From:	Anne Woiwode
To:	mi-waterstrategy
Cc:	Gail Philbin; Melissa Damaschke; Erma Leaphart; Nancy Shiffler
Subject:	Sierra Club comments on Water Strategy
Date:	Friday, August 28, 2015 2:24:08 PM
Attachments:	SierraClubCommentsonMichiganDEQ.docx (1).docx

To the Office of the Great Lakes:

Attached please find the comments of the Sierra Club on "Sustaining Michigan Water Heritage, A Strategy for the Next Generation". These are the compiled comments of the Michigan Chapter and the Great Lakes Program of the Sierra Club.

I've copied the principals engaged in preparing the comments so that if there are questions we can respond to them.

Thank you for accepting our comments.

Anne Woiwode, Conservation Director
Sierra Club Michigan Chapter

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Anne Woiwode, Conservation Director
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Sierra Club Comments on
"Sustaining Michigan Water Heritage, A Strategy for the Next Generation"

Submitted by the Sierra Club Michigan Chapter and the Sierra Club Great Lakes Program

August 28, 2015

"Sustaining Michigan Water Heritage, A Strategy for the Next Generation" (Strategy) provides a broad sweep of water related issues in Michigan, and the objective of setting out a thirty year horizon on these issues is a positive. Sierra Club offers these comments and recommendations seeking to improve and strengthen the Strategy, in particular in those areas where clearer, enforceable measures are needed to achieve the goals. On the whole, we are disappointed that the Water Strategy speaks to what government "can" and "should" do versus what it WILL do to protect waters within the Great Lakes Basin.

We respect and agree that all of the people of Michigan have a role to play in protecting and restoring our water quality, and Sierra Club has been among the organizations actively engaging our members and allies in water testing and storm water reduction for many years. However, the State of Michigan must take the leadership role, starting with creating a stronger vision statement, and establishing or adopting specific verifiable goals and data driven solutions. For example, enforcement regarding citizen complaints on some categories of water quality permits have been noticeably reduced in the past few years, making it appear there are fewer violations and problems than in fact exist.

In addition, the emphasis on voluntary measures should not take away from the state's duty to ensure that regulations are protective of water quality and health, that they are based on the current scientific information rather than just balancing stakeholders' positions, and that protective standards and permits are enforceable and, in fact, are enforced. This is the State of Michigan's primary obligation to its citizens in any Water Strategy - yet it seems to be significantly deemphasized over past statewide water plans.

Sierra Club is concerned that the Strategy takes a step back from the 2009 "Michigan Great Lakes Plan" (https://www.michigan.gov/documents/deq/MI-GLPlan_262388_7.pdf) with no explanation as to why this is being done. The 30 year horizon of the Strategy suggests that the goal is to create forward motion that is not subject to political whims, yet the Strategy makes no mention of the extensive work done under the Granholm administration towards this same goal. We ask that the Office of the Great Lakes compare the recommendations of the MI Great Lakes Plan with those of the Strategy and, in responding to comments, document and identify the differences.

In addition, we are perplexed that certain vital pieces of information are missing from the Strategy. For example, while there is a reference to researching technologies to treat ballast waters, there is no legislative or policy objective laid out based on extensive information that already exists.

Below Sierra Club offers more detailed comments on the Water Strategy by section. Please let us know if there are questions. Sierra Club is also willing to participate as a stakeholder in additional review and forums on the Water Strategy if invited.

GOAL 1: Michigan's aquatic ecosystems are healthy and functional

Reducing blue-green algae blooms: Sierra Club agrees wholeheartedly that it is essential to develop a Strategy to tackle blue-green algae. Michigan agricultural crop and livestock operation runoff contributes to the cyanobacteria growth that poisoned the Lake Erie drinking water of more than 400,000 people in southern Michigan and Toledo last summer, and that is threatening western Lake Erie again this year. Similar conditions are of concern in Saginaw Bay and other parts of the Great Lakes as well. However, the tools and actions cited in the Strategy that are intended to address this threat fall far short of addressing this dangerous and growing problem.

Research and data going back as far as thirteen years[1] has repeatedly demonstrated that agricultural practices along waterways, including buffer strips, grass strips, constructed wetlands, cover crops, and no-till, are inadequate in removing dissolved reactive phosphorus (DRP) from surface water, especially in heavily tiled fields. These are among the activities in the Michigan Agricultural Environmental Assurance Program (MAEAP) "suite of practices" the report promotes. They are good practices for certain issues, but not if the goal is to "achieve 40% phosphorus reduction in the western Lake Erie basin," because DRP will continue to enter waterways despite the use of these practices.

The state has repeatedly passed up opportunities to take substantive steps to address the problem, and unfortunately the Strategy again ignores these effective steps. Just this year, the Michigan Department of Environmental Quality (DEQ) declined to make a change to its concentrated animal feeding operations (CAFO) water quality permit that would have taken a significant step towards reducing phosphorus runoff. The DEQ could have replicated a recent decision made in Ohio to completely ban the application of CAFO wastes to frozen or snow-covered ground, which would virtually eliminate one of the most common sources of substantial agricultural discharges into waterways that feed into our Great Lakes. Despite extensive, well-documented comments submitted to DEQ regarding the proposed renewal for the CAFO NPDES General Permit, the DEQ decided instead that spreading wastes on snow-covered or frozen ground would be a voluntary option for CAFO operators. This decision reflects the failed status quo here, where Michigan state agencies ask for rather than require that permitted agricultural operations implement measures to protect our water quality. The Lake Erie water crisis of last summer points clearly to the failure of "voluntary" standards, and the Strategy should demonstrate that the state is capable of learning from such failures by enacting enforceable, proven requirements.

Refine and improve the water withdrawal assessment process: Sierra Club supports the acknowledgement in the Strategy that the Water Withdrawal Assessment Tool (WWAT) needs improvement, because the current iteration is flawed. Groundwater is the primary source of drinking water for the majority of Michigan residents. Additionally, groundwater keeps streams wet during times of low flow and keeps many of our streams cold enough to support coldwater fish such as trout (and our comments apply to Goal 2 as well).

In particular, the WWAT needs to address the short-term, high volume withdrawals used for oil and gas operations. The model does not adequately address these impacts. Hydraulic fracturing uses very large quantities of water to fracture wells. Oil and gas wells drilled in Michigan have used upwards of 20 million gallons for one well. In most cases, the water used to fracture the well is withdrawn from the ground near the hydraulic fracturing site. Back-flow from these wells can result in 30 to 75% of this water being returned to the surface. The use of deep injection wells to dispose of this water renders this water as a total loss to the hydrologic system. Data collected on the impact of water withdrawals is necessary to effectively update the WWAT model, and deficiencies in or loss of that data raise concerns about the validity of the tool (see related comments regarding monitoring).

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[1] Environmentally Concerned Citizens of South Central Michigan (ECCSCM), www.nocafos.org , have documented the repeated failure of these practices to prevent pollution from concentrated animal feeding operations (CAFO) from entering surface waters. Additional study references are available on request.

GOAL 2: Michigan's Water Resources are Clean and Safe

Sierra Club supports the general direction of the recommendations under this goal, and the definitive language of the "measures of success" is encouraging. We commend the recommendation to pass legislation to phase out the sale and use of microbeads as a solid and needed addition to current laws. The recommendation to "establish priorities and address emerging pollutants of concern" is also a solid goal. However we note that simultaneously the DEQ is proposing to weaken Michigan air toxics regulations. Michigan's unparalleled connection to and dependence on water, and our historic challenges addressing contamination of waters, argues for our state to implement protections based on precautionary principles. The continued existence of unresolved massive contamination sites in our state, and the stunning return of the algal blooms in Lake Erie should be a wakeup call that vigilance is critical when it comes to preventing pollution in Michigan.

It should be remembered that the first solid understanding of the presence and threat of air toxics occurred in Michigan as PCBs were discovered in Siskiwit Lake on Isle Royale, and that our lack of knowledge is no guarantee that a pollution does not exist. How the state identifies emerging pollutants is an important question, and the openness of Michigan agencies to responding to these will be a critical measure of success for the Strategy.

There are some specific additions and improvements Sierra Club urges be addressed in this section, and we note this is not an exhaustive list. Specifically, the state should adopt and enforce the updated EPA standards for protection of human health and the environment, for example the new standards for exposure to dioxane. The state should increase restrictions and monitoring of injection wells for oil and gas production waste, including presence of TENORMS.

GOAL 3: Michigan communities use water as a strategic asset for community and economic development.

GOAL 4: Michigan's water resources support quality natural resources, recreation and cultural opportunities.

These two goals go hand in hand and should not be considered separately. The recognition that Michigan's extraordinary water resources are an asset to all communities is one of the most important changes in attitude during the past several decades. Protection of these natural resources, and assuring that any economic development or recreational uses must work to assure the protection of these assets needs to be clearly articulated in the Strategy. These goals can be a positive, as long as it is recognized that water quality and ecosystem protection and restoration are an essential measure and need to come first; that access for the public for recreation, fishing, and other purposes should not be reduced in order to promote commercial developments; and that green infrastructure goes hand-in-glove with any proposals of this kind. Even though Goal 4 includes some of these ideas, these need to be integrated.

In developing commercial or recreational uses of our waters, Michigan must also assure that degradation of native ecosystems does not occur, and that restoration of those riparian and aquatic ecosystems is the top priority. For example, the state of Michigan has opened up the possibility of commercial development of fish farming both on the Great Lakes and in the Au Sable River, and in fact issued a permit for a commercial operation in the Au Sable that threatens Michigan's top, self-sustaining blue ribbon trout fishery. The Strategy must clearly articulate that not all uses of our waterways are on par with each other, and reject the argument that there is a "balancing of interests" when the net result is the degradation of unique and irreplaceable resources. Whether the damage occurs in a single action or

through incremental degradation, Michigan must adopt and enforce a position that non-degradation of our precious waterways is always the top priority.

Among the specific objectives for protecting our waterways, Michigan needs to assure reduction of mercury in the Great Lakes and inland fisheries by adopting of a strong, effective Clean Power Plan State Implementation Plan. Addressing climate disruption through this and many other measures is also essential in the goal of assuring our rivers, lakes and streams are healthy. As noted above, the State's proposal to reduce the number of air toxics regulated may result in introduction of dangerous materials into even the most remote waters – again.

The recommendations discuss monitoring beaches for contaminants, which is a good goal. However, as we have seen in Lake Erie's algal blooms, even when a situation begins to emergy it can take years of not decades to take steps to counteract it. Monitoring alone is insufficient if there is not a commitment to act to address the problems in a preventative fashion. Of particular concern for recreational uses of water is addressing nutrients, pathogens and biological contaminants and invasives in ways that are enforceable. Western Lake Erie is the canary in the mine of threats to Saginaw Bay, Green Bay and inland waterways from bacteria and other pathogens.

GOAL 5: Michigan has a strategic focus on water technology and innovation to grow sustainable water-based economies.

Sierra Club applauds the in depth discussion of water conservation and developing a conservation and reuse strategy. In addition to meshing with our commitments to the other Great Lakes and Provinces regarding sound policies for water conservation, this is an increasingly important priority in a world where climate disruption threatens water resources everywhere. However, we are concerned that the Strategy again focuses on voluntary action primarily. As climate change increasingly affects available water resources throughout North America, the state and Great Lakes Region need to assure that we have in place proactive, enforceable strategies for preventing water diversions and addressing water quantity, and that these measures are continually updated and sufficient to protect the waters here. The repeated efforts by Waukeshaw, WI, to seek a diversion out of the Great Lakes basin should be seen as the leading edge of what will be increasing urgent and politically powerful demands to undermine Michigan's wise policies to keep our water here and ask people to come here to use it, rather than divert it away.

GOAL 6: Michigan invests in infrastructure and supports funding to maintain clean water and healthy aquatic ecosystems.

The long term challenges of failure to invest in our infrastructure are among the most pressing issues facing many communities, and this goal is a good one. However, a concern of Sierra Club is what is unaddressed here: that access to water for drinking, washing, etc. is guaranteed in Michigan as a human right. Michigan has been the home to gross injustices as a result of the "cost of service" for water utilities being imposed on communities and individuals who were unable to afford it, not because they did something wrong but as a result of the loss of customers from those systems, for example in Highland Park. The Strategy needs to assure that Michigan policies address the questions of equity, of ensuring that water utilities continue to be publicly owned, and that the price of meeting the basic water needs for families is affordable.

GOAL 7: Michigan has integrated outcome-based monitoring systems that support critical water-based decisions.

Sierra Club strongly endorses the concept that Michigan needs a plan and funding for comprehensive monitoring of groundwater and surface water quality and quantity. The best argument for the need is contained right here in this document--the state's plan to reduce phosphorus runoff by 40% in the western

Lake Erie basin as described in Goal #1 relies on buffer strips and other practices that won't address the problem of dissolved phosphorus runoff. Leaders who rely on academic models that don't accurately reflect what happens on the ground are misled into thinking this will be money well spent. Evidence that these practices won't achieve the desired result is found in data gathered by ECCSCM through regular and meticulous edge-of-field testing around 41 sites in 19 Michigan townships in the western Lake Erie basin where CAFOS apply manure. In 2013 and 2014, 100% of samples (70 of 70) were above the safe level for aquatic species of .1 mg/L, and 96% (67 of 70) exceeded Michigan's water quality standard for point sources of 1 mg/L.

This is evidence gathered in one small part of the state by unpaid volunteers who care about their community and the health of the land and water. They see that a huge problem exists that is being ignored by the people in charge and decided to take matters into their own hands. The state needs to take a cue from them. Stop relying on academics to tell them what's happening on the ground and find the money to do regular edge-of-field testing near CAFOs all over the state to find out what's working and what's not. Otherwise the 40% reduction goal will remain just that--a goal, not an achievement.

Monitoring Tools are Essential: The State of Michigan appears to lack an emphasis on the most critical tools for determining the success or failure in achieving the proposed goals for the Strategy. Two years ago, Sierra Club learned that the Department of Natural Resources (DNR) had discontinued or cut back substantially on their 5-year basin reviews or assessments as a result of budget cuts and staffing cuts. These 5-year basin reviews focused on fisheries, looking at fish community and populations, macroinvertebrates, other wildlife, riparian habitat, land use and land covers, paying particular attention to changes in land use or cover in the most recent 5 year period such perviousness. If the state has discontinued these 5-year basin reviews, the ability to monitor changes in these waterways resulting from permits affecting both water quantity and quality has been lost. Without a systematic assessment process, there won't be any way to effectively analyze trends in changes to surface water quality. Watershed monitoring is occurring in some areas, but rather than the DEQ and DNR systematically identifying the most important waterways to monitor and assuring programs are in place (e.g. the Michigan reaches of the Maumee River basin and the Detroit River) the program is tied to voluntary actions. A well-developed and effectively implemented plan for monitoring Michigan's waterways that are particularly of concern to the health of the Great Lakes and key areas of our state and region should be a priority.

Goal 8: Michigan has the governance tools to address water challenges and provide clean water and healthy aquatic ecosystems.

This goal acknowledges that institutional barriers and gaps can undermine even the best of intentions for achieving actual environmental protection. We note that the focus is on agencies and policies that are focused on water. Integrated systems need to also recognize that air pollution, toxics, energy policies and other arenas can and do have an effect on water quality and quantity. As noted above, there is a need to also address contradictions across agencies vested with authority in these media and issues. For example, inadequate enforcement of air quality standards impacts water quality goals.

The emphasis on private foundations to support this work is troubling in several respects. The costs of addressing environmental challenges need to be borne by those who are benefiting from the activity that potentially compromises environmental quality. The Strategy needs to state clearly that funding programs to protect the water quality and quantity of Michigan needs to be a high priority for the state, and should neither depend on the largesse of private foundations, nor be undercut because those who benefit refuse to pay the costs. Michigan will not be able to sustain this Strategy or any other environmental programs if they are built increasingly on voluntary compliance and voluntary funding. And this premise ultimately shifts the burden to those who are the victims of improper environmental controls, who pay with their health and well-being, as well as the loss of ecosystem function and value.

The suggestion that there should be great collaboration and inclusiveness in water policies is good, especially when the importance of not undercutting the state's authority to maintain our legal authorities under the federal and state laws is clearly articulated. But the world is run by those who show up, and too often the people most in need of representation in the processes are unable to "show up". The increasing use of stakeholder processes where only a select group of invited people are at the table closes the door to those who are often the most at risk and in most need of having their voices heard. Open, public, transparent processes are critical at every level and the Strategy should prioritize this as an outcome for every step of the process.

Regarding the proposed measure of success that "by 2030, achieve a 40% reduction in number of designated uses or impaired waters," this measure is not explained and raises questions about 40% of what? Does this relate to river miles, or a change in 40% of the segments, or some other measure? One on-going criticism of Michigan's assessment of its progress in bringing our waterways back to fishable, swimmable, etc., is that waterways that have been designated agricultural drains have effectively been written off when it comes to cleaning them up. Many other waterways have "insufficient information" or have had no assessments completed according to DEQ's reporting the EPA. It will be impossible to use this merit to measure success if it is not future defined.

GOAL 9: Michigan citizens are stewards of clean water and healthy aquatic ecosystems.

Sierra Club strongly supports the encouragement of an engaged and informed citizenry who are participants in shaping policies and ensuring they are implemented. We are among the organizations that actively participate in a variety of stewardship work and educational efforts, and support the Strategy encouraging these types of activities. Sierra Club would strongly suggest expanding this section to also acknowledge the importance of the active participation of citizen in supporting the development of laws, policies and other tools for protecting our waters. The state needs to facilitate that through open, transparent and accessible decision making processes that are not simply limited to select stakeholders from the beginning. In addition, the Strategy should acknowledge the importance of agency enforcement of those policies, and, in some cases, citizens taking steps to enforce Michigan's environmental laws. While state agencies have the primary responsibility to enforce laws, citizens in our state are also given clear authority to act when our government agencies are either unable or unwilling to act.

From: John Gruchot
To: mi-waterstrategy
Subject: Water Strategy Comments - Ports & Harbors
Date: Friday, August 28, 2015 2:45:29 PM
Attachments: MI WaterStrategy - draft- comments.pdf

Attached is a letter transmitting comments from the St. Joseph River Harbor Authority on the State's Water Strategy.

Please contact me if you have any questions or need any clarification.

Thank you, for your efforts in developing the comprehensive document.

John Gruchot
Planning Coordinator - Berrien County - Community Development Dept.
701 Main St.
St. Joseph, MI 49085

269-983-7111 ext.8350

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ST. JOSEPH RIVER HARBOR AUTHORITY

August 28, 2015

Jon Allan
Director - Office of the Great Lakes
MI Department of Environmental Quality
P.O. Box 30473
Lansing, MI 48909

Re: Michigan's Water Strategy

Dear Mr. Allan:

The St. Joseph Harbor Authority would like to voice its support for recommendations within the draft of the State's Water Strategy (*Sustaining Michigan's Water Heritage, A Strategy for the Next Generation*). The harbor formed by the St. Joseph River where it empties into Lake Michigan is both a deep water commercial port and recreational harbor. While portions of the commercial port have been fortunate to receive periodic federal maintenance funding, it hasn't come without challenges because it's classification by the Corps of Engineers as a low use harbor (less than 1 million tons of cargo throughput annually). Funding for the purely recreational portions have been historically sporadic and local, with the exception of the much appreciated MDNR Waterways grant in 2013. Reviewing the *Water Strategy* with this knowledge, it appears that most of the goals and recommendations appear beneficial.

The Authority, therefore, generally supports the *Water Strategy* as drafted, and, from a harbor's perspective, finds some most pertinent. These include the recommendations that directly reference supporting investments in commercial and recreational harbors and ports, as in Goals # 3 and 4. Additionally, the recommendations for enlisting DEQ actions to identify and reduce upstream sources of sedimentations and stormwater' s role in that, establishing a Water Fund, and increasing water literacy (i.e. citizen understanding of and support for a water strategy), as expressed in Goals # 1, 6, and 9, are seen by the Authority as essential to overall success.

Please let our staff know if you need any further information in considering these comments (John Gruchot, 269-983-7111, ext.8350 or jgruchot@berriencounty.org)

Sincerely,

Virginia Sansone

Virginia Sansone,
Chairperson

cc: Berrien County Administrator - William Wolf

From: Sarah Nash
To: mi-waterstrategy
Subject: Comment on the Draft Michigan Water Strategy
Date: Friday, August 28, 2015 2:48:51 PM

To Whom it May Concern,

My name is Sarah Nash. I am the coordinator of the Justice, Peace and Sustainability Office for the IHM Sisters of Monroe, Michigan.

As you continue to develop the Michigan Water Strategy, I encourage you to think about and refine this strategy using a "Public Trust" framework.

From the FLOW Website http://flowforwater.org/:

"The Public Trust Doctrine holds that certain natural resources like navigable waters are preserved in perpetuity for public use and enjoyment. The state serves as a trustee to maintain the trust or common resources for the benefit of current and future generations who are the beneficiaries. Just as private trustees are judicially accountable to their beneficiaries, so too are state trustees in managing public trust properties.

In addition, any private, public or commercial existing or proposed use, diversion or discharge cannot harm the waters of the Great Lakes by materially reducing the flow, changing the levels, or polluting the waters of the Great Lakes Basin. Furthermore, those who seek to use, continue to divert or alter the waters of the Great Lakes Basin, have the burden of proof to show they will not impair, pollute or harm the water. If they do not satisfy this burden of proof, the proposed action is not permitted under the public trust.

Lastly, under the public trust, the waters of the Great Lakes Basin can never be controlled by or transferred to private interests for private purposes or gain. Our rights to use the water of the Great Lakes Basin cannot be alienated or subordinated by our governments to special private interests; this means that all reasonable private use and public uses may be accommodated so long as the public trust waters and ecosystem are not harmed and paramount public right to public uses are not subordinated or impaired. Because many citizens are not aware that the public trust doctrine is part of their bundle of rights in our democracy, many of our leaders and big business are ignoring and violating these principles."

I believe that consideration of this framework will serve you well. It is critical that we think of, value and protect our water not merely as a natural resource to be leveraged but as a priceless part of the commons.

Thank you for your consideration.

Sarah Nash
Coordinator, IHM Justice, Peace and Sustainability Office
IHM Sisters – Monroe, Michigan
Deep Faith. Courageous Spirit. Action for Justice

Direct: (734)240.9691
www.ihmsisters.org

Urged by the love of God to respond to the most serious needs of our time, we pursue justice, peace and sustainable ways of life.

For information about the IHM Sisters, visit http://www.ihmsisters.org

Electronic Mail is not secure, may not be read every day, and should not be used for urgent or sensitive issues.

From:	Laura Rubin
To:	mi-waterstrategy
Subject:	Comments from the HRWC
Date:	Friday, August 28, 2015 2:55:18 PM
Attachments:	image001.png water strategy comments 2015.pdf

Thank you for the opportunity to comment on the State's Water Strategy. We applaud the effort and vision of the OGL and others involved in the drafting.

Please find our comments attached.

Sincerely,
Laura

Laura Rubin
Executive Director
Huron River Watershed Council
1100 N. Main Street, Suite 210
Ann Arbor, MI 48104
734.769.5123 x 606
Cell: 734.678.2434

Thank you for the opportunity to comment on the State of Michigan's Water Strategy, Sustaining Michigan's Water Heritage, A Strategy for the Next Generation.
The Water Strategy is a strong document that confirms that one of Michigan's greatest assets is clean and abundant water. This priority needs to be embraced and institutionalized by the Governor, the legislature, the state agencies, watershed councils, and local governments. These partners are vital to the success of this strategy.

The overall goals, outcomes, and recommendations will help partners work toward a shared over-arching direction. HRWC is a partner in implementing the water strategy and will take a leadership role on many recommendations. As a partner on this Strategy though, we need the state agencies, legislature, and Governor to lead on several foundational role mentioned below.

1. Implementation – While tables 1 and 2 are fairly comprehensive, a discussion on the strategy's implementation is still unclear. Will the state facilitate meetings with partners on each goal to define short and long-term goals and divide responsibilities? Or is implementation of each goal left to disparate actions with a hope that together the actions will meet the overall goal? HRWC recommends annual meetings of stakeholders for each goal.

2. Roles -- Many of the recommendations require implementation at federal, state, watershed, and local levels. HRWC is a key partner at the watershed level but detail on non-governmental participation is lacking and watershed council roles are unclear. In Goal 8 on governance, the strategy should clarify partners to the strategy and their roles. The strategy should identify watershed councils as a key partner.

Inter-agency coordination and communication is also vital for the implementation, yet any description of how this will happen is lacking.

3. Enabling legislation-- Many of the goals require local government action such as stormwater improvements, asset management, and land use protections. Legislation is needed that allows local units of government more freedom to pursue these actions such as a statewide sanitary code, septic inspection regulations, and enabling legislation to support stormwater utilities. How will these be initiated, prioritized, and realized?

4. Funding--Funding from state and federal governments is vital to the success of this strategy. Thus, a greater emphasis on the importance of the continuation or development of the Clean Water Nonpoint Source funds and a Clean Michigan Initiative-like bond are

needed. Michiganders reliably demonstrate their commitment to invest in our state's water and natural resources to protect a shared heritage and quality of life.

5. The plan needs a strategy for evaluation. Measures vary widely on specificity and appropriateness.

Specific comments on Table 2. The Water Strategy Implementation Plan:

Goal 1 #10
HRWC has worked extensively with local governments and conservancies to enact ordinances and purchase land to protect buffers, riparian landscapes, and high quality natural lands that are critical to the protection of our water resources. Greater emphasis needs to be placed on conservation/protection strategies for natural lands, even those not located immediately in riparian zones. A statewide riparian buffer protection zone of 50 ft would be very effective at protecting aquatic ecosystems.

Goal 1 #11
HRWC advocates for dam removal and was successful in removing the Mill Pond Dam in Dexter, MI. HRWC will continue to advocate for strategic dam removal as an effective tool for river and stream restoration. Additional funding for the planning, deconstruction and restoration phases and technical support is needed from the State.

Goal 1 #13
More accurate data is needed to better calculate environmental flows for rivers. HRWC is working through MiCorps to develop volunteer monitoring procedures to measure flow. More flow monitoring is needed as is volunteer monitoring flow protocols.

Goal 1 #14
HRWC fully supports the use of green infrastructure across urban areas as a means of distributed stormwater runoff capture and treatment. HRWC has worked with local municipalities and regional organizations to help identify and plan for green infrastructure opportunities. HRWC also supports and works toward the conservation of existing green infrastructure across our watershed with planning assistance and land conservation strategies. Promoting green infrastructure is not sufficient. Phase II stormwater plans should be required to identify how green infrastructure and other stormwater infiltration strategies will be used to reduce impairments caused by excessive runoff, and the results should be measured and reported to DEQ.

Goal 1, #16

We believe the synergistic and innovative partnerships and planning needed to implement multiple goals of the Water Strategy are happening at the watershed level, and we are fortunate to have some outstanding watershed council and river restoration organizational models throughout the state. We urge that this recommendation be a top priority of the plan: *Enhance financial and technical support of local stakeholder efforts to develop and*

implement watershed management plans to restore impaired waters, protect high quality waters, and develop and utilize water resource assets.

Goal 1 #18 and elsewhere
The Water Strategy needs to have clear and enforceable actions to curtail agricultural runoff and phosphorus. Numerous studies conclude that the harmful algae blooms in Lake Erie are driven by excessive phosphorus levels and that the vast majority of excess originates from agricultural watersheds. Agricultural management practices should be directly tied to water quality improvements, and accountability is sorely needed. Agriculture impacts and strategic goals need more emphasis.

Goal 2 #1
Water budgets are commonly used as a tool to manage surface and groundwater use and ecological function. Water budgets need to be calculated for current and projected populations across major sectors. Many recommendations are based on the assumption that we know how much water we have as surface water and ground water. Yet this exercise has not been conducted in any meaningful way and is a necessary foundation for making water resource decisions, especially with a changing climate.

Goal 2 #3-7
These recommendations address key issues of concern to HRWC. In the Huron River Watershed, HRWC worked with local and county governments to pass point of sale septic inspection requirements. This needs to be implemented statewide. A statewide sanitary code is vital and needs to be passed in the first year. Finally, HRWC has developed materials directed at homeowners with septic systems in conjunction with County health departments. Funding and coordination is needed to get these materials distributed more widely.

Goal 2 #10
HRWC is advocating for a ban of coal tar based sealants and high PAH sealants. Michigan needs to revise water quality standards to better account for these established and potential carcinogens. HRWC is using the USGS data and working with local municipalities to pass local ordinances in hopes to gain enough momentum to pass a statewide ban. Minnesota, Washington, and New York have passed a statewide ban.

Goal 3 and Goal 4
HRWC is leading a river revitalization and water trail effort on the Huron. A statewide user survey and economic impact analysis will help make a stronger case for investments. Additionally, designated funding for water trail investments and recreation such as licenses and fees should be enacted. Finally education on water safety and instruction needs to be expanded for non-motorized watercraft as water trail use increases.

Goal 3
There is too much emphasis and text on harbors relative to other strategies.

Goal 5 #2

In addition to voluntary targets, hard requirements and goals need to be implemented and enforced. Voluntary measures will not get us to our goals. We also need mandatory measures and incentives.

Goal 5 #4
HRWC strongly supports a water conservation and reuse strategy and is working in the watershed to develop best practices and educational materials for homeowners. Major sectors should have set goals and minimum requirements rather than voluntary targets.

Goal 6
Many Michigan municipalities have dangerously old and unreliable water infrastructure. The recent SAW grant investments were a good start, but replacing and repairing aging infrastructure should be given more emphasis and funding focus. Local municipalities need enabling legislation for stormwater utilities. Stormwater utilities are widely used throughout the county to fund much needed stormwater infrastructure improvements. In the Huron River Watershed, the City of Ann Arbor has a stormwater utility and has accomplished substantially more projects and secured more matching funds for stormwater projects than any other community. The City of Ann Arbor fears a future lawsuit given the Lansing v. Bolt and Jackson County v. City of Jackson legal decisions. As the legal opinions are clear on a lack of justification for stormwater utilities, utility rules need to be clarified to allow other communities to feel safe in establishing a utility to pay for needed infrastructure improvements, green infrastructure and other stormwater management strategies. HRWC's conversations with state elected officials in SE Michigan indicate there's a foundation for bipartisan support.

Goal 7
HRWC's monitoring program is in its 20th year and growing. The Huron is hailed by scientists as the best studied river in Michigan. Funds are hard to find for consistent, long-term, and high quality monitoring data. Funding and central coordination through the MiCorps program is key to the success of this goal.

Additionally, the Pall Gelman spill in our watershed highlights the lack of knowledge and data on groundwater supplies and movement. Groundwater data needs greater emphasis.

Finally, monitoring should be considered integral to outcome-based management. Monitoring needs greater emphasis in stormwater rules and should be part of all conservation, remediation and restoration strategies.

Goal 8
This goal needs to be clearer on the governance roles of the federal, state, regional, watershed, and local partners. A chart detailing these roles and responsibilities would be helpful, including watershed councils as an appropriate governance structure. Right now this goal seems like a catch-all for extra issues. Clear roles of partners and lead agencies would be helpful with a clear statement to leverage and support watershed-based organizations to advance the goals and outcomes of the Water Strategy.

Goal 9

This goal is very important to the success of the strategy and HRWC prides itself on strong citizen engagement and stewardship. A coordinated and funded public education and outreach program on water literacy is needed, not solely focused on K-12 education. Under recommendation #2, the State already implements and adheres to the US EPA's survey tool method to assess behaviors and attitudes, the SIDMA/SIPES protocol. HRWC uses this protocol on our education and outreach efforts. Finally, HRWC has been coordinating the MiCorps project with the Great Lakes Commission. This program has had great success in engaging citizens in lakes and stream monitoring while producing extensive water quality and quantity data. Through the tenure of the program there have been strong ideas to expand and deepen the program such as expanded monitoring parameters (flow as referenced earlier), a more robust conference, and better database and analysis tools.

From:	Julie Stoneman
To:	mi-waterstrategy
Subject:	Heart of the Lakes Comments re Draft Water Strategy
Date:	Friday, August 28, 2015 2:56:19 PM
Attachments:	Heart of the Lakes Comments re DEQ Water Strategy.pdf ATT00001.htm

TO: Michigan Department of Environmental Quality / Office of the Great Lakes
FROM: Heart of the Lakes Center for Land Conservation Policy
RE: MDEQ Draft Water Strategy

On behalf of Heart of the Lakes, please find attached our comments on *Sustaining Michigan's Water Heritage: A Strategy for the Next Generation.* Thank you very much for the opportunity to comment.

Julie Stoneman

Associate Director
Heart of the Lakes
o: 989-292-3582, ext.102
f: 989-352-3152
julie@heartofthelakes.org
www.heartofthelakes.org

Register today for the September 21 Fall Conservation Summit in Bay City: www.heartofthelakes.org/events

August 28, 2015

Jon Allan, Director
Emily Finnell, Senior Environmental Quality Specialist
Office of the Great Lakes
Michigan Department of Environmental Quality

RE: Comments on MDEQ Draft Water Strategy

Dear Mr. Allan and Ms. Finnell:

On behalf of Heart of the Lakes, thank you for this opportunity to submit comments on the Michigan Department of Environmental Quality's draft *Sustaining Michigan's Water Heritage: A Strategy for the Next Generation.* As you know, Heart of the Lakes is a state association of nonprofit land conservancies and other organizations dedicated to the conservation of Michigan's environmentally significant land and water.

We especially want to thank you again for the meeting held earlier this week with representatives from both Heart of the Lakes and the Michigan Environmental Council. Overall, we are impressed with the vision and scope of the Strategy as it effectively frames many of the challenges and opportunities we have in Michigan as guardians of this essential resource. Per our discussions and our member organizations' commitment to protecting the state's waters, we offer the following changes.

Goal 1, Recommendation #16—Elevate This Recommendation as a Higher Priority

Rationale: We believe the synergistic and innovative partnerships and planning needed to implement multiple goals of a Michigan Water Strategy are happening at the watershed level, and we are fortunate to have some outstanding watershed council and river restoration organizational models throughout the state. We urge that Recommendation #16 under Goal 1 (Michigan's aquatic ecosystems are healthy and functional) be a top priority of the plan:

> *Enhance financial and technical support of local stakeholder efforts to develop and Implement watershed management plans to restore impaired waters, protect high quality waters, and develop and utilize water resource assets.*

Goal 8—Include Watershed Councils/Organizations as Part of a Needed Governance Structure

New Recommendation Language:

> *Recommendation*: Leverage and support watershed-based organizations to advance the goals and outcomes of the Water Strategy
>
> *Implementation Metric*: All major watersheds in the state have active and community-supported organizations dedicated to improving water quality in the state
>
> *Lead Actor*: Existing Watershed Councils/river restoration organizations

HEART OF THE LAKES
www.heartofthelakes.org
Heart of the Lakes ■ PO Box 1128, Bay City, MI 48706 ■ 989.992.3582

Rationale: For reasons stated above, we urge inclusion of watershed councils/organizations as critical to the governance structure needed to implement the Water Strategy.

Goal 1, Recommendations #14—Expand the Definition of Green Infrastructure

Revised Recommendation Language for #14:

Provide technical and financial support to communities ***and their partners*** to plan and implement green infrastructure techniques and low-impact development while preserving natural spaces ***that contribute to water quality, including application of these techniques*** in the design of new developments, redevelopments and road projects to ensure storm water management, improved hydrology, ***and overall water quality.***

Rationale: Under Goal 1 (Protect and Restore Aquatic Ecosystems) and in the strategy as a whole, we believe greater emphasis needs to be placed on conservation and protection strategies that prevent pollution and are more cost effective than remediation and restoration, such as the protection of lands that protect water resources. Recommendation #14 under Goal 1, which is a top priority, addresses this in part but only in relation to existing or proposed development. Green infrastructure should be more broadly defined and applied at a larger landscape level with the proactive protection of natural areas and farmland that store and absorb rainwater and snow melt, provide groundwater recharging and cleansing services, and contribute to other strategy goals such as access to quality natural resources, recreation and cultural opportunities (Goal 4). For example, the Huron River Watershed Council attributes the cleanliness of this urban river to the fact that 44% is still forest, wetlands and fields and that the biggest threat to the river is the loss of natural areas.

There have been several watershed-based initiatives around the state to scientifically identify natural lands critical to the protection of water quality. Findings show that permanently protecting such lands through acquisition of conservation easements (legal agreements to protect conservation values entered into voluntarily by private landowners) is a cost effective strategy when compared to restoration or remediation.[1] This approach is illustrated through the Michigan Department of Environmental Quality's nonpoint grant program, which has made significant investments in the implementation of best management practices (BMP) in approved watershed plans, including the purchase of conservation easements to permanently protect natural and farm lands, thereby preventing conversion to other uses that can lead to greater nonpoint pollution problems. In these instances, the BMP is a permanent, not a temporary fix; landowners are compensated for the value of the easements; and land stays in private hands and on the tax rolls.

As an example, the Grand Traverse Regional Land Conservancy reports that conservation easements acquired in support of approved watershed management plans annually keeps 17,537 pounds of nitrogen, 2,308 pounds of phosphorus, and 225 tons of sediment out of northwest Michigan waters. To date, investments of $3,672,422 from the state's Clean Michigan Initiative Fund and the Environmental Protection Agency's 319 program leveraged an additional $7,343,016 in additional funds (local match such as partial donation of easement value, other sources) to protect 5,984 acres of land under conservation easement within the Conservancy's service area. Permanent, nonpoint pollution protection—as well as a host of other benefits—is achieved at approximately $1,841 per acre. This cost

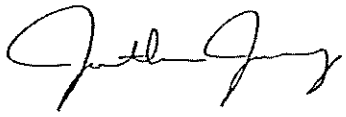
[1] Heart of the Lakes can provide sample studies that demonstrate this point

effective result is repeated by land conservancies and partners in some watersheds across the state, but needs to be supported and expanded.

For these reasons, green infrastructure recommendations should consider landscape or watershed level protection, including the identification and permanent protection of natural lands, and not just techniques in the context of new development, redevelopments and road projects—all of which require some "fix" as currently stated in the Recommendation #14. The Water Strategy and purposes of a proposed Water Fund should address the cost/benefits of pollution prevention—including strategic land protection on a watershed scale using innovative tools such as conservation easements—as a viable investment in the protection of Michigan's ground and surface waters.

We urge that the narrative under Goal 1 address the application of green infrastructure in the larger context as described here. To that end, we offer the revised language in an attempt to expand the green infrastructure definition in the concise fashion as requested in our meeting. Again, thank you for the tremendous amount of work that has gone into the draft Strategy and for the opportunity to provide comments. We are happy to answer any questions our comments might raise. We look forward to the final Water Strategy as well as participation in next steps toward implementation.

Sincerely,



Jonathan Jarosz
Executive Director

From:	Laura Ogar
To:	mi-waterstrategy
Cc:	Tom Hickner; rfinn@baycitymi.org; Deanne Berger; Debra Russell; RSpencer; Robert Redmond; Cynthia Gaul; Eileen Curtis
Subject:	Bay Co. Comments on Draft Water Strategy
Date:	Friday, August 28, 2015 2:56:26 PM
Attachments:	BayCoWaterStrategy2015.pdf

Please accept the attached comments on the draft Water Strategy, thank you.

Laura Ogar, Bay County Director
Environmental Affairs and Community Development
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515 Center Avenue, Suite 500
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ogarl@baycounty.net

BAY COUNTY
DEPARTMENT OF
ENVIRONMENTAL AFFAIRS
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THOMAS HICKNER
County Executive

LAURA OGAR, DIRECTOR
ogarl@baycounty.net

Community Initiatives
Geographic Information Systems
Gypsy Moth Suppression Program
Mosquito Control
Saginaw Bay Coastal Initiative (SBCI)
Transportation Planning

August 26, 2015

Mr. Jon Allan, Director
Office of the Great Lakes
Department of Environmental Quality
PO Box 30473-7973
Lansing, Michigan 48909

Re: Comments on the draft Sustaining Michigan Water Heritage, A Strategy for the Next Generation

Dear Mr. Allan,

Thank you for providing this opportunity to comment on the draft "Sustaining Michigan Water Heritage, A Strategy for the Next Generation" (Strategy). We were pleased to have been a part of the regional (Saginaw) focus group during the development of the Strategy and are especially appreciative that our community priority for greater access (pier) to the Saginaw Bay was acknowledged and included. Increasing stewardship of our water resources by our next generation is directly related to the positive experiences our youth have with the resource. In the Saginaw Bay area, even viewing access (the simple ability to see the water and waves) is rare. Developing visual and physical access to the Saginaw Bay shoreline is critical and assistance towards construction of an access pier would greatly enhance stewardship potential and stakeholder engagement.

The proposed Strategy is a comprehensive and well done plan for ensuring our water resources are improved and protected for the next generation. As the key Great Lakes state, we recognize that our brand is harmed when our waters are damaged from pollution sources. With that in mind we offer the following comments:

1) We encourage the Department of Environmental Quality (DEQ) to build the integrated governance tools identified in the Strategy by utilizing and realigning existing programmatic activities and staff resources. Specifically assigning DEQ staff to act as liaison with local communities would improve communication and understanding of local challenges. Providing targeted resources to support and partner with those communities who are actively engaged in on-the-ground problem solving efforts would help reduce institutional barriers and lead to more effective pollution prevention and durable water quality improvements.
2) We support efforts to explore creative long term funding source(s) for water quality improvements that include funding assistance for upgrades to our aging water utility infrastructure.
3) We support greater oversight and improved transparency in the management of active and inactive or abandoned oil and gas pipelines.
4) We support and encourage the proposed numerical limits for Phosphorus control within the Western Lake Erie Basin and request similar, meaningful limits also be established for the Saginaw Bay.
5) We strongly urge the development and adoption of a statewide Sanitary Code to ensure adequate operations and maintenance are built in to the ownership of these systems. The Saginaw Bay Coastal Initiative (SBCI) has a draft Regional Sanitary Code that we can offer as a good example for this.

The Office of the Great Lakes has done a very good job in developing the draft Strategy, which will be a comprehensive and effective approach to ensuring the health of our shared water resources once implemented. We support the elements identified in the Strategy and will work with DEQ to ensure its success. Implementation of its many focus areas will be a challenge and we encourage continued stakeholder involvement as the Strategy is put into action.

Sincerely,

Laura Ogar

Laura Ogar, Director
Bay County Environmental Affairs and Community Development
ogarl@baycounty.net

Cc: Tom Hickner, County Executive, Bay County
Bay County Board of Commissioners
Rick Finn, City Manager, Bay City

From:	John Loftus
To:	mi-waterstrategy
Cc:	DENNIS H. MARVIN; plamarre@portofmonroe.com; Kyle Burleson
Subject:	Comments from the Detroit Port Authority
Date:	Friday, August 28, 2015 3:00:04 PM
Attachments:	Marine Strategy comments.docx

Attached please find comments drafted by the Detroit Port Authority with input from other members of the maritime community. If you have any questions or concerns please contact me at (313) 259-5091.

Thank you for your time and attention.

John Loftus.

DETROIT/WAYNE COUNTY PORT AUTHORITY

Comments

SUSTAINING MICHIGAN'S WATER HERITAGE

I would like to commend the Governor for developing a Comprehensive Water Strategy for the State of Michigan. This is definitely a step in the right direction. Regarding the section titled "Create Vibrant Waterfronts" I believe greater emphasis is needed on the role of commercial port and maritime operations to State's economy and the steps needed to ensure its future healthe.

The map used in this section show the tremendous number of commercial marine operations throughout the State, if not the largest number of such operations per state than clearly one of the largest. Access to low cost, efficient water transportation is one of the key factors in the growth of the State. Water transportation plays a key role in the mining, steel making and auto manufacturing sectors. Today, the maritime industry in the State is responsible for 26,800 jobs, $3.8 billion in business impact and $180 million in state and local tax revenues. Waterborne transportation is also the most energy efficient and environmentally friendly way to move cargo to domestic and international market. Air emissions from the rail mode is 1.4 time greater than marine and trucks produce 7.5 time the emission as marine. Regarding energy consumption, rail and trucks use 2.2 and 10 times respectively as much energy as the marine mode.

Marine transportation can play a critical role in the State's economic revitalization and environmental stewardship of the Great Lakes. But the investment is needed not only in dredging and port infrastructure but in highway and rail access to port facilities. The recent collapse of a dock along the Rouge River between the Cities of Detroit and River Rouge, which has closed the Federal navigation channel for several weeks and impacted the operation of AK Steel, Marathon Petroleum, St. Mary's Cement and other terminal along with thousands of jobs, demonstrates the dire need for port infrastructure investment. There is additional investment needed in land side port access by both truck and rail to port facilities. The State can and must become more engaged in these issues along with empowering port interest to make the necessary improvements.

In addition, greater utilization of the water transportation we can reduce emissions that eventually make their way into the Lakes, reduce energy consumption, and reduce the wear and tear on our highway system. With the appropriate investment in the marine sector, the State can make Michigan's business more competitive through efficient, clean and safe water transportation.

The maritime interests of the State would be happy to in detail the infrastructure needs of the industry. We applaud the effort to date and look forward to working with you to make this strategy a success. Please direct any questions to John Loftus, Executive Director, Detroit/Wayne County Port Authority (313) 259-5091.

From:	Christine Kosmowski
To:	mi-waterstrategy
Cc:	rzilke@berriencounty.org; Anne Hendrix; "Stacy L. Hissong (SHissong@fsbrlaw.com)"; bosworth@micounties.org; Brian Jonckheere; Evan Pratt (pratte@ewashtenaw.org); Kogge, Stuart
Subject:	MACDC Water Strategy Comments
Date:	Friday, August 28, 2015 3:14:02 PM
Attachments:	MACDC Water Strategy Comments_final.pdf

To Whom It May Concern

The Michigan Association of County Drain Commissioners (MACDC) is composed of Drain/Water Resources Commissioners, engineering and environmental consultants, and contractors. As an organization we are dedicated to the protection of the health, safety, and welfare of Michigan's citizens, their lands and environmental quality, and to the protection and restoration of Michigan's water resources. We seek to accomplish these goals by promoting professional development, continuing education, and encouraging member involvement.

As Drain / Water Resources Commissioners, we are responsible for the management of water resources and storm water systems extensively throughout the State of Michigan. As managers of infrastructure which transports so much of our inland surface and ground water, we have a vested interest in the future management of those resources. Therefore, we appreciate and support the effort to develop a cohesive, long-term water strategy for the state in recognition of its abundant and precious water resources. We hope to be strong supporters and partners of the strategy and the effort to protect our state's valuable water resources.

Below are summary comments specific to Michigan's Drain Code of 1956 and attached are a compilation of comments pertaining to the goals in the document.

1. We would appreciate the opportunity to be on the stakeholder panel noted in Goal 8, Recommendation #3 from Table 2, concerning review of the Drain Code and other land use regulation/legislation, as MACDC members have a working knowledge of concerns, issues, and potential solutions.

2. On a related note, there may also be opportunities to improve the local impact on water quality from drainage infrastructure by forming another stakeholder group to evaluate legislative limitations of the Drain Code and other relevant legislation as well as solutions related to funding the solutions for water issues.

3. MACDC could help with generating a better inventory of County Drains at the statewide level.

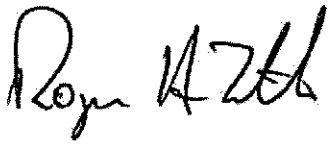
4. MACDC could help with the water enterprise budget as shown in Figure 2 and related text. MACDC could help provide a better assessment of "Big Picture" costs/estimates of annual O/M costs --- historic and then projected. The former would require us to assemble a multi-year history of the total amount assessed in those years from members.

5. Public Engagement/Awareness -- MACDC advocates for a state-led effort at the highest level regarding the value of our water resources to residents in the state. We offer our assistance

with this aspect of the water strategy, as well.

Thank you for the effort to develop this document and we appreciate the opportunity to submit comments. We look forward to working with the Office of the Great Lakes on the implementation of *Sustaining Michigan's Water Heritage; A Strategy for the Next Generation.*

Sincerely,



Roger Zilke
2015-2016 MACDC President

August 28, 2015

Office of the Great Lakes
DEQ
P.O. Box 30473-7973
Lansing, Michigan 48909

To Whom It May Concern:

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2. On a related note, there may also be opportunities to improve the local impact on water quality from drainage infrastructure by forming another stakeholder group to evaluate legislative limitations of the Drain Code and other relevant legislation as well as solutions related to funding the solutions for water issues.

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Thank you for the effort to develop this document and we appreciate the opportunity to submit comments. We look forward to working with the Office of the Great Lakes on the implementation of *Sustaining Michigan's Water Heritage; A Strategy for the Next Generation*.

Sincerely,

Roger Zilke
2015-2016 MACDC President

Cc: Stacy Hissong, MACDC General Council
File

MACDC Water Strategy Comments

August 28, 2015

We appreciate the state's efforts in developing a cohesive water strategy for the state in recognition of its abundant and precious water resources. As managers of infrastructure which transports so much of our inland surface and ground water, we have a vested interest in the future management of those resources. We hope to be strong supporters and partners of the effort to protect our state's valuable water resources.

Please accept the following comments in the discussion of the water strategy.

PRELUDE:

The introduction is a key portion of the strategy that needs to be able to catch the reader's attention and convince them to read the rest of the document. We hope the following comments will help to round out that important piece of the water strategy.

1. **Detail the process.** We think the readers would be interested to know how the process was started, all of the work that was put into soliciting input around the state, and the diversity of the stakeholders involved. We feel that this lends tremendous credibility to the process and should be celebrated whenever possible.
2. **Don't forget our groundwater resources.** The water strategy lists some impressive statistics on our surface water assets. The addition of our impressive stats on groundwater would be a great addition to the discussions.
3. **Provide all of the suggested recommendations.** Since many other recommendations were made by participants at the listening sessions, it would be interesting to see all of them, as well as a discussion as to how the 22 key priorities were selected.

Goal 1

1. **Don't forget our inland lakes.** Reduction of nutrients in any of our great lakes will fundamentally require changes to what is happening on land. We feel that it starts with our individual actions on land and that this needs to be one of the central underpinnings of achieving this goal. Current watershed protection initiatives focus on our lands with denser populations, but still miss enormous areas of the state which have tremendous impact on lake nutrients.
2. **Tracking water use and withdrawals.** Our ability to ensure aquatic ecosystem health and function will necessitate our ability to understand how our withdrawals are impacting those resources. Expanding the ability of the current water withdrawal tool would significantly improve that ability to monitor water budgets and determine which activities pose impediments to maintaining a healthy system.
3. **Couple land-use with water knowledge.** Historically, our efforts at protecting aquatic ecosystems have focused on mitigating impacts after they occur. Whether through legislative action, or other mechanisms, coupling resource protection at the pre-planning stages of land-use zoning and policy, is a far more efficient and effective means of achieving that goal.

Goal 2

1. **Make them measurable.** Nothing breeds success better than success. Having achievable goals allows participants to gauge their progress in achieving their objectives and allows them to celebrate their successes. It's ok to have simple discrete goals that are readily attainable. They're less intimidating and they motivate people to set new and more ambitious standards!
2. **Education, education, education.** Education should be a central theme in all of the goals, because it will take a strong effort in this arena to build consensus on the issues, demonstrate successes, and instill transparency that will promote trust in the program. Education should go beyond the citizenry to local units of government, and interest groups.
3. **Protect the source.** While all groundwater must be protected, alignment of DEQ review and oversight rules so that source water areas are cross-checked with planned activities with potential impacts to these areas is crucial. Evaluation of oil exploration and other potential high-impact projects in terms of potential impacts to sensitive areas such as source water zones should be incorporated into state permitting reviews.

Goal 3

1. **Incentives work.** Creating opportunity, incentivizing progress, and rewarding successes are all crucial strategies in fulfilling any major project or initiative. Incentives should be a major tool to be utilized in the effort to meet our goals.
2. **Provide the tools.** To the extent which local and state government can leverage tools to protect local resources and create these strategic assets will be key in the success of this goal. This may require legislative changes at the state level to provide local units with discretionary authority on local decisions. In many cases, local units have their hands tied with regard to key decisions impacting water resources. These bonds must be removed.
3. **Funding tools.** While not a popular topic, the extent to which these initiatives can be leveraged through direct funding, incentives, or community initiatives will be necessary to achieve our goals. Cleanup of contaminated sites, for example, will require dedicated funding as well as legal support by the state. A dedicated section of the AG's office, for example, may be prudent in marshaling many cleanup sites through to actionable projects.

Goal 4

1. **Asset management.** Asset management is a priority system which utilizes a risk and impact assessment to develop an efficient management plan. Use of this strategy will help identify the greatest risks to the resource and protect them accordingly. The sustainability of these resources will depend to a great degree on the extent to which we can properly identify these risk/impact relationships and focus on the greatest priority items.

Goal 5

1. **Mesh and meld policies.** From a statewide sanitary code to building and development codes which reward water-based technology and innovation, a system of clear and consistent policies will help with compliance in achieving efficiency targets within the state. Adapting a flexible system by which water-based innovation can be more easily adapted within the state should be a key component in achieving this goal. Too often, the introduction of new water-based innovation is stymied by inflexible rules and regulations. Creating flexibility in regulations while still protecting the resource is a difficult yet necessary endeavor.

Goal 6

1. **Enable stormwater utilities.** Resource protection is best done at the local level and providing the tools for citizens and local units of government to protect their local resources is critical. As the "forgotten utility," stormwater receives little of the benefits afforded many of the "conventional" utilities such as wastewater and drinking water. Recognizing the need to properly managing these assets like other utilities will be a key step in protecting water infrastructure. This concept ties into one of our prior comments on the ability of communities to fund conservation efforts.

Goal 7

1. **What gets measured gets managed.** Measurement is a key component of any adaptive management process. It provides justification to measures that work and helps eliminate those that don't. We like the mention of a decision framework and suggest that measurement and monitoring also be utilized to legitimize the most efficient best management practices. This means of ground truthing will help to promote these efficiencies and aid in attainment of our goal areas.

Goal 8

1. **Provide the legal tools.** As mentioned in previous goals, local units need the flexibility and authority to actively protect water resources and promote conservation. Consistency in regulation, flexibility in decision making, and funding tools make this a difficult yet crucial component in the implementation of the overall water strategy.
2. **Get on the same page.** Water protection and property protection statutes often work at cross purposes, due in large part to incongruent statutes and administrative policies. Revising statutes so that governmental organizations can work cooperatively instead of at loggerheads, will be essential in eliminating the inefficiencies of the existing system.
3. **Michigan's Drain Code of 1956.**
   - We would appreciate the opportunity to be on the stakeholder panel noted in Goal 8, Recommendation #3 from Table 2, concerning review of the Drain Code and other land use regulation/legislation, as MACDC members have a working knowledge of concerns, issues, and potential solutions.
   - On a related note, there may also be opportunities to improve the local impact on water quality from drainage infrastructure by forming another stakeholder group to evaluate legislative limitations of the Drain Code and other relevant legislation as well as solutions related to funding the solutions for water issues.
   - MACDC could help with generating a better inventory of County Drains at the statewide level.
   - MACDC could help with the water enterprise budget as shown in Figure 2 and related text. MACDC could help provide a better assessment of "Big Picture" costs/estimates of annual O/M costs --- historic and then projected. The former would require us to assemble a multi-year history of the total amount assessed in those years from members.

Goal 9

1. **Include all stewards.....and educate!** The list of stewards goes well beyond just communities and individuals. They include non-profits, chambers, businesses large and small, rotaries, and the list goes on. Education lies at the key to this, but leveraging the resources of so many groups that may not historically been considered partners in resource protection is crucial. In many cases, the market economy is recognizing the importance of resource protection and has embraced it more strongly than the public

sector. Inclusion of the private sector should be a strong focus of the strategy and associated educational efforts. MACDC advocates for a state-led effort at the highest level regarding the value of our water resources to residents in the state. We offer our assistance with this aspect of the water strategy, as well.

From:	Grenetta Thomassey
To:	mi-waterstrategy
Subject:	Water Strategy Comments
Date:	Friday, August 28, 2015 3:14:33 PM
Attachments:	TOMWC comments on Michigan Water Strategy.pdf

Thanks for the opportunity to comment on the Water Strategy! Grenetta

Grenetta Thomassey, PhD
Program Director
Tip of the Mitt Watershed Council
231.347.1181 ext. 118
231.838.5193 cell

Tip of the Mitt Watershed Council
426 Bay St., Petoskey, MI 49770
231.347.1181 www.watershedcouncil.org

August 28, 2015

Mr. Jon Allan
Michigan Department of Environmental Quality
Office of the Great Lakes
P.O. Box 30473
Lansing, MI 48909-7973

Dear Director Allan:
Thank you for the opportunity to comment on the recent release of "Sustaining Michigan's Water Heritage: A Strategy for the Next Generation." I am writing on behalf of Tip of the Mitt Watershed Council and more than 2,300 individual, business, and lake association members.

The draft Water Strategy, "Sustaining Michigan's Water Heritage: A Strategy for the Next Generation," is a good step towards protection and restoration of Michigan's most valuable resource – our waters – as well as the long-term support of our citizens, communities, and economy. We commend the Governor and Office of the Great Lakes for initiating and developing the Water Strategy. Implementation of the recommendations put forth in the Strategy would result in substantial improvements to the health of the Great Lakes ecosystem, Michigan's citizens, and our economy.

In the following sections, we provide recommendations that would strengthen Michigan's Water Strategy.

Overall Comments

Coordination: It must be noted that the Great Lakes are, in fact, a global treasure and, therefore, protection and restoration must be considered in the context of all who share the resource. While the Strategy is Michigan-specific, coordination with the other Great Lakes states, Canadian provinces, and Native American Tribes and First Nations is necessary to fully sustain our water heritage. It would be good to acknowledge this.

Funding: A substantial national and state commitment of financial resources will be required to implement the recommendations put forth in the Strategy. Therefore, the Water Strategy should include specific funding levels, as well as existing and new funding resources for each issue area's recommendations. Additionally, the Strategy should encourage full allocation of appropriated funding for existing programs.

Accountability: Successful protection and restoration of the Great Lakes requires accountability, coordination, and fiscal responsibility. The roles and responsibilities of involved parties need to be fully defined or outlined.

Leadership: In addition to outlining the roles and responsibilities of lead actors, it would improve the overall implementation performance if a central leadership position or authority was identified to provide more direction to the efforts of all the parties. We worry that there is no implementation step identifying the overall leader, in charge of implementing the plan. There needs to be an agency or office assigned and articulated as such. We understand the challenges of writing and implementing a 30-year plan as numerous governors, legislatures, and agency personnel will ultimately take part. However, let us take notice of lessons learned from similar efforts. The Comprehensive Everglades Restoration Program is a 30-year program, signed into law when Clinton was President and Jeb Bush was Governor of Florida. This program, started in 2000, is still going strong at its halfway point, 15 years old. One key reason for its success is the fact that lead agencies were identified as "orchestra leaders", making sure the plan did not sit on a shelf. (See http://www.saj.usace.army.mil/Portals/44/docs/FactSheets/CERP_FS_August2015.pdf).

Flexibility: Strategy goals must evolve with the advent of new stresses, technology, and scientific knowledge. It needs to be recognized by all that the Strategy is a living document, subject to the dynamic nature of the Great Lakes, and needs to maintain flexibility to adequately address and incorporate emerging threats, issues, technologies, and advancements in science.

Transparency: We recommend requiring Annual Reports to be developed for the Water Strategy, in addition to a "taking stock" exercise every 5 years. Annual reports should include information on progress made, successes, and obstacles or challenges faced with implementation of the recommendations. This will keep the document in the public's eye, and will show decision makers the important progress being made.

Wetlands: Oddly, there is very little reference to wetlands within the Water Strategy. Wetlands are some of our most valuable resources – they provide homes for wildlife, maintain water quality, and protect us from floods. They are places of beauty that contribute greatly to the overall health of our environment and our quality of life. Although the functions and values that wetlands provide make them our most valuable landforms, the United States and Canada have lost alarming amounts of wetland habitat. Michigan has lost 50% of its original wetlands. The percentage of Michigan's coastal wetlands that have been lost is even greater, at 70%. In total, over 5,600,000 acres of wetlands have been damaged or destroyed in Michigan. As we continue to lose wetlands in Michigan, it has becoming increasingly important for the State of Michigan to protect and wisely manage our wetland resources. This needs to be reflected in a 30-year vision for our waters. Therefore, in addition to Michigan's lakes, streams, and groundwater, wetlands need to be referenced and emphasized within the Strategy.

Table 2 Comments

GOAL 1.

- #1. The implementation metric for #1 should also articulate some state-specific metric of measurement, taken from the Michigan Aquatic Invasive Species Plan. In addition to ecological separation of the Great Lakes and Mississippi River Basins, we suggest including an additional recommendation: "By 2020, establish and fully fund a statewide Rapid Response Team, to address reports of new invasive species."

- #2. If the implementation metric is to be a pilot project with Ontario, the Canadian Province needs to be identified as a Lead Actor.

- #4. A comprehensive strategy to prevent nuisance and harmful algal blooms must include mandatory measures for agricultural. The current framework of relying solely on voluntary actions by farmers has proved ineffective to adequately address agricultural pollutants. To ultimately protect the health of the lakes and citizens, it is time to consider more strict and accountable requirements for agriculture. This should include, at a minimum, a full ban on winter application of manure and municipal sewer sludge on frozen fields.

- #7. The State should go beyond developing a harmful algal toxin assessment criteria and develop a statewide drinking water advisory, or action level target, for harmful algal toxins.

- #8. Non-governmental organizations (NGOs) should be included among the Lead Actors for this recommendation. NGOs have been many steps ahead of state and local governments, and ahead of communities, at large, on the issue of climate change. NGOs can provide valuable information to those entities, to help implement this recommendation.

- #10. NGOs should be included among the Lead Actors. Many NGOs throughout the State, including the Watershed Council, have developed materials on shoreline and riparian ecology that can be utilized to encourage landowners to protect and fully benefit from their riparian area.

  In addition, the State needs to promote statewide policies and regulations that protect and enhance the riparian zone. We have recently seen a rollback in environmental protections by the State Legislature. If we truly want to leverage Michigan's most treasured natural resource and ensure its long-term sustainability, then we need our elected officials to better protect lakes, rivers, and wetlands that are pillars of the state's $17-billion tourism industry.

- #13. In addition to refining and improving the water withdrawal assessment process, the legislative exemption for water withdrawals associated with oil and gas development needs to be removed from state law. Part 327, Great Lakes

Preservation Act, prohibits new or increased large quantity water withdrawals that cause an adverse resource impact. When the water withdrawal legislation was originally enacted in 2006 and revised in 2008, Michigan's oil and gas industry was using techniques that did not require large quantity withdrawals of water. As a result, a withdrawal associated with oil and gas production is exempt from Part 327. (MCL324.32727(1)(a)) However, recent hydraulic fracturing techniques use significantly greater quantities of water than traditional methods – as high as 21 million gallons per well. Given the changing technology and potential impact upon groundwater resources of the state from these withdrawals, the exemption granted for activities authorized under Part 615 needs to be removed from Part 327.

- We suggest inclusion of another recommendation for Goal 1: Uphold the Great Lakes-St. Lawrence River Basin Water Resources Compact (Compact) by ensuring that Great Lakes water diversion applications meet every standard and requirement of the Compact, during Compact Council Regional Reviews. We are expecting the City of Waukesha Diversion application to be approved by the Wisconsin Department of Natural Resources and submitted to the Compact Council. As the first request for a diversion of Great Lakes water outside the Basin under the Great Lakes Compact, the review and decision-making on the Waukesha diversion application will establish a valuable precedent, setting the standard for future diversions. It is imperative that the review and final decision be made on the standards put forth in the Compact.

- #16. We enthusiastically applaud the inclusion of this recommendation.

- #17. We suggest an additional recommendation to establish stormwater plans to protect high quality waters. The Watershed Council works with the cities of Petoskey and Harbor Springs, for example, in addition to numerous other cities and townships in our 4-county service area, to create stormwater management plans. This is very important and supplements work accomplished by numerous 319 grants to address non-point source pollution in our high quality water region.

- #18. A similar implementation step is needed to protect high quality watersheds that are under constant pressure from development. Development needs to be conducted in an environmentally responsible manner that prevents degradation to water quality and ecosystem health. Engaging landowners about healthy waters is a key investment for the state as it prevents spending thousands of more dollars to restore waters if they become impaired.

GOAL 2.

- #1. We enthusiastically applaud the inclusion of mapping local groundwater conditions. This is greatly needed.

- #2. EXCELLENT pick up here! We recently started researching information on geothermal, and shared our concerns with a member of the Water Use Advisory Council. This is an area that needs to be more publicized, because we have seen circumstances in Northern Michigan where geothermal systems are being constructed without any permit application or evaluation of impacts to water resources. (*ALSO NOTE: The implementation metric section, under 2020, has a typo that says: "for comland-usemunity water systems..."*)

- #4. First, we are not sure what this step actually means. The implementation metric refers to a "pipeline strategy" that we think means the recommendations put forth in July 2015 by the Michigan Petroleum Pipeline Task Force. If this is what is being referenced, the Water Strategy should identify it as such. Additionally, the Lead Actors need to include federal government agencies and pipeline operators with infrastructure within the state. You cannot have a solid emergency plan regarding pipelines without including key federal actors responsible for emergency management and response, such as U.S. Environmental Protection Agency (EPA), U.S. Coast Guard (USCG), and the Pipeline and Hazardous Materials Safety Administration (PHMSA), or the pipeline operators themselves.

  In addition to implementation of the "pipeline strategy," there are a number of actions the State could take to reduce the risk associated with oil transportation and improve preparedness to respond to pipeline emergencies.

  Examples include:
  - Enact legislation that amends Michigan Public Act 16 of 1929 and strengthens the review process for new oil pipelines by requiring a full environmental review of proposed routes, placing emphasis on minimizing pipeline water crossings.
  - Require that the Michigan Department of Environmental Quality (MDEQ) conduct a pipeline water crossing survey to assess the risks of existing pipelines running under the state's rivers, streams, and lakes.
  - Require approval of all spill response plans by MDEQ, subject to certain standards and open to public review and comment.
  - Further accelerate the replacement of bare steel and cast iron pipe within the State.
  - Prohibit transportation of crude oil and petroleum products in barges or tankers in Michigan waters.
  - Prohibit construction of new pipelines in the Great Lakes.

- #5. YES!!!! This is sorely needed – see MSU's recently released study showing we have underestimated the impacts of septic systems on our lakes and streams: http://msutoday.msu.edu/news/2015/septic-tanks-arent-keeping-poo-out-of-rivers-and-lakes/ . Lead Actors need to be more than the Legislature. At a minimum, local Health Departments should be named, in addition to the MDEQ.

- #6. The statewide code should require regular inspection and maintenance of all on-site wastewater systems, with proof of such submitted periodically to the county or township. The state should design and export a simple, standard record-keeping procedure required in the code. Additionally, Lead Actors need to be more than the Legislature. At a minimum, local Health Departments should be named, in addition to the MDEQ.

- #10: Community collection programs to properly dispose of unwanted and unused pharmaceuticals and personal care products can place a significant financial burden on local community entities. Long-term funding needs to be secured and allocated to ensure communities can continue collection programs and properly dispose of such contaminants, into the future.

GOAL 3.

- #3. The implementation metric should be quantitative, identifying how many communities by a certain year. The recommendation needs numbers and timelines attached to them so that progress can be tracked against schedules.

GOAL 4.

- #4. Include local governments as Lead Actors here.

