

Innovation in Water Conservation Best Practices

Analytical Report

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Executive Summary

About the Project

Michigan's water sectors were required under Public Act 35 of 2006 of the Natural Resource and Environmental Protection Act (NREPA) to design guidelines for generally accepted water management practices or environmentally sound and economically feasible water conservation measures within 12 months after the effective date of the Act. In 2008, Michigan's water sectors including public water supply, agriculture irrigation and non-irrigation sector, and the business and industry sectors adopted generally accepted water management practices or environmentally sound and economically feasible water conservation measures.

Since their adoption in 2008, there have been significant advancements in water efficiency, and some sectors have established processes to periodically review and update their practices and reflect advancements and innovations in science, research, and technology. This project builds upon these historical and more recent policy foundations. To support long-term sustainability of Michigan's water resources, this report documents review processes for how the state's water use sectors have engaged with and updated the 2008 generally accepted water efficiency and conservation BMPs. With a particular focus on the B & I sectors, it identifies innovations and technological advancements in water conservation best practices that can benefit Michigan's B & I water use sectors, contributing toward Michigan's goals under the MI Healthy Climate Plan (State of Michigan, 2022).

Results and engagement from this project will inform the State of Michigan Water Use Program and Michigan's Water Conservation and Efficiency Program, and advance progress toward achieving Michigan's water conservation and efficiency goals and objectives established under the Great Lakes Compact and Agreement. [This report provides a detailed summary of information, findings, and outcomes from the project. For a higher-level overview of the research approach and key takeaways, see the accompanying narrative report.](#)

Takeaways

The table below presents a summary of Michigan water sectors' processes to review and/or change water efficiency and conservation BMPs adopted and approved under Public Act 35 of 2006 of NREPA.

Executive Summary Table 1. Summary of Michigan Water Use Sector’s Water Efficiency and Conservation BMP Update Processes

Water Use Sector	Process to Update?	Notes
Public Water Supply	No	No formal process to update the 2008 BMPs was identified. However, public water practitioners tend to take guidance from the American Water Works Association (AWWA) and wider industry best management practices to foster water savings.
Agricultural Irrigation	Yes	Strategies are reviewed and updated by stakeholders and industry experts annually as a part of the Generally Accepted Agricultural Management Practices (GAAMPs) review process.
Non-Agricultural Irrigation	No	The Non-Agricultural Irrigation sector has not conducted a BMP review or update. Individual industries, such as Golf Course Management, have published updated BMPs.
Business & Industry	No	The Business and Industry sector has not conducted a review or update of the general BMPs, and the B & I subsectors have not conducted a review or update of sector-specific BMPs.

The original 2008 BMPs remain a strong foundation. Their core strategies continue to reflect sound water stewardship principles and align with environmental, operational, and sustainability goals. As technologies, water use patterns, and business practices evolve, there is potential to build on these practices to ensure continued relevance and impact.

Engagement throughout the project revealed that awareness and use of the 2008 BMPs among business and industry stakeholders is generally low. Where water-saving efforts are occurring, they are typically driven by broader sustainability goals—such as energy efficiency, cost reduction, or regulatory compliance—rather than direct reference to the BMP guidance. Building trust, clarifying intent, and providing sector-relevant tools may be important for increasing voluntary engagement.

Participants highlighted a variety of factors that influence whether and how water conservation is pursued. Common drivers include corporate sustainability commitments, cost savings, energy-water synergies, and customer or reputational expectations. Barriers

often stem from low water costs, limited staff capacity, competing priorities, or a lack of technical resources.

Several key themes emerged as potential opportunities for future exploration:

- **Education and Outreach:** Sharing sector-specific resources, case studies, and guidance through trusted networks may help raise awareness and make water efficiency efforts more accessible.
- **Voluntary Engagement Models:** Technical assistance, peer learning, trainings, and public recognition can help normalize and support voluntary action.
- **Incentives and Value:** Framing water conservation as a business opportunity—and supporting it with financial incentives or recognition—can help make the case for investment and participation.
- **Cross-Sector Integration:** Aligning water efficiency with energy and wastewater initiatives may amplify impact and reduce siloed efforts.
- **Benchmarking and Data:** Improved access to data and benchmarking tools can support internal goal setting, transparency, and sector-wide progress.
- **Emerging Sectors:** Strategic engagement with growing industries offers the chance to integrate water stewardship into the early stages of economic development.

Together, these insights provide a foundation for continued discussion and collaboration across Michigan’s business and industry sectors. While not prescriptive, the findings and first-hand insights from stakeholders offer a range of ideas and examples that may inform future efforts to advance voluntary water conservation and efficiency in alignment with the state’s water and climate goals.

Glossary Terms

BMP – Best Management Practice

B & I – Business and Industry

EGLE – Department of Environment, Great Lakes, and Energy

GAAMP - Generally Accepted Agricultural Management Practices

GAMP – Generally Accepted Management Practice

HOA – Homeowners Association

NERPA – Natural Resources and Environmental Protection Act

TDS – Total Dissolved Solids

About the Report

This report is organized in the following sections:

- [Section 1](#) provides an overview and introduction to the project.
- [Section 2](#) summarizes the project’s mixed methods qualitative approach, including both research and stakeholder engagement strategies.
- [Section 3](#) summarizes the findings from the non-B & I sector engagement, including the public water supply sector, the agricultural irrigation sector, and the non-agricultural irrigation sector.
- [Section 4](#) summarizes the findings from the B & I sector engagement, including a range of specific businesses and organizations that reflect or represent a range of businesses.
- [Section 5](#) summarizes the research findings of innovative and technological advancements in water sector water efficiency and conservation BMPs and their impacts within the business and industry sectors in other Great Lakes states and provinces and other innovative jurisdictions.
- [Section 6](#) summarizes project findings and provides a range of considerations and reflections from the project.

Section 1: Introduction

Michigan has a long history of working in tandem with neighboring Great Lakes states and Canadian provinces to protect shared water resources. This commitment was formalized in 2005 through the Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement. This was followed by the St. Lawrence River Basin Water Resources Compact, which, taking effect in 2008, created the Great Lakes – St. Lawrence River Basin Water Resources Council and committed each member of the council to establish a regional framework for protecting, conserving, and managing the waters of the Great Lakes and St. Lawrence River Basin, requiring each party to develop water conservation and efficiency programs aligned with shared objectives.

In 2006, the state of Michigan enacted Public Act 35 of 2006 of the Natural Resource and Environmental Protection Act (NREPA), which required the state’s major water use sectors to design and update guidelines for generally accepted water management practices or environmentally sound and economically feasible water conservation measures. This legislation directed Michigan’s major water use sectors to establish and periodically update guidelines for environmentally sound and economically feasible water management practices. In response, Michigan’s public water supply, agricultural

(irrigation and non-irrigation), and business and industry (B & I) sectors adopted a set of voluntary best management practices (BMPs) in 2008, forming a foundational approach to advancing water efficiency across the state.

Since their adoption in 2008, there have been significant advancements in water efficiency, and some sectors have established processes to periodically review and update their practices and reflect advancements and innovations in science, research, and technology. However, because of the voluntary nature of the 2008 BMPs, some sectors – including B & I – may be advancing their practices, but do not have an established process to review and update conservation measures to reflect advancements achieved since the practices were developed. To support long-term sustainability of Michigan’s water resources, this report documents review processes for how the state’s water use sectors have engaged with and updated the 2008 generally accepted water efficiency and conservation BMPs, with a particular focus on the B & I water use sectors.

As stewards of significant water use and innovation, B & I sectors have an important role to play in advancing conservation and efficiency—and in realizing the associated economic, environmental, and operational benefits across Michigan and the Great Lakes Region. AWE’s study, “Assessing the Economic and Environmental Benefits of Industrial Water Use Efficiency in the Great Lakes,” showed economic and process benefits to the participating industries in addition to environmental benefits to the watershed, and in many instances, long-term benefits to water and wastewater utilities as well. The importance of B & I water efficiency is reflected in the Michigan Water Strategy, which says “Michigan is recognized as a place to invest and locate a business due to its support of sustainable water technologies, water conservation, and high quality of life.” It also states that “Michigan has a strategic focus on water technology and innovation to grow sustainable water-based economies,” and “uses water more thoughtfully and efficiently to grow sustainable economies.”

This report highlights water conservation best practices that can benefit Michigan’s water sectors, contribute toward Michigan’s goals under the MI Healthy Climate Plan, and support the long-term sustainability of Michigan’s water resources, highlighted in the Michigan Water Strategy (The Michigan Office of the Great Lakes, 2016). The MI Healthy Climate Plan, a comprehensive plan meant to protect public health and the environment while helping to develop new clean energy jobs by making Michigan fully carbon-neutral by 2050, provides an opportunity to make greater advancements in water conservation and efficiency through the intersection of water, climate, and energy (State of Michigan, 2022). The Michigan Water Strategy is comprised of nine goals to support sustainable use of Michigan’s water resources in tandem with economic development. In the interest of

supporting the MI Healthy Climate Plan and Michigan Water Strategy, this report characterizes current engagement with the 2008 water efficiency and conservation BMPs and highlights innovative practices and trends.

Section 2: Research Approach

This project employed mixed-methods qualitative approach, emphasizing the collection of information and insights through first-hand accounts and perspectives from industry stakeholders. Methods were exploratory in nature and were not intended as prescriptive evaluations or formal assessments of the 2008 voluntary BMPs.

The remainder of this report presents findings and recommendations that are grounded in insights drawn from each and all components of the research approach.

2.1 Desktop Research & Review

Desktop research was used throughout the project to:

- Identify relevant water use sector stakeholders;
- Gather and review relevant industry research, literature, and reporting materials to inform project findings;
- Collect and review documentation on existing industry BMPs;
- Identify and document innovative water efficiency and conservation practices throughout Michigan and the Great Lakes region.

2.2 Stakeholder Identification

The project team initially compiled a list of potential stakeholders and representatives from all water use sectors. The stakeholder list was utilized to support outreach for project tasks and as a living tool for the project team to track the status of outreach, meeting details, and stakeholder notes. The list was continuously updated as new contacts were identified throughout the project. The scope of engagement was targeted at the State of Michigan's water use sectors engaged in the development of the 2008 voluntary BMPs for both the non-B & I and B & I water use sectors. The project team engaged both non-B & I and B & I stakeholders; however, greater emphasis and more robust engagement efforts were directed toward the B & I sector, as it was the primary focus of the project.

2.2.1 Non-Business & Industry Stakeholders

Water use sectors engaged in the non-B & I water use sector categories included:

- Agricultural Irrigation
- Non-Agricultural Irrigation
- Public Water Supply

Engagement with non-B & I water use sectors and subsequent documentation of engagement outcomes was led primarily by the Midwest Energy Efficiency Alliance.

2.2.2 Business & Industry Stakeholders

Water use sectors engaged in the B & I water use sector categories included:

- Aggregate Industry
- Beverage Industry
- Chemical Manufacturing Sector
- Electric Utilities
- Pharmaceutical Manufacturing and Research
- Pulp & Paper Industry
- Wet Process Cement Manufacturing

Engagement with B & I water use sectors and subsequent documentation of engagement outcomes was led primarily by Alliance for Water Efficiency, with support from the Midwest Energy Efficiency Alliance.

2.3 Stakeholder Interviews

The project team conducted interviews with stakeholders from each water sector – including representatives from government agencies, public institutions, non-profits and private sector organizations. Interviewees provided thorough accounts of processes for updating and communicating water efficiency and conservation BMPs, as well as supporting documentation and additional sector contacts. These accounts allowed the project team to identify multiple programs and processes to update BMPs within water use sectors. Interviewees also shared information on water efficiency progress to date, barriers experienced by policymakers and implementers alike, and recommendations for future programs and policies. A total of 22 stakeholders were interviewed, including 10 from the non-B & I sectors and 12 from the B & I sectors.

Participants and Recruitment

The project team conducted initial outreach to contacts through email invitations which outlined the project objectives and the corresponding interview process. The project team developed a 1-page document summarizing the overall project scope, objectives, and timeline, and included this document with any stakeholder outreach (see [Appendix A](#)).

Interview Design

As the purpose of this interview process was to collect descriptive information on the history, progress and challenges to updating BMPs for each sector, the project team chose

to utilize a semi-structured interview format. The project team developed a set of twelve research questions to guide conversations (see [Appendix B](#)). While these questions laid the framework for interview structure, interviews were open ended and guided by interviewees interests, experiences, and expertise. Interviews were remote and lasted approximately 30 minutes to 1 hour.

Interview Analysis

Interviews were not recorded, but detailed notes were taken from each meeting. Notes were reviewed by the project team and qualitatively analyzed for common themes. The project team then organized qualitative information to compare information across interviews and determine common trends and themes.

2.4. Michigan Chamber of Commerce

The project team coordinated with EGLE and the MI Chamber of Commerce to implement a range of education, outreach, and project recruitment strategies:

- Ron Burke (AWE), Emily Finnell (EGLE), and Mike Alaimo (Chamber) were guest speakers on the MI Chamber’s “MI Business Matters” podcast in an episode titled [“Water Usage and Efficiency.”](#) The podcast included a discussion on water use and management best practices in Michigan and provided a background on the research project, including highlighting the opportunity to join the B & I working group.
- AWE presented at the Chamber’s Environment & Energy (E&E) committee on August 1, 2024. The presentation provided background on the 2008 BMPs, a summary of the purpose and goals for the project, and the opportunity to join the working group or participate in an interview with the project team. One week after the presentation, E&E Committee members were sent a copy of the presentation slides and a link to complete a survey to indicate interest in participating.
- A project one-page summary, an industry survey, and presentation resources were sent to the Chamber’s general weekly newsletter on August 14, 2024.

2.5 B & I Outreach Survey

An online survey was launched to recruit B & I stakeholders to participate in the B & I Water Conservation Working Group, gauge interest in the project, and establish a baseline on industry understanding and familiarity with the 2008 BMPs. The survey was distributed via several industry channels, including the Michigan Chamber of Commerce, EGLE’s Water

Use Advisory Council, AWE’s communication channels, and via direct email outreach. The survey was available from August – October 2024 online via JotForm. The survey was completed by eight individuals. A full copy of the survey, as shared with stakeholders, is in [Appendix C](#).

2.6 B & I Water Conservation Working Group

The B & I Water Conservation Working Group was comprised of industry representatives across Michigan’s B & I water use sectors. The purpose of the working group was to:

- Share how the B & I sector has engaged with the voluntary 2008 BMPs
- Identify innovations and advancements in water efficiency and conservation BMPs since 2008
- Learn what other industries and states are doing to advance water efficiency and conservation
- Identify opportunities for Michigan’s B & I water use sectors to continue advancing and implementing BMPs

The working group convened virtually five times from October 2024 – March 2025. Working group meetings employed a mixture of guest presentations, group discussions, live polling, and offline exercise activities. There were fifteen individuals on the working group roster, Water use sectors represented included the aggregates, beverage, energy utility, and manufacturing water use sectors, among other general B & I stakeholders. Working group members engaged in the following topics:

Meeting 1 - Introductory Meeting (October 9, 2024)

During this meeting, AWE provided a summary and review of the project, shared goals and next steps for the working group, and facilitated introductions between working group members. AWE facilitated an interactive polling activity to better understand working group members’ understanding of the water efficiency and conservation BMPs across the B & I sector and their involvement in water efficiency and conservation at their respective organizations. AWE also used this meeting to identify and recruit more stakeholders to participate in the working group. There were 11 attendees at this meeting, excluding project staff.

Meeting 2 - Review of 2008 BMPs (October 30, 2024)

In meeting 1, AWE identified that a majority of working group members were unfamiliar with the voluntary BMPs that were adopted in 2008. In response to this, AWE provided a “deep dive” review of each water use sector’s BMPs, key terminology, and where to find relevant documents. After this presentation, working group members joined breakout

rooms to discuss takeaways and to reflect on what they learned. This was an opportunity for members to network across their industry and build relationships to collaborate on and advance water efficiency and conservation stewardship. Working group members were assigned a “Sector-Specific BMPs Exercise,” prompting them to review their sector’s 2008 BMPs and document whether their organizations have implemented the listed strategies. There were 10 attendees at this meeting, excluding project staff.

A copy of the “Sector-Specific BMPs Exercise” Worksheet responses can be found in [Appendix D](#). Three worksheets were completed by representatives from the Aggregates, Beverages, and Electric Utilities sectors.

Meeting 3 - Review of Water Stewardship Opportunities (November 19, 2024)

Meeting 3 was used to educate working group members on water stewardship opportunities across the Great Lakes Region. AWE shared a presentation reviewing key organizations, certifications, and initiatives driving water stewardship and efficiency best practices across Great Lakes states. Through this presentation, working group members participated in a polling activity to identify topics and initiatives of interest to learn more about in future working group meetings. There were 6 attendees at this meeting, excluding project staff.

Meeting 4 - Review of AWE’s Research on Water Conservation BMPs (02/25/2025)

During this meeting, AWE provided an overview of examples and innovations in water efficiency and conservation BMPs across Michigan and surrounding states, gathered from our research and engagement with business and industry stakeholders throughout the course of the project. There were 6 attendees at this meeting, excluding project staff.

Meeting 5 - Webinar on “Advancing Water Stewardship Across the Great Lakes Region” (03/12/2025)

The project team hosted a webinar for working group members to learn more about water stewardship initiatives across the Great Lakes region. To broaden the scope of engagement, AWE also opened the invitation to attend the webinar to broader B & I stakeholders that were engaged in the project and in AWE’s network. The webinar brought four guest speakers that work alongside businesses and industry leaders to advance sustainable water management practices through technical assistance, research, and industry training / learning.

This was the final working group meeting. There were 16 attendees at the webinar, excluding project staff.

Section 3. Non-B & I Water Use Sector

3.1 Engagement & Results Summary

This section focuses on identifying and documenting review processes and updates to the 2008 water efficiency and conservation BMPs for non-B & I water use sectors, including the (1) Public Water Supply, (2) Agricultural Irrigation and, (3) Non-Agricultural Irrigation water use sectors.

The project team conducted interviews with stakeholders from each water sector – including representatives from government agencies, public institutions, non-profits, and private sector organizations. Interviewees provided thorough accounts of processes for updating and communicating water efficiency and conservation BMPs, as well as supporting documentation and additional sector contacts. These accounts allowed the project team to identify multiple programs and processes to update BMPs within non-B & I water use sectors. Interviewees also shared information on water efficiency progress to date, barriers experienced by policymakers and implementers alike, and recommendations for future programs and policies.

Each sector had varied approaches to updating water efficiency best management practices, from annual systematic approaches conducted with government oversight, to ad hoc groups, to national nonprofit efforts. While each sector utilized a unique approach, a few patterns held true across water users. Interviewees asserted that practitioners (public water suppliers, farmers, golf superintendents, etc.) all had interest in saving water, and in connection, cutting operating costs. Below is a summary of takeaways gleaned from interviews in each non-B & I water use sector.

- In the public water sector, no formal process to update the 2008 BMPs was identified. However, public water practitioners tend to take guidance from the American Water Works Association (AWWA) and wider industry best management practices to foster water savings.
- The agricultural irrigation water use sector has established the most robust BMP update process of those reviewed. In 1981, the Michigan Right to Farm Act required the establishment of Generally Accepted Agricultural and Management Practices (GAAMPs), and the first irrigation water use GAAMP was published in 2003. The Right to Farm Act requires that GAAMPs are reviewed annually, with significant stakeholder input facilitated by the Michigan Department of Agriculture and Rural Development (MDARD). While farmers are not required to implement GAAMPs, there are significant

incentives to do so, and farmers tend to seek out water savings for the health of their crops and business models.

- In the non-agricultural irrigation sector, no formal process to update the 2008 BMPs was identified. However, there have been innovations in specific fields of the non-agricultural irrigation sector. Outreach conducted in this project focused primarily on the golf industry, which, through the guidance of the National Golf Course Superintendents Association of America (GCSAA), developed a statewide manual for Michigan Golf Course Best Management Practices.

Across all non-B & I water use sectors, interviewees cited similar barriers for water efficiency adoptions, naming resource constraints and education challenges with end users. For all sectors, there is a desire to increase efficiency, but resource constraints for institutions have made formally updating the 2008 BMPs documents challenging, and resource constraints for end users have made investing in more efficient technology difficult for many. Interviewees offered recommendations for potential policy solutions and grant programs to expand capacity and increase water efficiency statewide, which will be elaborated in more detail in the following sections.

The following sections provide detailed information on the history, progress, challenges, and opportunities to advancing water efficiency and conservation best management practices gleaned from stakeholder engagement with each non-B & I water use sector.

3.2 Public Water Supply Sector

Statements in the sections below are compiled from interviews with a subset of experts in the Public Water Supply water use sector.

3.2.1 History

One of the early efforts around water conservation was the convening of a group of stakeholders by MI Department of Environmental Quality (DEQ) Director Dan Wyant to provide advice on the State's Water Use program and establish a set of Best Management Practices (BMPs) (Water Use Advisory Council, 2014). The convening resulted in a 2014 report, titled the "[Final Report of the Water Use Advisory Council](#)," which details significant policy recommendations in the fields of withdrawal decision making, environmental monitoring, water efficiency and conservation and preventing adverse resource impacts in inland lakes and ponds.

In 2021, a group of public utility stakeholders led an effort to revisit the 2008 BMPs through the convening of a small taskforce. The taskforce set out to conduct outreach to industry representatives and issue recommendations to formally update the 2008 BMPs, however

resource constraints prevented the effort from advancing to a formal revision or published updated documents.

The 2014 Final Report of the Water Use Advisory Council provides many recommendations for policy updates to increase water efficiency across the public water supply sector, however, there have been no formal updates to the 2008 BMPs or publication of similar technical BMP documents since their initial development.

3.2.2 Progress

Interviewees are engaged in water efficiency more broadly, striving for advancement in alignment with American Water Works Association (AWWA) guidance and wider industry best practices. While the 2008 BMP documents are a valuable tool to promote and facilitate water efficiency and conservation BMPs in Michigan, multiple interviewees were unfamiliar with the 2008 BMP documents adopted under Public Act 35. Interviewees further noted that water efficiency is often a low priority for utilities due to having limited staffing and funding resources combined with access to ample water supplies across the state. Given these constraints, interviewees shared that funding streams for water infrastructure upgrades are beneficial to reduce pipe leakage and excessive water loss, however, further funding would be required to advance water efficiency across the state. Interviewees also cite resource scarcity as a major barrier, in funds to implement programs, staff to research advancements and time to prioritize efficiency within a suite of everyday challenges.

This barrier is especially prominent for smaller water systems, frequently in rural regions, that require grant funding to implement infrastructure upgrades. Rural public water suppliers are concerned that as the costs of infrastructure upgrade projects are distributed to ratepayers, investment would lead to a significant increase in rates and increase cost burden to customers.

Interviewees noted that major water efficiency efforts from public water suppliers tend to focus on water loss. Currently, public water suppliers are pursuing methods for leak detection, meter maintenance and managing peak demand – primarily, to reduce operational expenses and avoid costly infrastructure expansion. These concerns are especially high for counties that rely on groundwater, such as Ottawa County, but even lakeside townships, such as Holland, MI, are instituting new methods to reduce demand and avoid future water facility expansion.

3.2.3 Challenges

In all interviews, limited funding was cited as the major barrier to advancing water efficiency in the state of Michigan. Additional challenges cited include availability of water usage data, a perception of water abundance and limited resources for educating water users and implementing water efficiency best practices.

Interviewees noted that water use data availability presents a unique challenge for water utilities across the state. Water meter technology varies widely, with a handful of rural communities lacking water meter infrastructure all together. Utilities are slowly implementing Advanced Metering Systems (AMI) and Ultrasonic Meters, which present significant opportunities to advance water use efficiency and conservation among customers. Whereas older meter data collection depends on a user's ability, and interest, in checking, tracking and reporting monthly water usage, AMI allows households, and utility monitors, to identify potential leakages quickly, and recommend water efficient appliance upgrades over time. Interviewees also noted that "meter slippage" is not accounted for in the 2008 BMP documents, and in regions with outdated technology, slippage may be a major contributor to inaccurate water usage data.

