



## Great Lakes-St. Lawrence River Basin Water Resources Compact Water Conservation and Efficiency Annual Program Review

November 22, 2013

### State of Michigan

This Water Conservation and Efficiency Annual Program Review Report fulfills Michigan's obligation under Section 4.2.2 of the Great Lakes-St. Lawrence River Basin Water Resources Compact (Compact) to "annually assess its [water conservation and efficiency] programs in meeting the Party's goals and objectives, report to the [Compact] Council and the Regional Body and make this annual assessment available to the public."

#### **1. Lead agency and contact person.**

The Michigan Department of Environmental Quality (MDEQ) is the lead agency responsible for Michigan's Water Conservation and Efficiency Program. Mr. James F. Milne, Chief, Great Lakes Shorelands Unit, Surface Water Assessment Section, Water Resources Division, is the lead contact. Information about Michigan's Water Use Program, including water conservation and efficiency, is available at <http://www.michigan.gov/wateruse>.

#### **2. Status of Michigan's water conservation and efficiency goals and objectives consistent with the basin-wide goals and objectives.**

Michigan adopted goals and objectives consistent with the basin-wide conservation and efficiency goals and objectives set forth in Section 4.2(1) of the Compact on December 8, 2010 (Appendix 1). These goals and objectives were developed by the former Water Resources Conservation Advisory Council (WRCAC), a stakeholder forum of executive and legislative appointees that was established for collaborative study, evaluation, and advisement for all of Michigan's Water Use Programs. The WRCAC was eliminated by executive order of the Governor in October 2009. In 2013, Mr. Dan Wyant, Director, MDEQ, established a similar forum, the Water Use Advisory Council (WUAC), to convene discussions and evaluation of Michigan's water use program, including the conservation and efficiency program's goals and objectives.

Michigan's water conservation and efficiency goals and objectives continue to be met through the program that was initiated with the adoption of the Compact. Public comments for ways to enhance Michigan's Water Conservation and Efficiency Program were sought in 2011 and 2012. A major theme of these comments was the importance of a council to advise on Michigan's Water Use program and technical issues, assist in implementation, and monitor overall progress. This issue was addressed by the formation of the WUAC and the charge to the WUAC is inclusive of these general issues. Other public comments on the program are being addressed through the proceedings of the WUAC and its work groups.

#### **3. Michigan's Water Conservation and Efficiency Program overview.**

The foundation of Michigan's Water Conservation and Efficiency Program is the water withdrawal assessment required of all new or increased large quantity withdrawals (LQW). The assessment process was established by Michigan's ground-breaking legislation that evaluates proposed water uses relative to standards set for conserving and protecting the water resources

of the Great Lakes basin. See [Part 327, Great Lakes Preservation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended \(NREPA\)](#). Using the online water withdrawal assessment tool and available site-specific information, the likely resource impacts of a proposed withdrawal can be predicted in advance of withdrawing water. A proposed withdrawal must meet the environmental and ecological standard of “no likely adverse resource impact (ARI)” through the assessment process and be authorized before the withdrawal can occur. MCL 324.32706b. In doing so, water users consider conservation and efficiency of use. Authorized withdrawals are cumulatively tracked and accounted for against this standard at a sub-watershed scale, ensuring that the water resources of the basin - even at a small scale - will not be adversely affected or functionally impaired, as provided for within the law.

Michigan’s Water Conservation and Efficiency Program goes beyond the assessment process to comprise a comprehensive program of water use management. This program is structured by Part 327, Great Lakes Protection, of the NREPA, supported by other authorities such as the [Safe Drinking Water Act, 1976 PA 399, as amended \(SDWA\)](#), and establishes an integrated framework of roles and responsibilities for private and public water users and governmental agencies in managing Michigan’s water resources. Further, this framework creates opportunities for involvement by the public (e.g., local committees and volunteer efforts such as stream monitoring); universities (e.g., research and technical assistance); and other interested parties resulting in a latticework of shared investment in the sustainability of Michigan’s lakes, streams, and groundwater.

**4. Consistency of Michigan’s Water Conservation and Efficiency Program with the regional objectives and promotion of environmentally sound and economically feasible water conservation measures (Water Conservation Measures).**

**a. Guide programs toward long-term sustainable water use.**

**Michigan has implemented an adaptive, goal-based, measureable, and accountable system of water use management.** Michigan’s water withdrawal assessment process requires that all LQWs be measured against a pre-defined ecologically-based withdrawal limit for the water source in question. The assessment process uses a series of statutory gradations of projected impact to the resource from Zone A (least impact) to Zone D (an ARI, which is prohibited) as the basis for determining whether a withdrawal is authorized and, if so, under what conditions.

