social, cultural, and health dimensions.

Pilot Horizon Scans

Before the workshop, participants completed a pre-survey identifying 1-3 issues that met the following criteria:

- The issue is not yet adequately addressed in the Great Lakes region and remains unknown or “fuzzy.”
- If it materialized, it would generate short- or long-term disruption (economic, social, or environmental).
- There is no clear governance or management home for the issue, nor effective policies to address it; it is not a current policy priority.
- We lack a clear understanding of potential impacts and/or ways to address them.
- There is a research gap.
- There is a programmatic gap.
- The region lacks a cross-sector partnership network to address it.

The issues most frequently identified were:

- Rising freshwater demand (e.g., from data centers) and changing freshwater supply
- Microplastics and emerging contaminants
- Loss of resilience within Great Lakes governance systems
- Climate migration and its impact on water resources
- Pressure to export Great Lakes water
- Impacts of new invasive species (terrestrial and aquatic)
- Providing affordable water for all
- Resilience of Great Lakes shorelines and coastal regions
- Measuring progress in the Great Lakes beyond ecological indicators
- Loss of winter in the Great Lakes region
- Health of and funding for water infrastructure
- Dam removal and future fisheries management
- Access to the Great Lakes

EMERGING ISSUES

We presented these topics to the group at the end of the first day and used a sticky-dot voting exercise to identify priority emerging issues for the pilot horizon scan. Five topics stood out and were explored in depth by five groups of 4–6 individuals throughout the second day of the workshop.

1. Rising Freshwater Demand: Driven by industrial growth, data centers, and population shifts, rising freshwater demand poses significant ecological, economic, and social risks.

Impacts	Driving Forces	Future Scenario
<ul style="list-style-type: none"> • Positive: Cleaner water through new technologies and increased recycling to replenish aquifers; economic opportunities, utility and construction jobs; challenges that foster collaboration and improved governance. • Negative: Loss of habitat, wetlands, and groundwater; degraded water quality; resource competition; public health risks; rising costs and affordability issues for utilities and treatment. 	<ul style="list-style-type: none"> • Ecological: Climate change and drought. • Economic: Industrial expansion (particularly data centers) competes with agricultural water needs. • Social: Perception of an unlimited water supply in the Great Lakes; population migration increasing demand. • Political: Pro-business/tech-oriented policies and fragmented local decision-making encourage short-term choices. 	<p>A shared-resource mindset grounded in both short- and long-term goals. A transparent, adaptive water budget process that responds to ecological change and population shifts, supported by innovative technologies and global best practices.</p> <ul style="list-style-type: none"> • Next Step: Education and research to guide long-term strategy.

2. Microplastic Contamination: Emerging pollutants challenge existing regulatory regimes and require new governance approaches rooted in precaution and prevention.

Impacts	Driving Forces	Future Scenario
<ul style="list-style-type: none"> • Positive: New scientific understanding; expanded monitoring; job creation; improved coordination among municipalities; opportunities to strengthen governance; increased public advocacy. • Negative: Disrupted trophic interactions; altered biogeochemical cycles; higher risks from invasive species, costly cleanup; agricultural impacts; losses in recreation and tourism revenue; poor public health outcomes; negative public perception and media coverage. 	<ul style="list-style-type: none"> • Ecological: Ecosystems are passive recipients of accumulating microplastics. • Economic: Externalized production costs; remediation is not economically viable under current systems. • Social: Consumption and overconsumption preferences for convenience products; low public awareness. • Political: Difficult to regulate; significant corporate influence limiting regulatory action. 	<ul style="list-style-type: none"> • Next Step: Expand research and monitoring; increase staffing resources for microplastic cleanup.

3. Governance Challenges: Fragmented agreements, overlapping jurisdictions, and political tensions undermine collective response capacity.

Impacts	Driving Forces	Future Scenario
<ul style="list-style-type: none"> • Positive: Shared waters enable collaboration; strengthened monitoring, target setting, and stakeholder involvement; new opportunities to rebuild resilient systems. • Negative: Current agreements do not adequately address climate change; emerging issues fall outside existing structures; inequitable cost-sharing; disconnect between governance and societal value; too many decision-makers and too little cooperation. 	<ul style="list-style-type: none"> • Ecological: Disruption of scientific collaboration due to funding cuts; climate change and groundwater threats. • Economic: Massive water demands from AI data centers; increased recreation in the Great Lakes. • Social: Growing public appreciation of the Great Lakes; new issues that do not neatly fit current agreements; humanitarian water needs beyond the Compact. • Political: Tension between the U.S., Canadian, Tribal, and First Nations governments; uncooperative leaders; limited accountability. 	<ul style="list-style-type: none"> • Next Step: Develop accountable, effective governance systems that support a resilient Great Lakes region and healthy communities.

4. Water Affordability: Deep and persistent social inequities stem from historical underinvestment, structural racism, and the imperative to treat water as a fundamental human right.

Impacts	Driving Forces	Future Scenario
<ul style="list-style-type: none"> • Positive: Sewer separation reduces CSO; economic development; reduced health care costs; improved public health; greater trust in government. • Negative: Reduced resilience due to short-term decisions; CSO and flooding; costly emergency repairs; lost economic opportunities; weakened connection to local environments; eroded trust in institutions. 	<ul style="list-style-type: none"> • Ecological: Industrial contamination; increased demand; abundant surface water; new scientific knowledge. • Economics: Chronic underinvestment; rising labor and material costs; population decline; growing household and municipal debt. • Social: Structural and institutionalized racism; segregation; white flight; low trust in institutions. • Political: Short-term thinking; inconsistent policy; limited accountability to communities of color; low voter participation. 	<ul style="list-style-type: none"> • Next Step: Invest in water infrastructure to improve affordability and access at both household and community levels.

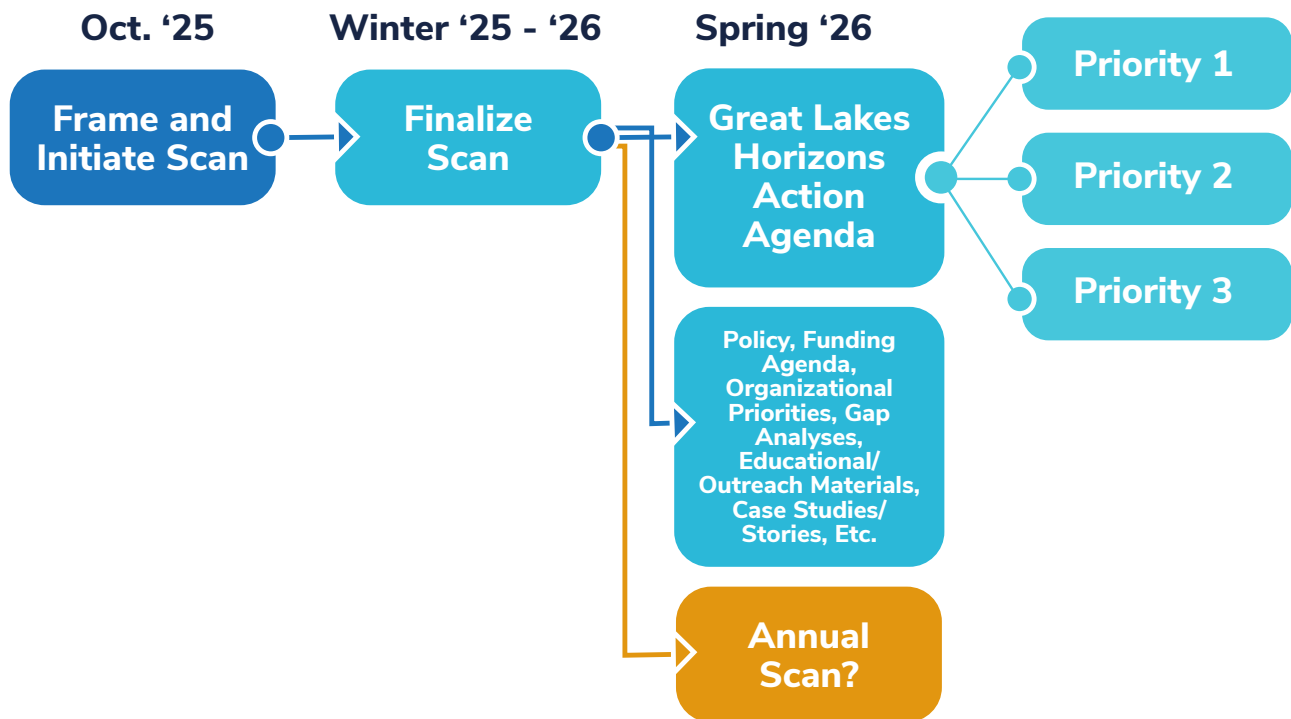
5. Declining Winter: Climate change threatens ecosystems, local economies, cultural identities, and Indigenous rights as winters become shorter, warmer, and less predictable.