- #5. Include local governments, Lake Associations, and NGOs as Lead Actors. Also, any public access site should include the establishment and maintenance of optimal greenbelts. Many state boat launches exhibit erosion and over-maintenance such as mowing and removal of native vegetation near the shoreline. This can have potential negative effects on aquatic systems. The presence of a healthy greenbelt helps to drastically reduce the impact of boat launch pollutants. In addition, this allows the state to lead by example, educating the public on greenbelts which can promote their use.

GOAL 5.

- #1. In addition to the Michigan Economic Development Corporation (MEDC) as a Lead Actor; we suggest including academia as well as the Michigan Department of Natural Resources (MDNR) as Lead Actors.

- #2. This recommendation should acknowledge the Compact, specifically, and emphasize how important this is to our ability to enforce the Compact standards in federal court.

- #4. We enthusiastically applaud this recommendation!

- #5. We recommend encouraging entrepreneurs who think outside the box to handle wastewater management. A good example is Big Fish Environmental (see: www.bigfishenvironmental.com.) In 2007, Big Fish became the first (and only) facility in Michigan to produce bio-solids that meet the Class A Pathogen Reduction criteria to be considered *Exceptional Quality* by the U.S. Environmental Protection Agency. Companies like Big Fish should be supported and encouraged!

GOAL 7.

- #1. We think the Compact should also be acknowledged on this step.

- #2 and #3. YES!!

GOAL 8.

- #2. We are very supportive of a Water Fellows Program.

- #3. It is past time to update the Drain Code!!

- #4. The State needs to amend Part 303, Michigan's Wetland Protection Act, to ensure the state program is consistent with Section 404 of the Clean Water Act. In 1984, the State of Michigan was given approval to administer Section 404. This means that the MDEQ was approved to administer a state dredge and fill permitting program, in lieu of the federal Section 404 program administered by the U.S. Army Corps of Engineers (USACE) and EPA. To keep the authority to administer Section 404, a state must maintain a program that is equivalent to the federal program administered by the EPA. This is required so that every state meets minimum water quality standards, and to maintain a level playing field for business and development interests.

  Michigan has not maintained a program equivalent to the federal program. The EPA conducted a comprehensive review of the state program and found numerous deficiencies. EPA identified corrective actions for the state to take, in order to address those deficiencies and keep administering Section 404. A new law, PA 98 enacted in July of 2013, was supposed to fix the deficiencies. But after changes by the Legislature, this law failed to correct all of the deficiencies, as it was intended to do in its original form, and introduced new inconsistencies with federal law. EPA has identified more than 20 provisions within the new law that are not consistent with, or are weaker than, federal law. In order to retain full authority under the Clean Water Act to continue to manage Michigan's own water resources, Part 303 must be amended to be consistent with federal law.

- #5. A leader needs to be identified for the Water Team. Additionally, the document needs to identify the tools and resources available and/or needed to achieve the 30-year vision.

Table 3 Comments

Continuing to advocate for Great Lakes Restoration Initiative funding and other federal programs that support the Great Lakes should be a priority within the Water Strategy Implementation Plan. Over the last six years, the Great Lakes Restoration Initiative has invested more than $1.9 billion in the Great Lakes states of Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York, and has been widely credited with accelerating the restoration of one of the world's most important water bodies. It supported more than 2,000 projects, which have restored more than 110,000 acres of fish and wildlife habitat, opened up fish access to more than 1,900 miles of rivers, and helped farmers implement conservation programs on more than 280,000 acres of rural working lands. The Great Lakes Restoration Initiative has also funded important work on toxic hotspots around the region and as a result enough cleanup work has been completed to delist five of these formerly contaminated sites—in the previous two decades before the GLRI, only one site had been delisted. State advocacy for this highly successful and unparalled program must remain a priority.

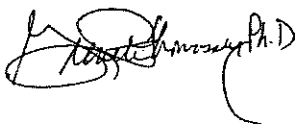
Conclusion

Protecting and restoring the Great Lakes is critical to Michigan's future. Michigan's 10 million residents depend on the Great Lakes for drinking water, recreation, and to support our economy. The Great Lakes keep our lights burning and assimilate our wastes. They cradle our fish and wildlife and provide endless hours of recreation. They temper our weather, allowing for a cornucopia of specialty crops. They define our state and our lives.

The state's economy, quality of life, scenic beauty and ecological health are irrevocably intertwined with the health and productivity of the Great Lakes. It is with this understanding that we again commend the Administration for taking on the charge of developing a Water Strategy, and we look forward to working jointly with all partners to sustain Michigan's water heritage for future generations.

Thanks again for the opportunity to comment. If you have any questions regarding these comments, please feel free to contact me at 231-347-1181 or grenetta@watershedcouncil.org.

Sincerely,



Grenetta Thomassey
Program Director

From:	Kyle Bredell
To:	mi-waterstrategy; Nicholas Joseph Schroeck; GLELC Detroit
Subject:	Draft Water Strategy Comments
Date:	Friday, August 28, 2015 3:19:23 PM
Attachments:	Water Strategy Comments.pdf

Please find enclosed comments to the DEQ's draft water strategy, as prepared on behalf of the Great Lakes Environmental Law Center.

Thank you,

Kyle Hampton Bredell
Student Attorney
Great Lakes Environmental Law Center
Detroit, MI

August 28, 2015

VIA ELECTRONIC MAIL TO: Mi-waterstrategy@michigan.gov

Office of the Great Lakes
Department of Environmental Quality
P.O. Box 30473
Lansing, Michigan 48909-7973

Re: Michigan's Draft Water Strategy

Dear Sir or Madam:

Please accept these comments submitted on behalf of the Great Lakes Environmental Law Center ("GLELC")[1] regarding the Michigan Draft Water Strategy. Although commenters generally support the draft, they have a few concerns. Written comments received on or before August 26, 2015, will be considered in the final action of the Michigan Department of Environmental Quality ("MDEQ"). Accordingly, these comments are timely submitted.

I. The strategy overemphasizes water as a tool for economic and business development throughout.

The introduction to the draft strategy lays out four core values identified with water: economic, environmental, social, and cultural, stating that all are equally important.[2] While the economic impact of any proposed environmental action plan is certainly very important to the plan's overall viability and ability to be implemented, the environmental impact should be the primary concern of an environmental plan of action.

Environmental and economic goals certainly can coexist and work towards the same end, but they can and frequently do conflict. Programs or policies which benefit the environment frequently come at an economic cost in terms of tax expenditures and increased burden to businesses. In such situations, the state should err on the side of protecting the environment. For example, the proposed strategy lists several points on how to use water for economic gain, suggesting that water-based recreation as an

[1] 1 A non-profit organization, based in Detroit, Michigan, dedicated to protecting the environmental
[2] Draft Water Strategy, Mich Dep't of Envtl Quality, p 1 (June 4, 2015), available at http://www.michigan.gov/documents/deq/deq-ogl-Draft_Water_Strategy_and_Appendices__06-04-2015_491266_7.pdf.

important tool for economic development.[3] This can, on occasion, be at odds with the goal of protecting our water resources. For example, power boat wakes can negatively affect shorelines and wetlands through erosion of natural shorelines.[4]

By weighing the core values of the economy and environment equally, the plan may encourage a way of thinking in which environmental action is only taken if it is helpful without coming at an economic cost. The plan should urge citizens and business, in the spirit of the stewardship which the plan advocates, that our environmental goals come with some cost, and we should be willing to make that sacrifice as part of our duty to future generations.

The strategy also urges that the State of Michigan "accelerate water technologies to solve water problems using an entrepreneurial business-led initiative."[5] While businesses and entrepreneurs should certainly be encouraged to take and active roll in developing these new technologies, the state should lead the initiative by drawing on our world-class universities. As the draft itself points out, while allowing business and industry to exploit the environment may have led to Michigan's economic boom, it was very costly for the environment.[6] By taking a lead roll, the State of Michigan can ensure that environmental concerns are placed before profitability.

II. The strategy should engage in a real discussion on guaranteeing low-income Michiganders access to drinking water.

The strategy spends a significant amount of time focusing on the health and safety of Michigan's drinking water, both through municipal systems and private wells. While much attention is rightfully given to ensuring the water is pure and safe to drink, little attention is given to ensuring that the most vulnerable Michiganders have access to it. While the draft states that "clean, safe water is fundamental to Michigan's economy," which it most certainly is, we urge the strategy to more importantly recognize access to drinking water as a fundamental human right, rather than an economic tool.

Detroit's controversial water shut-offs to low income residents is mentioned only in passing, stating that they have put a sharper focus on rates, affordability, and funding legacy infrastructure.[7] While this is certainly true, the draft fails to further elaborate on the true nature and seriousness of the problem. The draft's brief solution is to "evaluate current community practices regarding providing water to financially distressed customers to ensure all citizens have affordable access to water for drinking and sanitation."[8] This recommendation is slipped in among several other recommendations regarding infrastructure funding and future investment strategy, and does not go beyond

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[3] *Id.* at 7

[4] *Common Problems: Erosion,* Minnesota Department of Natural Resources, (August 28, 2015 3:01 pm) http://www.dnr.state.mn.us/restoreyourshore/sl/shoreline.html

[5] *Id.*

[6] *Id.* at 3

[7] *Id.* at 7

[8] *Id.* at 44

conducting an evaluation of existing policy, and possibly implementing changes at a later date. The strategy should go beyond simple evaluations and lay out firm steps and actionable recommendations, along with ways to measure success as it has with many of its other recommendations.

III. The impact of global warming must be addressed.

The very first goal of the strategy is to create healthy and functioning aquatic ecosystems, and lays out a number of specific goals and recommendations to accomplish these goals.[9] One of the biggest specific concerns addressed in the strategy is how to reduce harmful algae blooms, which have economic, environmental, and health impacts.[10] As global temperatures continue to rise, these harmful algae blooms are predicted to become more frequent and more problematic,[11] yet this fact is not mentioned in the strategy.

Throughout the entire proposal, the terms "global warming" and "climate change" are not mentioned at all. The affect of rising temperatures on algae blooms is just one example of the damaging effects global warming will have on Michigan's aquatic ecosystems in the coming decades. It is a problem that must be addressed in this strategy, if only to plan for the future, if not to propose solutions and ways of combatting this very real, and very pressing issue.

IV. The strategy must do more to address the imminent and serious threat of nutrient pollution.

As the plan recognizes, nutrient runoff can have a very serious ecological impacts on lakes and streams.[12] According to the Environmental Protection Agency, nutrient pollution is one of the nation's most serious environmental issues.[13] Excess nutrients in water can cause a variety of health and ecological problems, including contributing to the growth of toxic algae blooms.[14] Excess nutrients in drinking water can pose a direct threat to the health of young children, while the chemicals used to treat for nutrient pollution can lead to further health problems in adults.[15]

Nutrient pollution can also have a devastating effect on water quality and wildlife.[16] Algae blooms, fueled by these excess nutrients, deplete oxygen levels in

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[9] *Id.* at 6
[10] *Id.*
[11] *Impacts of Climate Change on the Occurrence f Harmful Algal Blooms*, United States Environmental Protection Agency (August 28, 2015, 2:44 pm), http://www2.epa.gov/sites/production/files/documents/climatehabs.pdf
[12] Draft Water Strategy at 10
[13] *The Facts About Nutrient Pollution,* United States Environmental Protection Agency (August 28, 2015, 2:44 pm), http://midwestadvocates.org/assets/resources/nutrient_pollution_factsheet.pdf
[14] *Id.*
[15] *Id.*
[16] *Id.*

water, suffocating fish and shellfish.[17] Toxins produced by the algae blooms can kill animals, fish, and pets.[18]

Nutrient pollution also directly impacts the economy, costing Americans roughly $1 billion annually, mostly due to losses from fishing and recreation.[19] Nutrient pollution cases have caused tens of millions of dollars in damage to commercial fisheries, and algae blooms negatively impact the value of waterfront properties.[20] Costs of cleanup can potentially run into the billions of dollars, and can shut entire towns off from access to drinking water, as was recently demonstrated in Toledo and parts of south-east Michigan which rely on the Toledo municipal water system.[21]

The bulk of nutrient pollution comes from agricultural sources.[22] While much of it of it comes from livestock waste, a significant amount comes from excessive use of fertilizers, both of which was into streams and lakes when it rains.[23] The strategy should include steps to encourage, if not require farmers to take affirmative steps to help lessen their nutrient pollution output. By applying the correct amount of fertilizer, at the right time of year, and through the proper method, farmers can significantly reduce the amount of fertilizers which runs into bodies of water.[24] By planting trees, bushes, and grasses around fields, farmers can create a buffer to absorb nutrients before they reach nearby streams and lakes as pollution.[25] It is also important for farmers to keep their livestock away from rivers and streams, as their waste washes down stream, releasing nutrients into and polluting the water.[26]

V. The strategy fails to address the closure of the Mackinac Straights pipeline.

The strategy supports Attorney General Schuette's calls to close the Mackinac Straights Pipeline,[27] a call which is echoed by the commenters. Every day, 500,000 barrels of oil flow through this sensitive area. Attorney General Schuette has called the pipeline "the most acute potential threat" to the great lakes, and advocates for aggressive action.[28]

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[17] *Id.*
[18] *Id.*
[19] *Id.*
[20] *Id.*
[21] *Id.*
[22] *The Sources and Solutions: Agriculture*, United States Environmental Protection Agency (August 28, 2015, 2:44 pm), http://www2.epa.gov/nutrientpollution/sources-and-solutions-agriculture
[23] *Id.*
[24] *Id.*
[25] *Id.*
[26] *Id.*
[27] Draft Water Strategy at 66
[28] Jim Lynch, *Schuette: Days Numbered for Mackinac Straits' Pipelines*, The Detroit News (August 28, 2015, 2:49 pm)
http://www.detroitnews.com/story/news/politics/2015/07/14/schuette-pipelines-straits-mackinac/30128275/

Enbridge, the company which runs the pipeline, has failed to adequately disclose their own safety test results or the methods used.[29] They have also failed to consider the effect that Aquatic Invasive Species, such as zebra mussels, may have on the safety and stability of their pipeline.[30] This same company is responsible for the spilling of 840,000 gallons of heavy crude oil into the Kalamazoo River in 2010.[31] A similar spill in the Straights of Mackinac would prove disastrous. The strategy should propose a concrete timeline with distinct milestones for retirement of this antiquated technology.

VI. Conclusion

GLELC appreciates your consideration in this matter and hopes that DEQ will take the above items into account before taking final action on the Draft Water Strategy. GLELC expects that the agency will continue to give precedence to public concern and will continue to ensure the ecological integrity of our state's waters.

Sincerely,

/s/ Kyle Bredell
Student Attorney
Great Lakes Environmental Law Center
[redacted]

Stephanie Karisny
Staff Attorney
Great Lakes Environmental Law Center
stephanie.karisny@glelc.org
313.782.3372

[29] *Id.*
[30] *Id.*
[31] *Id.*

From: Erin Johnston
To: mi-waterstrategy
Cc: Chris Swartz; Catherine Laux; Char Spruce
Subject: KBIC Comments on the proposed Michigan Water Strategy
Date: Friday, August 28, 2015 3:47:50 PM
Attachments: KBIC Comments_MI Water Strategy_2015.pdf
Importance: High

Please find attached comments from the Keweenaw Bay Indian Community on the proposed Michigan Water Strategy.

Thank you.

Erin Johnston
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Keweenaw Bay Indian Community
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Keweenaw Bay Indian Community
Natural Resources Department

August 28, 2015

Office of the Great Lakes
Michigan Department of Environmental Quality
P.O. Box 30473-7973
Lansing, MI 48909

RE: Michigan's proposed Water Strategy

Dear Mr. Allan,

The Keweenaw Bay Indian Community (Community), a federally recognized tribal nation submits the attached comments regarding the State of Michigan's (State) proposed Michigan Water Strategy: Sustaining Michigan's Water Heritage (Strategy). The Community is one of many tribes that have centuries of cultural and spiritual connections to the land, waters and fish in the streams and waterways of the Great Lakes. Under the 1842 Treaty of LaPointe, our Community reserved rights to hunt, fish, trap and gather on traditional homelands ceded to the United States. We thank you for the opportunity to comment on the content of the Michigan Water Strategy.

Tribal Involvement in the Process

The Community understands that the State does not possess the important historical trust responsibilities to Indian Tribes as the federal government as expressed and recognized within treaties and federal Indian Law. However, it is our expectation that the State, in accepting delegated responsibilities under the nation's Clean Water Act, also comply with federal standards and responsibilities for tribal consultation. Until now, there has been a lack of Tribal Government-to-Government consultation throughout this multi-year process. Furthermore, for effective and meaningful consultation, we urge the State of Michigan to allow Tribes to participate in any future conversations about the Strategy before a final draft of the strategy is published. The Community has had ongoing challenges towards achieving meaningful participation with the State to ensure adequate protection of our water, cultural resources, wildlife and other shared natural resources in accordance to tribal traditions and subsistence uses. The Community's position and authority as a sovereign entity should not only be relegated to public comment timeframes.

Upon reviewing the list of participants in the ten roundtables that were held throughout the State, the Region 5 roundtable hosted in Saginaw was the only roundtable with Tribal participation (Saginaw Chippewa Indian Tribe). During the Water Strategy webinar on August 17th, 2015 you stated that during the development process, the State "...had substantial and important conversations with our tribal sovereigns..." The Community does not feel that we were included in "substantial and important conversation" regarding this Strategy. Based on participant lists, it does not appear that substantial conversations took place across Indian County. We are wondering how and when Tribes were contacted during the Strategy development process.

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Ensure Clean and Safe Water

Discussion and recommendations within this chapter focus on legacy contamination, protection of drinking water, and emerging pollutants. We recommend additional attention be given to reducing sources of pollution from the extraction and burning of fossil fuels within Michigan. A recommendation could be added to this section requiring some level of conversion to renewable energy in support of statewide Clean Power initiatives.

Governance

The Strategy in its current draft fails to acknowledge the co-managerial role and responsibility of Tribes in the protection of Michigan's abundant and precious water resources. Throughout the Strategy there is reference to state, local and federal agencies, but no mention of Tribal governments in future implementation actions.

Within Chapter 8 there are several strong statements made expressing the need for the State to "exercise authority and autonomy over their [water and water resources] thoughtful management." These statements seem contradictory to an earlier statement (page 2 of the Strategy) that states "decisions made with regard to Michigan's water resources are subject to collaboration, consultation, oversight and regulation under a complex framework of regional governance structures and federal, state and tribal laws."

In addition, if the State intends to retain full authority under the Clean Water Act and continue to manage Michigan's water resources, we encourage the State to ensure that they have capacity and capability to be "good and thoughtful stewards of this global treasure" (Draft Strategy, page 36). Protecting 20% of the world's freshwater resources should not be taken lightly.

Ecosystem vs. Economy

Governor Snyder asked the Office of the Great Lakes to lead development of this Strategy for the state of Michigan based on an ecosystem approach. The first two Chapters of the current draft Strategy focus on protection and restoration of aquatic ecosystems and ensuring clean and safe water. However, the majority of the strategy focuses on economics and how the State can provide more access and encourage development along our water ways. The current draft strategy does not clearly define how the State intends to balance protection of water resources with promotion of use and development.

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Additional Topics to Address

For this Strategy to truly be comprehensive it should acknowledge highly important global environmental issues including Climate Change. The strategy is based on a 30 year vision emphasizing reduction of threats to aquatic ecosystems. Climate change is already impacting our water resources, both the Great Lakes and inland waters, and changes are predicted to increase in the next 50 to 100 years. Lack of discussion of climate change impacts on water quality and quantity and on water related infrastructure (dams, culverts, stormwater drainage, water treatment plants, waste water facilities, etc.) is a serious oversight in the current draft.

The Vision of the Community's Integrated Resource Management Plan is *"to live in harmony while enhancing and sustaining the resources of the Keweenaw Bay Indian Community **for the Seventh Generation.**"* We encourage the State to consider expanding the scope of the Water Strategy of sustaining Michigan's water heritage not just for the next generation, but for seven generations and beyond.

In closing, we appreciate the opportunity to comment on the proposed Michigan Water Strategy. As this Strategy is still in draft form, there is ample opportunity for Tribal involvement. The Community urges the State to include Tribal governments in further development of the Strategy and planning for implementation. Please feel free to contact me with any questions or comments that you may have regarding this letter.

Sincerely,

Lori Ann Sherman, Natural Resources Director
Keweenaw Bay Indian Community

CC: Warren C. Swartz Jr., Tribal President
Catherine Laux, Water Resources Specialist
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From:	Herbert, Georgeann
To:	mi-waterstrategy
Cc:	Jodee Raines; Aimee LaLonde-Norman (aimeeln@therouge.org); Laura Rubin (lrubin@hrwc.org); michele@crwc.org; Tricia Blicharski; marmstrong@cleanwater.org; Khalil Ligon (kligon@greatlakes.org); jerb@erbff.org; Tanner, Cynthia
Subject:	Joint Response-MiWaterStrategy-Stewardship
Date:	Friday, August 28, 2015 4:09:32 PM
Attachments:	Joint Response-MiWaterStrategy-Stewardship.docx

Please accept these comments from a combined group of freshwater organizations, led by the Erb Family Foundation

Thank you.

Georgeann Herbert
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August 28, 2015

Mr. Jon Allan
Director, Office of the Great Lakes, DEQ,
P.O. Box 30473-7973
Lansing, Michigan 48909

RE: Comments on Chapter 9 of the Michigan Water Strategy

Dear Mr. Allan,

Thank you for the opportunity to comment on the Draft Water Strategy. We appreciate the time, effort and thought that went into the preparation of this document.

We have collaborated in reviewing the draft Strategy and, in particular, Chapter Nine titled "Inspire Stewardship for Clean Water."

This chapter states as its goal that Michigan citizens are stewards of clean water and healthy aquatic ecosystems, with a desired outcome that individuals and communities understand their responsibility for and make responsible decisions regarding water resources. It is the belief of the organizations signing onto these comments that the strategy outlined in this chapter needs to be strengthened to achieve the desired goal and outcome in Chapter Nine, and that other chapters within the strategy will suffer if insufficient attention is paid to building stewardship and water affinity among Michigan citizens.

We believe the existing recommendations can be significantly strengthened, that some additional recommendations need to be added, and that the state of Michigan can make rapid progress in this effort by leveraging the experience and expertise of the many freshwater organizations who have been working in the state for many years.

STRENGTHENING RECOMMENDATIONS WITHIN THE STRATEGY

Recommendation #1: The first recommendation in Chapter Nine calls for integrating "water literacy principles into place-based education." It also suggests that the water literacy principles be integrated into "State of Michigan curriculum standards tied to Science, Technology, Engineering and Math (STEM) principles across all grade levels."

- We are concerned that there is no mechanism or financial support outlined in the plan to build sustainability among organizations currently involved in place-based education

efforts or to expand the network of such organizations across the state. Such a mechanism needs to be identified.

- It is the consensus of our organizations that water literacy should be mandated in the state curriculum, along with an investment in the necessary professional development for Michigan teachers. Much curriculum work has already been done in the Michigan Environmental Literacy Plan (www.mielp.org), The Great Lakes Stewardship Initiative http://www.glstewardship.org/ and by the Michigan Dept. of Environmental Quality MEECS , among others.

Recommendation #2: The second recommendation calls for developing "a survey tool to assess behaviors and attitudes toward Michigan's water resources to assess changes over time."

- Currently the DEQ requires the use of The Social Indicators Data Management and Analysis (SIDMA) tool to measures behavior changes when using Clean Initiative Funds for public education. This tool is already in use by many watershed groups and has extensive data on behaviors and attitudes of the Michigan citizenry. Many surveys have already taken place using the survey tool and recur on an ongoing basis, fielded by various place-based organizations. We invite the state of Michigan to access and centralize data already in hand before going to the expense of fielding a new survey and are prepared to assist in this effort.

Recommendation #3: The third recommendation calls for expanding "opportunities to engage citizen volunteers and participation, such as the Michigan Clean Water Corps (MiCorps) program, in gathering water quality and quantity data, in restoration, in providing access and in maintenance of important water related resources.

- Many of our organizations are participants in the MiCorps program and recognize its value; where it has failed to reach its potential is in the lack of a centralized marketing campaign to draw more volunteers, a mechanism for referring them to agencies in their own communities, and the necessary resources to collect and process data collected by the volunteers.

We propose that an outreach campaign aligned with the Pure Michigan brand would quickly expand the impact of the MiCorps program far beyond the ability of small organizations to engage citizens or draw visibility to the opportunities. In addition, environmental volunteerism can be promoted with Michigan high school students seeking to fulfill community service

requirements for graduation. Those responding should be able to work through a user-friendly yet robust centralized system to be matched with volunteer opportunities to pursue.

In addition, the state should consider creating a series of data collection apps to help normalize data held in the state's central repository. Free and open access to this data and a comprehensive dashboard will help citizens measure progress against local, regional, and statewide water and environmental issues.

ADDITIONAL PROPOSALS TO STRENGTHEN THE RECOMMENDATIONS

In addition to strengthening the existing recommendations, we propose additional areas of focus to build stewardship for Michigan's Water Strategy.

While the recommendations focus on K-12 education, we believe there should be an effort to engage young people in environmental and water literacy opportunities beyond high school. The Michigan Department of Natural Resources offers a number of strong place-based education opportunities that should be recognized and supported by the strategy.

We are surprised that adult education in stewardship is not included as a recommendation, beyond the opportunity to engage in volunteer activities. Adults are key to driving the success of the strategy in both the near and long term, and we must all work together to tap into the affinity with water and the Great Lakes that make stewardship a way of life. Strategies we would suggest include recognizing the work already underway to build stewardship, being specific about what stewardship looks like, linking water stewardship to quality of life issues in Michigan, and developing programs to incentivize personal responsibility for environmental and aquatic impacts.

Perhaps the most important audience for water literacy education are the elected officials and decision makers who will be implementing – or failing to implement – the state's water strategy in the years to come. These men and women should be a priority for adult education and encouraged to lead the way for their constituents and stakeholders.

We would also like to see the strategy reflect social and cultural values around stewardship in more detail. We believe these deep-seated values are an important driver of stewardship, since they involve a deep-seated respect for water and treading softly on the earth. Similarly, we stress the need to focus on water conservation as an important aspect of stewardship.

Another concern arises from our desire to sustain the conversation between the state and our organizations around the implementation of the Michigan Water Strategy. The conversations should not end once the strategy is finalized; instead, we encourage the state to leverage our expertise to assist with implementation, sharing of information, and creating consistent

conversations statewide. To do this, we hope to see guidance on how best to implement the strategy and promoted stewardship, dashboards and feedback on the progress being made, and an easy interface among groups of similar interests and state officials.

In order to do align efforts most efficiently, we encourage Michigan to create a centralized digital presence where messaging, information, and data can be easily accessed and replicated on the sites of a wide variety of place-based and citizen-oriented organizations.

IN CONCLUSION

As we review the stewardship chapter of the draft Michigan Water Strategy, we find ourselves wondering why this important mobilization of citizen support is relegated to the very last chapter of the strategy, when all that comes before is clearly based on mobilizing public will to support water strategies that could have a significant impact on water bills, property values, as well as on clean drinking water, recreation, and healthy water-based economies. We find ourselves asking where the work of watershed organizations, educational groups, and water advocacy groups fit within the state strategy. What role should we play and what role should the state play as Michigan moves from strategy to action in water?

Our organizations believe the Michigan Water Strategy is an important document for the future of our state and for its leading role in the Great Lakes basin. We are prepared to stand with the Department of Environmental Quality, the Office of the Great Lakes, and Michigan's Department of Natural Resources to help bring the vision expressed in this document to reality.

Sincerely,

John Erb
President
The Erb Family Foundation

Michele Arquette-Palermo
Program Director
Clinton River Watershed Council

Laura Rubin
Executive Director
Huron River Watershed Council

Aimee LaLonde-Norman
Executive Director
Friends of the Rouge

David Howell
Chairman
Friends of the Detroit River

Robert Burns
Detroit Riverkeeper

Nic Clark
State Director
Michigan Clean Water Action

From:	Charlotte Jameson
To:	mi-waterstrategy
Subject:	Comments: "Sustaining Michigan Water Heritage, A Strategy for the Next Generation"
Date:	Friday, August 28, 2015 4:22:08 PM
Attachments:	WaterStrategy_Petition.pdf MLCV_Comments_Water Strategy.pdf

Please find attached general written comments from the Michigan League of Conservation Voters as well as a public comments, in the form of a petition, on behalf of over fourteen hundred Michigan LCV members across the state.

We thank the Office of the Great Lakes staff for their work on the draft water strategy and look forward to the final version.

I am available at your convenience for any questions or concerns.
Best,
Charlotte

--
Charlotte Jameson
Policy Manager
Michigan League of Conservation Voters
Office: 734-222-9650 | Cell: 919-215-7133
Follow us on Twitter and Facebook

michigan league of conservation voters

Dear Office of the Great Lakes,

The Michigan League of Conservation Voters' (LCV) members commend you for taking the initiative to consider and strategize on how best to protect our state's unique freshwater resources.

Michiganders from across the state are encouraged to see our Governor prioritizing protections for the Great Lakes and Michigan's clean water. The release of your vision for strong, long-term water policy is a strong step in the right direction and we look forward to seeing a more concrete plan of action to turn that vision into reality for the Great Lakes State.

All of us in Michigan deserve access to clean drinking water and healthy rivers, lakes and streams. The Governor's initial water strategy is an opportunity for meaningful action to address the most serious threats facing our Great Lakes, like the toxic algae blooms in Lake Erie that led to contaminated drinking water and closed beaches last summer.

Clean water drives our economy and our way of life in Michigan, and our policies should reflect that. Developing a strong water strategy is a good first step, but we urge the Governor to dig into the specifics of how he can turn this innovative strategy into an actionable plan.

On behalf of Michigan LCV, our members, and our Board of Directors, I look forward to your continued engagement in protecting our precious clean water and hope to work with you to find policy solutions that work for our state.

Thank you for your consideration.

Sincerely,

Lisa Wozniak
Executive Director, Michigan LCV

michigan league of conservation voters

August 28th, 2015

Office of the Great Lakes,
Michigan Department Of Environmental Quality
P.O. Box 30473-7973
Lansing, Michigan 48909

Re: Comments on Draft "Sustaining Michigan Water Heritage, A Strategy for the Next Generation" Report

Michigan's incredible freshwater resources are an essential part of the Great Lake State's economy and way of life. The development of a comprehensive 30-year vision for our freshwater therefore is wholly appropriate and reflects a strong commitment to prioritizing and protecting the health and vitality of our lakes, rivers, and streams. The Michigan League of Conservation Voters (LCV) appreciates the work and deliberation that the Office of the Great Lakes, the Department of Environmental Quality, the Department of Natural Resources, the Department of Agriculture and Rural Development, and the Michigan Economic Development Corporation put forward to compile the draft report.

Michigan LCV supports the recommendations outlined within the report and the effort on the part of Michigan's state agencies to advance meaningful action to address serious threats to our waterways. However, we would hope that the final version of the report would include more specifics on how these recommendations will become realities for our state. Outlining implementation metrics, end dates, and lead actors is a good first step, but readers should walk away from the report understanding in a concrete way how these recommendations will be implemented. Additionally, we would urge for more clarity in how these recommendations will be funded and what work on them means for already tight departmental resources and staffing. Finally, given the sheer scope of the report we would push for a greater level of prioritization in the recommendations, both in the priority recommendation and the additional recommendations.

We at Michigan LCV are committed to seeing policies and regulations put in place that are effective and fully reflect the importance of clean water to our state. Recognizing the difficulty of the task that stands before our state governing bodies, Michigan LCV is happy to provide support and to act as a resource in the following areas:

- Develop a comprehensive strategy to prevent nuisance and harmful algal blooms
- Achieve a 40% phosphorus reduction in the western Lake Erie basin
- Develop and implement a uniform statewide sanitary code
- Establish inspection requirements for residential on-site wastewater systems
- Pass comprehensive legislation phasing out the use and sale of microbeads in Michigan

- Develop a water conservation and reuse strategy for the state that incorporates the use of green infrastructure, grey water systems, and energy production that includes recognition programs
- Establish sustainable funding mechanisms to achieve the Water Strategy goals including water infrastructure management
- Evaluate and implement necessary changes to laws including state and local land-use statutes as well as the Michigan Drain Code to create a more integrated, watershed based system for managing water at the landscape level and achieving water quantity and quality outcomes

Thank you for the opportunity to provide comments. We look forward to working with you as you pursue the recommendations outlined in the draft strategy. If you have questions please contact me at 734-222-9650 or charlotte@michiganlcv.org

Sincerely,

Charlotte Jameson
Policy Manager
Michigan League of Conservation Voters

michigan league of conservation voters

On behalf of the more than fourteen hundred undersigned Michigan LCV members, I urge you to take the good ideas and opportunities outlined in your Water Strategy and turn them into policies that work to keep the Great Lakes State the best state to call home.

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JudyGabrielse 49315-9001
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K, Tweedale 48021-3023
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Liela Abass 48124-3727
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Brett Vandrie 48906-4855
Yolanda Mitts 49088-8719
B. VanDuinen 48176-1549
D. Vanderkolk 49441-1342
Lynne Vanness 49684
Marie Vasquez 49221
Carol Glidden 49008-3949
Sue Moore 48640-4379
Karyn Goff 48170-3150
Debra Moore 48420-7713
Cathie Giebel 49116-5112
Teresa Gingras 48906
Jerry Gillissen 48912-3426
P. Adamczyk 48104-5316
Gina Adams-levy 48167
C. Vigneron 49046-8407
Robert Victor 48823-1909
V. Strader 49037-1312
R. Gonsalves 48076-4162
J. Morgenthaler 49331
Kristine Morris 49670-9336
Robert Aiello 48002-2104
SheilaMorway 49333-9264
Cath Allam 48154-4703
Tania Alill 48304
Deb Goldberg 48104-4632
Jayme Allan 48326-2216
LauraAldridge 49849-2227
Peter Allen 48104-1035
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Robert Wagner 49128
Lori Mulvey 49321-9523
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Rob Wagner 49128-9559
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Neil Gram 49071-9321
Beth Mostrom 48858-3745
Kristine Moy 48230-1278
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Wynona Allen 48178-1284
Mike Gormley 49237
KarenGraham 49014-9524
L. Goshorn 49453-9706
H. Alexander 48009-5682
Lisa Napolitan 48025-3352
Y. Alexander 49519-3366
Gail Walter 49001-3643
EdwardWalzer 49421-8587
David Green 49055-8806
James Gregart 48740
Rolf Amsler 48176-9555
Flora Greig 49103-9752
MikeAnderson 48854-9607
R. Anderson 48186-4638
CarlGrenadier 48025-4320
Jeffery Anderson 48503
J. Navarre 48111-3435
Sue Nearing 48768-9752
Sarah Newman 48103
Elden Nedeau 49441-1322
Nancy Griffin 49423-8927
Sheila Wasung 48073
James Watkins 49512
Anne Andries 49410-0007
Karen Nichols 49715-0128

MaryArmstrong 49635
Beth Armstrong 49004
PeterArmstrong 49460-9554
N. Weatherwax 49224-9107
Douglas Haan 49423-8855
Jean Norman 48154-2518
Ken Grunow 48223-1216
Margaret Nurski 48654-9553
John Guinn 48359-1526
Ingrid Gunderson 48105-2507
Robert Gurzick 48430-3240
I. Weingarten 48104-4424
Debra Halabis 48035-3260
Gwen Wellman 48348
Robert Welker 48198-3801
Susan Welsford 49441-5050
Jerald Bachman 48137-9752
Virginia Bachman 48137-9752
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Nancy Bahlman 48067-4056
Mary Ann Baier 48124-3356
Kurt Baker 48060-1626
George Oliver 48060-4305
Allen Olson 49855-9506
Patricia Banes 48350-2820
David Werner 48130-9818
Patrick Banks 48347-0136
David Ballou 48103-2524
Nancy Wengert 49024-3270
Elizabeth Haran 48348-2725
Patrick Hardin 48503
S. Westergaard 48103-5846
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SusanWheadon 49621-8526
Marilyn White 49301-9025
Mary White 48104-4441
Jayne Hamilton 48304-1751
R. Hammersley 49684-4144
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Dave Hanna 48089-5905
Donald Handy 48043-2221
Pam Wilbourn 48066-2958
Richard Han 48103-5290
Gwen Handelman 48104
Matt Hanes 48035-5117
Andrew Baron 48210-2358
Dawn Bartok 48173-9729
HeatherWhitman 48071-4323
Lexi Barris 49417-9340
Joyce Bartels 48823-7711
Tris Palmgren 48236-1734
Craig Owen 49079-8301
Larry Widigan 48449-9755
Safa Wick 49024-2639
Jill Baskins 48033-8601
B Bassett 49727-9691
GregBaughman 48301-1048
Chris Williams 48185-6592
Mary Williams 48302-2149
Roger Bauer 49636-5129
C. Williams 49055-8694
Veronica Hayes 48220-2428
Adam Williams 48108-9125
Judith Begin 48047-2056
N. Belanger-Iott 48827-1048
Ralph Bekker 49505-3860
Bobby Belknap 49635-9247
Victor Bella 49453-1233
Kevin Haynes 49740-9335
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Leon Heether 49347-9756
Amelia Hefferlin 48130-9424
Helen Hebben 49080-8601
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A. Willis 49601-1233
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R. Benjamin 48881-9754
Eliza Becuidoin 48158-8652
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dennis palmer 49621-9403
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Dwyne Patrick 49341-9666
JasonPatnoude 49072-9716
Susan Patton 48336-1126
Ken Hermonat 48237-2331
Nancy Witter 48105-1102
James Bess 49930-2132
Cindy Heister 48813-9741
HeatherHewett 49648-9156
Liz Paxson 49686-3917
Mary Helveston 48203-1447
Carol Berard 48855-6449
K. Berg 49953-1844
Sidney Berkowitz 48322
Joe Henne 49726-9639
Harvey Blankespoor 49329
S. Blankenship 49270-9716
Ann Wright 48103-3131
Heidi Peters 48363-1936
Edmond Hileski 49006
Carol Higgins 49072-8748
Sandra Petersen 49525
David Peterson 49080-9647
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Kyle Peterson 48313-5436
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shira blum 48076-1335
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Mary Hoadley 48322-4174
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June Picard 48706-1221
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Marie Holtrop 49546-7725
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BarbaraHolcomb 49221-9700
Mary Boehm 49418-2054
Don Bollinger 49706-9810
george piner 48116-5196
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Larry Pliska 48025-1940
Jan Wright 48197-8733
Kenneth Wright 48653-7410
Richard Booth 48138-1601
Teresa Boomer 48503
Jon Wyss 48195-1120
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Michele Bourdieu 49930-1606
Thomas Yocum 49629-9425
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Ashley Yonker 49006-2141
Michele York 48316-3522
Mary Homan 48080-1623
Rob Honeyman 48075-2115
Roger Hoos 48317-6202
Cheryl Plute 49913-2111
M. Polidori 48025-4660
A. Holbrook 49735-8929

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Dan Hornaday 49014-8314
Judy Hornai 49230-8987
C. Pomerleau 48104-4059
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Andrea Zajac 48895-1505
Jack Brandmeier 48106-2377
Joseph Popp 48126-1775
Joanne Popp 48911
Ruth Ziel 49855-9518
Peter Zubulake 48103-3200
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Janna Zeilstra 49512-2776
Colleen Zlydaszyk 49686
Marilyn Hotaling48073
Karen Zyczynski 48374-3870
Patricia Hubbard 49503-1844
NM Porter 48197-7123
Jacque Potoski 48195-1149
Tim Poxson 48842
Peggy Huebner 49127-1235
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C. bramlett-hawes 48079
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Linda Prostko 49316-0054
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Ronnale Irons 48467-9134
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Rick Brigham 49406-0586
James Reaume 49953-1013
Peter Read 49696-8832
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Rob Jenkin 48390-3121
Mary Jennings 48236-1128
Marty Jennings 48236-1128
Lola Janes 49895
Robert James 48166-9431
Matt Brzezinski 48081-1511
Todd Bryson 48430-4402
Richard Rider 49735-1433
Dorr Bugbee 49017-9451
Patricia Ridgley 49233-9691
James Bull 48146-4020
John Renfrew 49855-9552
Ann Remkus 49221-1755

Carol Byrd 48180-3134
James Renaud 48441-9493
M. buttenheim 48103-3257
Jackie Byars 48104-3864
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John Jellema 48197-2143
Shrisse Jefferson 48340
C. Ritsema 49506-5232
TimothyCaldwell 48858-4425
G. Campbell 49783-9409
Wanna Johnson 48060-4707
Carol Johnston 49740-9130
Matt Roberts 49093-9690
John Rogers 48104-4304
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Beverly Jones 48218-1025
Dylan Jones 49685-9255
Virginia Jones 49004-6644
Joan Jones 48160-9729
Joseph Kaleel 48759-1234
Paul Caswell 49829-3113
FaithCastle-Ball 49221-9485
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Fred Cepela 49684-7602
Vince Cerutti 48104-4928
L Kaniarz 49008-2908
Johnie Kemp 49746-8473
Robert Rogan 48207-2906
Charles Ryburn 48075-1173
Gregory Rossi 48329-4331
Ron Kardos 48430-9218
Marjorie Kardos 48430-9218
Kathryn Karaba 49015-3180
Karline Rousseau 48855
Ronald Katz 48070-1406
Terry Keck 48081-3119
Ilene Kazak 48212-3111
C. Kavanaugh 49003-2347
Joseph Sackrider 48609
Judy Clark 49445
Betty Kennedy 60660-6842
Don Rumelhart 48105-9336
ReneeKermeen 49333-8966
thelma kew 48186
Elena Chesney 48105-1142
Kat russell 49507
Emmy Cholak 49684
Holly Chisholm 48371-3229
AmandaSalvner 48104-3205

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Kathleen Kibbie 48169-9313
Kay Clifford 48103-5937
Lance Climie 49525-1814
Ken Kiel 49341-9236
Kaaren klingel 48169-9016
Daniel Cline 48640-8543
Joseph Klimovitz 49421
Robert Klein 48433-1021
AlvinSaperstein 48207-2717
Janice Colville 49964-0027
Cristine Santanna 48105
Sharon klotz 49269-9525
John Sauntry 49006-2169
Leah Knapp 49068-1930
Jim Schmidt 49401-8780
Nicole Cogar 49236-9640
Ron Cober 48023-2200
Patsy Coffman 48879-1933
Tara Conaway 49315-8346
Sara King 48103-9728
larry connell 48130-9447
Valerie King 49240-9639
V. Conover 48067-4602
K.Connaughton 48880-9419
Margaret Conti 48428-0321
John Conway 49120-2407
S. Knoppers 49345-9762
Liz Kirkwood 49686-2730
Tatiana Scavnicky 48220
Andy Sayles 49009-8547
Roland Schaedig 48104
Patricia Schachtner 97503
Matthew Schaut49938
Mary Korde 48324-2519
Ken Schilling 49507-3155
william scharf 49686-1885
Helena Coleman 48342
David Cope 49418-1120
Kathleen Cool 49080-1294
Bridget Cooper 48823-2420
tim coon 49770-8543
C. Schultz-Condon 48098
Jen Schuham 60148-2603
BarbaraKuhn 48138-1746
Greg Collins 49404-9413
Bernie Schupbach 48823
Julie Collins 48167-1008
John Korstange 49017-9448

Dawn Schumann 49406
Karen Schuur 49001-3919
Debra Schwartz 48135-1733
Elizabeth Schwab 48038
J. Kotlinski 48150-2822
Kimon Kotos 49461-9679
Mary Crawford 48823-4124
Karen Kostamo 48104-5369
Susan Corner 48917-9555
Jaynie Cordes 49505-5896
Anne Corlett 49453-9699
JamesCrowfoot 48103-6214
Gordon Seyfarth 49095-9743
Bradley Cross 48106-1303
M. Shaffer-O'Connell 49774
Bonnie Krauskoff 29909
Andrew Lahaie 49461-9280
Kelly Kroske 49240-0124
Joanne Lakosil 48127-2623
John Krohn 48912-2932
A Cu 49008
Gary Crump 48809-0176
Jan kruszewski 48362-1431
S. Sercombe 48073-2517
Karen Land 48105-1477
BarbaraLane 49601-8838
Stacy Shemot 48103-5306
Elizabeth Shelton 48184-2257
Rena Curtis 49519-6445
Keith D'Alessandro 48187
Anna Cushman 49024-5900
Helen Daley 48118-0341
Christine Daniel 48327-2820
Warren Danford 48081-3902
Jason Lantriq 48864-4057
Faye Lapp 49008
Joseph Latorre 48088-5756
Garrett Leanne 48239
Russell Davis 48197-8706
Leslee Shutes 49024-1151
Nina siagkris 49006-1040
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John de Vries 48910-2564
Robert Davidson 49686-1675
Kathleen Davis 49855-2407
Alex Leaven 48103-4913
Myles Davis 48381-2425
John Davis 48070-1526
Jeff LeClair 48906-6815

Howard Lederman 48072
Robert Deaton 49017
Bob DeKorne 49664-9637
Jennie deBeausset 48138
Terri Defilippo 49621-0254
Leonard Lewis 49201-8542
Rose Lewis 48342
Beyce Smith 49783-9026
Ruth Lezotte 49682-9563
Victoria Lewis 13601-6619
David Smith 49738-9448
Li Way Lee 48324-1951
Patricia Lefevre 48837-2139
Scott legleitner 48507-3506
Cynthia Leet 48103-3238
Ann Lehman 48350-2053
Dan Dene 48144-0445
E. Dempsey 48374
Sean Demers 48094-2902
Nancy Delosier 48101-1000
Yvonne DeLuna 49424-9384
Cineraria Sims 48038-7013
Susan Single 49753-9683
Susan Lindquist 47978-7511
Julie Smith 48130-8550
Judith DeVries 49009-9230
Amy DeSantis 48104-6189
Ray Detter 48104-1529
MikeDevarenne 49525-2921
Jeff Deyoung 49534-4578
Daniel Lipson 12561-2221
Christine Doan 48309-1602
Toby Dolinka 49506-4785
Suzanne Love 48912-3134
Gregory Lowrey 48071-2312
Joanne Lowery 49017-7645
Linda Luke 48111-2231
Eric Lucas 49286-1781
Jill Lucas 48135-3622
Ann Luft 49406-0096
Richard Luellen 48917-3628
N Sparling 48092-2335
Nancy Snell 49009-8834
K. Sneden 49331-9675
Thomas Spencer 49855
Kim Spencer 49855-8601
Carol Sperry 48160-9712
Donna Diller 49765-9587
Karen Donahue 48226-2404

Aric Donajkowski 49747-9704
Susan Lonchar 49015-2502
John Loken 48103-5943
Charles Dineen 49065-9644
MarianDonovan 48045-3020
S. Loucks Wilson 49523-0522
John Lorand 48858-4144
Carol Doty 48809-2417
Robert Snyder 49234-9731
Bernadine Dosch 49738-8455
Naomi Sofilic 48095-1843
Thor Sorensen 49506-2024
JoanSolmonson 49945-0016
C. Dinner 49721-9571
Lori Lyles 48507-1322
Robert Drake 48103-6169
Carol Drake 49126-9733
Richard Lutes 48033-2962
Tracy Lynn 49009-8122
andrew springsteen 49340
John Sprague 48848-8778
Frank Lynn 49546-1348
Nancy Squires 49648-9157
Mark Douma 48067-1948
K.A. Douglass 48823-3746
Michael Staebler 48104-1724
T. MacFarlane 49064-9769
Mary Dunn 48073-2591
Kristyn MacPhail 80123-3101
J. Drummond 48473-8940
FredericaSteller 48910-0302
M. Duncanson 48308-0263
Steve Dudzinski 48072-1331
Karen Stankye 48386-1613
Sharon Stenglein 49855-9009
Darlene Stanley 48118-1033
James Duffrin 49858-2950
Linn Duling 48848-9485
David Starr 48169-9476
Patricia Maguire 49839-0074
Deanna Maher 49424-2353
William Stimac 48072-3072
ChesterMahan 49713-9326
David Marckini 49460-9226
Michael Marcus 48212-3008
Alon Marie 48455
Greg Stoklosa 49738
Sally Stern 49431-2215
Charles Malonis 48072-3821

Linda Stevens 48051-2322
Mary Mangus 48108-2621
Peggy Malnati 48331-1303
Sharon Elachi 48178-8972
Linda Marble 95202-2616
robert eleveld 49503-4065
Eric Stordahl 49855-1632
R. Stonecipher 97205-1563
AlexandraEaton 48301-3921
Patricia Storrer 49635-9309
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Jill Ender 49120-1809
Jan Ebersole 48051-1536
Tom Emmott 49696-5243
James Stover 49306-9198
Richard Stiffler 49506-2064
Lyda Stillwell 49008-1711
Mike Strawn 48093-8640
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Grace Strong 49938-9746
William Sturk 49286-1030
Kathryn Stuart 48336-1314
Henry Martens 48651
David Martin 48708-7389
Chuyck Stuart 48603-1678
Judy Stuart 48603-1678
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Sarah Elliott 49505-4002
Walter Elmore 49686-3917
T. Mayrand 48089-3501
Jim Ellis 48073-2755
Virginia Erb 49685-0666
BarbaraEvans 49663-9567
Diana Eoll 49203-3809
M. Espinoza 48183-3622
Edna Ewell 48203
Pamela Esser 48302-2953
P Faith 48125-1804
Robert Swain 49506-2934
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Leslie Sutliff 48806-9753
Carol Swanson 49337-8162
Christine Sykes 49621-9760
Patty Swaney 48158-9488
Lewis Szymanski 49457-9742
Rolf Swanson 49855
Judith McAloon 49858-2327
Julio Mazzoli 48301-3547
Loralyn Sweet 48197-1928

Joseph Maurer 48235-4111
JerryMawhorter 48073-3469
Judy Falvo 48125-2156
MJ Faris 48081-3643
David Ferger 48034-1203
Albert Fecko 48015-1544
Bruce Fealk 48309-1750
NancyMcCarthy 49461-9576
DanielMcCarter 48104-5224
W. Tarver 48009-3845
Sandy McComb 49090-7142
AnnieMcCombs 49005-0269
Paul McCullough 48357-3158
Linda Teeter 49007-4676
Mary Fischer 48306
Beverly Finlayson 49696
Norm Fischer 48176-9084
J. Tessman 49022-7030
Richard Ternes 48846-8621
Jerey Tesch 49418-2289
Denise Thal 48104-4426
Patricia Tessler 48103-9472
J. Fitzsimmons 48104-1475
BarbaraTholin 49686-2909
BarbaraThibeault 48823-3406
Maggie McGuri 60657-0496
Doug McDonald 48103-3764
Michael McDonald 48367
NormanMcIntosh 49319-9109
Joel Flint 49508-6669
Katherine McIlroy 21218-4153
Martin McGladdery 48331
Sharon McGladdery 48331
James McIntos 48104-4504
Ralph McIntyre 48035-1900
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DouglasMcInnis 49670-9545
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Carol McGeehan 49423-7218
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A. McMillan 49242-1511
Karen McNeill 48043-2233
Michael McManus 48067
R McLravy 48823-3281
L. Thompson 48176-9158
P. Thompson 49337-8300
sarah flum 49878-9100
TracyThornburg 48310-6638

Christina Fong 49503-2937
Brandon Foote 48823-3982
Michael Tiedeck 49740-9753
Mary Ann Ford 48212-3123
Sarah Adrian 48076-3247
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Frank Vaydik 48603-2626
David Veenstra 48850-9572
Geof Veliquette 48116-1921
Eric Vermeulen 49418
Martha Vermeulen 49418
Carole France 49269-9807
Thomas Myers 48106-3603
Emma Myles 48207-5000
Philip Melcher 48009-3811
Michele Nalu 48306-4284
T. Menendez 48186-4807
Mark Morden 48060-1912
Susan Moreau 49036-7744
R. Gale-Gonzalez 48507
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HeatherWhite 48067-2425
Debra Hansen 49755-9101
Donna Hart 48162-7909
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Kathy Augustyniak 48650
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Yates Hafner 60305-1745
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Marck Oconnell 48703-9466
Mike Obrien 49713-0101
Helen Obenchain 49106
ElizabethWilson 48118-9479
Lee Peck 49033-9749
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Don Pell 48308-2533
B. Hernden 48026-3270
A. Herrada 48104-6944
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Donald Priest 49770-8604
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R. Prochowski 48097-4793
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Nancy Braun 48750-8816

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Stephen Brede 49770-2941
Marilyn Wolfe 49009-8941
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R. Ward Bissell 48105-1408
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Dan Blakey 48823-2924
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Marthea Jager 49507-3563
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Jack Bryan 48025
Charles Brumleve 49950-0254
Leah Johnk 48827-9776
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Mary Burns 48309-2158
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Jackie Richer 49685-0863
Pam Rexius 49453
Ruth Reynolds 48103-3048
Dolores Reynolds 49056-9560
Charles Calati 48933-1114
Irene Cahill 48823-3632
Anne Carpenter 48105-2371
E. Calcutt 49686-1915
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Ja Ring 48124-3215
Edward Riordan 48322-4174
Steve carpenter 48183-1595
Thomas Jones 49006-4166
Howard Rubenstein 48154
Zetta Chapman 48326-4227
Lenore Chapple 49445-2373
Gary Charson 48197-9228
Gary Cheadle 49682-9626
Ron Chelland 49444-3319
Michael Kwitt 48089-1230
Diane Cheklich 48201-1748
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Gabrielle King 48046-0525
Carol Costello 48138-1597
DanielMcCarter 48104-5224
Pat Schwing 48323-3070
C. Cozzolino 49022-9207
Ivan Secord 48178-9325

Fritz Seegers 49007-3205
Paul harkawy 48105
Susan Nicholas 48170-2209
Joyce Stein 49230-9776
Frank English 48212-3220
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Randolph Wiser 49621-9414
MarciaGoodrich 49931-1428
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Stan Kauffman 49769-9142
Sokuzan Brown 49017-3854
CharlaineShack 49406-0577
T. Miskovsky 48105-2711
R. Paruchuri 48108-3069
Alice Tobias 98105-5615
James Mulcare 99403-2576
Ken Calhoun 49006-2023
Ann Kendrick 49224-2226
Kathy Bradbury 48137-9669
Paul Barrie 48130-9783
Melissa Sargent 48211-3165
Trudi Huizenga 49508-6422
P. Kerr-Alexander 49416
Rebecca Young 49058-7692
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Michael Gullo 48640-3441
A. Hammoud 48124-1385
Eliza Bohland 48162-9648
Donna Martin 48230-1832
richard smith 48122-1010
todd davis 03060-5880
janet hendricks 48381-2554
Ian Nelson 95403-1767
Ocrun Higgs 11520-1605
virginia Green 01520-1265
Bob Flickinger 49026-9750
Mary Denyes 48130
Betty Anguiano 49456-1821
gordon scott 32507-1605
SANDY GARDNER 89315
Kathy Wilson 49801-3921
Judith Russo 48813-1701
M.Loudenslager 49099-9768
FrancesPoposki 49408-9713
Charles Davis 49038-9246
Robin Byrn 49046-9456
Mina Kukuk 49015-8618
Jack Hill 49058-0370

Kate Samra 49068-1076
Melissa Farrell 48197-9065
Jeffrey Wilcox 49453
Rituparna Mitra 48823-5879
Everyl Yankee 48857-9612
Gail Weatherwax 49007
V. Policht 48104-4368
Mark Chamberlin 48906-4370
Michael Moss 48091-2510
Cathy Larson 48876-9608
Jim Sullivan 49408-8627
Cathy King 48442-1339
Anthony Cap 49079-8731
Linda Howie 93720-0939
Lynn Stevenson 48030-2305
Brooke Still 20009-2341
Mary KALAMARZ 48044
Ardeth Inman 49629-0751
Lorraine Jung 49770-9219
Randall Havens 32347
ThomasBessler 48170-3110
BryanLancaster 91942-3233
ConcettaBurger 48134-1527
T. Debelak 49097-8473
C. Brashares 49203-5926
Carolyn Lindholm 48073
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Monica Cady 49745-9624
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Michele st. peter 48134
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Bryan Hill 48202-3945
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From:	Robert Whitesides
To:	mi-waterstrategy
Subject:	Comments
Date:	Friday, August 28, 2015 4:23:52 PM
Attachments:	GreatLakes Commons report - final-Mar2011.pdf Water is an economic good-How to use prices to promote equit.pdf

These comments are mine own and do not reflect the official or unofficial views of the Kalamazoo River Watershed Council or others.

While the press release announcing the release of the Strategy draft includes a reference to " Establishing a durable water fund to achieve water strategy goals including water infrastructure management, the mechanism for achieving this goal is missing from the draft.

I believe it is disingenuous to discard "volumetric surcharge" as an option prior to the intensive examination of alternatives demanded by the circumstances of diminished state and federal general fund balances and the political inaction on environmental and resource matters at the state and federal level. It is also disingenuous to prejudice the examination of fee structures with a priori comments on "culture and history", while in almost all other areas it is largely conceded that major education and dare I say propaganda campaigns are necessary to change the "culture".

"Given that Michigan's citizens and businesses withdraw
more than 4.2 trillion gallons per year, equivalent to the amount of precipitation that falls on the U.S. per day, even a tiny surcharge or access charge would add up quickly. The economic logic may make sense in the abstract, but it does not currently fit the culture and history of water and water use in the state.

Conversely, some argued that adding a price to water, even as an access charge versus a price on water per se, would commodify the resource, when it has historically been a public good or a public trust resource. Maintaining the ability to manage and ensure the sustainability of the water resources of Michigan and the Great Lakes is of utmost value to the state and the region, and even though a revenue stream could be created from a volume or access charge on water, the values potentially compromised under this scenario are too great to lose. However, there is still a compelling and growing need for investments in water and water infrastructure and for administrative and programmatic support in order for the state to meet its long-term vision for healthy, functional systems and prosperity.

To address the gap between actual investment need and public perception of that need, Michigan should launch a public education campaign to improve residents' understanding of the economic, environmental and social benefits of clean water, linking the investments necessary to achieve the benefits. If the public wants clean beaches and good water quality – and they say they do – public support of water infrastructure investments is critical. While we do not seek to facilitate a volumetric surcharge on water access, if that is something the public would ultimately support, then it would add to the options for funding long-term infrastructure and desired outcomes."

The survey conducted by the consultant identified how critically citizens are willing to consider new approaches, and not have them discarded out of hand:

"Newly proposed outcomes that received the most votes focused
on funding and stewardship of the resource."

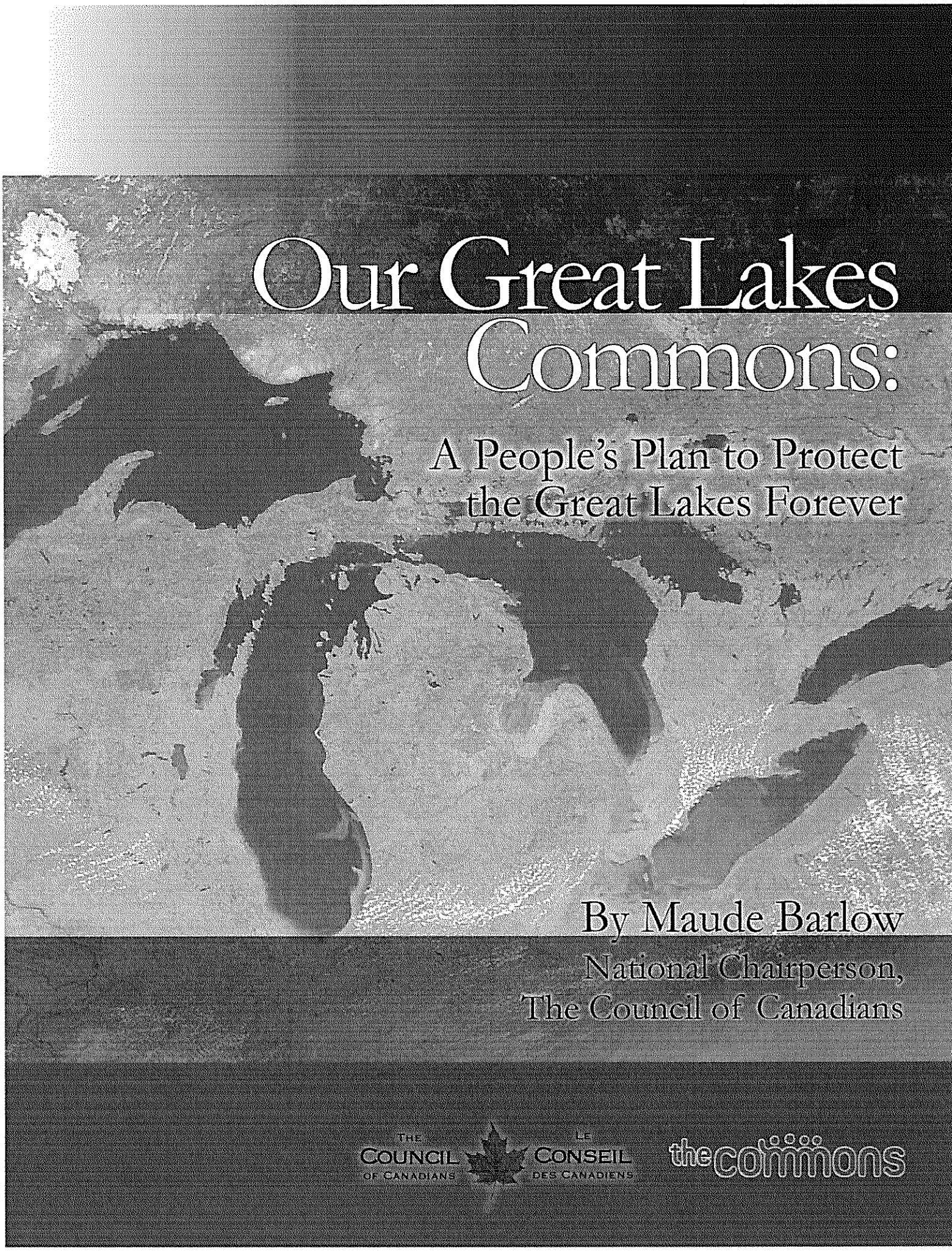
It is certain that a new paradigm must be built on pricing fees for participating in the exploitation of

the common resource under the reasonable use doctrine. I believe greater emphasis could be placed on the common resource nature of water, as outlined in the Great Lakes Commons report attached and other similar documents. I also believe that Michigan can advance the theory and application of regulation of common resources by advancing the pricing for water allocation in the form of user fees. This would avoid the problem of commodification that is usually associated with any discussion of pricing. The Water Policy paper "Water is an economic good: How to use prices to promote equity, efficiency, and sustainability" could form the basis for the final advance to non-commodity based fees. Certainly Michigan's universities and NGOs should have the competence to collaboratively determine the necessary next step.

Lastly, I am concerned by the leading nature of questions used in the consultant's survey which largely eliminated any innovative responses, and the limited representation in the Water Cabinet, which does not include a resource economist.

Best Regards,

Robert Whitesides



Our Great Lakes Commons:

A People's Plan to Protect the Great Lakes Forever

By Maude Barlow
National Chairperson,
The Council of Canadians

The Council of Canadians / Le Conseil des Canadiens
the commons

Our Great Lakes Commons:

A People's Plan to Protect the Great Lakes Forever

THE COUNCIL OF CANADIANS
LE CONSEIL DES CANADIENS

About the Author

Maude Barlow is the National Chairperson of the Council of Canadians and chairs the board of Washington-based Food and Water Watch. She is also an executive member of the San Francisco–based International Forum on Globalization and a Councillor with the Hamburg-based World Future Council. Maude is the recipient of ten honorary doctorates as well as many awards, including the 2005 Right Livelihood Award (known as the "Alternative Nobel"), the Citation of Lifetime Achievement at the 2008 Canadian Environment Award, and the 2009 Earth Day Canada Outstanding Environmental Achievement Award. In 2008/2009, she served as Senior Advisor on Water to the 63rd President of the United Nations General Assembly. She is also the bestselling author or co-author of 16 books, including the international bestseller *Blue Covenant: The Global Water Crisis and The Coming Battle for the Right to Water*.

Acknowledgements

This paper has arisen out of a series of meetings and consultations hosted by Harriet Barlow and *Our Water Commons*, a subcommittee of the group *On The Commons*, which took place at the Blue Mountain Center in New York State in November 2010. The consultations involved community, human rights, indigenous, and environmental leaders and activists from around the Great Lakes, leading to the birth of this project. It is therefore, a collective work of many minds and many groups.

For this report, I want to thank and acknowledge the following people for their ideas, support, collaboration and commitment: Harriet Barlow, Jim Olson, Daniel Moss, Julie Ristau, Alexa Bradley, Anil Naidoo, Brent Patterson, Wenonah Hauter, Emily Wurth, David Morris, Meera Karunananthan, Emma Lui, Mark Calzavara, Matt Ramsden, Jan Malek and the lawyers and policy leaders who took part in a Wingspread conference to guide the legal aspects of the process.

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On the Commons advances the commons movement. OTC names the commons and animates a growing network of citizens and organizations seeking commons-based solutions to the problems of our times.

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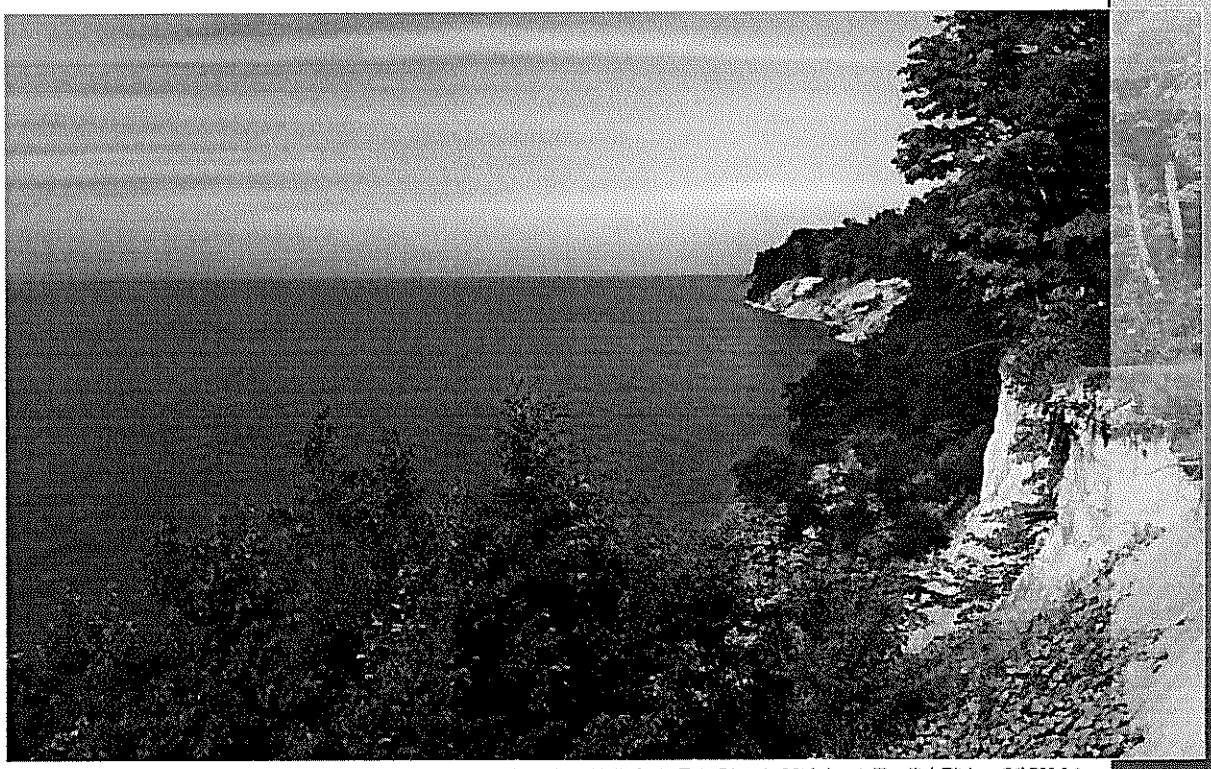
"This is not a mystery anymore. We know what needs to be done, ... The Great Lakes has gotten nine studies in four years from this administration, and Iraq has gotten $4.5 billion. Give Iraq the studies, and we'll take the money."

