# GUIDANCE FOR DEVELOPING & IMPLEMENTING A WATER CONSERVATION PLAN

## Best Management Practices for Water Conservation & Water Use Efficiency for Maryland Public Water Systems

**Maryland Department of the Environment**
**Water Supply Program**
**1800 Washington Boulevard, Suite 450**
**Baltimore, Maryland 21230**

**Guidance Revision History:**
**May 2013**
**March 2024**

## TABLE OF CONTENTS



## APPENDIX

## BACKGROUND

Maryland experienced drought conditions in 1999 and 2002 that impacted some water systems' ability to meet their customers' needs and prompted the State to consider measures that might improve water systems' water use efficiency. In January 2000, Executive Order 01.01.200.01 formed the Maryland Technical Advisory Committee on Water Supply Infrastructure. The Committee evaluated the capacity of water systems to meet demands during drought periods, high levels of unaccounted water as a result of leaking distribution systems, and inadequate levels of funding needed for water system improvements. The Committee then made recommendations to the Governor regarding community water system infrastructure deficiencies and needed improvements in Maryland. It was recommended, at that time, that the State focus water conservation efforts on water systems that serve more than 10,000 people and have high per capita usage.

In 2002, the Maryland Legislature passed House Bill 693, the Maryland Water Conservation Act. This Act requires certain public water systems to submit information about their water conservation best management practices when applying for new or renewed water appropriation permits. The Act also requires MDE to issue guidance for public water systems on best management practices for improving water conservation and efficiency in water use, treatment, storage, and transmission. This document constitutes guidance as required under the Maryland Water Conservation Act.

The most effective way for a water system to improve its water use efficiency is to develop and implement a water conservation plan. A water conservation plan is a written document developed by a public drinking water system that evaluates current and projected water use, assesses infrastructure, operations, and management practices, and describes actions to be taken to reduce water losses, waste, or consumption and increase the efficiency with which water is used, treated, stored, and transmitted.

All water systems in Maryland are encouraged to develop water conservation plans. Current MDE policies[1] require that certain public water systems develop and submit to MDE's Water Supply Program written water conservation plans. These plans are required for water systems that serve a population greater than 10,000 people and produce more than 100 gallons of water per capita per day. It is required when these systems are applying for a new or expanded water appropriation permit or awarded financial assistance from the State for infrastructure improvements. MDE may also request a water system to submit a plan based upon sanitary survey findings, engineering studies, or other fact-finding events conducted as part of routine compliance activities.

In addition to regulatory or other requirements, there are many reasons for water utilities to develop and implement water conservation plans. Maryland's potable water sources are limited natural resources, and with the State's population continually increasing, this resource must be managed carefully. Developing a water conservation plan also helps to optimize existing facilities and may reduce or eliminate the need to undertake new drinking water and/or

[1] MD. Environment Code § 5-5B-01 , § 5-5B-02 , § 5-5B-03, and § 5-5B-04

wastewater projects. In addition, water conservation leads to increased energy conservation and cost savings for utilities and their customers.

## DEVELOPING A WATER CONSERVATION PLAN

Water conservation plans should address conservation on the supply side as well as on the demand side. Conservation plans for the supply side (i.e., leak detection and repairs, metering, etc.) may require additional financial resources, however there is some potential for reduction in operating costs and recovery of lost revenues. Conservation plans for the demand side (i.e. reductions in consumer usage) may result in lost revenues, however, a well-designed pricing program can offset potential losses in revenue. Other benefits associated with implementing a conservation plan (which include eliminating, downsizing, or postponing the need for capital projects, improving the utilization and extending the life of existing facilities, lowering variable operating costs, avoiding new source development costs, improving drought or emergency preparedness, educating customers about the value of water, improving reliability and margins of safe and dependable yields, and protecting and preserving environmental resources) may also help to balance losses in revenue.