Impacts	Driving Forces	Future Scenario
<ul style="list-style-type: none"> • Positive: Milder winters; lower heating costs; extended tourism seasons; increased data to inform policy. • Negative: Shifting climate zones; species loss; forced migration; increased invasive species and pests; agricultural impacts; cultural loss; shipping and Coast Guard challenges from inconsistent ice conditions. 	<ul style="list-style-type: none"> • Ecological: Climate change; altered atmospheric composition. • Economic: Industrial emissions; manufacturing and shipping; carbon-intensive activity. • Social: Lack of consensus on climate change causes; distrust in science; reluctance to join international agreements; culture of convenience. • Political: Energy policy gaps; weak accountability; limited incentives for green-tech transition. 	<ul style="list-style-type: none"> • Next Step: Expand education, strengthen policy implementation, and plan proactively for long-term impacts.

These priorities reflect intertwined ecological, economic, and social dimensions that require integrated governance, equitable investment, and foresight-driven decision-making.

NEXT STEPS

The horizon scanning process developed through this workshop lays essential groundwork for a full regional scan. There is strong enthusiasm for a comprehensive Great Lakes Horizon Scan in 2026, integrating ongoing research, stakeholder feedback, and community participation. Next steps include refining emerging threats, deepening engagement, and developing a roadmap to sustain horizon scanning as a living tool for the region's long-term resilience.



APPENDICES

- Appendix A: 2025 Great Lakes Horizon Scanning Attendee List
- Appendix B: Great Lakes Horizon Scanning Workshop Agenda
- Appendix C: Opportunities and obstacles notes
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Appendix A: 2025 Great Lakes Horizon Scanning Attendee List

First	Last	Organization
Aaron	Suntag	Public Strategies Washington
Al	Steinman	Grand Valley State University
Alison	Bressler	U-M Water Center
Anna-Lisa	Castle	Elevate
Bo	Bunell	USGS Great Lakes Science Center
Bridget	Brown	Great Lakes & St. Lawrence Cities Initiative
Collin	Knauss	Great Lakes Protection Fund
Elan	Plochedly	Michigan State University
Emily	Finnell	Environment, Great Lakes, and Energy, Office of the Great Lakes
Erika	Jensen	Great Lakes Commission
Gabe	Ehrlich	U-M, LSA
Hira	Ahmad	Erb Family Foundation
Jen	Read	U-M Water Center
Jenny	Wensink	Graham Sustainability Institute
Jess	Rudnick	University of Illinois Extension, Natural Resources, Environment, and Energy (NREE) Program
Joel	Brammier	Alliance for the Great Lakes
John	Bratton	LimnoTech
Joy	Mullinex	Ohio Lake Erie Commission
Kathryn	Buckner	The Americana Foundation
Laura	Rubin	Healing Our Waters–Great Lakes Coalition
Lisa	Dinon	National Wildlife Federation
Margeurite	Xenopoulos	Trent University
Melissa	Scanlan	University of Wisconsin, Milwaukee
Melissa	Slotnick	University of Michigan, School of Public Health
Mike	Shriberg	U-M Water Center
Nancy	Stoner	Environmental Law and Policy Center
Patrick	Doran	The Nature Conservancy, Michigan
Sarah	Miller	The U-M Water Center

Appendix B: Great Lakes Horizon Scanning Workshop Agenda

Tuesday, October 7, 11:30 am to Wednesday, October 8, noon
Graduate by Hilton | 615 E Huron St, Ann Arbor

Tuesday, October 7

Noon: Welcome, Introductions and Framing

What is horizon scanning; what is its use in our work?

Participants consider:

- How can I use this in my work? How could this be useful to others in my organization, sector?
- What are potential opportunities for supporting horizon scanning in the GL region?
- What are potential challenges to horizon scanning in the region? (Notes Link)

Identification of issues just over the horizon

Participants consider and build on pre-meeting survey of potential issues to identify priorities for day two

5:30 pm: Adjourn Day One

Wednesday, October 8

8:30 am: Re-convene, Overview Day Two

Piloting horizon scanning - sense-making

Participants work with one of the prioritized issues from day one to:

- Assess potential impacts of the issue (Notes Link)
- Identify underlying, driving forces (Notes Link)
- Develop future scenarios (Notes Link)

Next Steps

Participants consider:

- Key next steps for each issue
- Who should be involved

Wrap up and reflections

12:00 noon Adjourn

Appendix C: Opportunities and obstacles notes

Groups 1-4 each included 6+ attendees from different backgrounds and perspectives led by a facilitator. Each table was tasked with discussing the possible opportunities and obstacles to Horizon Scanning based on their personal experiences.

Opportunities and Obstacles (Group 1)

AI Summary: Opportunities: The Great Lakes region can leverage regular convenings, diverse multi-sector leadership, funding networks, global collaborations, and existing reporting structures to support and sustain horizon scanning. Creative engagement, strong research communities, scalable collaboration models, and advanced data tools like AI will further enhance the process and drive meaningful action. **Obstacles:** political and governance challenges, economic and social realities, organizational silos, limited capacity and engagement, weak integration of human health and well-being, lack of trust and buy-in, undervaluing human dimensions, biases, and difficulties distinguishing meaningful signals from noise.

Opportunities	Obstacles
Existing processes/activities in the Great Lakes region that could be used or support all or part of the HS process, e.g., regular convenings such as HOW or GLEC; funding resources; key leadership	General and GL specific political, governance, economic, social realities that could prevent participation of a particular group/agency/organization
*CIGLR workshops for horizon scanning	Silos - water quality silo and fisheries silos are particularly significant
*Table Setters - Multi-sectors: Governments (Governors and Premiers, GLC, GL Science Action Team, GLSL Cities Initiative as convenors for Horizon Scanning); culture/story-telling (Circle of Blue); NGO (eg HOW); Thought leaders/academic; practitioners Convening a la GL Regional Collaboration Strategy We need to think about the agenda-setter(s) and what outcomes we're looking for	Politics/priorities of the day, short political attention span
*GL Funders Networks - leveraging the community to support the horizon process - non-partisan funding source bc there is not funding support within government budgets And they leverage each other	Capacity for orgs and individuals to meaningfully engage Esp for ppl who are not doing this work in their jobs - how do we hear from them?

