## Informing the Debate

Michigan Applied Public Policy Brief

Policy Variation among Local Governments and Implications for Freshwater Conservation and Management



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Michigan Applied Public Policy Research Program | Institute for Public Policy and Social Research

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## **Informing the Debate**

### MAPPR Policy Research Brief

### Policy Variation amongst Local Governments and Implications for Freshwater Conservation and Management

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#### **Executive Summary**

Many of our freshwater resources are facing various challenges such as decreased water quality, declining species biodiversity, and increasing instances of habitat degradation. Michigan contains 63 large river watersheds which drain into the Great Lakes, linking inland Michigan activities and landscapes with Great Lakes waters via run off, water drainage, etc. Water quality issues have continued to plague beaches and parks located both in lakes and rivers in Michigan. Water resources are of vital importance to the Great Lakes region due to their economic linkages and activities such as boating and recreation. Local governments have the ability to do a lot of self-regulation; this potentially results in a wide array of policies and ordinances which can directly and indirectly lead to water impairments. By implementing best management strategies and policies in local planning and zoning documents, engaging with the community and building capacity, local governments can help minimize activities that lead to water impairments.

The use of various policy and management strategies varied greatly across the study region for many of the topics covered in this research. Our results showed that spatial gaps in policy existed between local governments sharing watersheds and also between neighboring watersheds. There were also gaps between the identified importance of issues and the capacity to address them. More local governments indicated having planning and/or zoning professionals compared to environmental staff, with very few governments having a designated environmental position. Few governments sought funding from external sources, yet those that did were generally successful.

Recommendations to state officials include:

- assist local governments in bridging these capacity gaps by helping them seek creative means in implementing policy, planning and zoning structures
- work with local governments in building sustainable partnerships with various federal and state departments, nongovernmental/non-profit organizations, and university researchers
- help local governments to identify relevant grant programs geared towards municipalities
- support educational opportunities for local government officials in environmentally related programs
- encourage local governments to maintain their own official government email address and website
- Offer technological assistance for local officials wanting to increase their government's visibility on the internet.

These results reinforced the idea that local policy variation exists across the landscape and most importantly within watersheds. However, our research only covered one part of Michigan. If we were able to increase the geographic scope of our research to include local governments across the state of Michigan, especially in Upper Peninsula and the eastern part of Michigan, we would get a more complete picture of the types of policies and management strategies taking place across the State. More research is needed in quantifying the relationship between local policy and management strategies used and social and land use characteristics.

#### INTRODUCTION

Many of Michigan's freshwater resources are facing various challenges such as decreased water quality, declining species biodiversity, and increasing habitat degradation. According to the Wadable Streams Assessment (U.S. EPA, 2006), the most widespread stressors observed across the country are nutrification (nitrogen and phosphorus), riparian zone disturbance, and streambed sedimentation. These activities, coupled with overfishing, dams, invasive species, drainage of wetlands, agricultural runoff, sand bar removal, and siltation, result in the decline of aquatic organisms such as fish, amphibians, reptiles, and molluscs. In general, the Great Lakes region had the highest exceedance rate for beach samples exceeding water quality guidelines followed by the Gulf Coast and New England area (NRDC, 2014a). In addition to water impairments, water levels have been fluctuating in the Great Lakes basin, at times up to 0.5m annually (Maghrebi et al., 2015).

#### Michigan's Water Resources

Michigan contains 63 large river watersheds which drain into the Great Lakes, linking inland Michigan activities and landscapes with Great Lakes waters via run off, water drainage. Michigan borders four of the five Great Lakes, has 2,147 miles of Great Lakes coastline, 76,439 miles of rivers and over 11,000 inland lakes (approximately 46,000 if you include ponds, river impoundments and inland lakes that have a surface area greater than 1/10<sup>th</sup> of an acre (MDEQ, 2012)). According to MDEQ (2012), about 75 percent of Michigan's river miles support indigenous aquatic life and is designated for wildlife use.