Water conservation plans will vary based on many factors, including the size of the water utility. Large water systems serving more than 10,000 persons will require a more complex and detailed water conservation plan than smaller water systems. The U.S. Environmental Protection Agency published Water Conservation Plan Guidelines in 1998. This helpful reference can be found at the following Internet address: https://www.epa.gov/watersense/water-conservation-plan-guidelines

MDE endorses a format similar to that recommended in EPA's Guidelines, which offers instruction on completing conservation plans of varying complexity: Basic, Intermediate, and Advanced. Maryland water systems should use either the Intermediate or Advanced Guidelines as a reference when writing their own conservation plans. The Advanced guidelines may be more appropriate for systems serving more than 10,000 persons, or for systems likely to experience water supply problems (i.e. where water production is close to capacity, where significant growth is expected, or where dry weather conditions result in water supply deficiencies). The general steps for developing a water conservation plan are as follows:

**I. Establish the goals of the water conservation plan.** The first step in developing a water conservation plan is for the utility to establish a list of conservation planning goals. Measurable goals, such as a water use reduction goal (in terms of percentage of baseline water usage), are useful for later evaluation of the conservation plan. Other common goals for water utilities include postponing or eliminating the need for capital projects or new source development and improving drought preparedness. Utilities should consider involving their communities in the goal development and implementation process. In addition to helping to develop goals, participants can act as a focus group and serve as a gauge for the public's reaction to possible conservation measures.

**II. Conduct a water system audit.** Completing an initial water system audit is an integral part of developing a water conservation plan because it will serve as a baseline measure of water use. Subsequent annual audits can track progress towards meeting established goals. Most water systems already have the basic information necessary to complete a water audit. MDE guidance instructions for completing a Water System Audit and a template for reporting results can be found at the following web address: Conducting a Drinking Water Distribution System Water Audit (.pdf).

A water system audit collects data on accounted and unaccounted water. Unaccounted water includes water that is metered but not billed and water that is not metered. Unmetered water consists of authorized uses (fire protection, flushing mains, etc.), as well as unauthorized uses (losses due to accounting errors, thefts, inaccurate meters, and leaks). Utilities should strive to minimize the quantity of unmetered, unauthorized water use. A water system audit should also provide information about the quantity and type of population served, geographic considerations, number of total connections and metered connections, and the average and peak demands. EPA's worksheet "Water Accounting and Loss Control" is available at the following link: https://mde.maryland.gov/programs/water/waterconservation/Pages/water_auditing.aspx

A discussion summarizing conditions that might affect the water system and conservation planning should also be provided. Issues such as anticipated population growth, large quantities of unaccounted water, and major planned improvements should be included in this discussion.

**III. Prepare a demand forecast.** A demand forecast estimates water use requirements into the future. Demand forecasts can range from a simple projection based on population growth to complex models that contain several variables. The size of the utility will dictate the complexity of the projection. It is suggested that forecasts be prepared for 5, 10, and 20 years into the future. If a water system has prepared a demand forecast within the past two years, calculating a new demand forecast is probably not necessary. It is also recommended that forecasts be made for each water end user group (residential, commercial, etc.) as opposed to the water system as a whole, unless the water system serves a population of fewer than 10,000. The forecast should take into account any known, planned, or measurable changes that will have an effect on demand, with the exception of additional conservation measures considered in this plan. Further guidance for preparing ad water demand forecast can be obtained from the Water Supply Program. The worksheet can be found on page 12 at the following link: https://www.epa.gov/sites/default/files/2017-03/documents/appendix-a-water-conservation-measures.pdf

When the growth in projected demand is large, it may be useful to prepare an estimate of supply costs necessary to meet increased demand. In some cases, increased demand will require improvements or additions to the water system. Anticipated supply costs are needed to compare the costs of supply-side and demand-side conservation measures. Appendix B-3 contains a worksheet from EPA's guidance designed to help calculate the costs of any improvements and/or additions.

**IV. Identify and select potential water conservation measures.** MDE has categorized water conservation measures into Required Elements and Recommended Elements. Required elements

should be included for all water utilities, while the recommended elements may be evaluated for inclusion as appropriate. An integral part of evaluating these various conservation measures is a cost analysis. For each conservation measure the utility should estimate implementation costs and projected water savings. A cost analysis worksheet entitled, "Analysis of Each Conservation Measure or Group of Measures" from EPA's can be found on page 85 at the following link: https://www.epa.gov/sites/default/files/2017-03/documents/part-4-intermediate-guidelines.pdf

**A. Required Elements.** These elements should be included in all water conservation plans for Maryland public water systems.