Opportunities	Obstacles
Global perspectives - where the GL Region is already working with other global great lake regions, eg pairing with African GL, participate in world GL conferences and/or invite them to participate in our process	If this is going to be an issue in 10 years ppl say great, I don't have to think about it right now
Global perspectives - where the GL Region is already working with other global great lake regions, eg pairing with African GL, participate in world GL conferences and/or invite them to participate in our process	Weak at tying in human health and social / well-being dimensions undervalued
<p>*IJC SAB products, such as webinars, etc - venue for informing horizon scanning</p> <p>Status of the GL Report - could report in this process</p> <p>TAP - Trends and Assessment of Progress could have a component of that product</p> <p>Do these really drive action?</p>	<p>Human dimensions:</p> <p>It's not just economics and jobs - that short-changes the way we view things</p> <p>There is need for trust and buy-in to these processes; and water and governance systems</p> <p>Teodoro scholarship - trust in government = trust in water</p>
<p>Think about having fun and what would sustain the process; to keep networks resilient through disruption</p> <p>Care for the community and recruit new people</p>	Distinguishing signal from noise - how do we see signals
Sci-fi book clubs, watch movies, look to the arts for inspiration	Biases, such as recency bias, inevitability bias (climate refugees)
Research community is strong and willing	Perfectionism and comprehensiveness
GLFC approach to scaling this kind of work: from lake-based to Lake Committees to Council of Lake Committees	
<p>AI might help scan a huge variety of sources/data to help identify signals over noise</p> <ul style="list-style-type: none"> • Social media, data, papers, newspapers 	

Opportunities and Obstacles (Group 2)

AI Summary: Opportunities include leveraging existing convenings, funding sources, leadership networks, advisory boards, summit platforms, key commissions and research centers, effective communication channels, and strategic partnerships—including Native Nations—while learning from inclusive, coherent models like the AOC approach. **Obstacles** include political, governance, and economic challenges; limited and unreliable funding; resource constraints among tribal partners; episodic project-based support; lack of future-focused funding and workforce; fragile federal support; insufficient inclusion of economists; multi-lateral and partisan complexities; and difficulties in sustaining engagement and validating outcomes.

Opportunities	Obstacles
Existing processes/activities in the Great Lakes region that could be used or support all or part of the HS process, e.g., regular convenings such as HOW or GLEC; funding resources; key leadership	General and GL specific political, governance, economic, social realities that could prevent participation of a particular group/agency/organization
Include HS/what comes out of a HS as one of the charge questions of the GL Advisory Board ; these questions are the areas to focus on for future GLRI	Tribes working with state/federal bureaucracy can be challenging
Include HS/what comes out of a HS as a Summit idea for CIGLR	Resource and energy limitations of tribal partners to engage
GL Task Force - engaging them and having political leadership involved/on the same page, e.g., propose a policy agenda that they could get behind	Funding tends to be project-based, episodic and reactionary vs challenge-based and looking to the future ; if you want to have staff to being available on a relevant timeline, you need to have funding to plan around; the funding community should be aware of this challenge Funders tend to fund the problems of the past, not the future; that tends to dictate what work happens
GL Funders Network – lots of funding for GL work comes from this group, so engaging them	Federal support is really fragile right now
Great Lakes Commission – they have an annual meeting that could be leveraged; essential though to follow through and follow up	GL policy community has not involved many economists; they should be involved in this process How would you validate the outputs/outcomes of a HS in a traditional way
Water Center which has stayed in touch, sustaining a loose community	Lack of trained workforces to address the needs that get identified through a HS
Journal of GL Research that could support communication about a HS/what comes from a HS	Multi-lateral relationships in the current political climate of the trade war
Engaging key partners Native Nations, Inter Tribal Council of Michigan	Partisan differences, e.g., affects language groups use

Opportunities	Obstacles
GL Fishery Commission is a key partner to engage	Funding – not enough of it, not predictable Tribes in particular have seen this; funds run out and the work is not done; this way of working impacts relationships
What can be learned from the AOC model? It was reactionary but it had coherence, fed support, inclusive, and decentralized action	Sustainability issue: What are the incentives to get people to work together and dedicate their time?
	Humans tend to focus on the present; how do we help them focus on the future? What is the compelling case for involvement?

Opportunities and Obstacles (Group 3)

AI Summary: Opportunities include leveraging existing processes, funding, and leadership in the Great Lakes region while actively engaging diverse new voices—such as youth, students, families, and grassroots organizations—building capacity for underfunded and frontline groups, applying industry forecasting methods, and exploring reverse scanning to better understand early signals and issue development. Obstacles include difficulties engaging diverse community members—particularly those outside professional roles—balancing immediate needs with long-term concerns, reaching consensus as priorities shift, and bridging gaps between historic policy drivers and future requirements.

Opportunities	Obstacles
Opportunities: existing processes/activities in the Great Lakes region that could be used or support all or part of the HS process, e.g., regular convenings such as HOW or GLEC; funding resources; key leadership	Obstacles: general and GL specific political, governance, economic, social realities that could prevent participation of a particular group/agency/organization
Engage new voices that want to be a part of the process (e.g., youth), encourage new ideas, students (college, high school, children), families (childcare?), grass roots organizations.	How do you engage people in different communities to identify concerns, including community members, activists, advocates. Need to pull in different voices, people who aren't doing this as part of their jobs.
Supporting capacity for underfunded agencies and frontline community organizations to be a part of the process	Short term needs vs long term concerns. Why should this be a priority? How can we tie in future emerging issues to address immediate needs.
Learn from methods that industry uses for forecasting/horizons scanning	Challenges adjusting priorities and shift scope/agendas to reach agreement/consensus.
Could you reverse scan? Backtrack from a major issue and look back towards what were early indicators (when did people become concerned? When did it gain traction?)	Scope and scale - disconnect between historic policy drivers and what's needed in future

Opportunities and Obstacles (Group 4)

AI Summary: Opportunities include incorporating horizon scanning into existing Great Lakes convenings and networks—such as IAGLR, the Great Lakes Commission, funders, government task forces, collaborative researcher networks, SeaGrant, and community hubs—leveraging strong regional collaboration, bipartisan engagement, and community perspectives, and promoting awareness through initiatives like Great Lakes Appreciation Week, tourism, and the Pure Michigan campaign to connect people to water. Obstacles include limited affordability and organizational buy-in for broader stakeholder participation, skewed data based on who attends convenings, partisanship and lack of relevance for some groups, persistent silos in research and agencies, weak connections to the Great Lakes for inland communities, tensions between development and ecological priorities, competition among states for tourism, and ongoing campaign finance challenges.