~ Rahm Emanuel
Mayor-elect of Chicago, former
White House Chief of Staff to
President Barack Obama
October 2005

Introduction

This paper is intended to serve as a background, a call to understanding and a call to action on an exciting new proposal to designate the Great Lakes and its tributary waters as a lived *Commons*, to be shared, protected, carefully managed and enjoyed by all who live around them. The *Great Lakes Basin Commons* would need to be protected by a legal and political framework based on *Public Trust Doctrine*, underpinning in law that the Great Lakes are central to the very existence of those people, plants and animals living on or near them and therefore must be protected for the common good from generation to generation. This means that the Lakes could not be appropriated or subordinated for private gain. It is also our determination that the Great Lakes will be designated as a *Protected Bioregion*, recognizing that while there are many political jurisdictions governing the Great Lakes Basin, it is, in fact, one integrated watershed and needs to be seen and governed as such.

The Great Lakes of North America are in serious trouble. Multipoint pollution, climate change, over-extraction, invasive species, and wetland loss are all taking their toll on the watershed that provides life and livelihood to more than 40 million people and thousands of species that live around it. Once thought to be immune from the water crisis that threatens other parts of the world, the Great Lakes are a source of increasing concern as residents watch their shorelines recede, their beaches close and their fisheries decline. Added to this mounting ecological crisis are growing conflicts as some eye these precious waters for commercial bulk and bottled water export, mining, oil and gas exploration, private control of once public water services, and as an incentive to lure water-intensive industries to locate on them.



Lake Erie bluffs, Lake Erie. Photo by Nicholas A. Tonelli / Flickr - CC BY 2.0

There are many dedicated environmental and community organizations as well as elected officials around the Lakes, working very hard to restore them, and some real progress has indeed been made. There also exists already a rich history of Commons practices and laws, including the application of the Public Trust Doctrine to the Lakes by the U.S. courts, dating back to a shared vision of the First Nations peoples of the region. We seek to build on this history. However, there are conflicting visions for the Great Lakes. For every victory to extend a Commons framework for the Lakes there is a corresponding setback of exploitation. While many advocate that the Great Lakes belong to the public and must be protected for future generations, others put economic issues above both the health of the Lakes and the lived Commons and common good of those who depend on them.

Alexa Bradley, Great Lakes community activist, puts it this way: "For some, the Great Lakes represent a massive resource grab that takes many forms: privatization, appropriation, the entitlement to use and misuse water, and the prioritization of market economics over ecological and justice considerations. By its nature this resource grab is anti-democratic and undercuts both environmental protection and the equitable sharing of water. This exploitation makes the case for not just better water policy, but for a different kind of governance."

As well, many jurisdictions responsible for the Great Lakes govern with an uneven patchwork of rules, regulations and laws. Most have not mapped the groundwater feeding the Lakes and do not have extensive knowledge of the crises threatening them. All suffer from chronic underfunding, regulatory infractions, and inadequate enforcement of existing rules. It is easy to see why it seems that with every step that takes us forward, another takes us backward.

We believe the answer to this uneven and inadequate governance would be strengthened by the embrace of the narrative of the Commons by the people and communities living on the Great Lakes. It is our fervent hope that the leadership for this project will come from First Nations and local urban and rural communities, as well as existing and new organizations, to fortify a grassroots movement that will protect and nurture these Great Lakes for all the generations to come.

The Great Lakes Are in Trouble

"There is a misconception that the Great Lakes replenish themselves each year with rainwater. This is not true."

The Great Lakes of North America form the largest group of freshwater lakes in the world, holding more than 20 per cent of the world's surface freshwater and 95 per cent of North America's. Add to this the groundwater underlying and feeding the Great Lakes or its tributary streams and lakes, and the percentage is closer to 25 and 97 per cent respectively. The Lakes and the St. Lawrence River, which is their primary flow outlet to the Atlantic Ocean, are bordered by two Canadian provinces: Ontario and Quebec, and eight U.S. states: Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania and New York. The Great Lakes have a unique biodiversity and are home to more than 3,500 species of plants and animals. They were formed over 20,000 years ago when the last glacier continental ice sheet retreated. The Great Lakes provide life and livelihood to more than 40 million people and are the economic centre at the heart of the continent. They are, however, under serious threat from a wide variety of demands and sources.

Over-extraction and climate change

According to a 2004 study by the Great Lakes Commission, communities around the Great Lakes Basin pump 850 billion gallons (3.2 trillion litres) of water out of the Lakes and St. Lawrence River every day. Close to 2 billion gallons (over 7.6 billion litres) are "consumed" every day, meaning that they are not returned to the watershed.[1] There is a misconception that the Great Lakes replenish themselves each year with rainwater. This is not true. These are ancient glacial waters that will be drained if we overuse them. (This figure is likely higher today, as the demands on the lakes have continued to grow since this report was published.) Much of this loss is in virtual water exports, where water used in the production of commodities is exported out of the watershed along with the exported commodity. Around the Basin, 67,000 square miles (174,000 square kilometres) are devoted to agriculture, an area larger than most of the bordering states.[2] Much of the wheat, corn, oats, barley, grapes, cheese, milk, fruits, vegetables and livestock produced on these lands are exported away from the region, depleting the Great Lakes Basin of water. This water is not being replenished. Since 99 per cent of the water in the Lakes is from the glacial era, this water will not be replaced once it is used up. As well, renewable water is in decline. A recent Statistics Canada study showed the renewable water yield in southern Canada has declined 8.5 per cent in just four decades.[3]

On top of a lack of renewable sources, the sources that supply the Lakes are under assault. As with most other bodies of water in the world, the groundwater around the Lakes is being pumped with little oversight. Some communities on Lake Michigan's west coast are pumping so much groundwater they are now drawing water from the lake itself. The U.S. Geological Survey reports that by using deep wells that reach farther into the ground than Chicago's tallest skyscrapers soar into the sky, cities are pumping the aquifers beneath them so hard they are pulling water in through the bottom of Lake Michigan, reversing a flow as old as the lake itself. Chicago has been depending on local groundwater sources since 1864. As a result,

1 Quoted by the Alliance for the Great Lakes, *Muskegon Chronicle*, December 31, 2008

2 U.S. Environmental Protection Agency, Great Lakes Monitoring website, http://www.epa.gov/glnpo/monitoring/great_minds_great_lakes/social_studies/without.html

3 *Freshwater supply and demand in Canada*, 1971 to 2004, Statistics Canada, September 2010

the groundwater levels in the Chicago and Milwaukee areas have dropped at least 1,000 feet (305 metres).[4] The Chicago Diversion from Lake Michigan to the Illinois and Mississippi Rivers results in the withdrawal of 2 billion gallons (almost 8 billion litres) of water every day. The diversion decreases water tables as far away as Port Huron and Georgian Bay. Yet the University of Southern Illinois reports that population and industry in the Chicago area alone will grow so quickly in the next 20 years that demand for water in the area will increase by 30 per cent.

Many scientists attribute these water level drops to both climate change and over-extraction. A major December 2009 report by the International Great Lakes Study Board found that climate change had already had a discernable effect on the drop in water levels of the Lakes. The Union of Concerned Scientists warns that Great Lakes water levels could drop by another two feet (0.610 metres) within decades, particularly threatening Lake Huron and Lake Michigan.[5] The amount of water flowing out of Lake Superior at its outlet, the St. Mary's River, would have to rise by 50 per cent to reach the average of the past century. Over the last 100 years, water levels at the Port of Montreal have dropped six feet (two metres) and the Army Corps of Engineers reports that in 2010, water levels in the Lakes continued a disquieting drop that started in the early 1990s.

The Great Lakes are also warming up. *Canadian Press* reported in July 2010 that surface temperatures in normally frigid Lake Superior had warmed almost 11 degrees Celsius (52 degrees Fahrenheit) higher than normal. Scientists cite declining ice covers and decreased precipitation for the rise in lake temperatures. Jay Austin, a physics professor at the University of Minnesota's Large Lake Laboratory, says that the Lakes are getting to their end-of-summer temperatures weeks before they should, negatively affecting their aquatic chain of life and leading to algae blooms.[6] Lake Erie is undergoing huge ecological changes, all of it bad, says Jeff Reutter, director of Franz Theodore Stone Laboratory, Ohio State University's freshwater biological field station. Pollutants that cling to lake sediment, the flow of contaminants such as phosphorus, and plumes of algal blooms spreading across the southern shore of the lake all tell of a body of water warming faster than it should and contributing to Lake Erie's dead zone, an oxygen-deprived area devoid of life.

Pollution, wetland loss and invasive species

According to the U.S. Toxic Release Index and Canada's National Pollutant Index, there are at least 204 pollutants in the Great Lakes.[7] A total of 15 million kilograms (over 30 million pounds) of such toxins were found in the Great Lakes and St. Lawrence River Basin in the latest survey; another 10 million kilograms were injected underground. (On average, Canadian facilities released almost three times more carcinogenic and reproductive toxins than American facilities.) Although the Great Lakes Water Quality Agreement has helped to reduce levels of some contaminants such as mercury, dioxins, lead and PCBs, a 2007 Environmental Defence report found that fish from the Great Lakes are still loaded with these and other toxins, making many of them unfit for human consumption.[8] Other major concerns are the proliferation

4 Howard Reeves, *Water Availability and Use Pilot: A Multiscale Assessment in the* U.S. *Great Lakes*, United States Geological Survey, February 2011

5 Union of Concerned Scientists, *Confronting Climate Change in the U.S. Midwest*, September 30, 2009

6 Great Lakes warm up, could reach record high, *The Detroit News*, July 23, 2010,

7 Pollution Watch, *Partners in Pollution, An Update on the Continuing Canadian and United States Contributions to Great Lakes-St. Lawrence River Ecosystem Pollution*, 2010

8 Environmental Defence, *Up to the Gills, Pollution in Great Lakes Fish*, 2007

of non-point source pollutants including pharmaceuticals, flame-retardants, plasticizers and pesticides, none of which are covered by the Agreement, and the introduction of a whole new class of chemicals including endocrine disrupters. These chemicals do not dissolve in water but rather bind up into particles that float in the water like magnets, latching onto one another and creating a layer of contaminated sediment on the floor of the Lakes.

There are now 43 "Areas of Concern," – sites on the Great Lakes so contaminated, they have been targeted for special remediation. They include Saginaw Bay in Michigan where the tourist industry has been destroyed with the spread of a foul toxic algae called cladophora, and Sarnia, Ontario, nicknamed "Chemical Alley" where twice as many girl babies as boy babies are being born to the local First Nations peoples, the Aamjiwnaang, and where unusual sexual attributes to frogs and other species have been observed by Canadian wildlife experts.

The government toxic release indexes also do not include U.S. and Canadian wastewater plants, which release billions of gallons of untreated sewage and run-off into the Lakes each year and are the Great Lakes' largest source of such pollution. A 2006 Sierra Club report called the sewer systems in many Great Lakes cities "antiquated" and said they routinely dump raw sewage in the Lakes. The study, which examined 20 Canadian and U.S. cities found that they collectively dumped more than 92 billion litres (21 billion gallons) into the Lakes each year.[9] That is the equivalent of dumping more than 100 Olympic swimming pools of raw sewage into the Great Lakes every day. In his 2010 annual report, Ontario's Environment Commissioner added that pollution in the Great Lakes on the Canadian side is getting worse because the province's municipal wastewater discharge rules have not kept up with an exploding population growth.[10]

Nuclear waste poses another threat to the Great Lakes. There are more than 30 nuclear reactors along the shores of the Lakes and shipments of medical isotopes and radioactive materials are increasingly being transported through the Basin. The International Institute of Concern for Public Health has noted that radionuclides found in the Great Lakes water, including tritium, carbon-14, caesium and long-lived iodine-129, pose serious health hazards at even low levels. As if these threats aren't enough, in February 2011, the Canadian Nuclear Safety Commission gave the go-ahead for the first shipments of radioactive waste through the Great Lakes. The Bruce Nuclear Generating Station, located on the shores of Ontario's Georgian Bay, has been granted permission to ship at least 16 bus-sized radioactive steam generators to a recycling facility in Sweden through the waters of Lakes Huron, Erie and Ontario and out the St. Lawrence to the open sea. A coalition of groups from Michigan has estimated that the amount of hazardous waste that could be released into the Lakes in case of an accident is 50 times more radioactive than International Atomic Energy Agency standards. Plutonium-239 remains hazardous for 240,000 years.[11]

Bunker oil is yet another threat to the air and water quality of the Great Lakes. Bunker oil is a marine heavy oil that emits lethal chemicals into the air and kills wildlife when it is spilled into the water, either in accidents or in illegal dumping. Just 16 of the world's largest ships can produce as much lung-clogging sulphur pollutants as all the world's cars.[12] Yet Canada is resist-

9 Sierra Legal Defence Fund, *The Great Lakes Sewage Report Card*, 2006

10 Environmental Commissioner of Ontario, *Redefining Conservation, 2009/2010 Annual Report.*

11 News from Beyond Nuclear, *Groups Warn of Radioactive Waste Shipping Risks on Great Lakes*, September 16, 2010

12 Fred Pearce, *How 16 ships create as much pollution as all the cars in the world, Daily Mail*, November 21, 2009

ing even mild regulatory changes proposed by the U.S. Environmental Protection Agency to reduce bunker oil emissions.

Industrial and agribusiness-based chemical contaminants from the North American heartland are killing the Beluga whales of the St. Lawrence Estuary. The St. Lawrence has been named among the top 10 most endangered rivers in the United States by American Rivers. All of the pollutants from Chicago, Detroit, Montreal and Toronto travel down the Estuary to the marine Arctic microenvironment at the mouth of the Saguenay River where these magnificent animals call home. The pollution joins the effluent from the aluminium industry dotted along the shoreline. One quarter of all the St. Lawrence belugas have cancer and are among the most contaminated marine mammals in the world. In just 70 years, 90 per cent of the belugas of the St. Lawrence have disappeared. Tragically, the human population of the Saguenay has substantially higher rates of all types of cancer than the Canadian population.

Wetlands play a crucial role in offsetting pollution, acting as nature's filter. Ninety per cent of the 200 fish species in the Great Lakes depend directly on wetlands for some part of their life cycle. Tragically two-thirds of the wetlands of the lower Great Lakes and the St. Lawrence Basin have been lost and the destruction continues with increased development.

Another threat to the Lakes is a new and vicious stream of invasive species, introduced when foreign ships empty their ballast water, dumping organisms from virtually all over the world. At present there are about 185 invasive species in the Great Lakes. But the U.S. National Centre for Environmental Assessment recently issued a dire warning about 30 virulent non-native species that may soon reach the Lakes, and 28 virulent species that have already established a foothold, saying they pose serious ecological and environmental damage to the watershed and to native species.[13] The region's busiest ports – Toronto, Hamilton, Chicago and Milwaukee – are singled out as strong potential targets for invaders. New species such as the Asian carp and snakehead may soon join established predators such as the sea lamprey and zebra mussels that have clogged the intake pipes of power plants, industrial facilities and public waters systems.

"In just 70 years, 90 per cent of the belugas of the St. Lawrence have disappeared."

Recently, scientists have blamed the proliferation of zebra and quagga mussels for the die-off of large numbers of migratory birds over the Great Lakes. The mussels filter botulism and other naturally occurring toxins from the waters. More than 100,000 birds, many of them threatened species including many thousands of loons, have died in the last decade while migrating over the Lakes, and experts now believe it is as a result of eating goby fish, who in turn have eaten the contaminated mussels. Warming waters are also stimulating more plant growth, thereby increasing the amount of bacteria on the lake bottoms. Several years ago, so many dead loons washed up on the Lake Erie shores of a Pennsylvania state park, officials used a funeral home to incinerate them.

Mining, oil and gas exploration

Oil and gas deposits lay beneath four of the five Great Lakes. While the United States Congress banned drilling in the Great Lakes in 2005, Canada has not yet followed suit. Approximately 2,200 gas wells have been drilled under Canada's portion of Lake Erie since 1913, 550 of which are still producing. A report by the Ohio Public Interest Research Group documented

13 EPA National Center for Environmental Assessment, *Predicting Future Introduction of Nonindigenous Species to the Great Lakes*, July 2009

51 natural gas spills caused by gas drilling in the period studied – an average of one per month. During onshore and offshore drilling, a toxic combination of oil, water, arsenic, cadmium, lead, mercury and naturally occurring radioactive materials, called drilling muds, are dispersed into the well hole. Canada's National Pollutant Release Inventory, which tracks the use and disposal of toxic chemicals, does not require reporting for oil and gas drilling. Before he was defeated in the 2010 midterm elections, Senator Russ Feingold of Wisconsin called on the International Joint Commission – a commission appointed to oversee issues concerning lakes and rivers along the Canada-U.S. border – to ban oil and gas drilling on the Canadian side of the Lakes as well.

But not only does Canada not appear to be open to such a ban, there is great pressure to open up the St. Lawrence River to shale-gas exploration. Geologists believe that up to 50 trillion cubic feet of gas reserves may be locked in hard shale under Quebec's heavily populated St. Lawrence River Valley. Hydraulic fracturing or "fracking" involves drilling and pumping massive amounts of chemical-laced water into rock seams to force the natural gas to the surface. Quebec has already given out 600 permits for shale gas exploration under the St. Lawrence in anticipation of a full-fledged industry.

The pressure to supply the U.S. with Alberta's heavy oil is cause for another concern. Bitumen from northern Alberta's tar sands is increasingly being shipped by pipeline to refineries around the Great Lakes for processing. There is an ever-expanding network of pipelines leading from Fort McMurray to refineries at the tips of Lakes Superior, Michigan and Erie, reports *The Toronto Star.*[14] The refinement of tar sands oil has devastating impacts on water sources and local communities. Bitumen, the form of petroleum found in the tar sands, is the thickest and dirtiest form of petroleum to process and requires digging, heating and water use on extreme scales. Processing bitumen uses four times more water than conventional oil and releases nitrogen oxides and sulphur dioxides into the atmosphere, creating acid rain. As a result of this booming business of bitumen export from deep in the U.S. heartland, new and increased amounts of acid rain are falling on the Great Lakes.

There are currently 17 major refinery projects either being planned or developed around the Lakes.[15] The biggest is the BP refinery in Whiting on the south-eastern shore of Lake Michigan in Indiana, which is in the midst of a controversial expansion project aimed at boosting its capacity to process bitumen from the Canadian tar sands. Already, the plant's unpermitted modifications have resulted in a significant increase in nitrogen oxides, sulphur dioxide, carbon monoxide and particulate matter. An expansion of the Murphy Oil plant in Superior, Wisconsin could damage 300 to 500 acres of wetlands and consume 5 million gallons (almost 20 million litres) of water from Lake Michigan every day.

Mining exploration around the Lakes is yet another area of deep concern. A November 2010 six-part television series by the Public Education Center warned that the Great Lakes are threatened from a rash of foreign mining interests seeking to extract billions of dollars in copper and nickel found in a giant sulphide ore deposit. The deposit runs from the tip of Lake Superior through Minnesota's Arrowhead region and Wisconsin's Native American territorial lands, extends to Michigan's Upper Peninsula, all the way to Ontario. Dozens of companies are seeking exploration approval to mine the rock which, when exposed to air and water, sparks a

14 David Israelson, *Toronto Star*, September 12, 2010

15 Munk Centre, University of Toronto, *How the Oil Sands got to the Great Lakes*, October 2008

reaction that creates sulphuric acid. Much of the mining activity will come "dangerously close" to the Great Lakes Basin watershed.[16]

In Canada, mining operations now pose an urgent threat to water. An amendment to the Fisheries Act called "Schedule 2" allows healthy lakes and streams to be reclassified as "tailings impoundment areas" so they are no longer subject to the protection of the Act that prevents toxic dumping in healthy fish-bearing waters. A series of 44 ponds and 30 streams near Marathon, Ontario, situated on the northern most point of Lake Superior, are slated for destruction to make way for an open-pit metal-copper mining operation that will dump 5.3 million cubic metres (well over one billion gallons) annually into the local water systems.

As well, the Great Lakes are at deep risk due to the depletion of water for new energy sources often thought of as "clean." *Circle of Blue* Senior Editor Keith Schneider reports that the collision between energy needs and water supplies will have serious implications for all large bodies of water, including the Great Lakes. The massive rush for new domestic sources of energy, backed by government subsidies, requires huge new sources of water. For instance, it takes 1,000 gallons of water to produce one gallon of corn ethanol, and 6,500 gallons of water to produce one gallon of biodiesel from soybeans, forms of energy promoted as fossil fuel replacements. The plan by the U.S. government to produce 60 billion gallons (240 billion litres) of home-grown biofuels by 2030 will have a devastating impact on the nation's water supplies. Generating energy for "clean" alternatives is almost certain to consume much more water than the fossil fuels they are meant to replace.[17] The demand for biofuels, coupled with increased coal, thermal power, natural gas fracking, nuclear and hydropower energy production has led to a "choke" between water and energy says Schneider, one that water will not win.

Could the Great Lakes disappear?

The Great Lakes are in deep distress and under serious threat. For too long now it has been assumed that these magnificent bodies of water could withstand any amount of pollution, extraction, diversion and exploitation, so vast are their stores of water. But in the last two decades, we have started to learn a great deal about the global water situation and old assumptions about the "myth of water abundance" are being proven false. For years, we all believed that we cannot run out of clean water because an infinite amount of water perpetually circulates through the planet's hydrologic cycle and cannot be destroyed. While it is true that the water is still somewhere on the planet, it is often now not in a form we can access. Humans everywhere are taking water from where it is accessible and polluting it, dumping it into the oceans as waste, using it to mass irrigate crops in deserts, and sending it out of watersheds in the form of commodities and other exports in the name of global trade. As the demand grows, the supply diminishes.

A recent study on the global water supply conducted by water intensive industries and coordinated by the World Bank found that by 2030, global demand for water will exceed supply by 40 per cent.[18] Another recent global study of groundwater takings found that the rate of

16 Public Education Center, DC Bureau, Midwest Mining Rush Threatens Water, November 2010

17 Keith Schneider, *ChokePoint U.S.: Understanding the Tightening Conflict Between Energy and Water in the Era of Climate Change. Circle of Blue*, September 2010

18 McKinsey and Company and World Bank, *Charting our Water Future*, 2009

extraction has doubled in the last few decades, causing massive disruptions in communities where water supplies are running out.[19]

Even large bodies of water like the Great Lakes are not immune to our abuse. The Aral Sea was once the world's fourth largest lake and provided water for people in Afghanistan, Iran and five other countries of the former Soviet Union. Through massive dredging and diversions to grow cotton in the desert, the Aral Sea has lost more than 80 per cent of its volume and what is left is salty brine – an ecological tragedy. Lake Chad, once the world's sixth largest lake that served as the water supply for 30 million people in central Africa, has shrunk by 90 per cent and will likely disappear altogether in 20 years, according to the United Nations Food and Agricultural Organization. Researchers studying the crisis found that climate change had little to do with it and blamed human activities, especially poor farming practices, industrial development and diversions from the lake.[20]

The Great Lakes face the same abuses of over-extraction and diversion, pollution, poor agricultural practices, groundwater mining and growing demand. They are also subject to what Canadian environmentalist David Suzuki calls "exponential destruction," the assault on a resource that cannot be charted because it is coming so fast and from so many places. What may look like a mostly full body of water one day may be gone the next when the multiple and multiplying demands are so great.

Can the Great Lakes run out of water? According to the scientists who conducted the recent global study on groundwater extractions, *if groundwater around the Great Lakes is being drawn down at the same rate as it is globally, the Lakes will be bone dry in just 80 years.*

"What may look like a mostly full body of water one day may be gone the next."

19 American Geophysical Union, *Groundwater Depletion Rate Accelerating Worldwide*, Marc Bierkens, Utrecht University, 23 September, 2010

20 National Geographic News, *Shrinking African Lake Offers Lesson on Finite Resources*, April 26, 2001

Current Practices Are Not Saving the Great Lakes

Clearly the governance structures of the various jurisdictions are failing to adequately protect the Great Lakes, in spite of many attempts at joint actions. This does not mean there have been no attempts. In fact, there is a rich tradition of cooperation between the two countries and among the various states and provinces that share responsibility for them. There is also a myriad of state, provincial and federal laws governing water quality as well as highly regulated utilities supplying safe water to millions. Many communities also have watershed councils – citizen groups that champion watershed health, monitor their local waterways and advocate with their local, state and provincial governments to improve protection and equitable access to local water sources. Many of these local facilities, groups and regulations, as well as cross-border cooperation agreements, are based on the principle of protecting a shared Commons.

Cooperative agreements

The Boundary Waters Treaty of 1909 was created at the beginning of the 20th century when the importance of the Great Lakes was dominated by its use to transport goods to market. The treaty provides the principles and mechanisms to help resolve disputes and to prevent future ones, primarily those concerning water quality and quantity along the boundary between the United States and Canada. It was far-sighted enough to include a provision that the boundary waters "shall not be polluted on either side to the injury to health or property to the other side" and that there should be no effect on flows and levels. The Boundary Waters Treaty established The International Joint Commission (IJC) and set out a legal structure for regulating the Great Lakes as boundary waters between the two countries. The treaty requires that the Commission give all interested parties a "convenient opportunity to be heard" on matters under consideration, invites public participation and advice when it undertakes new studies or reports to governments, and provides information to the public on matters pertaining to the Lakes – all good Commons practices. The treaty and the IJC have long been considered global models of cooperation for countries that share boundary waters.

The 1955 *Convention on Great Lakes Fisheries* was created to deal with the decimation of fish stock in the Lakes, particularly trout and salmon. It created the Great Lakes Fishery Commission to coordinate fisheries research, jointly manage the Lakes' fisheries and jointly control invasive species, especially the sea lamprey. *The Great Lakes Water Quality Agreement,* first signed in 1972 and renewed in 1978 and again in 1987, expressed the commitment of the two countries to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin ecosystem and has become a major focus of the IJC. As the agreement was renewed, persistent toxic substances and phosphorus were added as targets to the original goal of industrial pollution control. The agreement is presently under review.

The Great Lakes Water Quality Agreement also established a Lakewide Management Plan for every lake so that each lake could have a specific plan drawn up for its unique situation and government structure. Every Lakewide Management Plan includes a Remedial Action Plan to

deal with the 43 "Areas of Concern" – areas of intense environmental contamination singled out for remedial action.

In 1985, the countries, states and provinces of the Great Lakes signed the *Great Lakes Charter*, which recognized the limits of the 1909 treaty and sought to establish new mechanisms for co-managing the Great Lakes. The signatories were worried about the deterioration of the Lakes and wanted to assert an understanding that they form one integrated watershed that must be managed as such. Priority goals were to conserve the levels and flows of the Great Lakes and to protect and conserve the environmental balance of the Basin. A year later, the U.S. Congress passed the *Water Resources Development Act* requiring unanimous consent of the Governors of the Great Lakes states prior to any new diversion out of the Basin.

Concern about commercial exports from the Great Lakes suddenly arose in 1998 when the then Premier of Ontario granted a licence to a private Canadian company to export six hundred million litres (about 150 million gallons) of water from Lake Superior per year and ship it by tanker to Asia for bottling. The outcry from both sides of the border forced the Premier to cancel the licence. The U.S. added the word "export" to the ban on diversions in the *Water Resources Development Act*, and the governments of the United States and Canada placed a temporary moratorium on new takings while the IJC studied the issue further. The result of this study was the 2005 *Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement*, which called the lakes "precious" and "interconnected," reaffirmed the Great Lakes Charter vision of an integrated system that looks at ground and surface water as a unified whole, and set a floor for regulating water withdrawals in the Great Lakes. All eight states and both provinces have since adopted legislation ratifying the agreement. In 2002, the Canadian Parliament amended the International Boundary Waters Treaty to ban bulk water transfers from the Great Lakes, and in 2008, the U.S. Congress adopted it as the *Great Lakes-St. Lawrence River Basin Water Resources Compact.*

"The recovery of the Lake Erie fishery was rightly seen as a model for cross-border environmental cooperation."

Some progress

Over the years, these cross-border agreements have resulted in some very important initiatives. One was a great reduction in the amount of phosphorus dumping in the Lakes, a result of both these cross border agreements and the 1977 *Clean Water Act* in the U.S. Phosphorus is a nutrient that in excess, will cause algae to grow out of control. Algae blooms can lead to biological death, called eutrophication. Measures to limit the nutrient included removing phosphorus in detergents and sewage treatment plants.

This in turn led to the (perhaps only temporary it may now appear) recovery of Lake Erie and the shrinking of its "dead zone." Lake Erie, the shallowest of the Lakes, was clearly in trouble as far back as the 1930s, as a result of intensive industrial and farm activity, as well as wetland and habitat destruction on its shores. In 1970, its commercial fisheries were closed due to mercury contamination. With the warming of Lake Erie came oxygen depletion, eutrophication and shorelines covered in cladophora, a green, slimy rotting moss that forced the closing of beaches and recreational areas. The recovery of the Lake Erie fishery was rightly seen as a model for cross-border environmental cooperation.

Another partial but important success story was the reduction of DDT and PCBs found in fish and humans living on the Lakes in the decade between 1995 and 2005, a drop that has

been attributed to the banning of these substances in the 1970s.[21] DDT was widely used in agriculture and insect control from the 1950s for at least 20 years. The fire resistant class of oils called polychlorinated biphenyls (PCBs) were widely used in transistors, capacitators and other electronics in the same decades. The return of the bald eagle is a moving part of this story. When the bald eagle was chosen as the national bird of the United States in 1782, there were about 100,000 nesting pairs; by the mid-sixties, that number was down to less than 500 nesting pairs. With the ban of DDT plus a recovery plan, there are now more than 10,000 pairs again, many of them living in the Great Lakes region. In 2007, the bald eagle was removed from the endangered species list.

The signing of the *Canada-United States Air Quality Agreement* in 1991 was largely meant to address transboundary air pollution leading to acid rain that was particularly harmful to the Great Lakes. Both countries agreed to reduce emissions of sulphur dioxide and nitrogen oxides, the primary precursors to acid rain, and to work on other acid related scientific and technical cooperation. Both governments claim that much progress has been made to reduce acid rain-causing emissions, a claim environmental groups acknowledge, but with caution. Pollution Probe says that while "great progress" has been made to meet reduction targets, the acid rain story is still unfolding, with new sources of pollution still being constructed and new science telling us that even reduced levels are not good enough to save our lakes and rivers from the scourge of acid rain.[22]

Working alongside governments to implement these agreements are a number of hardworking and dedicated environmental organizations such as the National Wildlife Federation and the Canadian Wildlife Federation, Sierra Club U.S. and Sierra Club Canada, Great Lakes United, Healing Our Waters Coalition, Alliance for the Great Lakes, the Canadian Environmental Law Association, various manifestations of Waterkeepers and hundreds of state, provincial and local citizen groups fighting to protect their portion of the basin. These groups advocate for the Lakes, conduct research, lobby for better laws and serve as watchdogs to governments at all levels. Yet despite these important cross-border agreements, the many cross border-working groups tasked with their implementation and the relentless energy and commitment of these and other non-governmental organizations, and despite the successes listed here, the threat to the Great Lakes continues to grow and the alarm bells continue to sound.

"The reason that so little real progress is being made is that there are really duelling notions about what the Great Lakes are, and whom they should serve."

Conflicting priorities

The reason that so little real progress is being made is that there are really duelling notions about what the Great Lakes are, and whom they should serve. The story of the global water crisis sets the stage all over the world: to feed the increasing demands of a consumer-based system, modern humans have seen water as a great resource for our personal convenience and profit, not as the most essential element in a living ecosystem. So we have built our economic and development policies based on a human-centric model and assumed that nature would never fail to provide, or that, where it does fail, technology will save the day. We have polluted, diverted and mismanaged the planet's finite supplies of water to the point that they are now dangerously close to collapse in many parts of the world. We have moved water from where it is needed to protect a healthy hydrologic cycle, to where we want it. Increasingly,

21 L. Knobeloch, M. Turyk, P. Imm, C. Schrank, and H. Anderson, *Temporal changes in PCB and DDE levels among a cohort of frequent and infrequent consumers of Great Lakes sportsfish*, Environmental Research, 109.66-71, 2008

22 Pollution Probe, *Acid Rain Primer*, Second Edition, 2006

humans see water as a commodity to be used for personal profit. Many in the private sector view the world water crisis as a great business opportunity. Judson Hill, investment analyst for NGP Global Adaptation Partners, recently told a Geneva agriculture investment conference that water scarcity is turning water into a bankable commodity and will generate "buckets and buckets of money" for smart investors.[23]

The waters of the Great Lakes are no exception to this rule. The history of the Lakes exposes deep threads of exploitation – from early settlement to the present day. From the time of European settlement, forests and wetlands were destroyed with impunity and extractive-industries such as pulp and paper dumped their effluent directly into the Lakes. The St. Lawrence Seaway was created in 1959 to open up the Great Lakes for international shipping and trading. It required much dredging and blasting, the building of massive hydroelectric power dams as well as the creation of a complicated series of canals and locks. (It also included the submersion of a number of villages and shorelines along the route, particularly on the Canadian side. Most of the lands and villages destroyed belonged to the Mohawk First Nations people of Akwesasne, who also witnessed the destruction of their fishing grounds, wetlands, arable farming land and access to the river.)

For the first time, deep draft ocean-going international vessels were able to come right into the heartland of North America. The creation of the Seaway opened the way for a huge expansion of industrial activity right on the Lakes in order to take advantage of the new shipping and trading opportunities, which in turn dramatically increased effluent dumping into the Lakes. Major manufacturing industries such as steel, paper, chemicals and automobiles, all attracted by plentiful water, set up shop in the Great Lakes region. Today, 36 per cent of U.S. cars and 38 per cent of Canadian cars are produced in the Basin. And of course, with the ocean-going vessels came the first of the invasive species that would destroy so much of the local native aquatic life of the Great Lakes.

That the Seaway served economic goals from the beginning almost to the exclusion of all others was evident with the mandate of the Moses-Saunders hydropower dam (built in the 1950s as part of the Seaway project), which required it to control the flow of the water levels in order to promote marine traffic and trading. Before the installation of the dam, water levels on the St. Lawrence and Lake Ontario water levels were dynamic and the natural flow enabled wetlands to survive by allowing shoreline seed banks to grow during periods of low water levels. Natural flows also protected access to inner marshes for fish spawning and served as protection for near shore animal activity during winter months. The new artificial controls of the water levels led to 50 years of environmental degradation of coastal wetlands says the Upper St. Lawrence Riverkeepers, and is a partial cause of the declining levels of the Lakes themselves.

Even the many agreements between the various government jurisdictions noted above are often based on the assumption of growth for the region, and one can see the duelling views of the Great Lakes right in the documents themselves. For instance, one of the official purposes of the 1985 Great Lakes Charter, aimed at joint reduction of environmental degradation, is "to provide a secure foundation for future investment and development within the region." The Canadian Environmental Law Association (CELA) notes that, in the current consultations leading up to a mandated review of the *Great Lakes Water Quality Agreement*, some industry interests are lobbying to move away from a focus on toxics to "other issues" and worries

23 *Private equity sees "buckets of money" in water bigs*, Reuters, November 9, 2010

that the IJC may be open to this line of thinking. "Has the ecosystem fallen off the negotiating table?" CELA demands to know, noting that it is difficult to discern if the ecosystem is still central to those responsible for updating the agreement.[24]

As well, the *Great Lakes Water Quality Agreement* only outlines a need for research on the threat of invasive species, but does not recommend a program to control or contain them. In 2006, Canada introduced regulations to set new ballast standards but with a loophole for ships with "No Ballast on Board" (NOBOB), that is, loaded with goods. Lack of ballast is not a fool-proof protection however. While NOBOB ships are heavy with cargo and little ballast water, they do still carry unpumpable water and sediment and can therefore harbour invasive species. New York State recently adopted regulations that would require all ships entering the Great Lakes to be outfitted with ballast treating systems that exceed current international shipping standards, but New York State Senator Darrel Aubertine and the Canadian Department of Foreign Affairs and International Trade have joined the powerful shipping lobby in opposing them, citing their possible negative impact on Seaway commerce.

Even the 2008 *Great Lakes Compact* that came about to prevent new water diversions from the Lakes has a serious flaw that benefits industry, serving as another example of the duelling visions for the Lakes. As Michigan environmental legal expert Jim Olson explains, the Compact (and therefore all the implementing legislation by the states and provinces) contains a loophole that allows for water withdrawals of up to 20 litres (5.7 gallons) in unlimited quantity, which in turn allows big water-bottling companies such as Nestlé, Pepsi and Coca-Cola to remove large amounts of water from the Lakes for export. (For example, Nestlé secured a permit to withdraw 150 gallons – nearly 600 litres – per minute from wells in Evart, Michigan *after* the Compact was signed.)[25] It also contains an exemption that includes water in any sized container without limit so long as the container is labelled "product," and the water is used in agricultural, manufacturing or industrial processes. This creates a giant precedent that water exporters can use to transfer water out of the Basin and to undercut the diversion ban, which is the intent of the law in the first place. Olson warns that once water is seen as a good, it is subject to tough new business rules under the under the terms of the North American Free Trade Agreement (NAFTA).

Open for business?

This view of the Great Lakes as primarily a commercial enterprise should come as no surprise. According to the Brookings Institute, if it stood alone as a country, the Great Lakes economy, with a gross regional product of $4.2 trillion, would be the second biggest in the world, next only to that of the United States. Politicians and business leaders are keenly aware of the business opportunities this vast body of water offers.

In 2010, as part of its new *Open for Business Act*, Ontario passed the *Water Opportunities and Water Conservation Act,* which, while setting some good (albeit voluntary) standards for water conservation, clearly aims to make the province "a leader in the development and commercialization of innovative technologies for the treatment and management of water and wastewater" and use Ontario's abundant water resources as an "economic incentive" for

24 Canadian Environmental Law Association, *Re-negotiation to Amend the Great Lakes Water Quality Agreement: Response to the Binational Webinars*, June 7-9, 2010

25 Jim Olson, Navigating the Great Lakes Compact: Water, Public Trust and International Trade Agreements, Michigan St. Lawrence Review, 1103, 2007

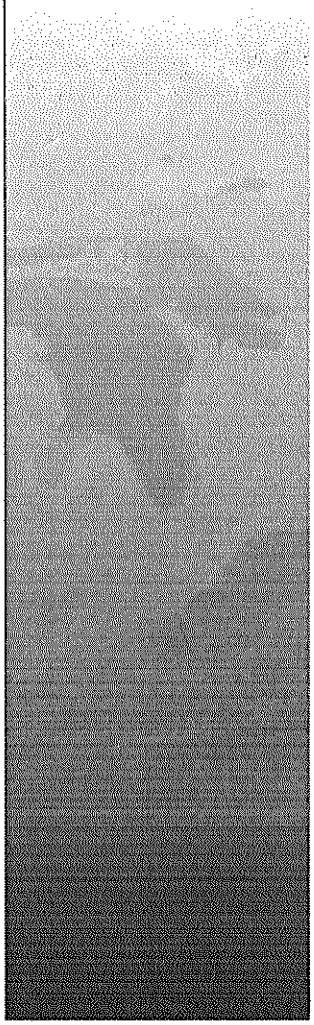
businesses to locate there. The same Bill weakened the requirements for public scrutiny of pollution permits.[26] The duelling visions of trying to care for the Lakes, while at the same time exploiting them, can be clearly seen in this legislation and where it might lead. Environmentalists are concerned with plans to open up a whole sub-basin of the Great Lakes to Greater Toronto-scale urban sprawl and industrial development, which will necessitate building huge water pipelines traversing the countryside from Lake Simcoe or Georgian Bay to inland communities.

Milwaukee's City Council is planning to entice water-intensive industries such as semiconductors, meatpackers, paper, pharmaceuticals and fabricators, to the city with deeply discounted water from the Great Lakes. "This is our comparative advantage," says Mayor Tom Barrett, who clearly favours the vision of the Great Lakes as an economic engine over that of a shared and protected watershed. He suggested poaching jobs from water-parched Atlanta. Local business leaders see this as an example for other Great Lakes cities and suggest the project be called WAVE – "Water Attracting Valued Customers." Critics point out that water intensive industries dispose of a lot of wastewater, which will be cleaned at public expense by public treatment plants, and are usually highly energy intensive as well, creating additional air and water burdens in the surrounding communities. As well, cheap water rates may lure the kinds of businesses that do not want to take measures to reduce their water footprints. The Alliance for the Great Lakes notes that if Great Lakes cities and their leaders do not recognize the intrinsic value of being situated near the world's largest concentration of freshwater lakes, how can they convince others of their value?

Chicago Mayor Richard Daley is proposing to bottle municipal tap water to sell for profit. As it is, commercial and bottled water users have access to the groundwater of the Great Lakes at cut-rate prices. Ontario charges large commercial water users only $3.71 per million litres (250,000 gallons). In Michigan, Nestlé pays just for the service charge of the municipal tap water it uses. The company pays the City of Evart 9.4 cents per 1 million gallons (4 million litres) and pays nothing for the 100 million gallons (4 million litres) of water it removes every year from the Sanctuary Springs Mecosta because these are private high capacity wells. In Detroit, as in many other Great Lakes cities, the rate charged per gallon of water decreases the more water is used. For instance, industry in Detroit uses more that 33,000 cubic feet a month, but pays almost 20 per cent less than both industry and residents using less than that amount. The bottled water industry is of course very interested in the water of the Great Lakes and pumps three hundred million gallons (more than 1 billion litres) out of the systems that feed the Lakes every year with the blessing of local governments.[27]

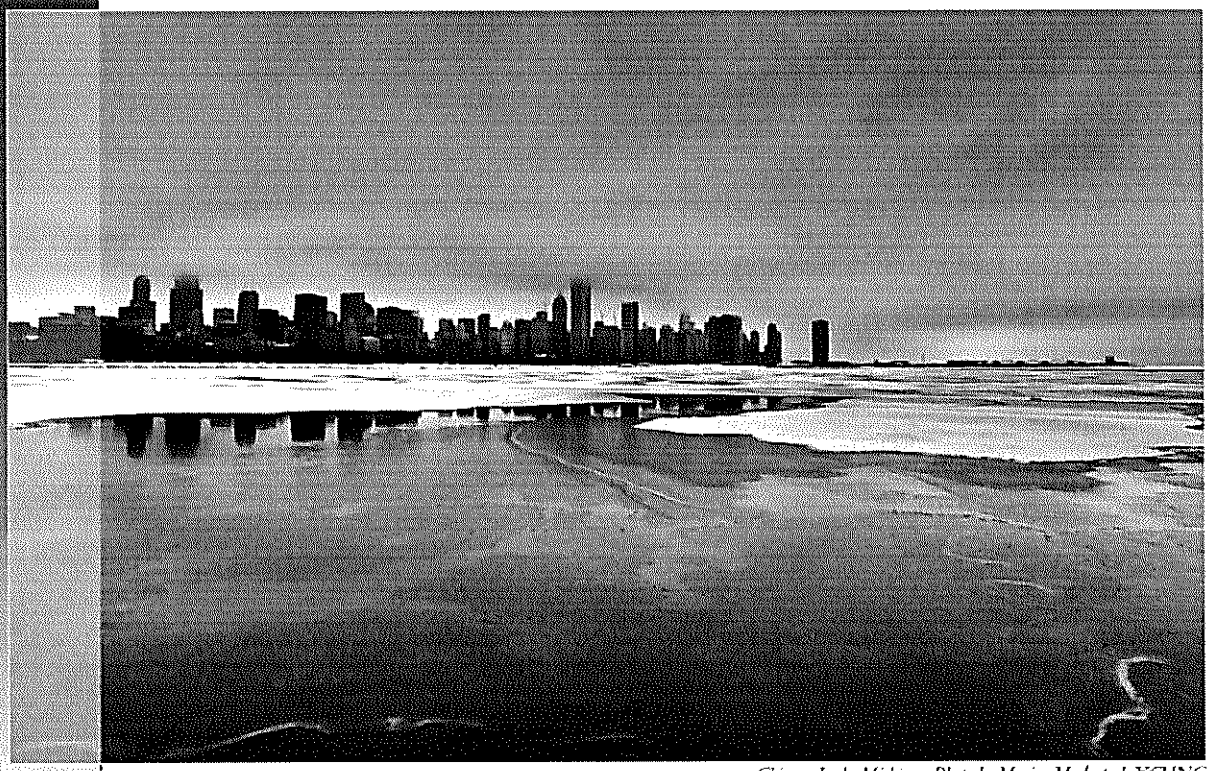
As well, many governments are now promoting the sale or contracting out of their public water systems to private companies, either because they are cash strapped and need private investment funds to upgrade neglected and aging infrastructure, or because they believe in private services ideologically. Public-private-partnerships are being promoted by many municipal, provincial and state governments as an alternative to public delivery of water and wastewater services and in some cases, funding for new initiatives such as water treatment plants, favour private sector involvement. Chicago is one of a number of Great Lakes cities seriously considering privatizing its water services. (Others include Toledo, Detroit, Grand Rapids, and Bay City.) A report by U.S.-based Food and Water Watch found that if Chicago moves to a

"Public-private-partnerships are being promoted by many municipal, provincial and state governments as an alternative to public delivery of water and wastewater services."



26 Lake Ontario Waterkeepers, *Waterkeeper's Weekly*, October 27, 2010

27 From an April 2008 speech by former Great Lakes Fisheries Commission member Dave Dempsey at Michigan State University Alumnus Theatre



Chicago, Lake Michigan. Photo by Marius M. / stock.XCHNG

private model, consumers will pay for the original investment many times over.[28] Privatization brings not only higher rates for consumers but also a loss of public oversight to manage and protect watersheds. Commodifying public water services of the Great Lakes renders a Great Lakes-centred vision for the Basin unattainable.

And despite the intent of the Compact to ban commercial water exports from the Great Lakes, pressure is growing to open up the Lakes for water trading. The influential policy think-tank, the Montreal Economic Institute, is proposing a $20 billion plan in annual bulk water sales that would take massive amounts of water from Northern Quebec and ship it by canals down to the southwestern United States through the St. Lawrence and the Great Lakes. While there has been no response yet from the Quebec government on this proposal, it has generated a fair bit of media and some support in Canadian business circles. This would not surprise the National Wildlife Federation, which warns of the growing demand on the waters of the Great Lakes as climate change decreases water and aquifer levels in other parts of the United States.[29]

Consistently underfunded

In the end the proof is in the funding. For decades, funding for the various joint agreements and reclamation projects for the Great Lakes has been so meagre, their recommendations have been impossible to implement. Many groups appearing before the current review of the *Great Lakes Water Quality Agreement* expressed widespread concern that inadequate and

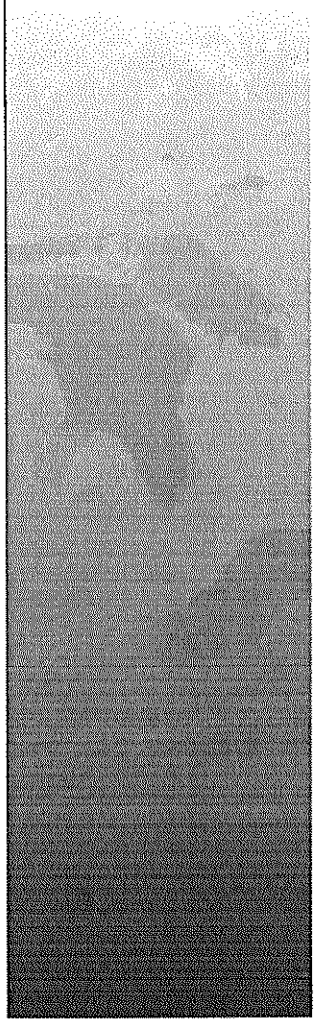
28 Food and Water Watch, *Water Privatization Costly for Chicago*, 2010

29 National Wildlife Federation, *Climate Change and Great Lakes Water Resources*, November 2007

inconsistent funding has hampered the overall success of the Agreement. A 2008 report by the Great Lakes and St. Lawrence Cities Initiative showed that local governments in Canada and the United States invest the lion's share of Great Lakes rehabilitation costs, an estimated $15 billion annually.[30] The U.S. government had cut federal funding for the Great Lakes to the bone to just over half a billion dollars annually in 2004, and the Canadian government allots a mere $8 million a year for Great Lakes clean-up and protection.

While the Obama administration has promised to increase federal funding for the Great Lakes to $2.2 billion over the next five years, this money is not adequate to the demand and the funds have not been forthcoming at the expected rate. The Environmental Protection Agency estimates that $73 billion is needed in the U.S. just for infrastructure repair and upgrade and the Canadian Water Network, a group of scientists and researchers across the country, places Canada's need for immediate infrastructure upgrading at close to $40 billion. As a consequence of this severe underfunding, not only are the remediation goals of the *Great Lakes Water Quality Agreement* not able to be realized, neither are the proper implementation of the Compact and its goal of controlling diversions.

It is clear then, that the measures taken to date are not adequate to the enormous task before us of rescuing and permanently protecting the Great Lakes of North America. If we truly saw the Great Lakes as a shared Commons to be protected for all time, we would have invested heavily in their reclamation and created powerful laws to prevent further harm. While no one would deny that there is an important economic dimension to the waters of the Great Lakes, the dominant tendency to see them primarily as an engine of growth and prosperity has placed them in grave and growing danger. A new narrative, widely held and acted upon, is needed now to save the Great Lakes.



30 Great Lakes and St Lawrence Cities Initiative, *Local Investment in the Great Lakes and St Lawrence*, February 2008

We Need a New Narrative to Protect the Great Lakes

What might happen if the citizens living around the Great Lakes decided to collectively protect them based on some of the very principles and practices that informed the First Peoples of the region, namely that the Great Lakes must be shared equitably by all who live around them and protected for seven generations into the future? What do we mean by a Commons? What is the Public Trust Doctrine? How could we protect a Bioregion?

A Commons approach

The notion of the Commons is a very old one. A Commons narrative asserts that no one owns water. Rather it is a common heritage that belongs to the Earth, other species and future generations as well as our own. Because it is a flow resource necessary for life and ecosystem health, and because there is no substitute for it, water must be regarded as a public Commons and a public good and preserved as such for all time in law and practice. Embracing the Commons helps us to restore to the centrestage a whole range of social and ecological phenomena that market economics regards as "externalities." A language of the Commons would restore more democratic control over the Great Lakes and establish their care and stewardship the joint responsibility of citizens and their elected governments based on the notions of social equity, ecological survival and governance by the people most impacted.

"A Commons narrative asserts that no one owns water. Rather it is a common heritage that belongs to the Earth, other species and future generations as well as our own."

The Commons approach is based on the belief that just by being members of the human family, we all have rights to certain common heritages, be they the atmosphere and oceans, freshwater and genetic diversity, or culture, language and wisdom. In most traditional societies, it was assumed that what belonged to one belonged to all. Many indigenous societies to this day cannot conceive of denying a person or a family basic access to food, air, land, water and livelihood. Many modern societies extended the same concept of universal access to the notion of a social Commons, creating education, health care and social security for all members of the community. There are many working examples of Commons in North America today that include systems of national, state and provincial parks, cooperative fishing compacts to protect local stocks from depletion, and public libraries.

A *Great Lakes Basin Commons* would reject the view that the primary function of the Great Lakes is to promote the interests of industry and the powerful and give them preferential access to the Lakes' bounties. It would embrace the belief that the Great Lakes form an integrated ecosystem with resources that are to be equitably shared and carefully managed for the good of the whole community. In a Commons framework, water is a fundamental human right that must be accessible to all. Private control of water cannot address itself to the issues of conservation, justice or democracy, the underpinnings of a solution to the crisis of the Great Lakes. Only citizens and their governments acting on their behalf can operate on these principles. Under a Commons regime, all private sector activity would come under strict public oversight and government accountability, and all would have to operate within a mandate whose goals are the restoration and preservation of the waters of the Basin and water justice for all those who live around it.

At the same time, it is *not* a return to the notion that the Great Lakes are indestructible due to their size,[31] or what has come to be known as "the tragedy of the commons."[32] It is rooted rather in a sober and realistic assessment of the true damage that has already been unleashed on the Great Lakes as well as the knowledge that they must be managed and shared in a way that protects them now and for all time.

Public Trust Doctrine

The Public Trust Doctrine underpins in law the universal notion of the Commons that certain natural resources, particularly air, water and the oceans, are central to our very existence and considered to be the property of the public, which cannot be denied access. The trust resources must, therefore, be protected for the common good and not appropriated for private gain. Under the public trust, governments, as trustee, are obliged to protect these trust resources and exercise their fiduciary responsibility to sustain them for the long-term use of the entire population, not just the privileged few who could buy inequitable access.

The Public Trust Doctrine was first codified in 529 A.D. as Codex Justinianus, after the emperor of that period who said, "By the laws of nature, these things are common to all mankind: the air, running water, the sea and consequently the shores of the sea." This "common law" was repeated many ways and in many jurisdictions, including the Magna Carta, and has been a powerful legislative tool in many countries to provide for public access to seashores, lakeshores and fisheries. U.S. courts have referred to the Public Trust Doctrine as a "high, solemn and perpetual duty"[33] and held that the states hold title to the lands under navigable waters "in trust for the people of the State." The Public Trust Doctrine has been used in recent decades to protect both the right of public access to water and water itself.

Oliver Brandes and Randy Christensen of the Polis Water Sustainability Project of the University of Victoria in British Columbia add that at its core, Public Trust Doctrine is a background principle of property law that serves to strike an appropriate accommodation between the public interest and private development rights through requiring continuous state supervision of trust resources. Public trust is a recognition, they say, that private rights to use water are not granted in a completely unencumbered fashion, but are obtained through an appropriation system administered by government and with implicit restrictions to not unduly and irreparably harm the resource and associated values. This public trust is a safeguard that prevents the monopolization of trust resources and promotes decision-making that is accountable to the public.[34]

The Public Trust Doctrine is an important tool in the movement to fuse solutions to both the ecological and human water crises. Under a public trust regime, all competing uses of Great Lakes water should have to pass a test, not just of fairness of access, but also that they will

31 As noted by a decision of the Michigan Supreme Court, nibbling effects can impair the public trust as much as one major event., People v Broedell, 112 NW 2d 517, Mich 1961

32 *The Tragedy of the Commons* is an essay written for the journal *Science* in 1968 by Garrett Hardin and is widely taught and referenced as an argument for private control of resources. It is now widely criticized for failing to distinguish between well managed and regulated common property and "open access" resources that can be accessed by anyone at any time without restraint.

33 Michigan Supreme Court, Collins v. Gerhardt, 1926

34 Oliver M. Brandes and Randy Christensen, *The Public Trust and a Modern BC Water Act*, Polis Water Sustainability Project, June, 2010

not draw down the future capacity of the watershed. Public trust offers a body of principles that combine public good, public control and public oversight with the long-term protection of the watershed. It also sets the stage for an agreed upon "hierarchy of use," whereby some uses of the water, such as the human right to water and water for ecosystem protection, will take precedence over others.

Protected Bioregion

As important as it is, the Public Trust Doctrine does not extend to the concept that the Commons themselves have the inherent right to protection. In the eyes of most Western law today, most of the community of life on Earth remains mere property, natural "resources" to be exploited. Where there is challenge to this exploitation, it is usually to protect a natural Commons so that it can still be of use to humans, usually for economic purposes. The main form of environmental protection of the Great Lakes has been based on the regulatory system, legalizing the discharge of large amounts of toxins into the Basin in the name of curbing the worst practices.

South African environmental lawyer Cormac Cullinan has written extensively on the need for "wild law" to regulate human behaviour in order to protect the integrity of the Earth and all species on it.[35] If we are members of the Earth's community, then our rights must be balanced against those of plants, animals, rivers and ecosystems, he argues. In a world that recognizes the rights of nature, the destructive, human-centred exploitation of the natural world would be unlawful and humans would be prohibited from deliberately destroying the functioning of ecosystems or driving other species to extinction. Humans have bought into the "myth of abundance" and used, abused and moved water as if it is unlimited. The time has come to reverse this pattern and learn to live within the cycles and systems of water that give us life.

Creating a *Great Lakes Protected Bioregion* would require a change in the relationship of the humans who depend on the watershed from one of exploitation to one of respect. A Great Lakes Protected Bioregion would require legislation that recognizes the inherent rights of the ecosystem and aquatic life of the Great Lakes Basin outside of their usefulness to the humans who live around it. Law and practice would protect all the waters of the Great Lakes Basin, and the restoration of its ground and surface waters would be a priority.

Existing Public Trust Law

Technically, as environmental lawyer Jim Olson points out, all the waters of the Great Lakes, connecting waters and all tributary lakes and streams (with the exception of groundwater) are subject to Public Trust law in the United States by virtue of the U.S. Supreme Court decision in *Illinois Central Railroad v Illinois* (1802), where the Court ruled that even though the state held title to the lands under navigable waters, it is a title held in trust for the people. Olson says, "The principles of governance, democracy, and public control already apply and exist; we, as recognized beneficiaries, need to educate and exercise."[36]

Knowledgeable environmental groups such as Midwest Environmental Advocates, a Wisconsin-based non-profit environmental law centre, agree, saying that because of these trust laws,

35 Cormac Cullinan, *Wild Law, A Manifesto for Earth Justice*, Green Books, Second Edition, *2011*

36 Jim Olson, personal correspondence, January 2011

the Great Lakes are already "the quintessential shared Commons" and need to be recognized as such.[37]

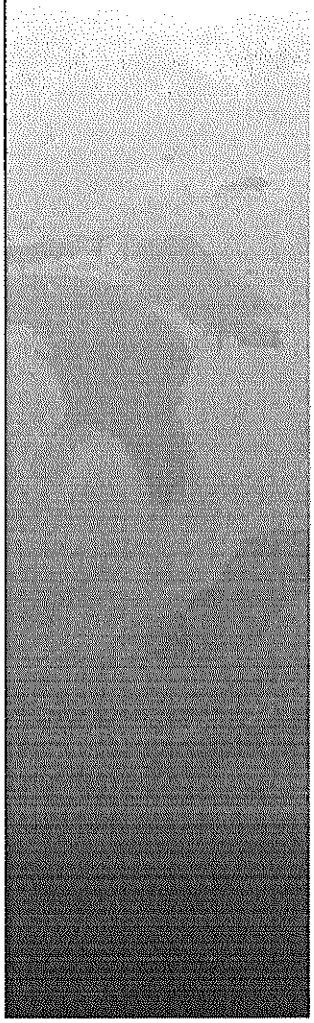
There is a rich history of public trust in U.S. law. The state Supreme Court of Idaho has stated "the public trust doctrine at all times forms the outer boundaries of permissible government action with respect to public trust resources." In 1983, the California Supreme Court used the Public Trust Doctrine to curtail the diversion of water to Los Angeles from fragile Lake Mono. The Audubon Society successfully argued that even though the tributaries feeding Lake Mono were not navigable (up until then only navigable waters were subject to public trust protection), the public trust was still violated because diverting from those streams jeopardized the public trust value of the lake. Two decades later, Olson used the Public Trust Doctrine to argue for limits to tributary groundwater access with dramatic effect on an adjacent stream, in a 2004 court challenge against a Nestlé bottling operation in Michigan. He said that groundwater and surface water are one and the same, and therefore the effects are the same whether the pipe is in the stream or in the groundwater that feeds it – both must be equally protected for the common good.

In 2008, concerned about major groundwater extractions, the State of Vermont passed the *Groundwater Protection Act* that declared the groundwater to be a public trust resource legally belonging to all Vermonters that must be managed in the best interest of all Vermonters. A permitting system has been set up for users over a certain limit per day, and the state has the right to revoke these permits if they are abused. Recently, the Vermont Natural Resources Council used the State's public trust legislation to challenge a tritium leak from nuclear power plant Vermont Yankee, saying that a violation of the integrity of the water is a violation of the rights of the owners – the people of Vermont. Maine has introduced a law that would require a majority vote of the local community before a large groundwater withdrawal or large-scale transport of public water could take place.

The Great Lakes states have some good public trust law and history as well. In 2005, the U.S. Supreme Court ruled that Michigan residents have the right to walk along that state's more than 5,000 kilometres of shoreline. Michigan, Wisconsin and Ohio all have the right of public access under the Public Trust Doctrine extending to all navigable lakes and streams. In a dispute between a Wisconsin property owner and the public, the Supreme Court established that streams and wetlands are interconnected and a private homeowner does not have the right to destroy a wetland because of the common ownership of the stream.

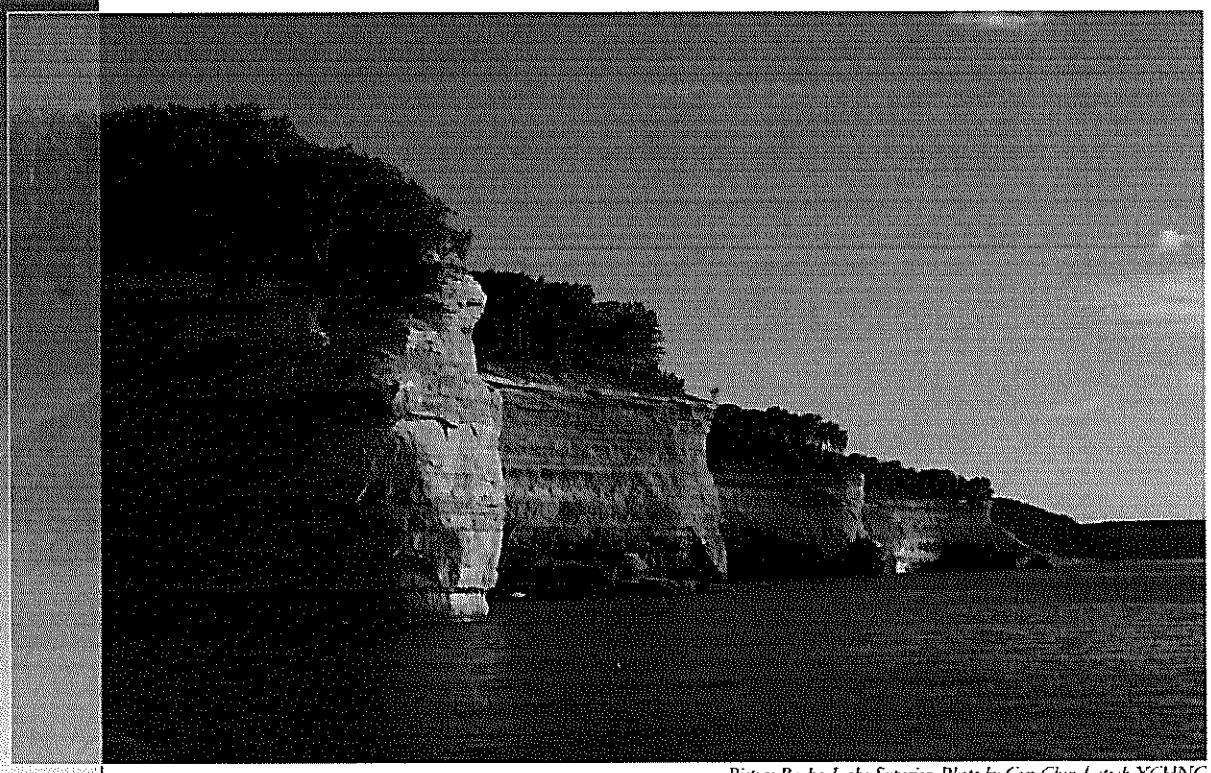
There is less of a history of public trust in Canadian law because, as distinguished Canadian water advisor Ralph Pentland explains, Canada's *Constitution Act* recognizes the on-going role and authority of the Crown as the owner of all public lands.[38] So the responsibility to preserve the Commons was vested more in government than in citizens. As Brandes and Christensen of the Polis Project point out however, just because no court in Canada has explicitly recognized or adopted the Public Trust Doctrine with respect to freshwater resources does not mean there is not some history of Commons protection in Canadian law. Public rights to shared resources have been affirmed in court cases involving the use of public rivers and oceans, including the rights of fishing and navigations; the use of lands dedicated for public use includ-

"Creating a Great Lakes Protected Bioregion would require a change in the relationship of the humans who depend on the watershed from one of exploitation to one of respect."



37 Midwest Environmental Advocates, *Realizing the Promise of the Great Lakes Compact: A Policy Guide for State Implementation, Vermont Journal of Environmental Law*, 2006-2007

38 Ralph Pentland, *Public Trust Doctrine – Potential in Canadian Water and Environmental Management*, Polis Project on Ecological Governance, June 2009



Picture Rocks, Lake Superior. Photo by Cee Chen / stock.XCHNG

ing parks and public commons; and the maintenance of key environmental features including clean air and water, healthy fish stocks and wildlife and publicly-owned forests.

More recently, limited public trust language has found its way into Canadian law. The Yukon and Northwest Territories have incorporated trust principles into recent environmental laws, the latter defining the public trust as "the collective interest of the people of the Territories in the quality of the environment and the protection of the environment for future generations." As Pentland notes, these Acts not only establish the public trust concept, they also provide means for the trust to be enforced by citizens who feel that it is threatened. British Columbia passed the *Islands Trust Act*, which, as the Polis Project points out, identifies lands vulnerable in the Gulf Islands to development pressure and provides that land use planning and decision-making must be done in a manner that "preserves and protects" the resource. And the Canadian environmental justice law group Ecojustice has filed an application on behalf of the Aamjiwnaang First Nation of Sarnia that the on-going approval of pollution of their local watershed by the Ontario Ministry of the Environment, and the resulting imbalance in their ratio of boy and girl babies, violates their basic human rights under the *Canadian Charter of Rights and Freedoms*.

One of the two Great Lakes provinces, Ontario, has yet to commit to key public trust law to protect the Great Lakes. Water in Ontario is governed under Common Law and is public. The beds of the Great Lakes belong to the Crown (the government). But the law also allows for "reasonable use." The many private claims to waterfront have meant that public access to the shoreline of the Great Lakes on the Canadian side is not secure. In April 2010, the Member of the Provincial Parliament from Niagara Falls introduced the *Great Lakes Shoreline Rights of Passage Act*, in the hope of gaining support from the Ontario government for this public trust

access, but has had little success to date. Quebec however, adopted a law in 2009 recognizing that "both surface water and groundwater, in their natural states, are resources that are part of the common heritage of the Québec nation." The Act states that every person has a duty to prevent or at least limit the damage done to water resources. The government of Quebec can now sue individuals and companies for damaging water resources.

Limits of existing Public Trust Law

Clearly then, the notion of a limited public trust are becoming more established on both sides of the border. However, there are still gaping holes in the legislative process, such as Ontario's reluctance to provide public access to shorelines on its side of the Lakes. The public trust is deeply undermined by the terms of the "investor-state" provision of NAFTA, which gives corporations from another NAFTA country the right to sue for financial compensation if governments change the rules of business even to protect the environment or the health and safety of their citizens. Canadian bottling, agriculture, mining and other private interests that have set up shop in the U.S. and their American counterparts operating in Canada have legal claims to the water they use for their business and can sue for millions – even billions of dollars – if governments use their authority to try to set limits on their water takings. In October 2010, the Canadian government set a dangerous precedent by "compensating" U.S. pulp and paper giant Abitibi Bowater for $130 million after it claimed it has ownership of the water rights from the Newfoundland operation it deserted. The government of Newfoundland and Labrador argued that the company only had the right to access the water as long as it was creating jobs in the province but that the water belongs to the people. Abitibi Bowater used NAFTA to argue that the water it used for business was its private property, not a public trust, and won.