**1. Metering.** Plans should describe the metering method(s) used, and establish protocols for maintaining meter accuracy, conducting calibration and repair, and replacing old or inaccurate meters. Inaccurate meters often result in lost revenue for the utility.

Recommendations:

- Evaluate installation of new metering if none exists.
- Develop and schedule a plan to test, calibrate, repair, and replace meters as necessary.
- Evaluate and replace older meters as necessary.
- Ensure that meters are appropriately sized. If a meter is too large for a customer, it will typically under-register water use, resulting in lower revenues.

**2. Water Accounting and Loss Control.** A well-designed loss-prevention program should target both real and apparent losses. Real losses are physical losses including leaks, bursts, and overflows. Apparent losses are non-physical losses that include meter inaccuracies and unauthorized consumption, such as theft or illegal use.

Recommendations:

- Inspect, clean, or perform other maintenance (such as corrosion control) on pipes to prevent leaks from occurring.
- Manage pressure to reduce volume and frequency of water loss.
- Control water level to reduce storage overflow.
- Implement improvements in metering and billing.
- Locate illegal or unregistered connections.
- Regularly employ leak detection equipment to detect leaks along water distribution mains, valves, services, and meters.
- Use remote sensors and telemetry technologies for ongoing monitoring of leak detection at source, transmission, and distribution facilities. This technology can promptly alert operators to leaks, changes in pressure, and problems with equipment.
- Repair leaks when detected. The cost of lost water can be measured in terms of operating costs associated with supplying, treating and delivering the water. Water lost to leakage produces no revenues for the utility. Although repairing leaks may be costly, cost savings will usually pay for the repairs over time.

**3. Pricing.** Water conservation will prove to be most cost effective when rate structures are modified to encourage customers to conserve water. There are several pricing strategies that can encourage water conservation.

Recommendations:

- Repeal volume discounts to eliminate any disincentive for conservation.
- Charge a higher unit price as use rises (i.e. increasing block rates).
- Implement higher rates during seasons when water use is higher.
- Charge excess use fees where appropriate for high-use consumers.

**4. Information and Education Program.** A good information and education program can be very effective in reducing consumer demand.

Recommendations:

- Provide understandable and informative water bills to customers. The water bill should contain consumer usage in terms of gallons per day. When customers are aware of their daily water use, they are more likely to conserve.
- Provide educational information through water bill inserts or other means. For water systems where residential water use is greater than 100 gallons per capita per day, this should occur at least once a year.
- Additional recommendations for public education are described in Appendix A.

## B. Recommended Elements

**1. Develop outreach for specific users.** Utilities typically serve three types of customers: residential, municipal, and industrial/commercial customers. Each of the outreach efforts described below is geared to one or more user types, which are identified in parenthesis.

Recommendations:

- **Conduct Water Use Audits for Consumers** (*Residential, Industrial/Commercial, and Municipal*). Water use audits can provide water systems and their customers with information about how water is used and help identify potential conservation strategies. Audits can be particularly effective when targeted towards large volume users, or other selective end use customers (e.g., single family homes with large yards, parks or other large landscapes, etc.).

- **Offer fixture retrofits and replacements** (*Residential, Industrial/Commercial, and Municipal*). Retrofitting involves making an improvement to an existing fixture, as opposed to replacing an existing fixture. Retrofit programs usually target plumbing fixtures and can be made available to customers free or at cost. Retrofit kits can be distributed directly, through community organizations, in conjunction with water audits, or to other targeted customer groups.
- **Offer rebates and incentives** (*Residential, Industrial/Commercial*). Options include having utilities install water-efficient fixtures by providing them at no cost, giving rebates for consumer purchased fixtures, or arranging for suppliers to provide fixtures at a reduced price.
- **Promote water reuse and recycling** (*Industrial/Commercial*). Some industries can reduce water demand by reusing water in the manufacturing process. In some cases, using gray water or treated wastewater for nonpotable water uses may be appropriate. Reuse and recycling can also be encouraged for large-volume

irrigation applications. Water reuse applications must meet applicable State and federal wastewater disposal regulations.

- **Encourage landscape efficiency** (*Municipal, Industrial/Commercial*). Utilities can promote water conservation principles into the planning, development, and management of new landscape projects such as public parks, building grounds, and golf courses. Existing projects can also be renovated to incorporate water-conserving practices. Water utilities can also work with commercial and industrial customers to plan and renovate their landscapes.