Opportunities	Obstacles
Opportunities: existing processes/activities in the Great Lakes region that could be used or support all or part of the HS process, e.g., regular convenings such as HOW or GLEC; funding resources; key leadership	Obstacles: general and GL specific political, governance, economic, social realities that could prevent participation of a particular group/agency/organization
Existing convenings in the Great Lakes - IAGLR, Great Lakes Commission, Great Lakes Funders Convening, Governors and Premiers, business events, festivals - put Horizon Scanning on the agenda at these existing meetings to gather horizon scanning data	Broad range of stakeholders beyond those currently attending the big convenings - need to make it affordable for people to gather and pay for the data collection at the convening.
GLRI - already has regional working groups who meet regularly across agencies	Polluters - missing the connection of a healthy environment to their bottom line or they think they are already doing everything they can.
Strong history of collaboration through GRLI and Great Lakes Agreements	Skewed information based on who is at the table
Great Lakes Task Force in the House and Senate could host a bipartisan hearing/briefing - non partisan discussion type event Panel of elected officials - two republicans/two democrats (Wisconsin Example)	Partisanship - and groups who feel that a healthy great lakes isn't relevant to them
Collaborative network of University researchers who are gathering the data - uniform defensible way of collecting the data and modeling/analyzing that data - the product would be more robust due to broader inputs - funnel the data - academics could inform what would be a representative survey to be enough to be defensible so that the governor's office could point to a reputable paper	Silos in research and the agencies and even between units and departments

Opportunities	Obstacles
SeaGrant could come together and activate to mobilize their networks	Lack of connection to water - Inland folks might not make a connection to the Great Lakes because they aren't on the water. Missing out on how the Great Lakes makes their community great
Engage at the community level - get the authentic community perspectives - community Hubs, houses of worship, libraries, food banks, community foundations, regional councils of government (SEMCOG)	Tension between development vs. ecological impacts on water - bringing in balanced voices may threaten the business sector - unbalanced power
<p>Develop Great Lakes Appreciation Week - PR/ slogan,</p> <p>Tourism - may be an opportunity with the new cruise ships moving through the great lakes</p> <p>Pure Michigan campaign</p> <p>Connecting people to Water</p>	Competition among states for tourism
	Campaign finance reform

Appendix D: Impacts, drivers, and future scenarios

On day two of the meeting, participants self-selected into five categories:

1. Rising Freshwater Demand/Changing Freshwater Supply
2. Microplastics
3. Future/Resilience of Great Lakes Governance
4. Providing Affordable Water for All
5. Loss of/Changes In Winter in Great Lakes Region

They practiced the horizon scanning process by identifying the scope, positive and negative impacts of the issue playing out, identified driving forces and developed future scenarios.

Group 1: Rising Freshwater Demand/Changing Freshwater Supply

Scope: Addressing rising and changing demands for clean, fresh water in the Great Lakes Basin: strategies for creating a water budget within the less than 1% renewal rate. Budgeting for short term plans (5 years) and long term goals.

Geospatial: Great Lakes Basin geography, staying within 1% water use/renewal budget, “clean” fresh water.

Timeline: Thinking like retirement - have long term goals but a short term budget that adjusts into the future.

Impact

Issue	Positive Impacts	Negative Impacts
Ecological	<ul style="list-style-type: none">• Bring new technologies into system to get cleaner water (e.g., learn from other regions with water insecurity)• Replenish aquifers with recycled water	<ul style="list-style-type: none">• Loss of habitat• Loss of wetlands• Increased greenhouse gasses• Increased heat storms• Instability of water levels• Groundwater depletion• Warmer water• Degrading water quality

Issue	Positive Impacts	Negative Impacts
Economic	<ul style="list-style-type: none"> • Potential for increased water recycling • Motivation to plan better for economic efficiency • Increase in construction and utility jobs • Forced consolidation of water systems • Increased economic opportunities in certain regions (e.g., data centers but also new technologies) 	<ul style="list-style-type: none"> • Loss of traditional jobs • Power to industries - accountability • Fewer owners/more workers - imbalance • Rising treatment cost • Water affordability • Impacts on tourism • Rising utility costs in general • Fishing impacts • Shipping impacts • Intake pipes for drinking water supplies
Social	<ul style="list-style-type: none"> • Might change behaviors towards conservation and protection • Migration can bring in new people to communities 	<ul style="list-style-type: none"> • Data centers - community impact (come and go, how does this impact?) • Resource competition • Health impacts - stress, physical health and connection/access to the water
Political	<ul style="list-style-type: none"> • Crises can create opportunities for collaboration and strengthening of governance • Potential for more representation in government depending on population growth 	<ul style="list-style-type: none"> • Competition between states

Drivers

Categories	Drivers
Ecological	<ul style="list-style-type: none"> • Climate change • Drought
Economic	<ul style="list-style-type: none"> • Industry use (Data centers, but not just. Full permitted amount of water not being used by utilities, so utilities are working to attract more industrial users- but can lead to overuse as industry grows; also industrial pollution) • Increasing power demands • Increased food system demands, possible increased irrigated agriculture in the future • Growth mindset for cities

Categories	Drivers
Social	<ul style="list-style-type: none"> • Inflated/erroneous sense of unlimited water resources • Population migration • Increase demands on utilities
Political	<ul style="list-style-type: none"> • Industry/data centers: Pro-business/tech forward political mindset • Political power imbalance between large corporations (e.g., data centers) and small local governments • Lack of understanding about what data centers/industries are actually doing for communities • Fragmented decision making among local governments • Decisions are being made in short term vs considering long term implications

Future Scenario

How will positive impacts be realized?	How will you avoid or mitigate negative impacts?
Shared resource mindset, recognizing short and long term goals. Developing a budget that sticks to changing ecological conditions, short and long term.	
How will driving forces be harnessed/utilized?	How will driving forces be harnessed/utilized?
Regional governments could set a water budget by identifying current demands and understanding what remains for future uses. Increased regulation and oversight at multiple levels, innovative increased participation from multisector residents and industry in conservation (e.g., maybe incentives).	
Who (what sectors, organizations and/ or individuals) will be involved?	Who (what sectors, organizations and/ or individuals) will be involved?
Empowerment of local communities. Incentivize environmentally responsible industries. Bring in different partners to the table to highlight issues that people want to see regionally. NGOs, local government, community members, state/province leaders.	

What do you think we need to do in the immediate future/right now to ensure the Great Lakes region moves toward this future?

Education/advocacy - provide resources to mayors and public about questions to address before hosting a new data center (or other industry). Local to state/province level education and communication (presenting recommendations - e.g., nonprofits - workshops to pull local governments together that focus on ecosystem and health impacts). Get the information to residents as well - Q: why do they use water, what do they use it for, what kind of jobs do they provide? Possible education tool: using draw re: Nestle in MI for bottle water to contextualize how much

- States propose moratoria on data centers until there's a state level ability to access all of the information and proposals. Needs to be a regionally-coordinated effort.
- Research on forecasting population migration and changing climate impacts to use in a budget model
- Requirements of transparency from industry for the community: how much water is needed, etc.
- Strong leadership on state level - building towards collective movement by state governors

Group 2: Microplastics and emerging contaminants

Scope: Human made materials introduced to the environment that have potential negative impacts to the environment and public health

Geospatial: Basin-wide, if not larger

Difficult to prevent and requires precautionary principles

Other notes about what we considered in developing the scope

- Issue is one of Complexity, ubiquitous nature
- To address them, you have to “treat the disease, not the symptoms” (but this is not what the HS process supports)
- Requires a governance structure
- Requires monitoring, detection/scanning of chemicals before they become an issue

Impact

Issue	Positive Impacts	Negative Impacts
Ecological	<ul style="list-style-type: none"> • Research and monitoring needs • Opportunities to create new scientific understanding • Could wipe out invasives 	<ul style="list-style-type: none"> • Disrupt trophic level interactions and alter biogeochemical cycles • In soils, gets taken up by plants and affects fish and wildlife which has impacts • Disrupts ecological systems • Increases risk of invasives • Increases ecosystem vulnerability