"The public trust is deeply undermined by the terms of the 'investor-state' provision of NAFTA."

As well, neither the public trust nor the Commons framework are widespread notions, really understood, or lived in practice. Further, there are on-going challenges to existing Commons protections by those who have a very different vision of the purpose and future of the Great Lakes. As Midwest Environmental Advocates note, this "quintessential shared Commons" is under pressure from within and without: "There are no uniform and comprehensive rules for management of water uses within the Great Lakes Basin and there are increasing pressures to export and exploit the Great Lakes by private industries."[39] They point out that while in their opinion, the public trust laws render the Great Lakes a Commons, their management of the Lakes would suggest otherwise.

Furthermore, existing definitions of the Commons in North American do not much address themselves to the issues of social or environmental justice. The lack of access to clean water is increasingly seen as a violation of fundamental human rights. Around the world, lack of access to clean water is now the largest killer of young children, and these deaths are directly related to the inability of their parents to pay for water services. In July 2010, the United Nations General Assembly adopted an historic resolution that recognizes the human right to safe drinking water and sanitation, and several months later, the UN Human Rights Council adopted a similar resolution. Because the Human Rights Council's resolution is an interpretation of two existing treaties, it strengthened the interpretation of the General Assembly resolution, making it binding. Both Canada and the United States worked to derail the resolution of the General Assembly although in the end, they abstained rather than vote against it. However,

39 ibid, Midwest Environmental Advocates

in a surprise and welcome move, the United States, which sits on the Human Rights Council, supported the second right to water resolution.

The human right to water is being violated in a number of communities around the Great Lakes. In Canada, First Nations communities are far more at risk of water contamination than the average population. In 2010, 49 First Nations communities had high-risk drinking water systems and more than 100 face on-going boil water advisories (out of about 600 First Nations reserves in Canada.) Many of these deplorable conditions have been dragging on for years and in some cases, decades.[40] Compared to other Canadians, First Nations' homes are 90 times more likely to be without running water. Several of the more seriously contaminated communities live on or near the Great Lakes and several others draw from source water seriously compromised by chemicals, pathogens, E. coli, giardia and cryptosporidium. The Walpole Island First Nation located at the head of Lake St. Clair on the Ontario side of the international boundary, for instance, has dealt for decades with contamination from the petrochemical industry and to this day lives with strict restrictions on eating local fish and wildlife.

On the U.S. side, high water rates have been responsible for water cut-offs in some poor communities. At least 45,000 residences in Detroit, Michigan have had their water disconnected, according to the Detroit Water and Sewerage Department[41] (although local activists put the number much higher). Water rates have climbed as industrial activity has declined, causing a steep drop in population and municipal revenues. Communities affected are largely African-American, poor, elderly, or single parents. As a result, a number of families have had their children taken from them by social services. Reminiscent of the townships of South Africa, some Highland Park families haul water from public venues or run hoses from neighbours' yards into their kitchens to survive. As water rates climb across the states, provinces and countries, there will be other communities affected in this way unless access to clean water is redefined as a human right and is guaranteed, regardless of ability to pay.

And what of the people living around the Lakes in proximity to the toxic cesspools so bureaucratically named "Areas of Concern?" What are their rights? Will Great Lakes residents be able to challenge mining, energy, chemical, pharmaceutical and other companies for discharging poisons into their drinking water as a violation of their human right to safe drinking water? Will people in a community where a bottled water company has drained their aquifer be able to challenge the company or the government for allowing the theft of community water? Why should the public keep paying for the clean-up of industrial and agribusiness pollution while so many corporations get to make large profits from this supposed Commons resource? How will we ever have a true definition of the Commons if we do not give citizens the right to challenge these and other violations of their rights?

40 David R. Boyd, *No Running Water, First Nations and the Constitutional Right to* Safe *Water in Canada*, November 2010

41 Circle of Blue Waternews, *In Detroit: No Money, No Water*, April 19, 2010

The Time has Come for the Great Lakes Basin Commons

We are hoping that this paper serves as a "call to understanding and action" to create the *Great Lakes Basin Commons*. The time has come for a cohesive analysis of the crisis facing the Great Lakes, a new narrative to guide us on this journey, and a common set of goals to unite us as we move forward to take remedial action. What we are proposing is different in kind, context, reach and framework from what exists now, although some of the foundation has surely been laid. There is a strong need for Basin-wide consistent laws, regulations and definitions to protect and expand the existing Commons groundwork if we are to save the Great Lakes. And for this to work, the public must understand and embrace the Commons concept and demand its supremacy in the governance of the Great Lakes. A new Commons narrative bound by a Commons set of principles and a new governance structure truly subject to citizen accountability could provide a path toward sustainable and equitable stewardship of the Great Lakes.

Commons principles

To help guide this process, a group of legal experts from both Canada and the United States met to set out some draft key concepts and approaches that are needed to form the basis for the kind of Commons regime that is needed to protect the Great Lakes and can serve as a guide to groups and communities wanting to move this agenda forward. "In theory," say the legal experts, "a Commons approach is simple – it requires only that we envision water as a shared resource and so recognize our shared responsibility to carefully steward our water resources. The goal of a Commons approach to water is to ensure that there is sufficient water to meet human and ecological and community needs for many generations to come."[42] The authors underline the need to identify key principles to guide the process and situate them within a good and strong governance structure.

Ten principles for the *Great Lakes Basin Commons:*

1) ***The waters of the Great Lakes belong to everyone and every living being that live on or around them.*** The waters are inherently a public resource, the same as the air we breathe. This principle derives from the physical nature of water, the fact that having access to water to drink is a biological imperative of all life, and because of the fact that water is critical to the water and ecosystems that sustain us.

2) ***Private interests of those with claims to the Great Lakes are subordinate to public rights.*** The concept of water as a Commons stands in stark contrast to the concept being advanced by some that water rights are a form of property equivalent to a permanent and exclusive entitlement that precludes any public use of the appropri-

42 *Water Commons Legal Framework*, A working document that came out of a 2009 Wingspread meeting of legal and policy experts. The principles that follow are a combination of ones proposed from this gathering and my own work.

ated water without public compensation. Individual water rights allocations must not interfere with collective and Earth rights.

3) ***The waters of the Great Lakes are a human right and must be equitably and justly shared.*** Every person living around them has the right to clean drinking water and sanitation consistent with the new human right to water obligations under the United Nations, regardless of ability to pay. Every person has the right not to have the water of their local watershed contaminated by industrial, agribusiness, mining, energy or other activities.

4) ***Governments have an affirmative obligation to manage and protect the water of the Great Lakes as a Commons.*** Not only does the public trust provide a basis for enforcement of the rights of people in the Commons, it demands respect. Governments must protect the water and its uses for all generations in a way that ensures that clean water is available for drinking, fishing, healthy ecosystems, as well as for agriculture, transportation, industry, and power generation. Water management, regulation and pricing must be consistent with principles of the public good and respect for human rights and Earth rights.

5) ***The Great Lakes Basin Commons recognizes the ecological rights of the watershed.*** Water belongs where nature put it. We must recognize the ecological integrity of water itself and the need to leave it as intact as possible in watersheds. As well, water is part of a cycle; one cannot disrupt any part of the cycle of the Great Lakes without disrupting the entire cycle. Groundwater and surface water of the Basin are linked. All water allocations and water management must support a balanced hydrological cycle where water withdrawals and contamination do not exceed the water sources ability to replenish and restore.

6) ***The Great Lakes Basin Commons will require constant and careful management.*** A central characteristic of a true Commons is its careful, collaborative management by those who use it, and allocation of access based on a set of priorities set by the community. As well, those living around the Lakes have a responsibility to prevent harm and must take responsibility to care for the watersheds for future generations. Good stewardship needs good law and will require the extension of public trust law in many areas and in a consistent manner.

7) ***The Great Lakes Basin Commons must encourage and empower decision-making at the local level.*** A water Commons should empower community-based investment, but subject to strong oversight by regional, state/provincial, and national interests in making sure that local groups are not captured by economic interests, or driven to compete for economic development by lowering water resource protections in a race to the bottom.

8) ***The water systems of Great Lakes communities should remain under public management.*** Where water systems have been privatized, they should be brought back under public control. Full cost recovery should not be the goal of water services; water should be seen as a public service like health care or education. Higher service rates can be set for industry and agribusiness.

9) ***Public participation is key to the Great Lakes Basin Commons.*** The availability of good information about the local watershed is crucial to its success and governments

have an obligation to collect baseline information on water quality and quantity (including "virtual water" that leaves the watershed) and disseminate it. A true Commons is based on a co-management model and requires true collaboration between community and government and ability of regulatory agencies to implement public recommendations.

*10) **All decisions about the Great Lakes should be made with the involvement of all recognized nations and people, including local First Nations/American Indian tribes.*** Indigenous peoples have lived around the Great Lakes for centuries and continue to do so today. These aboriginal communities are sovereign governments with strong traditions and cultural ties to the waters of their historic lands and must be recognized as having fundamental rights to these traditional lands and waters. They must be fully involved in the creation of a water Commons.

"A Great Lakes Basin Commons Watershed Plan would establish the Commons principles that no one owns the waters of the Great Lakes."

Commons legal framework

A Commons framework needs good law. As explained in this report, water is inexorably bound up in custom and the law. The law governs the control, use, disposal, protection and ownership of water and that law around the Great Lakes is currently a "colossal morass." Rarely, for instance, does water law conform to hydrological realities; rivers and aquifers transcend state and provincial boundaries but many water laws do not. Change is necessary in our legal regime before a Commons approach to water can be achieved and it must be based on a proactive, positive approach to the context, governance, and boundaries beyond which no

Mackinac Island, Lake Huron. Photo by Jill Smith / stock.XCHNG

private interest or person can go because of the nature of these magnificent waters and the ecosystem that surrounds them.

The Great Lakes Basin Commons needs a uniform and comprehensive set of rules for the good governance and protection of the Lakes. A *Great Lakes Basin Commons Watershed Plan* would establish the Commons principles that no one owns the waters of the Great Lakes; they must be equitably shared; the watershed itself has rights; and all the governments around them have an affirmative responsibly to govern in such a way that they are protected for all time.

Components of a Plan should include:

- A declaration that all the waters of the Great Lakes, including their groundwater and tributaries, are a public trust;
- A declaration that safe drinking water and sanitation is a basic human right of all the people living around the Basin;
- A process for citizens and communities living on the Basin to sue corporations and governments knowingly polluting their local water sources for violation of their human right to clean water;
- A declaration that water and wastewater services are public services to be equitably and affordably provided by governments;
- Integrated watershed planning and management; understanding that the Lakes, their tributaries and groundwater are all connected regardless of political jurisdiction and need watershed-wide governance;
- Collective watershed-wide assessment of the region's water resources and an assessment of the demands on the system, both short and long term;
- Intensive groundwater mapping and regulation to protect the long-term sustainability of current supplies;
- A process for priority allocation of the existing supplies based on a set of Commons values that must include ecosystem protection and the right to clean drinking water for all;
- The principle of local self-sufficiency; that no region will use more of the water resource than it supplies and will try to provide for the water footprint of its population with local water sources;
- Research on virtual water exports out of the Basin and new restrictions on water-intensive commodity production for export;
- Priority support for local sustainable food production to keep local water in the watershed basin;
- A plan for the capture and storage of water now leaving the watershed and long-term restoration of the Great Lakes watershed;
- Tough new restrictions on chemical, toxic and sewage pollution with serious enforcement standards and mechanisms;

- Strict new regulations on industrial food production to curb chemical run-off, including the input streams feeding the Lakes;
- Clear adoption of the precautionary principle in all federal, state and provincial laws pertaining to the Great Lakes;
- A program for wetland protection and restoration;
- A serious financial commitment to water and wastewater infrastructure to prevent the current loss of massive volumes of water due to old or non-existent systems;
- A moratorium on all oil and gas exploration in or near the Lakes and clear restrictions on all mineral exploration and extraction to ensure no damage to the Basin and its waters;
- A ban on all nuclear shipments on the Great Lakes;
- A ban on all bunker oil in ships travelling the Great Lakes;
- A ban on more tar sands pipelines carrying bitumen to the Great Lakes and the refining of it by industry near the Basin;
- Inflow protection for shorelines, not shipping, which will require allowing sufficient seasonal and year-to-year fluctuations in water levels to repair coastal wetlands in Lake Ontario and the upper St. Lawrence River;
- A moratorium on all ocean-going vessel access to the Great Lakes until a fool-proof plan is put in place to stop the influx of invasive species into the Basin;
- Open public access to all Great Lakes' shorelines to the public;
- A full ban on all commercial export of water from the Great Lakes;
- A full ban on bottled water extraction around the Great Lakes;
- Closure of the loopholes in the *Great Lakes Compact* so that water cannot be exported either in commercial bottled water operations or as containers marked "product";
- Removal of all references to water as a "good, investment or service" from all trade and investment agreements.

Commons governance

How might the *Great Lakes Basin Commons* be governed? First is the adoption of the notion and the need to protect the Lakes as a Commons, a Public Trust and a Protected Bioregion. Key to this of course, would be the widespread adoption of the principles outlined above as well as a *Great Lakes Basin Commons Watershed Plan* and legal framework by both the federal governments of Canada and the United States and all of the states and provinces that border the Lakes. Basin-wide regulatory agencies with the authority to enforce the law and who are accountable to local communities would be essential. This would have to be worked out between the two countries, neither of which would likely be willing to cede sovereign authority over their right to enforce their own laws. But as we have seen when big business

lobbies and governments from both sides of the border get together to promote common trade policies and standards for goods crossing the border, it is entirely possible to successfully cooperate on a larger project. Municipal buy-in would also be crucial and necessary for any success of the project.

Citizen participation is a cornerstone benchmark for success or failure. Active, meaningful public involvement is a critical component of a water Commons approach. Users of the resource must monitor public and private use of the water resource and publish the results of their monitoring.

Governments would need to provide local citizens with the tools they need to co-manage their water together with public authorities and empower citizen watershed councils with resources and coordination and provide tools for community capacity building. This means active encouragement, facilitation, funding, expert assistance, public education, information sharing, and outreach by public authorities for the purpose of citizen involvement. Empowering citizens must include providing legal standing for citizen watershed councils in their co-management and watchdog function. Given the broad range of interested parties, all interested sectors of civil society, including water operators, upstream water users, stewards within adjacent watersheds, and First Nations communities, should participate in citizen water councils. However public participation should not be seen as a substitute for strong regulatory agencies, but rather serve as a tool to strengthen them.

There are many current projects and examples that serve as models for the kind of local, state/provincial and federal cooperation that would be needed for the Great Lakes Basin Commons to succeed. The Detroit Peoples' Water Board was set up as a reaction to the water cutoffs and very effectively serves as a parallel citizen's board to the municipal board, advocating for access, protection and conservation of water. The Akwesasne Task Force on the Environment is a community-based, grassroots organization formed to address the water and other environmental issues of the Mohawk Nation. Its mandate is to conserve, protect and restore the natural and cultural resources of the community. The Tip of the Mitt Watershed Council of northern Michigan has organized local citizens for 30 years to monitor their water resources and advocate for their protection. Members use an extensive network to activate their base, educate the local community on water issues, and work with local governments to design comprehensive management plans for lakes and rivers.

The Hamilton Bay Restoration Council is a community non-profit group that works to clean up the Hamilton Ontario harbour and its watershed. It works with government, delivers school programs, and coordinates community planting and restoration events. The council has been credited with a major renewal plan to reclaim this once devastated harbour. The Ladies of the Lake is a dynamic organic grassroots organization made up of more than 100 women intent on bringing the community together to save Lake Simcoe, a sick body of water in the Lake Huron watershed, north of Toronto. Every year, they pose "in the buff" in a natural setting for a calendar that raises funds for their work. The ladies have become a household name in the region. The Blue Communities Project in Canada calls on local governments to adopt a Commons framework by passing municipal resolutions to ban the sale of bottled water in municipally-owned facilities and at municipal events, reject private-public partnerships for water and sanitation services, and recognize water as a human right. The Council of Canadians, Eau Secours and the Québec arm of the Canadian Union of Public Employees launched the project in Québec in November 2010.

Similar projects are active at the state/provincial and federal levels. More than 90 environmental groups on the U.S. side of the Lakes came together on the 50th anniversary of the Seaway to call for a ban on ocean-going tankers from entering the Great Lakes. Communities from all around the Lakes are coming together to stop the pending shipment of Bruce Power radioactive waste. U.S. public advocacy group Food and Water Watch is spearheading a campaign for a Clean Water Trust Fund that would finance badly needed municipal infrastructure repairs, allowing municipalities to keep their water services public. Food and Water Watch worries that cash-strapped municipalities are selling off their utilities to the private sector in the absence of federal funding to protect public services. Governments and non-governmental organizations such as the Stewardship Network of Ontario are working together to reclaim the almost 90 per cent of the Great Lakes wetlands that have been lost in that province. The Ontario government sponsors an introductory training course in wetland restoration for community volunteers who then act as partners with the government in a wetland restoration program that is very popular and has had some real successes.

The Obama administration has launched its Great Lakes Restoration Initiative, which, while not being adequately funded, does build on the Great Lakes Regional Collaboration Strategy, a wide-ranging cooperative effort among the Great Lakes states and the U.S. government to restore and protect the Great Lakes. The major focus areas of the initiative are toxic substances; invasive species; near shore health and nonpoint source pollution; habitat and wildlife protection and restoration; and accountability, educational monitoring, evaluation, communications and partnerships. This project could be greatly enhanced by a Commons framework.

Sandbanks Provi Park, Lake Ontario. Photo by C. Löser / Wikimedia Commons - CC BY-SA 2.0

Conclusion

Clearly there is much goodwill to move to a new level of consciousness to save the Great Lakes of North America. But to be successful, these and other activities must take place as part of a cohesive whole, backed by strong and meaningful laws. It is the long-term goal of the network proposing the *Great Lakes Basin Commons* to eventually see a full treaty between Canada and the United States that declares the Great Lakes to be a lived Commons, Public Trust and Protected Bioregion, one that is also adopted by the states, provinces and First Nations of the Basin. We also believe that a high level summit will be necessary to ensure the full commitment and participation of all those levels of government needed to make this shared vision a reality.

However a treaty is not our starting point. Our starting point is in the cities, towns, villages, hamlets and farms that ring the Great Lakes, and with the people and communities that live on and love them. Our organizational goal is to get communities around the Great Lakes, as well as the myriad of existing community and environmental groups, to become better linked to one another through the connecting narrative of a Commons discourse. We need to create a vocabulary to connect the many millions of people who are not experts on the details of the environmental threats to the Great Lakes, but who care about them and are ready to feel "ownership" of them. We need to strengthen peoples' cultural and visceral connection to the Great Lakes and promote their "right to care." And we need to build on the great work of countless national, state, provincial and community groups that have toiled for decades to protect the Lakes and let them know they are not alone.

We invite you to join us in this great task to forge a participatory, legally-based process that is commensurate with the challenges to the Great Lakes region and the communities that depend on them. In the end, we, the people of the *Great Lakes Basin Commons* are the real hope for their survival.

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Water is an economic good: How to use prices to promote equity, efficiency, and sustainability

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1. Introduction

In 1992 the Dublin Water Principles claimed "water as an economic good" for the first time in a UN setting. But water has been recognized as an economic good for many centuries before 1992. Throughout Europe and the early United States private water supply companies thrived in a wide variety of settings. The "sanitary revolution" of the 19th century saw the demand for public ownership and management of most of these companies in the name of public health. This, of course, did not obviate the need for water to be treated as an economic good, but a heavy emphasis on the public-good nature of water and its disposal led to the development of heavily subsidized public systems. With the exception of France, this was the path followed in most countries around the world. In the late 1980s, however, the World Bank and other multilateral and bilateral institutions discovered the virtues of "privatization" in the provision of public services and with privatization all of the attendant problems of setting tariffs and prices.

There are many different ways to promote equity, efficiency and sustainability in the water sector and water pricing is probably the simplest conceptually, but maybe the most difficult to implement politically. For example, the typical *command and control* approach taken in most countries with respect to water management leads to large government involvement because of its needs for detailed hands-on monitoring and measurement. Using price policies, however, still requires significant government intervention to ensure that equity and public goods issues are adequately covered. This paper focuses on the role of prices in the water sector and how they can be used to promote equity, efficiency, and sustainability.

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1.1. *Effects of price policies*

Economic theory has long ago explained how correct pricing of private and public goods can lead to gains in economic efficiency. From this literature, however, it is assumed that, given the typical price and income elasticities for water and the typical income distributions encountered, raising prices is regressive and therefore reduces equity. We argue in this paper that the conventional wisdom is incorrect—increasing prices can improve equity. Higher water rates allow utilities to extend services to those currently not served and those currently forced to purchase water from vendors at very high prices. More surprisingly we argue that price policy can help maintain the sustainability of the resource itself. When the price of water reflects its true cost, the resource will be put to its most valuable uses. In Table 1 we list the three generally accepted effects of price policy; demand reduction, efficient reallocation of the resource, and increasing the supply, together with three effects which are not generally associated with price policy, namely; improved equity, improved managerial efficiency, and improved sustainability of the resource. Here "water resources" encompasses surface water, groundwater and wastewater. We show that if water resources are managed in an integrated fashion where the economics, legal and environmental aspects complement each other, increased prices do improve equity, efficiency and sustainability of the resource.

Table 1
Three well-known and three lesser known effects of price policy

(a) *Increased price reduces demand*
(i) Substitutes become cheaper
(ii) Conservation becomes affordable
(iii) Change consumption preferences
(b) *Increased prices increase supply*
(i) Marginal projects become affordable
(ii) Provides economic incentives to reduce water losses
(c) *Increased price facilitates re-allocation between sectors*
(i) From irrigation to domestic and industrial
(ii) From off-stream to in-stream uses
(d) *Increased prices improve managerial efficiency due to increased revenues by*
(i) Improving maintenance
(ii) Improving staff training and education
(iii) Making modern monitoring techniques affordable
(iv) Making modern management techniques affordable
(e) *Increased prices leads to sustainability*
(i) Reduces demands on resource base
(ii) Reduces pollution loads due to recycling of industrial water
(f) *Increased prices reduce the per unit cost of water to poor people*
(i) Increases coverage of poor urban and peri-urban populations because additional water is available for extending the system
(ii) Reduces reliance by the poor on water vendors

1.2. Full cost pricing of water

The problem faced by the water sector is that prices and tariffs are almost universally below the full-cost of supply. This means that almost everywhere there are large inefficiencies in the water sector and that water prices need to be raised. The recent World Water Commission strongly endorsed the need for full-cost pricing of water services:

> Commission members agreed that the single most immediate and important measure that we can recommend is the systematic adoption of full-cost pricing of water services (World Water Commission, 2000, p. 33).

Unfortunately, there is some ambiguity on the exact definition of full-cost pricing. Here we use the definitions given by Rogers, Bhatia, and Huber (1998) for full-cost pricing of water services. That paper shows the relationships between full-supply cost, full-economic cost, and full-cost. They also provided definitions of the value-in-use of water services showing the relationship between economic value and full-value. In addition to cost and value, the third parameter needed for implementation of water price policy is the tariff, or price, to be charged for the water service. Unfortunately, the literature on water pricing often confuses costs, value, and price. For a clear policy analysis it is important to keep these three concepts distinct. Table 2 and Fig. 1 show these

Table 2
Three important concepts from water economics

COST	O&M costs, capital costs, opportunity costs, costs of economics and environmental externalities
VALUE	Benefits to users, benefits from returned flows, indirect benefits, and intrinsic values
PRICE	Amount set by the political and social system to ensure cost recovery, equity and sustainability. The price may or may not include subsidies. Prices for water are not determined solely by cost

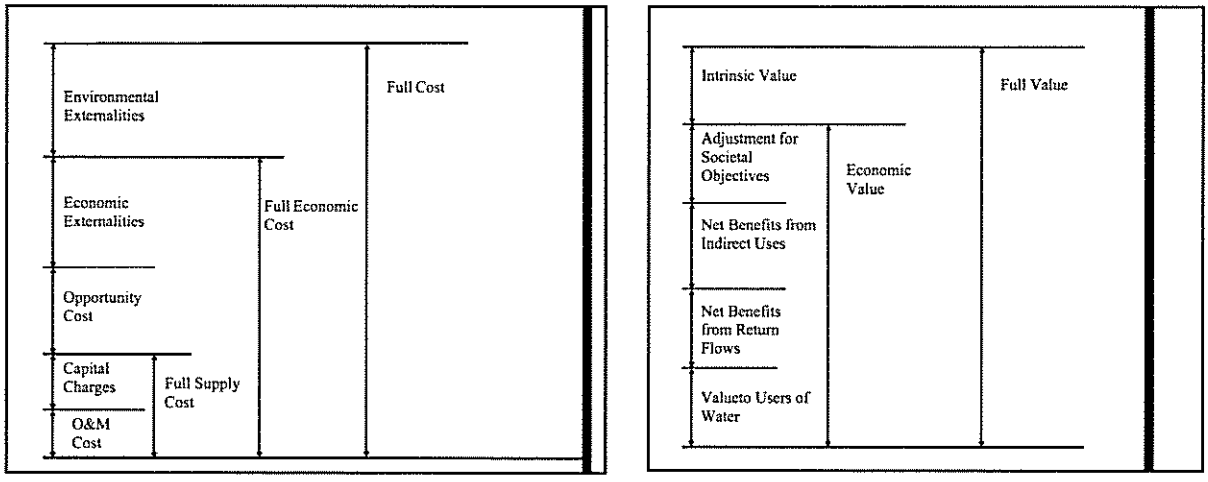

Fig. 1. General principles for cost and value of water.

concepts and how they relate to each other. Rogers et al. (1998) give detailed definitions of each of these components.

1.3. Pricing policies in OECD countries

Jones (1998) and OECD (1987, 1999a–d) summarize the recent developments in water pricing in the OECD countries. The Polluter Pays Principle (PPP) and the User Pays Principle (UPP) are now widely accepted in the OECD countries. The UPP was recommended as a measure to "at least cover the opportunity costs of capital, operation, maintenance, and environmental impacts." OECD (1989). This mirrors the recommendations of Rogers et al. (1998) and the Commission on Water for the 21st Century's Report (2000).

There has been increasing participation by the private sector with the government moving away from the role of "provider" to "regulator" of water services. Most countries have, however, chosen the "concession" rather than the "full privatization" model for development. The precise form of private sector participation still varies considerably. "Full" privatization (asset ownership and management) are found in England and Wales, and the Czech Republic; investor-owned in the US; and concessions (delegation of authority to fully private concerns) in France, Spain, Portugal, Hungary, Poland. Traditional direct/delegated public management is still found in Belgium, Denmark, Canada, Greece, Korea, and Sweden, and some areas in Austria and Italy (OECD, 1999c).

1.4. Pricing policies in Asian development bank member countries

The Asian Development Bank (1993, 1997) has carried out two surveys of water utilities in 38 large Asian cities at two intervals five years apart. Over the period water production rose 14%, per capita consumption dropped from 182 to 159 liters per capita per day (l/c/d), the average tariff rose 88%, unaccounted-for-water remained unchanged at 35% of production and the coverage of the population rose from 75% to 79%.

There were large variations in the per capita water consumption in different cities. Dhaka, Bangladesh, had the lowest of 43 l/c/d, and Apia, Western Samoa, the highest with 475 l/c/d. As a point of comparison Singapore had 168 l/c/d and Brussels 108 l/c/d. One assumes that Asian countries cannot afford the luxury of more than 200 l/c/d of water for domestic consumption, yet Taipei has 282 l/c/d, Delhi 257 l/c/d, Bangkok 217 l/c/d (Asian Development Bank, 1997). These large per capita consumption values may demonstrate the lack of metering and low tariffs in these cities.

Of the 50 utilities surveyed in 1997, only half had 100% metering of production and consumption; about a dozen have very little or no metering. Overall, 82% of the house connections, 97% of industrial connections, 80% of commercial connections, and 88% of institutional connections were metered. While these figures seem impressive, it is important to note that utilities do not provide 100% coverage. Fifteen utilities provided 100% coverage, but utilities like Cebu, Philippines, provided as little as 23%.

In the domestic sector, 32 of the 50 utilities used meters to determine payment; 7 utilities used flat rates, and 10 used a combination of the two forms. In the industrial sector, 35 utilities used a metered method, 2 used flat rates, and 12 used a combination. While total water production

increased between 1993 and 1997, the groundwater component in production volume decreased from 12% to 10.8%. Yet this was a net increase in volume.

The ownership and management of utilities take many different forms in these countries as well. Sixteen of the 38 utilities surveyed in 1993 were government departments, 18 were government enterprises, and 4 were more autonomous enterprises. Seoul, Bangkok, Singapore and Taipei had no grant financing of capital investments; at the other end of the spectrum Hong Kong, Manila and Shanghai required significant grant financing (Asian Development Bank, 1993). Private sector participation (PSP) has been on the rise in Asian utilities. PSP take many different forms and degrees in different cities and utilities. Among these: contracts for services; management contracts; leasing contracts; operating concessions; build, operate, and transfer; and full privatization. Twenty-seven of the 50 utilities had no PSP; 11 had some production contracts; 8 had distribution and leak repair contracts; 14 had bill collection and meter reading contracts; and 4 had management contracts.

2. Water prices

In the past most cities and utilities in the world have provided water to their customers almost free of charge because water is considered a basic necessity, and because water was a relatively cheap and abundant resource. But now with much larger communities requiring service, the only way to ensure that everyone has access to this basic need is to ration it in some way. And perhaps the best way to utilize water to the best and most-valued uses is to put a price on water, and construct appropriate tariff structures to meet different social, political and economic goals in different situations.

2.1. Objectives to be fulfilled when setting water tariffs

A tariff can take many different forms. Each form or design will address a specific objective. The "best" tariff design for a particular community and situation is one which strikes the most desirable balance among the objectives that are important to that community (Boland, 1997).

Consumers and suppliers of water have different expectations of water tariffs. Consumers like high quality water at an affordable and stable price. Suppliers like to cover all costs and have a stable revenue base. The level and structure of fees for water and wastewater services have consequences far beyond these expectations. Water-related fees can be expected to generate revenue, improve efficiency of the supply and supplier, manage demand, facilitate economic development and improve public welfare and equity (Potter, 1994). The following is a list of objectives that different tariffs can fulfill. No one tariff design can meet all objectives. But the key is for the utility or community to identify the objectives most relevant to its situation. The reader is referred to Boland (1997), OECD (1987, 1999a, c), Potter (1994), Howe (1997), and Wong (1999) for a more complete discussion of these objectives.

- The tariff must maximize efficient allocation of the resource.
- Water users should perceive the tariff as fair.
- Rates must be equitable across customer classes.

- They must bring sufficient revenue.
- Provide net revenue stability.
- The public must understand the rate-setting process.
- Promote resource conservation.
- Tariff-setting process should avoid rate shocks.
- Be easily implemented.
- Water must be affordable.
- Rates must be forward looking.
- The rate structure must attempt to reduce administrative costs.
- Include environmental costs.
- Not conflict with other government policies.
- Water prices must also reflect supply characteristics like water quality, supply reliability, frequency of supply.
- Tariff structure must vary depending on consumption measurability.
- More sophisticated rate structures may also account for daily peaks and seasonal variations in water demand.

2.2. Tariff elements

In order to achieve the goals listed above for tariffs, most OECD countries use some combination of the following elements in their tariff structures (OECD, 1999c). The exact combination of these elements depends on the specific situation and characteristics of the city, utility and behavior of customers.

- Connection charge.
- Fixed charge.
- Volumetric charge.
- Block charge.
- Minimum charge.

The two-part tariff system and increasing block tariff structure are two such popular combinations.

2.3. Two-part tariff system

Several OECD countries, for example Australia, Austria, Denmark, Finland and the United Kingdom, with successful water pricing schemes use a two-part tariff structure. This has fixed and variable elements. In these countries the fixed element varies according to some characteristic of the user, and the variable element often uses average cost pricing (OECD, 1999a). This method can be improved upon by using an increasing block tariff system (IBT) for the variable part. One of the main advantages of the two-part tariff system is the stabilized revenue base it affords the supplier. The fixed element protects the supplier from demand fluctuations and reduces financial risks. The variable element charges the consumer according to his consumption level and therefore encourages conservation.

2.4. Increasing block tariff structure

This is a more refined form of the two-part tariff system. IBT provides different prices for two or more pre-specified blocks of water. The price rises with each successive block. The utility must decide on the number of blocks, volume of water use associated with each block, and price to be charged for each block when designing an IBT structure (Boland & Whittington, 1998). While the first of these is more a management decision the second and third are political and social decisions.

IBT is a progressive tariff. This allows the utility to provide lifeline to the poor at below-cost rate, and charge higher prices for use beyond this minimum volume. This subsidy allows the poor access to water and sanitation and promotes public health. Thus IBTs are acclaimed for improving equity. Under this system poorer households get access to low-rate water since they possess fewer water consuming appliances (Whittington, 1997), and allow for rich-to-poor subsidies and industrial-to-household subsidies as well (Boland & Whittington, 1998).

3. The need for full-cost pricing

Basic economics require that the price of a service be at least as high as the cost of providing that service. Rogers et al. (1998) argued that sustainable and efficient use of water require the tariff to match not only costs of supply (i.e. O&M and capital costs), but also opportunity costs, economic externality costs, and environmental externality costs. Very often the tariffs do not even meet the full supply costs, and sometimes the value of water is lower than the cost of supply! The evidence presented below is from the Subernarekha Basin in India.

Fig. 2 compares costs and values associated with agricultural water use in the Subernarekha River Basin. The total economic value, calculated as the sum of net value of crop output, value of return flow, value of water in non-irrigated uses, and value of other societal objectives, is 9.7 cents/m^3. The total economic cost, calculated as the sum of O&M costs, capital costs, pumping costs and opportunity cost, is 65 cents/m^3. Shortage of information and data prevented Rogers et al. (1998) from estimating the intrinsic value of water and the environmental costs of providing irrigation water. Nevertheless, the disparity between value-in-use and cost is very large. Even if the intrinsic value were large it probably would not be large enough to meet this 55.3 cents/m^3 gap plus environmental costs.

Fig. 3 compares costs and values associated with urban and industrial water use in the Subernarekha River Basin. Assuming that both sectors use the same source, we use the same cost structure for both. Rogers et al. (1998) calculated the full cost of water to be 46.7 cents/m^3. The value in industrial use was \$2.60/m^3; the value in urban use was 25 cents/m^3.

Why is there such a gap in the value of water in the two sectors? Fig. 4 shows that the industrial tariff is more than double the urban tariff. So the urbanites over-consume and value the resource less. In this case there is an industrial-to-domestic-to-agriculture subsidy and each of the tariffs is much smaller than cost of supply.

In the above figures, "cost" includes supply costs and opportunity costs, but not environmental and economic externalities costs. Yet the tariff falls well below this cost. In the agricultural sector,

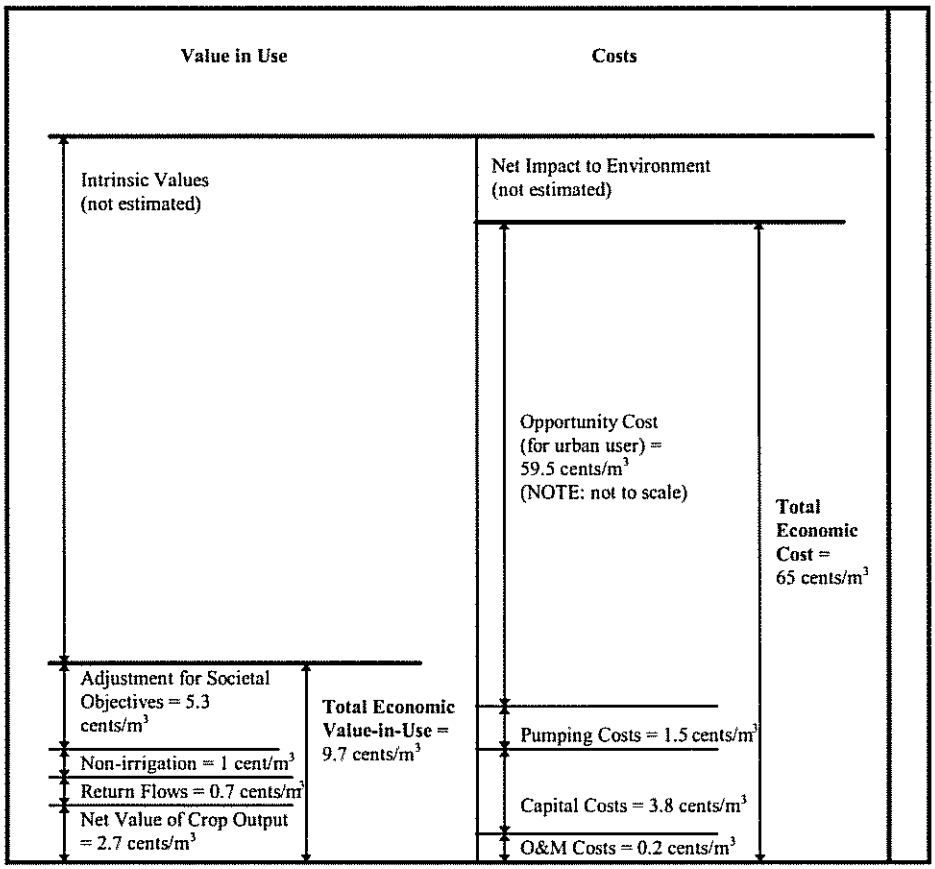

Fig. 2. Estimation of value-in-use for irrigated agriculture and costs of water in Subernarekha River Basin, India. Source: Rogers et al. (1998).

costs exceed value of the crop as well. Such low-priced water will only encourage wasteful use. Water suppliers must progressively increase tariffs to cover full cost of water.

Opportunity cost is the largest cost component in the irrigation costs given above. When the agricultural tariff increases and more water becomes available to the other two sectors, the opportunity cost of agricultural water will decrease. And because of reduced availability in this sector, the value of water in irrigation will increase. The story will be different in the other two sectors. As more water becomes available, the reduced capital and pumping costs will decrease the cost of industrial and urban water. And because of the more abundant resource, its value will also decrease. So values and costs can be expected to converge across sectors.

Although the above examples were taken from developing countries, water price differentials in different sectors are not unique to those countries. Such examples are rampant in industrialized countries as well. The Northern Colorado Water Conservancy District in the US, for instance, charges irrigators about \$3.50/acre-ft (about 0.3 cents/m^3), and about \$7/acre-ft (about 0.6 cents/m^3) for cities and industries. The capital costs not covered by direct water-related revenues are paid for from real-estate taxes levied against all urban and rural real estates in

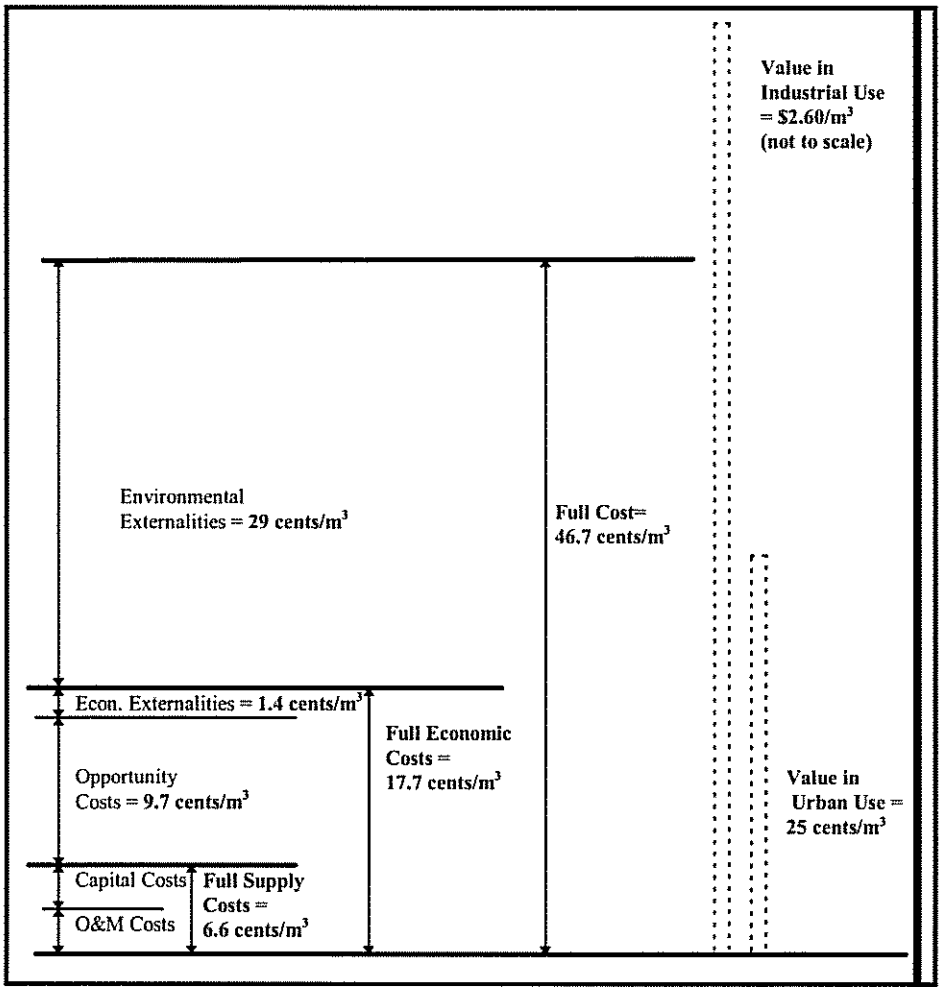

Fig. 3. Estimation of costs and values for the urban and industrial sectors in Subernarekha River Basin, India. Source: Rogers et al. (1998).

the District (Howe, 1997). In effect, industries and households subsidize water for the agricultural sector.

The large variations in values, costs and prices will allow for trading between sectors. Currently agriculture is the largest water user in most countries. On average, 69% of world's water is used in agriculture, and 23% in industry. In OECD countries, however, 65% is used in industry, while only 30% is used in agriculture (OECD, 1999b). Trading does not require that all agricultural water be transferred to the urban and industrial sectors. A small transfer of agricultural water can meet all the demands in urban and industrial sectors. On the other hand, since the required transfer is small, the required price increment is also small. At least on the first pass, a small increment in irrigation water prices (where the tariff can still be less than urban or industrial tariff) can help meet the highly valued needs in the other two sectors.

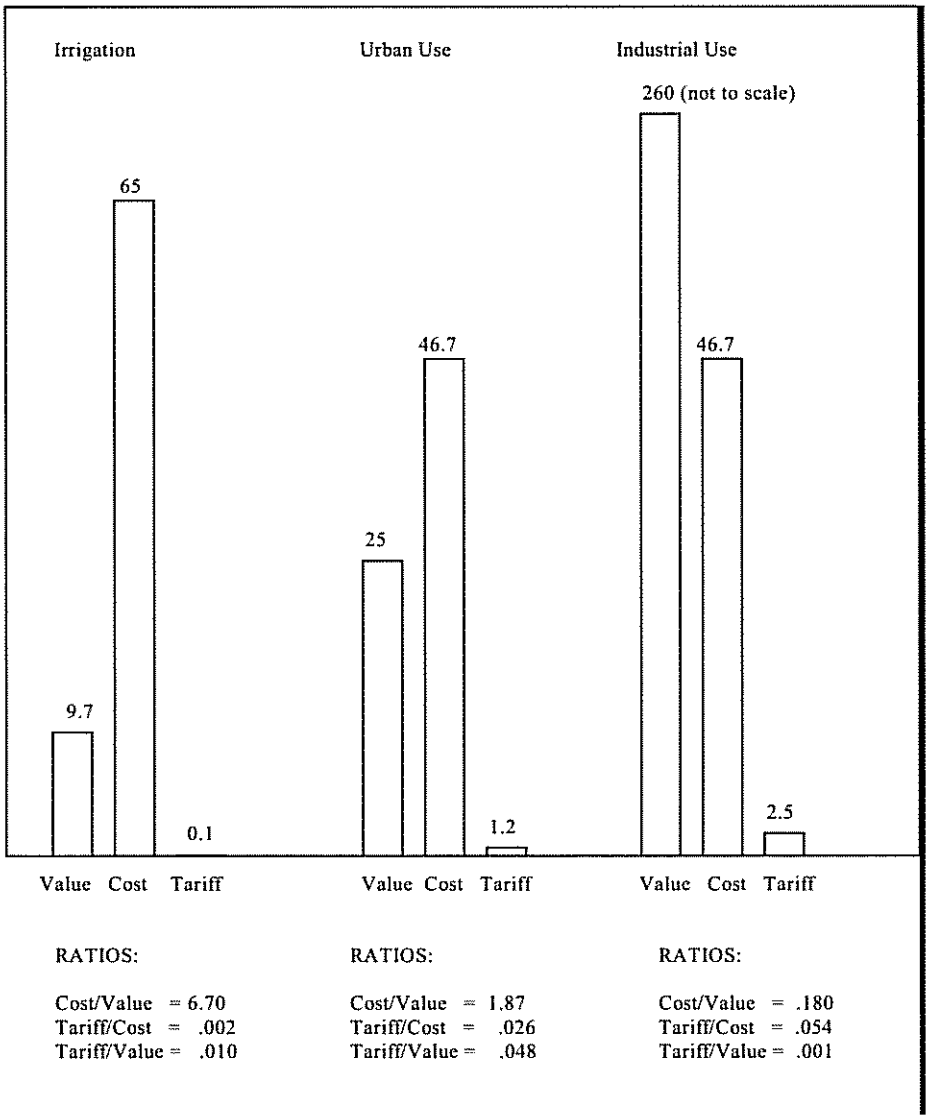

Fig. 4. Comparison of value-in-use, costs and tariffs for three sectors in Subernarekha River Basin, India (figures in cents/m^3). Tariffs are as follows: Agriculture 0.1 cents/m^3, urban households 1.2 cents/m^3, and industry 2.5 cents/m^3. Source: Rogers et al. (1998).

3.1. Backstop technology for water

While the previous subsection requires that water rates be increased, utilities' capacity to increase water rates is limited by the availability of alternate freshwater sources. The ultimate alternate source—the backstop source—of freshwater is seawater or brackish water.

A recent bid to design, build, own and operate a 25 million gallons-a-day sea water desalting plant made by Stone and Webster to the Tampa Bay Water's Board of Directors has

revolutionized the pricing capabilities of water utilities. Stone and Webster plans to use reverse osmosis for desalting sea water, and plans to provide water at a cost between $1.71 and $1.86/1000 gal ($0.45 and $0.49/m^3) in the first year of operation (Leitner, 1999). With desalting technologies being able to produce such low-cost water, water providers to urban and industrial areas will be hard-pressed to match and improve on this price.

Leitner (1999) notes that this particular cost is quite unique to Florida and its environs. Low sea water salinity at the proposed locations; low power costs in the US; no-cost cooling water; use of large-scale reverse osmosis trains; economies of scale; amortization over the 30-year contract period, and tax-exemptions all contribute to this low cost.

The net present value of Stone and Webster's plant is $222.60 million of which 48.6% is attributed to fixed costs, 29% to power costs, 4.7% to chemical costs, and 17.7% to other costs. So even if these proposed costs were modified to represent conditions at other locations, they would still prove to be substantially lower than previously known desalting costs. If this project were to be successful, industries and large cities in coastal areas may be increasingly motivated to switch to desalted water for future supply increments.

3.2. Subsidies

Many support measures and subsidies are used to promote growth, employment and increase incomes in particular sectors. There is also a growing awareness in OECD countries that subsidizing water use is not necessarily the best way to achieve sectoral economic or social objectives. In fact, some economic and social goals are harmed over the long-run by using a subsidy-based approach. This is especially true when these support measures are used to prop-up ailing industries that invariably contribute to significant environmental damage (Potier, 1996). General reduction in water prices shields all consumers from important economic and environmental signals. Any support measure that lowers the user costs of resource consumption, rather than encourages reduced or more efficient use of the resource, will contribute to potentially higher volumes of inputs, throughputs and pollution (OECD, 1998). Subsidy removal therefore is a step towards full-cost pricing of environmentally harmful activities. Subsidy removal is not a substitute for, but a complement to, policies which internalize social and environmental costs of these harmful activities (OECD, 1998).

Cross subsidies from industrial users to farmers and households have long been characteristic of OECD water pricing policies. These cross-subsidies are increasingly being recognized and are gradually being reduced (OECD, 1999b). But many cities in Asian and Pacific Region still allow for industrial water consumers to subsidize domestic consumers. The ADB uses the ratio between industrial tariff and domestic tariff as a measure of the subsidy. ADB (1993) showed that 85% of these subsidies are in the range of 1.4–3.9. Subsidies in larger cities ranged from 1.8 to 2.2, while in smaller cities they ranged from 2 to 3. A few cities—Cebu, ChiangMai, Kathmandu, Mandalay, Nukualofa, Port Vila, Shanghai and Taipei—had no subsidies while others—Delhi (10.9). Colombo (12.1), Bombay (28), and Medan (30)—had very large cross subsidies.

The reform of current subsidy and tax disincentives seems to offer room for a clear win-win situation. But the actual effects of any reductions will depend on the context in which the subsidies are granted in the first place and on the specific way in which they are reduced (Potier, 1996).

4. Need for integrated water resource pricing

The above sections motivated the need for full-cost pricing and listed some of the main requirements of a pricing structure. We further explained how increased water rates could actually help foster efficient use and improve equitable distribution of water. But proper water rates imposed by the public water supplier alone are insufficient to manage the resource. If the suppliers charged the full-cost of water and there were no regulations to protect groundwater sources, consumers will gradually exploit the groundwater sources. If there were no proper wastewater charge structure, consumers will pump groundwater and discharge the waste into the public wastewater system with no penalty.

> "The holistic management of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programs within the framework of national economic and social policy, is of paramount importance for actions in the 1990s and beyond" (UNCED, 1992, Agenda 21; Briscoe & Garn, 1995).

The holistic management of freshwater requires water-related authorities to work together and formulate complementary pricing schemes that will allow overall efficient use of the resource. In addition, policy-makers must formulate a regulatory backbone that will encourage consumers to adhere to the pricing schemes. This section motivates the need for integrated pricing structures especially in groundwater extraction and wastewater disposal.

Industries' decision to buy from public water suppliers, directly abstract, or treat and reuse depends on many factors. Among these are water quality required by that industry, whether the public supplier charges full-cost from industrial users, and whether direct abstraction licenses whose charges reflect the full economic cost of water are available (OECD, 1999a). If one or more water source components is weakly regulated, industries will exploit that weakness to minimize their production costs. Due to the common-property nature of groundwater and wastewater disposal services firms are likely to ignore social costs unless they are reflected in effluent taxes or extraction taxes. Examples of industrial exploitation of such weak points are rampant. A few examples are given in Sections 4.1 and 4.2.

Integrated water resource pricing requires that the region or utility or the group of water-related service providers integrate water prices, sewerage prices, additional charges for extra-strength effluents, direct industrial abstraction charges, and for direct discharge to watercourses (OECD, 1999a). Unfortunately, in both developing and industrial countries there is a huge gap between the concept of integrated water resources planning and how water resources planning and policy making are actually done. In practice, most water resources planning is done incrementally and is driven by the need to find solutions to relatively immediate and specific problems, and not grand issues of river basin or regional development (Whittington, Donald Lauria, & Xinming Mu, 1989). The World Water Council and the Global Water Partnership's recent attempts to formulate a Water Vision are aimed at bridging that gap. It is inevitable that developing countries gear many of their plans to meet pressing and urgent needs. However, having a longer-term vision that incorporates expanding water supply, managing groundwater, disposing wastewater and charging appropriate fees for different services will help put even those urgencies into perspective.

4.1. Groundwater extraction charges

Groundwater abstraction charges are common in most OECD countries. Belgium, Canada, Czech Republic, France, Germany, Hungary, Italy, Japan, Mexico, Netherlands, Poland, Spain, Australia, and UK (OECD, 1999a) are examples of these. In most countries the abstraction charge depends on the type of use—whether it is consumptive or non-consumptive, and by type of industry. In addition, Belgium, Czech Republic, Finland, France, Hungary, and the Netherlands include an environmental premium in the abstraction charge (Jones 1998). Although the extent of groundwater use in these OECD countries is significant compared to the use of publicly supplied water, direct abstraction charging schemes and structures are still quite new. Nevertheless, the introduction of direct abstraction charges has introduced better management capabilities to authorities and instilled better water use patterns among industries.

The less well-coordinated groundwater extraction policies in Metro-Manila, in the Philippines, on the other hand, are allowing for 6–12 m per year decline in groundwater levels, and salt-water intrusion into freshwater aquifers (Ebarvia, 1997). Since the government does not levy a charge on groundwater extraction, the only expenses to the consumer are the installation and operation of a well and pump.

A similar situation is found in Bangkok. Here the water supplied through the public supply system is already very cheap (about 5 baht/m^3 or 13.5 cents/m^3). But for large-scale industries, groundwater (including its pumping and transportation) costs even less (about 2 baht/m^3 or 5.4 cents/m^3). In addition, the groundwater supply is more reliable and is of better quality, therefore, industrial units steadily turn to groundwater sources. The estimated quantity of groundwater pumped in the Bangkok Metropolitan Area (BMA) is over 1.2 million cubic meters per day (MCM/day). The sustainable pumping rate is about 0.6–0.8 MCM/day. The high stress on aquifers is thus causing depletion of aquifers and ground subsidence (Potter, 1994). A Japan International Cooperation Agency (JICA) study showed that, on average, 22% of industrial water consumption can be reduced by conservation measures at costs ranging from 1.30 to 10.10 baht/m^3 depending on the industrial sector (Potter, 1994). These conservation costs are less than the BMA-purchased water, but are greater than groundwater costs. So industry has little incentive to conserve. The water supply situation is worsened because the low groundwater costs pull-down the public supply rates. If suppliers were to raise prices to full-cost, all consumers will eventually turn to low-cost, more-reliable groundwater. The only remedy is to set appropriate groundwater charges as well.

4.2. Wastewater and sewerage charges

Charging households and industries directly for their wastewater discharges is not common even today. Usually, the wastewater fee is a fixed percent of the water bill or is a fixed charge per house or is included in the property tax (OECD, 1999c). Charging wastewater dischargers according to the strength and quantity of wastewater will motivate them to conserve water, reuse or recycle water, and switch to cleaner production processes.

Utilities in the Czech Republic, Denmark, Finland, Germany, Hungary, Japan, Korea, Poland, Sweden, England and Wales are among those who levy a composite charge for water supply and wastewater collection services to households. Unfortunately, the bill rarely distinguishes the two

cost components. Although the high combined water and sewerage rates in cities like Boston have prompted residents to reduce water consumption, separating the two charges will further motivate consumers to reduce water use and wastewater discharges. Utilities in developing countries are far behind OECD ones with regards to sewerage billing. Of the 38 utilities surveyed by the ADB in 1993, only 11 even included sewerage surcharges in their water bills to households. By 1997, 25 of the 50 utilities included sewerage charges in the water bill. All other utilities, if they provided sewerage service, provided it free (Asian Development Bank, 1993, 1997).

Sewerage and strength-dependent effluent charges have been more widely used with the industrial sectors in OECD countries. The volume and characteristics of industrial sewage vary considerably from one company to another. Thus, industrial water consumption levels do not represent a good proxy for industrial sewerage and sewage disposal costs. The number of countries in which the costs of industrial sewage services are included in the price of water supply has therefore been decreasing steadily. Utilities in Australia, Belgium, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, Turkey, UK, and USA are a few that use an effluent charge based on pollution content in water (OECD, 1999b).

While residential users have little freedom of choice for wastewater disposal and for altering the composition of their effluents, commercial and industrial water users have a wide range of technology, input and project choices that affect their water-borne waste loads (Howe, 1997). In countries where sewage service costs have risen significantly, industrial users often find that the public sewer system is no longer the most cost-effective means of sewage disposal. Instead, in-house treatment, recycling and reuse emerge as more economical options, and industries choose to switch to more self-treatment and effluent reuse (OECD, 1999b). Such changes in industrial wastewater discharges invariably affect production processes and reduce water use patterns as well. Therefore appropriate wastewater charges can postpone water utility expansion needs by several years.

Due to increased water rates and more stringent regulation, several industries, including chemical, pulp and paper, textiles, and metallurgy industries, have changed production processes and have made significant progress in reducing their water demands in recent years. Industrial abstractions from public supply in West Germany decreased by one-third since the 1970. There was a sharp decrease in industrial water use in Sweden between 1970 and 1980, and a slow decrease from then on. Industrial water use in the Czech Republic fell by 40% between 1985 and 1993—to cite a few examples (OECD, 1999d). Industry innovates when it has sufficient incentive. Production cost reduction is often its best incentive.

5. More equitable distribution of water with increased water rates

5.1. The "poor" are willing to pay more

One of the main arguments for maintaining low tariffs is to allow the "poor" access to water. This argument has little credibility.

- In the agricultural sector, farmers often spend large amounts of money for pumping groundwater to improve reliability and timeliness of water supply. In Haryana, India, where

irrigation charges for surface water supplies are less than $10 per hectare per year, farmers are known to spend about $90 per hectare per year for groundwater irrigation. This is approximately 20% of the net value of output from crops. As such, the farmers have a high willingness to pay for timely, reliable water (Rogers et al., 1998). Farmers will benefit if suppliers improve reliability through improved management that will be possible with higher water charges.

- Low-priced water encourages excessive consumption by those connected to the supply system. This limits utility's coverage. The poor are left to purchase higher priced water from vendors. In OECD countries households spend about 1% of their income on water (OECD, 1999b). In Onitsha, Nigeria, the poor spend as much as 18% of their income on water (Whittington et al., 1989). Water costs in other developing countries' households span the entire spectrum between these two values. Because of the high water price the poor can afford only small quantities of water enough for bare necessities; and often not enough to meet hygienic needs. If utilities were to supply water at higher prices it would encourage conservation, improve water service coverage to reach the poor, and there will be far more equitable water distribution than there is now. If water must be provided to the poor at low-rates, utilities can use tariff structures such as lifeline rates, IBTs, or provide lump sum credits to low-income customers as in the Los Angeles' Metropolitan Water District (Boland, 1997). These strategies allow the utility to improve both equity and fairness towards its community.

6. Sustainable use of water with increased water rates

The UN's Agenda 21 sees sustainable development as a way to reverse both poverty and environmental degradation. A major theme is to eradicate poverty by giving poor people more access to the resources they need to live sustainably. Agenda 21's definition of sustainability includes; economic development, social development, and environmental protection. As discussed above, water pricing can improve economic efficiency and improve social equity, and by using less of the resource more efficiently lead to environmental enhancement. Hence, water pricing helps address all three of Agenda 21's concerns about sustainability of the resource.

In addition to the examples given above, a comparison of water rates in two cities reflects on the sustainability of water resources. The regional municipality of Waterloo in Canada, for instance, uses summer rates that reflect higher water demand in that season (Pearce & Markandya, 1989). This helps to conserve the water available in the summer. In Metro Manila, on the other hand, the user faces the same low cost for the resource regardless of the time of day or season of year (Pearce & Markandya, 1989; Ebarvia, 1997). This leads to deterioration of the resource.

7. Conclusions

Based upon the cases reviewed in this paper we can draw the following conclusions:

- There is ample evidence to support the contention that water is already viewed as an economic good in many, if not most, countries in the world.

- There is ample evidence for the success of pricing policy in water management from many countries in many different sectors of water use.
- This evidence indicates that unless there is integrated pricing of the resource supplied from all sources, the use of pricing will not necessarily lead to the desired outcomes.
- There are clear examples that water pricing can and has improved the distributional equity for the poor in many settings.
- There are clear cases where appropriate pricing has led to improved sustainability of the water resource.

Two policy issues also arise from the discussion of price policy; how to implement the price policy, and how high to raise the prices? The answers to these questions depend upon the nature of the property rights assigned to water in different countries. With completely privatized ownership rights to water one could expect that under a laissez-faire approach, something akin to the full-economic cost would be charged for water. If the environmental externalities were to be protected, then the government would have to intervene with some sort of command and control or tax policies. If in addition there were many poor people demanding water the government may wish to intervene with subsidies to the weakest users. If government controls the water rights it may wish to push for full-cost recovery including environmental externalities. Under no circumstances should the price of water be allowed to sink below the full-supply cost. There is a wide range of policy options available to implement price policy in the water sector. These range from direct pricing to green taxes, to effluent fees, to direct subsidies to utilities or the users. We do not say that subsidies should not be used at all. But the choice of policy depends crucially upon the local political and social conditions. Finally, we have not advocated that full-cost be unequivocally the only criterion for setting water prices. We argue that knowledge of the full-cost is the most important ingredient in water policy formulation.

References

Asian Development Bank. (1993). Water utilities data book: Asian and Pacific region.

Asian Development Bank. (1997). Second water utilities data book: Asian and Pacific region.

Boland, J. J. (1997). *Pricing urban water: Principles and compromises*. Paper presented at the World Bank seminar on Pricing of Sanitation and Water Services, February 18–19, 1997.

Boland, J. J., & Whittington, D. (1998). *The political economy of increasing block tariffs in developing countries*. Paper Presented at the World Bank Sponsored Workshop on Political Economy of Water Pricing Implementation, Washington, DC, November 3–5, 1998.

Briscoe, J., & Garn, H. A. (1995). Financing water supply and sanitation under Agenda 21. *Natural Resources Forum, 19*(1), 59–70.

Ebarvia, M. C. M. (1997). *Pricing for groundwater use of industries in metro Manila, Philippines*, EEPSEA Research Report Series, November 1997.

Howe, C. W. (1997). *Water pricing: An overview*. Paper Presented at the World Bank Seminar on Pricing of Sanitation and Water Services, February 18–19, 1997.

Jones, T. (1998). *Recent developments in the pricing of water services in OECD countries*. Paper Presented at the World Bank Sponsored Workshop on Political Economy of Water Pricing Implementation, Washington, DC, November 3–5, 1998.

Leitner, G. F. (1999). Developer selected for 25 MGD Florida West Cost seawater desalting plant. *The International Desalination Water Reuse Quarterly, 9/1*, 1999.
OECD. (1987). Pricing of water services.
OECD. (1989). Water resources management: Integrated policies. OECD, Paris.
OECD. (1998). Improving the environment through reducing subsidies. Part I. Summary and policy conclusions, Paris.
OECD. (1999a). Industrial water pricing.
OECD. (1999b). Pricing of water services: An update.
OECD. (1999c). Household water pricing in OECD countries.
OECD. (1999d). Agricultural water pricing.
Pearce, D., & Markandya, A. (1989). Marginal opportunity cost as a planning concept in natural resource management. In G. Schramm, & J. Warford (Eds.), *Environmental Management and Economic Development* (pp. 39–55). Baltimore, MD: Johns Hopkins University Press.
Potier, M. (1996). Can the removal of economic subsidies be beneficial to the environment? 1–1996 *Feem News Letter*. Extract from the speech on the Contributions of Economic Instruments in Environmental Policy of OECD Countries, Manila, 6–8 February, 1996.
Potter, J. (1994). *Dilemmas in water and wastewater pricing: Case study of Bangkok, Thailand.* Masters thesis submitted to the Department of Urban Studies and Planning, MIT.
Rogers, P., Bhatia, R., & Huber, A. (1998). *Water as a social and economic good: How to put the principle into practice.* Global Water Partnership/Swedish International Development Cooperation Agency, Stockholm, Sweden.
UNCED. (1992). A guide to Agenda 21: A global partnership. Geneva: UNCED.
Whittington, D. (1997). *Possible adverse effects of IBT in developing countries.* Paper Presented at the World Bank Seminar on Pricing of Sanitation and Water Services, February 18–19, 1997.
Whittington, D., Donald Lauria, & Xinming Mu (1989). *Paying for Urban Services*, World Bank Case Study, Report INU 40, Washington, DC, World Bank.
Wong, A. K. (1999). Promoting conservation with Irvine Ranch Water District's ascending block rate structure. In *Sustainable Uses of Water: California Success Stories*, Pacific Institute for Studies in Development, Environment, and Security, Preservation Park, Oakland, CA.
World Water Commission. (2000). A water secure world. UK: Thanet Press.

From: Jen Vanator
To: mi-waterstrategy
Subject: GLIFWC Comments on Michigan draft Water Strategy
Date: Friday, August 28, 2015 4:42:27 PM
Attachments: GLIFWC Comments on Michigan draft Water Strategy.pdf

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Please find attached GLIFWC's comments on Michigan's draft Water Strategy. Please let me know if you have any questions or have trouble opening the document.

Sincerely,

Jen

Jen Vanator
Great Lakes Program Coordinator
Great Lakes Indian Fish and Wildlife Commisison
715-682-6619, ext. 2104
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GREAT LAKES INDIAN FISH & WILDLIFE COMMISSION

P. O. Box 9 • Odanah, WI 54861 • 715/682-6619 • FAX 715/682-9294

• MEMBER TRIBES •

MICHIGAN	WISCONSIN		MINNESOTA
Bay Mills Community	Bad River Band	Red Cliff Band	Fond du Lac Band
Keweenaw Bay Community	Lac Courte Oreilles Band	St. Croix Chippewa	Mille Lacs Band
Lac Vieux Desert Band	Lac du Flambeau Band	Sokaogon Chippewa	

Via electronic submission

August 28, 2015

Office of the Great Lakes
Department of Environmental Quality
P.O. Box 30473-7973
Lansing, Michigan 48909

Re: Draft Water Strategy

Dear Sir or Madam:

Staff of the Great Lakes Indian Fish and Wildlife Commission ("GLIFWC" or "Commission") submit the following comments on the draft Water Strategy – Sustaining Michigan's Water Heritage ("draft Strategy"). The Commission is a natural resource agency exercising delegated authority from 11 federally recognized Indian tribes in Michigan, Minnesota, and Wisconsin.[1] These tribes retain reserved hunting, fishing, and gathering rights in territories ceded to the United States in various treaties, rights that have been reaffirmed by federal courts, including the US Supreme Court. The ceded territories extend over portions of Minnesota, Wisconsin, and Michigan, and include portions of Lake Superior, Michigan and Huron.

GLIFWC member tribes reserved these ceded territory rights to guarantee that they could continue their hunting, fishing, and gathering way of life (or "lifeway") in a manner that meets their subsistence, economic, cultural, medicinal, and spiritual needs. It must be noted that GLIFWC's focus is off-reservation, and it is from that perspective that these comments are submitted. GLIFWC staff's comments on this draft Strategy should not be construed as precluding comments by individual member tribes from their own sovereign and on-reservation perspectives. GLIFWC staff's comments are also in no way a substitute for direct engagement with the affected tribes.

[1] GLIFWC member tribes are: in Wisconsin – the Bad River Band of the Lake Superior Tribe of Chippewa Indians, Lac du Flambeau Band of Lake Superior Chippewa Indians, Lac Courte Oreilles Band of Lake Superior Chippewa Indians, St. Croix Chippewa Indians of Wisconsin, Sokaogon Chippewa Community of the Mole Lake Band, and Red Cliff Band of Lake Superior Chippewa Indians; in Minnesota – Fond du Lac Chippewa Tribe, and Mille Lacs Band of Chippewa Indians; and in Michigan – Bay Mills Indian Community, Keweenaw Bay Indian Community, and Lac Vieux Desert Band of Lake Superior Chippewa Indians.