**2. Pressure Management**. Reducing excessive pressures in the distribution system can save water by reducing stresses that could result in leakage, decreasing quantities of water that are currently leaking, and reducing the amount of flow through fixtures.

Recommendations:

- Assess the need for pressure management in residential areas with pressures greater than 80 pounds per square inch.
- Install pressure reducing valves in street mains and in buildings where appropriate.

**3. Water-Use Regulations**. Water utilities may wish to consider having regulations in place that manage water use during normal times as well as during times of drought or other water supply emergencies.

Recommendations:

- Institute restrictions or bans on certain non-essential water uses.
- Develop standards for new developments with respect to landscaping, drainage, and irrigation practices.
- Develop a fine or penalty system for frequent misuse of water during drought emergencies.

## V. Develop and present implementation strategy.

The water utility should develop a schedule and timetable for implementing the water conservation strategies. Implementation actions should include a timetable for securing budgetary resources, hiring staff, procurement of materials, acquisition of any necessary permits, and activity milestones.

## REFERENCES

Maryland Statewide Water Conservation Advisory Committee. Final Report. November 2000.

Maryland Technical Advisory Committee of Water Supply Infrastructure. Final Report. November 2000.

Thornton, Julian. 2002. Water Loss Control Manual. McGraw Hill. New York, New York. 645 p.

U.S. Environmental Protection Agency. Water Conservation Plan Guidelines. EPA-832-D-98-001. August 6, 1990

Best Practices to Consider When Evaluating Water Conservation and Efficiency as an Alternative for Water Supply Expansion, EPA 2016. https://www.epa.gov/sites/default/files/2016-12/documents/wc_best_practices_to_avoid_supply_expansion_2016_508.pdf

Water Availability Water Variability and Water Efficiency Considerations in Public Water System Supervision Programs Supporting Resiliency to Climate Related Impacts in Public Water Systems, 2021. https://www.epa.gov/system/files/documents/2021-11/water-availabity-guidance_508_final11921.pdf

# APPENDIX A

## PUBLIC EDUCATION

There is a wide array of options available for water utilities to educate water consumers about the benefits of conservation. EPA has published a document entitled "Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs", which is available on EPA's website at http://www.epa.gov/WaterSense/docs/utilityconservation_508.pdf or by calling the EPA Hotline at 800-426-4791. This publication provides details regarding successful water conservation programs for 17 utilities throughout North America. Almost all of these water conservation programs include a successful public education component. Some of the most frequently used public education initiatives are described below.

### Bill information and/or Flyers

Include information in customer invoices is a quick and easy way to convey messages to all water customers. Providing historical water usage to customers, with water usage expressed in gallons per day can also help consumers to become more mindful of their water usage. Another option is to include water conservation tips with the bill. Flyers can also be used convey water conservation messages; however, including information with bills is usually more cost effective.

### Website development

Utilities that currently have websites can develop a web page devoted to water conservation. Conservation tips and information regarding other conservation efforts the utility is promoting can be posted on the web page.

### School Programs

Water utilities or municipal water districts can work with local schools or environmental education centers to organize a water conservation program geared towards children. Options could include developing educational information for distribution in schools or having staff members available to make presentations to students. For example, staff members with the Town of Cary in North Carolina are available by appointment to teach lessons on water conservation and related topics to students (elementary and middle school) and to arrange tours of water and wastewater treatment plants. Schools and teachers can choose one of ten different lesson plans, all of which address different water topics.

### Community Education Programs

Utilities can also offer educational opportunities for members of the community. For example, Gilbert, Arizona runs a homeowners education program. Cary, North Carolina offers workshops that teach water efficient landscaping and gardening techniques.

### Water Audits

Several utilities throughout the country have offered free water audits to their residential customers. Most of these audits are performed in response to customer requests. During the water audit, a utility representative analyzes water use and suggests appropriate conservation measures. The utility representative may also inspect a property for leaks and/or install water-saving fixtures, such as low-flow showerheads or faucet aerators. To a lesser extent utilities have also offered free water audits to commercial users and large irrigation users.