Issue	Positive Impacts	Negative Impacts
Economic	<ul style="list-style-type: none"> • Research and monitoring investments • Creates cleanup jobs (consultants, researchers, gov jobs, private sector jobs) • Companies make money selling the products that produce the contaminants 	<ul style="list-style-type: none"> • Costly to cleanup and remove • Impacts/costs to human health • Cost of drinking water • Impacts on agriculture • Increase cost of O & M • Lost economic revenue, e.g., recreational fishing, tourism • Lower housing and commercial values
Social	<ul style="list-style-type: none"> • Improved governance structure if there are solutions to address the issue • -Manufacturing and cleanup jobs 	<ul style="list-style-type: none"> • Poor public health outcomes • -Lack of recreational opportunities • -Decreased quality of life • -Negative perception of an area that has been heavily impacted
Political	<ul style="list-style-type: none"> • New regulatory framework • Better coordination among municipalities because the issues can't be done in one municipality • Creates more advocates • More donations to campaigns that support your issue 	<ul style="list-style-type: none"> • Bad press • Political consequences if the issue is not addressed, e.g., not re-elected • Opportunity cost

Drivers

Categories	Drivers
Ecological	<ul style="list-style-type: none"> • The ecosystems are passive recipients of these impacts
Economic	<ul style="list-style-type: none"> • Profit • Classic externality, the cost of production is not taking into the cost to public health, environment, i.e., polluter doesn't pay • Remediation is not economical • It's much easier/cheaper to pay for cleanup than to stop producing the product • Consumer demand for ease of use and low cost
Social	<ul style="list-style-type: none"> • Consumption, perhaps overconsumption; desire for products that are easy to use • Lack of awareness of and connection to the problem • Lack of alternatives • The current discrediting of science • Culture of abundance

Categories	Drivers
Political	<ul style="list-style-type: none"> • Willingness of municipalities to choose/prioritize economic development without considering environmental/health impacts • Inherently difficult to regulate • Large investment of companies to influence political decisions and limit regulatory control

Future Scenario

How will positive impacts be realized?	How will you avoid or mitigate negative impacts?
<p>“Adaptively managed great lakes, including the entities and agreements that are flexible to handle emerging issues. With a realization that the governance is a “complex system”. But decision makers know how to navigate. And citizens are able to participate and their needs are met. Ability to navigate the scales and levels of governance reliably.</p> <p>Great lakes effective governance - people are being served in a way that is meaningful to them.</p> <p>Clear values that are meaningful to local needs</p> <p>And clear data/knowledge to inform decisions”</p> <ul style="list-style-type: none"> • Increased trust, increased civic engagement • Shared vision • Great Lakes identity/placemaking is strengthened/ mainstreamed • Identity moves from post-industrial to tourism and livability • Affordability and livability exists • Increased timeliness of response 	
How will driving forces be harnessed/utilized?	How will driving forces be harnessed/utilized?
<ul style="list-style-type: none"> • Agreements can handle changing and emerging issues • Clear information and data agreed upon - that are included in the conversation; and knowledge is trusted • Increased connections and collaborations between those entities - processes, entities and rule • Awareness and recognition of the nature that this is a complex system with no easy fix 	

Who (what sectors, organizations and/ or individuals) will be involved?	Who (what sectors, organizations and/ or individuals) will be involved?
<ul style="list-style-type: none"> • E.g. 2022 public forum - lots of members of public with meaningful questions that the administrators couldn't really answer -> having a systems perspective • Those that are impacted and those that are empowered to solve are both at the table • Industry • Water utilities (as part of local govt) • 2005 Regional Collaboration - lots of stakeholders involved...what would be different in a future design? 	
<p>What do you think we need to do in the immediate future/right now to ensure the Great Lakes region moves toward this future?</p>	
<p></p>	

Group 3: Future/Resilience of Great Lakes Governance

Scope: Accountable, effective Great Lakes governance system that leads to a resilient Great Lakes with healthy communities. Overviews of various agendas of diff organizations. Many go beyond the gl compact and gl water quality agreements. Indicative of the need for more than the federal agreements. Early indicators of more need

Geospatial: Multi-lateral/national/regional

Strategic: the decisions that affect the ways in which people and nature interaction with the lakes...health of communities and ecosystem;

Timeline: relevant now and for decades forth

Why is this on the horizon - the current system may not be resilient

Strategic: the decisions that affect the ways in which people and nature interaction with the lakes...health of communities and ecosystem; Accountable and effective and equitable and reasonable.

Impact

Issue	Positive Impacts	Negative Impacts
Ecological	<ul style="list-style-type: none"> • Shared waters allows for water quality protection collaboration • Strong emphasis on target setting, monitoring, and stakeholder involvement 	<ul style="list-style-type: none"> • Current agreements don't tackle climate change; scale of climate change may be too broad (ie beyond GL basin) • current agreements and entities may miss some emerging issues
Economic		<ul style="list-style-type: none"> • Cost sharing of meeting agreement goals is not fair/equitable • Current agreements and entities may miss some emerging issues
Social	<ul style="list-style-type: none"> • Find the ways to be accommodating of future impacts/issues 	<ul style="list-style-type: none"> • current agreements and entities may miss some emerging issues • Fragmented and overlapping governance, multi-jurisdictional complexity, lack of coordination (e.g., drinking water safety, beach closures) • Disconnect between governance (or perception of governance) and the value to society • Decreasing public understanding of the importance of governance structures. No understanding or appreciation of why this governance is important • E.g. flint water crisis really wasn't covered by the agreements and governance structure.
Political	<ul style="list-style-type: none"> • Current agreements: Diverse voices • If fail...opportunity to rebuild • Others have created elements of other governance systems 	<ul style="list-style-type: none"> • Politics of the day • Too many decision makers, too many jurisdictions not enough cooperation • Legal and regulatory gaps • Lots of different meanings of "great lakes", not a meaningful indicator of political support • Funding may be at risk, if funding declines or disappears, will the agreements be useless or toothless

Drivers

Categories	Drivers
Ecological	<ul style="list-style-type: none"> • Disruption of scientific collaboration due to funding cuts (ie, to CIGLR, from NOAA). Without coordinated research and monitoring, the ability to respond to ecological threats is weakened • Archives of data and future data collection • Climate change and groundwater threats, ie, droughts? - including impacts on water supply
Economic	<ul style="list-style-type: none"> • Massive water demands from AI Data Centers • Increased participation in GL leisure/culture - but is also costing more
Social	<ul style="list-style-type: none"> • People are valuing GL more • Stronger assertion of tribal authority - also belongs in political driver • New issues emerging that may not neatly fit into current structures and agreements • Disillusionment with large govt • Humanitarian needs of water outside of compact - and outside of region • Weak signals of water demands • Culture identity around great lakes • Is the gov system divorced from the way people interact with the GL - disconnect between decision makers and people
Political	<ul style="list-style-type: none"> • The biggest threat IMO is the political tension between the US and Canada, and between Tribes and First Nations • Uncooperative governors or mayors or local elected officials • Lack of accountability or diffuse responsibility (e.g., “not my job”) • “Great lakes” message as a prop for other discussions • Historical political consensus is eroding or changing - loss of those political “groups” e.g., center right • Existence of “flimsy” agreements - e.g., net pen aquaculture. Or exploitation of agreements for other purposes • GLRI has begun to stand the test of time

Future Scenario

How will positive impacts be realized?	How will you avoid or mitigate negative impacts?
<ul style="list-style-type: none"> • Debt relief for communities and households • Return to community-driven decision making, meaningfully involving individuals who live and work in a place in the management - occurring in a context where people fully realize the importance of long-term financial planning, a consensus for forward thinking • A more formalized structure around rate-setting that is public and justified • Local educational opportunities to learn about water management • Local employment and training opportunities result in more community-members being employed/engaged in the utility • Increasing trust in the system bc neighbors are employed in the system. • Some kind of multijurisdictional / regional cooperation that achieves economies without causing bureaucracies or disenfranchise community members • Increases trust in the system and uncovers additional potential cooperation opportunities • We prioritize the input of women bc of their nurturing/ mothering roles and relationship between water and pregnancy are intertwined 	
How will driving forces be harnessed/utilized?	How will driving forces be harnessed/utilized?
<ul style="list-style-type: none"> • Recognition that water is a need/right • Activist organizations 	