GLIFWC's member tribes understand that clean water is fundamental to life. They regard it as "the first medicine" and as the blood of their mother, the earth. With this perspective in mind, it is not difficult to understand the importance of water to the spiritual, cultural, medicinal and subsistence practices that underlie the tribal lifeway. GLIFWC's member tribes also believe that actions affecting natural resources must be judged on how well they will protect seven generations hence. They seek to ensure that principles of ecosystem management and biological diversity recognize and protect the fundamental interdependence of all parts of the environment.

It is with that background in mind that these comments are submitted. They are comprised of general comments that apply to the draft Strategy as a whole, and more specific comments for specific sections of the draft Strategy.

General Comments

1. Government-to-government relationships require timely and consistent communication, consultation, and collaboration.

GLIFWC staff applauds the draft Strategy's recognition of the importance of government-to-government relationships with tribes to the management of water and other natural resources. It is important, however, to understand that true government-to-government relationships require timely and consistent communication, consultation, and collaboration between the State and the tribes within its borders, as well as tribes with reserved rights within Michigan's borders. Such communication and consultation cannot be accomplished through public comment periods or other general methods of communication with general stakeholders. As sovereigns with interest in the natural resources both within their reservation boundaries and within the boundaries of the ceded territories over which they exercise co-management authority, the State should inform tribes early of any statewide policy or regulation that has the potential to impact those resources (either directly or indirectly) and allow tribes the opportunity to comment and collaborate prior to any public comment period.

While the draft Strategy's Water Cabinet included a representative from a tribe, the Water Cabinet also included members of non-governmental entities, such as farm credit services and the Nature Conservancy. Tribal governments are more than a stakeholder group – they are governments with which the State has a dedicated government-to-government relationship that requires early consultation. Additionally, a representative from a single tribe cannot speak for all of the tribes in Michigan and does not replace true government-to-government consultation.

2. The Strategy should incorporate tribes in each goal.

While the draft Strategy acknowledges the importance of its government-to-government relationship with the tribes within the Michigan borders, there is little recognition throughout the draft Strategy of how the draft Strategy relates to tribes, or of tribal participation in many projects and initiatives to protect and restore the quality of water throughout the State.

For example, the Introduction outlines the intention of the Measures of Success as a way to "examine system response...as a result of the collective impact of implementation of the Water Strategy recommendations and other efforts already underway by state, federal and local governments and partners and partners to rebuild healthy aquatic systems, clean water and vibrant economies." This sentiment is repeated on page 6, just before Table 1. Tribes are very active in many tribal, regional, statewide, and national efforts to protect and restore healthy aquatic systems and water quality. There should be recognition of the parts that all governments play as a way to build respect and cooperation among all governments.

Another example of tribal exclusion is on page 12, when discussing the prevention of aquatic invasive species ("AIS"). The draft Strategy recommends the State to "[w]ork with other Great Lakes states and provinces to harmonize aquatic invasive species prevention, early detection processes, and response actions across Great Lakes region." Tribes and intertribal agencies have a vested interest in preventing the introduction and establishment of AIS within waters over which they have management authority, and in fact are already quite active in regional and international initiatives to track and manage AIS, such as the Great Lakes Fishery Commission and on the Annex 6 Subcommittee of the Great Lakes Water Quality Agreement's Great Lakes Executive Committee. The draft Strategy should work to build inclusion and cooperation among all governments with an interest in the prevention of the introduction and establishment of AIS.

The draft Strategy makes clear that management of the water resources should be undertaken considering four core values: the economic, environmental, social and cultural. GLIFWC staff applauds this sentiment. Tribes approach each of these goals in potentially different ways. Overall, tribes are concerned about protecting traditional practices that depend on clean resources, such as fishing rights, and cultural, religious and medicinal practices. For the tribes, these uses must be protected — they serve as tribal baseline protection assumptions. In general they are consistent with the Strategy's list of recommendations, but are focused on specific tribal uses of resources.

The full inclusion of tribes in this Strategy is required to round out the understanding and interaction of each of these core values, and every effort should be made to include tribes in each of the Strategy's goals.

3. Protection must be given the same weight as restoration.

The Tribal Nations Issues and Perspective paper notes that many tribal lands are among the most pristine and non- degraded in the Great Lakes basin. In addition, tribes know that it is better to preserve than to allow degradation that will require restoration. Therefore, it is vital that "protection" have as much weight as "restoration" in the development of goals and ultimately in the implementation of the Strategy. A focus on restoration without protecting pristine areas will have little effect; as some areas are restored, others will be damaged. The Strategy must recognize and place proper emphasis on protecting the high quality areas that remain in the basin.

Specific Comments

1. The Strategy must directly address climate change.

Climate change will affect water resources in Michigan within the 30-year time frame of Michigan's Water Strategy. While it is true that Michigan's future climate is unclear, there are readily-available sophisticated models of the most likely climate future for the Midwest region, with a high level of agreement among scientists. These likely changes are as follows:

- Air temperatures are expected to increase from 1.8-5.4 °F by 2050. Growing seasons are projected to increase in length. Water temperatures will also increase in streams, rivers and lakes (Great Lakes Integrated Sciences and Assessments 2014).
- Precipitation is predicted to change in timing, frequency, and intensity. Extreme precipitation events are projected to be more frequent and intense. Summer droughts are predicted to be more frequent. Snowfall is expected to be reduced in most regions and more winter precipitation is expected to fall as rain (National Climate Assessment 2014).
- Ice cover duration on lakes will continue to decline. Lake temperatures have been increasing faster than air temperatures and are projected to continue increasing. Lake levels will likely continue to fluctuate, with most models projecting long-term declines (National Climate Assessment 2014, Great Lakes Integrated Sciences and Assessments 2014).

Climate change will make management of water resources increasingly challenging. Warmer water will affect water chemistry and aquatic species composition, with potential negative effects on cold-water fisheries. Warmer temperatures may also increase the likelihood of the success and distribution of invasive species. Flooding can lead to impacts on streamflow, water supply and quality, transportation and infrastructure. Higher levels of runoff from larger volumes of water can cause increased nutrient loading. Higher temperatures, longer growing seasons and increased frequency of drought could affect soil moisture, groundwater supply and the consumption of water for irrigation. Altered hydrology caused by changes in precipitation has the potential to impact many aspects of Michigan's water resources and resource management (National Climate Assessment 2014, Great Lakes Integrated Sciences and Assessments 2014).

Michigan should address climate change directly in its Water Strategy. To address all of these predicted effects, Michigan should incorporate additional flexibility and resilience planning into its Water Strategy. For example, water infrastructure, including dams, culverts, storm water and wastewater management systems, can be modified to accommodate higher flows for larger storms and increase storage capacity. Michigan could also promote resilience in natural systems, incorporate water conservation measures, promote continual research on the effects of climate change on water, and support adaptation strategies throughout the state. Planning for climate change will make Michigan's Water Strategy stronger and more successful.

2. Inclusion of subsistence economies.

The first chapter of the draft strategy provides recommendations for protecting and restoring aquatic ecosystems. These recommendations are premised on supporting resource-based economies. This premise should be expanded to include the support of subsistence based economies. Relying solely on the needs of a resource based economy allows for less stringent protection or restoration activities. For example, this chapter provides recommendations for healthy and functional ecosystems that are able to purify air and water and provide habitat for fish and wildlife. By expanding this section to include subsistence based economies, recommendations would be required to protect and restore air and water to the point they can provide habitat for fish and wildlife that are safe for human consumption.

Most fish consumption advisories, for example, are developed targeting people who fish for sport. Those advisories would be different if they targeted people who relied on fish as the basis of their subsistence diet, who would therefore eat many more fish. Fish and wildlife that are the basis for a community's daily diet are required to be less contaminated than fish or wildlife eaten sporadically by sporting communities, and would, therefore, require a less contaminated and healthier habitat.

3. Include tribes in groundwater planning.

The withdrawal of groundwater has the potential of affecting a wide geographic region. Any refinement and change to the water withdrawal assessment process or tools should be done through close consultation and cooperation with tribal governments throughout the state. Input from tribes is necessary to gain a better understanding of tribal water resources and the impact surface water/groundwater interactions will have on tribal resources.

4. Green infrastructure is a prime area for state, local, and tribal collaboration.

Green infrastructure is a new and emerging technology and way of community planning, and one that requires a lot of financial resources. Financial resources can be conserved by encouraging collaboration between state, local and tribal governments with regard to green infrastructure. Communities that have already begun to build or plan for green infrastructure should be tapped to provide technical assistance to communities that either do not have the capacity to do so, or who have yet to undertake the process, and this includes tribes. Tribes have as much interest as other communities in developing sustainable and environmentally friendly infrastructure. Sharing of experiences, knowledge and training should be provided both ways. Many tribal communities have already begun to plan for or develop green infrastructure and could provide a wealth of information and assistance to local communities. Other tribal communities lack the capacity and could greatly benefit from technical assistance that could be provided by the state or local communities. The draft Strategy should make it clear that collaborations and technical assistance for green infrastructure should not just be between the State and local governments, but also be with all governments.

5. Coordination over mercury monitoring should include tribes.

The draft Strategy recommends that there should be continued national and regional coordination of mercury reduction activities. GLIFWC has, for years, tracked mercury deposition in many inland lakes throughout the ceded territories. As subsistence economies, GLIFWC member tribes have significant interest in the deposition of mercury in lakes and rivers from which they harvest fish. In fact, tribal communities bear the brunt of mercury's detrimental effects due to the amount and pattern of fish that are consumed for subsistence and ceremonial purposes. Yet, reductions in emissions of mercury are not within the control of tribes to mandate or enforce. Information should be shared across all governments regarding the deposition of mercury throughout Michigan waters and collaboration should be undertaken regarding mercury reduction activities. Additionally, load reduction schedules for mercury should be established in the final Strategy and should be at least as stringent as those set by the Binational Program.

6. Tribes must be integrated into Great Lakes decision-making entities and policies.

GLIFWC member tribes hold treaty rights within Michigan boundaries. Exercise of those treaty rights present increased opportunities to the effective implementation of the Strategy. These tribes share in the goal of effective ecosystem management that protects the diversity of life, which is consistent with the goals of the Strategy.

Transparent government tools can help tribes engage in their co-management responsibilities within the ceded territories, and engage their citizens with regard to watershed stewardship. Governance tools should expand opportunities for everyone to be informed and should make both regulatory and non-regulatory environmental datasets accessible. Additionally, the Interdepartmental Water Team should include one seat for a tribal representative. While including a tribal representative on the Water Team would not substitute government-to-government consultation, it would allow for valuable input at the beginning stages of implementation discussions.

7. Revise the Aquatic Resource list to update the status of wild rice

The second table in the draft Strategy provides recommendations, implementation metrics, and the lead actor for Goal 1: Michigan's aquatic ecosystems are healthy and functional. The table should be amended to include a recommendation that the Aquatic Resource list be updated as it pertains to the status of wild rice. Wild rice was once present throughout the state, but has been in steep decline. Many tribes in Michigan have undertaken wild rice restoration projects, which have been known to conflict with state actions. The impact of state activity on historic wild rice beds, and wild rice beds that are currently undergoing restoration should be considered prior to every state action.

We appreciate the opportunity to comment on this draft Strategy. If you have any further questions or would like to discuss these comments, please do not hesitate to contact me at jvanator@glifwc.org or at 715-682-6619, extension 2104.

Sincerely,

Jennifer Vanator, Great Lakes Program Coordinator
Great Lakes Indian Fish and Wildlife Commission

From:	Catherine Daligga
To:	mi-waterstrategy
Subject:	Fwd: Comment on draft of "Sustaining Michigan Water Heritage, A Strategy for the Next Generation"
Date:	Friday, August 28, 2015 4:53:53 PM

Dear Water Strategy Policy Committee Members:

I agree that devising a comprehensive strategy to protect water, this marvelous resource present in such abundance in our state, is a worthwhile project. I appreciate the many person-hours that went into the meetings and consultations involved in preparing this document, as well as the deep background knowledge that must be exercised in the process.

However, I have some strong comments to make about this document, which I hope the final version will remedy in word, so that effective actions can be guided thereby.

I have criticisms to offer of the overall framing of the issue; specific points made, mostly by omission; and the process through which the draft was created.

As the draft states in the introduction, water does indeed define Michigan. But if the writers are going to be attentive to the definition of the words used, then I am concerned about the choice of words immediately afterwards. "[Leveraging] the power and presence of this treasured natural resource and ensuring its long-term sustainability are critical to advancing Michigan's prosperity." The connotations here are for market-driven considerations, in using "leveraging" instead of **protecting**, and "prosperity" instead of **well-being**.

The market cannot and should not be the primary driver of decisions made about our water. While I do not want or expect the statements of a religious leader to determine secular policy, it is still appropriate to consider the moral and ethical implications of the state policies that we create. Access to water is fundamental to life; disregard of that is a betrayal of our charge to each other as human beings.

According to the recent encyclical promulgated by Pope Francis, Laudato Si':

> [p. 23]
> ¶ 30. Even as the quality of available water is constantly diminishing, in some places there is a growing tendency, despite its scarcity, to privatize this resource, turning it into a commodity subject to the laws of the market. Yet *access to safe drinkable water is a basic and universal human right, since it is essential to human survival and, as such, is a condition for the exercise of other human rights.* [emphasis in original] Our world has a grave social debt towards the poor who lack
> [p. 24]
> access to drinking water, because they are denied the right to a life consistent with their inalienable dignity. This debt can be paid partly by an increase in funding to provide clean water and sanitary services among the poor. But water continues to be wasted, not only in the developed world but also in developing countries which possess it in abundance. **This shows that the problem of water is partly an educational and cultural issue, since there is little awareness of the seriousness of such behaviour within a context of great inequality.** [emphasis added]

There are essential human rights to clean water and sanitation that must be safeguarded by any statewide water policy and by the programs through which this policy is implemented. In this

regard, the discussion in chapter 6, "Invest in Water Infrastructure," is disingenuous at best. Several sentences are devoted to a characterization of Michigan's water as a "free, shared resource"--only to say oops, not so fast: the infrastructure costs money, and we have to pay for that. Except then, in the next paragraph, the observation is made that indeed, there are choices made relative to the assessment of those costs: entities that consume more water pay proportionately less for it! (p. 42)

The point glossed over is that there are deliberate and intentional choices made in the design of water rates and assessments. There is no abstract, absolute standard about what water costs, only the political decisions made by those in control. Consequently, decisions could also be made to implement a Water Affordability Plan, not only for the City of Detroit but statewide, to ensure that the human rights of all people to safe, clean water for drinking and sanitation are protected. It remains, again, a question of political will, not economic feasibility.

Apparently other decisions were made to write the document without explicit acknowledgement of several current pressures and issues above and beyond the crisis of water availability now affecting Detroit and Highland Park. Here are only three others:

1. the huge controversy in Flint over the inadequate, even dangerous water supply in use now;
2. the major threat posed to the ecosystem of the Great Lakes/St. Lawrence Seaway by the looming presence of Asian Carp just outside our watershed;
3. the incalculable danger presented by the inability of the state--the agent of the people--to insist on a thorough inspection (and replacement) of Enbridge's Line 5, now in service transporting oil for over 60 years, subject to corrosion by zebra mussels and the ravages of time, and located at one of the most vulnerable crossings in the whole waterway.

A policy intended to be of use for the next thirty years must not shy away from attending to the urgent and immediate problems we face right now. The potential harm to be caused by any of these three, should the worst case scenario not be proactively averted, is unimaginable--so far. If we are to claim to act on behalf of generations to come, we cannot postpone responsible action until a catastrophe occurs.

I will close my comment with a critique of the process involved in the preparation of this document, especially as it relates to chapter 8, "Build Governance Tools"

First, a relatively minor criticism, though I think it is relevant to the construction of the document as a whole. Pages 100-129 of the report describe the sixteen "Community Water Dialogues" that were held throughout the state in early 2014. Participation in these was by invitation only, and the sites were allegedly chosen to represent a variety of types of communities relative to the characteristics of the water. The closest site to Detroit was in Dearborn, and eleven people participated. On the face of it, that process seems tailor-made to exclude points of view that might raise uncomfortable questions for the overall project.

One of the follow-up meetings was held in Detroit, earlier this month. For that to have been the only public meeting held in the city, after the completion of the draft document, suggests an agenda intent on diminishing the impact of Detroiters on this process.

More importantly: It is the depth of hypocrisy to claim an interest in "better governance" when the overt policy of the state, during the Snyder administration, has been to subvert local democracy through the imposition of emergency managers, the eviscerating of contracts, and the transfer of public goods into private hands. We must do better than this with the vital objective of safeguarding our water as a public, common good.

I look forward to reading subsequent drafts of this document, and I would welcome the opportunity to become involved in one or more of the revisions.

Sincerely,

Catherine Daligga, Ph.D.

From:	Hans VanSumeren
To:	mi-waterstrategy
Cc:	Marguerite Cotto; Gabriel Schneider
Subject:	Water Strategy Comments - Northwestern Michigan College
Date:	Friday, August 28, 2015 4:56:13 PM
Attachments:	Northwestern Michigan College WS Comments.pdf

Please find attached our comments regarding the draft report "Sustaining Michigan's Water Heritage - A Strategy for the Next Generation"

Thank you,

--

Hans W. Van Sumeren
Director of Great Lakes Water Studies Institute
Northwestern Michigan College
(231) 995-1793
hvansumeren@nmc.edu

NORTHWESTERN MICHIGAN COLLEGE

COMMENTS ON DRAFT SUSTAINING MICHIGAN'S WATER HERITAGE: A STRATEGY FOR THE NEXT GENERATION

The Water Strategy is organized around nine goals and outcomes and provides recommendations for the implementations of each. Those that relate most closely to the community colleges in the state and Northwestern Michigan College (NMC) specifically are:

Goal 5 Promote Water-Based Economies – Michigan needs to collectively build robust multi-sector and multidisciplinary public-private partnerships between business, industry, academia, private capital and government. These partnerships will link ideation, invention and innovation, research and development, capital investment and end users. This approach will bring technologies to the market to better manage and solve water challenges in Michigan and across the globe. Directed research and development to address specific water challenges should provide the basis for forming a new paradigm of collaboration.

Outcome: Policies and innovative technologies are developed and adopted to grow and promote water-based economies

Recommendation #1: Market the state's competitive advantage as a highly attractive place for business creation and investment because of our abundant natural water assets, water research capabilities, highly skilled talent, economic development expertise, and powerful tourism and business-marketing brand.

> ***NMC Comment:*** *Position Michigan as a world-class fresh water destination for water based technology development and business location, specifically in the fields of sonar/acoustic applications and marine platforms including autonomous underwater vehicles where technology is developed, employees are trained and businesses are created which have global reach.*
>
> *Additionally, utilize Michigan's maritime education and training presence to enhance Great Lakes shipping options including clean diesel, biofuel development/testing and transportation strategies (short sea shipping).*

Recommendation #7: Create a strategic focus on water innovation to attract and accelerate new technologies to market through a business-led council comprised of private investors, entrepreneurs, corporations, public agencies and universities to better manage water challenges in Michigan and worldwide.

NMC Comment: *Include community colleges in this discussion as several Michigan community colleges already have strong business relationships with industry as it relates to water. Michigan community colleges serve as access to the Michigan New Jobs Training Program which can provide a mechanism for training of new positions created to expand water-related industry sectors.*

NMC charge: *Convene all Michigan Community Colleges to capture breadth of education and training applicable to water in the State, particularly as related to workforce development, while fostering new/additional collaborations that would benefit Michigan's water strategy.*

Goal 7 Monitor Water Quality – Michigan needs to develop and fund a coordinated, long-term monitoring strategy to provide baseline and trend information about surface and groundwater quality and quantity. This information is necessary to base decisions and best direct actions and future investments to support healthy people, ecosystems, communities and economies.

Outcome: Monitoring systems are in place at a scale and frequency to ensure water quality and quantity are maintained to support diverse uses and values.

Recommendation #3: Develop a long-term, sustainable funding source for groundwater and surface water quality and quantity monitoring that is continually improved with new technologies.

NMC Comment: *Include in this funding source, availability of funding for surface water monitoring equipment including, but not limited to buoys and allow for the applicability of this funding to include community colleges.*

Goal 9 Inspire Stewardship for Clean Water – Most importantly, Michigan residents need greater opportunities to learn about water. Michigan is surrounded by 20 percent of the world's fresh surface water, and with that comes a deep ethical obligation to be good and thoughtful stewards of this global treasure. A shared water ethic will guide Michigan into the future and ensure our children and future generations will have the same or better quality of life than we have today. The durability of this Strategy and ensuring the health of our water resources for generations to come depends on creating a culture of stewardship through lifelong education about water.

Outcome: Individuals and communities understand their responsibility for and make informed and responsible decisions regarding water resources.

Recommendation #1: Integrate water literacy principles into place-based education and State of Michigan curriculum standards tied to Science, Technology, Engineering and Math (STEM) across all grade levels.

NMC Comment: *Utilize existing expertise from the State's community colleges to support the development and implementation of water literacy education into State of Michigan curriculum standards. Provide support for guided/connected pathways toward post-secondary education relating fresh water opportunities.*

NMC Comment: *Position the state as the premier educational destination in the nation for education and continuing education ranging from applied technologies through advanced post-doctoral research.*

NMC Charge: *Develop and present a comprehensive inventory of the state's post-secondary water related programming for the purpose of stimulating discussions and an action plan for a national effort in student recruitment as Michigan is a world-class fresh water destination for water based education, technology development and business location.*

From:	Kendra Everett
To:	mi-waterstrategy
Cc:	Marty Fittante; Kara Butters; Pallone, Maggie (DEQ); Howes, Sarah (DEQ)
Subject:	Water Strategy Comments
Date:	Friday, August 28, 2015 5:10:08 PM
Attachments:	Comments on DEQ Water Strategy 8-28-15.pdf

Please see the attached comments from Senators Booher and Casperson on the DEQ Water Strategy. Thanks,

Kendra Everett
Sen. Tom Casperson
517-373-7840

TOM CASPERSON
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August 28, 2015

Office of the Great Lakes
Michigan Dept. of Environmental Quality (DEQ)
PO Box 30473-7973
Lansing, MI 48909

To Whom It May Concern:

We appreciate the opportunity to review and comment on the draft Water Strategy entitled "Sustaining Michigan's Water Heritage." As Michigan is blessed with the abundant water resources that we all value, the effort to plan and address issues where they exist is important.

After reviewing the voluminous draft strategy, we offer the following points as highlights of some thoughts for consideration:

- Appreciate references in the introduction to the use of water for various purposes including for drinking, use by industry, recreation, wildlife, etc. Maintaining use of water resources and truly balancing that use with other objectives will be crucial to the success of Michigan and our residents in the future (pages 1 and 2).
- Would exercise caution in recommending or pursuing any actions that could lead to the unnecessary or over-regulation of water resources (page 3 middle).
- Appreciate the efforts to ensure aquatic ecosystems are resilient and diverse though we hope common sense is maintained in the discussion (page 6). The problems with blue-green algae are a concern that need addressed to help with water quality issues, particularly around Cleveland. We were asked recently though if it's possible to determine how much of the phosphorous in Lake Erie is from Ohio and Ontario.
- Share the desire for there to be safe drinking water for all but wonder if the measure of success (100 percent of the population has safe drinking water with no reported violations of health-based standards) for Goal #2 is realistic (page 8). Also, if there is a bad test result of a well for example, what happens? Condemnation of property, bleaching, new well requirement, etc? We can foresee this causing concerns with funding and compliance.
- Wonder about the potential creation of a "water fund". Where would funding come from and is this as well as other parts of the strategy a way to grow government (page 8)?
- Curious about the measure of success for Goal #7 on achieving a "net stabilization of groundwater depth across the state" (page 8).
- Concern with the measure of success for Goal #8 which says "By 2030, achieve a 40% reduction in number of designated uses or impaired waters" (page 8). Not much more information is included about such a statement, but it raises questions of what that means and who it will impact?
- Appreciate the reference to preventing new aquatic invasive species (AIS) and controlling existing (AIS) as this issue is routinely mentioned in our districts as an issue by constituents (page 12).
- Regarding riparian systems and checking upstream and downstream of rivers, etc, causes some concern about where this effort may lead with regard to private property rights and impacts on landowners (page 15).

- In regards to managing groundwater withdrawals, this statement caught our attention as it seems to call into question use of groundwater while we have heard that the current approach to evaluating groundwater use lacks a solid scientific basis and needs real improvement: *"Despite the large volumes of surface and groundwater in Michigan – more than one quadrillion gallons by some estimates – there is growing concern about its use and about groundwater withdrawal effects on environmental function and integrity. Groundwater use and value is increasing, and the state must invest in the information and decision systems to realize groundwater's full value, promote its wise use, and protect its hydrological and ecological integrity."* As discussed in the past, before any additional regulation is discussed on use, and in the interest of improving the basis of current regulation such as the water withdrawal assessment tool, it is important for better science and data to be on hand (page 16).
- More discussion should be had regarding changes to existing dams (page 15) as we often hear from constituents on issues related to dams.
- Where are the priority watersheds that have degraded water quality and/or aquatic ecosystems due to nutrient runoff and soil erosion (page 18 recommendation)?
- Appreciate the reference to focusing resources on contamination sources with the highest potential for causing contamination of drinking water supplies (page 22) as financial resources to address all potential problems are limited and we need to prioritize.
- Concern with the unknown aspects of what may be pursued relative to well testing (page 22).
- Concern with the recommendation to develop and implement a "uniform statewide sanitary code" and "inspection requirements" as it is not apparent that systems in rural areas are causing problems to be concerned about at the state level (page 23). It would depend a great deal on what is meant by "periodic".
- Concern with various references throughout the strategy to what conceivably would be very significant financial resources needed to address various recommendations (Page 24 for example). The Legislature is designated as the "lead actor" on most of these funding items. Given fiscal and political constraints, we question the reality of accomplishing certain recommendations.
- Support references to use and increased access on water bodies across the state and efforts to improve commercial and recreational opportunities. Would ask that all areas are considered and not just areas that are more densely populated (page 33 for example).
- Appreciate references to marketing Michigan for business creation and investment because of our abundant natural water assets. With this in mind, we need to maintain and promote policies resulting in wise and balanced use vs the mentality of over-protection (page 36).
- Appreciate the references to reuse, recycling and grey water (page 38).
- Also appreciate the reference to aquaculture and recognition that there is opportunity for growth within the industry. However, the emphasis on closed-loop or recirculating systems over other types of aquaculture, such as commercial net pens, is troubling. The Michigan Aquaculture Association's (MAA) current strategic plan proposes that Michigan's aquaculture sector can grow from $5 million annually with 100 direct jobs to more than $100 million with 1,500 direct jobs. That growth will not happen solely from recirculating systems. Commercial net pen operations have been in operation in Ontario for years and should be allowed to operate in Michigan. Having an abundance of fresh water, we need to keep an open mind about different types of aquaculture and how it will take all types to grow the aquaculture industry in Michigan (page 38).
- Curious about the following comment on page 43: *"During public outreach for the Water Strategy, many residents suggested either putting a fee on water for all or some groups of water users – in its simplest form, a per gallon charge for water as it comes from the environment."* How many people made this comment and were they affiliated with a particular group, etc?

- Appreciate the attention to investing in water infrastructure as we commonly hearing about infrastructure update needs from communities and constituents. Are there ideas currently in mind for "establishing sustainable funding mechanisms to achieve water strategy goals including water infrastructure management" (page 45)?
- Reference is made to the MDEQ Environmental Advisory Council. Who is part of this council (page 52)?
- A recommendation is made for the evaluation and implementation of necessary changes to laws including state and local land-use statutes as well as the drain code. Who will be involved in making such recommendations to change various statutes (page 53)?
- Curious about what would be added to state of Michigan curriculum regarding water resources (page 56).
- Concern with the "implementation metric" for local health departments to assess and inventory all private septic systems by 2020 (page 62).
- Water policies may need to vary by region. A one-size fits all approach will not work when water usage and availability varies greatly across the state.

Overall, we appreciate having the discussion on Michigan's water resources and see the value in pursuing some of the included recommendations; however, much of the strategy and what may result is undefined and causes some concern about the potential cost and growth of government and who ultimately will make certain decisions that will impact Michigan residents, businesses and private property.

Thanks again for the opportunity to comment.

Sincerely,

Tom Casperson

Tom Casperson
State Senator – 38th District

Darwin L. Booher

Darwin L Booher
State Senator – 35th District

From: Benjamin Wickerham
To: mi-waterstrategy
Cc: Mary Fales
Subject: Comments on draft Water Strategy
Date: Friday, August 28, 2015 5:19:17 PM
Attachments: image001.png

To Whom It May Concern,

Thank you for the opportunity to comment on the draft Michigan Water Strategy. There are many facets of this plan that correspond to our scope of work, goals and long-term strategies for water quality. Specifically, there are four main comments/concerns we would like to offer from a water quality standpoint for you to consider:

1. We support the Strategy for its comprehensive breadth and ecosystems approach to managing all the state's water resources.
2. We recommend the Strategy approach the Water Fund concept in Strategic Action 6 (Chapter 6) from a water quality standpoint, instead of just a water quantity (withdrawal/use) standpoint. Perhaps look into a framework of nutrient credit trading?
3. Consider expanding the list of Michigan Water Protection Activities in Appendix 3. In its current extent, the list excludes several key federal and regional water quality related programs and initiatives.
4. Clarify what is meant by "water management systems" on page 38 when discussing efficient use of water for agriculture. Is this specifically regarding irrigation, overall water use, or drainage water management?

I and/or other Michigan TNC staff are available to provide more information on any of the above topics if needed. Furthermore, we welcome any opportunity to participate in current or future water resource planning efforts.

Thank you again for your consideration.

Respectfully Submitted,

Ben Wickerham,

P.P. Mary Fales, Saginaw Bay Watershed Project Manager

Ben Wickerham
Saginaw Bay Conservation Innovation Assistant
benjamin.wickerham@tnc.org
(517) 316-2286 (Phone)
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The Nature Conservancy
Michigan Chapter & Great Lakes Project
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nature.org

From:	Nicholas Occhipinti
To:	mi-waterstrategy
Subject:	WMEAC Water Strategy Comments
Date:	Friday, August 28, 2015 5:48:26 PM
Attachments:	WMEAC Water Strategy Comments 8.28.pdf

Attached

Thank you!

Nick

--

Nicholas Occhipinti, MPP
Policy and Community Activism Director
West Michigan Environmental Action Council
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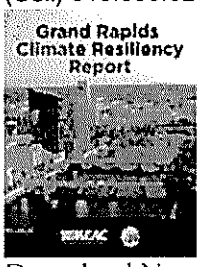

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August 28, 2015

Director Jon Allan
Office of the Great Lakes, DEQ
P.O. Box 30473-7973
Lansing, Michigan 48909

RE: Sustaining Michigan's Water Heritage Draft for Public Review; WMEAC Comments

The Office of the Great Lakes and collaborating state partners at the DEQ, DNR, MDARD, and the MEDC are to be commended for this comprehensive draft. The Strategy is thoroughly researched, organized and well written. It reflects many perspectives, citizen and expert input, and was built upon a facilitated Community Water Dialogue. The breadth and scope of the issues covered are matched with 62 specific policy recommendations, and an early attempt has been made to identify lead actors and clear metrics.

WMEAC appreciates the strategy's "ecosystems approach" and recognizes that the core values of our relationship with water — economic, environmental, social and cultural — are equally important. This means that in both times of economic growth and contraction we most hold up the environment as a foundationally important value. It means that sometimes citizen access might have to be curtailed to allow for the restoration of ecosystems. It means that sometimes brownfields will have to be 'clean enough' to clear the way for appropriate new developments. It also means that some areas should never by developed; ever. It means that we can't cut environmental corners to create economic activity. It means that government, private and NGO environmental efforts will have to be expanded, not curtailed, to meet the ambitious recommendations herein. It means that Michiganders will have to pay more in taxes and fees to protect our natural resources, and it means that Michigan's leaders, public and private, will have to stand up and unabashedly embrace new sources of funding as an investment in Michigan's future.

Our water resources have to be protected, maintained, restored and Michigan people and businesses are going to have to pay more to accomplish that. There's just no way around that basic fact. The Strategy's Community Water Dialogue participants agreed citing "funding and participation" as the most common barriers to success. If we are serious about pursuing this Strategy, and if we are to have success in meeting some of the ambitious objectives and recommendations it outlines, this basic fact has to be embraced, owned, and recognized up front. It has to be communicated clearly, loudly, and without apology.

Recommendation Highlights*
WMEAC supports the vast majority of the recommendations in this document. It would probably be easier to pick out those that we do not find terribly compelling than to list those we support. Therefore, neither list would be all that useful. What might helpful to identify are those recommendations that WMEAC is not only particularly supportive of, but those that we are ready and willing to invest resources into now, and into the future.

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Strategy recommendations that WMEAC is excited to join local, regional, and statewide collaborations to see executed:

- Develop and implement a uniform statewide sanitary code, establish a long-term, sustainable funding source and inspection requirements for onsite wastewater.
- Establish a long-term Water Fund to achieve Water Strategy goals including water infrastructure management.
- Promote green infrastructure, low impact development and green spaces to rebuild hydrologic integrity and address storm water.
- Evaluate and implement necessary changes to laws including state and local land-use statutes as well as the drain code to create a more integrated, watershed based system for managing water at the landscape level and achieving water quantity and quality outcomes.
- Water efficiency targets for all major water dependent sectors. Develop a water conservation and reuse strategy.
- Support groundwater and surface water monitoring.
- Integrate water literacy into state of Michigan curriculum standards.
- Develop and implement a water trails system.

*Attached you will find a memo identifying specific overlap between the City of Grand Rapids' Downtown Development Plan GR Forward Grand River Restoration and the Draft Water Strategy. This is just one example of a local initiative WMEAC is engaged in that can be used as a vehicle to move forward priorities from the draft Strategy.

Draft Implementation Metrics

The implementation metrics represent a very interesting column in Table 2 Water Strategy Implementation Plan. In general the metrics are very good. They are clear and specific. However, many of them are associated with an implementation date that at times is aggressive, and that at other times seems to be more of a placeholder than a real timeline metric. For example, many of the metrics seem to have somewhat arbitrarily identified 2020 as their date for completion.

Many of the date metrics also post-date the Snyder Administration. Therefore, it is only useful to include such a timeline if a Strategy Implementation Process is established to survive the Snyder Administration. This is certainly possible, but a robust value-add process must be outlined in the strategy (more on this later) describing how this will be accomplished. The strategy certainly acknowledges this fact in Chapter 8, and it makes a recommendation for the creation of an interdepartmental implementation team. Perhaps this should not be a recommendation, and instead should be issued as a statement, and paired with an outline of the process. The "recommendation" status leaves Strategy readers unsure of whether or not such an initiative will occur, and calls into question the State's internal buy-in and overall commitment to the strategy.

Lead Actor

Laudably, Table 2 Implementation plan attempts to identify Lead Actors responsible for moving recommendations forward. This is an important component of any implementation plan, and one WMEAC would love to see included in the final document. More, this feature would be even more useful if the identified Lead Actor has been contacted, briefed, and has committed to their role as such.

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For example, the Legislature has been identified as the Lead Actor for the recommendation "Develop and implement a uniform statewide sanitary code that is flexible and provides standards for site suitability based on risk." What is the appetite for legislative leadership to implement such an initiative? Indeed, if the Senate Majority Leader and Speaker of the House were willing to include this in their legislative platform, then identifying them as Lead Actor would be entirely appropriate. On the flip side if they have little knowledge of or interest in this priority, then it does the document a disservice to identify them as lead.

Careful thought should be given about how best to communicate in the Strategy likelihood of the Lead Actor actually owning responsibility for leading implementation of the recommendation for which they have been identified.

For many of the recommendations the Lead Actor is critically important. Community Water Dialogue participants reinforced this notion. They indicated their willingness to participate in many of the strategies initiatives, but they were very hesitant to lead. Therefore, a formal process for identifying, recruiting, and tagging Lead Actors might need to be established so that the final version of the Strategy will include a Lead Actor that has been briefed on the issue and that has some level of buy-in as a leader.

Strategy Implementation Process
Chapter 8 Page 54 expresses one of the most important ideas in the entire strategy. WMEAC agrees with the authors that this concept is fundamental to making the Strategy successful.

> "In order to ensure the Water Strategy is durable over time and across administrations, the elements of the Strategy need to be fully integrated into decision processes, governance structures, and the culture of state and local governments, other organizations, and individuals."
>
> "If the critical elements of this Strategy are not adopted and deeply engrained into ongoing decision-making processes, then little will come of them over time."

We are happy the authors recognize the challenge before them, and offer our support in any way we can be helpful. Perhaps there are a few ways, in addition to brute bureaucratic force, to make the Strategy durable over time. The first has already been identified as a recommendation:

1. Create an Interdepartmental Water Team to unite agencies to ensure a cohesive common strategy around implementation of the Water Strategy. The team will establish a process for stakeholder collaboration, criteria for setting implementation priorities, identifying cross agency joint projects, and an approach to assess and evaluate progress achieved against the metrics and outcomes.

The team should be formally established, well-organized, resourced, and directly connected to cabinet level decision makers and the Executive Office. As mentioned earlier, moving this from a Strategy

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recommendation to a confirmed fact – one that is announced with the finalized version of the Strategy would be highly valuable in building external confidence that State is committed to the Strategy.

2. The Governor has to invest political capital in the Strategy. WMEAC understands that every important issue can't be a priority for the Governor, but we also believe that for the Strategy to be effective the Governor will need to demonstrate privately and publicly that key pieces of the Strategy are very important to him. Public support from the Governor and top representatives will send signals across Michigan that the Strategy will be valued, resourced, and utilized. A high level of commitment will inspire reciprocity and commitment from external partners, funders, and the general public.

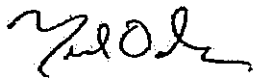
3. The Strategy should produce new and signature initiatives.
One or several big, signature initiatives will inspire and motivate people to get behind the Strategy. A great example is recommendation 5 on page 65: "Fund a pilot project, through a competitive bid process, for the initiation and evaluation of a new model for wastewater management." A host of recommendations from the Strategy would fit this bill: An aggressive push on statewide septics policy, the creation of a statewide water infrastructure fund and new revenue stream, etc...

In addition to a signature initiative, the creation of new programs, policies, and initiatives will breathe life into the Strategy. While existing DEQ, DNR, MEDC, and MDARD activities are certainly part and parcel to the Strategy, recounting, reorganizing, and rehashing a litany of existing DEQ/DNR activities will not inspire citizen, stakeholder and partner momentum.

4. Don't be shy about new funding, fees, and taxes
Strategy Community Water Dialogue participants identified funding as one of the top potential barriers to success. The majority of participants named external funding (state, federal, grants, foundations, etc.) as a potential source, but many participants also identified local sources, user fees, and even additional taxes. Dialogue participants were vocal and transparent about the need for new water funding. Strategy communicators and State representatives working with the Strategy should follow their lead. Strategy messaging should not be coy or defensive about the need for new funding. It is a fact that many in the Legislature are incredibly reluctant to create new revenue streams at the State or Local level. Many citizens are also reluctant, but the best way to confront that challenge is to be clear, open, and honest about the need.

Maintaining, expanding, and building new water infrastructure will be expensive. Protecting our incredible, world-class, fresh water resources will require serious expenditures; but Michigan is worth it, and we should be proud of it investing in its protection.

Sincerely,



Nicholas Occhipinti
WMEAC Policy Director

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From: Nicholas Occhipinti, West Michigan Environmental Action Council
To: Ann Armstrong Cusack, Office of Urban Initiatives
Date: 8/25/2015
RE: Grand River Restoration Water Quality Recommendations; Opportunities for Integration with State of Michigan (Draft) Water Strategy

Background: Grand Rapids is currently undergoing a major planning initiative and visioning process (GR Forward) that will steer development of the downtown and Grand River corridor for the next decade and beyond. At the center of that process is the restoration of the Grand River. Citizen access, water quality, recreation, and downtown economic development improvements are central goals of this initiative.

The GR Forward River Restoration plan shares strategic and tactical approaches with the State of Michigan water strategy. Harnessed effectively, the projects will feed off and support each other. More, Grand River Restoration is ripe with specific project, policy, and programming opportunities that will fulfill recommendations and metrics detailed in the Governor's Draft Water Strategy.

Many of the proposed issues are big, complicated, and difficult multi-year issues. That is precisely why it is so important to pursue them at a moment like this – when a unique opportunity has aligned many stakeholders behind two big visions. Grand River Recommendations (in no particular order):

River Restoration Recommendation	Governor's Water Strategy Recommendation
Improve **septic** programs and policies in the Grand River watershed area. Work with the Snyder Administration on a statewide septic code and with local health departments to adopt operational inspections and maintenance requirements in their septic regulations.	Develop and implement a uniform statewide sanitary code that is flexible and provides standards for site suitability based on risk. Establish a long-term, sustainable funding source to support onsite wastewater programs at the state and local levels and to assist financially distressed owners of private on-site wastewater systems with repair and replacement costs. (P. 23)
Address high impact **point-source** water quality infrastructure opportunities in the Grand River watershed area.	Establish sustainable funding mechanisms to achieve the Water Strategy goals including water infrastructure management. (P. 67)
Maximize implementation of **green infrastructure and low-impact development** (LID) within the River Restoration Project Corridor area by encouraging local policies and incentives that favor LID.	Utilize pricing and funding strategies to support infrastructure improvements while allowing for water conservation. By 2020, increase the number of communities that have pricing and funding strategies as part of their asset management plans to support infrastructure Improvements (p. 44)
The notion of improving the quality of the water in the Grand River should be **imbedded in the messaging, branding and funding initiatives** of the river restoration effort.	Implement a communication strategy focused on messages that link the relationship between investments in water infrastructure and clean water and the benefits infrastructure provides for drinking water, recreation, and cultural and economic

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	opportunity. (P 66)
Implement projects identified by the City of Grand Rapids **Green Infrastructure Opportunity Assessment**. Inspire a similar assessment and implementation process for managing stormwater runoff in upstream communities.	Provide technical and financial support to communities to plan and implement green infrastructure techniques and low-impact development while preserving natural spaces in the design of new developments, redevelopments and road projects to ensure storm water management and improve hydrology. (P. 60) Rec 17 Use existing authority to work with local units of government with storm water discharge or storm water-related hydrologic impairments in their waterways to establish Phase II storm water plans for impaired water bodies. (P. 60)
Address **livestock and cropland pathogen pollutants** in the Direct Drainage Subwatershed management unit of the Lower Grand River Watershed and in the Urban Waters Federal Partnership area. Plant buffer and filter strips along priority acreage adjacent to and encompassing the Direct Drainage Subwatershed and Urban Waters Partnership area.	Eliminate impairments in priority watersheds that have degraded water quality and/or aquatic ecosystems due to nutrient runoff and soil erosion. Engage landowners through a collaborative and adaptive community-based natural resource management process to identify local actions to change behaviors and solution to achieve those outcomes. (PP. 60-61)

Summary:
The chart serves as a side-by-side comparison of similarity in tactical and strategic approaches in the two plans. It is not a comprehensive list, but it does suggest the type and quality of synergies present. This list focuses on recommendations coming out of the water quality sub-group – additional water/river related synergies with the State Strategy can be found in the GR Forward Plan outside of the list focusing on the water itself. For example, dam removal, flood wall and riparian edge design, public access and recreational opportunities typify these other synergies

As with any visioning plan, each recommendation presented herein is at different stage of its conceptualization and implementation. Some have active government, private, and non-profit staff and resources behind them. Whereas others are new and exist mostly in the conceptual realm of literature and best practice. Finally, some of the recommendations have been previously forwarded through one initiative or another, but have hit significant political, economic, or social barriers.

Conclusion
A more sophisticated and formal analysis could be established to find the specific (existing and potential) ways in which synergy can be created between the two visions. Ideally, this could occur through a cooperative, formal, and resourced process in partnership with State of Michigan staff and River Restoration stakeholders. It is clear that several of the recommendations above will require this type of investment, coordination, and cooperation to move forward.

From: Shayna Petit
To: mi-waterstrategy
Subject: Petit Comments
Date: Friday, August 28, 2015 6:30:04 PM
Attachments: Petit- Water Strategy Comment .docx

Hello DEQ and Office of the Great Lakes,

Attached are my comments on the Water Strategy. I want to say tremendous job on this document--it both looks beautiful and poses many thoughtful recommendations. I look forward to speaking with you further about my comments.

Thank you,
Shayna

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Shayna Petit
Graduate Student - Community Sustainability (CSUS)
Michigan State University * Institute of Water Research
734.395.0094
petitsha@msu.edu
[redacted]

http://www.facebook.com/glccn -- @GLCCNetwork
http://www.facebook.com/IWR.MSU -- @IWR_MSU

Monday, August 24th, 2015

Office of the Great Lakes
Michigan Department of Environmental Quality
525 West Allegan Street
P.O. Box 30473
Lansing, MI 48909

Dear Director Jon Allan,

As a graduate student at Michigan State University focusing on Great Lakes policy and Community Sustainability, the Michigan Department of Environmental Quality's Water Strategy is very important to me. I strongly support your efforts at the Office of the Great Lakes, and commend your progress toward water sustainability in the state of Michigan through the goals put forth in this document. I am pleased with the overall Water Strategy recommendations, but want to offer my opinions on areas to improve in your implementation plan.

Goals for long-term education are clearly stated in the Water Strategy, but the short-term efforts could use more detail. In the document, there is strong mention of the need for education, mainly in the K-12 curriculum. This is extremely important, since water stewardship starts at a young age. As a long-term goal, I find this to be promising. However, in the short-term I would like to see a stronger, more influential plan for "branding" the Water Strategy and water stewardship within the Michigan community. The United Nations defines sustainability as using current resources while protecting and maintaining the same resources for future generations. We need to ensure that current adults are also onboard with conservation practices, in order to ensure the protection of our water resources today.

Corporate partnerships, specifically with the craft brewing industry, show major potential for strengthening this area of marketing. Michigan is 6th in the nation for number of breweries, with 159 breweries total in 2014 (Ruppert, 2015). Our unique access to the Great Lakes enables us to compete with states as large as California in the beer industry. And an important fact to remember is that without water, there is no beer. The brewing process for craft breweries requires on average 6-8 barrels of water to produce one barrel of beer (Leschin-Hoar, 2014). This includes not only the 90% water content of beer, but also the water used in the production process (Leschin-Hoar, 2014). Craft breweries across the country have been partnering with each other and NRDC to promote water neutrality and sustainability (Ellison, 2013). An exquisite example of inter-brewery partnerships is that of Michigan's Great Lakes Water Conservation Conference for Craft Brewers and Policy Makers, a periodic conference that began in 2009. Based on the increasing popularity of

Ellison, Garret. "8 Michigan Breweries Join National Environmental Group's Clean Water Campaign." *MLive*, April 9, 2013. http://www.mlive.com/business/west-michigan/index.ssf/2013/04/michigan_breweries_join_enviro.html.

Kallenberger, Mike. "Green Branding for Brewers." Power Point, St. Louis, MO, April 25, 2011. http://www.conserve-greatlakes.com/Resources/Documents/Green%20Branding%20-%20Kallenberger.pdf

Leschin-Hoar, Clare. "'Water Is Essential to What We Do.'" *Voice of San Diego*, February 14, 2014. http://www.voiceofsandiego.org/all-narratives/drought/water-is-essential-to-what-we-do/.

Ruppert, Geneva. "The Rise and Regulation of Craft Beer." Mackinac Center for Public Policy, July 22, 2015. https://www.mackinac.org/21550.

From: David Watkins
To: mi-waterstrategy
Subject: Fwd: [GLIN==>] Reminder: Public comments due on Michigan Draft Water Strategy - August 28, 2015
Date: Friday, August 28, 2015 6:50:34 PM

To Whom It Concerns,

I commend the contributors to this report for developing such a comprehensive and forward-looking strategy for protecting Michigan's water resources and leveraging their quality and abundance for sustainable economic growth. The strategy covers many of the challenges and opportunities that I would consider important, if not critical, and does an overall excellent job of identifying specific goals, recommendations, metrics and responsible parties. Although I was not able to read it cover to cover by the public comment deadline (but I will), I would just like to point out a couple notable omissions (which I believe are accurate based on my use of the "search" tool in Adobe Acrobat):

- It's baffling in this day and age that a "strategy for the next generation" would not include a single mention of climate change. While some effects of climate change are still highly uncertain, there is a growing body of scientific evidence that we will face (or are already facing) more extreme weather events and climate variability, which can increase the risk of floods and droughts and cause more rapid and extreme fluctuations in Great Lakes water levels. Furthermore, increasing temperatures will have adverse affects on aquatic ecosystems (e.g. cold water fisheries). All of these impacts can have significant effects on Michigan's economy. I would suggest climate change monitoring and adaptation planning (if not mitigation) be included in the strategy. I understand this is a politically sensitive issue for some, but I believe it can be posed in a politically neutral way oriented towards adapting to change -- similar to adapting to and mitigating the impacts of land use change.

- I think the strategy also misses an opportunity to address environmental justice issues, ranging from disparate impacts of water pollution (and climate change) on low-income communities to water shut-offs resulting from water utility financial distress, and tribal consultation on water management policy. It appears Michigan may have an environmental justice plan (https://www.michigan.gov/documents/deq/met_ej_plan121710_340670_7.pdf), which should at least be referenced in the water strategy; but even if the plan was not approved, addressing water-related social justice issues would seem paramount to promoting sustainable economic growth.

Thank you for your consideration of these comments.

Sincerely,
David Watkins
Houghton, MI

---------- Forwarded message ----------
From: **Finnell, Emily (DEQ)** <FinnellE@michigan.gov>
Date: Wed, Aug 26, 2015 at 12:31 PM
Subject: [GLIN==>] Reminder: Public comments due on Michigan Draft Water Strategy - August 28, 2015

To: "glin-announce@great-lakes.net" <glin-announce@great-lakes.net>

Reminder: **Comments on Michigan Draft Water Strategy are due by Friday, August 28, 2015.**

Written comments on the Draft Water Strategy may be submitted to the Office of the Great Lakes, DEQ, P.O. Box 30473-7973, Lansing, Michigan 48909, by fax at 517-335-4053 or by emailing Mi-waterstrategy@michigan.gov.

For more information about the Draft Water Strategy, visit www.michigan.gov/waterstrategy.

Emily Finnell

Office of the Great Lakes | MI Department of Environmental Quality

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David W. Watkins, Ph.D., P.E.
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Email: dwatkins@mtu.edu

From:	Jim Olson
To:	mi-waterstrategy; Allan, Jon (DEQ)
Subject:	FLOW Submission of Comments on Michigan Water Strategy Plan
Date:	Friday, August 28, 2015 10:33:31 PM
Attachments:	Scanned from a Xerox Multifunction Device (5).pdf

Mr. John Allan
Director
Michigan Office of the Great Lakes

Dear John and Staff,

Attached please find FLOW's comments on the Michigan Water Strategy Plan per public notice.

These comments are filed by email attachment per instructions, and are filed on or about 10:30 p.m., Friday, August 28, 2015.

Thank you for opportunity to submit these comments. Look forward to a good discussion.

Great job on guiding this tremendous effort.

Yours,

Jim Olson
President and Founder
FLOW

FLOW
FOR LOVE OF WATER

PROTECTING THE COMMON WATERS OF THE GREAT LAKES BASIN THROUGH PUBLIC TRUST SOLUTIONS

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August 28, 2015

Michigan Office of the Great Lakes
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
Michigan Department of Agriculture and Rural Development
P.O. Box 30473-7973
Lansing, Michigan 48909

Re: FLOW (Flow for Love of Water) Comments on Draft Michigan 30-Year Water Strategy Plan

Dear Office of the Great Lakes,

FLOW commends the Office of the Great Lakes for steering the draft Water Strategy Plan for Michigan stewardship of its most precious and abundant resource: water. We were impressed with the thoughtfulness of the report and big picture focus. We therefore center our comments primarily on the vision that "sustaining Michigan's water heritage" will support a healthy environment, healthy citizens, vibrant communities, and sustainable economies.

FLOW (For Love of Water) is a Great Lakes law and policy nonprofit organization whose sole mission is to find solutions to the pressing concerns, threats, and continuing harms to the integrity and sustainability of the waters, ecosystem, and protected public trust in the common waters of the Great Lakes Basin.[1] FLOW believes that protecting and properly managing each arc of the hydrological cycle as a single connected system of groundwater, lakes, streams, wetlands, Great Lakes and hydrosphere offers a common and unifying framework to evaluate, address find successful solutions for the water challenges we face in this century. .

Culture of Stewardship

The ability to achieve Michigan's vision for its water resources depends on a strategic, collaborative ecosystem-based plan that monitors the health and condition of our water resources, invests in water-related infrastructure, uses

[1] FLOW (For Love of Water) www.flowforwater.org (hereinafter "FLOW").

> water more thoughtfully and efficiently to grow sustainable economies, reconnects communities to water, and fosters a water ethic and culture of stewardship.[2]

Ecosystems Approach

> The forthcoming Water Strategy takes an ecosystem approach, focused on the fact that Michiganders are a part of the ecosystem in which we live and therefore have an effect on the health of our water resources. The Strategy recognizes the core values identified with water are four fold: economic, environmental, social and cultural. All are equally important. Communities across Michigan recognize the value of water quality improvement activities supported through state and federal investments. According to Brookings Institution and Grand Valley State University, restoring water quality and shorelines respectively result in a 3-to-1 and 6.6-to-1 return on investment in the form of increased property values and local economic development and improved ecosystem health and quality of life.[3]

In this second decade of the 21st century, it is more evident than ever that the Great Lakes face unprecedented systemic threats that have fallen outside the reach of current laws and policies. These threats include climate change, extreme weather, and fluctuations in flows and levels, phosphorous-loading and harmful algal blooms, invasive species such as quagga mussels and Asian carp, persistent plastic and toxins, and ultimately, the soaring demand for a finite water supply in the basin and beyond for drinking water, food, energy, and development that contradicts the fundamental understanding of water as part of a common shared water system and not an asset on a balance sheet. These are the challenges we face today and for the next decades, these are the challenges to which we must continue to respond.

At FLOW we continue to study and evaluate underlying frameworks that assure promote stewardship, protection, and sustainability of our water, environment, health, and economy: If we can protect water as a commons, recognizing rights of public and private use in a shared public water resource, and apply basic principles or benchmarks for evaluating strategies and actions across the spectrum of public and private sectors, we will make good decisions that achieve the vision, goals, and strategy for the benefit and long-term stewardship of Michigan's water heritage.

An important overarching framework and set of principles to achieving the Water Plan's vision and strategy can be found in the ancient body of law known as the public trust doctrine. Under

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[2]Draft Sustaining Michigan's Water Heritage, Michigan 30-Year Water Strategy Plan (Hereinafter "Water Plan"), Introduction, p. 1.
[3]Id., p.. 1-2.

United States Supreme Court[1] and Michigan law, the waters of the Great Lakes,[2] and our inland lakes[3] and streams are held by the state in trust for the benefit of its citizens. In essence, this public trust would foster the "culture of stewardship" and protect and sustain the integrity of our water and related ecosystem. At the same time the trust provides backstop or benchmark principles in which proper and lawful private and public use of water to support the needs of our quality of life, health, communities, and economy can occur side by side without losing track of the larger vision of the Water Plan.

Finally, new studies and models are discovering that our ecosystem, quality of life, and economy affect and are all affected, either negatively, positively or both, by the water cycle. In short, we live in a hydrosphere, and everything we do or everything that happens depends on the integrity of the hydrosphere. As Jacques Cousteau once said, "The water cycle and life cycle are one."

Specific Comments for Draft Water Plan:

Michigan's Public Trust in Waters of the Great Lakes, Lakes and Streams, and Tributary Groundwater.

Michigan's over 3,000 miles of coastline below the ordinary high water mark is part of or touches the waters of the Great Lakes. Thousands of more miles of shorelines touch on our rivers and lakes. The Great Lakes and their connecting and tributary waters are held in perpetual solemn public trust for the citizens of Michigan, who are the trust's legal beneficiaries.[1] Water is held by the State in trust, and while the state can allow for both public and private use, the State cannot subordinate or transfer its title or sovereign control to protect and manage this public trust.[2] The state has broad common law and sovereign authority to govern the public trust as a background principle. And as noted above, state statutes grant specific authority for use, occupancy and protection of our Great Lakes and waters from unlawful subordination or impairment,[3] and require information and planning to achieve protection and application of these

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[1]Illinois Central Rail Road v Illinois, 146 U.S. 387 (1892). Like air and wildlife, water is always moving and has been considered a commons in western common and civil law since the Justinian Code. J. Inst. 2.1.1; *Arnold v Mundy*, 6 N.J.L. 1 (1821); *Illinois Central Railroad v Illinois*, 146 US 387 (1892); James M. Olson, *All Aboard: Navigating the Course for Universal Adoption of the Public Trust Doctrine*, 15 VT. J. ENV. L. 148-151 (2014).

[2]Obrecht v National Gypsum Co, 361 Mich 399 (1960); People v Broedell, 361 ich (1961); Great Lakes Submerged Lands Act, NREPA< MCL 324.32501 et seq.; Michigan Water Law, NREPA, MCL 324.32701 et seq.; NREPA, Inland Lakes and Streams Act, MCL 324.30101 et seq.

[3]

[1] People ex rel Director of Conservation v Broedell, 365 Mich 201, 205 (1961).

[2] Illinois Central R Rd v Illinois, 146 US 387 (1892).

[3] MCL 324.32501 et seq. ("GLSLA").

basic principles.[4] The same is true for our inland lakes and streams, as well as our single hydrologically connected or tributary groundwater that feeds these lakes, streams, and the Great Lakes – a recognition of the water cycle noted above.

The public trust protects the waters and aquatic resources like fish and paramount public use and enjoyment of these waters for navigation, fishing, swimming, boating, drinking water and sustenance, such as food and health. As trustee and the "sworn guardians" of these waters and uses, the state has broad authority to protect these uses, remedy harms to these uses and water resources, and manage them through planning and implementation of strategies, programs, and specific governance or legal frameworks.[5] No one person is above the public trust in our navigable and tributary waters that feed these navigable waters and public uses and enjoyment. In this way, these waters can be broadly managed and protected through laws and regulations of the waters, bottomlands, water resources and land uses that threaten or adversely affect them, and at the same time allow for reasonable private and public use so long as the trust and waters are not materially harmed or interfered with from one generation to the next.

Finally the public trust provides the state, communities and citizens with a background principle for all property and water law that cannot be violated. Under state and U.S. Supreme Court decisions, the common law public trust in these waters and related aquatic resources can never be surrendered.[6]

2. Increasing Demand and Decreasing Sources for Water

a. Recent Events and Developments

Approximately 1 billion people are without enough safe freshwater.[1] World population will grow by another 2 billion people by 2050, with potentially another billion without safe drinking water. Demand for water will outstrip freshwater supplies by as much as 30 to 40 percent in 2040.[2] The demand for food production and stress and impacts from climate change will exacerbate the crisis.

Droughts like California or in other areas of the west are not only having a devastating effect on drinking water, development, farming, energy extraction, but a dramatic impact on water law and

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[4] People v Broedell, *supra* note 2.

[5] Obrecht v National Gypsum Co., supra, 105 NW2d 143, 149.

[6] Id., Illinois Central R Rd, supra.

[1] Study by Denmark's Aarus University, Vermont Law School and US Center for Naval Analyses. www.rt.com/news/17628-world-water-crisis-2040; Water.org www.water.org/water-crisis/one-billion-affected/; "Water Crisis," "Agricultural Crisis," Environmental Crisis," "Increase in Tension," www.worldwatercouncil.org/library/archives/water-crisis/.

[2] *Id.*, rt.com/news/ "world-water-crisis-2040."

policies.[3] Droughts in other parts of the world cannot be ignored,[4] both because of climate change impacts, shifting food production demands for soil and water, and pressures for foreign land and farming investment, which would include investment expectations in the right to use water through acquired ownership or control of land. Everything is on the table, and this raises uncertainty about the federal authority and role in water allocation in the United States. Moreover, these droughts, which are expected to be more frequent because of increasing temperatures and more frequent hot and variable weather and precipitation events,[5] the demand for drinking water, public water supplies, energy production and extraction, and farming and food has or will exhaust traditional water sources, such as snow melt, reservoirs, and groundwater.

In short, while California and other states at least initially seek to solve this devastating water crisis internally through increased conservation and water management strategies,[6] the increasing intensity and duration of droughts of this nature will undoubtedly trigger unprecedented political pressure for a national water policy that would allocate or divert water from one region of the United States to another.

b. Comment and Recommendations

Because of the magnitude and forecasted magnitude of more frequent and variable droughts around the world, not only should the Water Plan recommend application of the precautionary principle, it should incorporate into the report the growing uncertainty of the political climate along with droughts and water scarcity in other parts of North America and the world. Another drought in the U.S. such as Texas in the past several years in addition to California's extreme water shortages and management crisis could push political levers in the U.S. toward a national

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[3] "Drought is Only One Explanation for California's Water Crisis," World Resources Institute, March 27, 2014 (Climate change worsens complex, vulnerable water management systems and laws already vulnerable to slight changes in state and Colorado River water supplies. In the future or long-term, California will have to reduce growth and demand for water [FLOW Comments' author's note "or import it]). Governor Brown has launched $ 687 million plan to conserve and recycle water.

[4] Keith Schneider, "Water Challenges Asia's Rising Powers," YALE GLOBAL, July 12, 2011. http://yaleglobal.yale.edu/content/water-challenges-asia-powers-part-I.

[5] Intergovernmental Panel on Climate Change (IPCC), Fifth Assessment, Summary for Policy Makers, Working Group III, SMP 1.3, SMP 2.2, April 13, 2014.; see also *4 Degrees: Turn Down the Heat, supra* note 22.

[6] A. Maddocks, P. Rieg, and F. Gasert, *"Drought Is Only One Explanation for California's Water Crisis,"* World Resources Institute (April 8, 2014) < http://www.wri.org/blog/2014/03/drought-only-one-explanation-california%E2%80%99s-water-crisis>; *see also* California Sustainable Groundwater Management Act. Senate Bill 1168, Assembly Bill 1739, Senate Bill 1319 are a package of bills that allows state government to intervene to require future groundwater plans, allocate groundwater between users, and regulate, limit or suspend groundwater removals. See Randy Christensen and Oliver M. Brandes, *California's Oranges and B.C.'s Apples: Lessons for B.C. from California Groundwater Reform.* Victoria, Canada: POLIS Project on Ecological Governance, University Victoria/Ecojustice. <http://poliswaterproject.org/sites/default/files/OrangesApples_FINALWeb_0.pdf>.

water allocation policy that could result in undermining Michigan water law and the diversion ban and consumptive use provisions that we rely on for protecting Michigan's water resources.

By adding a public trust framework as background or backstop principles, Michigan, in the case of NAFTA or trade law claims, would strengthen their position because the public trust inherently adheres to the common nature and control of the water by the provinces and states, limits or qualifies diversions, and limits if not prevents a private claimant from asserting an expectation of a property or legal interest that would provide standing or is even protected by international trade law. Hence, public trust principles as a benchmark add protection and authority to safeguard the waters of Michigan from unforeseen demands from outside and protect our public and private uses, food production, tourism, and economy.[7]

3. Recent Developments in Hydrological Science and Modeling

A number of new studies, technique or models have identified greater understanding and knowledge about the overall relationship seemingly complex relationship between climate change, human activities, and the water or hydrologic cycle. These studies and models look at not only groundwater and surface water as a singular hydrologic system, but look further to the entire hydrologic cycle, which is itself a single hydrologic system of which groundwater and surface water represent the visible and meaningful arc for life, human uses and activities on the earth.[8] Because surface water and groundwater diversions and consumptive uses are inextricably intertwined with global and local effects and impacts on water, soil, energy, food, development from climate change and other human factors, more and more is being studied, modeled, and understood by new scientific and meta-data analytics techniques.[9]

In turn science and analytics are finding better ways to evaluate the relationships of local effects and global or macro-information, which allow them to better identify more accurately trends regarding groundwater and surface uses, impacts, and sources through the record of data and effects of human intervention or human-induced effects from urban and rural development, farming, energy production, and mineral and energy extraction on the hydrologic cycle. And the more that is understood about groundwater and surface water as a singular system within the

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[7] Scott S. Slater, *"State Water Resource Administration in the Free Trade Agreement Era: As Strong As Ever,"* 53 WAYNE L. REV. 649, 653-655 (2007).

[8] See generally, scientific methods and simulations for agriculture, water, and climate change effects, Bruno Basso, David Hyndman, Anthony Kendall et al., *Can Impacts of Climate Change and Agriculture Adaptation Strategies Be Accurately Quantified if Crop Models Are Annually Re-Initialized,* PLOS ONE/DOI:10:1371/journal.pone.0127333, June 4, 2015; Brasso, Kendall, and Hyndman, *The Future of Agriculture Over the Ogallala Aquifer: Solutions to Grow Crops More Efficiently with Limited Water,* Department of Geological Sciences (Received 21 Jun 2013, Accepted 26 Oct 2013) (AGU Publications, 10.1002/2013EF000107); U.S. and Canada Report on Relevant and Available Groundwater Science to Meet GLWQA Commitment, Feb. 23, 2015, http://binational.net/2015/02/23/groundwater-science/.

[9] Baseline Magazine, *"Circle of Blue Turns Business Intelligence and Analytics Systems to Aid the White House and Other Organizations Achieve Better Management of Water Resources,"* (April 30, 2014) http://www.baselinemag.com/analytics-big-data.

hydrologic cycle, the more that can be studied and understood about the systemic threats to water. Since water is so essential to life and human progress or survival, it becomes the limiting factor or lens through which other uses and factors can be viewed and understood. And as this understanding, data, and knowledge increases over the hydrological cycle, new adjustments or approaches can be established in law, policies, guidelines, and adaptation strategies to better respond and mitigate or solve systemic threats such as described at the outset that plague or challenge the Michigan's waters and ecosystem.

These studies which focus on the single hydrologic nature of groundwater, surface water, wetlands, springs and climate change have begun to show that farming practices, energy production, land use, urban or sprawling development, clearing of forests and vegetation, and numerous other human activities result in direct effects on the hydrology of groundwater, streams, lakes, wetlands, and large bodies of navigable waters. These effects in turn cause direct and cumulative impacts to wildlife habitat, plants, and ecosystems, in some instances with significant losses, damage and costs.

b. Comments and Recommendations

The Water Plan calls for an ecosystem approach. New developments in groundwater and watershed science, including research that looks at the hydrological system and water cycle, expand the methodology and framework to the water cycle or hydrologic cycle as a whole. This new approach demonstrates how human actions and natural forces within the water cycle can impact flows and levels or cause harm to "arcs" of the water cycle such as the single hydrologic connection of groundwater and surface water. Groundwater and surface water forms a foundation for a policy framework that looks at the hydrological science and water cycle as a whole, as suggested in the conclusion and elsewhere in this report. In other words, it is recommended that the commons and public trust principles framework should be used in conjunction with science to better determine effects to water levels, flows and impacts on water, watersheds, and ecosystems.