A user can evaluate where along this gradation his or her withdrawal would lie by using an online assessment tool. Proposed withdrawals that are assessed as Zone A have little projected impact and can proceed upon registration. Proposed withdrawals in known environmentally sensitive watersheds, or that are assessed as Zone C or D cannot immediately proceed and are subject to a site-specific review by the MDEQ.

The online assessment tool uses a series of conservative assumptions to screen for proposed water withdrawals that may result in ARIs. Based on the assessment, the MDEQ can determine whether a proposed withdrawal requires closer regulatory consideration. If so, the MDEQ can consider project-specific and site-specific factors such as the pumping schedule and whether the aquifer is hydraulically connected to surface water. Through this site-specific review, the MDEQ can adjust for the conservative assumptions used by the online assessment tool. When necessary, the MDEQ works with the applicant to evaluate potential project modifications (e.g., moving the well location, deepening the well, changing the pumping rate and/or schedule) that can avoid the projected ARI while still meeting the applicant’s needs.

The assessment process uses a water availability database that is continually adjusted to account for new withdrawals registered through both the online assessment tool, site-specific reviews, and authorized by permits.

Special attention is afforded the community water supply sector. The SDWA requires that the MDEQ evaluate proposed LQWs on behalf of a community public water supply system using the ARI standard set forth in Part 327, Great Lakes Preservation, of the NREPA. The MDEQ is required to use the water withdrawal assessment tool for this purpose and, if necessary, confirm the assessment by way of a site-specific review. Any withdrawal determined to be in Zone C requires that the community certify implementation of sector-specific Water Conservation Measures that the community supply deems reasonable.

Part 327, requires a permit for a LQW of more than 2,000,000 gallons per day; 1,000,000 gallons per day if the withdrawal is in Zone C; or 100,000 gallons per day if it results in an intrabasin transfer. MCL 324.32723. The Part 327 permit criteria mirror the Decision-Making Standard in Section 4.11 of the Compact. These criteria require the return of all water to the source watershed less consumptive use; no significant or cumulative ARIs as a result of the withdrawal; incorporation of Water Conservation Measures; compliance with all applicable local, state, and federal law and international agreements; and a demonstration that the use is reasonable.

Community water supplies are the only water withdrawal sector that may be granted approval for a withdrawal that has the potential for causing an ARI. Additional criteria must be met for such a withdrawal to be approved, including that there be no feasible and prudent alternatives. Proposed withdrawals by the city of Cadillac, city of Newaygo, Oakland County Drain Commission, and the Gogebic Range Water Authority were denied because of the availability of a feasible and prudent alternative. The first two denials were addressed by relocating wells to watersheds with greater water availability. The other two had as options: the purchase of water from an existing system with excess capacity and/or a switch to a Great Lakes surface water withdrawal. A Part 327 permit was later issued to the Gogebic Range Water Authority for a surface water intake in Lake Superior.

Part 327 recognizes the significant implications of considering approval of a community water supply withdrawal that might cause an ARI. The MDEQ is authorized to approve such a withdrawal only after balancing the environmental impact against the public benefit relative to public health, safety and welfare. MCL 325.1004(4). The MDEQ is required to include specifications on the site location, depth of well completion, pumping capacity and rate, and ultimate use as a condition of such an approved withdrawal. MCL 325.1004(4).

**Michigan develops and implements programs openly and collaboratively with local stakeholders, tribes, governments, and the public.** The water withdrawal assessment process was developed through two multi-stakeholder groups - the [Groundwater Conservation Advisory Council](#) and the [WRCAC](#). Mr. Dan Wyant, Director, MDEQ, established a new statewide council in 2013, the WUAC. The WUAC is actively addressing key topics important to the implementation of Michigan's Water Use Program. Additionally, since September 2011, the MDEQ has convened the Southwest Michigan Water Resources Council (SWMWRC) stakeholders group to focus on the surface and groundwater resources in the Kalamazoo and St. Joseph River Watersheds, which are under particularly high water use demands. Both the WUAC's and the SWMWRC's memberships include representatives of various major water users, water well drillers, municipal water supplies, water resource groups, local, state and federal agencies, conservation and environmental groups, tribal organizations, and universities. Group meetings are open to the public, and summary notes are posted on the [MDEQ Water](#)

[Use Program Web site](#) for the WUAC, and the [Southwest Michigan Planning Commission Web site](#).