Water quality issues have continued to plague both lakes and rivers in Michigan. The National Resources Defense Council annually puts out a report "*Testing the Waters*" (a collaborative effort with EPA and state agencies) looking at how many times water samples exceed water quality parameters. As of 2013, Michigan monitors 237 out of its 642 beaches, with 6% of the samples being recorded as exceeding the Beach Action Value (NRDC, 2014b). The Beach Action Value is a tool suggested by the EPA for states to use regarding beach notification purposes. Several beaches in Michigan repeatedly exceeded those guidelines, with two beaches exceeding it up to 45 and 50% respectively. The percent exceedance rates of the top ten Michigan beaches ranged from 21 to 50% with six of those ten beaches located in the same county. These results indicate that some regions in Michigan need assistance in minimizing water quality impairments in their region. It is also true that many beaches and rivers are not being tested in the state of Michigan.

Beaches and rivers are of vital importance to the Great Lakes region due to their economic linkages. A Great Lakes Commission report (2007) found that boating and recreation (direct and secondary effects) created 244,000 jobs and \$19 billion in sales and \$6.4 billion in personal income. Out of all the registered boats in the Great Lakes region, Michigan topped other great lake states with 953,554 registered boats (Great Lakes Commission, 2007).

While we have many federal and state laws, such the Clean Water Act, that are important when it comes to managing water quality and habitat degradation, local governments also have an important role to play in managing lands to keep our waters clean. When freshwater and urban areas intersect, an integrated approach to water management and land use planning is important (Carter et al., 2005). Lack of integrated management can lead to policies that are fragmented, ineffectual and lead to gaps in conservation efforts.

#### Local Governments

When looking at water conservation from a landscape perspective, the valley rules the stream, indicating the importance of land influences on aquatic resources (Hynes 1975). Local governments have an important policy role to play in protecting and managing aquatic resources, especially in "home rule" states like Michigan. In a "home rule" state, the state allows smaller units of governments more influence on planning, growth, and development. Home rule brings forth the idea that local governments are better suited to understand and respond to the needs of its population. The Michigan Planning Enabling Act part 33 describes how the master plan contains the direction, goals, and vision of the community while the zoning document is a set of rules and ordinances put into action that reflects the contents of the master plan.

With over 1,200 local units of government in Michigan, local policies to address aquatic issues likely vary and could be uncoordinated across the landscape. Local governments have a large degree of freedom in planning and zoning their lands and influence on aquatic resources. However, not a lot of work has been done to understand what type of policies local governments have in place to manage aquatic resources, the efficacy of these policies, integration of policy across local jurisdictions, and to what extent policy enforcement strategies are employed by local governments. Therefore, this study examines the variance in local policy and management activities in three main areas: 1) the differences in local policies and tools related to aquatic resources; 2) local governments' interactions and communication with members of their community; and 3) local governments' capacity to address aquatic resource problems.

#### DESCRIPTION OF RESEARCH METHODS

#### Study Location

Our research focussed on local governments located in the Central Lake Michigan Management Unit and Grand River watershed which contain six large river watersheds and 460 local units of government (i.e. townships and cities – Figure 1). The river watersheds are the Betsie-Platt, Manistee, Muskegon, Pere Marquette, Pine, and Grand (Upper and Lower). This region also contains the Manistee National Forest, which is 540,187 acres in size, spanning nine counties.

The Central Lake Michigan Management Unit, formerly an industrial area, is now being promoted as a tourist destination, recognized for its cold water trout streams and thus importance to Michigan's recreational fishing industry. The Grand River watershed is the second largest river basin in Michigan. Unlike the Central Lake Management Unit, this region contains areas of intense agricultural activity and dense urban areas. With the mouth of the river emptying into Lake Michigan, there are also many recreational areas in the watershed which are increasingly threatened by turbidity, nutrient inputs and water quality degradation.



**Figure 1.** Location of freshwater policy survey in Michigan. Region outlined in red are the HUC 8 watersheds where the survey was distributed to local governmetns.