4. The Water, Energy, Food, and Land Use "Nexus"

a. Recent Developments

Water is no longer just an afterthought in national and global conversations about energy, food, and climate.[10] And that's because water is viewed as a vital resource subject to greater scarcity,

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[10] The removal of high-volumes of groundwater from a watershed that is part of a single hydrologic system can cause substantial harm to other water bodies. See e.g. the trial court and Court of Appeals findings in *Michigan Citizens for Water Conservation v Nestlé Waters North America*, 709 NW 2d 174 (Mich App 2005), that the defendant's high-capacity wells that pumped near or at 400 gallons per minute caused substantial reductions in flows and levels to a headwater stream, two

variability, and unpredictability. In the next 15 years, a U.N. report warns the world could suffer a 40 percent shortfall in water by 2030 unless countries dramatically change their use of the resource.[2] Just this year, 2015 marked the first time water crises claimed the top spot in the World Economic Forum's 10th global risk report. Clearly the status quo can no longer stand. As the U.S. Department of Energy recently observed: "We cannot assume the future is like the past in terms of climate, technology, and the evolving decision landscape."[3]

Here in the Great Lakes and Michigan, there is a growing recognition that water is inextricably linked to everything we do, elevating the "nexus" connection at all decision-making levels.[4] The U.N.'s Food and Agriculture Organization (FAO) defines nexus as an approach that "helps us to better understand the complex and dynamic interrelationships between water, energy and food, so that we can use and manage our limited resources sustainably. It forces us to think of the impacts a decision in one sector can have not only on that sector, but on others. Anticipating potential trade-offs and synergies, we can then design, appraise and prioritise response options that are viable across different sectors."[5]

Diversions and "consumptive uses"[6] of water and climate change affect groundwater, and agriculture, food production, and energy extraction, production, and transport all affect groundwater and connected lakes and streams. To better understand the water-energy-food nexus, comprehensive studies of new emerging consumptive uses are critical so that decision-makers at all levels can implement adequate measures and standards that protect water quality and prevent against cumulative water loss to aquifers and watersheds within the basin. This section explores the following three consumptive uses and their impacts on water resources: (1) high-volume hydraulic fracturing for oil and gas and water resource impacts, (2) agriculture and virtual water and (3) thermoelectric energy and climate change.

b. Comment and Recommendations

Understanding the complex scientific relationships between water, energy, and food is the first fundamental step toward making meaningful policy changes to protect every arc of the hydrologic cycle. This approach can be combined with the recommendation to establish a study based on recent developments in hydrological science discussed in these Comments and the overarching commons and public trust framework that would help overall Michigan Water Plan strategies and decision-making more closely aligned with sustainability, ecosystem, and stewardship goals.

Issues that should be given more attention in the Water Strategy Plan as competing demands and for better planing and implementation of strategies include full understanding all risks and benefits related to the Plan's goals associated with such activities as:

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lakes, and nearby wetlands, which constituted an unreasonable use and transfer of water beyond the watershed.

High-Volume Hydraulic Fracturing and Water Resource Impacts: Unchecked water use for fracking operations leaves the Great Lakes Basin vulnerable to significant water scarcity and water quality. Water withdrawals for high-volume fracturing or other high-volume consumptive uses should be studied and regulated to obtain better hydrologic data regarding hydrologic effects and impacts on local creeks, springs, streams, and lakes, or the wells by competing water users such as farms, golf courses, and snow-making for ski areas. In addition, standards and criteria should require collection and disclosure of hydrologic data from before, during, and after the high-volume removal of water.

It is also recommended that the high-volume water wells for fracturing should not be permitted where there are likely local effects on flows and levels or impacts on water quality and ecosystems.

Finally, high-volume groundwater removals should take into account competing needs and uses from adjacent owners and communities, including adequate water for hydrologically connected streams, lakes, and wetlands, and take into account effects of climate change within and outside the basin.[11]

Agricultural and Virtual Water: Landowners have the right to reasonable use of groundwater or riparian surface water that move over or through the landscape or soil, while the body of water or aquifer is collectively held by the state as sovereign.[12]

Given the overall water and food crisis and the magnified effects from climate change, including hydrologic and ecological impacts at the local or watershed level, it is recommended that the Water Plan establish a virtual water measurement and analysis component, in cooperation with the states and provinces, to assure that intensified food production and associated consumptive use and export of virtual water is fully accounted for and made part of a review process. As Professors Scanlan and Kehl point out, virtual water from exports is not accounted for, in total loss of water to the Basin or in terms of overall impacts. This is crucial for Michigan's farms and agriculture industry to make sure that sustainability goals and stewardship

[11] The removal of high-volumes of groundwater from a watershed that is part of a single hydrologic system can cause substantial harm to other water bodies. See e.g. the trial court and Court of Appeals findings in *Michigan Citizens for Water Conservation v Nestlé Waters North America*, 709 NW 2d 174 (Mich App 2005), that the defendant's high-capacity wells that pumped near or at 400 gallons per minute caused substantial reductions in flows and levels to a headwater stream, two lakes, and nearby wetlands, which constituted an unreasonable use and transfer of water beyond the watershed.

[12] E.g. *Arnold v Mundy*, 6 N.J.L. 1 (1821).

goals are not compromised by increased demand for water from other countries or foreign interests. It is not every case that this is so, but Michigan must understand its own domestic water and food needs, and assure for their sustainability and protection before moving rapidly into such unchartered demands on water resources.

Under public trust law, states have the authority to consider the effects or impacts on public trust waters resulting from the loss of virtual water on groundwater, wetlands, lakes and streams.

Thermoelectric Generation and the Great Lakes: Climate change is all about water. Protecting Michigan's water and sustaining the economy may require an adaptive approach to address climate change. Addressing climate change and protecting the Michigan's water and ecosystems will require an interconnection between energy strategy and water strategy, so that energy targets are consistent with protecting waters from excessive losses or climate change impacts.

Accordingly, the Water Plan could call for an increase and improve data collection and establish targets to address climate change effects. These waters are recognized as national treasures and the states, including Michigan, have a "shared duty to protect, conserve, and restore"[13] these waters and their ecosystem for current and future generations. There is a public trust in the states[14] and a right of public navigation and fishing, also considered a trust,[15] in the waters and water resources are subject to this trust.

***Water-Energy-Food Nexus*:** The Water Plan could also recommend establishing an advisory board or team to study and integrate the competing needs of the water, energy, and food, and community "nexus" to advise the state on how to protect itself from competing or conflicting demands for water, energy, and food, water being the baseline or benchmark for decision making to protect. the integrity and health of our water, water resources, and ecosystems.

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[13] Compact Sec. 1.3(1).

[14] James Olson, *All Aboard, supra*, at 144-148.

[15] *Id.*, at 164-166

5. Governance, Law and Policy

a. Recent Developments in Water Law and Policy

There have been a number of significant developments in water law and public trust law, which along with a proper concern for common law limitations that limit uses of water by landowners or others outside a watershed or the basin, offer a supplemental basis for evaluating and protecting the waters of Michigan and the Great Lakes from diversions, withdrawals, consumptive uses, or other removals. In some instances, these recent developments could be used to strengthen the position of states and provinces in defending actions regarding denial or strict regulation of diversions and consumptive uses. In others, these developments may have weakened common law traditional limitations on water transfers off-tract or out of watersheds that protect flows, levels, water quality, and preferred traditional uses of water in connection with riparian or land overlying an aquifer. This section examines new developments in (1) riparian law and (2) groundwater law.

Riparian Law

The off-tract limitation or limit on diversions of groundwater that was removed from hydraulically connected lakes and streams may have been relaxed in *Michigan Citizens for Water Conservation (MCWC) v. Nestlé Waters*,[16] a case that influenced debate over Annex 2001 and later the diversion ban and the treatment of bottled water as a consumptive use, and consumptive uses and other provisions in the Compact. In the *MCWC v. Nestlé* case, the Michigan Court of Appeals ignored the "off-tract" or "out of watershed limitation" in Michigan Supreme Court cases in favor of a new "reasonable use balancing test."[17] Unlike the state Supreme Court's decisions, the Court of Appeals adopted the balancing test without regard to the status of the intermediate or end-user of the water. In short, Nestlé was not a riparian owner and admittedly diverted the millions of gallons out of the watershed for bottling and sale to a significant extent out of the Great Basin. Accordingly, the underlying right of a landowner to use water in connection with his or her land may have been expanded to include anyone, anywhere, at any time. However, it is not clear if the case applies to direct removals or diversions from a lake or stream under riparian law, because a subsequent Michigan Court of Appeals decision that applied *MCWC v. Nestlé* to Michigan's famed Au Sable River was vacated.[18]

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[16] *Michigan Citizens for Water Conservation v. Nestlé Waters North American Inc.* 709 N.W. 2d 174 (Mich. Ct. App. 2005), reh'g denied, 739 N.W.2d 332 (Mich. 2007).

[17] *Kennedy v. Niles Water Supply Co.*, 173 Mich. 474. 139 N.W. 241, (Mich. 1913); *Dumont v. Kellogg*, 29 Mich. 420 18 Am. Rep. 102 (1874); *Schenk v. City of Ann Arbor*, 196 Mich. 75; 163 NW 109 (1917).

[18] *Anglers of the AuSable v Department of Environmental Quality*, 793 NW 2d. 596 (2010), vacated on rehearing (the vacated court of appeals decision reinstated the trial court opinion and erased the suggestion that the "reasonable use balancing test" in *Nestlé* applied to riparian waters).

This could mean, although it is only arguable, that if a foreign landowner or water user like Nestlé is denied a right to withdraw and divert or export more water in containers in the future, the company could argue that its newly expanded right to use and sell water anywhere gives it an argument that it has standing to maintain a private investor claim in a private tribunal under NAFTA or other trade law.[19] However, this is countered by the Michigan Supreme Court cases,[20] the provisions in state law when adopting the Compact and water withdrawal legislation that preserve common law limitations like the watershed restriction and the fact that the Compact itself declares that water is "held in trust."[21] Nonetheless, the development in Nestlé must be closely watched, or a more uniform effort taken by the states and provinces, should the trend emerge there to maintain and reclaim, if necessary, by statute the watershed limitation. By doing this, Michigan can put itself on better footing. This would assure the state that it will have the final say on authorizing transfers of water for sale or diversion out of watersheds, and be in a stronger position to enforce laws and limits like the Compact, now or in the future.

Groundwater Law

It also appears that groundwater law took a similar turn in Michigan and Ohio. The *MCWC v. Nestlé* case may not apply to riparian lands or lakes and streams, but it does apply to groundwater. Again, however, a Supreme Court decision in *Schenk v. City of Ann Arbor* ruled that the city could not pump and divert groundwater off-tract to service its residents if it disrupted or interfered with a neighbors well or measurably diminished the flows or levels of a lake, stream, or wetland.[22]

In Ohio, the Supreme Court adopted the RESTATEMENT OF TORTS, 2d, Sec. 858, for groundwater law. Under Section 858 of the RESTATEMENT, 2d, the diversion or export limitation has been erased in favor of a broad balancing of a number of factors involving interference, harm, and the relative public and private benefit of a withdrawal and diversion or use regardless of whether the use is on-tract or off-tract.[23]

The importance of these changes is that a shift in the underlying common law may make it more difficult for farmers, communities, landowners, or businesses who rely on levels and flows of water in a watershed to defend against claims from outside a watershed or Michigan.

b. Comments and Recommendations

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[19] The implications and recommendation in connection with these issues are addressed in Section 7, *infra*.

[20] *Kennedy v. Niles Water Supply*, *supra* note 110; *Dumont v. Kellogg*, *supra* note 110; *Schenk v. City of Ann Arbor*, *supra*, note 17.

[21] Compact, Sec. 1.3(1)(b).

[22] *Schenk v City of Ann Arbor*, *supra*.

[23] *Cline v American Aggregates Corp.*, 474 N.E.2d. 324 (Ohio 1984).

For the reasons noted above on comments concerning riparian law, it is important to understand the implications and law and policy response that may be required to minimize the risk of claims against a state for denying or restricting an off-tract or out-of-watershed diversion or export of groundwater. For example, the Great Lakes Compact diversion ban may restrict it if the container or volume is greater than 5.7 gallons or 20 liters, but it does not mean the investor or landowner could not claim a broader right to use water to support a claim with a trade law tribunal, if the claimant acquired land in a state that allowed sale of groundwater off-tract, which of course is occurring, such as in *the MCWC v Nestlé* groundwater/riparian hybrid case discussed above. Michigan based on water as a public resource can control the taking or removal of groundwater for export elsewhere, because of the tract or out-of-watershed or impairment of flows and levels of a lake or stream. This limitation should be carefully studied, understood, and applied uniformly where possible; this will supplement the state's background common law or constitutionally to defend against private investor claims under trade laws..

6. Public Trust Law

a. Recent Developments in Public Trust Law

In the past ten years, public trust law has matured in the states as a comprehensive framework and background principle for water management and protection of flows, levels, ecosystems and protection and accommodation or balancing of public and private uses. Over this same time period, there has been increasing recognition and discussion in the literature and courts of the United States and Canada.[24]

First, there is a strong recognition, as in science and the Agreement and Compact, that groundwater, surface water, lakes, and streams are a single hydrologic system. There is also some beginning recognition of the relationship of the entire water or hydrologic cycle, the activities that affect it, and the flows, levels, and quality of traditionally recognized public trust waters that are "navigable."

The extension of public trust protection to groundwater is not surprising given the hydrological connection to public trust lakes or streams. In Wisconsin, the Supreme

[24] The sound application and principles of the public trust doctrine apply to the Great Lakes in the eight states and provinces under the analogous paramount trust to protect the public right to navigation, fishing and boating in Canada. Olson, *All Aboard, supra*, at 147-166; see also Barlow and Olson, *Report on the Public Trust Principles to the IJC, supra.* There is actually a fifth development in the Great Lakes states, but it is not within the scope of these comments on diversions, consumptives use, and other human land or water uses and activities. Consistent with previous cases, *Illinois Central Railroad v Illinois*, 146 U.S. 387 (1892), Michigan reaffirmed the public trust in the Great Lakes and ruled that the right of access, as distinct from more possessory use interests, for walking along beach to public trust waters included the beach up to the natural ordinary high water mark as determined by physical characteristics that distinguished a beach from permanent characteristics of upland. *Glass v. Goeckel*, 703 N.W.2d 58, 64–65, 73–74 (Mich. 2005). *See also Merrill v. Ohio Dep't of Natural Resources*, 955 N.E.2d 935 (Ohio 2011).

Court held that the public trust in a navigable lake required the DNR to consider the effects of a nearby high-capacity municipal groundwater well.[25]

Second, in 2000, the Hawaii Supreme Court first declared the groundwater component of a canal or channel to be subject to the public trust doctrine both under the common law and state constitution. The court reaffirmed its decision in a more detailed factual application of public trust principles in a 2012 case.[26] In a more recent decision in 2014, the court held that a local land use planning board, like the DNR in the Wisconsin case, must consider the effects and impacts on connected public trust waters as part of its review of a request for a special use permit for a major land development.[27]

Third, Vermont enacted a new groundwater law, supported by farmers and residents who were concerned about water exports or diversions from the state, that declared groundwater protected by the public trust doctrine. In its first test case, a lower court ruled that the traditional public trust principles applied to surface and groundwater, and that state agencies had a legal duty to consider the effects and impacts before it could approve permits that were alleged to involve effects to groundwater or lakes and streams.[28]

Fourth, courts in Arizona and California have also imposed a legal duty on a state agency to protect groundwater as part of a state's public trust water resources. Arizona found a public trust in all waters of the state, including groundwater, based on the hydrologic connection, recognition of a "trust" in natural resources or water in the state constitution, then applied public trust principles to restrict a diversion of water.[29] The courts in California have found a public trust in all navigable and tributary waters, holding that all allocations and appropriation rights to use or divert water are subject to the principles of public trust law.[30] The court noted three basic principles: "(1) prevents any party from acquiring a vested right in a manner harmful to the interests protected by the public trust; (2) The Legislature [acting through an authorized agency] has the power to grant usufructuary licenses...; and (3) the state has an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses wherever feasible."[31] It is only logical that traditional public trust law would restrict

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[25] *In re* 'Iao Ground Water Mgmt. Area High-Level Source Water Use Permit Applications, 287 P.3d 129, 190 (Haw. 2012).

[26] *Kelly v. 1250 Oceanside Partners*, 111 Hawaii 205. 140 P.3d 985, (Haw. 2006).

[27] *Kauai Springs Inc. v. Planning Comm. of the County of Kaua'i*, 324 P.2d 951 (Haw. 2014).

[28] See VT. STAT. ANN.tit.10, Sec. 1390(5) (2008); *In re Omya*, No. 96-10Vtec, at 3-5. .

[29] ARIZ. REV.STAT.ANN. Sec. 37-11130 (1992).

[30] *Light v. State Water Resources Control Bd*, 226 Cal. App. 4th 1463 (2014); CAL.CONST.art.X,Sec. 4.

[31] *Id.* at 226 Cal. App. at 1480-1482; *Audubon v. Superior Court*, 33 Cal. 3d. 419, 434, 437 (1983) extended the geographical scope of the doctrine to nonnavigable streams that feed navigable waterways, and it expanded the purpose of the doctrine to the preservation of water's function as natural habitat." *Id.* "An important purpose of the public trust over bodies of water is to protect habitat for wildlife." *Id.*

activities within a watershed or tributary stream that impair public trust uses or ecosystems connected with navigable waters, like the Great Lakes.

These four developments of public trust law summarized above all involve protecting water resources, including tributary streams and lakes and groundwater connected to or part of navigable public trust waters.[32] Accordingly, for purposes of these Comments and the draft Water Plan, the public trust doctrine developments provide significant new approaches or backgrounds to protecting and managing water resources.

Another important aspect of public trust law in the United States involves the application of public trust principles in law review articles and papers.[33] In the past ten years, there have been hundreds of legal and academic articles analyzing, explaining, and arguing for new applications of the public trust doctrine principles.[34] Only a few of them have been mentioned here.

b. Comment and Recommendation – Governance Based on Overarching Public Trust Principles

These public trust developments provide an evolving framework from which to address water, related land use, quality of life, and sustainability goals or strategies. As noted at the outset, the draft Water Plan is nearly silent on the public trust or developments in water law generally, yet these principles offer one of the strongest most powerful the background or backstops for all of Michigan's goals and strategies. For example, as noted in the next section, these principles provide a basis for exercising property power or police power regulations or other limitations to protect our water from claims by outside interest as demand and competition intensifies in the coming decades.

7. International Trade Law and Developments under NAFTA

a. Recent Developments

Since 2000 private investor claims under NAFTA and other trade laws have more than tripled.[35] While the legal policy and approach behind the diversion ban and consumptive

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[32] Jack Tuholske, *Trusting the Public Trust: Application of the Public Trust Doctrine to Groundwater Resources*, 9 Vt. J. Env. L. 189 (2008).

[33] For a complete review of cases and law review articles and papers on public trust law in the U.S. and internationally, see Michael C. Blumm and Mary Christina Wood, *The Public Trust Doctrine in Environmental and Natural Resources Law* (Carolina Academic Press 2014) (a textbook for a law school or university curriculum)

[34] One need only run a search on Westlawnext, LexisNexis, or simply google "public trust" or "public trust" & "water" or "climate change" or "public trust" & "parklands" to pull up long lists of articles, cases, reports, and papers.

[35] See *NAFTA Chapter 11 Investor-State Disputes (to October 1, 2010)*, Scott Sinclair, Trade and Investment Research Project, Canadian Centre for Policy Alternatives/Centre Canadien de

use regulations is generally sound and defensible, as noted by the Draft 10-Year Report, the increase and success of a few of these private investor claims for money damages for discrimination or expropriation of water use rights create uncertain, confusion an concern. The countries reserved sovereign power in the NAFTA and water is not mentioned. Moreover, the countries signed a side agreement that water "in its natural state" is not covered by NAFTA.[36] However, issues and concerns remain because of increased demand for water in North America from drought, increased food and energy production, and climate effects. The side agreement contains a provision that insulates water in its natural state "unless water, in any form, has entered into commerce or produced, it is not covered by the provisions of any trade agreement, including NAFTA."[37] The question of when and what triggers the moment in time when water "enters commerce" or is "produced" has not been answered, and the answer has been clouded by shifts in groundwater law that relax or erase common law restrictions on water from watersheds.[38] When water is "produced," it is "withdrawn by human or mechanical means."[39] A "product" may not be subject to diversion bans or other state limitations. If water is withdrawn and placed in a container and intended for a consumer, it could be argued that it is a "product" the moment it is withdrawn from the water source. Thus, these factors that are potentially outside the control of Michigan have raised enough questions and disputes, utmost caution is required.

Private investment claims under Chapter 11, NAFTA, are different than nation against nation challenges to regulations that violate fair treatment and free trade provisions. Although a challenge between nations as to the authority and power to maintain and enforce laws to protect health, exhaustible natural resources, and the environment, a private investor may file notice and pursue an individual claim in a essentially private tribunal for damages. These claims, especially if they are settled because of threat of high damages or uncertainty in result, have a chilling effect on otherwise reserved sovereignty over natural resources and water. For example, when Newfoundland rejected AbitibiBowaters claim to water rights that were tied to the termination of its timber contract, the company filed a NAFTA claim for $467.5 million, and rather than risk a ruling, the federal government settled for $122 million.[40]

b. Comments and Recommendations

Politiques Alternatives; *Table of Foreign Investor-State Cases and Claims under NAFTA and Other U.S. 'Trade Laws,'* Public Citizen, April 2015.

[36] Declaration on Water Resources and NAFTA, signed by Canada, Mexico and United States, Dec. 2, 1992, 32 I.L.M. 289 (1993); *see* Olson, *All Aboard, supra*, at 187 and accompanying footnotes.

[37] *Id.*

[38] See James M. Olson, *All Aboard, supra,*, at 187.

[39] Compact, Sec. 1.2, definition of "product."

[40] Public Citizen, *Table of Foreign Investor-State Cases, supra;* AbitibiBowater Inc., p. 19; The Toronto Star. *"Ottawa pays Abitibi $130M to settle claim."* (August 25, 2010); Kathryn Leger. *"AbitibiBowater wins NAFTA case vs. Ottawa."* THE GAZETTE (MONTREAL), (August 27, 2010)

The point is straightforward: There have been new arguments and an increase in claims under NAFTA that strongly suggest that states should explore what other supplemental or "backstop" defenses can be expressly articulated as declarations of law and policy to prohibit or minimize the risk of potential investor-state claims.[41]

Two ways to do this are (1) to expressly declare and serve notice to all that the Great Lakes and tributary navigable waters are subject to and protected by the sovereign authority and power reserved to the states and provinces under the public trust or trust in the public's right to navigation and fishing, or other related public resources and other public interests and uses; and (2) to establish a baseline on principles that restrict diversions or exports under the common law of riparian and groundwater as described and recommended above.[42]

Conclusion and Summary

The foregoing comments supplement the recommendations in the Draft Water Strategy Plan. They are intended to address background information and principles that affect the analysis and recommendations of the current draft plan. The analysis, comments and recommendations center primarily on a unifying framework for inspiring stewardship and cooperative common governance of water based on public trust principles to better understand and prepare for uncertainties from increases in global, national and regional demand for water and water scarcity, new scientific models for holistic or integrative approaches to protecting the entire water cycle or hydrosphere through effects on the arc of waters that flow on, in, over the earth, and the energy, food, land use and population "nexus. However, most all of these comments and recommendations touch on or promote the other recommendations in the Water Strategy Plan, such as vibrant waterfronts and coast lines, protecting water-based recreation, protecting investments in water infrastructure, and water-based economies.

FLOW wishes to thank the Michigan OGL, DEQ, DNR, and the DARD for their work in preparing the draft Water Strategy Plan and the opportunity to submit comments. Should you or others have questions or want to meet concerning these comments, please do not hesitate to contact us.

Sincerely yours,

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[41] M.A. Salman, *International Trade Law Disputes: New Breed of Claims, Claimants, and Settlement Institutions*, International Water Resources Association, 31 Water International pp. 2-11 (March 2006), with David Johnson, *Water and Exports under NAFTA, Law and Government Division*, 8 March 1999, PRB 99-5E <http://publications.gc.ca/collections/Collection-R/LoPBdP/BP/prb995-e.htm>, who lays out the government position and arguments about water as a "good" or "product" under international trade laws, including NAFTA.

[42] See Sec. 5, Water Law Recent Developments and Comments and Recommendations.

FLOW (Flow for Love of Water)

By:

James Olson
President and Founder

Elizabeth Kirkwood
Executive Director

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2. The United Nations World Water Development Report. *Water For a Sustainable World.* 2015 http://unesdoc.unesco.org/images/0023/002318/231823E.pdf

3. U.S. Department of Energy. *The Water-Energy Nexus: Challenges and Opportunities.* (June 2014) http://energy.gov/sites/prod/files/2014/07/f17/Water%20Energy%20Nexus%20Full%20Report%20July%202014.pdf; *see also* http://waterinthewest.stanford.edu/sites/default/files/Water-Energy_Lit_Review.pdf

4. See Great Lakes Commission, *Integrating Energy and Water Resources Decision Making in the Great Lakes Basin: An Examination of Future Power Generation Scenarios and Water Resource Impacts.* October 2011. http://glc.org/files/projects/glew/GLEW-Phase-I-Report-FINAL-2011-11.pdf; *see also* Michigan Office of Great Lakes. *Sustaining Michigan Water Heritage: A Strategy for the Next Generation.* (Draft June 5, 2015). http://www.michigan.gov/documents/deq/deq-ogl-Draft_Water_Strategy_and_Appendices_06-04-2015_491266_7.pdf

5. Food and Agriculture Organization of the U.N., *The Water Energy Food Nexus: A New Approach in Support of Food Security and Sustainable Agriculture.* (June 2014) http://www.fao.org/nr/water/docs/FAO_nexus_concept.pdf

6. Compact, Sec. 1.2. The withdrawal of water for agriculture is a classic consumptive use. So is use of water in traditional or historical oil and gas development within the basin.

From: Dawn
To: mi-waterstrategy
Subject: Comments on Draft Water Strategy
Date: Friday, August 28, 2015 11:51:59 PM

I am a board member of ***The Presque Isle Alliance for the Protection of Watershed and Natural Resources***, a private non-profit in Presque Isle, MI. I have the following comment on the water strategy plan.

New mines and quarries are effectively exempted from local zoning control except where they lead to "very serious consequences" under MCL 125.3205. This removes local control and input from the proper location of extractive activities, which have been shown to cause significant water pollution and serious impacts to lake levels due to reduction in watershed and dewatering activities. Our input into the Water Strategy Plan is to return to local authority on zoning for mines and quarries by repealing MCL 125.3205.

Thanks you for your consideration.
Dawn L. Solomon

Sent from my iPad

From: Alice Jennings
To: mi-waterstrategy; Alice Jennings
Subject: DEQ-MI Water Strategy
Date: Saturday, August 29, 2015 9:08:30 AM
Attachments: MI Legislature - Hearing on Water Affordability(3).docx

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Please find input from Detroit on Michigan's 30 year water strategy. Thank you, Alice Jennings

Sent by Outlook for Android

Michigan Legislature

Hearing on Water Affordability and Safety

June 3, 2015
10:00 a.m. – 11:30 a.m.

State Capitol

Convened by Representatives Stephanie Chang (Detroit)
Shelton Neeley (Flint)
LaTanya Garrett (Highland Park)

In Partnership with the Detroit Caucus and Flint Delegation
of
The Michigan Legislature

Alice B. Jennings, Esquire
Edwards & Jennings, P.C.
Detroit, MI

Thank you Representatives Stephanie Chang, Shelton Neeley and LaTanya Garrett for bringing us here today to testify about one of the most fundamental issues of our time, in our great state, affordable, safe and accessible water.

As you know, Michigan is surrounded by five great lakes, or twenty (20%) percent of the fresh water in the world. Yet, Detroit, Michigan, and other urban cities are experiencing a humanitarian and public health crises. Since January 1, 2013 over fifty-three (53,000) thousand Detroiters, residential customers of Detroit Water and Sewerage Department (DWSD), had water and sewerage abruptly terminated to their homes. We know from FOIA requests and Director reports authored by Director of the DWSD, Susan McCormick, that of the thirty-three (33,000) thousand shutoffs occurring in 2014, only approximately eighteen (18,000) thousand homes were restored to service by the end of the year.

This year alone, another several thousand residential homes have experienced the trauma of water service termination. Another thirty thousand homes are scheduled for shutoff in the next season of shutoffs, affecting tens of thousands of Detroiters. In her most recent May 2015 report Director McCormick states how the 2015 shutoffs are now well on their way:

> "From January 2015 to April 11, 2015, 13,303 accounts were checked for possible illegal usage, and 5,794 of those accounts were found on illegally and were re-shut.
>
> Since May 11, 2015, the Department posted 2,882 door hangers notifying customers of pending shut off of services; a total of 794 of those customers have either paid bills, or entered into a payment plan agreement. Currently, there are a total of 30,766 active payment plan agreements with a total combined balance of $25,106,446.53."

I cannot advise you of the exact numbers of Detroit children, disabled, elderly or others at risk Detroiters living in houses without water, though we know almost 15,000 homes were not restored to service by December 31, 2014. It is **unconscionable** that no analytical tool, study or review has been created by state or local government prior to the shutoffs, or at any time to capture the data on the social demographic of the inhabitants in the shutoff homes. We know that after 2007 no comprehensive collection effort was made by DWSD through a shutoffs policy; instead DWSD relied on placing the water bill on the Wayne County tax roll of the property. Wayne County would pay the DWSD bill until a sale through foreclosure allowed Wayne County to receive its payment back. This resulted in many citizens, at the time of water shutoffs, having residential bills in the thousands of dollars.

What we know, from the groundwork of community organizing performed by non-profit social justice organizations in Detroit: Michigan Welfare Rights Organization, Peoples Water Board Coalition, We the People of Detroit, National Action Network, Moratorium Now, and thousands of dedicated volunteers, is that human pain and suffering has occurred and continues to occur in Detroit. DWSD service increases and "payment plans", which are <u>not</u> based on affordability, are not sustainable and the track record in 2014 and 2015 is failure. If the

"assistance programs" were successful, another thirty thousand homes would not be at risk for shutoffs. Not having water service immediately makes a home uninhabitable under Detroit ordinances. Children under State law can be immediately taken from their parents or family and placed under protective services. Fear, humiliation and embarrassment are not uncommon where water has been shut off for non-payment. Public and private sanitation risks are magnified where no water sanitation is available in the home.

Reliance on the water bill going to Wayne County's Tax Collection Department, gave many Detroiters a way to buy food, medicine, pay rent or other expenses, while paying only part of their DWSD bill. In the case of landlords, money was collected in rent; but the water bill was not paid. DWSD's bills grew to thousands of dollars, particularly for low income Detroiters living below the federal poverty level.

The water shutoffs of 2014 were very harsh indeed. In mid-2013 a contractor, Homrich Wrecking, was hired to perform the shutoffs at a cost of five million six hundred thousand ($5,600,000.00) dollars. In April 2014, the DWSD shutoff policy required shutoff if the bill was 2 months late or over $150.00. A majority of Detroiters were at risk for water shutoff.

Recently, in May of 2015, in the face of the Detroit City Council voting to place a moratorium on water shutoffs, until a plan of action could be devised to address families with affordability issues prior to the shutoffs occurring, the DWSD's Board of Water Commissioners voted to extend the Homrich contract by another $1,000,000.00 or to 6.4 million dollars.

The early 2014 Detroit water and sewerage shutoffs occurred and will continue this year where a constellation of other economic and social hardships affect Detroiters:

Poverty – 39.3% of households lived below the federal poverty level. Considering employed Detroiters, the United Way's September 2014 study shows a review of working Detroiters, using 2012 data of "Asset Limited, Income Constrained, Employed" (ALICE), to be 29% of Detroit households that struggle to afford basic household necessities. Over 60% of Detroiters were already in severe financial hardship when the water shutoffs escalated in April 2014:

Unemployment – rates of 12.2% twice as high as other Michigan cities.

Foreclosures – Detroiters were hit hard by predatory lending practices of banks. The banks' targeted homeowners, who had paid off or were close to paying off their homes. Many of these homes were owned by senior citizens, many retired. This year 62,000 homes in Detroit were foreclosed in Detroit alone, up from 52,000 in 2014, and 42,000 in 2013 and 2012.

Bankruptcy – filed in July 2013, by Governor Snyder's Emergency Manager, immediately changed medical co-pay coverage for thousands of Detroit employees and retirees; in some instances several hundred dollars per month.

Bond Payout - Detroit Water and Sewerage Department paid over 500 million dollars for bond swaps to Wall Street when Detroit's bankruptcy triggered early interest payments.

Medical Conditions – Detroit has highest rate of childhood asthma in Michigan; three (3) times the state average.

Racial Disparity –Detroiters, 85% African Americans, are predominantly long term core city dwellers. The lack of city services affected African American population in a disproportionate way, compared to downtown and midtown Detroiters.

Cost of a Basic Necessity - Water – Going up, up, up each year. A DWSD chart shows the water/sewerage combined rate increase each year since 2001[1]. In June 2014, the water and sewerage rates were increased 8.7%. DWSD's proposed combined rate increase (12.8% waste water, 3.4% more in water and 16.7% increase in sewer rates) is scheduled for implementation in July 1, 2015.

Crumbling Water/Sewerage Infrastructure – Placed the costs of repairs and replacement almost 83% squarely on the bills of Detroit residents. Waste water ran unabated in thousands of empty, blighted properties. A estimate of waste water given by Assistant DWSD Director Daryle Latimer, is that 28% to 42% of all water running in Detroit is "waste water" or "non-revenue water" because of the decrepit DWSD infrastructure.

Dishonest Landlords – Renters paid rent, while property owners did not pay water bills.

In mid-2013 the city's contractor began to aggressively shut off water service to homes. By April 2014 the DWSD contractor continued sweeping through Detroit streets in a military fashion. Without following the due process requirements included in its Interim Collection Rules and Procedures of 2003, specifically rules on notice and medical waivers, the contract trucks started at one end of the blocks and shut off water to half or three-fourths of Detroiters on the same blocks. The contractor left a blue stigmatizing mark, spray painted on the water cap and many sidewalks. Thousands of Detroiters' water services were terminated each month after mid-2013.

As the crisis phone calls began to pour into various non-profit organizations, Michigan Welfare Rights Organization, the Peoples Water Board, We The People, Moratorium Now, and other, Detroiters began to take action. First they reached out to help. An international expert, Maude Barlow, from Council of the Canadians; and Charity Hicks (deceased), a "water warrior" from the Detroit People's Water Board; Food and Water, Watch and members of Circle of Blue, moved by the humanitarian crisis, filed a complaint with the United Nations.[2]

Testimony From Detroit

[1] After the 2004 increase the Colton Detroit Water Affordability Plan was created with the Ann Arbor Poverty Law Center, Michigan Welfare Rights Organization and Michigan Legal Services.

[2] Later in October 2014, two United Nations Special Rapporteurs, Lelani Farha and Catarina de Albuquerque made a three day fact finding visit. The United Nations report by the Special Rapporteurs state the Detroit water shutoffs violate the human rights of Detroiters and creates a public health crisis.

A civil and human rights lawsuit was filed on July 21, 2014. The *Lyda et al v City of Detroit* lawsuit was brought by ten Detroit families experiencing water shutoffs; with Constitutional Due Process and Equal Protection Counts[3], Health and Safety Counts and a Count on Public Trust and Human Right To Water.

Organizations with thousands of Detroit citizens affected by the shutoffs, Michigan Welfare Rights Organization, Peoples Water Board, Moratorium Now and Michigan Chapter of the National Action Network, became organizational Plaintiffs.

The pro bono committee of human rights lawyers from across the country heard of very tragic facts[4]:

- A mother of three, Nicole Hill, one of the Plaintiffs in the *Lyda* case, with an Eight Thousand ($8,000) Dollar water bill, sent her children to stay with relatives after the water was shutoff to her residential home. Mom stayed in the house. The little girl, age 7, got up in the middle of the night and decided she wanted her mother. Determined, she left her Aunt's home and walked out into Detroit streets at 2:00 a.m. An angel, a Good Samaritan saw the little girl and called the police. After talking to the child at 3:00 a.m., the police delivered the child to her mother. Crying, the child stated, "Mommy don't make me leave you again!" Ms. Hill was hospitalized with a severe viral infection for over a week after her water was cut off for a second time, again without notice. Ms. Hill's water bill is inconsistent with bills ranging from $27.00 to $689.00 in the last eight month period. Ms. Hill has received water bills during the timeframe when her water service was terminated.

The inhumane facts exposed in the *Lyda et al v City of Detroit* complaint and Plaintiffs' Motion for Injunctive Relief held in September 2014 are tragic:

- Denise Donaldson submitted a Declaration in support of an injunction of water shutoffs. Ms. Donaldson's mother was bedridden and required tube feeding. No provision for medical waiver was stated to Ms. Donaldson when she contacted DWSD about her water shutoff.

- Tracy Peasant, a putative Plaintiff in the *Lyda* case, and a DWSD customer, testified on September 22, 2014. Ms. Peasant's DWSD bill resulting from two (2) homes she rented, one with serious plumbing problems which the landlord would not repair, is over Eight Thousand ($8,000.00) Dollars at the time of shut-off in 2013. Ms. Peasant testified that she and her daughter and grandchildren lived in a home with eight (8) children, ages ranging from 15 to 1. Two of the children have asthma. Ms. Peasant is disabled due to injuries to her back and leg.

[3] Commercial customers, some with several hundred thousand dollars in overdue ills, were not subject to the same abrupt DWSD shutoff policies.

[4] A committee of civil rights and human rights attorneys from around the country, the NAACP-Legal Defense Fund, National Lawyers Guild, American Civil Liberties Union, Sugar Law Center, civil and human rights law firms and organizations.

From September 2013 to June of 2014, Ms. Peasant and her family, with an income of less than $700.00 per month, lived in a home without water, attempting to make do with big bottles of purchased water. Only in June 2014, after a "guardian angel" from the DWSD checked to make sure the water remained off, was Ms. Peasant's water restored. The DWSD employee stated after seeing so many children outside, "This is wrong!"

Though Ms. Peasant reached out to non-profit sources for help based on information she received from DWSD, no organization would assist her because her DWSD bill was over $2,500.

Ms. Peasant's water and sewerage was again shutoff in **April 2015**. DWSD requires that she pay $800.00 on her bill, money she does not have. No one from DWSD surveyed her prior to shutting off the water to determine her ability to pay or whether or not children or disabled adults lived in the residence. Despite attempts to obtain assistance, she is not eligible for assistance because her bill, due to plumbing not repaired by her landlord, is now $8,000.00.

Ms. Peasant testified she was not looking for free water, but an affordability plan similar to her utilities payment plan for electricity and gas, which she pays every month, based on her limited income.

- Maurikia Lyda, the lead Plaintiff in the water shutoff lawsuit, testified that she is a customer of DWSD. Ms. Lyda describes her income as low income. Ms. Lyda lives with her four children ages 14, 13, 10 and 5. The children attend public school. Ms. Lyda is a renter.

In June of 2014 Ms. Lyda's water service was cut off. The bill was $1,000.00. Ms. Lyda testified the day her water was shut off no one knocked on her door and advised her that the service was being disconnected. She noted that several other homes in her low income" neighborhood were also shut off.

Ms. Lyda describes how she called DWSD several times, staying on the line two (2) or three (3) hours without assistance, after she received notice that her water was being shut off. After Ms. Lyda went to a DWSD location she was told she had to pay $500.00 on the $1,000 bill and to have the bill removed from her landlord's account and put in her name. Plaintiff's water was shut off approximately one month prior to the morning that Plaintiff filed this lawsuit.

After the water was shutoff Ms. Lyda's children were sent to live with other relatives. Ms. Lyda was fearful that State of Michigan "protective services" would remove her children from the home if it was discovered there was no water in the home. Ms. Lyda describes a blue paint used to mark her home on the day the water services were terminated, which did not come off "that quick".

Though Ms. Lyda's water service was restored on June 21, 2014, without a payment, due to her litigation, she continued to seek help. After several months she received assistance from "Metro". Her bill for September 2014 was $424.00. At the September hearing Ms. Lyda's water was again subject to shut off after September 9, 2014. Ms. Lyda only learned of the shut off after calling DWSD, as she had not received a bill mailed to her home.

- Carol Ann Bogden testified on September 22, 2014 that she is a senior citizen, age 67, living alone on Social Security Disability. At the time of the hearing on September 22, 2014, her water service remained disconnected, from its shutoff date of July 11, 2014.

Ms. Bogden got behind in her own bills attempting to help a disabled adult son with major medical conditions. Ms. Bogden testified she would heat water from bottles on the stove to attempt to bathe herself and to live without running water.

The day of the shutoff Ms. Bogden reports a blue line was painted in front of her home. "I was really embarrassed. I started to cry. I thought that was done and over with back in the Second World War".

Ms. Bogden, though she had 10% to pay on her $1,006.00 bill, was not allowed to enter a payment plan because she did not have a current identification. Her purse had recently been stolen. DWSD refused to accept other forms of identification and at the time of the hearing in September 2014 would not allow her to enter a payment plan in person or by phone.

To get help on her $1,000.00 plus bill Ms. Bogden contacted THAW, United Way, Salvation Army, and Department of Human Services, none of the organizations had funds to assist her. Ms. Bogden indicated even if she was allowed to pay $90.00 a month on her overdue bill "it's going to be very hard", because it has nothing to do with her current bills.

- John Smith, a named Plaintiff in the Lyda litigation, testified in the September 22, 2014 hearing. Mr. Smith lives with his mother, a senior who suffers from lupus and heart problems. Mr. Smith is purchasing his home on a land contract. On or about late January 2014, DWSD shut off Mr. Smith's water services for a $1,099.99 bill. At the time of the water termination no one from DWSD advised Mr. Smith that his water would be cutoff that day, or asked if there was a disabled person in his home. Prior to the shutoff Mr. Smith was having trouble paying his water bill due to a layoff from his employment. Mr. Smith contacted organizations for help, but was denied assistance. During the five (5) months, Mr. Smith and his mother were without water service and he would buy bottled water or take a pail and borrow water from his neighbors.

Like Ms. Lyda, Mr. Smith's water was restored after he filed the litigation. Mr. Smith testified he is now back to work, but is still unable to pay the $1,000.00 bill. His new job pays income of only about $900 per month. Because Mr. Smith is so behind in his bills, he cannot pay the full amount of his water bill.

Mr. Smith testified he is not looking to get free water, but believes his payment plan should be a reasonable percentage of his income. Mr. Smith testified on September 22, that DWSD was going to have his water shut off again on September 23, 2014, according to a bill he saw in Court. He had not seen the bill before. Mr. Smith stated he would not be able to pay his bill and was at risk of having his and his mother's water terminated again.

- Nicole Cannon (deceased), a putative Plaintiff, testified on September 22, 2014 in the TRO hearing. Ms. Cannon testified that she was renting her home through Section 8 low income housing, but because she was paying part of her own rent, she did not receive any assistance with her utilities. Ms. Cannon testified that she receives Social Security Disability in the amount of $648.00 per month.

In 2014, Ms. Cannon's water bill was over $3,000.00, which she states resulted from a leak in the home. Though Ms. Cannon attempted on several occasions to have her landlord fix the leak, it was not done. Under Section 8 HUD rules, Ms. Cannon testified that even though she was renting, she was required to have the water bill in her own name.

Facing shut off of her water service in early 2014, Ms. Cannon paid $382.00 on the $3,000.00 bill in order to keep her water service from shut off. She paid this amount out of her $648.00 Social Security check. At the hearing, Ms. Cannon testified that she must now pay approximately $241.00 per month on her present and past water bill for a period of 24 months, to keep her water service from shut off. Ms. Cannon testified she would not be able to pay the $241.00 per month on her present and past water bill for a period of 24 months, to keep her water service from shut off. The current arrangement is not sustainable and she would likely face shut off of her water again, even though she was aggressively looking for help.

Ms. Cannon described her medical disability as sarcoidosis. She explained that she would not move out of her present home, with the $3,000.00 bill, because the present "bill is too high for me to move and relocate and I would have to take the bill with me".

Tragically, in January of this year Ms. Cannon, at age 44, died, leaving three children. The last few months of her life, Ms. Cannon struggled each month to "make ends meet".

- Chara Reynolds a putative Plaintiff, in this matter is a DWSD customer. Ms. Reynolds earns approximately $600.00 per month. Ms. Reynolds at the injunction hearing learned for the first time that DWSD had placed her in a payment plan presumably in anticipation of her testimony at trial.

Under the "payment plan" Ms. Reynolds would be required to pay both current bills and a part of the arrearages, approximately $170.00 per month. Ms. Reynolds testified that she would have a problem keeping up with a DWSD payment plan which was such a large percentage of her pay. Specifically, where here rent is $210.00 per month and her other utilities $300.00 per month.

Ms. Reynolds testified because of her mortgage terms, overdue water bills, if not paid, jeopardized her ability to keep her home, placing her in a position of default which can lead to tax foreclosure if she is unable to make the payments.

Plaintiff's Expert Testimony on the Water Shutoff Public Health Crisis

On September 22, 2014, Roger Colton, the author of the Detroit Water Affordability Plan, testified in the *Lyda* hearing for injunctive relief, that adoption of his DWAP plan would actually increase the amount of DWSD revenues. Roger Colton will testify at this hearing.

Plaintiffs, on September 22, 2014, presented testimony from George Gaines, MSW, MPH, the former Deputy Director of the City of Detroit Health Department. Mr. Gaines opined that the massive shutoffs, 24,000 in 2013 and 23,000 by September 2014, created a public health emergency:

> That means that you also don't have any water to wash your hands, and so you begin to think immediately about what diseases that would result from insanitary ways of defecating and I have a list of hepatitis, which is focally orally related. Salmonella which is focally orally related from people who defecate and do not sanitize their hands and comes in contact with water or food. Carditis. . . all of these diseases are communicable.

- John Armelago, R.N., at University of Michigan Health Center, testified on September 22, 2014, for Plaintiffs in the Motion for Injunctive Relief. In describing the medical impact of lack of water on human health, R.N. Armelago testified, "water service has a number of functions. One is hydration, one is hygiene, and one is sanitation." R.N. Armelago further testified that dehydration, body temperature regulation, joint mobility and central nervous system are all affected by lack of water. Most vulnerable are "the very young and the elderly, especially if the elderly are infirmed."

Regarding hygiene, R.N. Armelago testified that "hand washing is one of the first lines of defense in regards to diminishing the possibility of communicable disease.

- Maureen Taylor, MSW, President of Michigan Welfare Rights Organization (MWRO), testified on September 22, 2014, regarding the work of MWRO and its water shutoff water hotline, which received forty or more calls of water shut off per hour after the aggressive campaign began in April 2014. Ms. Taylor, a school social worker, testified about children attending school without water in their homes.

Ms. Taylor described one case of a DWSD customer who lost her job, had her water shut off; and then her children were taken and placed in foster care by social services. Ms. Taylor, describing her job as a school social worker, testified that she has moved families into homeless shelters or church basements to obtain temporary shelter until water is restored. Parents with children, whose water services were terminated, fear Child Protective Services. If Child Protective Services is notified, it can result in a child or children being removed from their home.

Ms. Taylor described the August 2014, Mayor's 10 Point Plan, created after this lawsuit was filed, as "woefully inadequate", based on the population being a fixed low income. "Folks that didn't have enough money in the beginning can't pay regular bills plus an addition".

In Detroit, in addition to large street protests attended by Detroiters, Michiganders and International Supporters against water shutoffs, Detroiters led by ministers, affected citizens, and human rights activists have been arrested for civil disobedience by blocking the contract trucks from leaving their central yard. The trial for these brave activist is expected in August of 2015.

The *Lyda* case is now on appeal. We have been supported by an Amicus Curie Brief filed by international attorneys from ESCR-NET – International Network for Economic Social & Cultural Rights.

Solutions

- State of Michigan Legislation addressing water affordability, accessibility and safety. The legislation should create a database reporting mechanism for the location and number of homes shutoff from water and sanitation with human inhabitants with protection for children, elders and the disabled. Affordability would be based on income; each residential customer's or family's ability to pay.

- Federal Legislation establishing a policy on water and sewerage affordability, based on each residential customer's ability to pay, requiring each state in the U.S. to have statutes on affordability, accessibility and safety.

- A federal dedicated source of funding to the Drinking Water State Revolving Fund and a renewal of the Build America Bonds Program to address aging water and sewerage infrastructure, which is but one of the reasons for rising costs, passed on to residential customers.

- In Detroit, Michigan, implement by ordinance the original Detroit Water Affordability Plan (2005) created by expert Roger Colton.

- In Detroit, Michigan, an immediate assessment of the number of Detroiters living in homes without water, including a survey of the number of children, disabled, elderly and other at-risk citizens, with a review of public health and safety issues. Restore all water service and then determine eligibility for assistance programs, in one stop, including federal and state assistance. Only if it is determined that the person has the ability to pay, but has not, will the water and sewerage services be terminated.

- In Detroit and Highland Park create a comprehensive DWSD Policy and Procedure for shutoff of residential and commercial accounts.

- Stop all water and sewerage shutoffs until DWSD has implemented policies and procedures addressing shutoffs by implementing the Colton, Detroit Water Affordability Plan.

- Declare an Amnesty on Detroit criminal prosecutions for "alleged water thief"; decriminalize the use of water as a "necessity"; instead evaluate Detroiters charged with water thief for financial assistance and affordability based on what Detroiters can afford to pay. Turn an alleged criminal into a contributor.

- Stop the stigmatization of families by spray painting the front of their homes with blue or yellow paint, when their water and sewerage is cutoff or threatened with shutoff.

WATER IS A HUMAN RIGHT!
Thank you.

Alice B. Jennings

From:	George Carr
To:	mi-waterstrategy
Cc:	Bud Sebastian; Richard Layman
Subject:	Comments from MGWA
Date:	Monday, August 31, 2015 2:09:16 PM
Attachments:	MGWA Response to Draft Water Strategy.pdf

Please accept the following comments and include them in the record.

Thank You

MICHIGAN GROUND WATER ASSOCIATION, INC.

Representing Michigan's Water Well Drilling Industry

601 Dempsey Road • Westerville, OH 43081

Phone (855) 225-6492 • Fax (614) 898-7786

e mail: michigangroundwater@comcast.net *web site: michigangroundwater.com*

Dear Mr. Allen

August 28, 2015

Michigan Office of the Great Lakes:

Since 1928, the Michigan Ground Water Association (MGWA) and its members have been on the front line as defenders of Michigan's water, our state's most precious resource. Many of our current members represent the fifth or sixth generation of hard working, knowledgeable well drillers dating back to the late 1800's. From the beginning of our group's inception, we have held tight to our motto: To PROVIDE, to PROMOTE, and to PROTECT Michigan's ground water. We applaud the State of Michigan's efforts in the 30 Year Water Strategy to share in MGWA's efforts and goals.

MGWA is pleased to hear the State wants to again make remediation of contaminated ground water sites a priority. Clean, natural ground water is vital to Michigan's economy. Reclaiming areas that have been previously damaged increases Michigan's vitality and keeps us on path to a sustainable future.

MGWA also welcomes the idea of providing controls to the installation of closed loop geothermal systems. These unregulated vertical borings pose a significant threat to Michigan's aquifers.

While the MGWA was not contacted for input into the first draft of the Water Strategy, our experience and knowledge is a vital component to developing Michigan's vision for water policy. The June 2015 Draft of the Water Strategy gives very few details in regards to specific targets related to ground water. That fact makes it difficult for our organization to give any detailed changes at this point in time.

In reading the document, however, there are items and issues that raise concern for our membership and all of the private well owners we represent in our state:

- Fracking is not mentioned in the document. While MGWA is neutral on the issue of fracking at this point in time, the process uses large quantities of ground water and has the potential to influence water quality in surrounding wells and aquifers.
- MGWA knows better than any other group the vast diversity of the state's hydrogeology from one area to another. Any water strategy needs to reflect that diversity and understand that what applies in one region of our state does not necessarily represent the entire state.
- Page 50 reads, "Michigan lacks a coordinated and comprehensive strategy for monitoring groundwater quality and quantity to improve understanding of this valuable resource, reduce threats of contamination, and guide better investments and decisions."

MGWA supports scientific research in understanding our resources. The Water Strategy must emphasize the use of real, verifiable, observed data for its research. This data in turn needs to be reviewed in a public forum with real peer reviewed science. The current process of using massaged computer calculations of crude, archaic data (as is the case in the Water Withdrawal Assessment Tool and the current Ottawa County Water Study) only produces fool's gold with no meaningful results. True assessment of the state's hydrogeology requires regional and site specific geological profiling by qualified experienced professionals using proven industry standards.

- On the topic of "Invest in Water Infrastructure" on pages 41-45, the Water Strategy addresses the issues regarding the aging infrastructure that exists in all area of our state. MGWA acknowledges that concern for our state's and local communities' future budgets. The Water Strategy needs to in turn acknowledge that private well owners assume all costs associated with the proper installation, maintenance, and abandonment of their water systems. Private well owners need to be recognized as independent and not viewed as a possible revenue stream (through taxing of water and/or mandatory municipal water connections) to fund these infrastructure repairs.
- Most important, the Water Strategy needs to acknowledge and continue Michigan's proud history and case law recognizing Riparian and Ground Water rights. Michigan property owners have and need to continue the right to the reasonable use of the water under their land. The notion that landowner water rights need to be surrendered to be protected needs to be specifically rejected by any Water Strategy for Michigan.

MGWA looks forward to future discussion on the Water Strategy and being an integral part in its development. While MGWA cannot support the Water Strategy as drafted, we welcome beginning discussions with your office and the agencies of our state to PROMOTE, PROVIDE, and PROTECT our ground water.

Sincerely,

Richard Layman
President
Michigan Ground Water Association

From: Finnell, Emily (DEQ)
To: mi-waterstrategy
Subject: FW: Info to forward to Joe Fitzsimmons
Date: Thursday, September 03, 2015 8:47:01 AM

Emily Finnell
Office of the Great Lakes | MI Department of Environmental Quality
PO Box 30473
Lansing, MI 48909
finnelle@michigan.gov
517-284-5036

From: Allan, Jon (DEQ)
Sent: Thursday, September 03, 2015 8:44 AM
To: Finnell, Emily (DEQ)
Subject: Fwd: Info to forward to Joe Fitzsimmons

Add to comments on water strategy.

Jon W Allan, Director
Office of the Great Lakes

Office 517.284.5034

Begin forwarded message:

> **From:** "Thelen, Mary Beth (DEQ)" <THELENM2@michigan.gov>
> **Date:** September 2, 2015 at 1:29:32 PM EDT
> **To:** "Allan, Jon (DEQ)" <AllanJ@michigan.gov>
> **Cc:** "Vaughn, Kari (DEQ)" <VaughnK3@michigan.gov>
> **Subject: FW: Info to forward to Joe Fitzsimmons**
>
> FYI as needed.
>
> Mary Beth
>
> Mary Beth Thelen
> Management Assistant to Director Dan Wyant
> Department of Environmental Quality
> Constitution Hall, 6th Floor South
> Phone: 517-284-6712 or 284-6700 (new numbers)
> Fax: 517-241-7401
> Thelenm2@michigan.gov
>
> ---
>
> **From:** Creal, William (DEQ)
> **Sent:** Wednesday, September 02, 2015 1:19 PM
> **To:** [redacted]
> **Cc:** Washburn, Bruce (DEQ); Wyant, Dan (DEQ)
> **Subject:** Info to forward to Joe Fitzsimmons

Thank you for your email and we appreciate your concerns. We are very aware of the potential environmental risks Concentrated Animal Feeding Operations (CAFOs) pose to the waters of Michigan and have worked to ensure the practices utilized by farms are protective of water quality. Currently, Michigan has about 260 such farms that are covered by our NPDES permits. Michigan is one of few states that requires that all CAFOs be covered by NPDES permits.

The NPDES permit already does not allow application to saturated fields and/or when heavy rain is forecasted. And we prohibit application to frozen and snow-covered ground except under very prescriptive requirements. Discharges resulting from an application to frozen and snow-covered ground are prohibited and when this occurs we take appropriate enforcement action. We have increased our focus on this and started an initiative last year to track wintertime applications to assess potential impacts and are continuing this effort. We are also working with partners to develop guidance and risk evaluations for farms not covered by the NPDES permit that choose to apply on frozen or snow-covered ground.

Your recommendation for municipal grade treatment is one that would take careful consideration. Land application of CAFO wastes may be more protective of the waters than allowing for a discharge of treated waste directly to surface waters. Permitted farms are required to be managed so that they do not discharge material that is harmful to our waters. There is a handful of farms that have installed advanced mechanical and in some cases chemical treatment to assist them in managing their CAFO wastes. A limited number of farms also have anaerobic digesters.

Thank you for your email and if you have specific instances that we can address, please let Bruce Washburn or I know.

Hi Joe:

Thanks for your efforts with League of Conservation Voters. Sabrina and I are very concerned that the state is really not dealing with the biggest water quality issue, CAFO's. Could you share these concerns with the governor? It is very disappointing to have the state marketing "Pure Michigan" and yet not dealing with a very critical water issue. CAFO's are not farms, they are factories processing food and making us deal with the waste. The EPA and DEQ should both be regulating them as such, not as farms.

Many state agencies recently put together a 30 year plan that outlines how Michigan plans to support high-quality water resources.

"Michigan's Water Strategy" (at link) is the summary of these efforts & unfortunately ignores the "Elephant in the Room",
15 CAFOs (Concentrated Animal Feed operations) in Michigan's portion

of the Lake Erie watershed that contribute untreated fecal waste, equivalent to the city of Boston.

Manure is only mentioned once in 160 pages of the water strategy, and that reference claims that manure only contributes nitrate. CAFO waste disposal applies the fecal waste, (concentrated dissolved Phosphorus, E coli, etc.) several times annually to land throughout the watershed, and this dissolved phosphorus threatens drinking water & contributes to the algal blooms in Lake Erie.

Although small farms still exist in Michigan, (and we boast about local, boutique farms), the reality is that nearly all of the dairy, eggs & meat at grocery stores (from small size to Costco), restaurants. hospitals, schools, and other institutions are sourced from CAFOs. Just as other industries are required to dispose of waste properly, factory farms should also be regulated.

MSU promotes a 4R *voluntary* program (Right Source, Time, Rate, & Place). Unfortunately factory farms do not comply with this voluntary program as the waste the animals generate is very huge quantities, and the least expensive option for their business model is to apply to the land over & over again. This waste creates a public health hazard and results in expensive water treatment costs for public drinking water (which impacts all of our wallets).

Progressive public health regulation of fecal waste from CAFOs would include:

1. **At the minimum, banning the application of manure (animal waste) on saturated or frozen ground or when heavy rain is predicted, implemented statewide by 2016.**
2. **Requiring municipal grade treatment of waste generated from Concentrated Animal Feeding Operations by 2020.**

Let me know if you are interested in a field trip to see the results of extensive CAFO waste applications, 1 hour west of Ann Arbor.

Thanks again for your hard work.
Doug and Sabrina Gross

From: Willi Water
To: mi-waterstrategy
Subject: Stormwater
Date: Wednesday, September 23, 2015 11:27:03 AM

Hello,

Is Macomb following Oakland's lead

https://www.oakgov.com/water/Documents/Standards/manufactured_treatment_systems_standards_update_2014.pdf

From:	Thomas Stephens
To:	mi-waterstrategy; dremcom@lists.d-rem.org
Cc:	Detroit Warriors; D-REM; PMA Group; D-REM Communications List
Subject:	Supplemental Comments - State Water Strategy
Date:	Saturday, October 03, 2015 8:24:58 AM

Dear Michigan Office of the Great Lakes:

I have received no response to the timely comments I filed on August 23 - not even any acknowledgment of their receipt. The State Water Strategy web site does not reflect any receipt or content of comments.

In the meantime, new test results regarding lead in the water and the bloodstreams of children in Flint have furthered revealed the true, basic nature and direction of state water policy.

I am now submitting a supplemental piece recently published (September 25) by Nick Dearden, Director of Global Justice Now, regarding the United Nations Sustainable Development Goals (SDGs), which raises parallel concerns expressed about the Draft State Water Strategy. It is extremely relevant and persuasive.

EXCERPT: "Unless you understand that the poverty of some flows from the wealth and power of others, efforts to fight poverty will not truly work."

Here is the link:
The UN Development Goals Miss the Point – It's All About Power

MORE EXCERPTS: "The real problem is that this wish-list comes with no historical background of how we got here, and no political strategy for how we get out. As such it relies on a mixture of more market and more technically competent governments. There's no sign that the economic model itself is broken – just that it needs some tuning.

Take one obvious gap: trans-national corporations. They aren't mentioned in the SDGs, yet the power of corporations is fundamental to the staggering levels of inequality which afflict the world, and are at the centre of an economic model quite prepared to burn the planet in its drive for ever more profit. It is impossible to realise the targets of the SDGs without tackling corporate power.

Nor is there any acknowledgment of colonial history, of slavery, of racism, of desperately unfair terms of trade, of structural adjustment policies which flushed dozens of countries' economies down the drain only 30 years ago ***[or of Michigan Emergency Management policies on the cutting edge of depriving our most vulnerable People of political agency, health and the means for life itself - TS]***. Far from critiquing the control of the market, the SDGs exhort world leaders to "remove market distortions" and "ensure the proper functioning of food commodity markets." ... ***[the same underlying flaw in the draft state water strategy document, as discussed at length in my***

original comments]

In short, power doesn't exist in the SDGs. The chapter on inequality nowhere mentions that the problem of poverty is inseparable from the problem of super-wealth; that exploitation and the monopolisation of resources by the few is the *cause* of poverty. Of course this lack of analysis isn't accidental. In the world of fighting poverty, of 'development,' corporations and the super-rich are no longer problems, but partners."

Thank you for your time and attention to this matter.

Tom Stephens
[redacted]

In Detroit, democracy and the rule of law were suspended by a brutal white supremacist, neoliberalizing corporate patriarchal takeover. For the barely concealed purpose of imposing the terrible costs and burdens of the Wall Street crash of 2008 on the most powerless and vulnerable among us.

http://www.counterpunch.org/2014/03/19/detroit-lives/

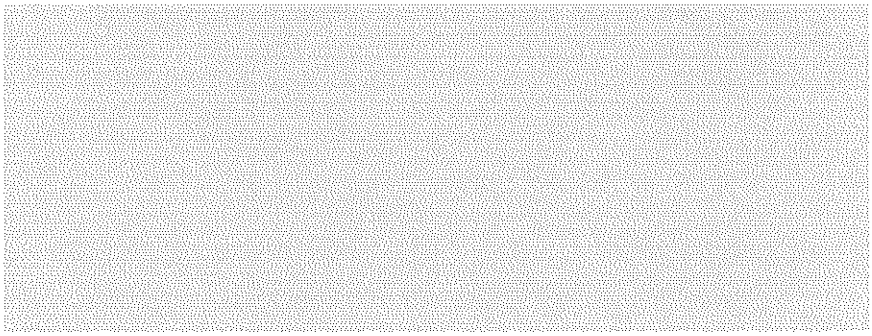
If you're going to kick authority in the teeth, you might as well use two feet. - Keith Richards

http://www.telegraph.co.uk/culture/music/music-news/10522722/Keith-Richards-21-of-his-best-quotes.html?

frame=2768039

From: Thomas Stephens [redacted]
To: "Mi-waterstrategy@michigan.gov" <Mi-waterstrategy@michigan.gov>
Cc: Detroit Warriors <commons-pwb-forum@lists.sierraclub.org>; D-REM <d-rem@lists.d-rem.org>; PMA Group <pmadetroit@googlegroups.com>; D-REM Communications List <dremcom@lists.d-rem.org>
Sent: Sunday, August 23, 2015 9:44 AM
Subject: [DREMcom] Final Comments on Draft State Water Strategy

"*... access to safe drinkable water is a basic and universal human right, since it is essential to human survival and, as such, is a condition for the exercise of other human rights.*"
–Pope Francis, Laudato Si' (P. 23 ¶ 30)



From:	Mark Cornwell
To:	Finnell, Emily (DEQ)
Subject:	Re: Draft Water Strategy Comments
Date:	Monday, October 19, 2015 10:44:35 AM
Attachments:	Water Quality Implications and the Toxic.pdf KimKoretsky2012.pdf

Thank you Emily,

Attached you will find a report that I just received this morning.

Another is recent research by Kim and Koretsky and others at Western Michigan University.

While I am not an academician, having read enough research I am growing more convinced of the implications of road salt connectedness to mobilization of heavy metals and possible even a link to liberation of phosphorus.

Best regards

On Mon, Oct 19, 2015 at 10:32 AM, Finnell, Emily (DEQ) <FinnellE@michigan.gov> wrote:

> Thank you for your interest in the draft Water Strategy. The Office of the Great Lakes received many thoughtful and in-depth comments both in electronic and hard copy format and has completed the process of reviewing and cataloging comments as part of the record. We will be working with our steering committee to make revisions and prepare a final strategy and anticipate a final strategy being released in late spring of 2016.
>
> We appreciate your comments and interest in the current and future of management of Michigan's water resources.
>
> Sincerely,
>
> Emily Finnell
>
> Office of the Great Lakes | MI Department of Environmental Quality
>
> PO Box 30473
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> Lansing, MI 48909
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> finnelle@michigan.gov
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Effects of road salt deicers on sediment biogeochemistry

Seon-young Kim & Carla Koretsky

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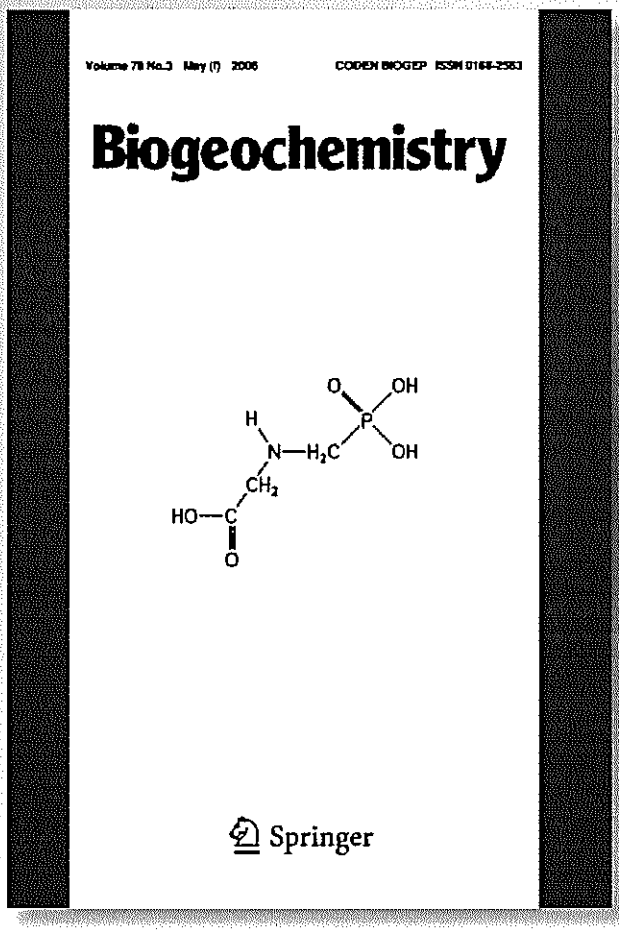

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Effects of road salt deicers on sediment biogeochemistry

Seon-young Kim · Carla Koretsky

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Abstract Road salt deicers, especially NaCl and $CaCl_2$, are increasingly applied to paved areas throughout the world. The goal of this study is to investigate the influence of high concentrations of these salts on wetland biogeochemistry. Sediment cores were collected in fall and spring from a freshwater wetland fringing an urban kettle lake (Asylum Lake, Kalamazoo, MI, USA), and incubated for 100 days in deionized water (control) or with treatments of 1 or 5 g/L $CaCl_2 \cdot 2H_2O$ or 5 g/L NaCl to simulate addition of road salt deciers. At monthly intervals, cores were sliced into three depths (0–5, 5–10, 10–15 cm) and pore waters extracted for analysis of pH, total alkalinity and dissolved Mn(II), Fe(II), PO_4^{-3}, NH_3, H_2S, SO_4^{-2}, Na, K, Mg, and Ca. Changes in solid phase geochemistry were assessed by measuring the percent organic matter and the distribution of Fe and Mn among four operationally defined sediment fractions (exchangeable, carbonate, reducible, oxidizable) in the control and treatment cores. Addition of NaCl, and especially $CaCl_2$, stimulated significant growth of microbial mats at the core sediment–water interface and led to decreased pH and increased concentrations of Mn(II), Fe(II) and exchangeable cations (Ca, Mg, K, Na) in the sediment pore waters. This study demonstrates that the influx of road salt deciers is likely to have a significant impact on biogeochemical cycling in wetland sediments.