Interviewees frequently cited the issue of an "abundance mindset" surrounding Michigan's water supply as a major implementation barrier for water conservation programs. This mentality impacts water usage on the customer side, but this narrative also impacts the way that utilities approach water efficiency programming. Across interviews, water efficiency served more as a co-benefit for larger infrastructure projects (such as lead pipe replacement) than as a priority action item on its own. Interviewees did note that there has been a shift in this mindset in recent years, at least partially correlated with statewide climate goals (MI Healthy Climate Plan) and individual organization's sustainability goals. Interviewees also mentioned that utilities are working to educate customers on the importance of water conservation and reduce end user demand as utilities incrementally implement infrastructure upgrades. Another noted that for some smaller water systems, this de-prioritization of water efficiency was tied to staffing constraints and inaccessibility of program design resources.

According to interviewees, in rural regions of Michigan, where water utilities have smaller staff sizes, serve fewer households, and communities are more resource scarce, the prospect of large-scale water efficiency projects, and even customer education programs, can feel out of reach. Hiring outside consultants and engineers to approach infrastructure upgrades, in addition to the research time associated with seeking out the latest in water efficiency, is costly. Even developing one-pagers, pamphlets, and communication materials to distribute to households requires resources and staff time that many smaller

utilities do not possess. Interviewees also noted that while resources exist for utilities to learn about best practices, through utility networks, nonprofit entities, and AWWA guidelines/materials – the time and resource barriers to accessing these materials is the first stopgap to water efficiency advancement.

3.2.4 Opportunities

Interviewees provided a few recommendations for advancing water efficiency best management practices across the public water sector. Additional funding streams, prioritizing grant funding to increase access for small scale water systems for staffing, training, systems upgrades, and/or educational material development, were highlighted as a major opportunity. Water practitioners also recommended that the state develop a landing page for resource accessibility – including basic educational materials that utilities could distribute to households, updated utility best management practices for water efficiency and supporting research and expert consultations. From a policy perspective, interviewees proposed that an annual water audit, required of each public water supplier, may assist in maintaining accountability and catalyzing progress.

3.2.5 Engagement Summary

Summary of the main motivators, challenges, and recommendations:

Main motivators for water efficiency in the Public Water Supply Sector:

- Rising cost of surface water.
- Reducing peak demand to avoid infrastructure expansion.
- Water loss and leak detection overall, for utility efficiency.

Main challenges for water efficiency in the Public Water Supply Sector:

- Lead pipe replacement is the major focus of water utilities at this time.
- No major regulatory accountability for utility water efficiency.
- Limited water use data availability, collection, and tracking due to older or outdated water meter technology
- Voluntary measures are not equipped to garner the level of savings required.
- Lack of a conservation ethic because water supplies are ample or perceived to be ample.

Recommendations for advancement:

- Annual water audit, that is more than voluntary.
- Water meter maintenance – continuing efforts to update to AMI systems.

- Institute water infrastructure grant programs targeted at small-scale public water providers.

Develop a landing page for resource accessibility – include basic water efficiency customer educational materials, updated utility best management practices for water efficiency and references for expert consultations.

3.2.6 Additional Information

Resources this sector leverages to update their practices:

- [AWWA guidelines and technical resources for water efficiency](#)
- [Final Report of the Water Use Advisory Council \(December 12, 2014\)](#)
- [The Michigan Rural Water Association](#)

3.3 Agricultural Irrigation Sector

Statements in the sections below are compiled from interviews with a subset of experts from the Agricultural Irrigation water use sector.

3.3.1 History

In 1981, the Michigan Legislature passed into law the [Michigan Right to Farm Act](#), which required the establishment of [Generally Accepted Agricultural and Management Practices](#) (GAAMPs), and an annual review of such practices. The GAAMPs are written to provide “uniform, statewide standards and acceptable management practices based on sound science” (Michigan Commission of Agriculture & Rural Development, 2025). GAAMPs are currently developed for eight agricultural sectors: manure management and utilization (1988), pesticide utilization and pest control (1991), nutrient utilization (1993), care of farm animals (1995), cranberry production (1996), site selection and odor control for new and expanding livestock facilities (2000), irrigation water use (2003) and farm markets (2010). GAAMPs are developed with industry, university and multi-governmental agency input, and currently assembled in sector-specific advisory committees (Michigan Commission of Agriculture & Rural Development, 2025). Stakeholders are identified in annual reporting, and annual reports are published by the [Michigan Department of Agriculture and Rural Development](#) (MDARD). According to an interviewee, information on water efficiency and conservation BMPs in the agriculture irrigation sector tend to be siloed by type of agriculture.

The utilization of GAAMPs within each sector is voluntary, but agricultural producers who voluntarily abide by these practices, as applicable to their individual operations, are provided protection from public or private nuisance litigation under the Right to Farm Act (Michigan Right to Farm Act, 1981). The GAAMPs do not serve to establish any legal criteria

for water conflict resolution, nor do they intervene with priority rights to water use (Michigan Commission of Agriculture & Rural Development, 2025).

The [GAAMPs for Irrigation Water Use](#) are based on the core principle of stewardship of water quantity, water quality, soil, plant quality and crop yield. These management practices cite water efficiency as a key metric, emphasizing the importance of using water responsibly to maintain both water supplies and soil and environmental health (Michigan Commission of Agriculture & Rural Development, 2025). The GAAMPs define “over-irrigation,” with some exceptions, as “when water applications exceed the quantity needed to replace the soil/substrate moisture deficit” (Michigan Commission of Agriculture & Rural Development, 2025). The GAAMPs state that, generally, the amount of irrigation water utilized should be equal to the total evapotranspiration (since last irrigation) minus any precipitation that occurred during that period (Michigan Commission of Agriculture & Rural Development, 2025).

Agriculture large quantity water withdrawal users, defined as those with the capacity to withdraw 70 gallons per minute (gpm) or greater, are required to annually self-report water usage to MDARD or MI EGLE. The legally affirmed self-reporting system requires an estimation of monthly water withdrawals for agricultural uses. It also requires entities to consider, as applicable to their operation, an irrigation BMP checklist derived from the Irrigation GAAMPs. For a new agriculture withdrawal, EGLE may or may not require the new user to identify conservation practices in alignment with GAAMPs. This requirement is determined on a case-by-case basis and depends on whether a site-specific review is mandated. Otherwise, there are assumptions that water use will be conserved.

3.3.2 Progress

Interviewees who work directly with farmers echo this assumption, stating that farmers, and the agriculture industry more widely, are seeking to develop and implement the most water efficient systems they can. A phrase utilized by the industry is “more crop per drop” – working from an understanding that reducing water waste and frequency of overwatering saves money, fosters healthier crops and conserves resources. However, interviewees cited that water use monitoring is tedious and labor-intensive with outdated technologies. Advocate efforts to enhance water efficiency have proven successful, leading to an uptick in adoption of lower cost new technologies, including soil moisture sensors which allow farmers to better time irrigation and determine how much water soil is truly capturing. Farmers are open to new technology, and outreach programs that offer technical assistance and product demonstrations have shown success in reducing knowledge barriers to entry.

Interviewees noted that the age of a farm’s irrigation system plays a large role in the overall water efficiency of a farm. For example, in the case of farms that utilize pivot irrigation systems (over 8,000 in the state) about 1/3 of these systems are over 20-years old.

Technology has advanced significantly in the last two decades. The Michigan State University irrigation team conducted a field study in which they evaluated and retrofitted center pivot irrigation systems, with support from MSU Project GREEN. Retrofitting aged pivot irrigation systems led to savings of 3 million to 9 million gallons of water for a hundred-acre irrigated field each year (Michigan State University, 2024). Advocates argue that updating these systems statewide would lead to significant water, and energy, savings for farmers and the greater state of Michigan.

Michigan State University is currently conducting a pilot program titled “[Improving Irrigation Efficiency and Annual Water Use Reporting](#)” – which includes significant farmer outreach. Interviewees stated that the project has shown that farmers consistently have interest in irrigation water efficiency technology, but cost barriers continue to deter users from adopting new technologies. The MSU Irrigation Team is providing irrigation education and on-site demonstrations to articulate the value of water efficiency, both for preserving environmental resources and enhancing farm productivity. Certain outreach even involves splitting a farm plot in two, placing new technology on half of the field, and comparing crop yield and water usage over a season. This program is funded through Michigan State University, but the MSU team is pursuing state funding to expand farmer outreach programs and advance agricultural irrigation water efficiency.

3.3.3 Challenges

While these programs are effective in demonstrating the value of water efficiency, upgraded irrigation systems and soil moisture monitors – up-front costs remain a major barrier to adoption across the state. Interviewees noted that federal government cost-share programs are helpful for upgrading irrigation systems, but that the application process is tedious and there is no guarantee of funding, often deterring small farms from pursuing these funds. Interviewees noted that other states (citing California, Florida, Utah and Nebraska), with higher water stress than Michigan, have established state-funded programs that assist farmers in saving water and growing production. For instance, Utah recently invested \$25 million in advancing farmers and ranchers water conservation (Utah Department of Agriculture and Food). Interviewees noted that more funding opportunities and a streamlined application process (with technical assistance available) would help dismantle current barriers.

3.3.4 Opportunities

Interviewees emphasized that the motivation to institute more efficient irrigation practices is prevalent across the industry, and that funding and resources are the barriers to advancing water efficiency in the agriculture irrigation sector. Interviewees asserted that they did not believe that mandatory regulatory policy, such as consistent water metering or annual water audits, for the agriculture industry would be effective. Instead, they recommended expanding programs, such as the MSU pilot program, that conduct 1:1

farmer engagement and build strong partnerships through technical assistance to determine effective water efficiency upgrades on a case-by-case basis. Advocates assert that pairing such programs with funding streams, to place farmers on an accessible path to a more efficient and cost-effective production, may unlock the true potential for water savings within this sector.

3.3.5 Engagement Summary

Summary of main motivators, barriers and recommendations:

Main motivators for water efficiency in the Agriculture Irrigation Sector:

- Self-Reporting water usage – agriculture large quantity water withdrawal users, defined as those with the capacity to withdraw 70 gpm or greater, are required to annually self-report water usage to MDARD or MI EGLE.
- Disease Prevention – overwatering may lead to disease and crop loss.
- Impacts on neighboring wells – for many farms, water is siphoned from wells and groundwater sources, over extraction can lead to community losses and potential lawsuits.
- Practical reasons – costs of energy.
- Production – accomplishing a better “crop for drop” ratio.

Main challenges for water efficiency in the Agriculture Irrigation Sector:

- Expenses – updated technology is costly, and for different agricultural scales can be out of reach. Overwhelmingly farmers have interest in efficient technology, but there are few federal or state government cost-share programs.
- Maintenance – water leakage is a common issue, and ensuring maximum irrigation system efficiency takes expertise and attention.
- Time – applications for funding are time intensive, and the initial adoption and education of a new system can take a time investment.

Recommendations for advancement:

- Expand farmer outreach programs to have more 1:1 conversations with growers, introducing them to efficient technologies and demonstrating the impacts of effective irrigation on crop production.
- Expand education programs for irrigation system salespeople – communicating the value of efficient irrigation systems.
- Develop government cost-share programs to assist farmers in implementing efficient irrigation systems.

3.3.6 Additional Information

Resources this sector leverages to update their practices:

- Technical advisory from industry experts through the WUAC irrigation committee throughout the Michigan Department of Agriculture and Rural Development (MDARD) Generally Accepted Agriculture Management Practices (GAAMPs) annual review.
- Michigan State University irrigation research, farmer outreach, and resource dispersal.
- [The Generally Accepted Agricultural Best Practices – MDARD](#)
 - [2024 Irrigation Water Use GAAMPs](#)
 - [2025 Irrigation Water Use GAAMPs](#)
- [Improving Irrigation Efficiency and Annual Water Use Reporting](#) – 2023 Report

3.4 Non-Agricultural Irrigation Sector

Statements in the following sections below are compiled from interviews with a subset of experts from the Non-Agricultural Irrigation water use sector.

3.4.1 History

No formal published updates to the 2008 non-agriculture irrigation Best Management Practices were identified through this project. However, certain sectors within the non-agriculture irrigation sector have published water use guidance for member organizations or affiliates. One example of such projects is the [Michigan Turfgrass Environmental Stewardship Program](#) (MTESP), which began amidst significant growth in the MI golf industry between 1980-2000 and ensuing public scrutiny surrounding the environmental impact of golf course construction and maintenance (Michigan Chapter GCSAA, 2021). MTESP formed as a collaborative between the [Golf Course Superintendents Association of America](#) (GCSAA), Michigan State University (MSU) and [Michigan Department of Agriculture and Rural Development](#) (MDARD) (Michigan Chapter GCSAA, 2021). MTESP’s mission remains to protect the environmental resources surrounding golf courses in Michigan. The golf industry represents one of the major water users in the non-agricultural irrigation sector, but it also serves as a notable example of an independent effort to develop industry BMPs and facilitate adoption across stakeholders.

Michigan State University (MSU) has maintained a research department dedicated to turfgrass stewardship, a key collaborator of MTESP, since the mid-1990s. The [MSU Department of Plant, Soil and Microbial Sciences: Turfgrass](#), provides cutting-edge research in golf course, sports facility, and lawn turfgrass care, primarily funded by the [Michigan Turfgrass Foundation \(MTU\)](#). The Michigan Turfgrass Foundation works in partnership with Michigan State University, supporting ongoing programs in research,

education, and professional turfgrass management extension to benefit all (Michigan Chapter GCSAA, 2021).

MTESP has been involved in stewarding golf course water efficiency best management practices since the 1990s. In the mid-1990s, MTESP led a statewide effort to engage golf course superintendents to self-assess potential environmental impacts unique to their property and seek tools to minimize those impacts and achieve regulatory compliance for pesticide and fertilizer use. MTESP held seminars to engage superintendents and provided technical guidance on developing improvement plans. MTESP also offered site visits to program participants, where MTESP personnel would review improvement plans and verify regulatory compliance. MSU, MDARD, and MTU formally recognized golf course properties that achieved specific program standards for environmental protection and regulatory compliance (Michigan Chapter GCSAA, 2021). More recently, MTESP adapted BMPs for use by other turfgrass professionals in athletic fields, schools, and other ground maintenance sectors (Michigan Chapter GCSAA, 2021).

In 2017, GCSAA pledged to develop state-specific [water efficiency BMPs in all 50 states](#) by 2020. To facilitate this process, GCSAA developed the “[Best Management Practices Planning Guide & Template](#),” designed to help state golf organizations, including GCSAA chapters, draft state BMP plans. The “Guide & Template” provides information on identifying funding resources and carrying out key processes for development, guided by professional turfgrass/horticultural scientists from the University of Florida with experience developing the Florida turfgrass BMP program. Other industry representatives assisted in compiling this document, including superintendents, GCSAA Chapter leaders, university scientists, environmental professionals, golf course architects and more (GCSAA, 2023). GCSAA and the GCSAA Foundation then provided funding opportunities to GCSAA-affiliated chapters to develop state-level BMP programs, encouraging them to form similar coalitions of stakeholders throughout development (GCSAA, 2023).

In 2021, MI-GCSAA, in partnership with MTESP, published the “[Best Management Practices for Michigan Golf Courses](#),” including a section on irrigation water management approaches for course play and non-play areas. The report details BMPs in relation to regulatory considerations, irrigation water suitability, water conservation and efficient use planning, irrigation system design, irrigation pumping systems, irrigation system program and scheduling, turf drought response, irrigation system quality, pond location and design, pond use and maintenance, metering, irrigation leak detection, sprinkler maintenance, system maintenance, winterization and spring, sensor technology, maintained turf areas and non-play and landscape areas (Michigan Chapter GCSAA, 2021). Development of the MI BMPs document was phase I of GCSAA’s larger sustainability initiative -- phase II involves peer-to-peer outreach to each GCSAA affiliated golf course in the state of Michigan, to assist courses in tailoring the MI BMPs to their specific course needs (GCSAA, 2023).

Nationwide, GCSAA has been a leader in water efficiency and golf course sustainability since its inception, offering trainings and materials for Golf Course Superintendents. In 2005, GCSAA began developing an “Environmental Profile,” tracking the environmental impact of member organizations across the country, including water usage statistics (GCSAA, 2022). In 2015, phase II of the environmental profile was reported, and [Golf Course Environmental Profile \(Phase III, Volume I\)](#) was published in 2022, measuring a 29% reduction in water use since the 2005 baseline (GCSAA, 2022). It is important to note that this statistic includes the change in water usage due to golf course closures as well, not solely water efficiency programming.

3.4.2 Progress

Interviewees noted that significant research and investment have gone into water use reduction within the golf industry since 2005 and more efficient irrigation systems have cut water use significantly. Handheld moisture meters were described as a recent innovation that has proven helpful in testing the effectiveness of an irrigation system and allowing Superintendents to hand water patches of turf under certain conditions for courses that are unable to make the large investment in an entirely new irrigation system.

3.4.3 Challenges

Interviewees emphasized that water efficiency and conservation BMPs in the golf industry are widely supported. Similarly to the agricultural industry, cost savings and turfgrass health are drivers for superintendents to reduce water usage. However, according to interviewees, due to the upfront costs of system upgrades, board approval processes, and complex financing streams, project approval can take upwards of a decade. In addition, while GCSAA has a significant network throughout the state, a large percentage of golf courses in Michigan are family-owned or public. These courses are likely to have far more limited resources, which is a major barrier for water efficiency improvements, and a less direct connection to GCSAA programs and resources. GCSAA MI and MTESP work to engage with these stakeholders.

Funding streams for golf course irrigation innovations are also limited. GCSAA is working to compile nationwide grant programs, and potential avenues for unlocking funding, but, according to interviewees, these require Superintendents to “get creative” – applying for urban agriculture grants as a part of the pollinator protector programs or various EPA grants, for example. At the time of interviews, GCSAA is lobbying for Superintendent incentives at the federal level, hoping to expand agricultural grants to golf courses across the country.

3.4.4 Opportunities

Interviewees noted that golf course Superintendents are key stakeholders in progressing water efficiency and conservation BMPs within MI and in advocating for change with organization leadership, and local decision makers. Interviewees recommended supporting these advocates and creating channels for family-owned, small-scale, and public golf courses to access resources for system improvements as a major pathway for advancement.

3.4.5 Engagement Summary

Summary of main motivators, barriers, and recommendations described in interviews:

Main motivators for water efficiency in the Non-Agriculture Irrigation Sector:

- Reduce operational costs associated with water supplies.
- Cultivate healthy turfgrass and reducing the costs of turf replacement.

Main challenges for water efficiency in the Non-Agriculture Irrigation Sector:

- Funding for non-agriculture irrigation, specifically in the recreational golf sector, is limited.
- Many golf courses are family owned or public (local government controlled) and are less likely to be engaged in the Golf Course Superintendents Association of America (GCSAA), who are advancing water efficiency and conservation BMPs.
- Irrigation upgrades are costly, and navigating the board leadership decision-making process from private organizations and finding financing can take years to complete.

Recommendations for advancement in the Non-Agriculture Irrigation Sector:

- Develop financial assistance programs for small-scale golf courses to implement irrigation system upgrades.
- Conduct outreach to smaller-scale golf courses that are not GCSAA members, to educate stakeholders on innovations in irrigation water efficiency.

3.4.6 Additional Information

Resources this sector leverages to update their practices:

- The MSU Department of Plant, Soil and Microbial Sciences: Turfgrass – research facility.

- The Golf Course Superintendents Association of America – significant water usage reduction resources.
- [Best Management Practices for Michigan Golf Courses](#)
- GCSAA [Golf Course Environmental Profile \(Phase III, Volume 1\)](#)

3.5 Opportunities for Future Inquiry

This study sought to identify independent water efficiency and conservation BMP update processes within the Public Water Supply, Agricultural Irrigation, and Non-Agricultural Irrigation water use sectors. Through interviews with industry representatives, the project team identified multiple avenues for innovation in water efficiency and conservation BMPs and information dissemination. Interviewees also provided insights on current barriers to water efficiency advancement, such as local resource constraints and education gaps, as well as recommended programs and policies, including grant programs and technical assistance hubs.

3.5.1. Opportunities for Future Engagement

Due to the nature of this study, findings were limited by a smaller stakeholder sample size and a methodology focused on policy and practitioner engagement. Additional interviews with a more diverse set of stakeholders would aid in developing policy and program recommendations.

This research did not include interviews or engagement with any end users (e.g. homeowners, farmers, golf course superintendents). Rather, end user interests are primarily represented through the perspectives of interviewees who engage with end users. Expanding this engagement process to end users in future research may help tailor recommendations to hard-to-reach audiences (rural water systems, small farms, public golf courses) and enhance the impact of state investments.

The project team also identified additional water use sub-sectors that were not included in this report but may be beneficial in future engagement:

- Indoor agriculture, also termed controlled environment agriculture, is a technology-based approach to agriculture where crops are grown indoors in controlled environments such as greenhouses (e.g. temperature, water, light). This industry is expanding across the United States and within Michigan (Davis and Weber, 2024).
- Other commercial non-agricultural irrigation fields, such as campus landscaping or sport field turfgrass, were not engaged in this study but may offer supplemental insights to the golf course turfgrass industry.

- The ski industry, and their snowmaking practices, arose in interviews as a potential industry to investigate, given Michigan’s changing winter climate and a potential increased demand for snow production. Engaging these subsectors, and more, would expand the current analysis and help tune program and policy development.

3.5.2. Opportunities for Future Research

As this study was focused on Michigan policy and practitioner outreach, there is additional research that could be done through literature reviews, case study analysis, and investigation of innovative processes outside of Michigan. For many of the recommendations supplied by interviewees, supplemental research is necessary to design effective programs and policies.

Additionally, convening Michigan stakeholders within each sector to discuss the 2008 BMPs and potential opportunities for advancement may be helpful for certain sectors. While the Agricultural Irrigation Sector convenes annually to update their BMPs, the Public Water Supply sector and Non-Agricultural Irrigation sectors may benefit from a structured working group. The 2021 Public Water Supply sector effort to independently update the 2008 BMPs demonstrates the desire for such an organization, however resource constraints proved a barrier to independent operation of such a group. For the Non-Agricultural Irrigation sector, significant advancements in water stewardship within the golf industry may be better transposed to additional Non-Agricultural Irrigation sub-sectors through a formal convening.

As an introductory study, this research provided significant background information on the development of water efficiency and conservation BMPs in each water use sector, as well as advancements since the 2008 BMPs. However, to further advance water efficiency through the development of additional programs, policies and incentives across each sector, additional outreach and research are necessary.

Section 4: B & I Water Use Sectors Engagement Summary

This section summarizes engagement with stakeholders representing the B & I water use sectors, and the outcomes and information gleaned from engagement throughout the project.

4.1 Engagement & Results Summary

The project team developed and implemented an engagement and documentation strategy to gather information on the advancement of water efficiency and conservation BMPs across Michigan’s B & I water use sectors.

The engagement plan included the implementation of the following tasks:

1. Development of a stakeholder list including organizations and representatives across Michigan’s business and industry water use sectors
2. Email and phone outreach to identified stakeholders to inform them about the project and invite them to participate
3. Presentation to Michigan Chamber of Commerce Energy & Environment Committee and participation in Chamber podcast to inform members about the project
4. Launch an online survey to assess baseline awareness of 2008 BMPs and recruit participation in stakeholder engagement opportunities
5. Virtual interviews with identified stakeholders to gather information on current review processes for updating the 2008 BMPs and to identify innovative strategies
6. Regular convening of a working group comprised of B & I water use sector stakeholders to promote industry learning on water efficiency and conservation, document industry engagement with the 2008 BMPs, and identify innovations, opportunities, and challenges to advancing water efficiency and conservation
7. Distribution of a “BMPs Exercise Worksheet” (Appendix D) for B & I working group members to review the original 2008 BMPs and identify which strategies are being implemented, updated, or improved upon within their respective industries.