#### Survey Distribution

To determine the diversity of planning, zoning and management strategies of local governments with regards to freshwater conservation, we surveyed local governments within the study region. The survey was administered both online and through a mailed hardcopy. We sent the online survey to one member of each local government, either the clerk, supervisor, planning or zoning official. The first recipient was allowed and encouraged to forward the online survey link to others in the township. At the end of the online survey period, we mailed paper copies of the survey with pre-addressed and stamped return envelopes, followed by a reminder postcard three weeks later, and one last mailing of the paper survey to non-responding governments.

We used the ArcGIS program version 10 to map each survey response variable by government and HUC8 watershed (Michigan Geographic Data Library). These maps provided visual and descriptive results identifying what types of policy and management strategies were being used in the study region, where policy and management strategies were lacking, areas of synergistic and non-synergistic policy activity, and areas where collaboration and outreach initiatives were being employed.

#### Survey Response Rate

Including both electronic and mailed survey responses, we obtained 264 partial and/or completed surveys out of a total of 460 local governments in our study region (indicated in green in figure 2), a response rate of 57.39%. We received 137 responses via postal mail and 127 responses using the online survey. One township opted out of the online survey and seven returned blank surveys.



Figure 2. Townships that returned a freshwater conservation survey.

#### Study Results

In order to see how important environmental issues were to local governments, we asked "how much time and effort" they spent on seven issues ranging from crime to the environment. Governments were asked to consider their ordinances, goals, objectives and/or concerns and rank the issues on a scale of one to seven, where seven indicated "not much time/effort at all". Average scores for the seven issues ranged between 3.65 and 4.92 and are mapped in figure 3. Governments spend the least effort on health care/social services (4.92, figure 3e) followed by education (4.84, figure3c). These two issues also received the highest number of "not applicable" responses at 88 and 82 respectively. The environment ranked third behind transportation/infrastructure (3.65, figure 3g)) and crime/justice/public safety (3.74, figure 3a) as the top issue. Figure 3d shows a few "hot spots" located within the Grand River and portions of the Manistee and Muskegon watershed regions where townships expended relatively more effort on environmental issues. Twenty-three local governments felt that time and efforts expended towards environmental issues were not applicable. Governments that did not place a lot of time and effort on environmental issues were spread throughout the study region (figure 3d).



Figure 3. Time and effort expended by local governments on issues such as a) crime, justice and public safety, b) economic development, c) education, d) environment, e) health care and social services, f) tourism and recreation, and g) transportation and infrastructure

#### Study Results Continued

Governments were asked to rank the importance of commonly discussed aquatic and environmental issues on a scale of one to seven. A score of one indicated that the issue was "extremely important" to their government while seven was "not important at all". Governments were given the option of selecting "not applicable" to issues they felt did not apply to them. Results are presented with the average environmental issue score and corresponding map in parenthesis. Of the ten issues, water pollution was deemed most important (2.81, figure 4a) followed by water availability (3.05, figure 4b), land and/or soil degradation (3.30, figure 4d), and waste management and disposal (3.44, figure 4i). Climate change ranked the least important (4.88, figure 4g) with 54 of 259 respondents identifying climate change as not applicable to them. Following climate change were ecosystem services (4.33, figure 4j) and the management of aquatic species (4.14, figure 4f).

The Lower Grand River watershed and the northern part of the Betsie-Platte watershed showed regions of higher effort in order to manage urban sprawl and loss of open green space (figure 4h). In figure 4f, a small cluster of township governments in the northern portion of the Manistee watershed felt that managing aquatic species was important as did several governments in the Muskegon watershed.



Figure 4. How important various aquatic and environmental issues are to local governments where a) water pollution, b) water availability, c) air pollution, d) land and/or soil degradation, e) wildlife conservation, f) management of aquatic species, g) climate change, h) urban sprawl and loss of green space, i) waste management and disposal, and j) ecosystem services

Because water pollution was ranked as the issue of most importance in our study site, we further explored how local governments within each watershed responded to the importance of water pollution. Several neighbouring townships and cities within the Lower Grand watershed and in the Traverse Bay region found water pollution to be of importance. Governments located within the Pine River ranked water pollution as being more important with an average of 2.35 out of seven (Table 1), with the average score ranging between 2.35 to 3.10.