Pursuant to the intergovernmental accords between the federally-recognized Indian tribes of Michigan and the Governor of the State (2004 and 2009), the MDEQ meets with the leaders of Michigan's tribes at least twice yearly to discuss and promote the preservation, protection, restoration, and enhancement of the Great Lakes ecosystem.

**Michigan prepares and maintains long-term water demand forecasts.** Community water suppliers are required under the SDWA to conduct reliability studies based upon 5-year and 20-year projections of water use. These studies must be updated every five years unless the system can demonstrate a long-term stability in its customer base, service connections and resulting water use. Trends in water use must be identified including information on the current and projected average daily demand, maximum daily demand, maximum hourly demand, and demand that would be necessary in a fire emergency. Monthly and annual production totals are required of each source including a breakdown of water use by customer class. Systems are required to have a water shortage response plan for emergencies.

Both the WUAC and SWMWRC were convened in part to consider sustainable water use, potential water use impacts and conflicts, and trends and projections in water use demands. Using these collaborative forums and diverse resources affords far greater opportunity to prepare long-term forecasts than would otherwise be available through the state agencies alone.

**Michigan uses long-term strategies that incorporate water conservation and efficient water use.** The water withdrawal assessment process employs voluntary and compulsory water conservation and efficiency provisions.

Michigan has prepared [Generic Water Conservation Measures](#) applicable to all large quantity water users based on recommendations from representative trade associations. [Water Conservation Measures](#) have also been accepted by the MDEQ for certain significant water use sectors. All registrants must acknowledge that they have reviewed applicable Water Conservation Measures and farms are required to report their applicable Water Conservation Measures and an implementation plan for those practices on an annual basis.

Additional attention on conservation and efficiency is required in relation to at-risk withdrawals and localities. In environmentally sensitive areas that are approaching the ARI threshold, all registrants using the same water source are required to review and consider implementing applicable Water Conservation Measures. Additionally, an applicant that proposes a withdrawal that will push a watershed near the ARI threshold must implement Water Conservation Measures that they consider to be reasonable as a condition of withdrawal approval. Applicants for withdrawals requiring a permit must certify they are in compliance with applicable Water Conservation Measures developed for their sector or specific withdrawal as a condition of approval.

**Michigan builds upon existing efforts by considering practices and experiences in other jurisdictions.** As a member of the Great Lakes-St. Lawrence River Basin Water Resources Council and Regional Body, Michigan regularly participates in conversations on the practices and experiences in other jurisdictions and considers applicability to Michigan. The WUAC is also reviewing the programs, experiences and technical approaches related to water use, conservation and efficiency of other states and nations as part of their work.

**b. Adopt and implement supply and demand management to promote efficient use and conservation of water resources.**

**Michigan maximizes water use efficiency and minimizes the waste of water by the actions outlined in this section.**

**Michigan promotes appropriate innovative technology for water use.** The MDEQ works closely with the [Michigan Section of the American Water Works Association](#) (AWWA) through the operator certification and training program and the AWWA Water Efficiency and Conservation Committee. The purpose of the AWWA Water Efficiency and Conservation Committee is the education of water system operators and citizens about the merits of efficient use of our water resources. Functions of the AWWA Water Efficiency and Conservation Committee include: developing and distributing to operators educational materials that address the need to use available water resources efficiently, working with the Community Awareness Committees to promote water efficiency and conservation activities, developing and distributing media releases to educate the general public of the need to use water efficiently and activities they can undertake, and promoting cooperative efforts in water efficiency and conservation.

Michigan State University and Purdue University work together to support an Extension Agent/Irrigation Educator whose focus is on outreach to agricultural producers and agribusinesses. This outreach provides information on irrigation efficiency and new and leading edge equipment and technologies that can improve both water conservation and the farmer's bottom line. The universities remain central to identifying, through research and work with irrigation manufacturers, new and improved methods to serve Michigan's extremely diverse agricultural sector.