The engagement plan strategies outlined above entailed an iterative, trial-and-error approach to identify effective engagement methods. One-on-one interviews emerged as the most effective strategy for gathering in-depth perspectives, particularly in building trust and facilitating open dialogue. In contrast, broader outreach efforts, such as email campaigns and informational webinars, were less successful in creating sustained engagement. Engaging business and industry stakeholders around the voluntary BMPs

presented several challenges over the course of the project. Despite outreach efforts through multiple channels, overall participation was limited.

The following sections provide information on observed challenges and opportunities to advance water efficiency and conservation best management practices gleaned from engagement with stakeholders representing the B & I water use sectors.

4.2 BMPs Implementation Progress

4.2.1 Water Efficiency and Conservation as a Co-Benefit

For those engaged in the project, it was common that water efficiency and conservation strategies being implemented were secondary, co-benefit outcomes of other priority efforts—such as energy efficiency improvements, cost reduction measures, or wastewater management initiatives—and/or were tied to company-specific sustainability goals. For example, interviews with energy waste reduction program administrators revealed that, while water efficiency was not a primary concern, there has been growth in the electric industry’s recognition of water efficiency as a means for energy savings. Interviewees noted that they don’t necessarily think about water efficiency and savings independently, but that they play a role in most utility’s energy savings programs. By installing water efficiency devices, primarily high efficiency faucets, shower heads and flow restrictors, utilities can reduce the amount of water a household uses and thus the amount of water a household must heat, saving energy.

This example is reflective of broader stakeholder responses to engagement opportunities throughout the project. In the project survey, when stakeholders were asked if their organization had implemented water conservation or efficiency strategies more broadly, most (62%) responded yes (**Figure 1**). However, during a working group meeting, when asked specifically about the progress their organizations have made in implementing the 2008 BMPs adopted by the state, responses were more varied. As shown in **Figure 2**, most stakeholders reported a moderate to low level of BMP implementation. Many were largely unaware of the 2008 water efficiency and conservation BMPs. Taken together, these insights suggest that among stakeholders who participated in the project, there is an opportunity to raise awareness about the 2008 BMPs as a tool and resource for the B & I sector to build upon already existing, on-the-ground water conservation practices.

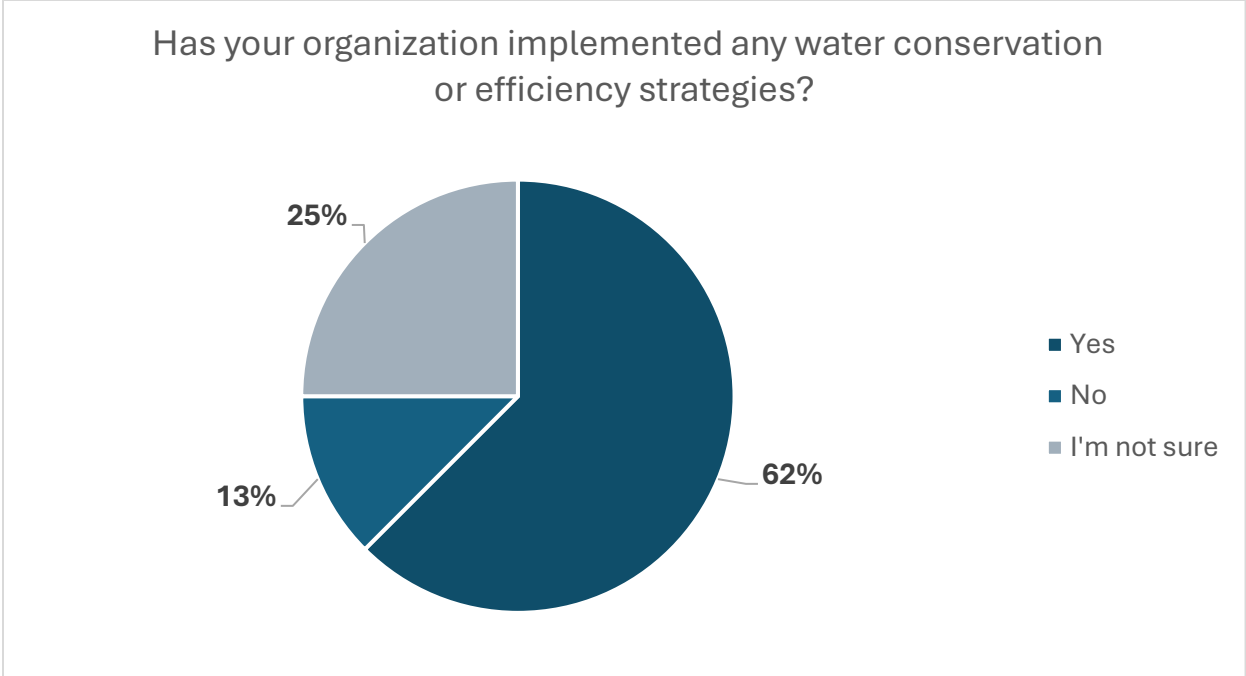


Figure 1. Figure displaying stakeholder responses to an online survey question asking “Has your organization implemented any water conservation or efficiency strategies?”

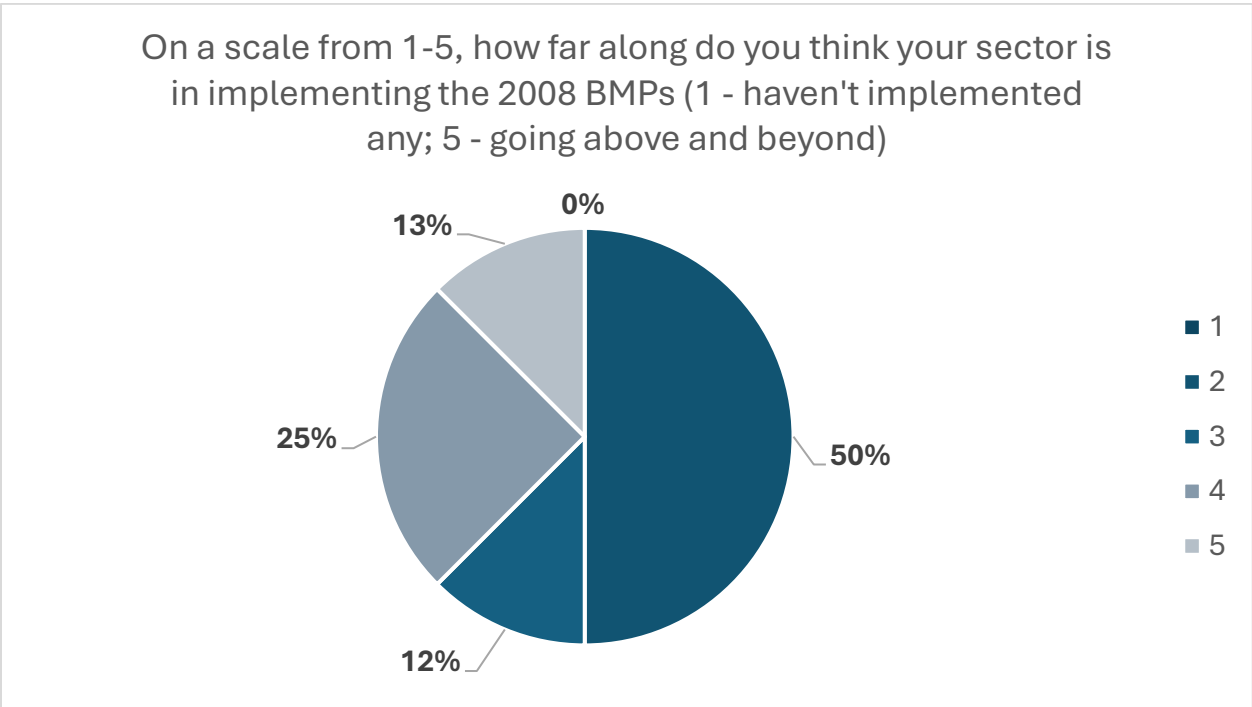


Figure 2. Figure displaying stakeholder responses to an in-meeting poll asking, “On a scale from 1-5, how far along do you think your sector is in implementing the 2008 BMPs (1- haven’t implemented any; 5- going above and beyond).”

4.2.2 Advancing Voluntary BMPs Amid Competing Priorities

Engaged stakeholders also indicated that water efficiency and conservation are not always immediate priorities, given the range of environmental and operational priorities they must balance and manage. Challenges relating to water quality, wastewater management, stormwater, and energy efficiency often rose to the top. Some stakeholders also reflected on challenges in adhering to other existing regulations. These competing demands may limit capacity to engage with voluntary initiatives or integrate BMPs that fall outside of core compliance requirements.

Others also cited the perception of abundant water as a barrier to garner public and organizational support to advance water efficiency and conservation. Because stakeholders are not facing immediate water supply constraints, and the price of water is low, there is little motivation to reduce consumption. This challenge is especially difficult for industrial users, where potential water savings are high, but the cost of process improvements is often larger than the cost of paying for more water. Interviewees cited that it's difficult to motivate this behavior without additional incentives or regulations.

4.3 Observed Challenges

4.3.1 Sustained Stakeholder Participation

A key challenge throughout the process was maintaining consistent participation, especially over an extended period. While general stakeholders—such as representatives from associations, advocacy groups, or government entities—were more readily accessible and responsive, it was more difficult to engage specific companies or facilities within each water use sector. These organizations often required multiple points of contact and follow-up, and many declined or did not respond despite repeated outreach efforts. In some cases, stakeholders expressed a degree of caution around sharing internal practices. This dynamic may have contributed to the overall difficulty in establishing open, two-way dialogue, and in gathering comprehensive feedback from participants. Additionally, organizational turnover may have played a role in the observed disconnect. Many of the BMPs were developed in 2008, and current staff may not have been involved during earlier phases of rollout or adoption. Identifying and supporting new champions within companies—those who are positioned to lead internal water efficiency efforts—will be important for re-establishing awareness and alignment with EGLE's water conservation goals.

These engagement outcomes underscore the importance of building trust to support shared learning, and that there is no one-size-fits-all model for stakeholder engagement.

Successful strategies required flexibility, time investment, and sensitivity to the varying capacities and motivations of different water use sector stakeholders.

4.3.2 Data Availability & Quality as Low Hanging Fruit

According to stakeholders engaged throughout the project, water use and consumption data availability, quality, and tracking remain key challenges to advancing effective water conservation strategies across Michigan’s B & I water use sectors. As highlighted by Fresh Coast Climate Solutions, inconsistent data collection and monitoring limits the ability to track progress, coordinate across entities, and identify opportunities to improve efficiency (Fresh Coast Climate Solutions, 2025). This is echoed by interviewees from the electric utility sector, who emphasized that limited access to water savings data complicates efforts to assess and communicate the co-benefits of water efficiency, such as reduced energy consumption and associated carbon emissions. They suggested that developing stronger metrics and data linkages across water, energy, and emissions could help unlock greater investment from utilities and bolster public support for water-saving upgrades.

Despite access to data being a challenge, understanding your “water footprint” also presents a large opportunity for advancing efficiency across B & I water use sectors. Participating stakeholders noted that this is the first step to improve water management systems. For example, the University of Minnesota’s Technical Assistance Program recommends conducting regular water audits, establishing a baseline of water distribution and flow, and installing submeters to regularly measure and monitor water use as best practices for water conservation (Minnesota Technical Assistance Program, 2025).

4.4 Observed Opportunities

4.4.1 Corporate Sustainability Goals as a Pathway to Water Efficiency

Many of the stakeholders engaged through this project have established corporate environmental, social, and governance (ESG) goals, as shown in **Figure 3** below. Stakeholders also reported being primarily motivated by their ESG goals to implement water saving strategies (54%) followed by associated cost savings (38%) (**Figure 4**). This creates a valuable opportunity to align water efficiency and conservation priorities with existing organizational commitments. These goals often come with reporting requirements, resulting in a degree of transparency through public sustainability reports and progress updates. Companies with ESG goals are also more likely to have dedicated staff focused on sustainability, which can serve as key points of contact for future engagement. Additionally, stakeholder involvement in industry sustainability networks or

associations presents a pathway to lower the barrier to entry for water conservation initiatives, and facilitates peer learning, knowledge sharing, and relationship building.

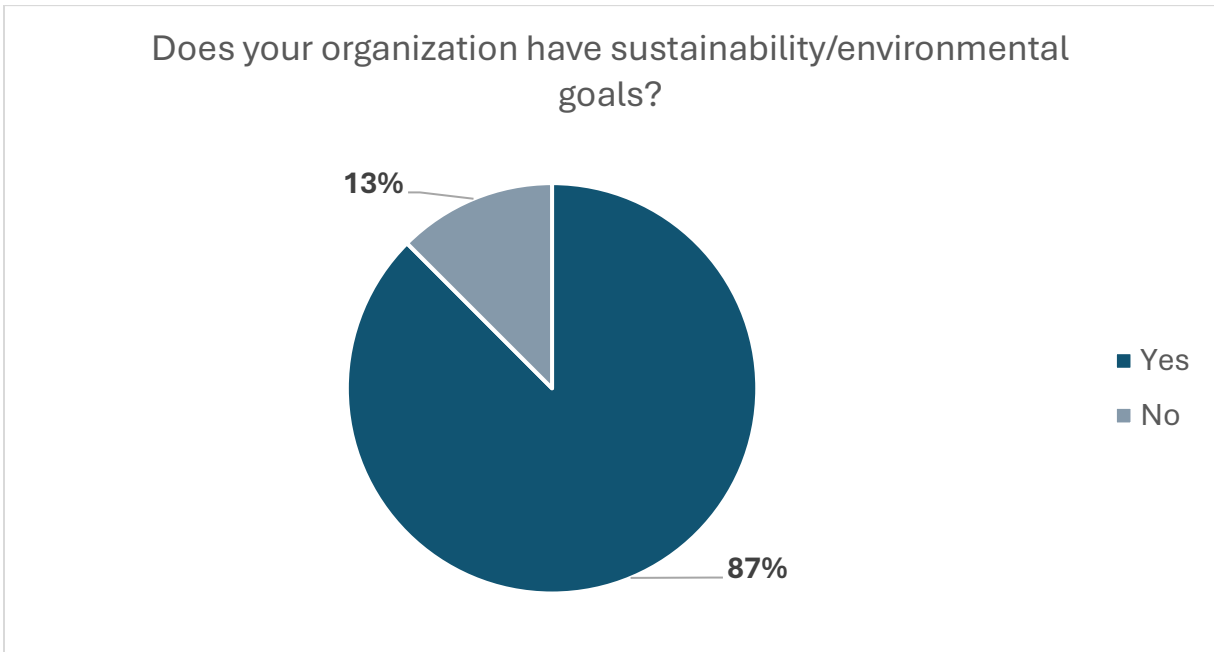


Figure 3. Figure displaying stakeholder responses to an online survey asking, “Does your organization have sustainability/environmental goals?”

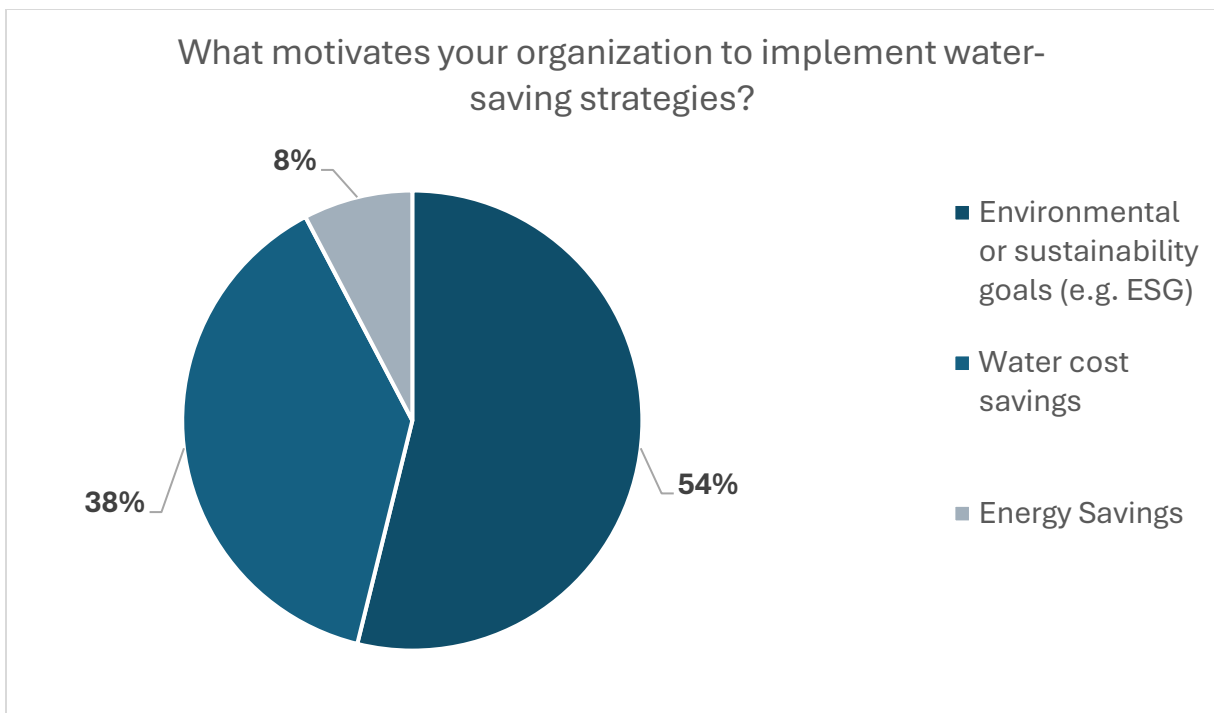


Figure 4. Figure displaying stakeholder responses to an online survey asking, “What motivates your organization to implement water-saving strategies?”

4.4.2 Provide Education and Learning Opportunities

Stakeholders engaged expressed interest in exploring water stewardship opportunities and acknowledged that their organizations have at least some potential—ranging from slight to high—to further reduce water use (**Figure 5**). Some also expressed a desire to learn more about available technologies and strategies to support these reductions

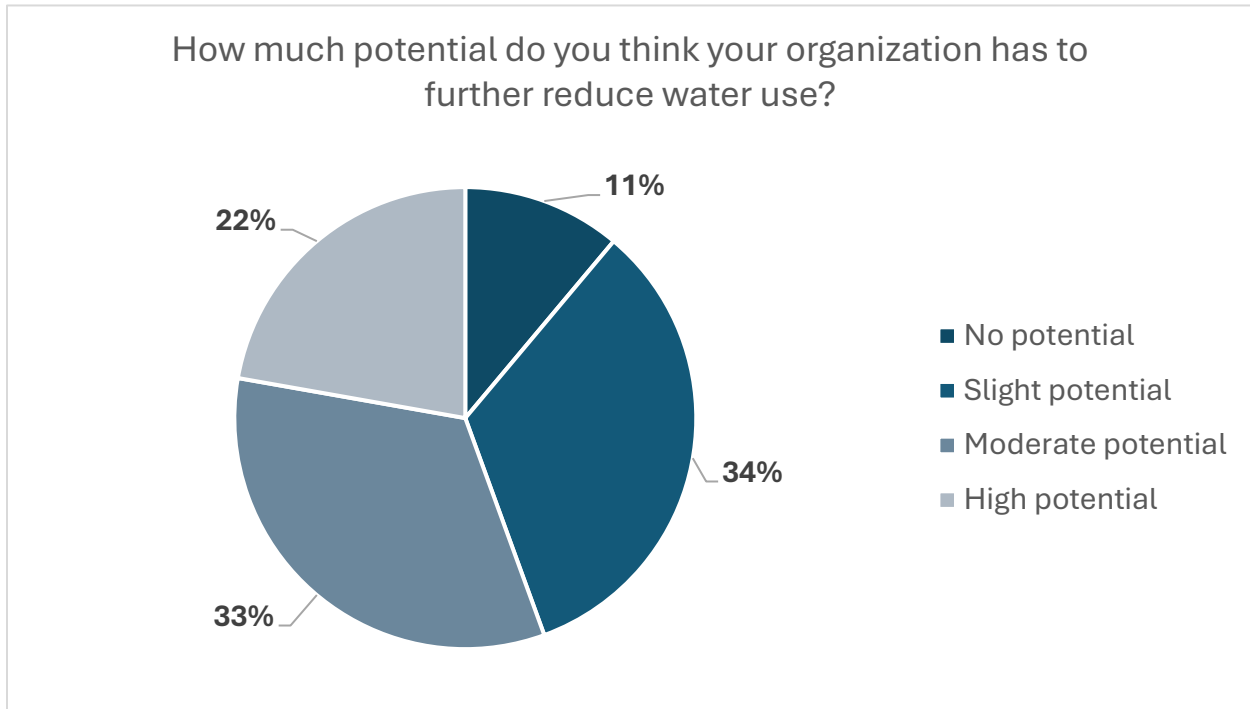


Figure 5. Figure displaying stakeholder responses to an online survey asking, “How much potential do you think your organization has to further reduce water use?”

Stakeholders represent a wide range of industries, each with different starting points, capacities, and priorities when it comes to water use. Progress in implementing water efficiency conservation practices varies based on factors such as company size, available resources, and operational constraints. Tailoring outreach and guidance to reflect these differences—such as through sector-specific case studies, success stories, or technical support—can help ensure that engagement is both relevant and actionable for a diverse set of B & I water use sectors.

4.4.3 Leverage Existing Industry Groups

Engagement efforts highlighted the value of working through trusted industry groups and organizations that already have established relationships with business and industry (B & I) stakeholders. These partnerships can serve as effective channels for outreach, technical

support, and peer learning. Several existing programs and networks offer promising opportunities for collaboration.

- The [Federal Energy Management Program \(FEMP\)](#), in partnership with the U.S. Environmental Protection Agency (EPA), developed 14 water efficiency best management practices to help agencies improve water use and meet federal sustainability goals. These BMPs may serve as a useful reference or framework to build upon existing BMPs and offer another resource or avenue for B & I water use sectors to learn about strategies and opportunities to advance water efficiency efforts.
- In the Great Lakes region, the [Council of the Great Lakes Region \(CGLR\)](#) and [The Water Council \(TWC\)](#) jointly lead [Great Lakes WISE](#) (Water Innovation and Stewardship Exchange)—a peer-to-peer network of cross-sector stakeholders focused on advancing water sustainability performance and best practices. This forum offers a model for collaboration and could be a valuable platform for future outreach, engagement, and education.
- The [Alliance for Water Stewardship \(AWS\)](#) provides a globally recognized standard for water stewardship. Its international framework helps companies and organizations assess, plan, and improve their water practices in a consistent and measurable way.
- [Fresh Coast Climate Solutions](#) works with business and industry to design, develop, and implement water stewardship BMPs, provide water gap analyses and risk assessments, and offers various stakeholder engagement opportunities. The organization recently released [regional gap analysis](#) focused on corporate water stewardship and watershed protection in the Great Lakes. This analysis identifies both challenges and opportunities for advancing water-related sustainability across the region and offers insights that can help guide future program development and collaboration.

Aligning with existing efforts and organizations provides opportunities to build trusted relationships, reduce duplication of effort, and more effectively support the adoption of water efficiency and conservation practices across sectors.

Section 5: Water Efficiency and Conservation Best Management Practices Innovations and Trends

5.1 Introduction

The 2008 BMP documents provide a robust framework for effective water conservation practices across industrial and commercial business in Michigan. In the original documents these practices are referred to as environmentally sound and economically feasible water conservation measures, generally accepted management practices (GAMPs), and best management practices (BMPs). To streamline terminology, all practices to optimize water efficiency and conservation will be referred to as BMPs.