**Table 1**. How local governments ranked the importance of water pollution within each watershed (1 being "Extremely important", 7 "Not important at all" and N/A as "not applicable").

		Governments who ranked water	Part of a watershed management	Number of governments that returned
Watershed	Average score	pollution	plan (%)	survey
PINE	2.35	20	27.27	22
<b>BETSIE-PLATTE</b>	2.55	20	66.67	21
LOWER GRAND	2.60	57	55.17	58
PERE			45.28	53
MARQUETTE-				
WHITE	2.80	46		
MUSKEGON	2.84	75	32.50	80
MANISTEE	2.94	33	28.21	39
<b>UPPER GRAND</b>	3.10	50	44.23	52

\*note: governments located in multiple watersheds had their choice included in each of the watersheds they are located in.

#### Watershed management plan

In order to address water pollution concerns on a broad scale, some local governments adopt watershed management plans. Watershed management plans allow governments located within the same watershed to coordinate their efforts in minimizing negative impacts to aquatic environments. Watershed management plans work alongside local planning and zoning policies.

When asked if their government was part of a watershed management plan, 27% responded they were part of a DEQ approved watershed management plan and 15% were part of plan approved by another organization. Ten governments were either "in the process of coming up with a management plan" or the plan was in "the process of being reviewed". Twenty-nine governments did not answer the question. The Betsie-Platte watershed had the highest percentage of townships participating in a watershed management plan (67%) while the Pine watershed had the lowest (27%) (Table 1). Governments that straddled multiple watershed boundaries indicated participation in each of the watersheds in which they were located.

#### PLANNING AND ZONING

Most townships had a master plan and zoning ordinance (indicated in green in figure 5). Slightly more governments had a master plan (77.73%, figure 5a) than a zoning ordinance (76.14%, figure 5b). There was a higher tendency for townships in the northern region of our study area to be without a master plan or zoning ordinance than in the south.



Figure 5. Governments with a) comprehensive planning document, and b) zoning document

#### POLICIES

We identified the most commonly used policy and practice strategies to protect freshwater resources and asked local governments whether they had such policies and practices. These included efforts to 1 control runoff or pollution originating from land, 2) protect small wetlands, and 3) prevent the spread of invasive species.

#### General water related policies

We asked governments several questions about commonly used policies and practices to minimize runoff and pollution from land. Presence of such policies are shown in green in Figure 6). More governments indicated that they had aquatic setback requirements (141) compared to having vegetative riparian buffer (67) and storm water ordinances (61). Governments having setback requirements for development near lakes, rivers, streams, wetlands or high risk erosion areas tended to be spread throughout the study region with small clusters of neighbouring townships and cities occurring in the Lower Grand River watershed and the southern portion of the Pere-Marquette watershed. Sixty-seven governments (mainly in the western portion of our study area) reported having vegetative riparian buffer width requirements near natural features such as lakes, rivers, streams or wetlands. Fewer governments had a storm water ordinance, those having a storm water ordinance tended to be located in the Lower Grand River watershed.



Figure 6. Governments having a) vegetative riparian buffer, b) setback requirements for development near natural features, and c) storm water ordinance.

\*"none of the above" was an option for the storm water ordinance question

We asked local governments to identify from a list of 18 commonly used practices designed to minimize water pollution, the practices they mandated, or for which they offered incentives. These practices included having grassed swales, open space design, planting native vegetation, incorporating porous asphalt and pervious concrete, etc... No government selected all 18 practices. The maximum number of items selected was 16 (figure 7). Eighty-seven townships did not select any of the options. The highest frequency of items chosen was 2 (29 governments) followed by 1 (25 governments). Overall, most of the responding townships selected fewer than half of the 18 practices. Of the 251 governments that responded to this question, 99 selected between one and four items on the list. Forty-three governments selected between five and seven options. Twenty-two governments identified as mandating or offering incentives for eight or more of the items on the list. When asked about having open space requirements in their planning and zoning ordinances, most townships did not (59.5%) while 13.26% did in both planning and zoning ordinances, 18.6% in zoning ordinances, and 4.16% in their master plans.