**Michigan manages existing water supplies to prevent or delay the demand for and development of additional supplies.** The MDEQ has denied proposed withdrawals because the applicant had the alternative of purchasing water from an existing system with excess capacity. In order to prevent the need to develop new capacity, community water supplies practice conservation measures involving the efficient use of water as a standard aspect of system operation. For example, various processes in the treatment regime of water plants such as filter backwash, sludge decanting, and sludge dewatering create a "water only" waste stream. Historically, this water had been pumped to waste. Today, it is much more common for the water to be rerouted to the front of the treatment regime and delivered to the customer after treatment. This practice averages a two (2) percent reduction in the total water pumped, and in some systems it may be as high as ten (10) percent. Wash-down water for cleaning in water treatment plants is also generally derived from recycled water.

**Michigan provides incentives to encourage efficient water use and conservation.** Potential large quantity water users have an incentive to maximize water use efficiency and minimize waste of water in order to pass the online assessment tool, avoid the need for a site-specific review, or the need to obtain a permit. Adjusting the well pumping rate and/or irrigation schedule is one of the easiest ways to modify a proposed large quantity water use to pass a site-specific review.

The Michigan Department of Agriculture and Rural Development (MDARD), through the Michigan Agriculture Environmental Assurance Program (MAEAP), works directly with agricultural producers to identify risks and offer efficiencies for farm operations. This includes an evaluation of a producer's irrigation system based on industry best management practices. This also includes evaluation of pumping rate and uniform distribution of irrigation water. A farm completing the MAEAP process will become "environmentally assured," an honored distinction in the agricultural community. While the MAEAP is voluntary, a producer registering a LQW that

falls into a Zone C will provide irrigation scheduling information related to seasonal use of their proposed withdrawal and certify that they are using applicable Water Conservation Measures.

In addition, the Agricultural Water Enhancement Program (AWEP) is a voluntary conservation initiative that provides financial and technical assistance to agricultural producers to implement agricultural water enhancement activities on agricultural land for the purposes of conserving surface and ground water and improving water quality. The Michigan Association of Conservation Districts secured AWEP funding for southwest Michigan agricultural producers by submitting a successful partnership proposal in 2009. This funding is used as financial assistance for producers in the St. Joseph and Kalamazoo River Watersheds to implement conservation measures that reduce their water use and improve water quality in those large basins that contribute directly to Lake Michigan.

The [Drinking Water Revolving Fund](#) (DWRF), Part 54, Safe Drinking Water Assistance, of the NREPA, specifically references energy efficiency considerations. The DWRF projects must consider operation and maintenance costs in the analysis and select the most cost-effective alternative, including considerations in the selection of processes and equipment that are less intensive in terms of energy use and water treatment chemicals. Reductions in energy use and materials frequently equate to a reduction in water use. The DWRF program treats these considerations as a *de facto* requirement that a project has energy and water efficiency as a stated primary goal of the project and not just an incidental benefit.

**Michigan includes water conservation and efficiency in the review of proposed new or increased uses.** Any LQW determined to be a Zone C withdrawal through the water withdrawal assessment process must certify implementation of Water Conservation Measures applicable to its water use sector. MCL 324.32706c(4). Water conservation and efficiency is also part of the project review for a LQW permit application. Applicants for withdrawals requiring a permit must certify they are in compliance with applicable Water Conservation Measures developed for their sector or specific withdrawal as a condition of approval.

**Michigan promotes investment in and maintenance of efficient water infrastructure.** The DWRF loan program is in the fifth year of providing funds in the form of principal forgiveness for a portion of loans to community water supply projects that address green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities. The federal grant for the loan program requires 20 percent of the grant funds be made available for projects that fall within the categories that are considered environmentally innovative activities. From a water supply perspective, the water efficiency efforts focus on the funding of conservation and reuse efforts, as well as water loss reduction and prevention, to protect water resources for the future.