The 2008 BMP documents address practices across the communication, industrial process, domestic water use, and landscape spheres. In addition to a general model, which applies widely across industrial and commercial business sectors, seven industries created industry-specific BMP documents. These industries accounted for more than 80% of water withdrawals in the state of Michigan according to MDEQ's "Water Use Program" at the time of the 2008 BMP document creation (Barr, 2008). These industries are the aggregate sector, beverage industry sector, wet process cement manufacturing sector, chemical manufacturing sector, electric utilities sector, pharmaceutical manufacturing and research sector, and pulp and paper sector. Many of the industry-specific BMPs apply to multiple industries, due to similarities in manufacturing processes or technologies that cool water. These BMPs are a strong foundation to practice water efficiency and conservation within the B & I sector.

Investing in BMPs creates the opportunity to conserve energy in addition to water, as energy consumption is embedded within water production and use. Energy is needed to heat, chill, clean and transfer water among business and industry activities. Reducing water withdrawals and reusing water onsite can increase water efficiency, save energy, and reduce operating costs. The application of these measures varies by industry, but the principles of water recycling and reuse apply across industries. The connection between water efficiency and energy efficiency is increasingly important as changes in climate will increase total precipitation, frequency of extreme weather events, and temperature (Michigan Department of Health and Human Services, 2025). There is also a greater need and responsibility for business and industry leaders to build resilient business models that will thrive in future climate conditions and protect natural resources, such as water, air and the landscape. To this end, environmental tradeoffs between energy intensive and water intensive processes need to be considered from an integrated lens that considered short term performance and long-term impacts. In some situations, energy and water savings coincide, in other situations water efficiency leads to water intensity and vice versa. Throughout this section, there is repeated connection between water efficiency and conservation.

5.1.1 Section Structure

This overview of water efficiency and conservation innovations and trends will include **general BMPs** for Michigan industry and commercial businesses and **industry-specific BMPs** related to the seven industries with the greatest historical water withdrawals (Barr, 2008). The general BMPs listed in this section apply to other commercial businesses and industries, which can include but are not limited to food manufacturing, hospitality, restaurants, education, and retail industries.

5.1.1.1 General Model BMPs

The general BMPs were published in a document titled *Water Withdrawal and Conservation Practices* (General Model BMP document). As previously mentioned, the 2008 BMPs published in this document still apply today, and they are a strong foundation for B & I water efficiency and conservation practices. Innovations in the water efficiency and conservation space build upon these foundational practices through technological advancements. This section is structured to present BMP innovations and trends in relation to the 2008 BMPs. The innovations are structured as follows. A statement from the General Model BMPs will be presented in underlined italics, as shown:

2008 BMP: “Direct statement from original 2008 General Model BMP document.”

Following each *2008 BMP statement*, there will be a description of water efficiency and conservation BMP innovation(s) and/or trend(s) that build upon that foundational 2008 BMP. In some instances, there are innovative BMPs that do not build upon BMPs included in the original 2008 General Model BMP document. These new BMPs will be listed as follows. A new BMP will be presented in underlined italics, as shown:

Beyond 2008 BMP: New BMP that was not included in the original 2008 General Model BMP document.

Following each *Beyond 2008 BMP statement*, there will be a description of the water efficiency and conservation BMP innovation(s) and/or trend(s) that align with the BMP.

The water efficiency and conservation General BMPs apply widely to commercial business and industry. To organize the General BMPs innovations and trends, each innovation is grouped by water efficiency and conservation practice area:

- Employee training and education (Section [5.2.1](#))
- Employ water-free alternatives (Section [5.2.2](#))
- Conduct routine and thorough maintenance of equipment (Section [5.2.3](#))
- Monitor and evaluate water use and efficiency (Section [5.2.4](#))
- Incorporate water efficiency decisions in strategic planning (Section [5.2.5](#))
- Invest in water reuse and recycling (Section [5.2.6](#))
- Capitalize on alternative water sources (Section [5.2.7](#))
- Improve water efficiency of cooling systems (Section [5.2.8](#))
- Improve water efficiency of heating systems (Section [5.2.9](#))

- Implement heat recovery and infrastructure (Section [5.2.10](#))
- Improve facility efficiency and reduce energy needs (Section [5.2.11](#))
- Improve efficiency of domestic water use operations (Section [5.2.12](#))
- Landscaping (Section [5.2.13](#))
- Benchmarking (Section [5.2.14](#))

5.1.1.2 Industry-Specific BMPs

Following General BMPs, Industry-Specific BMPs for the aggregate industry, beverage industry, wet process cement manufacturing, chemical manufacturing sector, electric utilities, pharmaceutical manufacturing and research, and pulp and paper industry sectors are presented in Section [5.3](#). Each sector published a water conservation plan document. The structure of this section mimics the structure of the General Model BMPs Section ([5.2](#)) because most of the 2008 Industry-Specific BMPs still apply today. The water efficiency and conservation innovations and trends expand upon the 2008 BMPs. Therefore, the industry-specific innovations are structured as follows. A statement from the 2008 Industry-Specific BMPs will be presented in underlined italics, as shown:

2008 BMP: “Direct statement from original 2008 Industry-Specific BMPs.”

Following each *2008 BMP statement*, there will be a description of water efficiency and conservation BMP innovation or trend that builds upon that foundational BMP. In some instances, there are BMPs that have not been listed as part of an Industry-Specific BMP. These new Industry-Specific BMPs will be listed as follows. A new BMP will be presented in underlined italics, as shown:

Beyond 2008 BMP: New BMP that was not included in the Industry-Specific BMP documents.

Following each *Beyond 2008 BMP statement*, there will be a description of the water efficiency and conservation BMP innovation that aligns with the BMP.

Many of the Industry-Specific BMPs overlap with the General Model BMPs. This is because the 2008 General Model BMPs apply to many sectors, and each industry adopted and customized industry-specific BMPs from the 2008 General Model BMPs. In these instances, the Industry-Specific sections will refer to the General Model sections. In addition to BMP innovations and/or trends, examples of businesses in Michigan and the Great Lakes region successfully implementing water conservation practices are included throughout the industry-specific BMPs.

5.2 General Model BMPs

5.2.1 Employee training and education

These BMPs relate to the General Model guideline for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement](#)

[manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

2008 BMP: “Incorporate water conservation policies and procedures into employee training programs.”

In addition to incorporating water conservation policies and procedures into employee training programs, water conservation knowledge can be shared with employees to increase awareness. For example, companies can share findings of water audits with employees and strategize how to improve water efficiency in that area of the business or manufacturing process.

2008 BMP: “Participate in water conservation advisory groups or similar organizations.”

Additionally, participation in industry groups and water conservation advisory groups is an effective way to learn about water conservation practices for a region or industry. Details about the following list of active groups are provided in Section [4.4](#):

[Federal Energy Management Program \(FEMP\) – U.S. Department of Energy \(2025a\)](#)

[Council of the Great Lakes Region \(CGLR\)](#)

[The Water Council \(TWC\)](#)

[Great Lakes WISE – jointly led by CGLR & TWC](#)

[Alliance for Water Stewardship \(AWS\)](#)

[Fresh Coast Climate Solutions](#)

5.2.2 Employ water-free alternatives

Water-free technologies differ across industries, yet there are opportunities to implement water-free processes across all industries. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

Air-cooling is applicable to all referenced industries. Water-free cleaning and conveyor systems most commonly apply to [beverage industry](#), [chemical manufacturing](#), and [pharmaceutical manufacturing and research](#) sectors. Industry-specific examples are discussed in Section [5.3](#).

2008 BMP: “Consider replacing water-cooled equipment with air-cooled equipment.”

Air-cooling technology can be used in facility operations and environment control in lieu of water-cooled equipment. Cooling towers are most commonly used to dissipate heat from an industrial process or to cool a building. On a facility-wide scale, wet cooling towers can

be supplemented with dry or hybrid cooling towers, which use no water (dry cooling) or much less water (hybrid cooling) compared to wet cooling tower systems. More information on cooling towers is provided in Section [5.2.8](#).

Beyond the 2008 BMPs: Replace water-based processes with water-free processes

Water-free cleaning processes have the potential to reduce facility water use. Packaging bottles can be cleaned via water-free processes. Ionized air removes contaminants while reducing the total amount of water used in the cleaning process (Inline Filling Systems, 2025). Vacuum and air-pressurized systems are another water-free cleaning method that removes dust and debris without employing water (Goodway, 2025).

Conveyor systems can be newly designed or retrofitted to water-free processes. The use of a dry lubricant eliminates the need for soapy or soluble lubricant solution to make the conveyor belt slick (SKF, 2009). Dry lubricants are useful for conveyor systems that transport PET, glass, cardboard and can containers. Benefits beyond water savings include enhanced operatory safety by reducing slip hazards, lower risk of product contamination from bacterial growth and package degradation by higher moisture content, reduced cleaning costs, and increased conveyor system efficiency due to less maintenance interruptions (SKF, 2009).

5.2.3 Conduct routine and thorough maintenance of equipment

Establishing routine equipment maintenance and operation inspections can extend equipment lifecycles, improve water efficiency, reduce energy consumption, and save costs. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

2008 BMP: “Incorporate water conservation into ISO or other existing QA/QC processes.”

Regular quality control and quality assurance (QA/QC) procedures for equipment and facility processes ensure efficient and effective operations. Water monitoring through routine audit, flow meters, and water quality sensors facilitate routine and hands-off monitoring. Submetering within a facility provides plant operators and building managers with the insight to identify leaks and opportunities for improved water efficiency.

In addition to water quantity and quality tracking throughout the facility, scaling equipment for process load can save water and energy. Retrofitting equipment and/or purchasing new equipment that can be scaled assist in adjusting water use for process load.

5.2.4 Monitor and evaluate water use and efficiency

These BMPs relate to the General Model guideline for industrial and commercial business in Michigan. Additionally, these BMPs relate to the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#),

[pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors, which accounted for over 80% of water withdrawals in 2004 (Barr, 2008).

2008 BMP: “Maintain general water use inventory for the facility and update periodically.”

Accessible technology in the form of flow meters, conductivity meters, and pH meters allow companies to track water flow and quality throughout a facility on a routine basis. Submetering within a facility and using advanced metering infrastructure (AMI) allows for quick and easy monitoring of water throughout a facility, which opens doors for water efficiency improvement and leak identification. Examples of activities or locations where submetering is beneficial for large facilities include

- Cooling tower makeup water and blowdown
- Boiler feed makeup water
- Water supply to hot water systems
- Makeup water to close-water loops
- Manufacturing processes or equipment that utilize high water volumes

5.2.5 Incorporate water efficiency decisions in strategic planning

These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

2008 BMP: “Consider the impact of future facility modifications or production changes on water usage. Changes to routine operations provide a good opportunity to evaluate current practices for possible water conservation opportunities.”

When planning and developing new infrastructure plans or methods of facility operation it is best to work with the local government and water supplier to optimize water efficiency. New infrastructure and/or facility operations will alter water consumption and wastewater volume, and partnership with the local municipality may elucidate designs and processes to enhance efficiency. Additionally, companies can take advantage of public resources to further inform decision making. Some examples of national and global resources with public water and climate data are the United State Geological Survey (USGS, 2025), National Oceanic and Atmospheric Administration (NOAA, 2025), and World Wildlife Fund Water Risk Filter (WWF, 2025). Context and data informed decision-making improves company longevity and success.

Beyond working with local water providers and municipalities, infrastructure design can facilitate opportunities for water efficiency and conservation. Water reuse and recycling technologies pose an opportunity to significantly improve water efficiency on-site for new facilities. Heating, cooling, and water systems need to be intentionally designed with water

efficiency in mind to successfully employ some of the water efficiency best management practices detailed in this document. For example, to operate a water capture and reuse system for a boiler, the steam end-use and boiler system must be close enough to justify condensate reuse from an energy and cost perspective (Strade, 2020).

Another example of intentional infrastructure design is the implementation of clean in place (CIP) systems in beverage, chemical, and pharmaceutical industries. Strategic design should consider the modularity of CIP systems so that systems can be upgraded as technology advances. Furthermore, efficient cleaning processes and the potential for CIP heat waste capture should be considered to improve water and energy efficiency. Implementation of mobile CIP units can also allow for increased flexibility and efficiency as technology advances or facility processes change (Future Bridge, 2025).

5.2.6 Invest in water reuse and recycling

Water reuse within a facility can be applied to most industries. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [beverage industry](#), [chemical manufacturing](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

2008 BMP: “Improve rinse cycles by using cascading or counter-current rinsing from processes that require highly pure water to rinse parts from other processes that do not require such high-quality water.”

5.2.6.1 Clean-in-Place Systems

Clean-in-Place (CIP) systems increase efficiency and present an opportunity to decrease total water use. Rather than taking instrumentation apart for cleaning, CIP systems allow cleaning within a pipeline, bioreactor, fermenter, mixing vessel, and additional equipment. CIP systems typically include the following steps (Mahajan, 2025):

1. First flush
2. Caustic wash
3. Acid wash
4. Intermediate wash
5. Final wash
6. Sanitizing rinse
7. Final rinse or air blow

The number and order of CIP steps depend on the process. Water can be reused between each of these steps. For example, the discharge water from the final rinse can be used for the first flush or the caustic wash, and the intermediate wash discharge may be used in the acid wash. The duplication of water use within a single CIP cycle can reduce the total amount of water used in the cleaning process. Furthermore, CIP water has the potential to be entirely reused after treatment.

Optimizing energy efficiency of CIP systems will also reduce water use. For example, heat waste from CIP systems can be captured via a heat pump. CIP pump speed can be

moderated to match the current demand for peak and off-peak hours, rather than operating at a consistent speed, in order to save energy (Future Bridge, 2025).

5.2.6.2 Packaging

Product packaging preparation and cleaning methods can also be modified to reuse water within the facility. When preparing new containers for packaging a warming step is used to prevent condensation on the containers filled with product. The warmer is commonly warm water that does not come in contact with the product. This water can be reused on site in pre-cleaning stages or in cooling and heating systems.

Used packaging products, like glass and polyethylene terephthalate (PET) bottles, can be reused after cleaning and sterilizing. In Michigan, retailers are required to charge a 10¢ deposit on every single-serve carbonated beverage (i.e. beer, soft drinks, and carbonated & mineral water). Grocery stores that sell carbonated beverages are required to pay back that 10¢ deposit when those containers are returned to the store for recycling (State of Michigan, 2022). Michigan is one of 10 states with a beverage container deposit law (State of Michigan, 2022).

Returned bottles can be cleaned for reuse, reducing energy consumption and waste. The cleaning processes for used bottles incorporates

- Pre-rinsing to remove debris with water that has been treated to lower total dissolved solid concentrations
- Sodium hydroxide wash at 176°F (80°C) to clean bottles and remove labels
- Disinfection with steam or chemical sterilant
- Bottle cooling with water that has been treated to lower total dissolved solid concentrations
- Final bottle rinse water that has been treated to lower total dissolved solid concentrations

Opportunities for water reuse in this process include reusing the final rinse water as pre-rinse water. Steam condensate from the disinfection step can be captured and used in pre-cleaning processes or alternative uses in the facility, such as boiler makeup water. All water reuse operations in beverage and food facilities should adhere to safety guidelines and implementation methods (Agriculture & Food System Institute, 2013).

Beyond the 2008 BMPs: Invest in water cleaning technology to advance water reuse and recycling opportunities within a facility.

5.2.6.3 Zero-Liquid Discharge

Zero-Liquid Discharge (ZLD) is a water treatment process where no wastewater is discharged back to the environment. All wastewater is treated and recycled within the facility. ZLD is plant specific but requires onsite cleaning and water reuse processes to achieve near zero water waste. To accomplish ZLD, facilities must have accurate monitoring for total dissolved solid concentrations, organic matter concentrations and/or

biological oxygen demand and chemical oxygen demand, chemical characteristics of TDS and OM composition, solvents incorporated in solution.

Methods of water treatment included in ZLD technology includes

1. Ultra filtration to remove colloidal matter, bacteria, and viruses
2. Reverse osmosis to remove dissolved inorganic and organic solids through a high-pressure membrane
3. Multiple effect evaporator to remove dissolved solids through evaporation (distillation) process
4. Mechanical vacuum compressor to remove dissolved solids through a pressurized evaporation process
5. Crystallizer to dry water with high concentrations of dissolved solids and capture solids
6. Agitated thin film dryer to dry water with high concentrations of dissolved solids and capture solids
7. Incinerator to burn concentrated wastewater with a high concentration of dissolved solids

ZLD facilities are becoming more popular as water stress and pressure for water conservation rise. While ZLD systems can be used across industries, studies have cited successful use in food and beverage, chemical, pharmaceutical, pulp and paper, textile, steel, and fossil fuels (Rathoure, 2020). Energy consumption in the ZLD process varies based on the method of water treatment, but it can be an energy intensive process. Typically, treatment methods that have the capacity to treat high salinity waters require more energy. The range in electrical energy consumption per thousand gallons can span 7.6 kWh to 147.6 kWh and up to 253.6 kWh in thermal energy consumption from common methods such as reverse osmosis to new technologies like brine concentrators and forward osmosis (Tong & Elimelech, 2019). Energy consumption and water conservation are tradeoffs to consider when choosing the method of water treatment for ZLD in a facility. Furthermore, environmental tradeoffs between water conservation and energy conservation should be considered as a whole when investing in new technologies.

5.2.6.4 Nanofiltration

Nanofiltration is a method of filtering water that has been applied across the food and beverage, pharmaceutical and pulp and paper industries which can aid ZLD operations (Ahmad et al., 2022). Nanofiltration methods consist of water flowing through filters with very small pore sizes of 1 nanometer. Nanofilters can filter out long-chain organic molecules and large, complex salt compounds. The filtering capabilities of nanofiltration make it a very useful technology for leaching wastewater to be reused within a facility (Ahmad et al., 2022). After nanofiltration, water can be reused for processes such as factory or machine cleaning, low pressure steam generation, and irrigation purposes (Ahmad et al., 2022).

5.2.7 Capitalize on alternative water sources

Commercial businesses in all industries have the opportunity to source alternative water for operations. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

Beyond the 2008 BMPs: Utilize alternative water sources for facility activities when environmentally sounds and economically feasible.

Alternative water is a broad term that describes water use in a process that is either recycled, reused, captured, and/or unconventionally sourced (i.e. not direct withdrawal from a natural body of water or purchase of municipal water). In cooling and heating processes, alternative water can include blowdown recovery, recycled water within a plant or condensate recovery (AWE, 2022). Additionally, rainwater capture on-site or outdoor water from fountains onsite can be used as an alternative water source in a cooling or heating process (East Bay Municipal Utility District, 2025).

Furthermore, water from within the plant can be recycled and reused as an alternative water source. Cleaning water can be captured, cleaned, and reused in a cleaning process or transported elsewhere within the facility for use. Water cleaning and reuse applications detailed in the Section [5.2.6](#) describe opportunities to clean and reuse water within a plant as alternative water resource.

5.2.8 Improve water efficiency of cooling systems

Most facilities rely on cooling towers and/or heating ventilating, and air conditions (HVAC) systems for building, facility, and/or process temperature control. These systems frequently use water as a medium to transfer heat into or out of a space or for a process. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

2008 BMP: “Investigate potential chemical treatments to reduce the amount of make-up water required for cooling towers, steam boilers etc.”

2008 BMP: “Consider retrofit applications that use once-through cooling water (chillers, compressors, condensers etc.) which close-loop recirculation systems, while keeping in mind that a decrease in water withdrawal for once-through cooling may increase overall process water consumption.”

5.2.8.1 Cooling Towers

Cooling towers remove heat from a building or an industrial process by evaporation. Large cooling tower systems are common in power plants, manufacturing facilities, and petroleum refineries. However cooling tower systems are incorporated across a wide

spread of business and industry sectors and facility types. Paired with chillers, cooling towers are one the most wide-spread cooling mechanisms to control facility and building temperature and processes. Cooling towers are also incorporated into heating, ventilating, and air conditioning (HVAC) systems to cool large buildings, such as office buildings, hospitals, schools, data centers, and more. Many of the BMPs to advance water conservation in cooling processes relate to improving cooling tower water use efficiency. This section will explore the opportunities to improve cooling tower water use efficiency.

Cooling towers rely on an evaporative heat transfer process. Heat from an air conditioning compressor, chiller, or industrial process is transferred via a heat exchanger the cooling tower in the form of warm water. The warm water is introduced near the top of the cooling tower chamber and met with upward air flow to induce evaporation. The evaporated water rises to ambient air. The remaining water is cooled and condensed at the bottom of the chamber where it is pumped back to the heat exchanger to transfer more heat (AWE, 2022). Not all the remaining water is recycled. A fraction of water droplets remain suspended and are removed from the top of the tower with the evaporated water. The loss of this suspended water is called drift. A portion of the condensed water must be discharged instead of being recycled in the system because the total dissolved solid (TDS) concentration increases in the residual concentration after evaporation. This is called blowdown, and the removal of high TDS water prevents scaling and corrosion within the cooling tower system. Water is lost from cooling tower systems from evaporation, blowdown, drift, and system leaks. To keep the balance of water steady within a cooling tower system, makeup water is needed to replace these sources of lost water:

Makeup water = evaporation + blowdown + drift + leaks/overflow

Makeup water can be considered the cooling tower water use.

Cooling tower water loss and consumption can account for a significant proportion of business and industry site water use. There are opportunities to improve operational efficiencies. Reducing makeup water, blowdown water and leaks are the primary opportunities for water use reduction. Evaporation is a necessary process in a cooling tower and drift is a minor source of water loss. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) requires that cooling towers have efficient drift eliminator that reduce drift to less than 0.002% of recirculated water volume. Water lost to leaks can be limited by routine maintenance checks and monitoring flow. Makeup water can be reduced by increasing the cycles of concentration of water circulating in the cooling tower system. The cycle of concentration refers to the TDS

concentration of water in the tower. A cycle of concentration can be calculated by the total dissolved solid concentration of the water.

$$\text{Cycle of Concentration} = \frac{\text{Conductivity of Blowdown Water}}{\text{Conductivity of Makeup Water}}$$

The relationship between cycles of concentration and water efficiency is the following (AWE, 2022):

1 cycle of concentration: one pound of dissolved solids is discharged as blowdown for every one pound of dissolved solids introduced through the makeup water

2 cycles of concentration: ½ pound of solids is discharged as blowdown for every one pound of dissolved solids introduced through the makeup water

3 cycles of concentration: 1/3 pound of solids is discharged as blowdown for every one pound of dissolved solids introduced through the makeup water, and so on...

Companies have an opportunity to optimize water efficiency by increasing cooling tower cycles of concentration. Water conservation associated with increased cycles of concentration above 6 cycles of concentration is diminished. An increase in cycles of concentration from 3 cycles of concentration to 6 cycles of concentration can reduce the amount of makeup water used in the system by 20% and the amount of blowdown by 50% (U.S. Department of Energy, 2025b).

Increasing the cycles of concentration must be balanced by treating water to maintain the integrity of the cooling tower system and prevent scaling, corrosion, biological growth, and foreign material fouling. Conductivity controllers should be used to monitor blowdown water concentration to measure the total dissolved solid concentration of water circulating within the cooling tower system.

2008 BMP: Investigate potential chemical treatments to reduce the amount of make-up water required for cooling towers, steam boilers etc.

Methods to allow for increased cycles of concentration while preventing equipment degradation include

5.2.8.1.1 Preventing Scaling

Prevent scaling of equipment, which is the deposition of calcium and magnesium salts that damages the cooling tower infrastructure over time. Scaling can be prevented by adding threshold inhibitors to the water that will increase the concentration of dissolved solids which can stay in solution, adding crystal growth modification polymers that alter the formation of dissolved solids so that they stay in solution, or adding dispersants that change the attractive forces between the dissolved solid particles and prevent them from precipitating (AWE, 2022).