Who (what sectors, organizations and/ or individuals) will be involved?	Who (what sectors, organizations and/ or individuals) will be involved?
<ul style="list-style-type: none"> Local community members are drawn into advisory / oversight roles and operational roles through training and engagement Significant youth involvement, training and engagement asking youth how and where they want to be involved in the system, eg employment; and asking young people how they want the system to work, e.g., I want to have a stake in the water resources in my region, to inform creative strategies about how we move us to the eventual goal. State and local government A multijurisdictional / regional cooperation/collaboration that achieve economies without causing bureaucracies or disenfranchise community members Leaders from community-based organizations who are already breaking down community barriers and finding commonalities between/among struggles faced by communities 	
<p>What do you think we need to do in the immediate future/right now to ensure the Great Lakes region moves toward this future?</p>	
<ul style="list-style-type: none"> Refocus the GL region's environmental priorities in a way that infuses social justice issues, such as affordability, into the priorities as core and recognizes that basic human health is an environmental issue 	

Group 4: Affordable Water for All

Scope: household level affordability, shutoffs, community level affordability, access = right, water is essential to life and everyone has a right to access

Strategic: Policy/ regulatory issue right now

Federal role: setting minimum standards and funding to ensure

State: governance / oversight

Timeline: Historic disenfranchisement (e.g., how urban governance has been outsourced to white, suburban communities) has caused issues and some level of repair is required to address; aging infrastructure has been purposeful

Geospatial: Water infrastructure - drinking water, sanitation and stormwater

Moving forward, what programs, policies and regulations need to be in place to ensure that all Great Lakes residents (state/province-wide) have available and affordable, safe and sustainable drinking water and sanitation services?

Impact

Issue	Positive Impacts	Negative Impacts
Ecological	<ul style="list-style-type: none"> Separated sewers would have resulted in few or no CSOs 	<ul style="list-style-type: none"> CSO, flooding, wasted water
Economic	<ul style="list-style-type: none"> Economic development Reduced healthcare costs 	<ul style="list-style-type: none"> Emergency repairs are more expensive Deferred economic opportunity (for individuals and community) bc of diversion of resources to immediate needs
Social	<ul style="list-style-type: none"> Better public health - capacity to address emerging contaminants 	<ul style="list-style-type: none"> Health and other impacts Disconnect from the local environment - can't access or not safe enough to use as recreational asset
Political	<ul style="list-style-type: none"> Trust in government 	<ul style="list-style-type: none"> Lack of trust in government and other authority, institutions Lack of resilience bc of short-sited nature and lack of capacity to respond to changing conditions

Drivers

Categories	Drivers
Ecological	<ul style="list-style-type: none"> Contamination from industries Increased demand on water resources General abundance of surface water Perception that there is lot of water New scientific knowledge, e.g., understanding of our environment and factors impacting human such as emerging contaminants Overall reduced ecosystem/water quality, need for more cleaning cost/tech
Economic	<ul style="list-style-type: none"> Historic inadequate investment in infrastructure Rising costs of labor and materials to maintain/sustain service Limited financial resources at state and local level, and loss of federal support; also competitiveness for resources Private investment is attracted to places where DW is clean, safe and inexpensive Cost of Initial investment and maintenance/upkeep expense limits development of new infrastructure to areas previously without access Population decline/tax base Increasing debt burden at household and community levels

Categories	Drivers
Social	<ul style="list-style-type: none"> • Structural and institutionalized racism • Segregation and white flight • Recognition that everyone has a need to access water • Lack of trust in institutions
Political	<ul style="list-style-type: none"> • Short-term thinking - eg not beyond the current political term • Lack of policy consistency - swinging to extremes • Disconnect / lack of awareness about what “systems” influence affordability - who is responsible, who do we talk to, where does responsibility lie • Lack of transparency of the system • Ambivalence toward issues that affect black and brown communities • Capitalism that commodifies things that should be rights • Lack of voter participation / political control limiting access to essential resources • Lack of responsiveness of the legal system and government bureaucracy

Future Scenario

<p>How will positive impacts be realized?</p> <ul style="list-style-type: none"> • -Est. basin wide consortium (needs coordination; research and monitoring are key focuses; funding structure sim to GLPF) • -Systematic process to characterize contaminants of interest and sources • - Sources that are not just present in surface waters (beyond that) need to be addressed 	<p>How will you avoid or mitigate negative impacts?</p> <ul style="list-style-type: none"> • Better education of the public and elected officials • Consistent and adequate investment in research and monitoring • Effective communications • Strong public private partnerships • Strong regulatory framework • Price reflects externalities
<p>How will driving forces be harnessed/utilized?</p> <ul style="list-style-type: none"> • Requires political leadership • Economic accountability • Better education systems/tools, e.g., case examples that demonstrate values that align with addressing the issue 	<p>How will driving forces be harnessed/utilized?</p>

Who (what sectors, organizations and/ or individuals) will be involved?	Who (what sectors, organizations and/ or individuals) will be involved?
<ul style="list-style-type: none"> • Private sector • Researchers, universities • Regulatory agencies • Venture capitalists • Educators • NGOs • Public/stakeholders, e.g., consumers, recreational interests, etc • Public health officials 	
<p>What do you think we need to do in the immediate future/right now to ensure the Great Lakes region moves toward this future?</p>	
<ul style="list-style-type: none"> • Establish basin wide consortium (needs coordination; research and monitoring are key focuses; requires thought about a funding structure, some sim to GLPF) • Figure out how to business and industry to the table • What nudges, smaller interventions could make a difference? E.g., certification to put on a product to make it environmentally friendly for the GL, hotels • Communications, e.g., amplify the voices that call for change, narrative that captures the issue and what needs to be done, include public health perspective/implications • Political leadership and champion for addressing the issue • Difficult to prevent and requires precautionary principles 	

Group 5: Loss of/Change in Winter in the Great Lakes Region

Scope: Decadal scale across whole great lakes binational watershed to answer basic winter ecological research questions and economic management impacts on winter tourism and ways of life

Geospatial: Great Lakes, binational watershed including all rivers and lakes

Temporal: Go back a century for data (at least as far back as the 1970), decadal trends - planning 10 years into the future - also the timing of when the season starts and finishes

Strategic:

Policy: global driver in carbon emissions, local state can only make small impact, sustainability of communities who rely on winter tourism. We make policy based on what is happening in the spring/summer when our research vessels are out in the water.

Research: we don't know much about what is happening during the great lakes in the winter - we need fundamental research to understand processes in the lakes in the water - critical knowledge gaps about what is happening at all trophic levels in all the bodies of water, not having snowpack/frozen ground - changing soils, nutrient cycling, and algae blooms, ecological zone grown

Management: economic viability of recreation, tourism, ice fishing

Notes: Cultural Interruptions, winter-based business - how long can they stay open and how much investment goes into making snow; ecological restoration projects are difficult under uncertainty.

Impact

AI Summary: Shifting climate zones and milder winters in the Great Lakes region will bring both opportunities—such as expanded agriculture, longer tourism and research seasons, reduced road salt, and lower heating costs—and serious challenges, including shifting native and invasive species, harm to winter traditions and Indigenous rights, altered ecosystems, increased management costs, and the need for policies and collective capacity to adapt to these profound environmental and cultural changes.