**Retrofits, Replacements, and Rebates**

Utilities can sponsor water fixture retrofit or replacement programs. Distribution of water saving fixtures can occur in a variety of ways including distributing and installing fixtures during water audits or including the fixtures in free or low-cost water conservation kits. Water conservation kits can be provided to customers upon request or can be distributed at public events. The Houston Department of Public Works and Engineering had success distributing conservation kits, with water saving fixtures, to over 10,000 fifth graders as part of an education program in the elementary schools.

Rebate programs are not used as frequently as retrofit and replacement programs, however several cities have had success with rebate programs. Seattle, Washington sponsored a program called WashWise where citizens that purchased a water-efficient washing machine received a mail-in cash rebate. Over the past two decades, many utilities have offered rebates for replacing old toilets with new, water-efficient toilets.

**Landscape Efficiency Programs**

On average, throughout the country, outdoor water use accounts for about 40 percent of all residential water use. Teaching citizens about outdoor water conservation can have a positive impact on water conservation. Tampa, Florida distributes rain sensors for irrigation systems on a limited, as requested basis and they also conduct sensible sprinkling evaluations for a limited number of households each year. There are several utilities that have developed daily watering guides. Phoenix, Arizona publishes a Lawn Watering Guide in the weather section of the daily newspaper each day and several utilities in California have watering indexes that are updated weekly posted on their websites.

## APPENDIX B (cont.)

## CASE STUDIES

### CARY, NORTH CAROLINA

The population in the Town of Cary, North Carolina increased dramatically in the 1990s, placing a strain on the Town's water system. Cary began to plan an expansion of its water treatment facilities. In 1996, the Town adopted a water conservation program as part of its integrated resource management plan. The program's goal was to reduce the Town's average per capita water use by 20 percent by the year 2015. They exceeded this goal by reaching a 20 percent reduction in 2013 and reached a total 30 percent reduction in 2023.

In 2000 the Town of Cary adopted a Water Conservation and Peak Demand Management Plan. To reduce peak water use the Town constructed two reclaimed water systems at its wastewater treatment plants. The reclaimed water receives at least advanced secondary treatment, meets water quality requirements as defined by the North Carolina rules, and is reused for irrigation and cooling after it flows out of a water reclamation facility. Cary employs three tactical strategies when it comes to water conservation.

- Regulatory Action: Irrigation System Requirements, Drought Tolerant Plant Requirement, Water Waste & Rain Sensor Ordinance;
- Educational Efforts: School Programs, Residential Audits, Public Outreach, And Waterwise Workshops;
- Financial Incentives: Tiered Rate Structure, Rain Barrels, High-Efficiency Appliance Rebate Programs.

Having faced two significant droughts in 2001-2002 & 2007-2008, adaptive management plans were enacted, along with residential behavioral practice shifts that have continued beyond the drought period. In 2011 Cary installed smart meters that allowed residents to monitor their water usage and set usage alerts. Much of Cary's conservation success has been due to actions from industry and individuals playing their part to reduce water usage. The adoption of warm-season turf, improved efficiency in technology, and development patterns have contributed to a 30 percent reduction in water use per capita since 1996.

## MASSACHUSETTS WATER RESOURCES AUTHORITY

The Massachusetts Water Resources Authority (MWRA) provides water to a population of 3.1 million people located in 46 cities, towns, and municipal water districts maintaining over 400 miles of tunnels, pipes, and aqueducts. In 1986 MWRA enacted a water conservation plan to reduce customer yields to a safe sustainable level. By 1989 yields had reached the goal and continued to fall to approximately 203 mgd from 2013-2017. Attention to leak detection and repair programs resulted in a 20 percent reduction in the early stages of their water program. Water rate increases have given residents an incentive to reduce water usage and update to more efficient appliances. MWRA maintains a water conservation plan to uphold and further improve the conservation efforts that have come before.

MWRA's water conservation plan had several aspects that are described below:

- Leak Detection Program. Surveys for leaks in MWRA's water distribution system in 2023 led to approximately 0.47 mgd of water saved. Surveys in community systems that purchase from MWRA led to an estimated 3.70 mgd of water savings.
- Retrofit Program. Distribution of 3,417 water-saving fixtures (low-flow showerheads and faucet aerators), installation instructions, and leak detection dye tablets;
- Business Outreach. The Authority developed a water management program for businesses and institutions.
- Public Education Program. The Authority developed and conducted extensive public and school education programs. Over 41,800 pieces of water conservation literature have been distributed along with the MWRA School Education Program conducting 330 classroom presentations reaching 10,779 students in the service area.
- Meter Upgrades. Metering systems were improved to track and analyze water usage. Over 22,000 water meters have been replaced since 1999.
- Conservation Rate Structure**.** The Authority instituted water and sewer rates that encouraged water conservation in the community.