5.2.8.1.2 Minimize Corrosion

Minimize corrosion of equipment to preserve equipment integrity. Corrosion reduction can be accomplished by monitoring the pH, biological activity and chemical characteristics of makeup water as the optimal corrosion control method will depend on these factors. Additionally, phosphates, zinc, or organic phosphate water treatment may be applied for corrosion control. Film-forming azoles can also be used to prevent corrosion in heat exchange equipment that contains yellow metals such as copper (AWE, 2022).

5.2.8.1.3 Reduce Foreign Material Fouling

Reducing foreign material fouling degrades cooling tower infrastructure over time. Polymer-based dispersants can be applied to prevent deposition and fouling from scale-forming (calcium and magnesium) and non-scale forming (silt and algae) contaminants. Installing a side-stream filtration system to filter suspended solids from circulating within the cooling tower system will reduce foreign fouling (Duan et al., 2012; U.S. EPA, 2012). For large (>100 tons) cooling tower systems, apply an automatic chemical feed system to control the chemistry of the makeup water. Automatic chemical feed systems should be paired with flow and conductivity monitors to measure the water chemistry (DOE, 2025). Chemical feed systems must be based on the chemistry of the makeup water, blowdown and cooling tower materials.

5.2.8.1.4 Control Biological Growth

Control biological growth within the cooling tower system by introducing oxidizing biocide to breakdown cellular structure and/or a nonoxidizing biocide to interrupt organism metabolism. Biological growth can also be reduced by limiting the amount of sunlight within the cooling tower to reduce biological growth by installing covers on open distribution decks (U.S. Department of Energy, 2025b).

5.2.8.1.5 Material Selection

Material selection of the cooling tower infrastructure can reduce risk of fouling. By choosing corrosive resistant materials higher cycles of concentration a facility can achieve higher cycles of concentration. Materials such as stainless steel, plastic-coated metal, or ceramic extend the lifespan of the cooling tower compared to galvanized metal or epoxy treaded metal.

Additional best practices for cooling tower operation include the following:

5.2.8.1.6 Monitoring and Controlling Water Flow and Water Quality

Water flow and water quality can be monitored and controlled by installing flow meters to measure the inflow rate of makeup water and outflow rate of blowdown can assist with tracking leaks and managing cycles of concentration. Conductivity and pH controllers can also measure water quality and assist in managing concentration cycles to maximize water efficiency while balancing equipment maintenance (AWE, 2022).

5.2.8.1.7 Acid Treatment

Acid Treatment, also referred to as pH control, can help prevent scaling and fouling. The pH of water used within a cooling tower increased with higher concentration of calcium carbonate, which can also cause scaling of equipment. The addition of acid lowers the pH of the water and reduces the likelihood of scaling. Acids such as ascorbic acid, hydrochloric acid, and sulfuric acid can be added to lower the pH (AWE, 2022).

5.2.8.1.8 Ion Exchange/Water Softening

Ion Exchange/Water Softening is a process where hard water (high dissolved calcium and magnesium concentrations) is treated via an ion exchange process, where calcium and magnesium ions are swapped with lower reactivity sodium ions. This process is called softening and reduces the likelihood of equipment scaling by removing the ions which create calcium carbonate (AWE, 2022).

5.2.8.1.9 Membrane-Driven Filtration

Membrane-Driven Filtration includes multiple filtration methods, such as micro-filtration (MF) and ultrafiltration to remove suspended solids and nanofiltration (NF) and reverse osmosis (RO) to remove dissolved solids. This process cleans makeup water and blowdown water for recycling within a cooling tower system.

5.2.8.1.10 Electro-Chemical Water Treatment

Electro-chemical Water Treatment uses electricity to remove dissolved solids. It can be thought of as forced scaling. By sending a current through the water, dissolved ions are pulled to either end of the current, creating an acidic solution at one end and a basic solution at the other end. Calcium and magnesium minerals along with silica will precipitate within the reactor rather than within the cooling tower system.

5.2.8.1.11 Alternative Water

Alternative water sources can include capturing rainwater, recycled or reclaimed wastewater, and blowdown recovery. Recycled or reclaimed water on-site must be cleaned prior to use in the cooling tower system. Additionally, the blowdown water recovery must be cleaned to be used again within the cooling tower system. Air handler condensate can also be captured and used in a cooling tower system. This condensate has been distilled through an evaporation process; therefore it has a low TDS concentration that makes it a clean and useful source of water for cooling tower operations (DOE, 2025).

2008 BMP: “Consider retrofit applications that use once-through cooling water (chillers, compressors, condensers etc.) with closed-loop recirculation systems, while keeping in mind that a decrease in water withdrawal for once-through cooling may increase overall process water consumption.”

Alternative cooling tower designs such as dry cooling towers and hybrid cooling towers reduce water use and employ close-loop systems, where there is no direct contact between the air and water being cooled.

5.2.8.1.12 Dry Cooling Towers

Dry cooling towers use ambient air to dispel heat waste. Rather than relying on evaporative cooling, cool air flows over pipes of water resulting in a heat exchange where the warm air rises out of the cooling tower. Dry cooling towers are typically larger than wet cooling towers that cool at the same capacity because water has greater heat capacity than air, allowing heat to dissipate at a faster rate when water is used as a transfer medium. However, these systems can result in significant water savings and reduce air pollution. Dry cooling tower installation is also a method of employing water-free technology.

5.2.8.1.13 Hybrid Cooling Towers

Hybrid cooling towers also termed adiabatic cooling towers, are another method improving water efficiency. Hybrid cooling towers contain both wet and dry cooling systems and can function in wet mode or dry mode. When ambient temperatures are warm, the system functions in wet (pre-cooler) operation, where warm air is drawn into the adiabatic chamber and moisture is introduced to the air to cause evaporation and lower the air temperature and dissipate heat through evaporation. When temperatures are cooler, the system functions in dry mode, where the cooling tower functions as a dry tower and removes heat via convection (AWE, 2022).

Due to the multifaceted setup, the overall amount of water is reduced. An adiabatic cooling tower system will also limit the total amount of energy and costs associated with water treatment for the cooling system, however more energy may be used when operating in dry mode depending on the ambient temperature. In low ambient temperature conditions the system can undergo “free cooling” where the air in the central chiller is cool enough due to ambient conditions so that no additional air exchange or cooling mechanism is needed to cool the circulating water via a heat exchange process (Fosco, 2015). An adiabatic cooling system is a good opportunity capitalize on ambient temperature for energy and water savings in Michigan, where seasonal temperature swings allow for “free cooling” in late autumn – early spring months.

5.2.8.1.14 Water-side and Air-side Economizers

Water-side economizers increase the water efficiency of a chiller and reduce the load on a cooling tower. Chillers typically utilize water as a transfer medium to remove heat from a building or process. The warmed water containing waste heat is transferred to a heat exchanger so that the heat can be released via a cooling tower. A water-side economizer reduces the energy load and water consumption in this process. If the ambient temperature is cool and dry enough a water-side economizer can be used so that the to be chilled water (warm water) can be cooled by the cooling tower condenser water, eliminating the need for the chiller. This can save both energy and water (Energy Star, 2025a).

An air-side economizer can also be installed to cool large buildings and reduce energy and water needs. An air-side economizer brings in cool ambient air to distribute to building to servers in the building ventilation system. The warm air from the building is expelled outdoors rather than being cooled. Air-side economizers reduce the need for water in the cooling process and take advantage of ambient conditions, which allow for “free cooling” (Energy Star, 2025b)

5.2.8.2 Chilled water systems (chillers)

Chilled water systems (chillers) remove heat from a process by circulating cold water to capture and transfer heat. Chillers function by flowing cold water through a closed loop (i.e. water is not gained or lost) or water/air is used to remove heat from a condenser. Air cooled chillers use ambient air to lower refrigerant temperature and transfer heat, while water cooled chillers use water as a heat transfer mechanism to reduce the temperature of the refrigerant. Air cooled systems significantly reduce the water used but can require more energy. An industrial scale water cooled chiller system can be, but not always, connected to a cooling tower to remove the water heat. Following cooling tower best management practices will reduce water needs associated with cooling spaces or heat waste from manufacturing processes.

Best management practices for water cooled chillers include the following activities.

5.2.8.2.1 Optimize Chiller Efficiency

Optimize chiller efficiency by mitigating the temperature difference between chilled water and the condenser loop of the chiller. Chillers can be turned off when not needed, and variable speed control can be applied to circulation motor pumps to adjust chilling with load, conduct routine maintenance (U.S. EPA, 2012b). Measures to increase efficiency will also save on energy use and affiliated water and energy costs.

5.2.8.2.2 Reducing the Demand on Chiller Systems

Reducing the demand on chiller systems by lowering the cooling needs in a facility and results in water and energy savings. Chiller demands can be reduced by not cooling locations where employees do not routinely work or utilizing cool water from other on-site use to temper water before entering the chiller.

5.2.9 Improve water efficiency of heating systems

Businesses across industries require heating needs for operations and facility temperature control purposes. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

2008 BMP: Investigate potential chemical treatments to reduce the amount of make-up water required for cooling towers, steam boilers etc.

5.2.9.1 Boilers

Boilers are used to heat water for facility and/or process control. Boilers also produce steam for manufacturing and cleaning processes within facilities. There are multiple types of boilers, including hot water boilers and steam boilers. Hot water boilers are used to heat water, while steam boilers produce steam. Boilers can either be low-pressure, typically used in commercial application for water heating, or high-pressure, typically used in industrial settings or for power generation (U.S. EPA, 2012c; East Bay Municipal Utility District, 2008).

Hot water boilers heat water for a specific use in a facility, such as cooking or cleaning, or are used as a method of temperature regulation (heating). A hot water boiler for specific facility activities operates as an open system, meaning water is not recycled but exported for its end use. A hot water boiler for temperature regulation operates as a closed loop, where hot water is cycled and undergoes air heat-exchange to warm a location. Improved water efficiency for hot water boilers can be achieved with proper equipment and pipe maintenance.

Steam boilers release steam to the environment which can either be discharged to the sewer, reused in the facility or recycled. If water is discharged to the sewer, cooler water is needed to temper (reduce the temperature) of the wastewater prior to sewer discharge. When water evaporates within the boiler, dissolved solids remain, increases the total TDS concentration of the residual water. Similar to cooling tower systems, high TDS concentrations can result in equipment corrosion. To combat corrosion, high TDS water is removed by blowing it down and replacing it with make-up water that has a lower TDS concentration. Introducing make-up water in the boiler water to dilute the TDS concentrations and prevent corrosion.

2008 BMP: “Investigate potential chemical treatments to reduce the amount of make-up water required for cooling towers, steam boilers etc.”

The **chemical treatment processes** detailed under Cooling Towers applies to water treatment to boiler systems. **The quality of water** introduced and maintained within a boiler system is dependent on the final use of water (i.e. heating water for temperature control or manufacturing process). Water quality can be tracked with conductivity meters, pH meters, and routine laboratory testing to ensure it minimizes fouling and meets the requirements of process.

Monitoring water chemistry can allow a facility to increase the **cycles of concentration** of water cycling through a boiler system to the optimum level for the boiler water use and materials. A description of cycles of concentration and optimization is provided in the Cooling Towers section.

Water condensate capture and reuse reduces the total amount of water needed to operate a boiler system because (1) water is recycled and (2) the amount of water needed to temper discharge steam is significantly or fully reduced (U.S. EPA, 2012c). Since the condensate is essentially distilled water, the total dissolved solids concentration is very

low and little to no cleaning of the condensate is needed before being introduced back into the boiler system. Furthermore, the reuse of condensate within the boiler system can reduce total energy needs because the water is at a higher temperature, less energy is needed to meet the boiling point.

Infrastructure difficulties might arise when attempting to retrofit a steam reuse solution. For example, it is difficult to implement steam reuse on-site if a boiler location is distant from the facility operation where steam may be reused. However, there are opportunities to consider these design implementations when building and developing new plants, which relates to a best management practice of water efficiency and conservation in infrastructure planning.

Expansion tanks can be used to temper hot water if wastewater is discharged rather than reused within the facility. An expansion tank eliminates the need for cool water to temper the water prior to discharge to sewer system or body of water.

5.2.9.2 Hot Water Systems

Hot water systems are used to heat water for building domestic uses, laundry, dishwashing, and manufacturing processes. Best management practices for hot water systems include the following.

Efficient water heating systems save both water and energy. When water is heated efficiently, less energy is used in the process to heat the water. Additionally, less energy is used to pump water through the pipes because less cool water is needed to be pumped through pipes before the water is fully heated. Energy Star provides guidance for commercial water heaters (Energy Star, 2025c). Well insulated pipes will allow water to retain heat when traveling from the heater to the end-user, improving both water efficiency and energy efficiency.

In large commercial buildings a hot water recirculation system can be used to continuously pump hot water through a building. This circulation system reduced the distance that hot water needs to travel to the end-user. This process improves overall water efficiency because the water meets the desired temperature quicker.

Alternatively, large buildings can install tankless water heaters to provide instant hot water. While more water efficient, tankless water heaters are limited by water flow and are most appropriate for localized domestic uses (U.S. Department of Energy, 2025c).

5.2.10 Implement heat recovery infrastructure

In many industries waste heat is generated through a manufacturing process or cooling process. The waste heat can be captured and utilized to reduce both water and energy needs. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

Beyond the 2008 BMPs: Install heat recovery infrastructure to capture and reuse heat within the facility when environmentally sound and economically feasible.

Heat pumps can capture waste heat prior to water entering the cooling tower (U.S. Department of Energy, 2023). Heat pumps are a mechanism to remove heat from a system and can be implemented in facility cooling or heating system to utilize the heat elsewhere in the building. Installing a heat pump in a cooling system with a cooling tower reduces the cooling load for the tower and allows the heat to be used elsewhere in the building. Additionally, a heat pump can be installed as part of a boiler or a heating system to capture excess heat.

Heat can be used for building temperature control, heating domestic water. Combined heat and power systems can also capture waste heat from the system combustion turbine, which can be used to regenerate a desiccant system to remove humidity from the building, thereby lowering the latent heat load. Reducing humidity and lowering latent heat within a building can allow for energy savings when heating a building in a cooler climate, such as Michigan.

5.2.11 Improve facility efficiency and reduce energy needs

Improving facility efficiency and reducing energy needs can be addressed through revising operating procedures and reducing the cooling and heating needs in a facility. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

2008 BMP: “Install flow restrictors, aerators, spring-loaded valves and timers on faucets and nozzles.”

Companies can invest in high pressure, low volume spray nozzles to efficiently use water for manufacturing processes. Building upon this BMP in an operational capacity, ensuring the size of the equipment is appropriate for the activity will improve water efficiency. When equipment is oversized for a process, both water and energy are wasted. Refining equipment use as process loads change within facilities will increase efficiency.

Furthermore, equipment can be retrofitted to improve efficiency. For example, liquid ring vacuum pumps can be replaced with mechanical seal pumps, which reduce water use and elongate the life of the pump. Common seal methods are gland packing seal methods and single mechanical seal methods. Gland packing seals are seals comprised of compressed and lubricated materials packed around a pump to form a seal. Single mechanical seals are comprised of a hard and soft rotating and stationary face supported by a lubricant to form a seal. Both gland packing seals and single mechanical seals can induce high water use to keep the seals cool and control leakage issues (Amory, 2021). Employing mechanical seal technology can reduce water use by negating the need for cooling and flush water requirements, which are needed in gland packing seal methods and single mechanical pumps (Sorvoja, 2024). Seal face technology also reduced energy

consumption and increased energy efficiency by reducing friction around the pump. Furthermore, mechanical seal face pumps have a longer lifetime because of the reduced friction and debris capture (Sorvoja, 2024). Pump replacement can apply to most industries but this BMP is specifically noted in [pharmaceutical](#), and [pulp and paper](#) industry BMPs.

2008 BMP: “Shut off faucets and nozzles when not in use.”

To further enhance water efficiency, invest in industrial smart sensor faucets and nozzles that will adjust water use to washing needs and automatically turn off the faucet or nozzle when not in use. Investment in water-efficient general cleaning equipment can improve facility efficiency as well. These include water efficient equipment like high pressure washers, industrial scrubbers, steam cleaners, spray-and-vacuum machines. Water free cleaning equipment includes industrial sweepers and industrial vacuums.

Beyond the 2008 BMPs: Improve facility efficiency and reduce energy requirements to minimize water consumption for environment control.

A reduction in facility energy needs can improve water savings by reducing the amount of water needed for cooling and heating systems. There are multiple ways to reduce energy needs, including practical methods and innovative technologies.

Reduce heating and cooling needs in locations that do not need specific temperature control. This can include relying on ambient temperatures or moderating the set temperature indoors.

Geothermal infrastructure reduces the need for water use for facility cooling and heating operations by modulating building temperatures year-round. Geothermal systems rely on stable ground temperatures to cool or heat air prior to circulation through a building. The implementation of a geothermal system can reduce heating or cooling needs within a facility, as the ground temperature in Michigan will remain approximately 55°F throughout the year (City of Ann Arbor, 2025a).

5.2.12 Improve efficiency of domestic water use operations

In all business and industry facilities water is used for domestic purposes. Installing efficient toilets, urinals, faucets, and shower heads, can improve domestic water use in facilities. Fixtures must meet standards of the Michigan Plumbing Code, which is based on the International Plumbing Code, 2021. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

2008 BMP: “Replace continuous- or timed-flush urinals in restrooms with low-flow manual flush or sensor-controlled equipment. This can be as simple as retrofitting the flush valve with a new spring and diaphragm.”

2008 BMP: “Replace older toilets that use as much as 22 litres per flush with ultra-low-flush toilets (6 litres per flush) or dual-flush (6 litres for solid waste, 3 litres for liquid waste).”

2008 BMP: “In new installations consider waterless urinals, which do not consume any water (eliminating water supply lines and flush valves), are easy to install and meet public health standards.”

Beyond 2008 BMPs: Install water efficient shower heads.

Beyond 2008 BMPs: Install water efficient faucets.

Efficient domestic water fixtures save water and money. The appropriate fixture of appliance for a facility is dependent on the intended use and frequency of use. EnergyStar energy efficient and WaterSense water efficient products can provide significant water and cost savings (WaterSense, 2025). The WaterSense website provides a list of certified products that meet the label standards.

- Toilets: maximum flush per gallon 1.6 gal (6 litres)
- Flushometer-Value Toilets: maximum flush per gallon 1.28 gal (4.8 litres)
- Urinals: maximum flush per gallon 0.5 gal (1.9 litres)
- Showerheads: maximum flow rate (gpm): 2.0 (7.6 litres per minute)
- Bathroom faucets maximum flow rate (gpm): 1.5 (5.7 litres per minute)

Appliance efficiency and water conservation considerations when replacing or adding domestic water fixtures advance water efficiency on-site.

5.2.13 Landscaping

Most businesses and industries include on-site landscaping at facilities. Improving outdoor water efficiency can lead to high water savings for a facility. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

2008 BMP: “Install soil-moisture sensors and controllers.”

2008 BMP: “Install drip irrigation to reduce water use in landscape areas.”

2008 BMP: “Use more drought-tolerant native vegetation.”

2008 BMP: “Install trigger-heads or nozzles on hoses and devices used for cleaning and watering.”

These BMPs apply to the [aggregate](#), [beverage](#), [cement](#), [chemical](#), [electric power](#), [pharmaceutical](#), and [pulp and paper](#) industries.

On-site landscaping can take high volumes of water, particularly during the growing season in Michigan. Building upon the 2008 BMPs, there are multiple practices that can

improve outdoor water use efficiency and reduce the outdoor water use needs. Outdoor water use efficiency can be improved by submetering onsite to more easily identify leaks in irrigation systems. Water efficiency can also be improved with routine maintenance. Investing in weather-based irrigation controls can reduce the need for watering in already wet conditions. Early morning watering or evening watering will prevent excess evaporation, increasing the amount of water the landscape receives and reducing total water needs. Additional methods of reducing water needs include implementing xeriscaping, which is a combination of hardscaping and native vegetation that requires little to no irrigation (U.S. EPA, 2012d).

5.2.14 Benchmarking

Benchmarking is the process of comparing business or industrial processes to industry best management practices. Companies can take advantage of water and energy benchmarking processes internally to improve processes or external metrics and reporting platforms to gauge water and energy efficiency. These BMPs relate to the General Model BMP guidelines for industrial and commercial business in Michigan as well as the [aggregate industry](#), [beverage industry](#), [wet process cement manufacturing](#), [chemical manufacturing](#), [electric utilities](#), [pharmaceutical manufacturing and research](#), and [pulp and paper](#) sectors.

Beyond 2008 BMPs: Conduct internal and external benchmarking to evaluate water use efficiency within a facility and across the business.

The three most common ways to use benchmarking are

1. Compare a facility to an average or median for the industry type or company facilities
2. Show variation among industry or company benchmark data for different facilities to rate efficiency
3. Track industry or company benchmarks over time to identify trends

All these uses of benchmarking data provide direction to improve water efficiency and cost saving endeavors. Many companies headquartered in Michigan or with facilities in Michigan benchmark internally and externally. For example, PepsiCo (2025) utilizes internal (within company) benchmarking to improve water efficiency operations across food and beverage production facilities. They company also benchmarks against peers in the food and beverage industry to improve performance. National and local benchmarking programs exist to facilitate benchmarking efforts across industries and geographies. Energy benchmarking has a more robust structure compared to the water benchmarking industry. Due to current efforts in the water efficiency sphere, water use benchmarking is growing.

Benchmarking can be thought of as a fraction, where the numerator is the B & I company process, and the denominator is the comparison metric. For water efficiency this looks like

$$\frac{B\&I \text{ company water efficiency}}{\text{Water efficiency comparison metric}}$$

The value of benchmarking is embedded within the comparison metric, because the benchmark does not report the actual progress of the company if an unfitting metric is used for comparison.

5.2.14.1 Comparison Metrics

Most water benchmarking is conducted in units of gallons per square foot of building floor space per year (gal/sq. ft./yr), this metric is termed water use intensity (Energy Star, 2025d). This benchmark can be misleading when providing a direct comparison among large empty spaces (e.g. a warehouse) compared to a production space (e.g. a commodity manufacturing plant) or a populated facility (e.g. a hospital). Water efficiency can be benchmarked with other metrics, like gallons per person per day, per room, dwelling unit, seats or bed per day. The table provides an example of potential comparison metrics by facility type

Table 8. List of comparison metrics as a function of the activities at the facility, as a metric of the facility itself, and people who use or work at the facility. Table modified from Kiefer et al. (2015) and U.S. EPA (2024)

Facility Type	Function Metric	Facility Metric	Other People Metrics
Manufacturing	Units of Product Produced, Dollars Produced	Square Feet, Number of Pieces of Equipment	Employees
Automotive Shop	Vehicles Serviced	Square Feet, Number of Bays	Employees
Office	Employees, Visitors	Square Feet	–
School	Students	Square Feet	Faculty, Staff
Healthcare	Patients, Discharges, Out-Patients, Patient Nights	Beds, Square Feet	Employees
Commercial Laundries	Pounds of Laundry	Washer Capacity, Square Feet	Employees
Restaurant	Meals Served	Number of Seats, Square Feet	Employees, Customer
Hotel/Lodging	Guests	Rooms, Square Feet	Employees
Retail	Transaction, product	Square Feet	Customer, Employees
Service	Service Provided	Square Feet	Employee
Warehouse	–	Square Feet	Employee
Data Centers	Water use effectiveness	Square Feet	–

5.2.14.2 Benchmarking Factors

There are multiple factors that will contribute to differences in water use and efficiency among companies. These factors will inherently influence benchmarking data, potentially making a company or facility look competitive compared to the metric.

Climate zones will impact water use for irrigation, cooling, and heating purposes. Water used for temperature control—boiler heating systems and chiller cooling systems—will

differ based on climate. The seasonal temperature changes of Michigan may require a company to use more water to moderate temperatures within a building compared to a building located in a milder climate. Conversely, the seasonality of Michigan reduces the need for outdoor irrigation water use all year, where this might be needed in a state with a year-round growing season.