The MDEQ worked with the AWWA Water Efficiency and Conservation Committee to develop sector-based conservation measures for community water supplies as required by Part 327. These conservation measures support the following principles and practices: efficient use of supply sources, appropriate facility rehabilitation or replacement, leak detection and repair, accurate monitoring of consumption and billing based on metered usage, full-cost pricing, water use efficiency standards for new plumbing fixtures and appliances, conversion of existing high water use fixtures and appliances to more efficient designs, use of efficient irrigation systems and landscape design, development and dissemination of educational materials on water conservation, public information programs promoting efficient water use and conservation, integrated resource planning and water reuse where appropriate, and continued research on efficient water use practices. The AWWA's recommended water conservation practices are

outlined in "[Guidelines for Generally-Accepted Water Management Practices for the Public Water Supply.](#)"

**c. Improve monitoring and standardize data reporting among state and provincial Water Conservation and Efficiency Programs.**

**Michigan is improving measurement and evaluation of water conservation and efficiency use.** Michigan's water withdrawal legislation requires the annual reporting of water use for virtually all LQWs. Reports are due by April 1 for water use during the previous calendar year. Water use reporting includes the amount and rate of withdrawal on a monthly and annual basis, source of water, purpose of use, amount of consumptive use, the latitude and longitude of the well location if the source is groundwater, and if practicable, the static water level in the well.

Any community water supply system that provides treatment, regardless of how limited, is required to provide monthly operation reports which include system pumpage. The operation reports must be submitted in the month immediately following the month of operation. The SDWA requires each well serving a community water supply to be equipped with a meter or other acceptable means to measure the volume of water produced. Historically, other means have been used on many small systems such as using the pumping rate and the run time of the pump to determine use. The MDEQ generally considers this unacceptable and requires the installation of meters to determine pumpage or use from individual wells or groups of wells. A vast majority of community water supplies meter the use of each customer providing full-cost pricing on all water served to the customer base.

Collection of accurate water use reporting data from individual facilities has presented challenges over the history of the program, which dates to 1995 for non-agricultural withdrawals, and 2004 for agriculture. The quality of the data submitted over time has been highly variable, with inadequate funding and staff to fully follow up when questions arise. Previously, water users have filled out paper forms to be transcribed by staff into a database. Now, through a joint funding agreement with the MDEQ and the United States Geological Survey, the MDEQ and the MDARD have jointly developed an online reporting system and database that reduces the potential for error, decreases the amount of time to report and enter into the database, and links more effectively with the water withdrawal assessment process. The new system became available in 2012.

**Michigan encourages measures to monitor, account for, and minimize water loss.**

Part 327 requires water users to annually review measures to monitor and minimize water loss. Farms reporting their water use to the MDARD must include their applicable Water Conservation Measures and an implementation plan for those practices. The MDARD provides a check list which farms use to identify and report the Water Conservation Measures used.

As part of the sanitary survey process for water utilities, the MDEQ conducts a review of the total water pumped compared to the amount of water for which the water utility has billed. Water unaccounted for represents the water loss through system leaks and peripheral consumptive use processes, which are routinely in the five (5) to ten (10) percent range. The MDEQ advises the community to address water losses when unaccounted for water reaches 15 percent of the total volume pumped.

**Michigan tracks and reports program progress and effectiveness.** Michigan issues an [annual report](#) of LQWs registered using the online assessment tool, site-specific reviews, and permit applications that includes yearly totals and cumulative totals since the start of the Water

Withdrawal Assessment Program. The MDEQ also tracks the outcome and timeliness of site-specific reviews.

**d. Develop science, technology, and research.**

**Michigan encourages the identification and sharing of innovative management practices and state of the art technologies.** Michigan's water withdrawal assessment process has won national awards presented by the Council of State Governments, Environmental Council of the States, and Renewable Natural Resources Foundation. The development and technical basis of the water withdrawal process has been described in numerous publications. See Appendix 2 for a list of publications.

**Michigan encourages research, development, and implementation of water use and efficiency and water conservation technologies.** One of the goals of both the WUAC and SWMWRC stakeholder groups is the research, development, and implementation of water use and efficiency and water conservation technologies.

**Michigan seeks a greater understanding of traditional knowledge and practices of basin tribes.** The MDEQ participates with Great Lakes tribes in the Tribal/State/United States Environmental Protection Agency Exchange Network, an Internet- and standards-based method for securely exchanging environmental information between partners. This network is used by states and tribes to report water quality monitoring data (including physical, chemical, biological, and fish tissue data). The United Tribes of Michigan are represented on the WUAC, and the MDEQ is represented on the Exchange Network governance board with the National Congress of American Indians.

**Michigan supports research to understand the linkages between water use and ecological responses.** The MDEQ partners with the United States Geological Survey and volunteer monitoring groups to maintain and improve the stream gauging network in Michigan. The MDEQ, the Michigan Department of Natural Resources (MDNR) Fisheries Division, and the United States Geological Survey are collaborating with the SWMWRC to install additional stream gauges and collect additional stream flow measurements in southwest Michigan.