Keywords Road salt · Deicer · Redox · Wetland · Anaerobic · Sediment

Introduction

Globally, the use of road salt deciers, typically NaCl and $CaCl_2$, has increased dramatically with urbanization and expansion of paved areas. For example, in the United States, ~164,000 tons of salt per year was used for deicing purposes in 1940 compared to >15,000,000 tons in the early 2000's (Salt Institute 2011). In Canada, an estimated 4,749,847 tons of NaCl was applied as a decier in 1997–1998 with levels of use in most provinces the same or increasing over the period from 1980 to 2000 (Environment Canada 2001). Road salt is also commonly used in Europe (e.g. Kjensmo 1997; Thunqvist 2003; Rodrigues et al. 2010; Galuszka et al. 2011) and Asia (e.g. Kayama et al. 2003; Kim et al. 2004).

Electronic supplementary material The online version of this article (doi:10.1007/s10533-012-9728-x) contains supplementary material, which is available to authorized users.

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Many adverse environmental impacts associated with road salt use have been reported. For example, investigators have demonstrated using both field and laboratory studies that road salt additions may result in decreased aquatic biodiversity (Tuchman et al. 1984; Bridgeman et al. 2000; Ramakrishna and Viraraghavan 2005), detrimental effects on amphibians (Sanzo and Hecnar 2006; Karraker et al. 2008) and changes in microbial community structure (Hale and Groffman 2006; Tiquia et al. 2007). Road salt additions also alter the chemistry and density structure of lakes, with important ecosystem consequences (e.g. Bubeck et al. 1971; Bubeck and Burton 1989; Kjensmo 1997; Bridgeman et al. 2000; Judd et al. 2005; Novotny et al. 2008; Koretsky et al. 2011), and there is increasing concern regarding the potential contamination of potable water supplies by deicers (e.g. Williams et al. 1999; Kaushal et al. 2005; Bester et al. 2006; Findlay and Kelly 2011).

Relatively little is known regarding changes in sediment biogeochemistry resulting from the enormous seasonal influx of NaCl, $CaCl_2$ and other deicing agents to wetland soils (e.g., Environment Canada 2001; Kelly et al. 2008). Both field and laboratory studies show that deicer additions may lead to increased concentrations of calcium, potassium and magnesium in wetland pore waters (e.g. Bauske and Goetz 1993; Norrstrom and Jacks 1998; Lofgren 2001; Norrstrom and Bergstedt 2001; Backstrom et al. 2004), and decreases in pore water pH (Lofgren 2001; Backstrom et al. 2004), presumably due to ion exchange processes. Backstrom et al. (2004) attributed seasonal decreases in the dissolved organic carbon concentrations of soil pore waters to the combined effects of coagulation and sorption of DOC resulting from decreases in pH and increases in dissolved Ca levels caused by influxes of road salt. Several studies have also suggested that addition of road salt deicers may increase trace metal mobility and bioavailability in soils and sediments. For example, increases in dissolved cadmium are attributed to release via ion exchange and to enhanced solubility due to the formation of aqueous cadmium-chloro complexes (Amrhein et al. 1992; Bauske and Goetz 1993; Lofgren 2001; Backstrom et al. 2004; Mayer et al. 2008; Nelson et al. 2009). Increases in dissolved Zn, Cu, Cr, Ni and Pb have also been documented in field and laboratory studies of soils and sediments impacted by road salt deicers (Amrhein et al. 1992; Bauske and Goetz 1993; Norrstrom and Jacks 1998; Lofgren 2001; Backstrom et al. 2004; Nelson et al. 2009). Considerably less is known regarding changes in organic matter degradation pathways or cycling of redox-sensitive elements such as manganese, iron and sulfur in wetlands impacted by deicers. Mayer et al. (2008) collected pore waters from Rouge River Pond bottom sediments (maximum water depth $\sim$4 m) with large concentrations of Na ($\sim$2,000 ppm) and Cl ($\sim$3,000 ppm) at the sediment–water interface due to road salt deicer runoff, and found elevated concentrations of Fe (up to 100 ppm) and Mn (up to 4 ppm) in the upper 40 cm of the sediments, suggesting that road salt could influence redox processes in wetland sediments and soils.

The objective of this study is to investigate changes in sediment pore water and solid phase geochemistry, especially major (Na, Ca, Mg, K) and redox-sensitive (Fe, Mn, S) elements, resulting from the application of NaCl and $CaCl_2$ deicers to wetland sediments. Sediments cores were incubated in deionized water, NaCl or $CaCl_2$ solutions to mimic the effect of runoff with high levels of road salt deicers. The evolution of the pore water chemistry (pH, total alkalinity, Fe(II), Mn(II), sulfate, sulfide, phosphate, ammonia, calcium, magnesium, potassium, and sodium) was monitored as a function of deicer and incubation time. Changes in solid phase organic matter content were measured using loss-on-ignition, and a sequential extraction scheme was used to assess changes in solid-phase metal-association with four operationally defined fractions (readily exchangeable metals, carbonate, reducible and oxidizable). These measurements were intended to provide insights into changes in sediment geochemistry resulting from the widespread application of NaCl and $CaCl_2$ deicers.

Methods

Experiments were conducted using sediments from a fringe wetland on the west side of Asylum Lake, a $\sim$19.8 ha kettle lake located in Kalamazoo, MI. The lake is surrounded by light residential development together with forests and meadows in a nature preserve. The wetland sediments have been influenced by both surface water runoff and groundwater input contaminated by road salt, primarily originating from US-131, located to the west of the lake (Fig. 1). Sauck

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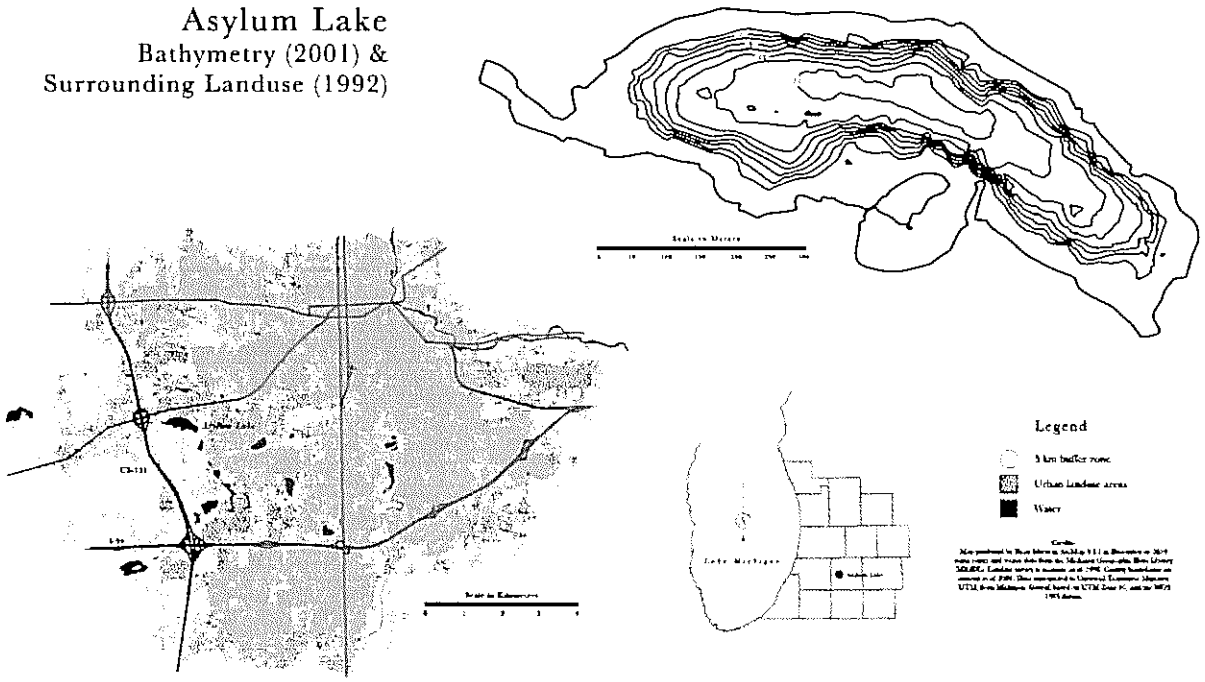

Fig. 1 Maps of study site showing urban land use in 5 km buffer zone and bathymetric map of Asylum Lake (based on data collected by Western Michigan University Facilities Management, personal communication)

and Barcelona (1992) measured dissolved Na and Cl concentrations of up to 248 and 480 mg/L, respectively, in shallow ground waters to the west of Asylum Lake and east of US-131 in June 1992. Sodium and Cl levels were nearly two orders of magnitude lower in ground waters located just to the west (up gradient) of US-131 (Sauck and Barcelona 1992). Koretsky et al. (2011) reported ~90 mg/L Na and ~160 mg/L Cl in Asylum Lake surface waters increasing to >100 mg/L Na and >200 mg/L Cl in lake bottom waters (~16 m depth) collected in July 2010. Prior studies demonstrated that sediment pore waters from the south shore of Asylum Lake were strongly redox-stratified with both iron- and sulfate-reduction suggested to be important organic matter degradation pathways (Koretsky et al. 2006).

In this study, sediments were collected in fall 2009 and spring 2010 using cylindrical PVC cores (diameter 5 cm, length 15 cm). The experiments were replicated in spring and fall because microbial community structure in wetland sediments often shows strong seasonal variations (e.g., Koretsky et al. 2003, 2005, 2006). Thirty cores were collected in fall and 39 were collected in spring. In each season, three cores were used to measure the initial conditions. The remaining cores were incubated in sets of nine, with each set placed in a vat containing deionized water (control), 5 g/L NaCl (0.086 M NaCl = 2.0 mg/L Na = 3.0 mg/L Cl), 5 g/L $CaCl_2 \cdot 2H_2O$ (0.034 M $CaCl_2$ = 1.4 mg/L Ca = 2.4 mg/L Cl) or 1 g/L $CaCl_2 \cdot 2H_2O$ (0.0068 M $CaCl_2$ = 0.27 mg/L Ca = 0.48 mg/L Cl).

The concentrations of salt used in the incubations were based on reported levels of NaCl in surface waters and soils in areas of road salt deicer application. Environment Canada (2001) reports up to 5 g/L NaCl in urban lakes and ponds, up to 4 g/L NaCl in ponds and wetlands and >18 mg/L NaCl in road runoff impacted by deicers. High levels of chloride have also been reported in roadside soils in Sweden (>1.74 g/L Cl; Backstrom et al. 2004) and in the upper portion of retention pond sediments in Michigan (>3 g/L Cl; Mayer et al. 2008). Ohne (1990) found up to 9.1 g/L Na and 13.5 g/L Cl in wetland surface waters adjacent to salt storage facilities in Maine. Fall cores were incubated in 5 g/L NaCl or 5 g/L $CaCl_2 \cdot 2H_2O$. Because a large effect on the pore water biogeochemistry was observed with the $CaCl_2$ treatment, spring

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cores were also incubated in a lower concentration of $CaCl_2$ (1 g/L $CaCl_2 \cdot 2H_2O$).

Water levels were maintained at 8 cm above the sediment–water interface by adding small quantities of deionized water to each vat periodically as needed. Every 30 days, for 3 months, three cores were sacrificed from each treatment vat and sliced into three vertical subsections (0–5, 5–10, 10–15 cm depths) in a Coy anaerobic chamber (~95 % N_2 and 5 % H_2 atmosphere). Pore waters were removed from each depth interval using suction under N_2 followed by syringe-filtration (0.45 μm). Redox-sensitive species (total alkalinity, ammonia, sulfide, ferrous iron) and pH were measured immediately. UV–Vis spectrophotometric methods were using to measure total alkalinity (bromophenol blue; Sarazin et al. 1998), ammonium (indophenol blue, Grasshoff et al. 1982), phosphate (molybdate blue; Greenberg et al. 1992), sulfide (methylene blue; Grasshoff et al. 1982), sulfate (barium gelatin turbidity, Tabatabai 1974), and ferrous iron (ferrozine, Stookey 1970). Samples analyzed by ICP-OES for major elements (Ca, Na, Mg, K) were preserved in trace-metal grade nitric acid and were spiked with internal standards (1,000 ppb Y) prior to analysis. ICP-OES measurements were made with matrix-matched calibration standards (DI, NaCl or $CaCl_2$).

To assess the organic carbon content of the soils, loss-on-ignition was measured. Sediments were first air dried to constant weight, sieved (2 mm) and then ~5 g subsamples were weighed and heated at 550 °C for 5 h and reweighed (Heiri et al. 2001). A sequential extraction scheme (Tessier et al. 1979, 1982, 1996) was used to assess Fe and Mn associations with four operationally defined fractions (readily exchangeable, carbonates, reducible and oxidizable). Approximately 1–2 g of fresh sediment (weighed exactly) was extracted using the reactants and procedures shown in Table 1. After addition of each extractant, the slurry was centrifuged and the supernatant removed, syringe-filtered, and preserved for ICP-OES analyses with trace metal grade nitric acid. The remaining sediment was washed by adding deionized water to the wet sediment, mixing the slurry by hand, centrifuging and discarding the supernatant, after which the next extracting agent was added. The filtered, acidified supernatants were spiked with internal standards (1,000 ppb Y) and analyzed for total Fe and Mn using ICP-OES with matrix-matched calibration standards.

Speciation calculations were completed with the software JCHESS (Van der Lee and De Windt 2000) to calculate saturation indices for a suite of carbonates including calcite ($CaCO_3$), dolomite ($CaMg(CO_3)_2$) and rhodrochrosite ($MnCO_3$). The default thermodynamic database (based on the EQ3 database) was used for the calculations, together with the entire suite of data measured for the pore waters as a function of treatment and time. For these calculations, the measured total alkalinity was assumed to be equal to the total dissolved carbonate (e.g. Koretsky et al. 2007).

All statistical analyses were performed using PASW statistics software (version 18.0, SPSS Inc., Chicago, IL). Comparisons of treatments (i.e., control, 5 g/L NaCl and 1 g/L $CaCl_2 \cdot 2H_2O$ or 5 g/L $CaCl_2 \cdot 2H_2O$) were performed by one-way ANOVA at each sampling time. Repeated measures ANOVA was employed to analyze for treatment and time effects on measurements.

Results

Pore waters

Average concentrations of dissolved solutes from three replicate cores extracted at three depths (0–5, 5–10, 10–15 cm) as a function of incubation time are shown in Fig. 2. The full suite of depth-dependent data is available in the supplementary data. pH remains

Table 1 Sequential extraction methodology adapted from Tessier et al. (1979, 1982)

Target fraction	Reagent	Time	Temperature
Exchangeble	8 mL 1 M $MgCl_2$ adjusted to pH 7.0	1 h	Room temp
Carbonate	8 mL 1 M sodium acetate, adjusted to pH 5.0 with acetic acid	5 h	Room temp
Reducible	20 mL 0.04 M hydroxyl amine HCl in 25 % (v/v) acetic acid	6 h	95 °C
Oxidizable	3 mL 0.02 M HNO_3 and 5 mL 30 % H_2O_2 (adjusted to pH 2)	2 h	95 °C
	5 mL 3.2 N ammonium acetate in 20 % (v/v) HNO_3, + DI to total volume of 20 mL	30 min	Room Temp

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relatively constant with time at ~7.5–8 in both the spring and fall controls, declining with time in all treatment cores (Fig. 2a; Table 2). pH values are similar in the fall and spring treatments, with values declining to pH ~ 7 by 100 days in cores amended with 5 g/L NaCl or 1 g/L $CaCl_2 \cdot 2H_2O$ and to ~6–6.5 in cores amended with 5 g/L $CaCl_2 \cdot 2H_2O$ (Fig. 2a; Table 3). Alkalinity levels are greater in the initial cores collected in spring (~8.5 mM) compared to those from fall (~2.5 mM; Fig. 2b; $F = 27.2$, $P < 0.01$). In fall, alkalinity increases with time in all cores, except for a low value in the control core at 100 days. In contrast, in spring, alkalinity generally decreases with time in all cores. Alkalinity levels tend to be greatest in the cores incubated in 5 g/L NaCl and lowest in the control cores and those incubated with 1 g/L $CaCl_2 \cdot 2H_2O$ (Fig. 2b; Tables 2, 3).

Dissolved Mn(II) concentrations are very low (~50 μM) in the control core pore waters, changing little with incubation time (Fig. 2c; Table 2). In contrast, Mn(II) levels increase with time in all of the treatment cores. The most dramatic changes occur in cores treated with 5 g/L $CaCl_2 \cdot 2H_2O$; in these, dissolved Mn(II) concentrations increase about tenfold, reaching ~600 μM after 100 days of incubation. Mn(II) levels also increase in the 5 g/L NaCl and 1 g/L $CaCl_2 \cdot 2H_2O$ treatment cores, although more slowly, reaching ~200 μM after 100 days (Fig. 2c; Table 3).

Like dissolved Mn(II), dissolved Fe(II) concentrations are low (<1 μM) throughout the incubations of the control cores, while concentrations increase dramatically with time in the 5 g/L $CaCl_2 \cdot 2H_2O$ treatments, reaching up to 1,980 μM Fe(II) after 100 days (Fig. 2d; Table 2). Dissolved Fe(II) concentrations also increase with time in the 5 g/L NaCl and 1 g/L $CaCl_2 \cdot 2H_2O$ treatments, but more slowly than dissolved Mn(II), with maximum dissolved Fe(II) concentrations of ~15–110 μM after 100 days of incubation (Fig. 2d; Table 2).

Dissolved sulfate and sulfide were measured on the fall cores only. Sulfate concentrations decrease precipitously with time in both the control and the treatment cores from initial levels of ~250 to <50 μM after 100 days of incubation (Fig. 2e). Sulfide concentrations increase with time, from an initial concentration of <20 μM, reaching levels as high as ~65 μM after 65 days (Fig. 2f).

Phosphate concentrations are close to detection limits in the initial fall cores (Fig. 2g), increasing with time in the control and treatment cores. The largest accumulation of phosphate occurs in the 5 g/L $CaCl_2 \cdot 2H_2O$ treatments, reaching ~35 μM at 100 days, with the lowest accumulation of phosphate in the control cores. Phosphate concentrations were not measured in spring. Average ammonia concentrations as a function of time and treatment are quite variable (Fig. 2h; Table 2), although depth-averaging of the data obscures some trends. Depth-dependent data (see supplementary materials) reveal that more ammonia typically accumulates with time in the deeper sections of 1 g/L $CaCl_2 \cdot 2H_2O$ cores ($P < 0.05$). Initial levels of ammonia are greater in spring (~100 μM) compared to fall (near detection limits). In fall, ammonia levels increase with time in all cores, except that a low value is observed in the control at 100 days. In spring, ammonia levels increase more rapidly with time in the deeper sections of the 5 g/L NaCl or $CaCl_2 \cdot 2H_2O$ cores (supplementary material; Table 2), with increased ammonia levels occurring at 100 days in the deeper portions of the control and 1 g/L $CaCl_2 \cdot 2H_2O$ cores (Fig. 2h).

Solid phase

Organic matter concentrations calculated from loss-on-ignition (Heiri et al. 2001) are greatest in the upper 5 cm of the core, decreasing with depth for all treatments (Fig. 3). No significant differences in percent organic matter are observed between the treatments and controls, nor does organic matter percentage change significantly with time (Table 2). Due to these small changes in bulk organic matter, analyses were not completed for the sediments from the spring incubations.

A sequential extraction technique was used to assess partitioning of Fe and Mn among four operationally defined sediment fractions: exchangeables, carbonates, reducibles and oxidizables (Tessier et al. 1979, 1982, 1996). Few consistent trends emerge with respect to the average concentrations of Fe or Mn extracted with the exchangeable, carbonate or reducible fractions as a function of time or treatment (Fig. 4; Table 2). In the fall cores, the quantity of oxidizable-associated Fe and Mn increases as a function of time in all cores, including the controls (Fig. 4g, h).

Most of the Fe is extracted in the upper portion of the cores and is associated with the reducible and oxidizable fractions (Fig. 5a–f). After 100 days of incubation, the quantity of reducible- and oxidizable-associated Fe in the fall cores is somewhat lower

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in the treatments compared to the control cores (Fig. 5a–c). However, in spring, the levels of both reducible- and oxidizable-associated Fe are significantly greater in the upper portion of the treated cores compared to the control (Fig. 5d–f). As for Fe, few consistent trends in extractable Mn are observed as a function of either treatment or incubation time (Fig. 5g–l). In contrast to Fe, Mn is much more evenly distributed among the four fractions and among the three depths of the core (Fig. 5g–l). Most of the Mn is typically extracted with the carbonate and reducible fractions of the sediment. After 100 days of incubation, carbonate- and reducible-associated Mn is somewhat greater in the upper 0–5 cm of the NaCl treatments compared to the controls, but few other differences between controls and treatments are apparent.

Discussion

Stimulation of anaerobic respiration

The reductive dissolution of Mn(IV) and Fe(III) oxides results in accumulation of dissolved Mn and Fe in suboxic pore waters (e.g. Davison 1993). Mn(IV) and Fe(III) reduction is often microbially mediated and coupled to oxidation of organic matter, but can also occur chemically or microbially via reaction with more reduced solutes, such as ferrous iron (for Mn(IV) reduction) or sulfide (e.g., Burdige and Nealson 1986; Burdige 1993; Yao and Millero 1996; Boudreau 1999). Mn(IV) is a more energetically favorable electron acceptor compared to Fe(III), therefore, Fe(II) typically accumulates after readily reducible Mn(IV) is exhausted.

Dissolved Mn(II) and Fe(II) increased significantly with time in cores treated with NaCl, and especially in cores amended with 5 g/L $CaCl_2{\cdot}2H_2O$, but not in the control cores (Fig. 2c, d; Table 3). Mn(II) production rates were ~5.5, 1.3–1.6 and 1.1 μM/day after 100 days of incubation in the 5 g/L $CaCl_2{\cdot}2H_2O$, 5 g/L NaCl and 1 g/L $CaCl_2{\cdot}2H_2O$ experiments, respectively. Dissolved Fe(II) accumulated more slowly: ~15, 0.34 and 1.0 μM/day after 100 days of incubation in the 5 g/L $CaCl_2{\cdot}2H_2O$, 5 g/L NaCl and 1 g/L $CaCl_2{\cdot}2H_2O$ experiments, respectively. The significant accumulation of Mn(II), followed by Fe(II), in the treated cores suggests that the addition of NaCl or $CaCl_2$ stimulates anaerobic respiration with consequent reductive dissolution of Fe(III) and Mn(IV) oxides.

Fig. 2 Average **a** pH, **b** alkalinity, **c** dissolved Mn(II), **d** dissolved Fe(II), **e** sulfate, **f** sulfide, **g** phosphate, **h** ammonia, **i** magnesium, **j** calcium, **k** sodium and **l** potassium as a function of time and treatment. *Error bars* indicate standard deviations of measurements completed at three depths (0–5, 5–10, 10–15 cm) on triplicate cores. Na was not measured in cores with added Na, and Ca was not measured in cores with added Ca and sulfide was not measured for 100 days incubation

The rates of Mn(II) production observed here are similar to those measured by Thomsen et al. (2004) in anoxic incubations of sediments from the bottom of Lake Michigan (~3 μM/day in 1–2 cm portion of sediment core incubated for 20 days). Thomsen et al. (2004) also measured production of ΣCO_2, Fe^{+2}, NH_4^+ and sulfate reduction rates. With these data, they demonstrated that although a significant quantity of dissolved Mn(II) accumulated, most of it was produced by reoxidation of more reduced solutes, with relatively little contributing to organic matter mineralization. This may also be the case for incubations in this study, particularly given that significant ferrous iron production occurred in spring and fall (up to 15 μM/day), whereas Fe(II) production rates reported by Thomsen et al. (2004) were generally quite low. Sulfate consumption rates in the fall cores from this study are lower (~2.5 μM/day) compared to those reported by Thomsen et al. (2004), but without sulfate reduction rates and ΣCO_2 data, the contributions of each anaerobic respiration pathway to organic matter mineralization cannot be determined. Nonetheless, the large accumulation of Fe(II) and Mn(II), especially in the 5 g/L $CaCl_2{\cdot}2H_2O$ treatments, suggests that anaerobic respiration is stimulated by the addition of the deicing salts.

Primary productivity was not measured in this study. However, visual evidence of enhanced primary productivity was apparent at the top of cores incubated in NaCl or $CaCl_2$. Thick, orange-red fungal or microbial mats developed at the top of these cores, but not on control cores incubated in DI water (Fig. 3). Furthermore, the mats were thicker, brighter and formed more quickly on the cores incubated in 5 g/L $CaCl_2{\cdot}2H_2O$ compared to those incubated in 5 g/L NaCl. Thus, we hypothesize that degradation of the organic matter produced in these mats resulted in the significant accumulation of dissolved Mn(II) and

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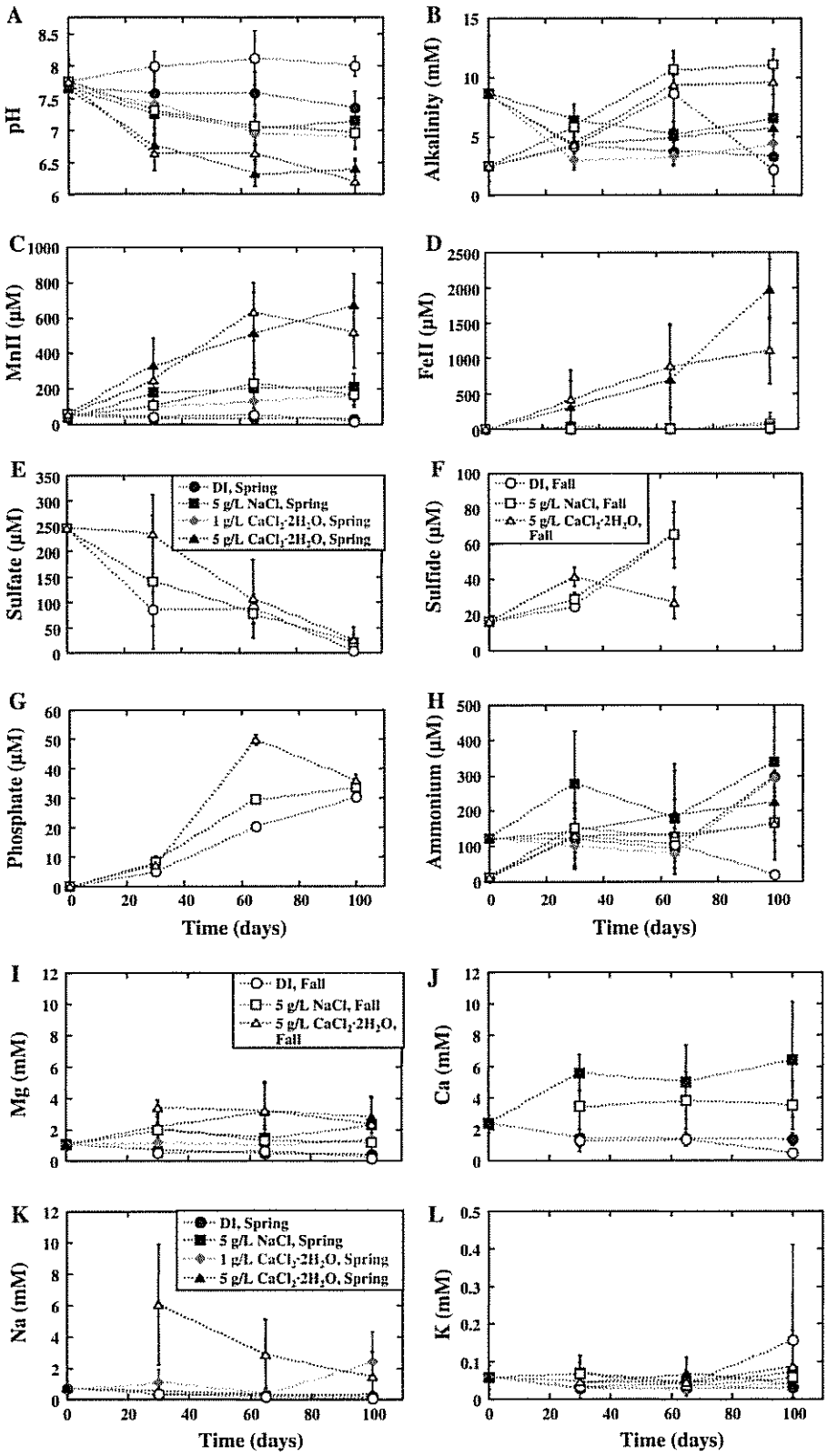

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Table 2 The *F* statistic and degree of freedom for the treatment and time effects and their interactions on measurements as results of repeated measures ANOVAs

GLM repeated measures				
Measurements	Season	Treatment	Time	Treatment × Time
pH	Fall	$F = 319.7$ ($df = 2$)***	$F = 36.3$ ($df = 3$)***	$F = 23.7$ ($df = 6$)***
	Spring	$F = 16.9$ ($df = 3$)*****	$F = 21.8$ ($df = 3$)***	$F = 2.2$ ($df = 9$)
Alkalinity	Fall	$F = 1.2$ ($df = 2$)	$F = 1.18$ ($df = 3$)	$F = 78.3$ ($df = 6$)***
	Spring	$F = 9.0$ ($df = 3$)**	$F = 28.7$ ($df = 3$)***	$F = 1.5$ ($df = 9$)
Dissolved Mn(II)	Fall	$F = 43.8$ ($df = 2$)***	$F = 20.0$ ($df = 3$)***	$F = 10.4$ ($df = 6$)***
	Spring	$F = 100.5$ ($df = 3$)***	$F = 20.1$ ($df = 3$)***	$F = 22.5$ ($df = 9$)***
Dissolved Fe(II)	Fall	$F = 43.8$ ($df = 2$)***	$F = 20.0$ ($df = 3$)***	$F = 10.4$ ($df = 6$)***
	Spring	$F = 100.5$ ($df = 3$)***	$F = 20.1$ ($df = 3$)***	$F = 22.5$ ($df = 9$)***
Ammonium	Fall	$F = 1.6$ ($df = 2$)	$F = 6.8$ ($df = 3$)**	$F = 1.0$ ($df = 6$)
	Spring	$F = 1.9$ ($df = 3$)	$F = 7.6$ ($df = 3$)**	$F = 0.7$ ($df = 9$)
Organic matter content	Fall	NA	NA	NA
	Spring	$F = 0.4$ ($df = 3$)	$F = 2.8$ ($df = 2$)	$F = 0.5$ ($df = 6$)
Exchangeable Fe	Fall	$F = 3.2$ ($df = 2$)	$F = 4.9$ ($df = 3$)*	$F = 5.6$ ($df = 6$)**
	Spring	$F = 1.2$ ($df = 3$)	$F = 0.8$ ($df = 3$)	$F = 0.9$ ($df = 9$)
Exchangeable Mn	Fall	$F = 1.1$ ($df = 2$)	$F = 4.0$ ($df = 3$)*	$F = 0.4$ ($df = 6$)
	Spring	$F = 1.1$ ($df = 3$)	$F = 4.5$ ($df = 3$)*	$F = 1.1$ ($df = 9$)
Carbonate Fe	Fall	$F = 1.3$ ($df = 2$)	$F = 4.6$ ($df = 3$)*	$F = 2.8$ ($df = 6$)*
	Spring	$F = 0.9$ ($df = 3$)	$F = 2.0$ ($df = 3$)	$F = 1.4$ ($df = 9$)
Carbonate Mn	Fall	$F = 2.6$ ($df = 2$)	$F = 4.9$ ($df = 3$)*	$F = 0.3$ ($df = 6$)
	Spring	$F = 0.02$ ($df = 3$)	$F = 2.5$ ($df = 3$)	$F = 0.3$ ($df = 9$)
Reducible Fe	Fall	$F = 0.8$ ($df = 2$)	$F = 3.6$ ($df = 3$)*	$F = 2.2$ ($df = 6$)
	Spring	$F = 0.2$ ($df = 3$)	$F = 0.8$ ($df = 3$)	$F = 0.6$ ($df = 9$)
Reducible Mn	Fall	$F = 1.5$ ($df = 2$)	$F = 2.4$ ($df = 3$)	$F = 0.7$ ($df = 6$)
	Spring	$F = 0.6$ ($df = 3$)	$F = 0.1$ ($df = 3$)	$F = 0.5$ ($df = 9$)
Oxidizable Fe	Fall	$F = 1.1$ ($df = 2$)	$F = 2.3$ ($df = 3$)	$F = 0.9$ ($df = 6$)
	Spring	$F = 0.01$ ($df = 3$)	$F = 1.2$ ($df = 3$)	$F = 0.8$ ($df = 9$)
Oxidizable Mn	Fall	$F = 1.6$ ($df = 2$)	$F = 0.7$ ($df = 3$)	$F = 1.0$ ($df = 6$)
	Spring	$F = 2.5$ ($df = 3$)	$F = 1.8$ ($df = 3$)	$F = 1.6$ ($df = 9$)

Asterisks indicate statistically significant differences (*$P \leq 0.05$, **$P \leq 0.01$, and ***$P \leq 0.001$)

Fe(II) which was particularly apparent in the 5 g/L $CaCl_2 \cdot 2H_2O$ treatments.

Anaerobic respiration should result not only in increased levels of Mn(IV) and Fe(II), but also in mineralization of nitrogen and phosphorous. The similar release of phosphate in treated and control cores (Fig. 2g) is somewhat surprising. Possibly, trends in phosphate concentrations released by organic matter mineralization are obscured by multiple geochemical processes occurring in the cores; phosphate levels are also effected by adsorption on Fe(III) oxides or clays, precipitation of sparingly soluble P-bearing aluminosilicates and by uptake of phosphate by biota (Jahnke 1992). Thus, enhanced release of phosphorous in the treatment cores relative to the controls due to increased organic matter mineralization might be difficult to detect based on pore water data alone. Ammonia can be contributed to the pore waters via ammonification. The more rapid increase of ammonia at depth in the spring trials for the 5 g/L NaCl and $CaCl_2 \cdot 2H_2O$ cores (supplementary data) is consistent with more rapid onset and greater magnitude of anaerobic respiration in these treatments. However, no significant differences in total ammonia accumulation

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Table 3 The F statistic and degree of freedom for the treatment effects on measurements as results of One-way ANOVAs

One-way ANOVA				
Measurement	Season	Incubation days		
		30	60	100
pH	Fall ($df = 2$)	$F = 42.8$***	$F = 55.0$***	$F = 254.6$***
	Spring ($df = 3$)	$F = 14.6$**	$F = 14.5$**	$F = 20.0$***
Alkalinity	Fall ($df = 2$)	$F = 1.2$	$F = 1.2$	$F = 78.3$***
	Spring ($df = 3$)	$F = 6.8$*	$F = 3.9$	$F = 16.6$**
Dissolved Mn(II)	Fall ($df = 2$)	$F = 42.4$***	$F = 65.1$***	$F = 11.2$**
	Spring ($df = 3$)	$F = 33.4$***	$F = 77.3$***	$F = 51.2$***
Dissolved Fe(II)	Fall ($df = 2$)	$F = 12368.6$***	$F = 9.5$*	$F = 14.3$**
	Spring ($df = 3$)	$F = 12.2$**	$F = 17.8$**	$F = 80.9$***
Ammonium	Fall ($df = 2$)	$F = 0.1$	$F = 0.2$	$F = 3.3$
	Spring ($df = 3$)	$F = 2.8$	$F = 0.9$	$F = 0.5$
Mg	Fall ($df = 2$)	$F = 20.3$**	$F = 20.9$**	$F = 3.8$
	Spring ($df = 3$)	$F = 30.0$***	$F = 10.8$**	$F = 11.1$**
K	Fall ($df = 2$)	$F = 0.7$	$F = 0.1$	$F = 0.4$
	Spring ($df = 3$)	$F = 4.7$*	$F = 1.4$	$F = 1.2$
Na	Fall ($df = 1$)	$F = 4.2$	$F = 8.7$*	$F = 1.4$
	Spring ($df = 2$)	$F = 3.6$	$F = 0.3$	$F = 3.6$
Ca	Fall ($df = 1$)	$F = 5.5$	$F = 8.6$*	$F = 13.9$*
	Spring ($df = 1$)	$F = 57.2$**	$F = 188.9$***	$F = 13.8$*

Asterisks indicate statistically significant differences (*$P \leq 0.05$, **$P \leq 0.01$, and ***$P \leq 0.001$)

are observed between the two treatments and little difference is apparent between the control and treatments in fall (Fig. 2h; Table 3). As for phosphorous, nitrogen mineralization may be masked by other processes, including uptake or release of ammonia by clay minerals and oxidation of ammonia by less reduced solutes.

Respiration processes also influence pore water pH (e.g. Van Cappellen and Wang 1996; Boudreau 1999). Aerobic respiration produces acidity, according to:

$$CH_2O + O_2 = CO_2 + H_2O = H^+_{(aq)} + HCO^-_{3\,(aq)} \quad (1)$$

where "CH_2O" represents organic matter; conversely, anaerobic respiration consumes acidity. Pore water pH is also affected by chemical reactions: acidity is produced both by the oxidation of reduced solutes by oxygen and also by precipitation of carbonates, via,

$$Ca^{+2}_{(aq)} + HCO^-_{3(aq)} = CaCO_{3(s)} + H^+_{(aq)} \quad (2)$$

Thermodynamic speciation calculations (see Methods) indicate that calcite, dolomite and rhodochrosite are all supersaturated in both the NaCl and the $CaCl_2$ treatments. The significant decrease in pH in these treatments (Fig. 2a) is consistent with carbonate precipitation. Acidity may also have been contributed by photosynthetic production of oxygen in the mats, which was subsequently consumed in the suboxic underlying sediments together with ion exchange processes (see below).

Solid phase geochemistry can also be examined to evaluate organic matter mineralization pathways. For example, increased organic matter productivity might be reflected in greater quantities of organic matter, especially in the upper portion of the cores. However, solid-phase organic matter does not change significantly with time or treatment (Fig. 3; Table 2). This may be because loss-on-ignition is a bulk technique that cannot distinguish pools of organic matter (e.g. labile vs. refractory). Furthermore, in these organic-rich sediments, relatively small changes in organic matter content occurring over the course of the incubation experiment may be indistinguishable from the high background levels of organic carbon in the

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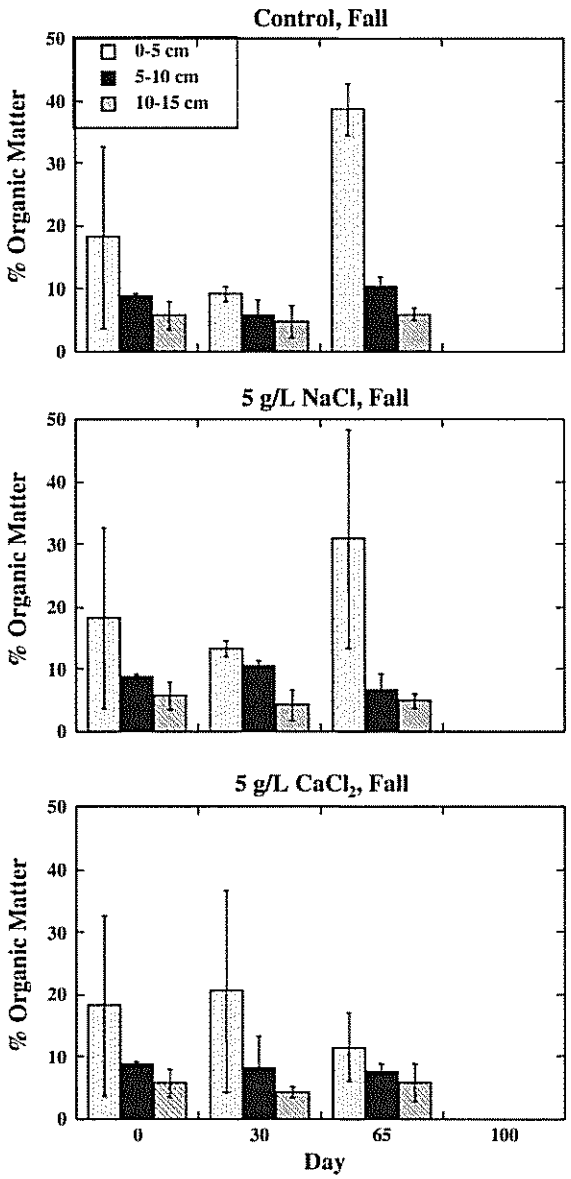

Fig. 3 Average and standard deviations of percent organic matter in triplicate cores as a function of depth and time for fall **a** control, **b** 5 g/L NaCl, and **c** 5 g/L $CaCl_2 \cdot 2H_2O$

initial sediment cores. Thus, changes in the labile fraction of the organic matter produced by enhanced primary production may not be detectable using the loss-on-ignition technique.

Reductive dissolution of Fe(III) and Mn(IV) oxides should reduce the level of Fe and Mn associated with operationally defined reducible fractions of the sediment and increase the levels associated with other operationally defined fractions, particularly carbonate- or oxidizable-phases. However, these pools do not change significantly with time (Fig. 4e, f; Table 2). Previous studies have shown that some Fe oxides may be only impartially removed by the Tessier sequential extraction step targeting the reducible fraction, and that this step may also partially remove Fe associated with Fe monosulfides (e.g. Filgueiras et al. 2002; Koretsky et al. 2006). Sediment preservation, especially drying or freeze-drying, can also mobilize metals, changing their distribution among various fractions (e.g., Rapin et al. 1986; Kersten and Forstner 1986; Hjorth 2004). Although other studies have shown that sequential extraction data, when used to compare similar sediments, and particularly when examined in conjunction with detailed pore water data, may yield useful insights into sediment geochemistry (e.g. Koretsky et al. 2006, 2007), the lack of correspondence observed here between increased dissolved Fe(II) and Mn(II) and Fe and Mn distribution among the extracted fractions (Figs. 2c, d, 5) is likely due to the inherent limitations of these operationally defined techniques.

Ion exchange

Addition of 5 g/L $CaCl_2 \cdot 2H_2O$ stimulates fungal or microbial mat growth and subsequent accumulation of reduced Fe(II) and Mn(II) in the core pore waters (Figs. 2c, d, 6). Calcium is a critical macronutrient for higher plants (e.g. Likens et al. 1998), but it is not essential for the growth of many microorganisms (Madigan et al. 2003). Furthermore, addition of 5 g/L NaCl also enhanced microbial mat formation and anaerobic respiration in treated cores, albeit to a lesser degree than the $CaCl_2$. Thus, while addition of the macronutrient Ca may be partially responsible for the observed mat growth, another mechanism must also be at work. One such process might be the release of key nutrients (e.g. Mg, K, NH_4^+, trace nutrients) from organic matter and clays via ion exchange processes.

Previous studies have demonstrated that NaCl or $CaCl_2$ additions to soils and sediments stimulate ion exchange, releasing both major and trace cations to pore waters. For example, Norrstrom and Bergstedt (2001) used column studies to demonstrate that Na^+ displaces Ca, K and Mg from cation exchange sites in soils collected from several sites in Sweden. Similarly,

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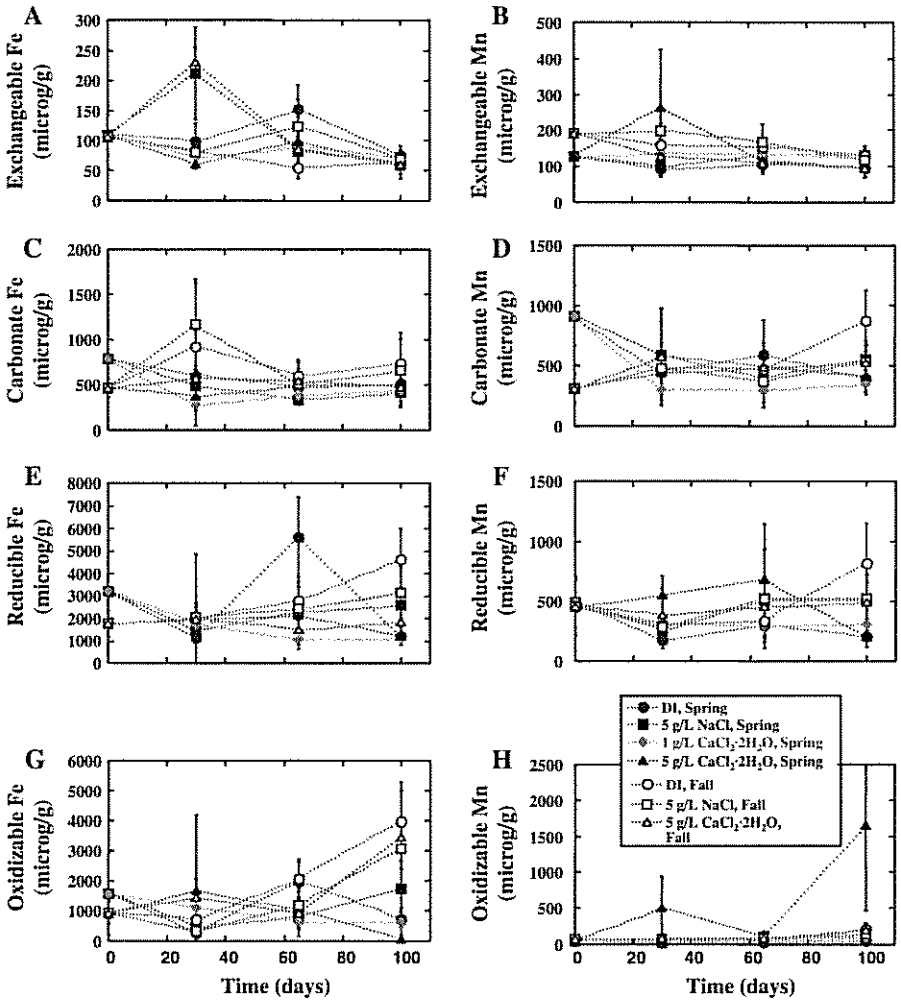

Fig. 4 Concentrations of **a** Fe or **b** Mn extracted with the exchangeable fraction, **c** Fe or **d** Mn extracted with the carbonate fraction, **e** Fe or **f** Mn extracted with the reducible fraction and **g** Fe or **h** Mn extracted with the oxidizable fraction of the cores as a function of time and treatment. *Error bars* indicate standard deviations of measurements completed at three depths (0–5, 5–10, 10–15 cm) on triplicate cores

Lofgren (2001) showed that NaCl additions mobilize Zn, Cd, Ca and Mg in streams and soils of a forested catchment. Backstrom et al. (2004) observed increased Cd, Zn and Ca levels, and decreased pH, in soils near a road treated with NaCl. They attributed these changes to ion exchange processes, together with the formation of Cd-chloro aqueous complexes. Amrhein et al. (1992) used leaching experiments to demonstrate that NaCl mobilizes Cr, Pb, Ni, Fe and Cu, which they attributed to the combined effects of increased dispersion of organic matter, together with ligand and ion exchange processes. Nelson et al. (2009) similarly found that infiltration of soils with NaCl or $MgCl_2$ mobilizes Pb, Cu and Cd through a combination of organic matter dispersion, ion exchange and the formation of aqueous metal-chloro complexes. Bauske and Goetz (1993) used a combination of field studies and laboratory leaching experiments with NaCl and $CaCl_2$ to demonstrate the potential mobilization of Zn and Cd via ion exchange and the formation of aqueous metal-chloro complexes.

In this study, incubation in either NaCl or $CaCl_2$ resulted in increased levels of dissolved Mg, K, Na

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(for Ca additions) and Ca (for sodium additions) compared to controls and decreased pH (Fig. 2i–l; Table 3), consistent with findings from prior studies. The equivalent positive charge added to the core pore waters in this study varies between 18 mM for the 1 g/L $CaCl_2{\cdot}2H_2O$ treatments and 86 mM for the 5 g/L NaCl treatments, with an intermediate equivalent charge (68 mM) for treatments with 5 g/L $CaCl_2{\cdot}2H_2O$. Thus, ion exchange should result in the greatest release of cations in the 5 g/L NaCl treatments, with the least release in the 1 g/L $CaCl_2{\cdot}2H_2O$ experiments. This trend is confirmed by the experimental data: with respect to the major elements, additions of the three solutions liberated similar proportions of positive charge relative to the added equivalents of charge. The sum of the charge equivalents associated with K + Mg + Ca (for sodium additions) + Na (for calcium additions) is approximately 14, 13 and 3 for the 5 g/L NaCl, 5 g/L $CaCl_2{\cdot}2H_2O$ and 1 g/L $CaCl_2{\cdot}2H_2O$ experiments, respectively, which is equivalent to 16, 19 and 22 % of the total positive charge added with the NaCl or $CaCl_2$.

Ion exchange reactions are non-specific; addition of NaCl and $CaCl_2$ will release NH_4^+ and trace nutrients to the soil solutions, in addition to major ions. Enhanced nutrient release could promote the observed mat formation and subsequent accumulation of anaerobic respiration products [dissolved Fe(II) and Mn(II)] in the treatment experiments. The quantities of the nutrients, like the major ions, released by each treatment should be directly related to the added equivalent charge. Thus, the 5 g/L NaCl addition would be expected to release the largest quantities of nutrients and stimulate the greatest amount of productivity. However, this is not the case. Instead, there is a greater mat growth and more production of Mn(II) and Fe(II) in the 5 g/L $CaCl_2{\cdot}2H_2O$ compared to the 5 g/L NaCl experiments in spite of the higher charge equivalents added with the NaCl treatments (86 mM compared to 68 mM). Thus, ion exchange processes alone cannot fully explain the incubation data. The mechanism for the apparent stimulation of productivity and increased Mn(IV) and Fe(III) reduction must involve at least some Ca-specific effects. Determining this mechanism will require further study, but possibilities include direct stimulation of mat growth (i.e. Ca behaving as a limiting nutrient) or mineral precipitation effects (e.g. enhanced calcite precipitation).

Fig. 5 Average Fe and Mn concentrations extracted with the exchangeable, carbonate, reducible and oxidizable fractions as a function depth at the termination of the experiments (100 days), for **a** Fe in fall control, **b** Fe in fall 5 g/L NaCl, **c** Fe in fall 5 g/L $CaCl_2{\cdot}2H_2O$, **d** Fe in spring control, **e** Fe in spring 5 g/L NaCl, **f** Fe in 5 g/L $CaCl_2{\cdot}2H_2O$, **g** Mn in fall control, **h** Mn in fall 5 g/L NaCl, **i** Mn in fall 5 g/L $CaCl_2{\cdot}2H_2O$, **j** Mn in spring control, **k** Mn in spring 5 g/L NaCl, and **l** Mn in 5 g/L $CaCl_2{\cdot}2H_2O$. *Error bars* indicate standard deviations of measurements completed on triplicate cores

Conclusions

Addition of the two commonly used road salt deicers, NaCl and $CaCl_2$, to wetland sediments results in significant biogeochemical changes. The salt additions, particularly $CaCl_2$, stimulate growth of a microbial or fungal mat, and enhanced production of dissolved Mn(II) and Fe(II). Pore water pH decreases dramatically, likely due to a combination of carbonate precipitation, oxidation and ion exchange reactions. Supply of Ca from $CaCl_2$, together with the addition of macro- and micronutrients to pore waters via ion exchange reactions, is hypothesized to stimulate increased primary productivity and anaerobic respiration. However, further study is required to determine the mechanism of this stimulation and to quantify primary productivity and organic matter mineralization pathways.

The use of road salt deicer is widespread and continues to increase in much of Asia, North America and northern Europe. This study demonstrates that additions of NaCl and $CaCl_2$ to wetland sediments may greatly influence sediment biogeochemistry, even in the absence of macrofauna and macrophytes. Prior work has focused mostly on enhancement of ion exchange reactions, organic matter dispersion and aqueous complexation as mechanisms to enhance trace metal levels. Another potentially important mechanism is release of metals from reductively dissolving Mn(IV) and Fe(III) oxides. The apparent stimulation of anaerobic respiration observed in this study could have important consequences for trace metal cycling. Trace element bioavailability and mobility is closely related to metal speciation (e.g. Allen et al. 1980; Campbell 1995). Reduction of Mn(IV) and Fe(III) oxides is expected to release adsorbed trace metals into solution, potentially enhancing their bioavailability and mobility. Such processes could be quite important, particularly in road side sediments, which not only receive the

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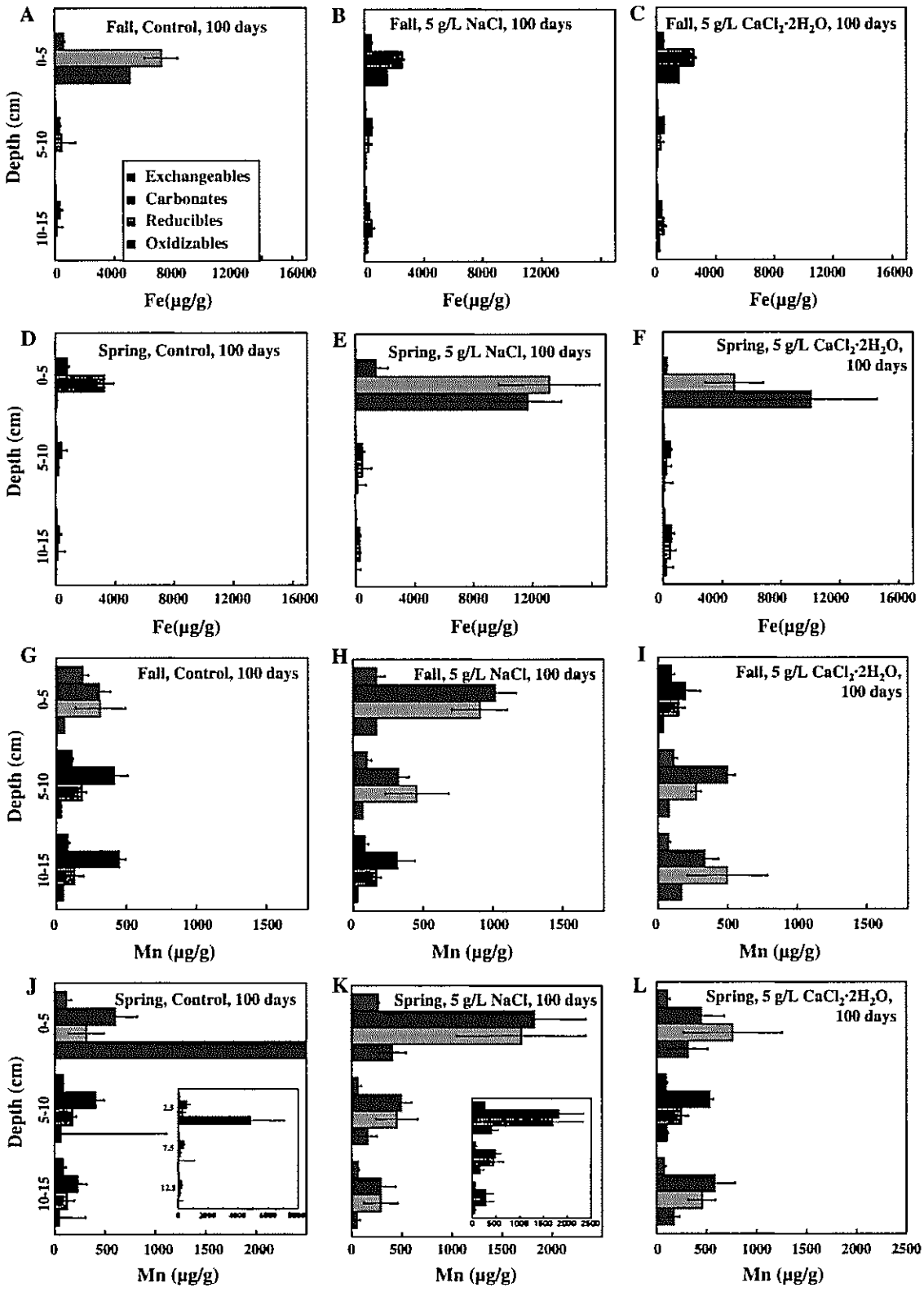

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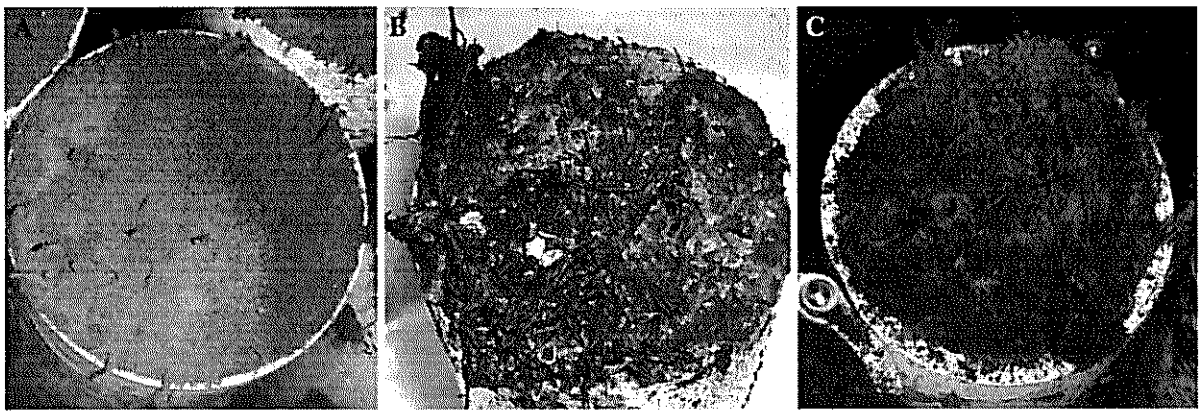

Fig. 6 Photographs of cores incubated in **a** DI water, **b** 5 g/L NaCl and **c** 5 g/L $CaCl_2 \cdot 2H_2O$ after 60 days of incubation in fall

highest road salt loadings, but which often have a legacy of Pb contamination from leaded gasoline and which may have high levels of other trace metals, such as Cu, Zn, Cd and Cu (e.g., Amrhein et al. 1992; Nelson et al. 2009). Changes in trace metal speciation resulting from road salt deicers have largely been attributed to ion exchange, organic matter dispersion and aqueous complexation reactions (Amrhein et al. 1992; Bauske and Goetz 1993; Norrstrom and Jacks 1998; Lofgren 2001; Backstrom et al. 2004; Nelson et al. 2009). This study suggests that the onset of suboxic conditions with reduction of Fe(III) and Mn(IV) oxides may also be a significant factor. Future investigations should consider this pathway, together with changes in redox and microbial community structure that may result from road salt influx to wetland soils and sediments.

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References

Allen HE, Hall RH, Brisbin TD (1980) Metal speciation. Effects on aquatic toxicity. Environ Sci Technol 14:441–443

Amrhein C, Strong JE, Mosher PA (1992) Effect of deicing salts on metal and organic matter mobilization in roadside soils. Environ Sci Technol 26:703–709

Backstrom M, Karlsson S, Backman L, Folkeson L, Lind B (2004) Mobilisation of heavy metals by deicing salts in a roadside environment. Water Res 38:720–732

Bauske B, Goetz D (1993) Effects of deicing-salts on heavy metal mobility. Acta Hydrochim Hydrobiol 21:38–42

Bester ML, Frind EO, Molson JW, Rudolph DL (2006) Numerical investigation of road salt impact on an urban wellfield. Ground Water 44:165–175

Boudreau BP (1999) Metals and models: diagenetic modeling in freshwater lacustrine sediments. J Paleolimnol 22:227–251

Bridgeman TB, Wallace CD, Carter GS, Carvajal R, Schiersari LC, Aslam S, Cloyd E, Elder D, Field A, Schulz KL, Yurista PM, Kling GW (2000) A limnological survey of Third Sister Lake, Michigan with historical comparisons. J Lake Reserv Manag 16:253–267

Bubeck RC, Burton RS (1989) Changes in chloride concentrations, mixing patterns, and stratification characteristics of Irondequoit Bay, Monroe Country, New York, after decreased use of road-deicing salts, 1974–1984. Water Resources Investigation Report 87-4223. USGS, Reston

Bubeck RC, Diment WH, Deck BL, Baldwin AL, Lipton SD (1971) Runoff of deicing salt: effect on Irondequoit Bay Rochester, New York. Science 172:1128–1132

Burdige DJ (1993) The biogeochemistry of manganese and iron reduction in marine sediments. Earth-Sci Rev 35:249–284

Burdige DJ, Nealson KH (1986) Chemical and microbiological studies of sulfide-mediated manganese reduction. Geomicrobiol J 4:361–387

Campbell PGC (1995) Interactions between trace metals and aquatic organisms: a critique of the free-ion activity model. In: Tessier A, Turner DR (eds) Metal speciation and bioavailability in aquatic systems. Wiley, New York

Davison W (1993) Iron and manganese in lakes. Earth-Sci Rev 34:119–163

Environment Canada (2001) Priority substances list assessment report: road salts. Minister of Public Works and Government Services, Ottawa

Filgueiras AV, Lavilla I, Bendicho C (2002) Chemical sequential extraction for metal partitioning in environmental solid samples. J Environ Monit 4:823–857

Findlay SEG, Kelly VR (2011) Emerging indirect and long-term road salt effects on ecosystems. Ann N Y Acad Sci 1223:58–68

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Galuszka A, Migazewki ZM, Podlaski R, Dolegowska S, Michalik A (2011) The influence of chloride deicers on mineral nutrition and the health status of roadside trees in the city of Kielce, Poland. Environ Monit Assess 176: 451–464

Grasshoff K, Ehrhardt M, Kremling K (eds) (1982) Methods of seawater analysis. Verlag Chemie, Weinheim, p 419

Greenberg AE, Clesceri LS, Eaton AD (eds) (1992) Standard methods for the examination of water and wastewater. American Public Health Association, Washington, DC

Hale RL, Groffman PM (2006) Chloride effects on nitrogen dynamics in forested and suburban stream debris dams. J Environ Qual 35:2425–2432

Heiri O, Lotter AF, Lemcke G (2001) Loss on ignition as a method for estimating organic and carbonate content in sediments: reproducibility and comparability of results. J Paleolimnol 25:101–110

Hjorth T (2004) Effects of freeze-drying on partitioning patterns of major elements and trace metals in lake sediments. Anal Chim Acta 526:95–102

Jahnke RA (1992) The phosphorous cycle. In: Butcher SS, Charlson RJ, Orians GH, Wolfe GV (eds) Global biogeochemical cycles. Academic Press, New York, pp 301–315

Judd KE, Adams HE, Bosch NS, Kostrezewski JM, Scott CE, Schultz BM, Wang DH, Kling GW (2005) A case history: effects of mixing regime on nutrient dynamics and community structure in Third Sister Lake, Michigan during late winter and early spring 2003. Lake Reserv Manag 21:316–329

Karraker NE, Gibbs JP, Vonesh JR (2008) Impacts of road deicing salt on the demography of vernal pool-breeding amphibians. Ecol Appl 18:724–734

Kaushal SS, Groffman PM, Likens GE, Belt KT, Stack WP, Kelly VR, Band LE, Fisher GT (2005) Increased salinization of fresh water in the northeastern United States. Proc Natl Acad Sci USA 102:13517–13520

Kayama M, Quoreshi AM, Kitaoka S, Kitahashi Y, Sakamoto Y, Maruyama Y, Kitao M, Koike T (2003) Effects of deicing salt on the vitality and health of two spruce species, *Picea abies* Karst, and *Picea glehni* masters planted along roadsides in northern Japan. Environ Pollut 124:127–137

Kelly VR, Lovett GM, Weathers KC, Findlay SEG, Strayer DL, Burns DJ, Likens GE (2008) Long-term sodium chloride retention in a rural watershed: legacy effects of road salt on streamwater concentration. Environ Sci Technol 42:410–415

Kersten M, Forstner U (1986) Chemical fractionation of heavy metals in anoxic estuarine and coastal sediments. Water Sci Technol 18:121–130

Kim K, Rajmohan N, Kim HJ, Hwang G-S, Cho MJ (2004) Assessment of groundwater chemistry in a coastal region (Kunsan, Korea) having complex contaminant sources: a stochiometric approach. Environ Geol 46:763–774

Kjensmo J (1997) The influence of road salts on the salinity and the meromictic stability of Lake Svinsjoen, southeastern Norway. Hydrobiologia 347:151–158

Koretsky CM, Moore C, Lowe K, Meile C, DiChristina TJ, Van Cappellen P (2003) Seasonal oscillations of microbial iron and sulfate reduction in saltmarsh sediments (Sapelo Island, GA, USA). Biogeochemistry 64:179–203

Koretsky CM, Moore C, DiChristina TJ, Van Cappellen P, Meile C, Lowe KL, Violler E, Kostka JE (2005) Salt marsh pore water geochemistry does not correlate with microbial community structure. Estuar Coast Shelf Sci 62:233–251

Koretsky CM, Haas JR, Miller D, Ndenga NNT (2006) Seasonal variations in pore water and sediment geochemistry of littoral lake sediments (Asylum Lake, MI, USA). Geochem Trans 7:11

Koretsky CM, Haveman M, Beuving L, Cuellar A, Shattuck T, Wagner M (2007) Spatial variation of redox and trace metal geochemistry in a minerotrophic fen. Biogeochemistry 86:33–62

Koretsky CM, MacLeod A, Sibert R, Snyder C (2011) Redox stratification and salinization of three kettle lakes in southwest Michigan, USA. Water Air Soil Pollut. doi: 10.1007/s11270-011-0954-y

Likens GE, Driscoll CT, Buso DC, Siccama TG, Johnson CE, Lovett GM, Fahey TJ, Reiners WA, Ryan DF, Martin CW, Bailey SW (1998) The biogeochemistry of calcium at Hubbard Brook. Biogeochemistry 41:89–173

Lofgren S (2001) The chemical effects of deicing salt on soil and stream water of five catchments in southeast Sweden. Water Air Soil Pollut 130:863–868

Madigan MT, Martinko JM, Parker J (2003) Brock. Biology of microorganisms, 10th edn. Prentice Hall, Upper Saddle River

Mayer T, Rochfort Q, Borgmann U, Snodgrass W (2008) Geochemistry and toxicity of sediment porewater in a salt-impacted urban stormwater detention pond. Environ Pollut 156:143–151

Nelson SS, Yonge DR, Barber ME (2009) Effects of road salts on heavy metal mobility in two eastern Washington soils. J Environ Eng 135:505–510

Norrstrom AC, Bergstedt E (2001) The impact of road de-icing salts (NaCl) on colloid dispersion and base cation pools in roadside soils. Water Air Soil Pollut 127:281–299

Norrstrom AC, Jacks G (1998) Concentration and fractionation of heavy metals in roadside soils receiving de-icing salts. Sci Total Environ 218:161–174

Novotny EV, Murphy D, Stefan HG (2008) Increase of urban lake salinity by road deicing salt. Sci Total Environ 406:131–144

Ohne T (1990) Levels of total cyanide and NaCl in surface waters adjacent to road salt storage facilities. Environ Pollut 67:123–132

Ramakrishna DM, Viraraghavan T (2005) Environmental impact of chemical deicers—a review. Water Air Soil Pollut 166:49–63

Rapin F, Tessier A, Campbell PGC, Carignan R (1986) Potential artifacts in the determination of metal partitioning in sediments by a sequential extraction procedure. Environ Sci Technol 20:836–840

Rodrigues PMSM, Rodrigues RMM, Costa BHF, Martins AALT, da Silva JCGE (2010) Multivariate analysis of the water quality variation in the Serra da Estrela (Portugal) Natural Park as a consequence of road deicing with salt. Chemom Intell Lab Syst 102:130–135

Salt Institute (2011) http://www.saltinstitute.org/Production-industry/Facts-figures/U.S.-salt-production-sales. Accessed 1 June 2011

Sanzo D, Hecnar SJ (2006) Effects of road de-icing salt (NaCl) on larval wood frogs (*Rana sylvatica*). Environ Pollut 140:247–256

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Sarazin G, Michard G, Prevot F (1998) A rapid and accurate spectroscopic method for alkalinity measurements in sea water samples. Water Res 33:290–294

Sauck WA, Barcelona MJ (1992) Final Project Report. Long-term hydrogeological research and education test site, KCHE 51-611851. Institute for Water Sciences, Western Michigan University, Kalamazoo

Stookey LL (1970) Ferrozine—a new spectrophotometric reagent. Anal Chem 42:779–781

Tessier A, Campbell PGC, Bisson M (1979) Sequential extraction procedure for the speciation of particulate trace metals. Anal Chem 51:844–851

Tessier A, Campbell PGC, Bisson M (1982) Particulate trace metal speciation in stream sediments and relationships with grain size: implications for geochemical exploration. J Geochem Explor 16:77–104

Tessier A, Fortin D, Belzile N, DeVitre RR, Leppard GG (1996) Metal sorption to diagenetic iron and manganese oxyhydroxides and associated organic matter: narrowing the gap between field and laboratory measurements. Geochim Cosmochim Acta 60:387–404

Thomsen U, Thamdrup B, Stahl DA, Canfield DE (2004) Pathways of organic carbon oxidation in a deep lacustrine sediment, Lake Michigan. Limnol Oceanogr 49:2046–2057

Thunqvist EL (2003) Increased chloride concentration in a lake due to deicing salt application. Water Sci Technol 48:51–59

Tiquia SM, Davis D, Hadid H, Ksparian S, Ismail M, Sahly R, Shim J, Singh S, Murray KS (2007) Halophilic and halotolerant bacteria from river waters and shallow groundwater along the Rouge River of southeastern Michigan. Environ Technol 28:297–307

Tuchman ML, Stoermer EF, Carney HJ (1984) Effects of increased salinity on the diatom assemblage in Fonda Lake, Michigan. Hydrobiologia 109:179–188

Van Cappellen P, Wang Y (1996) Cycling of iron and manganese in surface sediments: a general theory for the coupled transport and reaction of carbon, oxygen, nitrogen, sulfur, iron, and manganese. Am J Sci 296:197–243

Van Der Lee J, De Windt L (2000) CHESS tutorial and cookbook. User's guide Nr. LHM/RD/99/05 Fontainebleau. CIG-Ecole des Mines de Paris, Fontainebleau

Williams DD, Williams NE, Cao Y (1999) Road salt contamination of groundwater in a major metropolitan area and development of a biological index to monitor its impact. Water Res 34:127–138

Yao W, Millero FJ (1996) Oxidation of hydrogen sulfide by hydrous Fe(III) oxides in seawater. Mar Chem 52:1–16

Water Quality Implications and the Toxicological Effects of Chloride Based Deicers

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Abstract

Traditionally, the main priority of winter road maintenance has been assigned to level of service, cost-effectiveness, and corrosion rather than other less well-characterized effects such as impacts to water quality. It is increasingly vital to understand the environmental footprint of deicers, including their impacts on aquatic ecosystems. Chloride based deicers do not degrade in the natural environment and their application on winter pavements can lead to accumulation in adjacent environments over time. Information presented to date on deicers generally includes chemical composition and performance of deicers, while additional information on deicer aquatic toxicity is needed to enable fully-informed decisions by stakeholders. This work presents a state-of-the-knowledge review of the impacts of chloride based deicers and additives on water and aquatic species, and the issue of heavy metal leaching. Toxicity associated with the direct effect of deicers or with the indirect effect via their interactions with runoff chemistry is reviewed as well. This work will assist the stakeholder agencies in the search for effective practices to reduce the toxicity and other water quality implications of chloride based deicers.