Variations across industry will also impact benchmarking metrics, as not all facilities across and industry function the same. For example, product generation within a similar industry may require different amounts of water for production. Amenities offered by a hospitality industry or office building will also differ and affect the total amount of water used on site (Kiefer et al., 2015).

Equipment and facility age will also impact water use and efficiency. Older equipment and facilities might be less efficient than newer facilities. Facility and equipment maintenance will improve lifespan and efficiency. However, newer facilities with advanced technology have the potential to further increase water savings.

5.2.14.3 National Benchmarking Tools & Resources

Tools

In 2024, the US EPA released a benchmarking guidance report, which provides in-depth detail on benchmarking strategies and provides previously reported water use intensity metrics across industries (U.S. EPA, 2024).

On a national scale, US EPA Energy Star Portfolio Manager Program (Energy Star, 2025e) provides a free benchmarking platform for business and industry to assess energy use, water use, waste, and materials and emissions. Property type categorizations include the following as of 2025:

- Data Center
- Hotel
- Hospital
- K-12 School
- Multifamily housing
- Retail
- Warehouse
- Wastewater
- Worship Facility

As of 2024, the EPA Energy Star Portfolio Program Manager Program included over 300,000 properties across the United States for energy, water, an/or waste and materials benchmarking.

The Laboratory Benchmarking Tool (LBT, 2025) is another national tool to track water use and energy use in laboratories across the United States. Supported by the International Institute for Sustainable Laboratories, this tool has provided peer benchmarking for 1327 facilities as of 2025.

Published Public Resources

The U.S. Energy Information Administration’s Commercial Buildings Energy Consumption Survey (CBECS) published a Commercial Buildings Energy Consumption Survey in 2018, which provided energy and water use data for commercial buildings across the country (U.S. Energy Information Administration, 2022). This report provides water use data for commercial buildings from 2012 – 2018.

The U.S. Department of Energy (DOE) Better Buildings® Initiative provides a platform for business and industry leaders to voluntarily share energy and water use benchmarking efforts (U.S. Department of Energy, 2025d). This program aims to improve the efficiency of buildings and share potential energy, water and cost savings. The Water Savings Network provides resources for industry water savings, water efficiency planning and operations, and an opportunity to join the network (U.S. Department of Energy, 2025e).

Michigan City Benchmarking Efforts

The Institute for Market Transformation (IMT) provides a map that denotes states and cities that have benchmarking requirements (Institute for Market Transformation, 2025). Within the state of Michigan, Ann Arbor and Detroit have benchmarking requirements for public, commercial, and multifamily buildings.

As of 2025, the City of Detroit has required all commercial and family buildings greater than 25,000 square feet to annually report energy and water use (City of Detroit, 2025). Detroit utilizes the US EPA Energy Star Portfolio Manager Program to aid in standardization and reporting, so that the local effort coincides with national standards (Energy Star, 2025e).

Since 2021 Ann Arbor has required commercial and campus buildings to provide water and energy data for city-wide benchmarking through the Energy and Water Benchmarking Disclosure Ordinance (City of Ann Arbor, 2025b). As of 2025, buildings larger than 20,000 square feet are required to report metrics using the US EPA Energy Star Portfolio Manager Program (Energy Star, 2025e). The benchmarking program aids business and industry partners in measuring efficiency among peers.

5.3 Industry-Specific BMPs

This section focuses on the seven industries that published an industry-specific water conservation plan with best management practices in 2008 (State of Michigan, 2025b). The framing of this section mimics Section 5.2 and is described in Section 5.1.1. As mentioned in Section 5.1.1, many of the Industry-Specific BMPs overlap with the general BMPs. This is because each industry adopted and customized industry-specific BMPs from the General Model. Therefore, many Industry-Specific innovations and trends relate to the General Model innovations and trends. In these instances, the Industry-Specific innovations refer to the General Model BMPs (Section 5.2). In addition, BMP innovations, examples of businesses in Michigan and the Great Lakes region successfully implementing water conservation practices are included throughout the industry-specific BMPs. This section

also includes examples of innovative water efficiency measures taken by companies in Michigan and the Great Lakes region.

5.3.1 Aggregate Industry

Water is used in aggregate mining and production for aggregate washing and dust suppression. Wastewater from aggregate washing is commonly transferred to a settling pond to allow for suspended solids to settle out of the wastewater. Settling ponds lose water via evaporation and can be an environmental hazard because of subsurface leaching or overflow. Furthermore, settling ponds require large volumes of makeup water during the settling and excavating process. Clarified water from these ponds is sometimes reused for aggregate washing process depending on local regulations.

5.3.1.1 BMPs

2008 Aggregate Industry BMP: “Minimize water discharge to what is needed to keep the facility operating.”

The first step to identifying opportunities for water savings is to conduct a water audit to quantify water use and inspect equipment to ensure that it is functioning properly. For example, excess water may be used during the aggregate spray and cleaning stages. Using high pressure, low volume spray nozzles and flow restrictors to reduce unnecessary high water volume will increase efficiency and water savings (New Hampshire Department of Environmental Services, 2020). Additionally, investing in recycled water processes and/or water-free processes will reduce facility water consumption and discharge. Recycled water can be used for stone cutting operations to reduce total water consumption discharge. Water-free methods, such as dry sorting techniques, can be used as well. Dry sorting techniques examples are dry vibrating or conveyor systems to separate the aggregate can be installed rather than using water-based systems (New Hampshire Department of Environmental Services, 2020).

Water use can further be reduced on site by installing water settler/clarifier systems to minimize reliance on settling ponds. Settler/clarifier systems introduce a formulated polymer to induce flocculation (clumping) of fine particles in the wastewater, which allows these particles to more easily be filtered out. Solid aggregate waste can be repurposed on-site and clarified water can be reused for aggregate washing (Kuhar, 2024).

2008 Aggregate Industry BMP: “Use process water in spray bar systems and for dust suppression to optimize water usage when practical.”

In addition to using process water for dust suppression, the amount of water needed for dust suppression can be reduced by minimizing areas for truck traffic and parking and minimizing the areas which have no vegetation by planting native vegetations on areas that are not mined.

5.3.2 Beverages Industry

The beverage industry includes bottled water, non-alcoholic beverages and alcoholic beverages. The water used in the beverage industry extends beyond the water bottled to make the product. Water is used in the crop growing, manufacturing, and cleaning processes. Many of the BMPs for the Beverage industry align with the chemical and pharmaceutical industries.

5.3.2.1 BMPs

2008 Beverage Industry BMPs: “Optimize waste use reducing production ‘runs’ management and Clean-In Place (CIP) practices within beverage production facilities.”

CIP Systems optimize maintenance efforts, energy, and water for processes in the beverage industry. Recycling water within a CIP system improves water conservation. Additionally, ensuring that the size of the process traps used in CIP cleaning processes are appropriate will ensure process and water efficiency, product quality, and product safety (Forbes Marshall, 2025). Beyond ensuring the appropriate size of equipment, optimizing the cleaning time and volume of chemical cleaning solution can result in energy savings. If excess cleaning time and solutions are employed in the cleaning process, energy consumption associated with mechanical cleaning and waste solution treatment will increase in association with utilizing CIP systems (Bowler et al., 2023). These systems can be optimized through testing or more complex modeling methods. Navigate to Section [5.2.6](#) to learn more about CIP and water reuse BMPs.

2008 Beverage Industry BMPs: “Install Flow restrictors, aerators, spring-loaded valves and timers on faucets and nozzles as appropriate.”

Spray devices, which spray the side of the vessel with cleaning solutions, are commonly incorporated into CIP systems for vessel cleaning. Static spray balls with high flow, low pressure can decrease efficiency. Switching static spray balls out for cleaning machines—low flow, high pressure fixture—or rotating spray heads—low flow, medium pressure fixtures—can improve water use and efficiency. In general, CIP cleaning machines are more efficient and have a greater cleaning impact than other cleaning methods.

2008 Beverage Industry BMPs: “Use chemical treatments when possible to reduce the amount of make-up water required for cooling towers, steam boilers etc.”

Cooling towers, steam boilers, and other temperature control devices are used in beverage facilities. There are multiple methods to increase cooling tower and boiler efficiency, including increasing cycles of concentration, recycling water, and reducing energy needs. If steam boilers are used to produce steam for a production process, steam water quality must meet production standards for safety and water quality monitoring should be routinely conducted if water is being recycled. Navigate to sections [5.2.8](#) and [5.2.9](#) for more information on cooling towners and steam boilers.

Beyond the 2008 Beverage Industry BMPs: Implement steam, heat, and energy capture when environmentally sounds and economically feasible.

Beverage companies need to cool machinery in the manufacturing process and need to keep products cool. Heat is a byproduct of the cooling process, and it is a valuable resource to utilize elsewhere in the plant to save both energy and water. Cooling is either accomplished via a chiller compressor, water, or ambient air. Heat can be captured via a heat pump and reused for other processes, such as preheat boiler makeup water.

In turn, boiler steam can be condensed and captured to return to the boiler or used elsewhere in the facility. Steam can also be recycled in the boiler system via a steam condensate pump. Since the condensate is already at a higher temperature, less energy is needed to transform the water back to steam. Navigate to Section [5.2.10](#) for more information on heat recovery infrastructure.

Beyond the 2008 Beverage Industry BMPs: Utilize water-free technology when environmentally sounds and economically feasible.

Cleaning water-based methods may be replaced with water-free methods to reduce water consumption and discharge. In the beverage industry, CIP methods can incorporate forced carbon dioxide (CO₂) to clear pipelines and instrumentation in lieu of water.

Furthermore, bottles can be cleaned via water-free processes. New bottles may be cleaned with ionized air rather than water to prepare the bottle for the product (Inline Filling Systems, 2016). A typical container cleaning process for the beverage and food industry will include:

1. Rinse the container with water or gas
2. Detergent wash (as needed)
3. Rinse with water or gas
4. Drain liquid
5. Dry the container

By rinsing new product bottles, ionized air, rather than water, contaminants can be effectively removed from the packaging and water can be saved (Bower, 2017). All package washing procedures must align with the U.S. Food and Drug Administration (FDA) sanitary guidelines for pharmaceutical, food, and beverage guidelines.

Conveyor systems used to bottle and transport products within a beverage facility can utilize a dry lubricant instead of a soapy solution to keep the conveyor belt slick but reduce the total amount of water use. Navigate to Section [5.2.2](#) for more information on water-free conveyor systems and cleaning operations.

An additional way to utilize water-free technology is to implement expansion tanks in heating systems. Steam boilers are used for multiple cleaning and heat generating processes within the beverage industry. If steam boiler condensate is discharged instead of recycled, utilize an expansion tank to temper hot condensate instead of adding cool

water to the condensate to temper it prior to sewer discharge. Navigate to Section [5.2.9](#) for more information on expansion tanks.

Beyond the 2008 Beverage BMPs: Reuse water and maximize alternative water sources on site.

Water reuse in a beverage plant may involve water reuse from cooling tower operations (blowdown), capturing storm water or landscape irrigation, or water reuse within the plant. Condensed steam from boiler operations can be recycled for boiler use or utilized elsewhere in the building. Additionally, water can be cleaned and reused on site for toilet and urinal flushing. Navigate to Section [5.2.6](#) for more information on water reuse and recycling.

Zero-liquid discharge (ZLD) technology can be employed in a beverage plant. For example, in distillery operations there are several methods of wastewater treatment that ZLD methods can accommodate through reverse osmosis and multiple effect evaporators:

1. Bio-methanation; reverse osmosis and multiple effect evaporator; incineration
2. Bio-methanation; reverse osmosis and multiple effect evaporator; drying
3. Concentration with multiple effect evaporator; coprocessing in cement/thermal power plant
4. Bio-methanation and reverse osmosis; multiple effect evaporator; bio-composting

Navigate to Section [5.2.6](#) to learn more about cleaning water with ZLD technology and on-site reuse.

5.3.2.2 Example

Terra Firma Brewery

Terra Firma Brewery is located in Traverse City, Michigan. This craft brewery is part of the growing craft beverage industry in Michigan, where the Michigan Craft Beverage Council acknowledges 769 craft beverage businesses as of May 2025 (Michigan Department of Agriculture and Rural Development, 2025). Terra Firma seeks to lead the way in sustainable brewing endeavors. The brewery is not hooked up to the municipal water system. It relies on water capture and on-site water reclamation for beverage processing. The brewery employs water reuse from brewing processes in addition to heat capture and reuse from brewing processes. More than 500 thousand gallons of water from manufacturing for irrigation and fertilization use on farm crops.

5.3.3 Wet Process Cement Manufacturing

Cement can be made through two processes: a wet process and dry process. The wet cement process mixes dry ingredients of limestone, sand, clay, iron ore, flu ash and alternative raw materials with water to create a slurry that is dried in a kiln (American Cement Association, 2025). After it is dried in a kiln the cement is formed into clinker and mixed with additional additives to form cement. Cement is commonly used to form

concrete, but it can be used in other processes as well. In addition to the general BMPs, the Cement Manufacturing Industry has three additional water conservation strategies.

5.3.3.1 BMPs

2008 Wet Process Cement Manufacturing BMP: “Maintain a general water use inventory for the facility and update annually or as needed following change management procedures.”

Advanced metering infrastructure (AMI) and robust data analysis tools allow for consistent monitoring of water flow and continuous analysis of flow data to better track water used in a cement manufacturing facility. Monitoring can help identify opportunities for improved efficiency or leaks. Navigate to Section [5.2.4](#) to learn more about monitoring and evaluating facility water use.

2008 Wet Process Cement Manufacturing BMP: “Re-use waste process water for truck washing and dust suppressant.”

2008 Wet Process Cement Manufacturing BMP: “Use of Storm water and quarry dewatering for road watering and storage pile dust suppressant.”

Building upon these BMPs, water needed for dust suppressant on road and around the facility can be reduced by minimizing road space and truck traffic area. Additionally, native grasses can be planted in locations with no mining activity to reduce dust.

2008 Wet Process Cement Manufacturing BMP: “Shut off faucets and nozzles when not in use.”

Retrofitting industrial faucets and nozzles with smart sensor faucets and nozzles improves water efficiency. Smart sensor devices will optimize water use for the task and turn off automatically when not in use. Navigate to Section [5.2.11](#) to learn more about efficient fixtures.

2008 Wet Process Cement Manufacturing BMP: “Consider the impact of future facility modification or production changes on water usage. Changes to routine operations provide a good opportunity to evaluate current practices for possible water conservation opportunities.”

When planning for operation changes and/or facility reconstruction consider retrofitting wet cement processes to a dry cement process, where there is no slurry formation. Instead, raw materials are ground to a fine powder and immediately heat in the kiln to generate clinker.

5.3.4 Chemical Manufacturing Sector

Chemical products manufactured within the state of Michigan include the following (Gandhi, 2023):

- Basic chemical manufacturing

- Other chemical products and preparation manufacturing
- Paint
- Coating and adhesive manufacturing
- Pesticide, fertilizer and other agricultural manufacturing
- Pharmaceutical and medicine manufacturing
- Resin
- Synthetic rubber, artificial synthetic fibers and filaments manufacturing
- Rubber product manufacturing
- Soap
- Cleaning compounds
- Toilet preparation manufacturing

Water is used in a variety of ways in the chemical manufacturing process, depending on the product type. Common water uses include the following:

- Temperature control - cooling, boiler feed water, heat transfer
- Environment control - air pollution control, fire suppression
- Pump packing glands
- inclusion in the product, reactant, or solvent
- Convey the product, and domestic uses

5.3.4.1 BMPs

The Chemical Industry sector cited the same BMPs as the overarching Business and Industry Water Withdrawal and Conservation Practices. BMPs are listed below in reference to direct application to the Chemical Industry. An often critical use of water in the chemical industry is environment control (temperature and humidity) and cooling after a chemical reaction. Chemical reactions are highly temperature dependent. Therefore, specific temperature and humidity conditions are needed for chemical reactions to occur. Water is a useful medium to transport heat into or out of a process system. Additionally, water is used to mediate the temperature of the facility to increase process stability. Cooling towers, chillers, and boiler systems are used to dissipate and provide heat for chemical manufacturing. Navigate to sections [5.2.8](#) and [5.2.9](#) to learn more about efficient cooling and heating systems.

2008 Chemical Manufacturing Sector BMP: “Maintain a general water use inventory for the facility and update it periodically.”

Monitoring and evaluating water flow into a facility through advanced metering infrastructure and routine data analysis can allow for leak detection and indication of inefficient processes. It is also beneficial to measure conductivity and pH through in-situ meters and conduct routine laboratory water quality testing to ensure the water quality meets the process operational needs. Navigate to Section [5.2.4](#) to learn more about water monitoring and evaluation.

2008 Chemical Manufacturing Sector BMP: “Consider replacing water-cooled equipment with air-cooled equipment.”

In order to reduce the water used in facility temperature control and chemical reaction cooling processes, cooling towers can be retrofitted or designed as hybrid or dry systems, which significantly decreases the amount of water used in the cooling process. Navigate to Section [5.2.8](#) to learn more about hybrid and dry cooling towers.

Beyond this BMP, water-free technologies can be implemented throughout the product manufacturing process. For example, product packaging can be cleaned via ionized air or ultraviolet (UV) disinfection systems to remove bacteria and viruses from packaging before introducing the product (Goodway, 2025). Vacuums and pressurized air systems can replace water cleaning methods to remove debris from the packaging. Application of dry lubricants on conveyor belts systems throughout the facility also reduces water use. Navigate to Section [5.2.2](#) to learn about the benefits of dry lubricant conveyor systems.

2008 Chemical Manufacturing Sector BMP: “Improve rinse cycles by using cascading or counter-current rinsing from processes that require highly pure water to rinse parts from other processes that do not require such high-quality water.”

Clean in Place (CIP) processes are used in the chemical manufacturing industry to support efficient and effective chemical manufacturing. Water can be recycled within the CIP process by reusing final rinse water, which is clean and high quality, as the initial rinse water. Navigate to [5.2.5](#) to learn more about CIP systems and water reuse opportunities.

2008 Chemical Manufacturing Sector BMP: “Investigate potential chemical treatments to reduce the amount of make-up water required for cooling towers, steam boilers, etc.”

One of the primary uses of water chemical manufacturing is for temperature control, and a notable fraction of water can be saved by recycling water in cooling and heating systems. Navigate to Section [5.2.8](#) to learn more about opportunities for cooling tower and chiller water treatment and reuse. Navigate to Section [5.2.9](#) to learn more about opportunities for boiler water treatment and reuse.

5.3.4.2 Example

Cabot Corporation

Cabot Corporation is an international company headquartered in Boston with a manufacturing plant located in Midland, MI. The company is a member of the American Chemistry Council and was acknowledged for their sustainability efforts. Cabot’s water stewardship program aims to reduce water use across facilities through water intensity target setting. The company has conducted comprehensive water balance and efficiency assessments to analyze how much water is brought into facilities and how it is used in facilities to improve water efficiency and reduce the total amount of water used. The company has a commitment to water intensity reduction by 2025. The company has used

the Aqueduct Risk Tool to match water priorities with water stress environments (World Resources Institute, 2025).

Cabot had a 2024 sustainability goal of “reduc[ing] water withdrawal intensity by 20% below 2019 levels” (Cabot, 2024). From 2021 – 2023, the company’s absolute water withdrawals and discharge decreased, while total water consumption stayed stable. Cabot’s water withdrawal and discharge intensity also decreased from 2021 – 2023. To maximize energy efficiency, Cabot has also focused on energy recovery and exports by capturing energy produced from steam and hot water. These efforts have aided them in extending beyond their 2025 energy ratio goals. Cabot maintains a database for waste and water use, in addition to other environmental and safety variables to track total water usage, safety concerns and impact on the environment. Cabot seeks to recover and reuse water from operations when feasible. Cabot’s “2025 water goal focuses on the withdrawal of water for production, and [their] overarching strategy includes mapping water use, monitoring water risks, tracking legal requirements, assessing water management costs, sharing water conservation good practices, and implementing water efficiency projects at prioritized locations.” Water resources are managed at the facility level and guided by the Environment Committee (Cabot, 2024).

Dow Chemical Company

Dow Chemical Company is headquartered in Midland, MI. Dow Chemical Company (Dow) is a member of the American Chemistry Council, and the company was recognized for their sustainability efforts. Dow’s primary consumptive water use is from evaporative losses from cooling. Water is used for manufacturing purposes among Dow plants, particularly for cooling. A relatively smaller amount of water is used for product production.

Approximately 96% of water withdrawn by Dow is sustainably returned to the environment (American Chemistry Council, 2025), meaning water consumption is only 4%. Dow has set 2030, 2035, and 2050 water-based milestones to ensure that the top 20 water-dependent sites have water stewardship plans and 10 of those sites be water resilient by 2030; certify all sites have water stewardship plans by 2035; partner to conserve 50,000 acres of habitat and advance water resiliency so that the top 20 water-dependent sites are water resilient by 2050 (Dow, 2024). Water resiliency is assessed by water supply and quality, water asset management, wastewater discharge, climate and weather conditions. Dow site in Midland, MI is one of Dow’s top 20 water-dependent sites. Dow uses Aqueduct and the World Wildlife Fund (WWF) Water Risk Filter tools for informing water decisions (World Resources Institute, 2025; WWF Germany, 2025). Additionally, all high-capital investments are required to account for any impact on water as part of capital process.

5.3.5 Electric Utilities

Steam electric power plants function by combusting fossil fuels to convert water to steam. The steam drives a turbine that is connected to a generator. The used steam is condensed, pumped back to the boiler, and the excess heat generated from condensation is released through a cooling tower. Water use in a cooling tower system is the primary water use for

electric power companies. Navigate to Section [5.2.8](#) to learn more about best management practices for cooling towers.

5.3.5.1 BMPs

2008 Electric Utilities BMPs: “Create a leak detection and repair program with regular inspections of major water systems.”

Monitor water use and efficiency by installing flow meters on makeup water inlets, blowdown outlets, and other water transfer systems to track water flow and identify leaks. Advanced metering infrastructure allows for routine monitoring. Navigate to Section [5.2.4](#) to learn more about monitoring water use and efficiency within a facility.

2008 Electric Utilities BMPs: “Identify the water quality, quantity, and temperature of major water uses throughout the facility to determine possible water recirculating or recycling opportunities.”

Water quality can be monitored with conductivity meters, pH meters and routine water testing, and can be cleaned for recycling within a facility. Beyond monitoring and cleaning water, companies can utilize materials resistant to corrosion and fouling for cooling tower construction, repairs, and retrofits to extend the lifetime of infrastructure in addition to improving water efficiency. Overall, monitoring water chemistry and selecting degradation-resistant materials will allow facilities to maximize cycles of concentration while maintaining equipment integrity. Navigate to Section [5.2.4](#) to learn about water monitoring, Section [5.2.6](#) to learn about water reuse, and Section [5.2.8](#) to learn about best management practices for cooling tower operations.

2008 Electric Utilities BMPs: “Investigate alternative raw water sources for major processes.”

Utilizing alternative water resources in cooling tower systems is an opportunity to improve operation efficiency. Makeup water may be recycled multiple times, pulled from other processes at the plant, or be rainwater sourced on-site. To maintain high quality makeup water and ensure equipment integrity, alternative water resources must be monitored for quality. Navigate to Section [5.2.7](#) to learn about alternative water resources.

2008 Electric Utilities BMPs: “Confirm that unnecessary cooling water pumps are not being operated during cooler seasons, within the limits of practicality (Note that at least two cooling water pumps are needed for normal operation to prevent catastrophic damage to the power plant in the event a single pump fails).”