The MDNR Fisheries Division, Michigan Trout Unlimited, and other partners collect temperature and fish community information from Michigan streams to further calibrate the models that led to the development of the Michigan stream classification system. The MDNR Fisheries Division and the MDEQ Water Resources Division conduct field inspections to validate or improve the water withdrawal assessment tool performance. One of the goals of the WUAC and SWMWRC stakeholder groups is strengthening scientific understanding of the linkages between water conservation practices and ecological responses.

**e. Develop education programs and information sharing for all water users.**

**Michigan undertakes a range of activities to ensure transparency, provide public access to information, educate users, share experiences, enhance regional information sharing, increase collaboration with professional organizations, and aid in the dissemination of sector-based information.** The MDEQ posts links to water use information and conservation best management practices on its [Water Use Program Web page](#). Upon request, this information is also sent to those who do not have Internet access or those making specific requests for data that are not immediately available online. Staff of the MDEQ has made numerous presentations to professional organizations and other interested parties both within



Michigan and across the United States on Michigan's Water Use Program and the online assessment tool.

The Michiana Irrigation Association promotes ongoing educational activities related to efficient irrigation, including workshops, demonstrations, field meetings, displays, and the preparation and distribution of educational material. The Michigan Irrigation Association was started in the 1970s with the objective of promoting the development, proper use, management, and acceptance of irrigation equipment and practices. It is comprised of irrigators from the counties surrounding the southwest Michigan and northern Indiana border. Seventy percent of the reported irrigation water use capacity in each state is in this area.

Michigan State University has held many focus group sessions with different sectors of large water user groups including agriculture, municipalities, and golf courses. The purpose of these sessions is to gauge understanding of the current Water Use Program, especially related to the institution of water user groups should the need arise to convene one locally.

The MDEQ maintains a Web site with information about key aspects of the Water Use Program and contact information for staff. Information about the WUAC is posted on the Web page, including the charge to the WUAC and its work groups, meeting dates, locations, agendas and summaries, and council membership. All meetings of the WUAC and its subcommittees are open to the public.

#### **5. Description of the state or provincial Water Conservation and Efficiency Program implementation time line and status.**

All components of Michigan's Water Conservation and Efficiency Program have been implemented. The foundation of the program, the water withdrawal assessment process, has been fully in effect since July 2009. The technical basis of the program is well published and nationally recognized. Sector-based Water Conservation Measures have been developed and are in use. The groundwork has been laid for other program components, like the development of local water user committees. Limited state resources have affected program staffing but additional resources have now been secured to support Michigan's implementation of this important program. Michigan has shown strong commitment to this forward-looking approach, and seeks to remain vigilant for the betterment of the program and to uphold the ideals of the Compact.

## Appendix 1

December 8, 2010

### Michigan Water Conservation and Efficiency Program Water Conservation and Efficiency Goals and Objectives

#### GOALS

1. Ensuring improvement of the waters and water dependent natural resources;
2. Protecting and restoring the hydrologic and ecosystem integrity of the Basin;
3. Retaining the quantity of surface water and groundwater in the Basin;
4. Ensuring sustainable use of waters of the Basin; and,
5. Promoting the efficiency of use and reducing losses and waste of water.

#### OBJECTIVES

1. Utilize Michigan's Water Use Program and Water Withdrawal Assessment Process to guide long-term sustainable water use.
  - a. The programs will be adaptive, goal-based, accountable and measurable.
  - b. Continue to develop and implement programs openly and collaboratively, with local stakeholders, Tribes and First Nations, governments and the public.
  - c. Prepare and maintain long-term water demand forecasts.
  - d. Develop long-term strategies that incorporate water conservation and efficient water use.
  - e. Review and build upon existing planning efforts by considering practices and experiences from other jurisdictions.
2. Adopt and implement supply and demand management to promote efficient use and conservation of water resources.
  - a. Maximize water use efficiency and minimize waste of water.
  - b. Promote appropriate innovative technology for water reuse.
  - c. Conserve and manage existing water supplies to prevent or delay the demand for and development of additional supplies.
  - d. Provide incentives to encourage efficient water use and conservation.
  - e. Include water conservation and efficiency in the review of proposed new or increased uses.
  - f. Promote investment in and maintenance of efficient water infrastructure.
3. Improve monitoring and standardize data reporting among State and Provincial Water Conservation and Efficiency Programs.
  - a. Improve the measurement and evaluation of water conservation and water use efficiency.
  - b. Encourage measures to monitor, account for, and minimize water loss.
  - c. Track and report program progress and effectiveness.
4. Develop science, technology and research.
  - a. Encourage the identification and sharing of innovative management practices and state of the art technologies.
  - b. Encourage research, development and implementation of water use and efficiency and water conservation technologies.