INTRODUCTION

Chloride based deicers are well known as essential tools for increasing the safety and mobility of winter roadways (Andrey, 2010; Strong et al., 2010; Usman et al., 2010; Shahdah and Fu, 2010; Ye et al., 2013). Increasing contamination derived from the continued use of deicers has become a significant environmental concern as

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detrimental effects on water, soil, vegetation, and wildlife have been observed in the field and a variety of risks have been assessed in the laboratory (Ramakrishna and Viraraghavan, 2005; Levelton Consultants Limited, 2007; Fay and Shi, 2012; Wang et al., 2012; Fay et al., 2013a, 2013b; Ke et al., 2013; Cooper et al., 2014; Dudley et al., 2014; Dailey et al., 2014; Baek et al., 2014; Devitt et al., 2014). Of particular interest are the toxicological effects of chloride based deicers in the natural environment. Specifically, the chloride based deicers may present cumulative risk over time, as they are highly mobile (migrating quickly in the environment) and conservative (non-degradable). It is thus difficult to remove them from environment (Environment Canada, 1999; Mason et al., 1999; Kaushall et al., 2005; Winston et al., 2012). The impetus for this work was the assessment of water bodies by US Environmental Protection Agency (EPA) and the designation of some of these water bodies as "impaired" because of chlorides and their potential effects on stream biota (Keller and Cavallaro, 2008). This has in part led to the establishment of total maximum daily loads (TMDL) requirements restricting departments of transportation (DOTs)' use of chloride based deicers.

RESEARCH OBJECTIVES

The objectives of this work are to synthesize the available information in the published domain on the increasingly important water quality issue associated with chloride based deicers and then use this information to assist agencies in developing guidelines, standards and practices to protect water resources from this risk.

BACKGROUND

Since the 1960s, chloride salts have been the primary products used by roadway agencies for deicing (breaking the ice-pavement bond, typically by application of solid chemical after the bond formation). More recently, they are also used for pre-wetting (addition of chemicals to solid salt or abrasives) and anti-icing (prevention of the ice-pavement bond, typically by application of liquid chemical in advance of the bond formation). Road salts can enter the roadside environment through a wide variety of pathways, such as runoff, splash and spray from vehicles, or from snow that has been plowed or hauled off site (Zinger and Delisle, 1988; Ramakrishna and Viraraghavan, 2005). Figure 1 outlines the pathways of deicer movement in the environment (Rubin et al., 2010; Ratkevičius et al., 2014). Once applied, deicers can become a part of road runoff or be dispersed aerially. Once in runoff, they can be part of a surface flow (40-50%) or groundwater transportation (50-60%) and therefore impact soil, flora and fauna. If distributed aerially, deicers can impact the soil, water (mostly surface water), flora, and air quality (Rubin et al., 2010; Ratkevičius et al., 2014; Cheng and Guthrie, 1998; Fischel, 2001).

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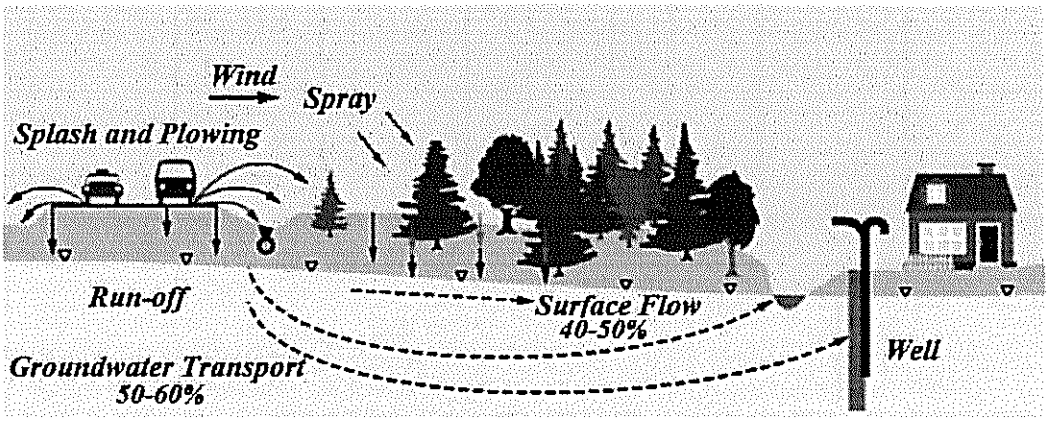

Figure 1. Pathways of deicers into the environment (adapted from Rubin et al., 2010; Ratkevičius et al., 2014).

Information presented to date on the aquatic toxicity of chloride based deicers generally includes chemical composition and properties of deicers. Additional information on their aquatic toxicity such as impacts of chlorides on aquatic species is needed to enable fully-informed decisions by stakeholders. Such toxicity could be associated with the direct effect of deicers or with the indirect effect via their interactions with runoff chemistry. Toxicity testing has not been required of manufacturers or vendors producing chloride based deicers and the associated additives (e.g., corrosion inhibitors and thickeners). As such, little toxicity data has been collected or published in the field of winter maintenance (Corsi et al., 2010). Toxicity research has been conducted on similar products used in other fields including aircraft or airfield deicers (Corsi et al., 2006) and dust suppressants (Williams and Little, 2011), but available data are still very limited. For roadway winter operations, deicers tend to have limited inclusion of additives, which are generally more toxic component compared to the aircraft or airfield deicers (Pillard, 1995; Corsi et al., 2009). Roadway deicers may have additives such as anti-caking agents, corrosion inhibitors, dyes, beet juice, molasses, corn, and other agricultural products (Levelton Consultants Limited, 2007; Fay and Shi, 2012).

Concerns associated with the use of chloride based deicers include increased salinity in waterways and soils, infiltration of cations (e.g., Na^+, Ca^{2+}, and Mg^{2+}) and chloride anion (Cl^-) into soils and drinking water, degradation of the environment along the roadside, and potential risk to biological diversity (TRB, 1991a; Environment Canada, 2001). Studies have demonstrated that sodium chloride (NaCl) can pose significant risks to vegetation, soil, water, and aquatic life and mammals (Vitaliano, 1992; Robidoux and Delisle, 2001; Fay and Shi, 2012). Since the 1970s, road salts have also been shown to impact flora and fauna in the near-road environment, including water bodies (Crowther and Hynes, 1977; Dickman and Gochnauer, 1978). According to Environment Canada (2010), "increased salt concentrations in lakes can lead to stratification, which retards or prevents the seasonal mixing of waters, thereby affecting the distribution of oxygen and nutrients." Bowen and Hinton (1998) found elevated chloride concentrations in surface water affected the spatial patterns of total phosphorous concentrations and induced higher

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turbidity and bacteria growth, degrading the overall health of streams and making them potentially inhospitable for fish populations. Field research has found that elevated background and spike chloride concentrations in waterways have reduced the richness of amphibian species in some waterways (Turtle, 2000; Houlahan and Findlay, 2003; Collins and Russell, 2009). Deicers have been found to negatively impact aquatic community structures, such that elevated chloride concentration are correlated with reduced species richness and food web dynamics (Sanzo and Hecnar, 2006; Collins and Russell, 2009; Van Meter et al., 2011). Laboratory and field studies in Canada found that in southern Ontario, Quebec and other areas of heavy road salt use, chloride concentrations in ground and surface water are often sufficient to affect biota (Environment Canada, 2001). While changes in macroinvertebrate drift behavior and mortality caused by elevated salt concentrations were found to be highly dependent on concentrations and exposure time, and vary among taxa (Blasius and Merritt, 2002).

Work by Granato (1996) found that in addition to adding the chemical constituents (Na^+, Ca^+, and Cl^-) to aquatic systems, the use of NaCl and $CaCl_2$ deicers can also be considered a source of constituents in runoff:

- NaCl deicer – sulfate, calcium, potassium, bromide, vanadium, magnesium, and fluoride
- Calcium chloride ($CaCl_2$) deicer - sodium, potassium, sulfate, bromide, silica, fluoride, strontium, magnesium

This work did not list potential constituents associated with the use of $MgCl_2$ based deicers.

Chloride salts are readily soluble in water, difficult to remove, and tend to accumulate over time (Howard and Haynes, 1993). Chloride anions are highly mobile, do not "significantly absorb into mineral surfaces", and do not "biodegrade, volatilize, (or) easily precipitate" (Bowen and Hinton, 1998). It has been shown that a high percentage of deicers can migrate from the road as surface runoff and then enter streams and rivers (Crowther and Hynes, 1977; Scott, 1981; Hoffman et al., 1981; Demers and Sage, 1990). Evidence shows that chloride salts can accumulate in aquatic systems, and are conservative (Environment Canada, 1999; Mason et al., 1999; Kaushall et al., 2005; Winston et al., 2012). According to Environment Canada (2001), "research has shown that 10-60% of the salt applied enters shallow subsurface waters and accumulates until steady-state concentrations are attained." Road salt applied by the Swedish National Road Administration contributed to more than half of the total chloride load for the river basin of Sagan (Thunqvist, 2004). Dailey et al. (2014) sampled central Ohio rivers in 2012-2013 and "high Cl^-/Br^- mass ratios in the Ohio surface waters indicated the source of Cl^-" was in part road salt. They also revealed "increasing trends in Cl^- and Na^+ concentration beginning in the 1960s at river locations with more complete historical datasets."

Elevated chloride concentrations are generally linked to spring flushing events. Of special importance is the study of snowmelt runoff from the first major snowmelt due to high concentrations of pollutants contained in this "first flush". A field study in Ohio (Dailey et al., 2014) also observed "higher Cl^- and Na^+ concentrations and fluxes…in late winter as a result of increased road salt application during winter months". Elevated chloride concentrations have been observed in summer, due to

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recharge of surface water by ground water during times of low flow (Environment Canada, 2001). Shallow wells, reservoirs, and low-flow surface waters adjacent to roadways or storage sites are most susceptible to contamination by deicers as they can infiltrate into groundwater aquifers (TRB, 1991a). The Pennsylvania DOT and some other northern state DOTs have had to purchase wells or provide replacement water where contamination has occurred (TRB, 1991a).

Current standards used by US EPA for chloride in surface waters are 230 mg/L maximum chronic exposure for a four-day average concentration of dissolved chloride, associated with sodium, and 860 mg/L maximum acute exposure for a one-hour average concentration, no more than once every three years on the average [US EPA 440/5-88-001)] (US EPA, 1988). The US EPA standard should apply to most locations except where more conservative values may be necessary, such as where locally important and sensitive species are present. When chloride concentrations in streams reach or exceed the acute and chronic standards, toxicity to aquatic species can result. In addition to toxicological impacts, elevated chloride concentrations can disrupt normal functions of surface water; e.g., cause density stratification and late vertical mixing in waters. A state can adopt these standards or develop a site-specific or pollutant-specific standard if it is adequately justified, which can be higher or lower than the federal standard. Work completed by the Iowa DNR and US EPA can be used as the basis to set site-specific acute and chronic chloride criteria based on measured water hardness and sulfate levels (Iowa DNR, 2009). The established equations are provided as follows: acute chloride threshold = $287.8\times[\text{hardness}]^{0.205797}\times[\text{sulfate}]^{-0.07452}$ and chronic chloride threshold = $177.87\times[\text{hardness}]^{0.205797}\times[\text{sulfate}]^{-0.07452}$. The new chloride criteria "appear to provide a more accurate representation of the potential toxic effects of elevated chloride levels in freshwater streams and rivers" (MassDOT, 2012).

Impaired or threatened waters (rivers segments, streams, lakes) identified by states, where the required pollution controls are not enough to maintain or reach applicable water quality standards are added to the 303(d) list maintained by the US EPA, and will have TMDLs established based on the severity of the pollution and the sensitivity of the waters (US EPA, 2012). The 977 waterways currently considered impaired or threatened waterways are on 303(d) listings due to impacts associated with elevated salinity, chlorides, and total dissolved solids (TDS). The following parameters that are of interest to chloride toxicity and are covered by the 303(d) listing include chlorides, TDS, total suspended sediments (TSS), and biological oxygen demand (BOD). In 2004, New Hampshire added five waterways along I-93 to the list of chloride impaired, reaching a total of nine streams violating the states standard for chloride, after elevated ground water chloride levels were detected, associated with years of heavy salt use (Fredrick and Goo, 2006). Cooper et al. (2014) mentioned that groundwater is a "long-term reservoir for accumulating road salts" and as a result, these accumulated "road salts represent a risk to the safety of drinking water sources." The mechanism proposed by Corsi et al. (2015) suggests that during the snowfall seasons, chloride is stored in shallow groundwater systems and after that is slowly released into the baseflow.

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WATER QUALITY IMPACTS BY CHLORIDE DEICERS AND ADDITIVES ECOSYSTEM HEALTH IMPACTS OF CHLORINE DEICERS AND ADDITIVES

Chlorides are readily soluble in water and difficult to remove, and thus concerns have been raised over their short-term and long-term risks to water quality, on aquatic organisms, and on human health (TRB, 1991b; Environment Canada, 2010). The chloride salts applied on winter roads can migrate into nearby surface waters and impact them via various pathways. NaCl from road runoff is responsible for increased salinity or osmolality of surface and ground waters several months after the last road treatment (Thunqvist, 2004). Ramakrishna and Viraraghavatan (2005) reported that this could reduce water circulation and re-aeration in lower depths, resulting in changes in population or community structure of aquatic biota.

Impacts of chloride based deicers on water. Karraker et al. (2008) investigated the effects of road salt on water quality, by measuring water quality variables at 28 roadside pools and 14 forest pools. Water temperature, pH, dissolved oxygen, and conductivity in each pool were measured monthly May through August. The results showed that the conductivity, pH, dissolved oxygen, and water temperature differed between forest and roadside pools. Mean conductivity was nearly 20 times higher in roadside (357.8 µS; range 11.6 – 2904.8 µS) than forest pools (18.6 µS; range 5.7 – 41.4 µS). Conductivity was strongly correlated with both sodium and chloride. Sixty-one percent of roadside pools had higher average conductivity than all forest pools. Conductivity in roadside pools declined exponentially with increasing distance from road (Karraker et al., 2008). Mean water temperature was lower in roadside (48.9°F, 9.38°C) than forest (55.6°F, 13.1°C) pools. Mean pH was higher in roadside (5.3) than forest (4.7) pools. On the other hand, the dissolved oxygen (mg/L) was nearly one-third higher in roadside pools (3.6 mg/L) than in forest pools (2.0 mg/L). The results also showed that water quality variables varied over time. Conductivity, pH, and water temperature increased between May and August in both roadside and forest pools. Conductivity and dissolved oxygen in pools were similar in May among years. However, pH decreased and temperature decreased. Forest ponds were larger in perimeter than roadside ponds, but similar in maximum pond depth and canopy cover (Karraker et al., 2008).

Deicer impacts on surface and ground waters depend on the site-specific properties of the receiving water body. The quantity of precipitation affects the dilution rate of the applied deicers and the flushing rate of the system (TRB, 1991a). Factors unique to each site can also influence potential impacts – temperature, topography, sunlight, wind, etc. Additionally, surface waters have a wide array of physical, biological, and chemical cycles and interacting processes (Mayer et al., 1999). Field testing of chlorides has produced widely variable results from no observed effects (Jones et al. 1992; Baroga, 2005), to highly elevated chloride concentrations (TRB, 1991a; Godwin et al., 2005; Environment Canada, 2010). It is very important to understand how the size and flow rate of the water body influence the impacts of chloride contamination on aquatic species. Questions remain on: how do cold temperatures or other seasonal factors affect the tolerance on aquatic species,

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before seasonal standards or criteria can be established; what are the appropriate location and frequency of water quality sampling for determining representative chloride concentration non-compliance due to deicer applications; what are the guidelines for optimizing the potential of road right-of-way in mitigating the flow rate and composition of chloride-laden stormwater runoff. These issues should be explored by future studies.

Impacts of chloride based deicers on aquatic species. Salt has negative effects on aquatic organisms by altering the osmotic balance between the organism and its surrounding environment. Salt concentrations less than those of the organism's protoplasm or other fluids are common in freshwaters and most terrestrial soils, and so the organisms must expend energy to prevent simple diffusion of salts out of their bodies (Findlay and Kelly, 2011). If concentrations rise to surpass the isotonic point of the organism, it faces the converse problem of an inwardly directed diffusion gradient and must either exclude ions or actively excrete those that may cross their integument/membrane. Threshold levels for salt effects vary widely across organisms and/or life stages (Findlay and Kelly, 2011).

Many studies have addressed the effects of chloride based deicers on wildlife species and research has shown that road salt exposure negatively affects mammals, birds, invertebrates, and amphibians that utilize roadside habitats (Vitt et al., 1990; Mineau and Brownlee, 2005; Ramakrishna and Viraraghavan, 2005; Harless et al., 2011; Karraker and Gibbs, 2011). However, most field data are correlative, where investigators survey a range of water bodies that may vary in salt loads but undoubtedly also vary in other contaminants (Peters, 2009). In a survey of macroinvertebrates in urban streams, Cuffney et al. (2010) found that the chloride ion was frequently and strongly associated with indicators of poor macroinvertebrate communities, but it was acknowledged that other measured (and probably unmeasured) solutes co-varied with chloride, which may have included stream geomorphology, habitat availability, metals or organic compounds associated with urban runoff or wastewaters. Furthermore, Corsi et al. (2010) found road salt to cause detrimental impacts to surface water on local, regional, and national scales, with short- and long-term impacts to stream water quality and aquatic life.

Fay et al. (2013a) cited that by increasing the volume of water or the flow rate of stream, the tolerability towards deicers will increase which is due to the diluted incoming chloride. In general, the degree to which the surface water is contaminated from deicers is a function of the amount of time the deicer takes to reach the water body, the dilution factor, the residence time of the water body, and the frequency and rate of deicer application (D'Itri, 1992).

Amphibian toxicity. The deposition of chemical pollutants into roadside wetlands from runoff is a current environmental concern. In northern latitudes, a major pollutant in runoff water is NaCl from deicers. Collins and Russell (2009) conducted a survey from 26 roadside ponds for amphibian species richness as compared to chloride concentration and concluded that chloride concentrations in ponds associated with deicing salts, influenced community structure by excluding salt intolerant species. Many studies have found that as salinity increases survivorship and mobility

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decrease (Sanzo and Hecnar, 2006; Karraker and Ruthig, 2009; Denoël et al., 2010). Amphibians are likely to be the most affected by chemical and deicer runoff. Amphibians possess highly permeable skin and have aquatic larval stages, and many use roadside wetlands for breeding (Harless et al., 2011). Amphibians are considered good indicators of ecosystem health, and inhabit a wide range of habitats (wetlands, ephemeral water bodies, road side ditches, etc.) and for these reasons extensive toxicity testing has been conducted using amphibians (Vitt et al., 1990). Of the amphibian species tested, salamanders may be the most intolerant amphibians to varying salt concentrations (Collins and Russell, 2009).

Road salts and heavy metals have been shown to have the greatest impacts on amphibians (Birdsall et al., 1986; Sanzo and Hecnar, 2006). Studies have found that chloride concentration spikes that occur during spring runoff and from direct runoff from the road threaten embryonic and larval stage of amphibians (Collins and Russell, 2009). The effects of hyposalinity on the wood frog (Rana sylvatica) included a significant decrease in body weight, not undergoing metamorphosis, decreased activity and increased developmental abnormalities, and death (Sanzo and Hecnar, 2006). Kim and Koretsky (2013) collected sediment cores in fall and spring from a freshwater wetland fringing an urban kettle lake in Michigan and "incubated for 100 days in deionized water (control) or with treatments of 1 or 5 g/L $CaCl_2.2H_2O$ or 5 g/L NaCl to simulate addition of road salt deicers". Their study revealed that the influx of chloride deicers would significantly affect the microbial activities in wetland and biogeochemistry of wetland sediments. In contrast, a cold-climate outdoor study of bioretention mesocosms with soil, mulch and vegetation layers (Denich et al., 2013) indicated that the application of a salt/aggregate mixture did not significantly affect the mobility of heavy metals in the simulated bioretention facility.

Even between amphibian species, toxicity is highly variable. For example road salt were found to significantly affect embryonic survival of the spotted salamander (Ambystoma maculatum), while having little effect on the green frog (Rana clamitans) (Karraker and Ruthig, 2009). In a study conducted by Collins and Russell (2009), it was found that spotted salamander (Ambystoma maculatum) and wood frogs (Rana sylvatica) did not occupy high chloride ponds, and acute toxicity tests (LC50) found them to be more sensitive than the American toad (Bufo americanus) to chloride. Spring peepers (Pseudacris crucifer) and green frogs (Rana clamitans) showed intermediate sensitivities (Table 1).

A case study in North Carolina on the impacts of deicers to amphibians found that the amount of snow, or water equivalent, is important because for many DOTs the application rate is relatively constant (250 lbs/l-m) per snow or ice event (Winston et al., 2012). Therefore smaller snow and runoff events can have a greater impact on amphibian populations than larger snowfalls.

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Table 1. A summary of example different toxicity studies including chemicals used, species tested and the observed LC50 values at 48 h and 96 h of exposure to chemical deicers.

Reference	*Chemical used*	*Species tested*	*LC50 (g/L Cl^-)*	
			48-h	*96-h*
Collins and Russell (2009)	NaCl	Spotted salamander		1.18
		Wood frog		1.72
		Spring peepers		2.83
		Green frogs		3.11
		American toads		3.93
Harless et al. (2011)	CH_4N_2O	Wood frog	14.37	14.29
	NaCl	Wood frog	7.82	7.56
	$MgCl_2$	Wood frog	7.28	7.11
	CH_3COOK	Wood frog	5.42	4.23
	$CaCl_2$	Wood frog	4.72	3.98
	$C_8H_{12}CaMgO_8$	Wood frog	3.39	3.23
Baek (2014)	$CaCl_2$	Cloeon dipterum	6.14	
	$CaCl_2$ (Deicer)	Cloeon dipterum	6.50	
	$CaCl_2$	Ecdyonurus levis	6.32	
	$CaCl_2$ (Deicer)	Ecdyonurus levis	8.34	
	$CaCl_2$	Glyptotendipes tokunagai	3.84	
	$CaCl_2$ (Deicer)	Glyptotendipes tokunagai	5.69	
	$CaCl_2$	Gammarus sobaegensis	3.54	
	$CaCl_2$ (Deicer)	Gammarus sobaegensis	5.85	
	$CaCl_2$	Caridina denticulata denticulata	18.88	
	$CaCl_2$ (Deicer)	Caridina denticulata denticulata	20.73	

A study looked six commonly used deicers (urea, NaCl, $CaCl_2$, $MgCl_2$, KAc, and CMA) and their toxicity to larval wood frogs (Rana sylvatica). Survival was inversely related to higher concentrations for all deicers tested (Harless et al., 2011). Tadpole survival had significantly lower threshold concentrations for all deicers. Acetate based deicers had lethal effects on tadpoles at the lowest concentrations. $CaCl_2$ and $MgCl_2$ were found to be more toxic to frog tadpoles than NaCl, most likely because they have two chloride ions per molecule (Dougherty and Smith, 2006; Harless et al., 2011). Interestingly, LC50 values decreased with time, suggesting that organisms were either less capable of tolerating deicers overtime, or that there was a lag in the lethal effect (Harless et al., 2011). The relative toxicity scale for larval and tadpole frogs was: NaCl<$MgCl_2$<$CaCl_2$<Acetate based (Table 1) (Harless et al., 2011).

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Benthic species toxicity. Riva-Murray et al. (2002) found that declines in several indices of macroinvertebrate "health" were correlated with higher chloride concentrations, but the absolute levels were so low (<50 mg/L) that it is unlikely that direct toxicity was causing the patterns. Thus, while it is fair to say that chloride is associated with negative effects on benthic insects at low concentrations, other contaminants and stressors are most likely affecting populations as well. This is confirmed by a more recent study by Baek et al. (2014), which reported that "Cl^- concentrations (from $CaCl_2$ deicer) in the field sites (<25 mg/L) were much lower than the LC50 values of five selected macroinvertebrate species (Gammarus sobaegensis, Caridina denticulata denticulata, Glyptotendipes tokunagai, Cloeon dipterum, and Ecdyonurus levis)". The laboratory test revealed that the LC50 value of the five select species ranged from 3.54 to 20.73 g/L.

Experiments focused on altering salt levels in surface waters have been rare but do provide more direct links between salt concentrations and response variables. For example, NaCl was added to reach ambient concentrations of 1,000 mg Cl^-/L in a stream, and resulted in changes in benthic algae and protozoans within one to a few weeks after initiation of the experiment (Dickman and Gochnauer, 1978; Evans and Frick, 2002). In another study, Cl^- was added to levels of 2,165 mg/L, and caused an increase in drift of benthic insects out of the experimental sub-channels placed in an Ontario stream within a few hours (Crowther and Hynes, 1977).

Baek et al. (2014) conducted quantitative field sampling of benthic macroinvertebrates at eight surface water sites exposed to $CaCl_2$ deicer applications in South Korea and reported that "despite the heavy application of road deicers during the snowy season, the deicer may not directly affect benthic macro-invertebrate communities over short time periods." Casey et al. (2014) mentioned that highway deicing chloride seldom can harm fish, and have no significant harmful effect on microfauna and invertebrates.

Invertebrate species toxicity. Research testing the acute toxicity of chloride to four freshwater invertebrate species, including water flea (Ceriodaphnia dubia), fingernail clam (Sphaerium simile), planorbid snail (Gyraulus parvus), and tubificid worm (Tubifex tubifex), was completed under different levels of water hardness (all four species) and sulfate concentrations (C. dubia only) (Linton and Soucek, 2008). Tests with C. dubia acclimated and tested under different levels of total water hardness and sulfate were performed simultaneously by two different laboratories (Linton and Soucek, 2008). Results were comparable. The 48-h LC50 for C. dubia acclimated and exposed to acutely lethal chloride concentrations at 25 to 50 mg/L hardness (i.e., 919 mg Cl^-/L) is approximately half that of C. dubia exposed at 600 to 800 mg/L hardness. Conversely, sulfate over the range of 25-600 mg/L exerted only a small (inverse) effect on chloride toxicity to C. dubia. The mean 48-h LC50 at 25 mg/L for sulfate was approximately 1,356 mg Cl/L, while at 600 mg/L sulfate, it was 1,192 mg Cl^-/L (reduction of 12%). Again, LC50 values between labs were consistent. Ninety-six hour LC50 values for three other freshwater invertebrate species ranged from a low of 740 mg Cl^-/L for S. simile exposed to chloride at 50 mg/L hardness, to a high of 6,008 for T. tubifex exposed to chloride at 200 mg/L hardness. For both these species, increasing the acclimation and dilution of water hardness reduced the acute toxicity

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of chloride by approximately 1.4 to 1.5 times. Water hardness did not appear to influence the acute toxicity of chloride to the planorbid snail, G. parvus. Acute LC50 values at 50 and 200 mg/L hardness were 3,078 and 3,009 mg Cl/L, respectively. Rank order of sensitivity to acutely lethal chloride at a given water hardness is in the order (most to least): S. simile>C. dubia>G. parvus>T. tubifex. Siegel (2007) tested toxicity thresholds for NaCl and chloride for various species and found freshwater aquatic species react differently to varying exposure concentrations. Based on these findings, invertebrate species appear to be more sensitive to chloride than are vertebrate species, with fathead minnow being the most sensitive species tested (Siegel, 2007).

Fish toxicity. Salt tolerance of aquatic species varies tremendously. Depending on whether fish are fresh or salt water species, fish have been reported to tolerate between 400 and 30,000 mg/L (Siegel, 2007). Road salting and increased salinity can lead to excess growth of salt tolerant species (Siegel, 2007). Interestingly, aquatic species may adapt to increased levels of chloride with time, such that surviving organisms may develop the means by which to handle the osmotic shock imposed by the excess chloride (Mineau and Brownlee, 2005). Furthermore, saltwater species are not vulnerable to anthropogenic sources of NaCl, except for fluctuations of greater than 10%.

There is a wide range in salt concentrations known to have negative effects on organisms, and most of these data come from laboratory exposures under controlled conditions with only one stressor (salt) acting at a time. For many organisms, the short-term lethal concentrations are far above levels seen in the environment, except under extreme conditions (Findlay and Kelly, 2011). For example, adult freshwater fish species do not show lethal effects until concentrations approach tens of grams of salt per liter. Young fishes show negative effects at much lower levels, but even so, these concentrations are roughly equivalent to those in direct road runoff, much higher than concentrations occurring after dilution by water sources. Effects near roads are, of course, more evident than for points further from the actual area of salt application with reasonably sharp declines in concentrations within tens of meters of the road (Albright, 2005; Lax and Peterson, 2009).

Spring rains have been postulated to dilute deicers following input into waterways. One study tested this theory and found spring rains may help when low to moderate chloride concentrations are present, but in situations where water lacks outflow or flushing and chloride concentration reach 1000 mg/L, permanent damage can occur to egg membranes (Karraker and Gibbs, 2011).

Biotoxicity work for the Colorado DOT on the boreal toad tadpole, juvenile rainbow trout, Ceriodaphnia (aquatic invertebrate), and Selenastrum (algea) found that application rates of $MgCl_2$ typically used are highly unlikely to cause or contribute to environmental damage at distances greater than 20 yards for the roadway (Lewis, 1999). Work in Chautauqua Lake, New York on sunfish found that NaCl contributed to toxicity but zinc and cadmium were also found to be of concern (Adams-Kszos et al., 1990). A study in Washington observed deicer impacts on Steelhead (Oncorhynchus tshawytscha), Chinook salmon (Oncorhynchus mykiss), and bull trout (Salvelinus confluentus), threatened and endangered species, and

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general stream ecology (Yonge and Marcoe, 2001). Elevated chloride concentrations from 5 to 8 mg/L were found, but the authors suggested the deicing activities did not adversely impact the stream ecology.

Models have shown that cyanide has potential to impact some species in areas of high road salt use (Environment Canada, 2001). Sodium ferrocyanide and ferric ferrocyanide are used to prevent clumping of solid chloride based deicers while in storage and during deicing operations (Letts, 2000). In Canada, sodium ferrocyanide was added to rock salt at a range of 30 to 240 mg/kg of salt. Potassium ferro- and ferricyanide solutions were originally believed to be much less toxic (no effect at 2000 to 8732 mg/kg), but due to a fish kill in a stream caused by ferro- and ferricyanides from industrial effluent, it was found that photo-decomposition can release the cyanide ion (Burdick and Lipschuetz, 1950). Experimental results found ferro- and ferricyanides to be toxic at 1 – 2 mg/kg when photodecomposition was considered (Burdick and Lipschuetz, 1950).

Letts (2000) tested the issue of photodecomposition of ferrocycanide to create free cyanide, a much more toxic substance, in the ecosystems that commonly receive deicer laden runoff. Letts (2000) concluded that in most situations the ferrocyanide will precipitate, break down via photolysis volatilization, or biological degradation before it can cause harm to the ecosystem. Additionally, dilution rates commonly seen in ecosystems receiving deicer laden runoff will reduce the potential for harm to organisms. Letts (2000) does caution that impacts could occur to organisms in roadside ditches in urban areas with heavy salt use. Photoenhancement, or increased aquatic toxicity due to a chemical transformation of a substance due to UV exposure, was also observed by Little and Calfee (2000), when testing the toxicity of sodium ferrocyanide (from yellow prussiate of soda (YPS) used in fire retardant). Rainbow trout (Onchorhyncus mykiss) and Southern leopard frog (Rana sphenocephala) were exposed to various fire retardants and UV light treatments. Rainbow trout were always more sensitive to fire retardants than the Southern leopard frog, and both species were equally affected by low concentration of YPS alone when exposed to UV. Cyanide agents can interfere with a fish's gills impeding breathing causing death (MN Pollution Control Agency, 2000). In Minnesota, run-off from the salt piles was reported to contain between 5 and 40 times the amount of free cyanide that is toxic to half of the fish exposed, caused by concentrated runoff from salt piles that were improperly managed at that time (MN Pollution Control Agency, 2000). Environment Canada (2001) concluded that "road salts that contain inorganic chloride salts with or without ferrocyanide salts are 'toxic'."

Aquatic invertebrates' toxicity. In Iowa, the US EPA tested acute toxicity of chloride to four freshwater species, water flea (Ceriodaphnia dubia), fingernail clam (Sphaerium simile), planorbid snail (Gyraulus parvus), and tubificid worm (Tubifex tubifex) under varying concentration of sulfate and levels of water hardness (Linton and Soucek, 2008). The study found that for two species (S. simile & T. tubifex), increasing the acclimation and dilution of water hardness reduced the acute toxicity of chloride by up to 1.5 times, while sulfate was found to negatively impact chloride toxicity by up to 12% for C. dubia.

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Research conducted on aircraft and airfield deicers and dust suppressants has laid the foundation for toxicity testing of roadway deicers. Work by Pillard (1995) investigated the toxicity of ethylene and propylene glycol and the associated aircraft deicer additives on Ceriodaphnia dubia and Pimephales promelas. Corsi et al. (2006; 2009) reported aquatic toxicity data for airfield pavement deicers, KAc and Sodium Formate (NaFm) using US EPA tests methods (US EPA 2002a,b), and aquatic organisms Vibrio fischeri, Pimephales promelas, Ceriodaphnia dubia, and Selenastrum capricornutum. The Airport Cooperative Research Program (ACRP) published an extensive document on developing new formulations for aircraft deicers that have lower toxicity and BOD (ACRP, 2008). Aircraft deicers tested were acetate and formate based products and ethylene and propylene glycols. Toxicity testing was conducted using US EPA methods on fathead minnow, daphnia magna, and rainbow trout. Chauhan et al. (2009) reported that airport runway deicers (e.g., acetates) feature a typical Daphnia magna 48-hr LC50 value of 1,000 mg/L and a typical Pimephales promelas (fathead minnows) 96-hr LC50 value of 1,000 mg/L, whereas the more eco-friendly proprietary alternatives featured LC50 values up to 4,875 mg/L. For chronic toxicity, common airport runway deicers had C. dubia IC25 values typically in the range of 400-820 mg/L, and P. promelas LC25 values typically in the range of 180-280 mg/L, whereas the more eco-friendly proprietary alternatives featured IC25 values in the range of 1,100 to 2,600 mg/L.

Aquatic vegetation is similarly vulnerable to the changes in salt concentrations. One algal species has demonstrated extreme sensitivity to exposures to chloride; with concentrations of 71 mg Cl^-/L inhibiting growth and chlorophyll production, while others can tolerate chloride concentrations between 886 and 36,400 mg/L (US EPA, 1988). An increase in chloride may also allow for non-native species to become more predominant. Other aquatic plants exhibit various sensitivities, with growth inhibition observed in desmids at 200 mg Cl^-/L, EC50 equal to 1482 mg Cl^-/L in diatoms, and reduced growth and reproduction at 1820 mg Cl^-/L in angiosperm (US EPA, 1988). Although noteworthy, the sensitivities exhibited by the algae and desmids do not weigh into the final threshold determination because the toxicity tests were not conducted with measured concentrations of chloride, a biologically significant endpoint, and an aquatic plant of consequence in U.S. waters.

Heavy metal leaching by deicers. Research conducted in Sweden found that concentrations of cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) in soil adjacent to roadways were related to the use of deicing salts (Backstrom et al., 2004). The methods of mobilization of the heavy metals included ion exchange, lowered pH, chloride complex formation, and possible colloid dispersion. The researchers express concern about mobilization of heavy metals due to the use of NaCl as a deicing product and potential contamination to shallow ground water.

Soil columns leached with NaCl mobilized organic materials and iron oxides. The potential to carry adsorbed heavy metals along with them increases as electrolyte concentrations decrease (Amrhein, 1992; Norrström, 1998). Zinc and cadmium are far more susceptible to changes in pH and become more mobile with increasing acidity (Backstrom, 2004; Amrhien, 1992). Doner (1978) also performed soil column experiments with both chloride and perchlorate salts to test the theory of

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complexation as a mechanism of metal transport. Perchlorate has an ionic strength equal to chloride but is known to form very weak metal complexes. The results showed 1.1 to 4 times as much movement of cadmium, nickel and copper for chloride salt leachate as compared to the perchlorate leachate. Cadmium tends to be associated with readily leached compounds and is more mobile than other heavy metals when in soils (Norrström, 1998). The addition of chloride from deicer salts increases the mobility of cadmium via complexation with the chloride. The resulting negatively charged ligand complexes further compete with clay for cadmium ions (Lumsdon et al. 1995). This is also true, to a lesser extent, when CMAs are used by complexation with acetate (Amrheim, 1992). Cadmium has also been demonstrated to be more mobile in high salt concentrations by cation exchange with sodium, magnesium and calcium (Amrhein, 1992; Backstrom, 2004). Chromium is more closely associated with the transport of organic materials and occurs at higher levels when CMAs are used as deicers. This was also true for lead, copper and nickel (Amrhein, 1992).

In the Netherlands, a remediation facility consisting of a detention basin and a constructed wetland were tested for retention of heavy metals and Poly-Aromatic Hydrocarbons (PAHs) from road runoff (Tromp et al., 2012). This study found the system was very effective at removing PAHs, 90-95% removal; however, during application of deicers, concentrations of copper (Cu), zinc, (Zn), cadmium (Cd), and nickel (Ni) were found to be much higher in the wetland effluent. The researchers recommended modifying the hydraulic management of the system, to bypass the road water runoff, during times when deicers are being used so as to maintain the integrity of the remediation facility.

CONCLUDING REMARKS

Environmental risks of chloride based deicers, indicating that the actual effects depend on individual site conditions as well as the type and amount of deicers applied. Overall, maintenance yards have the potential to for releasing high chloride concentration runoff into the adjacent environment and pose a risk of point source pollution. In contrast, stormwater runoff from roads where deicers have been applied at controlled application rates tends to be diluted by precipitation (averaged at 500:1) and poses a risk of non-point source pollution.

Spikes in chloride concentrations in waterways near roads are often observed in the first flushing event, or with spring melting of accumulated snow. If elevated chloride concentrations are observed in times of low flow or when baseflow dominates surface waters near roads, groundwater recharging the waterways may be the source of chlorides.

The density of road networks and the application rates used can directly influence the chloride concentrations observed in surface and groundwater. Land use, soil characteristics and subsurface geology influence groundwater chloride concentrations, as well as precipitation and deicer application rates. Based on these findings, mapping of sensitive areas, road density, annual precipitation, etc. can aid in identifying areas for reduced salt use or where alternative products may be better suited.

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Species that have been shown through laboratory testing to be good indicators of the impacts on chlorides are salamanders for amphibious species and fathead minnow. Generally speaking, invertebrate species appear to be more sensitive to the effects of chloride than vertebrate species. Recent laboratory testing has shown that increasing species acclimation to and diluting water hardness reduces the toxic effects of chloride by 1.4 to 1.5 times. The presence of sulfate during chloride toxicity testing was found to increase toxicity by 12% for the same species. This testing was completed with a limited number of species at this point in time.

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REFERENCES

Albright, M. (2005). "Changes in water quality in an urban stream following the use of organically derived de-icing products." *Lake and Reservoir Management*, 21, 119-124.

Amrhein, C., Strong, J.E., and P.A. Mosher. (1992). "Effect of deicing salts on metal and organic matter mobilization in roadside soils." *Environmental Science and Technology*, 26, 703-709.

Andrey, J. (2010). "Long-term trends in weather-related crash risks." *Journal of Transport Geography*, 18 (2), 247-258.

Backstrom, M., Karlsson, S., Backman, L., Folkeson, L., and B. Lind. (2004). "Mobilization of heavy metals by decing salts in a roadside environment." *Water Research*, 38, 720-732.

Baek, M.J., Yoon, T.J., Kim, D.G., Lee, C.Y., Cho, K., Bae, Y.J. (2014). "Effects of road deicer runoff on benthic macroinvertebrate communities in Korean freshwaters with toxicity tests of calcium chloride ($CaCl_2$)." *Water, Air, & Soil Pollution*, 225 (6), 1-14.

Baroga, E.V. (2005). "2002-2004 Salt Pilot Project." Final Report for the Washington State Department of Transportation, Seattle, Washington.

Birdsall, C.W., Grue, C.E., Anderson, A. (1986). "Lead concentrations in bullfrog *Rana catesbeiana* and green frog *R. clamitans* tadpoles inhabiting highway drainages." *Environmental Pollution*, 40 (3), 233-237.

Blasius, B. J., Merritt, R.W. (2002). "Field and laboratory investigations on the effects of road salt (NaCl) on stream macroinvertebrate communities." *Environmental Pollution*, 120, 219-231.

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Bowen, G.S., Hinton, M.J. (1998). "The temporal and spatial impacts of road salt on streams draining the Greater Toronto Area." In *Groundwater in a Watershed Context Symposium*. (Ed.) Piggott, A.R. Canadian Water Resources Association, Burlington, Ontario, 303-309.

Burdick, G. E., Lipschuetz, M. (1950). "Toxicity of ferro-and ferricyanide solutions to fish and determination of the cause of mortality." *Transactions of the American Fisheries Society*, 78, 192-202.

Casey, P.C., Alwan, C.W., Kline, C.F., Landgraf, G.K. Linsenmayer, K.R. (2014). "Impacts of Using Salt and Salt Brine for Roadway Deicing." *Final research report for Idaho Transportation Department*, Contract No. RP-231.

Chauhan, S.P., Roshon, M.S., Conkle, H.N., Samuels, W.D., Berman, E., Wyderski, M. (2009). "Development of Environmentally Benign & Reduced Corrosion Runway Deicing Fluid." Strategic Environmental Research and Development Program, Final report for SERDP Project SI-1535.

Cheng, K. C., and T.F. Guthrie. (1998). *Liquid Road Deicing Environment Impact.* File number 498-0670. Prepared for the Insurance Corporation of British Columbia. Levelton Engineering Ltd., Richmond, BC.

Collins, S.J., Russell, R.W. (2009). "Toxicity of road salt to Nova Scotia amphibians." *Environmental Pollution*, 157: 320-324.

Cooper, C. A., Mayer, P. M., Faulkner, B.R. (2014). "Effects of road salts on groundwater and surface water dynamics of sodium and chloride in an urban restored stream." *Biogeochemistry,* 121, 149-166.

Corsi, S.R., Geis, S.W., Loyo-Rosales, J.E., Rice, C.P. (2006). "Aquatic toxicity of nine aircraft deicer and anti-icer formulations and relative toxicity of additive package ingredients alkylphenol ethoxylates and 4,5-methyl-1H-benzotriazoles." *Environmental Science and Technology*, 40 (23), 7409-7415.

Corsi, S.R., Geis, S.W., Bowman, G., Failey, G.G., Rutter, T.D. (2009). "Aquatic Toxicity of Airfield-Pavement Deicer Materials and Implications for Airport Runoff." *Environmental Science and Technology*, 43, 40-46.

Corsi, S.R., De Cicco, L.A., Lutz, M.A., Hirsch, R.M. (2015). "River chloride trends in snow-affected urban watersheds: increasing concentrations outpace urban growth rate and are common among all seasons." *Science of the Total Environment*, 508, 488-497.

Corsi, S.R., Graczyk, D.J., Geis, S.W., Booth, N.L., Richards, K.D. (2010). "A Fresh Look at Road Salt: Aquatic Toxicity and Water-Quality Impacts on Local, Regional, and National Scales." *Environmental Science and Technology*, 44(19), 7376-7382.

Crowther, R.A., Hynes, H.B.N. (1977). "Effect of road de-icing salt on drift of stream benthos." *Environmental Pollution*, 14, 113-126.

Cuffney, T.F., Brightbill, R.A., May, J.T., and I.R. Waite. (2010). "Responses of benthic macroinvertebrates to environmental changes associated with urbanization in nine metropolitan areas." *Ecological Applications*, 20, 1384-1401.

Dailey, K.R., Welch, K.A., Lyons, W.B. (2014). "Evaluating the influence of road salt on water quality of Ohio rivers over time." *Applied Geochemistry*, 47, 25-35.

© ASCE

Demers, C.L., Sage Jr, R.W. (1990). "Effects of road deicing salt on chloride levels in four Adirondack streams." *Water, Air, and Soil Pollution,* 49, 369-373.

Denich, C., Bradford, A., Drake, J. (2013). "Bioretention: assessing effects of winter salt and aggregate application on plant health, media clogging and effluent quality." *Water Quality Research Journal of Canada*, 48(4), 387-399.

Denoël, M., Bichot, M., Ficetola, G.F., Delcourt, J., Ylieff, M., Kestemont, P., Poncin, P. (2010). "Cumulative effects of road de-icing salt on amphibian behavior." *Aquatic Toxicology*, 99(2), 275-280.

Devitt, D.A., Wright, L., Landau, F., Apodaca, L. (2014). "Deicing salts: Assessing distribution, ion accumulation in plants and the response of plants to different loading rates and salt mixtures." *Environment & Natural Resources Research*, 4(1), 73-93.

Dickman, M.D., Gochnauer, M.B. (1978). "Impact of sodium chloride on the microbiota of a small stream." *Environmental Pollution*, 17, 109–126.

D'Itri, F.M. (1992). *Chemical deicers and the environment.* Lewis Publishers, Boca Raton, Florida.

Doner, H.E. (1978). "Chloride as a factor in mobilities of Ni(II), Cu(II), and Cd(II) in soil." *Soil Science Society of America Journal*, 42, 882-885

Dougherty, C.K., Smith, G.R. (2006). "Acute effects of road-deicers on the tadpoles of three anurans." *Applied Herpetology*, 3, 87-93.

Dudley, M.M., Jacobi, W. R., Brown, C.S. (2014). "Roadway deicer effects on the germination of native grasses and forbs." *Water, Air, & Soil Pollution*, 225(6), 1-12.

Environment Canada and Health Canada. (2001). "Priority Substances List Assessment Report for Road Salts." http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/psl2-lsp2/road_salt_sels_voirie/index-eng.php

Environment Canada. 2010. "Risk management strategy for road salts." http://www.ec.gc.ca/nopp/roadsalt/reports/en/rms.cfm, accessed in March 2013.

Evans, M., Frick, C. (2002). "The effects of road salts on aquatic ecosystems." *NWRI Contribution No. 02-308*, Environment Canada, National Water Research Institute, Burlington/Saskatoon, Canada.

Fay, L., and X. Shi. (2012). "Environmental Impacts of Chemicals for Snow and Ice Control: State of the Knowledge." *Water, Air & Soil Pollution*, 223, 2751-2770.

Fay, L., Shi, X., Huang, J. (2013a). "Strategies to mitigate the impacts of chloride roadway deicers on the natural environment." *NCHRP Synthesis 449*, Transportation Research Board, Washington, D.C.

Fay, L., Akin, M., Shi, X., Veneziano, D. (2013b). "Revised Chapter 8, Winter Operations and Salt, Sand and Chemical Management." *of the Final Report on NCHRP 25-25(04).* American Association of State Highway and Transportation Officials, Standing Committee on Highways, Washington, D.C.

Findlay, S.E.G., Kelly, V.R. (2011). "Emerging indirect and long-term road salt effects on ecosystems". *Annals of the New York Academy of Sciences*, 1223, 58-68.

© ASCE

Fischel, M. (2001). *Evaluation of Selected Deicers Based on a Review of the Literature*. Final Report No. CDOT-DTD-R-2001-15, Colorado Department of Transportation.

Fredrick, R., Goo, R. (2006). "Deicers – Water Resource Threat?" *Presented at the Potomac DWSPP*, Rockville, Maryland.

Granato, G.E. (1996). "Deicing chemicals as source of constituents of highway runoff." *Transportation Research Record*, Record 1533.

Harless, M.L., Huckins, C.J., Grant, J.B., Pypker, T.G. (2011). "Effects of six chemical deicers on larval wood frogs (Rana sylvatica)." Environ. Toxicol. Chem. 30(7), 1637-41

Hoffman, R.W., Goldman, C.R., Paulson, S., Winters. G.R. (1981). "Aquatic impacts of deicing salts in the Central Sierra Nevada Mountains, California." *Water Resources Bulletin*, 17 (2), 280-285.

Houlahan, J.E., Findlay, C.S., (2003). "The effects of adjacent land use on wetland amphibian species richness and community composition." *Canadian Journal of Fisheries and Aquatic Science*, 60, 1078-1094.

Howard, K.W.F., Haynes, J. (1993). "Groundwater contamination due to road deicing chemicals – salt balance implications." *Geoscience Canada*, 20 (1), 1-98.

Iowa Department of Natural Resources (DNR). (2009). *Water Quality Standards Review: Chloride, Sulfates, and Total Dissolved Solids.* http://www.iowadnr.gov/portals/idnr/uploads/water/standards/ws_review.pdf

Jones, P.H., Jeffrey, B.A., Watler, P.K., Hutchon, H. (1992). "Environmental impacts of road salting." In. F.M. D'Itri (Ed.), *Chemical deicers and the environment.* Lewis Publishers, Boca Raton, Florida.

Karraker, N.E., Gibbs, J.P. (2011). "Road deicing salt irreversibly disrupts osmoregulation of salamander egg clutches." *Environmental Pollution*, 159 (3), 833-835.

Karraker, N.E., Gibbs, J.P., Vonesh, J.R. (2008). "Impacts of road deicing salt on the demography of vernal pool-breeding amphibians."*Ecological Applications*, 18 (3), 724-734.

Karraker, N.E., Ruthig, G.R. (2009). "Effect of road deicing salt on the susceptibility of amphibian embryos to infection by water molds." *Environmental Research*, 109 (1), 40-45.

Ke, C., Li, Z., Liang, Y., Tao, W., Du, M. (2013). "Impacts of chloride de-icing salt on bulk soils, fungi, and bacterial populations surrounding the plant rhizosphere." *Applied Soil Ecology*, 72, 69-78.

Keller, A. A., Cavallaro, L. (2008). "Assessing the US Clean Water Act 303 (d) listing process for determining impairment of a waterbody." *Journal of Environmental Management*, 86(4), 699-711.

Kim, S.Y., Koretsky, C. (2013). "Effects of road salt deicers on sediment biogeochemistry." *Biogeochemistry*, 112 (1-3), 343-358.

Lax, S., Peterson, E.W. (2009). "Characterization of chloride transport in the unsaturated zone near salted road." *Environmental Geology*, 58, 1041-1049.

Letts, A.D. (2000). *Effects of sodium ferrocyanide derived from road salting on the ecosystem.* Morton Salt, Morton International Inc., Chicago, Illinois.

© ASCE

Levelton Consultants Limited (2007). "Guidelines for the selection of snow and ice control materials to mitigate environmental impacts." *National Cooperative Highway Research Program*, NCHRP Report 577, Washington, D.C.

Lewis, W.M. Jr. (1999). "Studies of Environmental Effects of Magnesium Chloride Deicer in Colorado." *Colorado Department of Transportation*, CDOT-DTD-R-99-10, Denver, CO.

Linton, T.K., and D.J. Soucek. (2008). "Acute toxicity of chloride to selected freshwater invertebrates." Draft Final Report. US EPA. http://www.dnr.mo.gov/env/wpp/rules/rir/so4-cl-GLEC-INHSchloriderpt.pdf

Little, E.E., and R.D. Calfee. (2000). "The effects of UVB radiation on the toxicity of fire-fighting chemicals." *Final Report for Wildland Fire Chemical Systems*, US Forest Service.

Lumsdon, G., Evans, L., Bolton, K. (1995). "The influence of pH and chloride on the retention of cadmium, lead, mercury and zinc by soils." *Journal of Soil Contamination*, 4, 137-150.

MassDOT. (2012). "Environmental status and planning report." *EOEA #11202, Public Review Draft*, Massachusetts Department of Transportation.

Mayer, T., Snodgrass, W.J., Morin, D. (1999). "Spatial characterization of the occurrence of road salts and their environmental concentrations as chlorides in Canadian surface waters and benthic sediments." *Water Quality Research Journal of Canada*, 34 (4), 545-574.

Mineau, P., Brownlee, L.J. (2005). "Road salts and birds: an assessment of the risk with particular emphasis on winter finch mortality." *Wildlife Society Bulletin*, 33 (3), 835-841.

MN Pollution Control Agency. (2000). "Worth his salt." *MPCA Magazine,* November, Minnesota Pollution Control Agency.

Norrström, A.C., Jacks, G. (1998). "Concentration and fractionation of heavy metals in roadside soils receiving de-icing salts." *The Science of the Total Environment*, 218, 161-174.

Peters, N.E. (2009). "Effects of urbanization on stream water quality in the city of Atlanta, Georgia, USA." *Hydrologic Processes*, 23, 2860-2878.

Pillard, D.A. (1995). "Comparative toxicity of formulated glycol deicers and pure ethylene and propylene glycol to *Ceriodaphnia dubia* and *Pimephales promelas*." *Environmental Toxicity and Chemistry*, 14 (2), 311-315.

Ramakrishna, D.M., Viraraghavan, T. (2005). "Environmental impact of chemical deicers – A review." *Water, Air, and Soil Pollution*, 166, 49-63.

Ratkevičius, T., Laurinavičius, A., Tuminienė, F., Bradulienė, J. (2014). "Reduction of negative impact of salts used for winter road maintenance on the environment." *The 9th International Conference "ENVIRONMENTAL ENGINEERING"*, Vilnius, Lithuania.

Riva-Murray, K., Bode, R.W., Phillips, P.J., Wall, G.L. (2002). "Impact source determinations with biomonitoring data in New York State: concordance with environmental data." *Northeast. Nat.*, 9, 127-162.

Robidoux, P.Y., Delisle, C.E. (2001). "Ecotoxicological evaluation of three deicers (NaCl, NaFo, CMA) – Effect on terrestrial organisms." *Ecotoxicology and Environmental Safety*, 48, 128-139.

© ASCE

Rubin, J., Gårder, P.E., Morris, C.E., Nichols, K.L., Peckenham, J.M., McKee, P., Stern, A., Johnson, T.O. (2010). *Maine Winter Roads: Salt, Safety, Environment and Cost.* A Report by the Margaret Chase Smith Policy Center the University of Maine. http://mcspolicycenter.umaine.edu/files/2010/02/Winter-Road-Maint-Final.pdf

Sanzo, D., Hecnar, S.J. (2006). "Effects of road de-icing salt (NaCl) on larval wood frogs (*Rana sylvatica*)." *Environmental Pollution*, 140 (2), 247-256.

Scott, W.S. (1981). "An analysis of factors influencing deicing salt levels in streams." *Journal of Environmental Management*, 13 (3), 269-287.

Shahdah, U., Fu, L. (2010). "Quantifying the mobility benefits of winter road maintenance–A simulation based analysis." In *TRB 89th Annual Meeting Compendium of Papers DVD*, Transportation Research Board, Washington, D.C.

Siegel, L. (2007). "Hazard identification for human and ecological effects of sodium chloride road salt." *Final report for State of New Hampshire,* Department of Environmental Services.

Strong, C. K., Ye, Z., Shi, X. (2010). "Safety effects of winter weather: the state of knowledge and remaining challenges." *Transport Reviews*, 30 (6), 677-699.

Thunqvist, E.L. (2004). "Regional increase of mean chloride concentration in water due to the application of deicing salt." *Science of the Total Environment*, 325, 29-37.

TRB (Transportation Research Board). (1991a). *Road salt use in the United States*, National Research Council, Washington, D.C.

TRB (Transportation Research Board). (1991b). *Highway deicing: Comparing salt and calcium magnesium acetate*, National Research Council, Special Report 235, Washington, D.C.

Tromp, K., Lima, A.T., Barendregt, A., Verhoeven, J.T.A. (2012). "Retention of heavy metals and poly-aromatic hydrocarbons from road water in a constructed wetland and the effect of de-icing." *Journal of Hazardous Materials*, 203-204, 290-298.

Turtle, S.L. (2000). "Embryonic survivorship of the spotted salamander (*Ambystoma maculatum*) in roadside and woodland vernal pools in southeastern New Hampshire." *Journal of Herpetology*, 34, 60-67.

U. S. Environmental Protection Agency (US EPA). (1988). "Ambient water quality criteria for chloride." *EPA PB 88-175-047.* Washington, D.C.

U.S. Environmental Protection Agency (US EPA). (2012). http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/overview.cfm. Accessed November 2013.

Usman, T., Fu, L., Miranda-Moreno, L.F. (2010). "Quantifying safety benefit of winter road maintenance: Accident frequency modeling." *Accident Analysis & Prevention*, 42 (6), 1878-1887.

Van Meter, R.J., Swan, C.M., Snodgrass, J.W. (2011). "Salinization alters ecosystem structure in urban stormwater detention ponds." *Urban Ecosystems*, 14 (4), 723-736.

Venner, M., Leisenring, M., Pankani, D., Strecker, E. (2004). "Identification of research needs related to highway runoff management." *National Cooperative Highway Research Program, NCHRP Report 521,* Washington, DC.

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Vitaliano, D. (1992). "Economic assessment of the social costs of highway salting and the efficiency of substituting a new deicing material." *Journal of Policy Analysis and Management*, 11, (3), 397-418.

Vitt, L.J., Caldwell, J.P., Wilbur, H.M., Smith, D.C. (1990). "Amphibians as harbingers of decay." *Bioscience*. 40 (6), 418.

Wang, W., Chen, Z., Liu, T. (2012). "Potential impacts of different chemical deicing salts on soil health along roadsides." In *Proceedings of the Twelfth COTA International Conference of Transportation Professionals (CICTP)*, Beijing, China, 2937-2946.

Williams, B.K., Little, E.E. (2011). "Dust control for low-volume roads: Update on public lands highway discretionary program project, environmental effects of dust suppressant chemicals on roadside plant and animal communities." In *Transportation Research Board 90th Annual Meeting Compendium of Papers*, Washington, D.C.

Winston, R.J., Hunt, W.F., and Pluer, W.T. (2012). *Road Salt and Its Effects on Amphibians: A Concern for North Carolina?* North Carolina Department of Transportation, No. TA-2012-05.

Ye, Z., Veneziano, D., Shi, X. (2013). "Estimating statewide benefits of winter maintenance operations." *Transportation Research Record*, 2329, 17-23.

Yonge, D., Marco. N. (2001). "An evaluation of the impacts of highway deicers on Peshastin Creek." *Washington DOT*, Final Report T1804-2.

Zinger, I. and Delisle C.E. (1988). "Quality of used-snow discharged in the St. Lawerence River, in the region of the Montreal harbour." *Water, Air, and Soil Pollution*, 39, 47–57.

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From: Barbara Stevenson
To: Finnell, Emily (DEQ)
Subject: Re: Draft Water Strategy Comments
Date: Monday, October 19, 2015 11:08:16 AM

Hope that needs of low income people are included as well as prevention of disasters such as Flint!

Sent from my iPhone

On Oct 19, 2015, at 10:32 AM, "Finnell, Emily (DEQ)" <FinnellE@michigan.gov> wrote:

> Thank you for your interest in the draft Water Strategy. The Office of the Great Lakes received many thoughtful and in-depth comments both in electronic and hard copy format and has completed the process of reviewing and cataloging comments as part of the record. We will be working with our steering committee to make revisions and prepare a final strategy and anticipate a final strategy being released in late spring of 2016.
>
> We appreciate your comments and interest in the current and future of management of Michigan's water resources.
>
> Sincerely,
> Emily Finnell
> Office of the Great Lakes | MI Department of Environmental Quality
> PO Box 30473
> Lansing, MI 48909
> finnelle@michigan.gov
> 517-284-5036

From: Jim Olson
To: Finnell, Emily (DEQ); mi-waterstrategy
Subject: RE: Draft Water Strategy Comments
Date: Monday, October 19, 2015 1:39:12 PM

Emily,

Thank you for note.

While the text of our comments remains unchanged, we found a mix up in footnote numbering and will be submitting before Nov. 1 a substitute copy with corrected footnotes.

Yours,

Jim Olson

From: Finnell, Emily (DEQ) [FinnellE@michigan.gov]
Sent: Monday, October 19, 2015 10:32 AM
To: mi-waterstrategy
Cc: Finnell, Emily (DEQ)
Subject: Draft Water Strategy Comments

Thank you for your interest in the draft Water Strategy. The Office of the Great Lakes received many thoughtful and in-depth comments both in electronic and hard copy format and has completed the process of reviewing and cataloging comments as part of the record. We will be working with our steering committee to make revisions and prepare a final strategy and anticipate a final strategy being released in late spring of 2016.

We appreciate your comments and interest in the current and future of management of Michigan's water resources.

Sincerely,
Emily Finnell
Office of the Great Lakes | MI Department of Environmental Quality
PO Box 30473
Lansing, MI 48909
finnelle@michigan.gov<mailto:finnelle@michigan.gov>
517-284-5036

From: [redacted]
To: Finnell, Emily (DEQ)
Subject: Re: Draft Water Strategy Comments
Date: Monday, October 19, 2015 2:25:52 PM

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all that is well and good but if we don't do something about enbridge line 5 now before 2016 arrives it maybe well too late and you kiss "PURE MICHIGAN" GOODBYE!

On Monday, October 19, 2015 10:36 AM, "Finnell, Emily (DEQ)" <FinnellE@michigan.gov> wrote:

Thank you for your interest in the draft Water Strategy. The Office of the Great Lakes received many thoughtful and in-depth comments both in electronic and hard copy format and has completed the process of reviewing and cataloging comments as part of the record. We will be working with our steering committee to make revisions and prepare a final strategy and anticipate a final strategy being released in late spring of 2016.

We appreciate your comments and interest in the current and future of management of Michigan's water resources.

Sincerely,
Emily Finnell
Office of the Great Lakes | MI Department of Environmental Quality
PO Box 30473
Lansing, MI 48909
finnelle@michigan.gov
517-284-5036

From: mi-waterstrategy
To: mi-waterstrategy
Subject: FW: Great Lakes 30 year report
Date: Tuesday, March 08, 2016 11:08:51 AM

From: Miller, Candice [mailto:Candicehr3102@mail.house.gov]
Sent: Wednesday, June 24, 2015 11:16 AM
To: Allan, Jon (DEQ)
Subject: Great Lakes 30 year report

Excellent work Jon, this is the most comprehensive work product i've seen. One suggestion, although perhaps this is too specific and you only want to speak in generalities, about a dozen years ago we developed a real time water quality monitoring system at the 7 water intakes in the st Clair river and 2 of the lake st Clair intakes, Mt Clemens and new baltimore. The devices checked for almost 30 different contaminants every 15 minuets, it became part of the notification protocols especially for the previously very common, chemical spills in the st Clair river. Once we were able to detect what and from where, guess what, no more chemical spills. But most of the municipalities didn't want to pay for it once the federal dollars ran out, very shortsighted. Also Granholm used federal homeland security dollars to built an extension of this system along the rest of lake st Clair, down the Detroit river. Not sure what's happening there either.

My point is, the only way for this to really work is for the state to take it over and have a plan for the entire system, it really could be an inexpensive model for the entire state.

Anyway, call me if you have any questions or suggestions and sincere good luck in continuing to improve and protect our magnificent great lakes.

Sent from my BlackBerry 10 smartphone on the Verizon Wireless 4G LTE network.