Issue	Positive Impacts	Negative Impacts
Ecological	<ul style="list-style-type: none"> • Shifting climate zones could allow new things to grow - expand agricultural capacity - winners • Less harsh winter - • Understanding the science will help us manage the changes • Possible to extend field research season under safe conditions 	<ul style="list-style-type: none"> • Shifting climate zones could cause native species to go extinct - losers • Forced migration north of species that require winter • Invasive species - community composition changes • Reduced ice coverage • Changes in nutrient cycles both on land and in the lake • Winter stratification will go away - implications for spring bloom • Algae blooms may start sooner and last longer • Rising temperatures - growth of aquatic plants like wild rice that need freezing temps for long enough. • Indigenous hunting and gathering rights are geographically bound so if the plants and animals change they lose access • Treaty rights on lake Whitefish - already declining due to invasive species but also impacted by ice • Pests diminished by colder winters - pests could be come more prevalent

Issue	Positive Impacts	Negative Impacts
Economic	<ul style="list-style-type: none"> • More navigation and trade possible - freighters can extend their time • Lower heating costs • Longer fishing season • Longer spring/fall water tourism seasons • Less road upkeep snow plows and salt 	<ul style="list-style-type: none"> • Harmed winter tourism - ice fishing, snow mobiling, skiing • Pests diminished by colder winters - pests could be come more prevalent - economic impacts on crops • Expense of management • Impacts on maple sugaring industry/ harvest (no longer have a reliable/ predictable maple tapping season)
Social	<ul style="list-style-type: none"> • By losing out on winter activities - new activities could arise 	<ul style="list-style-type: none"> • Winter culture loss • Way of living change - winter story telling in Anishenabe culture • responsibilities around ice breakers and safety with weaker less safe ice.
Political	<ul style="list-style-type: none"> • Data and visual to support policy - people universally understand the decline of winter • Policies for education to help people adapt 	<ul style="list-style-type: none"> • Governance and negotiation of indigenous restrictive spaces • Tension over managing the Great Lakes for shipping - will impact coast guard policy - there will still be intermittent ice • Do we have the collective societal capacity to manage this issue?

Drivers

AI Summary: carbon-emitting industries, societal distrust of science, consumptive behaviors, and contentious energy policies, compounded by short-term thinking, lack of consensus, weak political accountability, and unequal impacts across communities.

Categories	Drivers
Ecological	<ul style="list-style-type: none"> • These are also responses: • Climate change • Change in the atmospheric gas composition • Temperature change
Economic	<ul style="list-style-type: none"> • Industry and polluters • Short-term thinking • Carbon emitting factories, manufacturing, shipping • Businesses that prosper under status quo of emitting carbon • Perceived cost of lower emitting

Categories	Drivers
Social	<ul style="list-style-type: none"> • Lack of consensus that the driver of changing climate is carbon • Distrust in science • Lack of acceptance of change • Distrust of joining international agreements like the Paris climate agreement or binational treaties • Culture of convenience • Consumptive behavior leading to more carbon emissions - disproportionately caused by wealthier communities and impacting marginalized communities
Political	<ul style="list-style-type: none"> • Energy policy - carbon emissions • Priorities for how we draw down coal plants and replace them with renewable energy • Energy policy is like political hot potato • Lack of accountability for elected leaders • Lack of constituent support for climate policies • Lack of incentive to support transition to green technologies.

- Changes in what is possible throughout the year - duration of unfrozen vs. frozen activities
- Changes in fish populations
- Changes in agriculture

Future Scenario

Scenario: Climate conditions that don't get worse and we are ready to adapt to the challenges we predict are coming

AI Summary: In a scenario where climate conditions stabilize and we are prepared to adapt, a diverse coalition—including businesses, governments, tribal and local communities, advocacy groups, scientists, and the public—commits to reducing carbon emissions, managing shipping and industry, supporting ecological adaptation (like new crops and animal corridors), preserving winter culture, protecting habitats, and sharing knowledge, with immediate actions focused on policy reform, public accountability, research, funding prioritization, equitable governance, and integrating Indigenous knowledge to ensure a resilient and thriving Great Lakes region.

RAD - Resist - slow consumption; Accept, Direct - policies to alter/change adapt to shorten winter.

How will positive impacts be realized?	How will you avoid or mitigate negative impacts?
Assuming <ul style="list-style-type: none"> • reduction in global carbon emissions • There are still areas with ice cover 	<ul style="list-style-type: none"> • Adaptively managing shipping, industry to commit to reduce carbon emissions, esp as shipping channels go more months a year • Prevent further pollution

How will driving forces be harnessed/utilized?	How will driving forces be harnessed/utilized?
<ul style="list-style-type: none"> • Harness the energy/intent of the younger generation to affect policy changes that lead to recommitment to policies that reduce carbon emissions • Identifying areas where winter conditions will still persist to promote them to maintain snow industries and allow people to safely recreate and protect winter culture - through platforms like PureMichigan (some states may need to shift the activities they are directing people to) • Proactively protect the habitat below the ice - i.e. where do we expect invasive mussels and ice cover and where do we go to manage them most efficiently 	<ul style="list-style-type: none"> • Take advantage of new crops that can thrive under a changing climate • Rethink porosity of borders • Tribal communities - adapt by moving • Will be able to grow more crops in the Great Lakes region • Support project to help animals migrate - develop habitat, ecological restoration - rewilding - environmental corridors • Identify invasive species and help ecosystems adapt before it becomes a problem • Proactive research to identify what could change with consistently warmer waters
Who (what sectors, organizations and/ or individuals) will be involved?	Who (what sectors, organizations and/ or individuals) will be involved?
<ul style="list-style-type: none"> • Business, manufacturing, transportation - embrace realities of climate change - make better products and improve efficiency • Consumers - less consumption • Governments recommit to binational agreements around the great lakes and international climate agreements • Zoning and land management 	<ul style="list-style-type: none"> • Everyone managing land/SeaGrant/Extension • Knowledge exchange platforms to help people prepare for the changes • (land use change, and ice safety) • Economic policy to mitigate impacts of less consumption • Adapt infrastructure to extend trading season - shift coast guards and ice breaker policy - this will lead to economic benefits that could be enhanced sustainably • Agriculture sector will adapt with new crops

What do you think we need to do in the immediate future/right now to ensure the Great Lakes region moves toward this future?

- Advocacy organization - public accountability and holding officials accountable to develop climate policies - more regulation, education campaigns so everyone is on the same page
- Distributing funding to support projects that can help achieve these goals - prioritization for consider grant applications
- Winter science research - use results to allocate resources to winners and new opportunities in a changing climate - how can we manage towards the fisheries that will do better under future climate scenarios
- Documenting how local communities are interacting with their environment during a time of environmental change - how ethics guide decision making processes and how effective those are - sharing information out with policymakers
- Learn from: Indigenous knowledge about how they have adapted to long-term environmental changes in the past before could help us adapt now.
- Co-governance: ingenious and western communities and across western defined borders
- The Department of Interior has an obligation to work with tribes - alter land access to help tribes access their relatives as ecosystem composition changes.
- Zoning: Influence local decision making through outreach tools to the people living in those communities in addition to the local governments

Appendix E: Uses and products poster photos

2 USES

- Grant app.
- Support research (agenda) to inform policy @ state + regional level
- proposals, slide decks, demo currency of info/work
- public ed + non-tech audiences / drive at hour region
- Context for local/built system issues w/in larger ecosystem
- Strategic planning to allocate resources + personnel
- Shift in mindset

PRODUCTS

- ← Publication (peer rev.)
- Workshop or dedicated time @ annual mtg/conf
- info graphics, timeline, charts (annual update)
- Consistent report structure
- Actionable + targetted recs
- Framing + talking points → "Why the Great Lakes"