Figure 7. Total number of best management practices selected by governments as those mandated or encouraged via incentives (from a list of 18 commonly used options).

#### Wetlands

Wetlands perform many valuable ecosystem services such as filtering out pollutants, providing an area of recreation, and existing as habitat for sensitive species. Wetlands smaller than five acres in size are generally managed by local governments, unless given a special status by state or federal governments.

We asked four questions related to wetland protection (figure 8). Few local governments had stricter wetland policies than set by the State of Michigan (4.55% - figure 8a). Eleven of twelve townships responding "yes" were located in either the Upper or Lower Grand River watersheds with the twelfth located in the Betsie-Platte watershed. When asked if they had a goal of "no net loss" of wetland number or acreage within their master plan, 6.41% governments answered yes (30 governments did not answer the question). When asked if an ordinance of "no net loss" of wetland number or acreage was present, 2.98% answered "yes" (29 did not answer the question) and were located in the Upper or Lower Grand River watershed (figure 8c). When asked if they had a wetland restoration plan, 3.39% of responding governments selected "yes". Six out of eight governments were located in the Upper and Lower Grand River watershed (figure 8d). In general, responding governments did not address small wetland protection in their master plans and zoning ordinances. Over 10% of townships did not know their local government's position on the four wetland policy questions.



Figure 8. Different policies used to protect wetlands less than five acres in size such as a) ordinance stricter than the state, b) "no net loss" goal in the master plan, c) "no net loss" ordinance, and d) wetland restoration plan in either the master plan or zoning documents

#### Efforts to prevent the spread of aquatic invasive species

Aquatic invasive species remain a hot topic amongst federal and state policy makers. Aquatic invasive species not only affect sensitive native species but can also impact water quality and in some situations alter stream hydrology.

Local governments were asked to identify actions, if any, they took to minimize the spread of invasive aquatic species, educational tools used to identify these species, and if they recorded and maintained records regarding invasive species found within their jurisdictions. Results are presented with the number of governments using the method and the percentage in parenthesis. The top three methods used by governments to minimize the spread of invasive species were educational fact sheets (48, 19.92%), posting signs for the general public and particularly boaters, (42, 17.25%) and a regionally linked database containing local monitoring data (22, 5.79%). Few governments used a boat washing station (5, 2.08%), volunteers at boat launches for educational and inspection purposes (4, 1.67%) or had a live bait use/release restriction that was stricter than the state (2, 0.83%). In general, governments did not utilize commonly used methods to combat the spread of invasive species. As shown in figure 8, multiple governments in the Betsie-Platte watershed selected multiple methods.



Figure 9. Different strategies used by local governments to minimize the spread of invasive species a) fact sheets, b) database with local monitoring data, c) monitoring database linked locally, regionally, and/or nationally, d) live bait restrictions stricter than the state, e) signs posted near boating ramps, parks and/or inland lakes, f) boat washing stations, and g) volunteers located at boat launches

#### EDUCATION AND OUTREACH

Websites and email are used by government officials to engage and interact with their constituents, – typically posted information includes information on contacting local officials, current events, meeting summaries, educating the public about township goals, objectives, policies, and ordinances. Websites can also be used to connect community members with township boards and officials, as well as to each other, via forums and links to social media.

Roughly 62% of local governments had a website (164) and tended to be located in the Upper and Lower Grand River watersheds, tourist destinations along Lake Michigan, and near Traverse City. From a list of nine items, we asked governments to select how many of those items they had on their website. Some governments had websites but did not have any of the nine items we listed in the survey. Only five governments reported having all nine items, and these were scattered throughout the study region. On average, townships selected about 50% of the nine items. The item selected the most was including meeting minutes (91%, figure 10a). The next most selected items were zoning documents (83%, figure 10c), public notices (73%, figure 10g), planning documents (67%, figure 10b) and feedback forms or emails for elected officials (61%, figure 10i). The Lower Grand River was a hot spot for the above listed items as well as a few governments located in the Betsie-Platte watershed. Some of the least selected items were discussion forums (figure 10h), information on environmental issues (figure 10e), having a social networking page (figure 10f) and links to other organizations/partners (23.78%, figure 10d).