When constructing new or retrofitting cooling towers, companies have the opportunity to invest in hybrid or dry cooling tower systems. Hybrid cooling tower systems are closed-loop systems that rely on both dry cooling and wet cooling depending on the differential between ambient temperature and waste heat. Dry cooling systems rely on air cooling. These systems reduce water use but can lead to higher energy consumption. Navigate to Section [5.2.8](#) to learn more about cooling tower water efficiency and conservation BMPs.

Beyond 2008 Electric Utilities BMPs: Prioritize on-site operations and building energy efficiency.

Energy efficiency at electric power plants can be improved by maintaining equipment, reusing water onsite for building heating and cooling purposes, and utilizing the ambient environment to assist with temperature control. These will reduce the amount of water needed for on-site heating and cooling processes. Navigate to Section [5.2.11](#) to learn more about reducing facility energy needs.

Beyond 2008 Electric Utilities BMPs: Implement forward-looking water conservation plans.

Plan for future water efficiency and conservation and energy efficiency measures by developing a water conservation plan and considering water efficient operations in power plant expansion and renovations. Water efficiency and conservation and energy efficiency may include investing in and/or adopting alternative energy assets which require less energy and water for energy production. Efficiency plans can also include working with water utilities to develop water conservation plans. Navigate to Section [5.2.5](#) to learn how to incorporate water efficiency and conservation into strategic planning.

5.3.5.2 Examples

Indiana Michigan Power

Indiana Michigan Power is a subsidiary of American Electric Power (AEP) serving northeast Indiana and southwest Michigan. The company states its commitment to efficient water use in the annual sustainability report. AEP monitors and reports the company's water use on an annual basis and investing in renewable energy sources that do not require water for energy production (American Electric Power Company, 2025a).

About 92% of AEP power-generating operations required water in 2025, and 2% of this water is consumptive use through evaporative loss and flue gas scrubbing, while the remainder of water use is returned to the environment (American Electric Power, 2025b). In 2024 the company had a 48% reduction in surface water use since 2013 and an 83% reduction in surface water consumptive use since 2013. In addition, Indiana Energy produced more than 87% of emission-free energy in 2023 from 15 renewable energy plants, including wind, solar, hydroelectric plants, and a nuclear power plant.

Consumer Energy

Consumers Energy (CE) is the second electric energy provider in the state of Michigan, serving over 1.8 million customers as of 2023 (State of Michigan, 2024). Consumers Energy states that the company considers water-related issues and efficient operations in their long-term strategic plan, which includes evaluation of new facility investment. Water use intensity has shown an overall annual decline from a 2012 baseline. After the retirement of the Classic Seven generating plants in 2016, CE achieved a 46% water use reduction. Additionally, the company set a goal in 2018 to save 1 billion gallons of water by 2022. CE accomplished this goal by 2021, and in 2022 set a goal to save 1.7 billion gallons of water

from 2023 to 2027 (Consumers Energy, 2025). With the retirement of remaining coal plants and the addition of the New Covert Generating Facility, CE projects an overall water use reduction of 99% by 2040 compared to 2012 levels. CE will be one of the first utilities in the nation to be entirely coal-free (Consumers Energy, 2025).

Water consumption volume and water discharge quality are tracked at all steam electric generating facilities via flow meters and water quality tests to meet the company's water conservation and quality goals. Additionally, water reuse is tracked at 50% of steam electric generating facilities. At coal-fired powerplants, once through cooling water is reused for makeup water in air quality control systems and stormwater runoff is collected coal pile storage so that it can be reused as onsite condenser cooling water (CDP, 2023). In addition to retiring all coal-fired power plants using once-through cooling in 2025 and transition to natural gas-fired power plants, CE is conducting other innovative measures to reduce water consumption:

- Retrofitting equipment at hydroelectric facilities to eliminate water use for noncontact cooling
- Installing low-flow water fixtures at all new facilities
- Using air or nitrogen for pipe pressure testing instead of water, when deemed safe
- Reusing water by installing bentonite clay slurry reuse systems for horizontal directional drilling projects
- Monitoring water withdrawal, consumption and discharge at 100% of sites

The company is always investing alternative renewable energy resources that do not require water for energy generation.

5.3.6 Pharmaceutical Manufacturing & Research

Water is used within the pharmaceutical manufacturing industry in research for the following activities:

- Drug manufacturing processes
- Operating laboratory equipment
- Cleaning processes
- Environmental control (temperature and humidity)
- Industrial scale production and shipping
- Domestic use

Water use in cooling towers is one of the primary uses of water in the pharmaceutical industry. Water use for environmental control is particularly important when a pharmaceutical plant contains cleanrooms. Cleanroom maintenance is intensive, as temperature and humidity must be kept at precise values. Navigate to Section [5.2.8](#) and [5.2.9](#) to learn about cooling and heating system water efficiency and conservation BMPs.

However, water is used for more than environmental control measures. The US Food and Drug Administration details water quality and corresponding acceptable uses for water within the pharmaceutical industry (FDA, 1986):

1. Non-potable.
2. Potable (drinkable) water
3. United States Pharmacopoeia (USP) purified water
4. USP water for injection (WFI)
5. USP sterile water for injection
6. LUSP sterile water for inhalation
7. USP bacteriostatic water for injection
8. USP sterile water for irrigation

5.3.6.1 BMPs

2008 Pharmaceutical Manufacturing and Research BMPs: “Use clean in place technologies.”

Clean in place (CIP) technologies are essential components of manufacturing for many pharmaceutical companies. CIP systems can use high volumes of water and chemicals to properly clean out a process line. Water conservation of CIP systems can be improved by recycling water for different cleaning processes within the CIP system, using high-efficiency spray nozzles, and controlling nozzle spray patterns (Future Bridge, 2025). Further implementing advanced technologies to control CIP systems, such as automation, smart controls, and real-time sensors can allow companies to analyze cleaning efficiency through data and prevent excess water use. Navigate to Section [5.2.6](#) to learn more about CIP systems.

2008 Pharmaceutical Manufacturing and Research BMPs: “Install cooling towers to reduce once-through cooling water use, where appropriate.”

When considering cooling tower construction, companies can plan for dry or hybrid cooling tower installation to reduce water consumption. Hybrid cooling systems rely on reduced water use or no water use depending on the temperature difference between ambient air and heat waste. Hybrid cooling systems can allow pharmaceutical manufacturers to reduce water consumption by up to 98% compared to open-loop cooling (Fosco, 2015). Navigate to Section [5.2.8](#) to learn more about cooling tower efficiency and conservation BMPs.

2008 Pharmaceutical Manufacturing and Research BMPs: “Retrofit application that use once-through cooling water (chillers, compressors, condensers, etc.) with closed-loop recirculation systems.”

Cooling water is needed for batch processes in multipurpose reactors that enable temperature dependent chemical reactions or chemical crystallization; cooling of creams, ointments and other pharmaceutical materials before packaging, wet granulation

processes for drug tablet production, molding drug capsules, liquid sterilization (Strade et al., 2020).

In addition to retrofitting once-through cooling systems, facilities can save energy and water in cooling operations by cleaning water before use for cooling. Pre-cleaning water will remove dissolved solids and will allow the water to be a more efficient heat transfer medium, as water's specific heat capacity is lowered by dissolved solids (i.e. it is less efficient at transferring heat). The process of pre-cleaning will also reduce the need for pipe cleaning and maintenance. Navigate to Section [5.2.6](#) to learn more about water reuse, recycling, and cleaning operations.

2008 Pharmaceutical Manufacturing and Research BMPs: "Replace liquid ring vacuum pumps with mechanical seal vacuum pumps."

Vacuum lines are used in pharmaceutical manufacturing plants. Liquid gland packing seal methods or single mechanical pump seals for vacuum lines use high quantities of water. These types of pumps also are at risks for leaks, decreasing water efficiency (Amory, 2021). Overall, seal face technology lower energy needs and increases water efficiency. Mechanical seal face pumps have a longer lifetime because of the reduced friction and debris capture in the pump (Sorvoja, 2024). Navigate to Section [5.2.11](#) to learn more about mechanical pump water and energy efficiency.

2008 Pharmaceutical Manufacturing and Research BMPs: "Consider opportunities for water reclamation and reuse throughout the process and facility."

Steam condensate reuse is a key opportunity for water reuse on site in a pharmaceutical plant. Types of steam used in the pharmaceutical industry are:

- Plant steam for indirect contact process heating (can be produced from pre-treated potable water)
- Chemical-free steam for humidification and HVAC systems (can be produced from pre-treated water without volatile boiler additives)
- Pure steam for sterilization (condensate must meet WFI, the purest grade of pharmaceutical bulk water, characteristics)

Reusing high purity condensate water also reduces energy and treatment costs because the water does not need to go through the entire treatment process and is at a higher temperature for steam production. Another opportunity to optimize water reuse is to retrofit open-loop water cooling processes to closed-loop cooling for systems where water does not come in contact with the product (Strade, 2020).

The process of balancing wastewater contamination concerns and water reuse has improved due to advancing technologies. A combination of multiple cleaning technologies can result in clean water to be reused throughout the facility or on the property (landscape) (Strade et al., 2020). Cleaning processes may include suspended solid removal, biological reactors, mineralization, catalytic oxidation processes, nanofiltration and ionizing radiation (Strade et al., 2020). The application of cleaning processes is dependent on the

drug production process, the drug concentration, and the chemistry of pharmaceutical residue in wastewater. Opportunities for water reuse include rejected water from reverse osmosis for drug production or preparation for water in plant steam generation, and pharmaceutical wastewater (Strade et al., 2020).

Nanofiltration can further allow for water reuse. Pharmaceutical wastewater can include pharmaceutical active compounds (PhACs), endocrine disrupting compounds, other organic and inorganic pollutants. Since many of these compounds are larger molecules, nanofiltration is an effective method to remove them from wastewater if the filter is appropriately sized. Studies have shown the effectiveness of these filters to treat pharmaceutical industry wastewater to meet standards for landscape irrigation and industrial reuse (Azaïs et al., 2014; Thakura et al., 2015; Wang et al., 2015; Yacouba et al., 2021). Nanofiltration technology can also be used in zero-liquid discharge systems, which can be used to significantly reduce water consumption and waste in the pharmaceutical industry. Due to the nature of drug production, pharmaceutical wastewater must be thoroughly cleaned before being recycled and/or discharged to a treatment plant or the environment.

Wastewater from pharmaceutical production can be categorized into high chemical oxygen demand, low total dissolved solid water or high chemical oxygen demand, high total dissolved solid water. ZLD technology can treat both types of pharmaceutical wastewater types through following processes (Rathoure, 2020).

High Chemical Oxygen Demand, Low Total Dissolved Solids Water Treatments

- Primary, secondary, tertiary treatments to chemically treat water and reduce TDS, including a pressure sand filter, activated carbon filter, and filter press
- Reverse osmosis system
- Multi effect evaporator/incinerator

High Chemical Oxygen Demand, High Total Dissolved Solids Water Treatment

- Primary treatment
- Chemical stripper to remove VOCs
- Multi Effect Evaporator
- Agitator thin film drier
- Mult effect evaporator/incinerator

Navigate to Section [5.2.6](#) to learn more about ZLD technology to improve water efficiency and conservation.

Beyond the 2008 Pharmaceutical Manufacturing and Research BMPs: Employ water-free technologies when environmentally sound and economically feasible.

Water-free processes can be adopted for cleaning, packaging, and conveyor purposes. Similar to the beverage industry (Section [5.3.2](#)), containers for pharmaceuticals must be thoroughly cleaned prior to product packaging. The pharmaceutical and medical industries

require sterilized packaging. Water-free technologies like ultraviolet (UV) disinfection systems that remove bacteria and virus from packaging or vacuum and air-pressurized systems are water-free cleaning methods that remove dust and debris without employing water (Goodway, 2025). Ionized air may also be used to clean packaging (Inline Filling Systems, 2025). All packaging washing procedures must align with the USFDA sanitary guidelines for pharmaceutical, food, and beverage guidelines.

For conveyer belts, a dry lubricant can reduce the need for soapy solutions to make the conveyer belt slick for transporting product packaging and packaged products. Navigate to Section [5.2.2](#) to learn more about water-free cleaning, packaging and conveyor processes.

5.3.6.2 Examples

Pfizer

Pfizer is an international pharmaceutical and biotech corporation with manufacturing plants in Kalamazoo and Rochester, Michigan. The company states that it is motivated to invest in water efficiency and conservation because of moving industry standards, competition and commitment to clean water. Pfizer is piloting advanced wastewater management and treatment practices, investing in high efficiency plumbing fixtures, and LEED certified construction for new lab buildings (Pfizer, 2023). In addition, Pfizer performs water stress assessments on internal sites and key suppliers with international standards (Pfizer, 2022). The company follows the antimicrobial resistance (AMR) Industry Alliance's (AMRIA) Antibiotic Manufacturing Standard (2022), which prioritizes safe manufacturing, wastewater reduction and safe wastewater quality discharge.

Perrigo

Perrigo is an American Irish pharmaceutical manufacturing company with its largest manufacturing plant in Allegan, Michigan. Perrigo seeks to “[d]ecouple water use and business growth through awareness, training, efficiency measures and closely monitoring and recording how we use water” (Perrigo, 2024). Specifically in the Allegan Michigan plant, Perrigo has implemented efficient plumbing fixtures, such as toilets and faucets across the 550,000 square feet of the building campus. The company has employed water efficient calibrating and cleaning production equipment and optimizes purified water production for cleaning equipment and production of pharmaceutical ingredients at the Allegan plant as well (Perrigo, 2024).

5.3.7 Pulp and Paper Industry

The paper production process is a multi-step process, involving preparing the wood, pulping, and making paper from pulp. Within each of these overarching processes there are supporting steps. To prepare the wood for pulping, logs must be debarked and chipped. Then, the chips need to be washed prior to pulping. The pulping process includes separating and cleaning the wood fibers, refining the pulp to improve fiber bonding, washing and bleaching the pulp. A paper making machine is used to transform the pulp into paper, where fibers are formed into paper shape. The sheets are then pressurized to enhance the material density and drain water via a dewatering process. The sheets are

dried and covered in a polymer or starch coating, rolled and cut. The process to transform pulp into paper is an energy and water intensive process.

5.3.7.1 BMPs

2008 Pulp and Paper Industry BMP: “Replace liquid ring vacuum pumps with mechanical seal vacuum pumps.”

Vacuum lines are used throughout a paper mill for dewater and filtration processes. Water use and energy consumption can be reduced by utilizing seal face technology for mechanical seals in lieu of gland packing seal methods or single mechanical pump seals for vacuum lines. Mechanical seal face technology reduces water and energy consumption because there is less friction within the pump and less water is needed to operate the pump. Investing in mechanical seal pumps will improve the lifetime of the pump in addition to saving on water and energy costs. Navigate to Section [5.2.11](#) to learn more about mechanical seal pump water efficiency and conservation.

2008 Pulp and Paper Industry BMP: “Consider opportunities for water reclamation and reuse throughout the process and facility.”

2008 Pulp and Paper Industry BMP: “Investigate alternative water sources for major processes, including using clarified, cooling or wastewater for certain processes.”

In addition to the methods of water reuse mentioned in the 2008 BMPs, air flotation "technologies can be used to remove the suspended solids in residual water from paper machines to be used elsewhere in the mill.

Water in the chemical pulping process can be reused after regeneration (cleaning). The chemical pulping process – kraft and sulfite pulping – involves high temperatures that induce a chemical reaction to breakdown woodchips and remove lignin so that wood can be transformed into paper. Residual chemical pulping water can be used and treated through a furnace or gas stripper to remove volatile compounds. The treated water is a clean product to be used elsewhere in the mill.

Nanofiltration of wastewater can prepare water for reuse in pulp and paper plants. Wastewater from pulping contains high chemical oxygen demand. Bleaching the pulp results in wastewater with high concentration of toxic organic compounds and making the paper results in wastewater with high chemical oxygen demand and total dissolved solids (Toczyłowska-Maminska, 2017). Nanofiltration can clean water with these contaminants due to the size and design of nano filters (Ahmad, 2022). Multiple studies have shown the effectiveness of this technique with water reuse for reuse in the bleaching process, paper machine shower water, and paper manufacturing water (Kaya et al., 2010; Khosravi et al., 2011; Diniz Caldeira et al., 2021).

Nanofiltration can further be used in net-zero discharge operations, where there is no net water consumption because the amount of water withdrawn from the water source is less than or equal to the amount of water discharged to the same source. Navigate to Section

[5.2.6](#) to learn more about the role of nanofiltration in water efficiency and conservation BMPs.

Beyond the 2008 Pulp and Paper Industry BMP: Utilize water-free technology when environmentally sounds and economically feasible.

Water free technologies can assist in water use reduction in the paper making process. The wood preparation process can be accomplished by employing dry debarking technology, such as drum debarking, rotary ring debarking, rosser-head debarking, or compression debarking (Chahal and Ciolkosz, 2019). Furthermore, water free processes can be implemented in the conveyor process by employing a dry lubricant on conveyor systems to transport products within the paper manufacturing plant. Navigate to [Section 5.2.2](#) to learn more about water-free conveyor systems.

Beyond the 2008 Pulp and Paper Industry BMP: Recycled paper production when environmentally sounds and economically feasible.

Recycled paper production reduces the initial steps of stripping and preparing the woodchips for pulping. Instead, shredded paper is filtered for major contaminants and mechanically repulped. Most commonly this repulping process is done with a slurry. The slurry is screened and deinked (color removed). Fibers are then used to make recycled paper. Removing the initial wood-preparation steps reduced total water use in the paper production process, saves energy, and allows for long-term sustainable tree harvesting.

5.3.7.2 Examples

Green Bay Packaging

Green Bay Packaging (GBP) is a pulp and paper company based in Green Bay, WI with over 40 locations across the United States. The company is committed to advancing water efficiency and enhancing conservation measures. GBP has invested in a closed-loop, net-zero water system for the GBP mill located in Green Bay, WI. Every gallon of freshwater is reused 30 times prior to undergoing a cleaning process (Bauer-Lotto, 2022). The cleaning process includes an initial treatment onsite followed by a two-phase treatment at the local municipality and returned to the GBP mill for third and fourth cleaning phases (Green Bay Packaging Inc., 2025). The water is then reused in the paper making process. The GBP Mill can internally recycle 1.1 million gallons of water per day (MGD) and reclaim 2.5 MGD per day. This can result in 1.3 billion gallons of water savings per year (Bauer-Lotto, 2022). Additional GBP water and energy saving initiatives include generation of containerboard with 100% recycled fiber, onsite heat and steam recovery from paper manufacturing, and harvesting biogas from an onsite anerobic digester (Bauer-Lotto, 2022).

International Paper

International Paper is one of the largest paper companies in the world. The company's headquarters is located in Memphis, Tennessee and has a paper mill in Three Mills, Michigan. The company's 2030 vision is to reduce water use per ton of production by 25% (International Paper, 2024). International Paper has implemented a series of process and

technical changes to meet this goal. Process changes include meeting with stakeholders to identify primary sustainability concerns, such as manufacturing water use and water quality. International Paper has also implemented context-based water management plans among processing plants, which are tracked and carried out through flow metering in facilities and internal benchmarking efforts. Tracking water use and comparing water use efficiency among plants assists in reducing the prevalence of leaks within facilities and improves manufacturing processes. International Paper returns 89% of water used in manufacturing to the environment. Furthermore, select mills operate on recycled municipal water. The International Paper Sustainability Report (2024) highlights these accomplishments and goals.

5.3.8 Emerging Sectors

New high-water use business and industry sectors are emerging as commerce continues to develop in the state of Michigan while other sectors are declining. Data centers and snow making are examples of industries that are growing in the state, and it is expected that these industries could be large water users in the coming decades. Conversely, wet cement is a declining industry within the state of Michigan, and therefore, there are less opportunities to target water savings. This section provides background and opportunities to invest in research and application of water conservation best management practices for emerging industries in the context of Michigan's climate.

5.3.8.1 Data Centers

Data centers rely on air and/or water for cooling, where higher energy loads associated with higher computing performance require water cooling methods that are more efficient than air cooling. Therefore, many data centers use high volumes of water sourced from municipal water treatment plants for cooling purposes. Large data centers are among the top 10 water consuming industries within the United States (Siddik et al., 2021), and a single large data center that relies on water cooling technologies can use up to 5 million gallons per day (Osaka, 2023). Tax break legislation (General Sales Act of 2024, MCL 205.54ee) and the perceived ample water supply from the Great Lakes will likely entice companies to construct new data centers in the state of Michigan. As the concentration of data centers in Michigan grows, water use will grow with it (Starr, 2025). Data center energy and water consumption both contribute to the carbon footprint of data centers. Water consumption indirectly contributes to data centers' carbon footprint because of the energy required to extract, pump, and treat water used in data center cooling processes.

There are opportunities to improve water efficiency and conserve water in data center operations. Investing in efficient information technology equipment and intentionally designing data center facilities can lessen cooling needs (Van Geet & Sickinger, 2024). Furthermore, there are opportunities to take advantage of Michigan's seasonal climate to temper energy and water needs in data centers. Air-side and water-side economizers take advantage of cooler ambient temperature to lessen energy needs by cooling water or air directly from heat exchange with ambient conditions. When taking advantage of a water-side economizer, the need for a chiller is removed, but a cooling tower is still needed.

Cooling tower systems are commonly used in data center cooling process. Following the cooling tower BMPs increase water efficiency (Section [5.2.8](#)).

New cooling systems are being explored to reduce the water consumption of data centers. For example, Microsoft is installing closed-loop cooling systems and adopting chip-level cooling technology in newly constructed data centers to completely reduce evaporative cooling. Data centers in Phoenix, AZ and Mt. Pleasant, WI are the first Microsoft data centers in the United States that will be constructed with this technology (Solomon, 2024). These pilot designs are planned for construction in 2026. The company expects to reduce water by 33 million gallons annually per facility (Moss, 2024). With Microsoft's 2023 purchase of land near Grand Rapids, MI, there is a possibility that this innovative data center infrastructure will be implemented in Michigan.

5.3.8.2 Snow Making

Snow making operations are foundational to the Michigan ski industry, where snow making allows resorts to open when planned and stay in operation until the end of the winter sport season. The importance of snowmaking is increasing as the climate changes, and it is a water and energy intensive process. While snowmaking is primarily a nonconsumptive process, where most water is returned to the watershed via snow melt, there are opportunities to enhance snowmaking efficiency to reduce pressure on water resources. Water distribution systems can be more effective by adjusting pipe size, efficient and appropriate size motors, variable frequency drivers on water pumps, gravity fed delivery systems (National Ski Areas Association, 2023). These changes can reduce head loss, leaks, and increase overall operational efficiency. Michigan has the second greatest number of ski resorts in the United States (Spohn, 2025) and resorts have increasingly relied on snowmaking to stay opens for the winter sport season in recent years (Simpson, 2025).

Resorts are employing new solutions to improve snowmaking operations. For example, Boyne Resorts, a company that owns and operates 10 ski areas across the United States, including one in Boyne MI, are advancing snow making efficiency to achieve net zero greenhouse gas emissions while meeting growing snowmaking demands. Upgrades in water distribution and air distribution will be paired with new snow guns to reduce water and energy needs. In addition to improving water and energy efficiency, the equipment will reduce labor and increase snow output capacity (National Ski Areas Association, 2023).

Section 6: Summary of Findings and Considerations for Future Action

6.1 Project Purpose and Context

This project was initiated to explore how Michigan’s business and industry (B & I) sectors engage with water efficiency and conservation practices, particularly in relation to the state’s voluntary best management practices (BMPs) first developed in 2008. The work was funded by the Michigan Great Lakes Protection Fund and the Michigan Legislature through the Water Use Advisory Council (WUAC), and administered by the Michigan Department of Environment, Great Lakes, and Energy (EGLE).

The project aimed to identify innovations and advancements in water efficiency and conservation BMPs that could support progress toward Michigan’s water efficiency and conservation goals, as well as its broader climate and sustainability targets under the MI Healthy Climate Plan (State of Michigan, 2022). The scope of work centered on stakeholder engagement with the water use sectors, a review of BMP adoption processes, and an exploration of successful approaches from other Great Lakes states and beyond.