OTHER

- Timing / cycle
- How to use our regional "GL" identity to bridge other more challenging issues
- Bring process to other sectors

Uses

- Strategic planning
- ID partners
- Education, shared preparation and understanding
- ID priorities
- ID ~~pro~~ trends, threats, opportunities
- Research initiatives
- Funding (obtaining it)

Products

- Policy development
- "How to" guide for HS
- Accessible edu materials ✓
- Publication
 - Concept note/action plan (implementation focused)
- Case example / proof of concept
- Bullet points / outcomes in digestible format
- Collaborative/network to ^{resolve} ~~solve~~ the problem
- Grant proposal
- The "right" comms products for the topic

USES	PRODUCTS (4)
Establishing/guiding Program priorities	meetings
Educating board members (x3)	Network map ↳ by issues
Strategic Planning	Short issue briefs (2 pages)
Staying informed personally + organization	Academic papers w/ lots of collaborators/coauthors
Identifying blind spots	Campaign Strategy
Broadening skillsets	Case studies illustration, real community impact
Process can give weight to identifying future issues	Story telling journalism
Relationship building * ↳ find who cares +	→ ?

Figure 3: Table 4

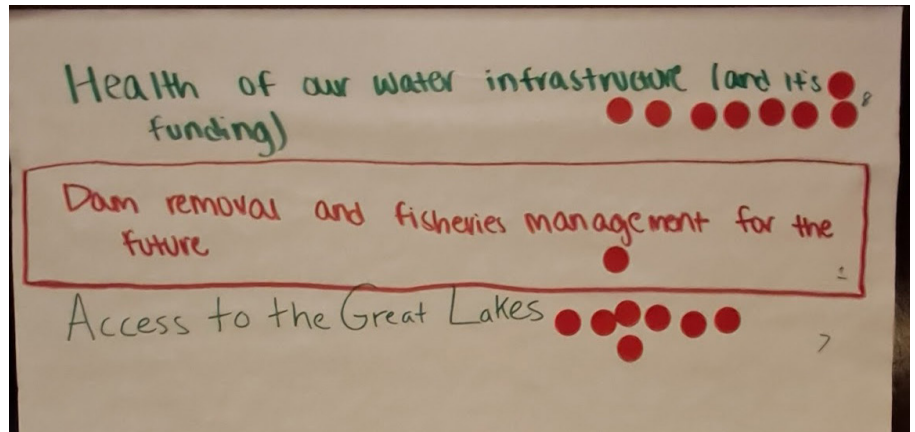
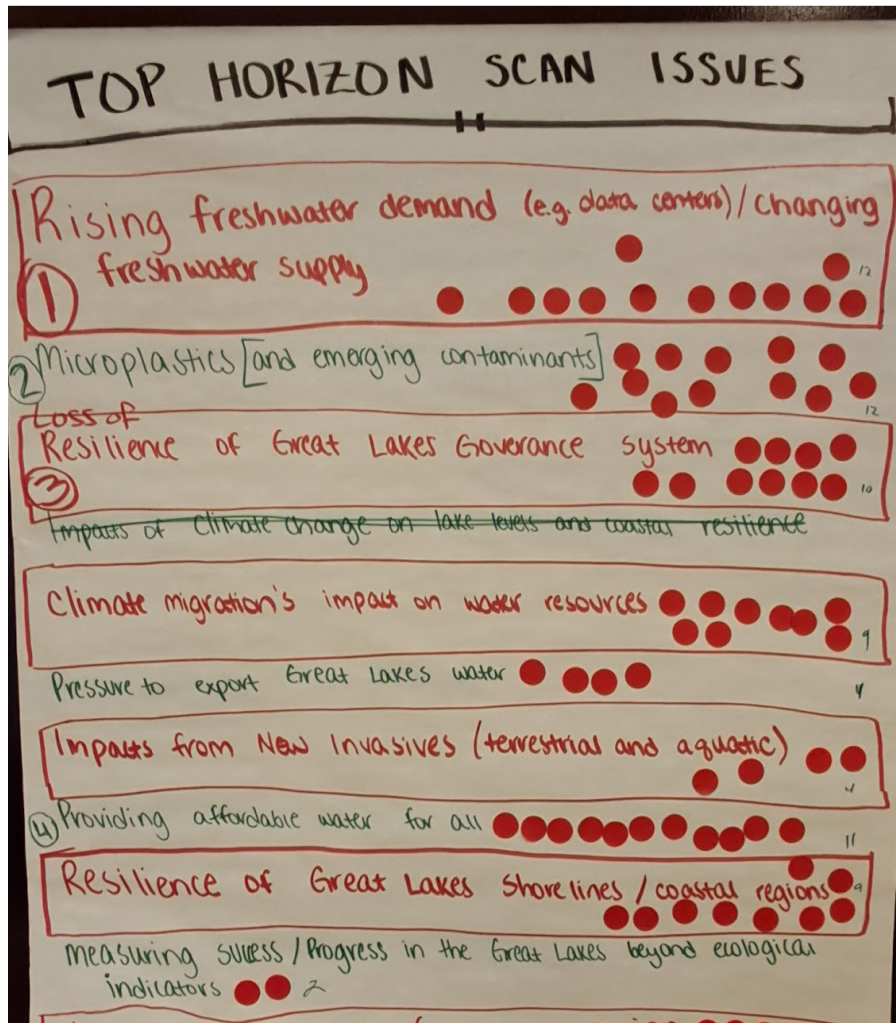
Emerging issues:
 - Wildfire smoke
 - Water ^{publ.} access - zoning
 - affordable housing

Table 5

<u>USES</u>	<u>products</u>
- practiced for IDing projects	- Strategic Approach
- situation analyses	- Policy Plan
- specific to scenarios	- Education/Outreach Materials
- learn from other areas	- Management Structures
- bring back to organizations	- Public Outreach
- spark ideas + integrate into planning	- Accessible Plan
- smaller scans could feed into broader Great Lakes Scan	- Gap Analysis + Duplication Analysis
- capacity building	
- sector collaboration	

Figure 4: Table 5

Appendix F: Horizon scan issues poster photos



Appendix G: Key elements of a trusted process poster photos

Key Elements of a Trusted Process

Experts - sound science

Broad comming partic - geo etc
+ sectors + not the usual suspects -
Safety, build relationships, solidarity/reciprocity
Info @ various scales + phases

Solutions focus - things we can address
+/-ve impacts transparent

Scheme for prioritizing issues - criteria,
consensus

Common purpose + common language
- GL not adequate for scope, not good shorthand

Process needs say how input on scope
would be considered + operationalized - structured process

▷ sociocological "fit" + "mis fit"
boundaries are often mismatched

Key Elements of a Trusted Process

Neutral environment / convenor
- ~~the~~ anticipate + address stresses/fears
concerns; logistical needs; support for participants

Multiple opps for input beyond mtg - be clear
me live how it will be used + decisions will be made

Be aware of how we are contextualizing
+ conceptualizing issues
↳ can we address in the scoping process?
eg by/through engagement with native
notions of inherently different scopes

Buy-in → commitments, guidelines, way to
commit
pre-decisional process

How water will be protected b/c you participated
↳ how does this become policy that ~~drives~~ drives?

A process that is consistent so others begin to
build on/in

2 - Key Elements

- Focus / domain constraints/structure
scale
Key → think about the initial scan process

- Foundational "problem statement"
- Novel issues or things that will stress existing things?
- Prioritize curiosity over expertise - mix of ppl in process.

Appendix H: Bibliography

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