Figure 10. Items appearing on government websites a) meeting minutes, b) planning documents, c) zoning documents, d) links to watershed groups and partners, e) environmental information, f) social network links, g) public notices, h) discussion forums, and i) feedback forms and email addresses

### **GOVERNMENTAL CAPACITY**

Government capacity is measured in this study by the number of appropriate staff, funding levels and technology usage. Environment-related positions might assist in informing local environmental policy, planning and zoning; identifying possible environmental concerns, solutions; and writing grants for funding environmentally related projects. Funding may be used to support hydrological, water quality and habitat studies or to hire additional staff, start monitoring programs, perform outreach, and gain access to tools and technology enabling more efficient and well-founded policy decisions.

#### Environmental, planning and zoning staff

Few environmentally trained staff such as environmental compliance officers, environmental scientists or other environmental positions were employed by local governments throughout the study region (figure 11a-c). Of the 264 respondents, 9 (3.41%) governments had either a full or part-time environmental compliance officer; less than 2 (1%) had a full or part-time environmental scientist while 11(4.17%) had some other environmentally-based position not listed such as "watershed treatment staff", "compliance manager for sanitary sewage client discharge" and "wetland officer".



Figure 11. Local governments that have environmentally or planning/zoning related staff that are either full or part time a) environmental compliance officer, b) environmental scientist, c) other environmental position, d) zoning officer, e) planning professional

More local governments indicated that they had planning and zoning professionals (figure 11 d and e) compared to environmental staff positions. Governments that had planning officers were located throughout the study region with higher concentrations in the Lower & Upper Grand and Betsie-Platte Watersheds. Zoning officers were present in 66.29% (175) of the governments with 29.55% (78) having a planning professional. There was significant overlap between those having zoning officials and those having planning professionals.

#### Funding

We asked local governments if they sought external funding for hydrological studies, water quality monitoring, and habitat quality assessment studies. Few did (identified in green in figure 12). More governments sought funding related to water quality (40, figure 12b), compared to hydrological studies (20, figure 12b) and habitat quality assessment (16, figure 12c). Out of the governments that applied for funding, 95% were successful in securing funds for initiating hydrological studies, 87.5% for water quality monitoring and 87.5% for habitat quality assessment studies with 20, 40 and 16 applying respectively. In all three cases, more than 200 governments did not seek external sources of funding for monitoring and assessment.



Figure 12. Number of local governments who sought external sources of funding for a) hydrological studies, b) water quality monitoring, and c) habitat quality assessment studies

We asked if local governments set aside funds for education and outreach for water conservation efforts. Out of 250 responding governments, 6.0% (15) governments responded "yes" (figure 13a). Nine of those governments were located in either the Upper or Lower Grand River watersheds. When asked if governments had funds for small grant programs (for nongovernmental organizations, citizens and/or businesses), 2.04% (5) out of 245 responding governments answered "yes" as shown in figure 13b. These governments were spread across the study region.



Figure 13. Governments having funds set aside for a) education and outreach initiatives, and b) small grant programs for nongovernmental organizations, citizens and businesses

#### Geographic Information Systems

We asked local governments if they used Geographic Information Systems (GIS) data to inform decision making when creating, updating, or enforcing land use planning documents and zoning ordinances. Of the 264 respondents, 126 (47.73%) responded "yes" (shown in green in figure 14) while 59 (22.35%) did not use GIS (shown in orange). Many of the local governments using GIS were located within the Betsie-Platte, Lower and Upper Grand River watersheds (figure 14). A small cluster of local governments was located in the southern portion of the Muskegon watershed (near and at the mouth of the river).