MWRA's conservation program has been successful. The average daily demand decreased from 336 mgd in the 1980s to 203 mgd in 2018. Continuing the efforts that have led to such reductions will continue and be improved upon where possible. MWRA will have to prepare for the impact of Climate Change in the form of stormwater management and droughts in the future.

## NEW YORK CITY, NEW YORK

From the late 1970s to the early 1990s, New York City's (NYC) water facilities were exceeding safe yields with a water demand of over 1,400 mgd. Water and sewer rates were skyrocketing and the City faced the need for major water infrastructure projects. In 1992, NYC conducted a cost analysis of supply alternatives and found conservation to be the most economical option. Back in 2013, the Delaware Aqueduct was announced to be taken offline for repairs in 2024. NYC DEP developed multiple management strategies to prepare for this project.

In 2022 NYC's population was estimated at 8.34 million people with a water demand of 999 mgd. Using the management strategies from the 2013 Water Demand Management Plan, an estimated 22.7 mgd were conserved between 2013 to 2023. These management strategies are divided into six categories; Municipal, Residential, Non-Residential, Distribution Optimization, Water Supply Shortage Management, And Wholesale Customer Demand.

NYC's conservation program objectives are described below:

- Municipal Water Efficiency: Achieve water savings through efficient water fixtures in public facilities. Responsible for 8.52 mgd saved.
- Residential Water Efficiency Program: Replace inefficient fixtures in multi-family buildings. Responsible for 1.03 mgd saved.
- Nonresidential Water Efficiency Program: Create water conservation incentives for private properties. Responsible for 0.21 mgd saved.
- Water Distribution System Optimization: Enhance leak detection, pressure management, and metering. Responsible for 7.65 mgd saved.
- Wholesale Customers Water Demand Program: Develop and implement tailored demand management plans for the largest customers. Responsible for 5.31 mgd saved.
- Water Supply Shortage Management: Revise the Water Shortage Emergency Rules in preparation for potential changes in DE's water supply.

Additional incentive and affordability programs have been designed to address equity, aid in redevelopment, and provide outreach opportunities to those in the community. As the largest water & wastewater utility in the US, NYC DEP is focusing on long-term planning to improve its water efficiency as water demand has dropped to 999 mgd in 2022 compared to 2018's 1008 mgd average.

## GALLITZIN, PENNSYLVANIA

Gallitzin is a small city, with a population of 2,000 residents, located in western Pennsylvania. During the early 1990s, the Gallitzin Water Authority (GWA) was experiencing water losses of over 70 percent. In addition to high water loss, problems with the water system included recurring leaks, high operational costs, and complaints of low pressure. In response to these problems, GWA instituted a comprehensive leak detection and corrosion control program in 1994.

As part of the leak detection program, GWA developed accurate water production and distribution records using seven days of data collected from meters at the plant and pump station. Next, they created a system map to locate leakage. GWA identified 95 percent of the leaks in-house using a leak detector and employed an outside contractor to identify the remaining five percent.

In 1998, four years after the initiation of the leak detection program, water use decreased by almost 60 percent and water loss dropped from 70 percent to nine percent. This resulted in cost savings for the GWA, including $5,000 on annual chemical costs and $20,000 on annual power costs. Other benefits to the water system included extending the life expectancy of equipment, reducing purchased water costs during droughts, reducing overtime costs, and improving customer satisfaction.

## CASE STUDY REFERENCES

Environmental Protection Agency. 2002. Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs. EPA-823-B-02-003.

Massachusetts Water Resources Authority Website. 2024. https://www.mwra.com/04water/html/wat.htm

New York City Department of Environmental Protection Website. 2024. https://www.nyc.gov/site/dep/water/drinking-water.page

Town of Cary Water Conservation, 2024. https://www.carync.gov/services-publications/water-sewer/sewer/water-conservation