- c. Seek a greater understanding of traditional knowledge and practices of Basin First Nations and Tribes.
  - d. Strengthen scientific understanding of the linkages between water conservation practices and ecological responses.
5. Develop education programs and information sharing for all water users.
- a. Ensure equitable public access to water conservation and efficiency tools and information.
  - b. Inform, educate and increase awareness regarding water use, conservation and efficiency and the importance of water.
  - c. Promote the cost-saving aspect of water conservation and efficiency for both short-term and long-term economic sustainability.
  - c. Share conservation and efficiency experiences, including successes and lessons learned across the Basin.
  - d. Enhance and contribute to regional information sharing.
  - e. Encourage and increase training opportunities in collaboration with professional or other organizations in order to increase water conservation and efficiency practices and technological applications.
  - f. Ensure that conservation programs are transparent and that information is readily available.
  - g. Aid in the development and dissemination of sector-based best management practices and results achieved.
  - h. Seek opportunities for the sharing of traditional knowledge and practices of Basin First Nations and Tribes.

## Appendix 2

Recent publications on the water withdrawal assessment process and its technical underpinnings include:

- Hamilton, D. A., and P. W. Seelbach. 2011. Michigan's Water Withdrawal Assessment Process and Screening Tool. Michigan Department of Natural Resources, Fisheries Special Report 55, Lansing.
- Hamilton, D. A., R. C. Sorell, and D. J. Holtschlag. 2008. A regression model for computing index flows describing the median flow for the summer month of lowest flow in Michigan. U.S. Geological Survey Scientific Investigations Report 2008-5096. Reston, Virginia.
- Lyons, J., T. G. Zorn, J. Stewart, P. W. Seelbach, K.E. Wehrly, and L. Wang. 2009. Defining and characterizing coolwater streams and their fish assemblages in Michigan and Wisconsin, USA. *North American Journal of Fisheries Management* 29:1130-1151.
- Reeves, H. W., D. A. Hamilton, P. W. Seelbach, and A. J. Asher. 2009. Groundwater-withdrawal component of the Michigan water-withdrawal screening tool: U.S. Geological Survey Scientific Investigations Report 2009-5003. Reston, Virginia.
- Seelbach, P. W., L. C. Hinz, M. J. Wiley, and A. R. Cooper. 2011. Use of multiple linear regression to estimate flow regimes for all rivers across Illinois, Michigan, and Wisconsin. Michigan Department of Natural Resources, Fisheries Research Report 2095, Lansing.
- Steinman, A.D., P.W. Seelbach, J. W. Allan, and F.J. Ruswick. 2011. Science as a fundamental framework for shaping policy discussions regarding the use of groundwater in the State of Michigan: a case study. *Water Policy* 13 (2011) 69–86.
- Wills, T.C., E.A. Baker, A.J. Nuhfer, and T.G. Zorn. 2006. Response of the benthic macroinvertebrate community in a northern Michigan stream to reduced summer streamflows. *River Research and Applications* 22: 819-836.
- Zorn, T. G., P. W. Seelbach, and M. J. Wiley. 2009. Relationships between habitat and fish density in Michigan streams. Michigan Department of Natural Resources, Fisheries Research Report 2091, Lansing.
- Zorn, T. G., P. W. Seelbach, E. S. Rutherford, T. C. Wills, S. Cheng, and M. J. Wiley. 2008. A regional-scale habitat suitability model to assess the effects of flow reduction on fish assemblages in Michigan streams. Michigan Department of Natural Resources, Fisheries Research Report 2089, Lansing.
- Zorn, T. G., P.W. Seelbach, and E. S. Rutherford. 2012. A Regional-Scale Habitat Suitability Model to Assess the Effects of Flow Reduction on Fish Assemblages in Michigan Streams. *Journal of the American Water Resources Association*. 1-25. DOI: 10.1111/j.1752-1688.2012.00656.x.