Figure 14. Governments who use GIS to inform decision making

#### DISCUSSION

The goal of this research was to examine the variation in the use of policy and management strategies of local governments related to freshwater resources. We surveyed local governments across several watersheds in Michigan, asking questions related to planning/zoning, general water conservation policies/practices, community engagement and outreach, and capacity. The use of various policy and management strategies varied greatly across the study region for many of the topics covered. Our results showed that spatial gaps in policy existed between townships and cities sharing watersheds and between neighbouring watersheds. There were also gaps between the identified importance of issues and the capacity to address them.

After analyzing the survey responses, the Betsie-Platte watershed (popular tourist area) and the Lower Grand River watershed (containing multiple large cities, agricultural areas and is a big tourism draw) more often, relative to other areas, had policies and management strategies in place to protect freshwater resources and also used diverse strategies to engage with and communicate with citizens. Limited numbers of townships in the Manistee National Forest indicated having conservation policies, planning and zoning. All three regions are popular destinations for water related tourism, with the last region containing a large federally-managed forested region. Further investigation is needed to determine if the lack of policy and management strategies are due to federal restrictions placed upon local townships.

Water pollution was found to be an important topic for local governments. However, there is a gap between the recognized importance of water pollution and the measures taken. This was especially apparent when considering the lack of environment-related staffing and financial capacity in place. Few governments had environmentally related staff positions, and few governments sought funding. The state might help assist local governments in bridging these capacity gaps by helping them seek creative means in implementing policy, planning and zoning structures. They may also help local governments build partnerships with various federal and state departments, nongovernmental/non-profit organizations, and university researchers. State officials may also help local governments by offering assistance in identifying grant programs geared towards municipalities, supporting educational opportunities for local government officials in environmentally-related programs, grant writing workshops, and constructing watershed management plans. Our results indicate that the need for more support is greatest for local governments that tend to be smaller, less experienced, and further distanced from universities, state and federal government offices.

Some regions used multiple ways to communicate with various stakeholder groups. However, many local governments located in counties such as Lake, Missaukee, and Mason lacked online communication methods. In part, some of this could be due to limited technological resources (equipment and staff), reliance on their county, no broadband access, or governments choosing to not use the internet. State policy makers might encourage local governments to maintain an official government email address and website containing up to date information. Perhaps technological assistance for local government officials wanting to increase their government's visibility on the internet and social media networks would help to mainstream information exchanged regionally and at the State level

Maps generated from this research provides a visual representation of the types of policy and management strategies being implemented. These results can be used to help state and federal policy makers identify where to focus their attention and support with regards to implementing stronger freshwater conservation policies and strengthening capacity. Local government officials can look at the maps and decide what policies and tools they might consider adding to their current planning and zoning documents.

While our results reinforced the idea of local policy variation across the landscape and within watersheds, our research only covered one part of Michigan. If the geographic scope of the research included local governments across the entire State of Michigan, a more complete picture of what local governments are doing in the field of freshwater conservation could be unveiled.

In the process of this study, other questions arose. For example, "Why do we see spatial variation?" and "If we can detect an effect of this local policy fragmentation?" We also found a disconnect between some issues identified as being important while others not. Climate change and air pollution were ranked as issues of least importance yet both influence water quality (US.EPA, 2015b), which was identified as being important to local governments. These questions, coupled with the results of this study, ultimately feed into the larger question of "Are local governments equipped to deal with challenges to freshwater resources in the wake of climate change and non-native species?"

Currently, there is much inconsistency in the types of policy and management strategies being used both within watersheds and among watersheds. Because water flows through many different regions, the lack of policy and conservation methods in one area affects water quality in another area. These study results offer an opportunity for townships to coordinate their activities, policies and community outreach and engagement activities. It also starts the dialogue between neighbouring local governments and state officials in determining what types of support is needed to create or join watershed management plans. On a larger scale, this research offers a method other Great Lakes or international governments can use to identify policy gaps within their state or provincial region. The results can be used in comparing water protection strategies and ultimately work towards building a more coordinated approach towards managing the water within the Great Lakes basin.

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## Informing the Debate

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