The core tasks included:

- Develop and implement an engagement and dissemination strategy to involve Michigan water sectors in the project to maximize the benefits of the project results and findings.
- Summarize existing Michigan water sectors’ processes to review and/or change water conservation best management practices (BMPs).
- Research innovation and technological advancements in water sector water efficiency and conservation BMPs and their impacts within the business and industry sectors in other Great Lakes states and provinces and other innovative jurisdictions.
- Summarize findings that will advance Michigan water sectors’ water efficiency and conservation BMPs within the business and industry sectors to help contribute to Michigan’s water efficiency and conservation program goals as well as practices that may also contribute toward achieving Michigan’s climate and carbon neutrality goals.
- Share project results and findings to inform and advance innovation in their sector’s water efficiency and conservation practices and contribute toward achieving Michigan’s climate and carbon neutrality goals.

6.1.1 Summary of Project Approach

This project employed mixed-methods qualitative approach, emphasizing the collection of information and insights through first-hand accounts and perspectives from industry stakeholders. Methods included desktop research, surveys, email and phone communication, individual interviews, and stakeholder group meetings. Methods were exploratory in nature and were not intended as prescriptive evaluations or formal assessments of the 2008 voluntary BMPs. For more information about the research approach, please visit [Section 2](#).

6.1.2 Summary of All Water Use Sectors BMP Review Processes

Table 9 presents a summary of Michigan water sectors’ processes to review and/or change water efficiency and conservation BMPs adopted and approved under Public Act 35 of 2006 of NREPA.

Table 9. Summary of Michigan Water Use Sector’s Water Efficiency and Conservation BMP Update Processes

Water Use Sector	Process to Update?	Notes
Public Water Supply	No	No formal process to update the 2008 BMPs was identified. However, public water practitioners tend to take guidance from the American Water Works Association (AWWA) and wider industry best management practices to foster water savings.
Agricultural Irrigation	Yes	Strategies are reviewed and updated by stakeholders and industry experts annually as a part of the Generally Accepted Agricultural Management Practices (GAAMPs) review process.
Non-Agricultural Irrigation	No	The Non-Agricultural Irrigation sector has not conducted a BMP review or update for the sector. Individual industries, such as Golf Course Management, have published updated BMPs.
Business & Industry	No	The Business and Industry sector has not conducted a review or update of the general BMPs, and the B & I subsectors have not conducted a review or update of sector-specific BMPs.

For more information about each of these water use sectors, including perspectives from stakeholders as well as deeper reflections on opportunities and challenges, please visit these sections:

- [Section 3](#) summarizes the findings from the non-B & I sector engagement, including the public water supply sector, the agricultural irrigation sector, and the non-agricultural irrigation sector.
- [Section 4](#) summarizes the findings from the B & I sector engagement, including a range of specific businesses and organizations that reflect or represent a range of businesses.
- [Section 5](#) summarizes the research findings of innovative and technological advancements in water sector water efficiency and conservation BMPs and their impacts within the business and industry sectors in other Great Lakes states and provinces and other innovative jurisdictions.

6.2 Key Findings

This section details a few high-level observations based on the engagement, insights, and research throughout the project.

6.2.1 2008 BMPs Still Strong Collection of Strategies

The original 2008 voluntary water conservation best management practices (BMPs) remain a relevant and useful foundation for advancing water efficiency across Michigan’s water use sectors. The principles and strategies outlined in the BMPs for the business and industry sectors were the main focus of this project’s review. The strategies found in the general template as well as the separate industry-specific templates continue to reflect sound conservation practices that align with both environmental stewardship and operational efficiency goals. These practices are still critical for making measurable progress in water conservation and resource management. As water use patterns, technologies, and other factors have evolved, there are opportunities to build upon this foundation. The review of the BMPs with identified enhancements is explored further in [Section 5](#).

6.2.2 Opportunity to Raise Awareness and Use of Existing BMPs

Stakeholder interviews and survey results indicate that awareness of Michigan’s 2008 voluntary BMP documents among B & I participants remains limited. Where water efficiency and conservation actions are occurring, they are often indirect byproducts of other business objectives—such as energy savings, wastewater reduction, or cost-cutting initiatives—rather than direct responses to the BMP framework.

Despite limited familiarity with the state’s existing guidance, many stakeholders reported implementing at least some water-saving strategies. However, most were not formally aligned with the 2008 BMPs, and no B & I stakeholder identified an internal process for periodically reviewing or updating water conservation practices.

Trust-building and clarifying intent appear to be important for some stakeholders to increase engagement and participation. Some stakeholders expressed concern about sharing internal data without a clear understanding of how it would be used, even in voluntary contexts.

6.2.3 Key Themes of Drivers and Barriers Emerged

A range of factors shape how and whether water efficiency and conservation strategies are pursued.

Common drivers included:

- Corporate sustainability commitments, ESG goals, and/or leadership directives are key enablers
- Operational efficiency or cost savings, including financial savings (e.g., from lower energy or wastewater costs)
- Regulatory or reputational risk management
- Synergies with energy efficiency programs
- Peer influence, reputational benefits, and customer expectations can also play a role

Common barriers included:

- Low water costs that limit financial incentive to implement strategies
- Real or perceived abundant water availability may reduce the perceived urgency of conservation efforts
- Competing environmental priorities (e.g., energy efficiency, emissions, water quality, wastewater compliance, other environmental compliance or mandates)
- Competing business or organization priorities
- Lack of dedicated staff or technical expertise
- Limited awareness of available tools and templates

6.2.4 Engagement and Institutional Memory is a Factor

Efforts to engage B & I stakeholders over the course of the project were met with variable participation. Some stakeholders expressed caution around sharing internal practices, especially in contexts that could be perceived as regulatory. Additionally, organizational turnover may have contributed to a disconnect between current personnel and the original

rollout of the 2008 BMPs. This underscores the importance of identifying and empowering new champions within organizations to help carry water stewardship goals forward and institutionalizing best practices within organizational processes and policies so they can last across staffing turnover.

6.3 Reflections and Opportunities

This section highlights possible considerations, opportunities, and examples identified to support water stewardship in Michigan from research, stakeholder conversations, and a review of the literature.

6.3.1 Education, Outreach, and Access to Resources

- Trusted industry groups and networks can be effective channels for water conservation outreach—for example, organizations like the Michigan Chamber of Commerce, water stewardship organizations and initiatives, or trade associations have established relationships with businesses that could support information-sharing about water conservation. More about this, including specific examples, are detailed in [Section 4](#). However, it should be noted that the general business organizations or networks, even those that are sustainability focused, have many priorities and focus areas. There may be opportunities to support in-person engagement activities, including roundtables or sector-focused workshops, to foster dialogue, build familiarity, and encourage connections among businesses interested in water stewardship. These could be coordinated along with events where folks are already convening.
- Developing accessible, sector-specific resources—such as case studies or guides illustrating how water conservation plan templates or BMPs could apply to different industries—is a common way to make water efficiency efforts more relatable and tangible. It is important that these are crafted with business and end/user perspective in mind to be most effective.

6.3.2 Enhance Voluntary Frameworks with Clearer Pathways and Support

- There are a variety of approaches that could support broader voluntary adoption of water efficiency and conservation practices across business and industry sectors. One potential strategy involves offering technical assistance, which can be through a state agency or through non-regulatory partners such as university extension programs or dedicated resource efficiency organizations. These types of services

have been effective in other regions by providing tailored, on-site support that helps businesses identify and implement practical water-saving measures.

- Additional strategies to strengthen voluntary engagement include developing tools and resources in close collaboration with specific industries. For example, co-developing water use assessments or decision-support tools with a specific industry can ensure they are practical, relevant, and aligned with sector-specific needs. Applied research pilots can also provide real-world data and insights that inform scalable solutions. Offering support for facility-level water audits and provide positive pathways to build relationships with businesses and offer them valuable assessments, data, and recommendations.
- Another approach is to create opportunities for peer learning and relationship-building within and across sectors. Informal exchanges—such as roundtables, regional workshops, or industry-led learning cohorts—can promote the sharing of success stories, build trust, and lower the barriers to participation by showing what’s possible in real-world settings.
- Sector-specific trainings and certification programs may also help build internal capacity and establish a shared understanding of water stewardship principles. These programs can support professional development and create pathways for individuals within companies to lead efficiency efforts.
- In some cases, public recognition or awards programs have been used to highlight leadership in water conservation and encourage voluntary participation. Sharing case studies or offering formal acknowledgment can help validate early adopters and inspire others to explore similar efforts.

Collectively, these types of voluntary engagement frameworks—especially when aligned with business interests such as operational efficiency, sustainability goals, or reputation management—can help create clearer pathways for action, without relying on regulatory drivers.

6.3.3 Incentivizing Participation and Demonstrating Value

- Identifying and communicating the business case for water conservation can be a powerful way to encourage voluntary participation across diverse industries. When water efficiency is framed in terms of operational benefits—such as cost savings, risk reduction, system resilience, or alignment with sustainability goals—it may resonate more strongly with internal decision-makers. In many cases, water-saving measures can also lead to improvements in energy efficiency or wastewater management, creating additional co-benefits that strengthen the value proposition.

- Sharing case studies that illustrate real-world examples of successful implementation can help demonstrate feasibility and return on investment. These stories—whether from within Michigan or from other regions—can serve as relatable, practical references for businesses considering similar actions.
- In addition to making the value of water conservation more visible, certain types of incentive structures may help lower the barrier to entry for voluntary efforts. These could include:
 - Funding to support audits, assessments, research, and pilots
 - Grant programs to support capital investments in water-efficient technologies or process improvements
 - Tax incentives or rebates tied to verified water savings
 - Green business certifications that recognize companies for leadership in sustainability, including water stewardship
 - Access to recognition platforms that enhance reputational value

Such incentives, where feasible, could be aligned with broader state goals related to economic development, climate resilience, or ESG accountability. Incentives may also be more effective when paired with clear documentation of potential savings, available resources, and success metrics. Ultimately, when the operational and strategic benefits of water conservation are well understood and supported by meaningful incentives or recognition, participation may become a more natural extension of existing business planning and sustainability initiatives.

6.3.4 Leverage Cross-Sector Opportunities

- Water conservation efforts may gain greater traction when aligned with existing programs focused on energy efficiency, wastewater reduction, or broader sustainability initiatives. These areas often share common goals—such as reducing operating costs, improving system performance, and meeting environmental targets—and are already familiar to many businesses. By integrating water-related messaging and strategies into these established efforts, organizations may be more likely to see the relevance of water efficiency within their broader resource management approach.
- For example, process upgrades that reduce both water and energy use—such as improvements to cooling systems, steam generation, or equipment cleaning—can offer meaningful co-benefits across multiple environmental performance areas. Packaging water efficiency alongside energy or wastewater initiatives may also

make the business case more compelling, especially when these efforts are supported by shared technical resources or incentives.

- There may also be opportunities to partner with utilities or infrastructure agencies to deliver coordinated outreach and programming. Water utilities, energy providers, wastewater utilities, and sustainability coalitions often maintain direct relationships with commercial and industrial customers and may serve as trusted messengers. Through these partnerships, it may be possible to embed water conservation within broader resource efficiency campaigns or to pilot integrated programs that bundle technical assistance, data tools, or financial incentives across multiple resource areas.
- Another opportunity would be to leverage opportunities to integrate smart water practices and BMPs into any municipal and regional resilience and sustainability planning that might be occurring, especially as connected to the MI Healthy Climate Plan (State of Michigan, 2022).

By approaching water efficiency not as a standalone goal but as part of a systems-based strategy, cross-sector coordination can help amplify the value of conservation efforts, reduce duplication, and promote more holistic sustainability outcomes.

6.3.5 Support Benchmarking and Data Access

- Improved access to water use data and benchmarking tools can support businesses and industries in understanding their water use patterns and identifying opportunities for increased efficiency. Benchmarking allows organizations to track performance over time, compare usage across facilities, and evaluate their practices in relation to broader sector trends. This kind of information can help inform internal goal setting, support planning efforts, and guide investment in water-saving strategies.
- Benchmarking may also contribute to a clearer picture of how different sectors are progressing in terms of water conservation. When aggregated or anonymized appropriately, data from multiple organizations can reveal patterns, highlight emerging best practices, and identify areas where additional support or innovation may be beneficial.
- In addition, data-driven approaches can help demonstrate the value of water conservation by quantifying outcomes, supporting transparency, and informing future policy or program development. Making these tools and datasets more accessible—whether through voluntary reporting, shared platforms, or technical

assistance—could help businesses of all sizes engage more effectively in water stewardship efforts.

As interest in resource efficiency and sustainability grows, clear and consistent access to water use information may offer a valuable foundation for ongoing improvement, collaboration, and alignment with broader conservation and climate goals. More about benchmarking and data can be found in [Section 5](#).

6.3.6 Explore Strategic Engagement with Emerging Industries

Michigan’s expanding economic sectors and emerging industries highlight an opportunity to incorporate water stewardship as a foundational element of sustainable development. Integrating water use considerations early in land use planning and growth strategies helps ensure that these sectors develop in ways that protect water resources while supporting economic vitality. By providing tailored outreach and industry-specific tools, Michigan can enable these sectors to better understand their water consumption patterns and identify efficiency improvements from the start. This proactive approach aligns with broader goals of sustainable growth, balancing resource conservation with innovation and expansion to support resilient communities and ecosystems. More about some of the identified emerging sectors of note can be found in [Section 5.3.8](#).

6.4 Closing Reflection

This project set out to explore the current state of water efficiency practices in Michigan’s business and industry sectors and identify opportunities for innovation, collaboration, and continued learning. The findings reflect both progress and gaps—and offer a range of real-world examples that may inform future planning and program development.

As Michigan works toward its water conservation and climate goals, the ideas and insights captured in this project may serve as a starting point for future partnerships, pilot initiatives, and deeper engagement with the businesses and communities that manage water every day.

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Appendix A: Project One-Pager



Innovation in Water Conservation Best Management Practices

In 2024, the [Alliance for Water Efficiency](#) is conducting a project in partnership with Michigan's Department of Environment, Great Lakes, and Energy's (EGLE) Office of the Great Lakes (OGLE). This project will inform the State of Michigan [Water Use Program](#) and advance progress toward achieving Michigan's water conservation and efficiency goals and objectives.

The State of Michigan seeks to capture **innovations and technological advancements in water conservation best management practices** (BMPs) that can benefit Michigan's water sectors, contribute toward Michigan's goals under the MI Healthy Climate Plan, and **support long-term sustainability of Michigan's water resources**.

The [MI Healthy Climate Plan](#), a comprehensive plan meant to protect public health and the environment by making Michigan fully carbon-neutral by 2050; there are opportunities to make greater advancements in water conservation and efficiency through the intersection of water, climate, and energy.

To accomplish this, the Alliance for Water Efficiency will:

- Engage with all Michigan water sectors to capture efforts and progress regarding water conservation [best management practices since 2008](#).
- Summarize each sector's pathways to review and update water conservation BMPs.
- Identify advanced and innovative water conservation best management practices for the business and industry sectors.
- Share results and recommendations with all water use sectors, stakeholders, and EGLE's [Water Use Advisory Council](#) and its Water Conservation and Efficiency Committee.

History: The States and Provinces of the Great Lakes-St. Lawrence River Basin have long been [working together](#) to protect this treasured, shared resource. In 2005, an [Agreement](#) was signed by all parties and a [Compact](#) was signed by all US Governors, taking effect in 2008. The parties committed to develop regional water conservation and efficiency objectives and a program. [Public Act 35 of 2006](#) of the Natural Resource and Environmental Protection Act (NREPA) required Michigan's water sectors to design guidelines for generally accepted water conservation measures. In 2008, Michigan's water sectors each submitted their measures.

Water Use Sectors:

Public Water Supply

Agricultural Irrigation

Non-Agricultural Irrigation

Business & Industry

Project Contact: Liesel Hans at Liesel@a4we.org

The [Alliance for Water Efficiency](#) is a stakeholder-based 501(c)(3) non-profit organization dedicated to the efficient and sustainable use of water. AWE is proud to partner with the [Midwest Energy Efficiency Alliance](#) and H.W. Hoffman & Associates, LLC for this project.

Appendix B: Stakeholder Interview Questions

1. Are there any additional organizations that are relevant to this water use sector?
2. Current BMPs
 - a. What has been the process to review and potentially update the original 2008 BMPs?
 - i. Who has been/ is involved?
 - ii. What approach is used?
 - iii. How does your sector learn about water conservation practices?
 - iv. How does your water use sector share information?
 - b. Is there anything more you can share about the historical context of this sector and water conservation?
 - c. What interactions have you/this water use sector had with EGLE since onset of the original water conservation BMPs?
 - i. To what extent, if at all, have you interacted with EGLE's Water Use Advisory committee related to water conservation BMPs in this water use sector?
3. What are the main motivators/drivers for your water use sector to implement water conservation practices?
4. The state has adopted the MI Healthy Climate Plan and part of this project is to help highlight how water conservation can contribute to carbon reductions. How does your water use sector see water fitting into climate change efforts?
5. What successful examples of implementing water conservation can you share?
 - a. What level of variation in adoption and implementation of water conservation practices exists across the water use sector? (Who is doing this particularly well and how much "better" are they than the average organization/company in this sector?)
 - b. How is implementation monitored or tracked?
6. What funding streams have been used or are available to help this water use sector implement water conservation practices?
7. Who/what type of role typically champions, supports and/or implements water conservation practices?
8. Where does information about water conservation best practices, water conservation goals, and/or tracking of implementation live in a organization in this water use sector?
 - a. What planning efforts might this tie into?
9. What are the barriers or challenges to this water use sector implementing water conservation practices?

- a. What ideas do you have that would help overcome these barriers?
- b. What support they might the state offer to better implement or make progress on BMPs and water conservation in general?

10. What are you working on next? What do you hope to do in the future related to water conservation practices in this water use sector?

11. What questions do you have for us?

12. Is there anything else you think we should know?

- a. Is there anyone else you think we should talk to about this water use sector?

Appendix C: B & I Outreach Survey



Survey on Sustainability & Water Conservation in Michigan's Business Sectors

Alliance for Water Efficiency is partnering with the Michigan Department of Environment, Great Lakes, and Energy, Office of the Great Lakes to learn about efforts to implement smart water efficiency practices across Michigan's business and industrial sectors. Your participation will inform this project and support goals to reduce greenhouse gas emissions and achieve carbon-neutrality under the MI Healthy Climate Plan. Your time and expertise are valuable. Complete responses by August 30, 2024 to be eligible to win a \$100 gift card. The survey should take between 5-7 minutes.

Part 1 of 4: Your Organization & Water

1. Business Type *

- Automotive
- Beverage
- Chemical
- Construction
- Data & Computing Technology
- Energy
- Health Services
- Hospitality and Tourism
- Pharmaceutical
- Pulp and Paper
- Retail
- Other

2. How does your organization use water? Select all that apply. *

- Domestic uses (drinking, bathrooms, kitchens)
- Process purposes
- Cooling and heating
- Cleaning
- Ingredient
- Irrigation of landscapes or crops
- Other

3. Has your organizations implemented any water conservation or efficiency strategies? *

- Yes
- No
- I'm not sure

4. If yes, what strategies has your organization implemented?

5. How much potential do you think your organization has to further reduce water use? *

- No potential
- Slight potential
- Moderate potential
- High potential
- Very high potential

6. What motivates your organization to implement water-saving strategies? *

- Water cost savings
- Other operational cost savings
- Water supply constraints
- Energy Savings
- Environmental or sustainability goals (e.g. ESG)
- Other

7. How does your organization or industry share or gain knowledge about water efficiency practices? *

Part 2 of 4: Sustainability Goals

8. Does your organization have sustainability/environmental goals? *

- Yes
- No
- I'm not sure

9. (If yes to 8) Are any of the goals related to water quantity or quality? *

- Both
- Quantity only

- Quality Only
- I'm not sure

10. Does your organization have dedicated position(s) focused on sustainability or environmental goals and projects? *

- Yes
- No
- I'm not sure

11. What else would you like to share about how your organization works to advance water and energy efficiency, climate change adaptation and mitigation, and overall sustainability?

Part 3 of 4: Michigan's Water Use Programs

12. Are you familiar with the State of Michigan's Water Use Program in support of agreements among Great Lakes states to manage water use across the Great Lakes Basin? The program collects water use information and manages water withdrawal permits. *

- Yes
- Somewhat
- No
- I'd like to learn more

13. Are you familiar with the State of Michigan's Best Management Practices developed in 2007-08 which identified water conservation measures for various water use sectors across Michigan? *

- Yes
- Somewhat
- No
- I'd like to learn more

14. Who else should we connect with for this project (either at your organization, in your industry, or otherwise)? *

List organizations here

Part 4 of 4: Next Steps

Information shared through this survey is for project purposes only; data will be summarized and anonymized. Our team will also request permission to utilize non-anonymized individual survey data. This

project is exploratory in nature and participation in this survey is not related to any existing or future regulatory action or reporting. For more information about the project or this survey, please contact amanda@a4we.org.

15. Name *

First Name

Last Name

16. Organization *

17. Role *

18. Email *

example@example.com

19. Are you a member of the Michigan Chamber of Commerce? *

- Yes
 No

20. How would you like to stay involved? *

- I'm interested in participating in a working group to inform this project. (The working group will meet for four to five 90-minute meetings this Fall/Winter 2024. Convenings will include peer-to-peer sharing, learning, and discussions on the future of water conservation and sustainability across Michigan's business and industrial sectors.)
- I would like to share information about my organization or industry and stay informed on the project, but I am not interested in participating in the working group.
- I want to stay informed on this project. (Note: This will include a few informational emails throughout the project, including a final email indicating when the project is complete.)
- None - I am not interested or able to contribute more time to the project.

21. Regardless of answers to questions above, would you be interested in attending an in-person peer learning event based on the information collected during this project? *

- Yes
 No
 Maybe

Submit

Appendix D: Sector-Specific BMPs Exercise Worksheet Template



**Alliance for Water Efficiency
MI Business & Industry Water Conservation Working Group
Sector-Specific BMP Exercise Worksheet**

This exercise is part of your participation in the Michigan Business & Industry Water Conservation Working Group. The purpose of this worksheet is to help you engage with your water use sector's best management practices for water conservation and efficiency by identifying 1) what has been widely implemented 2) where there are opportunities for growth, and 3) what innovations already exist across your organization and sector.

Name:

Title:

Organization:

Date:

1. What water use sector are you representing?

(BMP and plan template documents are hyperlinked)

- [Aggregates](#)
- [Beverage](#)
- [Chemical Manufacturing](#)
- [Electric Utility](#)
- [Pharmaceutical](#)
- [Pulp and Paper](#)
- [Wet Process Cement](#)

Instructions: Review your sector's specific best management practices (BMPs) from 2008 and respond to the questions below. It is recommended that you complete the worksheet by referencing the generally accepted water conservation plans and documents. You can access them by going to the Department of Environment, Great Lakes, and Energy's webpage [here](#) or clicking the hyperlinks on your sector in question #1.

Please fill out this worksheet and submit it to Amanda@a4we.org by Friday, November 15th by EOD.

2. Does your organization or organizations in your sector typically have a Water Conservation plan?

- Yes
- No

Please explain:

3. If yes, was the Water Conservation Plan template from 2008 used?

You can find a link to the generic template developed by the MI Chamber of Commerce [here](#) or find sector-specific templates at the beginning of the worksheet.

- Yes
- No

4. Which BMPs outlined in 2008 have been widely or consistently implemented in your industry?

5. Which BMPs have NOT been widely or consistently implemented? Why not?

6. Please list any innovations and new practices that are not listed in the original 2008 BMPs:

7.

8. Have there been any efforts to update the 2008 Water Conservation Plan template and BMPs for your sector?

- Yes
- No

Please explain:

