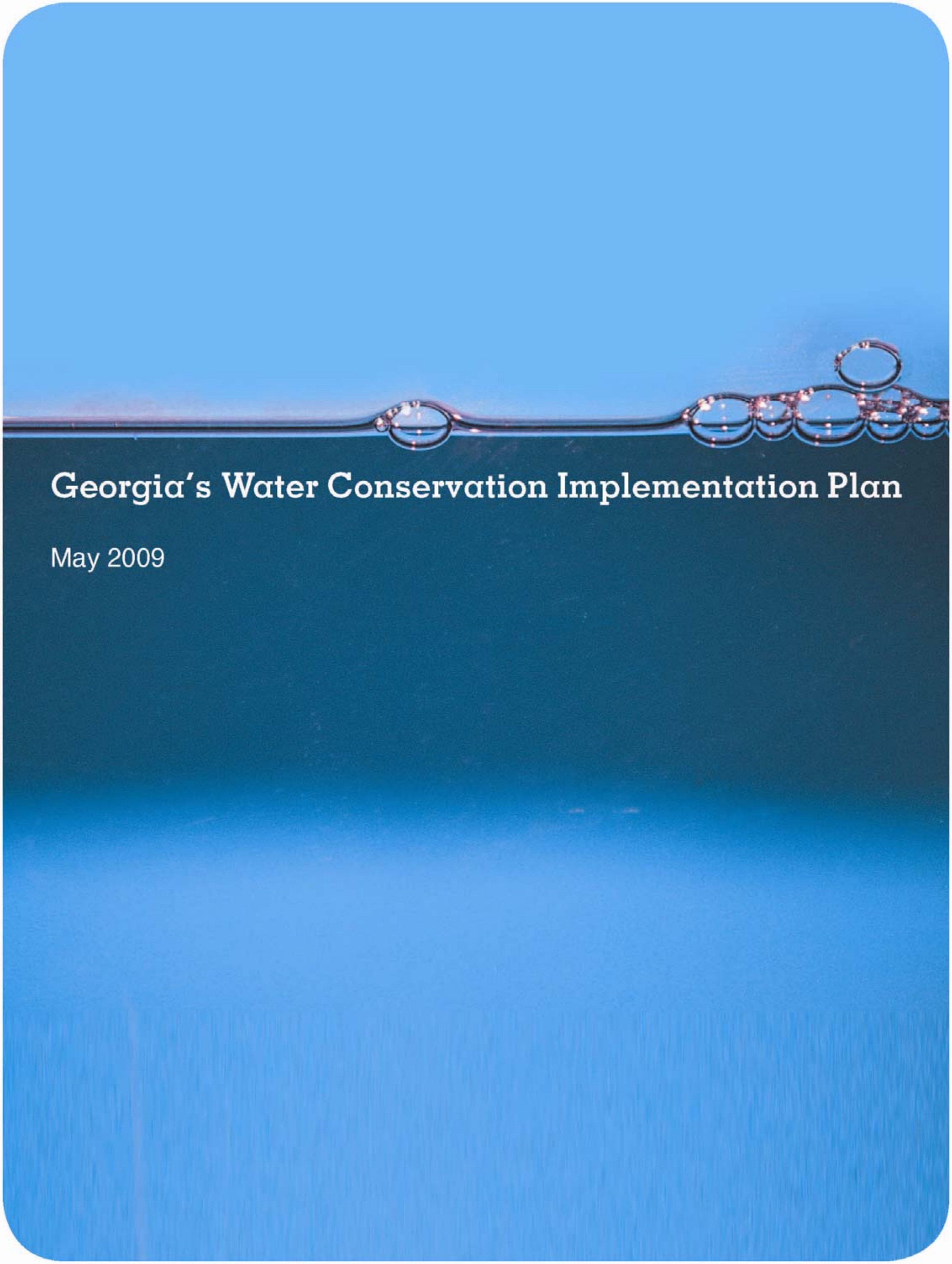

Georgia's Water Conservation Implementation Plan

May 2009

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Georgia Department of Natural Resources
Environmental Protection Division

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Executive Summary

As Georgia's population and economy grow, there will be increasing demands on our state's water resources. A commitment to more efficient and sustainable water use will help us meet the challenges this growth will bring. Water conservation, defined as the beneficial reduction of water use, water waste and water loss, can help ensure that we are able to continue to meet growing water demands. The ultimate goal of water conservation is not to discourage water use, but to maximize the benefit from each gallon used. Georgia's Water Conservation Implementation Plan (WCIP) is designed to create a culture of conservation and guide Georgians toward more efficient use of our state's finite water resources.

In 2005, Georgians withdrew approximately 5.5 billion gallons of water a day from surface and ground water sources - enough to fill about 15 Georgia Domes with fresh water daily. These withdrawals supported 9.5 million citizens and a $397 billion gross domestic product. Water is critical to sustaining a healthy economy and maintaining a high quality of life for Georgia citizens.

Georgia's water resources face many challenges. Our state's population is projected to substantially increase over the next 20 years. With such growth, we can expect greater demands and withdrawals from our water resources. While abundant, Georgia's water resources are finite. Improperly managed withdrawals and excessive consumptive use can negatively impact Georgia's water bodies, our water uses and the environmental services our waters provide. Georgia also faces uncertainty regarding impacts that global climate change may have on our region's climate conditions. By prioritizing efforts to conserve water and maximize water efficiency, we can protect our finite resources without causing harm to the economy or the quality of life that current and future Georgians enjoy.

Georgia's State-wide Water Management Plan (SWP), www.GeorgiaWaterPlanning.org, recognizes water conservation as a priority water quantity management practice that can help manage the consumptive use of our state's rivers, streams and aquifers. Compared to other types of tools for managing water resources (such as those that increase water supplies or return water to the source), conservation is one of the most cost-effective. Water conservation can extend the life of existing water supplies and preserve water for recreation and environmental needs. The SWP calls on the Georgia Department of Natural Resources to create the WCIP to guide Georgia's diverse water use sectors toward greater water use efficiency.

The WCIP provides specific goals and benchmarks for Georgia's seven major water use sectors. The major water use sectors include: agricultural irrigation (Chapter 2); electric generation (Chapter 3); golf courses (Chapter 4); industrial and commercial (Chapter 5); landscapes (Chapter 6); domestic and non-industrial public uses (Chapter 7); and state agencies (Chapter 8).

Each sector-specific chapter details water conservation goals, benchmarks, best practices and implementation actions designed to reduce water waste, water loss, and, where necessary, water use. The goals are sector-specific aspirations for water use and efficiency, designed to be flexible, so that they are applicable for users with differing circumstances and recognize prior investments in conservation. The benchmarks present quantifiable metrics of efficiency or time-oriented activities that can be used to determine progress toward a particular water conservation goal. Each chapter also contains a menu of water conservation practices specific to the water use sector. The practices are generally cost-effective and applicable in Georgia and should be evaluated by water users determine those that are appropriate and beneficial to them. Finally, the chapters outline implementation actions that, when resources are available, can be undertaken by a host of state-wide organizations and state agencies to provide technical, financial, and administrative assistance to help achieve common water management goals.

The WCIP can be used to guide decisions related to water use and water management by:

- Educating water users about water conservation practices and the goals they can accomplish,
- Informing regional water plan preparation that will be overseen by regional water planning councils,
- Helping water use sectors collectively improve water use efficiency, and
- Informing DNR rule-making regarding water conservation requirements in permitting.

The WCIP will be reviewed and revisited to incorporate breakthroughs in knowledge and technology. EPD will publish an annual report indicating the status of progress on implementing the elements of the WCIP, and the WCIP will be reviewed and revised every five years as part of the cycle to update the SWP.

The WCIP describes seven foundational water conservation goals: educating and empowering Georgia's water users; creating incentives to encourage efficiency; enhancing data collection, monitoring, research and evaluation; measuring water use and water efficiency; planning for the future; funding water conservation efforts, and integrating water and energy conservation efforts.

The WCIP draws on two principle sources of data: the USGS and the Georgia EPD Watershed Protection Branch. For some sectors, data on consumptive use is incomplete. Future versions of the WCIP will likely include additional data gathered as part of the regional water planning process.

Although each individual, business-owner, farmer, and government official faces unique situations and challenges, the WCIP presents a variety of ways that each can contribute to the conservation of our state's finite water resources. This plan can guide Georgians toward more efficient and sustainable water use to help ensure that our water resources continue to support growth and prosperity while maintaining healthy natural systems.

Acknowledgements

As directed by the Governor's October 24, 2007, and October 31, 2008, Executive Orders and the Georgia Comprehensive State-wide Water Management Plan (February 6, 2008) the Georgia Department of Natural Resources, Environmental Protection Division developed this Water Conservation Implementation Plan with assistance from a diverse group of stakeholders.

While the content of the WCIP is the sole responsibility of the Environmental Protection Division, many individuals volunteered their time, experience, information and expertise to the development of this plan. Without their help and cooperation, Georgians would not have such a comprehensive implementation plan. The Georgia Department of Natural Resources, Environmental Protection Division extends a special thanks to the following individuals who contributed to the development of this plan:

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CHAPTER 1:

Introduction

Georgia's Water Conservation Implementation Plan (WCIP) is designed to foster a culture of conservation in Georgia. It is a resource to be used by Georgia business owners, farmers, homeowners, water service providers, and government officials to achieve greater water efficiency and help sustain our state's water resources.

Historically, Georgia's water resources have been viewed as inexhaustible. In years with normal levels of rainfall, Georgia's water resources are plentiful; however, the state's water supplies are vulnerable to inevitable drought conditions. The state's growing population and economy have intensified this vulnerability, and conflicts regarding water use have arisen. Ongoing droughts, increasing demands, and conflicts over water use will require more careful management so it is possible to meet water needs while minimizing impacts to the state's land and water resources.

Georgians face the necessity of changing the way we view our water resources, and we are rising to meet the challenge. Georgians are becoming aware of the need to change water management practices and are more willing than ever to adjust daily routines to help conserve and sustain water resources.[1] As the commitment to sustaining water resources grows, our dependence on restrictions and emergency water use reductions diminishes. If, for example, Georgians conserve water and use it more efficiently every day, we will be more resilient to dry conditions when droughts occur – minimizing the need for emergency cutbacks to maintain finite supplies.

Water conservation is defined as the beneficial reduction of water use, water waste and water loss.[2] Conservation, implemented as a long-term water management practice, is fiscally responsible and can enhance our ability to grow. Water conservation does not lower our quality of life or deter business. It can lead to more efficient and effective business operations and help water users recognize the value of water. The ultimate goal of water conservation is to maximize the benefit from each gallon used, while not preventing water use.

This water conservation implementation plan (WCIP) is a resource for Georgia's diverse water users, regional councils, state-wide associations and

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[1] "Understanding the Georgia Public's Perception of Water Issues and the Motivational Messages to which they will respond – Final Report." Conducted for the Georgia DNR, P2AD by Responsive Management. Available online at http://www.p2ad.org/documents/wa_messaging.html

[2] Georgia Comprehensive State-wide Water Management Plan. Section 2: Definitions (40) and Vickers, A. 2001. *Handbook of water use and conservation: homes, landscapes, businesses, industries, farms.* WaterPlow Press. 446 pgs.

organizations, and state agencies. For most water users, the WCIP helps identify practical ways to conserve water. For regional water councils, the WCIP helps evaluate and identify practices appropriate for the water users within their region. For state-wide associations, organizations and agencies, the WCIP helps organize water management efforts to achieve common goals.

The WCIP is built upon seven foundational water conservation goals that will advance the water users of the state toward greater efficiency, and will foster a culture of conservation in Georgia. This plan also outlines water conservation goals that are specific to each major water use sector in the state (see Chapters 2 through 8 for details). All of these goals within the WCIP have been developed with assistance from state agencies and individuals from the major water use sectors.[3]

Water in Georgia

The United States Geological Survey (USGS— www.usgs.gov) estimates that Georgians withdrew approximately 5.5 billion gallons of water a day from our surface waters and aquifers in 2005[4], enough water to fill about 15 Georgia Domes with fresh water every day.[5] This amount of water supports a state gross domestic product (GDP) of about $397 billion[6], making Georgia the 10th largest economy in the country.[7] Water is critical to sustaining this healthy economy and maintaining a high quality of life for Georgia citizens.

The water withdrawn from Georgia's surface waters and aquifers supports a broad range of uses, which this plan categorizes into seven major water use sectors. Although the terms water withdrawal and water use are often used interchangeably, the two have different meanings, especially across sectors. *Water withdrawal* is defined as the removal of water from a natural water body, such as river, stream or aquifer.[8] *Water use* is defined as the utilization of water

[3] For information on the process to develop the WCIP, see Appendix B of the WCIP, and for a list of individuals who contributed to the process, see Acknowledgements section of the WCIP.
[4] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002. Estimates of state-wide water use for those sectors not included in USGS were estimated by the Georgia EPD using water use reports submitted to the Watershed Protection Branch of Georgia EPD in 2007 and other sources. Details on calculations and assumptions used in estimates are available in Appendix A of the WCIP.
[5] Personal communication Ashley Boatman, Public Relations Specialist with the Georgia Dome. November 3, 2008.
[6] According to the U.S. Department of Commerce, Bureau of Economic Analysis, GDP by state, or the state's value added, is the state counterpart of the Nation's gross domestic product (GDP). GDP by state is derived as the sum of the GDP originating in all the industries in a state. Data available online at http://www.bea.gov/regional/gsp/
[7] U.S. Department of Commerce, Bureau of Economic Analysis. Gross Domestic Product by State (GDP by State) Interactive Map. June 5, 2008. http://www.bea.gov/regional/gdpmap/GDPMap.aspx
[8] See O.C.G.A. Section 12-5-31

for natural and human uses.[9] This plan uses the term *water use* to refer to water for a particular purpose (such as irrigation, washing or cooling). Water that is used or reused may be obtained from a direct water withdrawal from a stream, aquifer or reservoir, or may be obtained from a water provider. After water is used, some portion of that water is usually returned to the source. Consumptive use is the difference between the total amount of water withdrawn from a water body, and the total amount of that withdrawn water that is returned to that same water body over a specified period of time.[10]

Throughout our state's history, Georgia's diverse water users and state economy have benefited from opportunities to withdraw water to meet growing demands. Between 1980 and 2000, Georgia's population grew from 5.5 to 8.2 million citizens, [11] about a 50% increase. Over the next 20 years, Georgia's population is projected to continue this trend of substantial growth.[12] With Georgia's projected population and economic growth, we can expect greater demands and withdrawals from our water resources.

While abundant, Georgia's water resources are finite. Improperly managed withdrawals and excessive consumptive use can negatively impact Georgia's water bodies, our water uses and the environmental services our waters provide. Because drought occurs in Georgia, proper management of water withdrawals is important to help optimize flows in rivers and streams. Due to extreme drought conditions, many of Georgia's rivers, streams and reservoirs are currently, or have recently been, at record lows.[13] When stream or reservoir levels fall or when the volume of water flowing in streams decreases substantially, water bodies lose their capacity to dilute and assimilate pollutants, like wastewater and toxins. This can, in turn, increase the cost of treatment for human use and increase the threats to aquatic and riparian ecosystems.

Georgia also faces uncertainty regarding impacts that global climate change may have on our region's climate conditions. Scientists around the world believe that changes in the climate may have negative impacts on water supply reliability, flood risk, and ecosystem health.[14] They warn that current water management practices are likely to be inadequate in the face of changing patterns of temperature and rainfall.

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[9] Georgia Comprehensive State-wide Water Management Plan. Section 2: Definitions.
[10] Georgia Comprehensive State-wide Water Management Plan. Section 2: Definitions
[11] U.S. Census Bureau - http://www.census.gov/
[12] Nelson, A. C. 2004. "Toward a new Metropolis: The Opportunity To Rebuild America." Virginia Polytechnic Institute and State University. A Discussion Paper Prepared for The Brookings Institution Metropolitan Policy Program. December, 2004. 51 pgs.
[13] National Weather Service http://www.srh.noaa.gov/printable.php?pil=DGT&sid=FFC&date=2009-03-11%2020:16:27 and USGS Real Time Water Data for Georgia http://waterdata.usgs.gov/ga/nwis/rt
[14] Kundzewicz, Z.W., L.J Mata, .W. Arnell, P.Doll, P.Kabat, B. Jimenez, K.A.Miller, T. Oki, .Sen and I.A. Shiklomanov, 2007: *Freshwater resources and their management. Climate Change 2007: Impacts, Adaptations and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E.Hanson, Eds., Cambridge University Press, Cambridge UK, 173 –210.

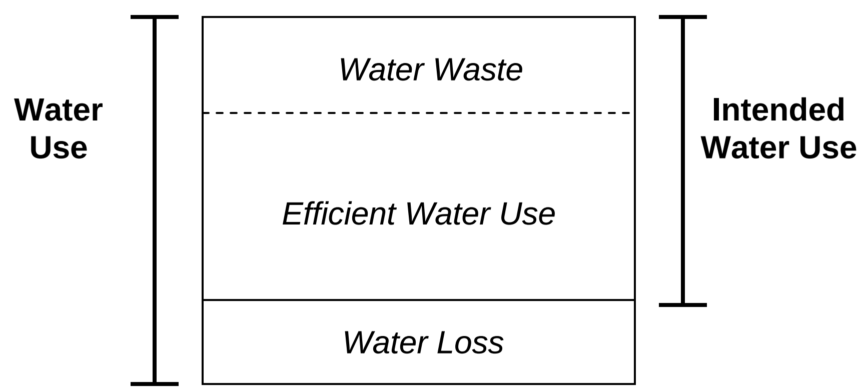
Looking ahead Georgians must change the way we use water every day and improve how we manage our water resources. By prioritizing efforts to conserve water and maximize water efficiency, we can protect our finite resources without causing harm to the economy or the quality of life that current and future Georgians enjoy.

Benefits of Water Conservation

Water conservation is no longer considered an incidental component of water management. Case studies, research projects and programs throughout the world have documented that water conservation is a powerful demand management tool that can extend the life of existing supplies, eliminate the need for costly new or expanded supplies, lower water treatment costs, and preserve water for recreational and environmental needs and future economic development or environmental opportunities.[15]

The ultimate goal of water conservation is not to prevent water use, but to maximize efficiency and the benefit from each gallon used. Efficient water use is considered the minimal amount of water that is technically and economically feasible to achieve an intended water use function.[16] Efficient use can be maximized by implementing water conservation efforts to 1) reduce water waste, which is water that meets an intended use, but may not be considered efficient; 2) reducing water loss, which is water that does not make it to an point of intended use, usually due to leaks or faulty equipment, and 3) reducing efficient water use, which when necessary, can be accomplished through the use of new or high-efficiency technology or changing water-using behavior. The diagram below demonstrates the general is general relationship.

Diagram 1A *– Water use = intended water use (efficient water use + water waste) + water loss.*



[15] U.S. EPA. 2002. "Cases in Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs." Office of Water EPA832-B-02-003. 2002; Pacific Institute. 2003. *Waste Not, Want Not: The Potential for Urban Water Conservation in California* www.pacinst.org; AwwaRF and U.S. EPA 2007. *Water Efficiency Programs for Integrated Water Management.* *www.awwarf.org*

[16] Georgia Comprehensive State-wide Water Management Plan. Section 2: Definitions, (47) "Water use efficiency"

Though conservation does entail some expense, it is a highly cost-effective water management practice when compared to major structural practices such as building reservoirs, transferring water and boring new wells. To experience the array of benefits water conservation offers, it should be fully integrated into a mix of water management strategies and implemented as a cost-effective, long-term water management practice.

The benefits of water conservation are realized on several levels. Businesses can streamline operations and reduce operating costs through water-conserving technologies. Water providers can significantly reduce water treatment and production costs when investments are made to address water lost within their treatment and delivery system. Landscapes can be less vulnerable to drought conditions when they are designed for efficiency and the plants positioned to require less water.

When observed more broadly, the benefits of water conservation take on added significance. At the regional level, investments in water conservation today may afford water users in the same region the opportunity to provide water to more users in the future. At the watershed level, reducing the volume of water drawn from a river or stream can preserve aquatic environments and recreational opportunities of that river or stream.

State-wide, the benefits of water conservation can manifest themselves in a variety of ways. In terms of economic development, emphasizing water conservation can promote responsible management of limited resources. In areas where resources are not currently limited, water conservation practices can ensure that water can support current and future uses. A state-wide commitment to conservation also promotes equity across regions and across water use sectors.

On all levels, water conservation can help preserve our ability to thrive. Efficient water use across all major water use sectors will help ensure that we have the water to meet future needs as our population and economy grows.

State-wide water planning: A context for water conservation

In February 2008, the Georgia legislature adopted the state's first Comprehensive State-wide Water Management Plan (SWP — www.GeorgiaWaterPlanning.org). The SWP introduces a state-wide vision for water resource management and endorses water conservation as a valuable tool for achieving that vision.

The SWP establishes a four-step planning process. First, the Georgia Environmental Protection Division (EPD – www.gaepd.org) will conduct water resource assessments to define the capabilities of Georgia's water resources in terms of water supply and capacity to assimilate pollution. Second, a regional water planning council will be responsible for using regional population and employment estimates to forecast needs for water and assimilative capacity within a water planning region. Third, regional water planning councils will prepare a draft regional water development and conservation plan (WDCP), that will identify the management practices to be employed to ensure that the forecasted water and wastewater needs can be met without exceeding the capacities identified in the resource assessments. The regional water management plans will be reviewed by EPD, and if they are consistent with established guidance, adopted by EPD. Once the plan is adopted, the fourth step of the process is for water users in the planning regions to implement the WDCPs and EPD to make water permitting decisions based on the plans.[17]

Among other policies, the SWP defines a water quantity policy to manage consumptive uses of surface water and groundwater, alterations of flows through reservoir operations, water withdrawals, storage, and other actions that affect flow regimes, to ensure that current water needs are met without unreasonably foreclosing the ability of future generations to meet their own water needs.[18] Although the term consumptive use has many different definitions, the SWP defines it as "the difference between the total amount of water withdrawn from a defined hydrologic system of surface water or groundwater and the total amount of the withdrawn water that is returned to that same hydrologic system over a specified period of time."[19]

The SWP identifies three major categories of water quantity <u>management practices</u> that can be employed to help manage consumptive use. These include demand management practices (i.e. water conservation and water reuse), return management practices (i.e. centralized wastewater treatment, on-site sewage management and land application systems), and supply management practices (i.e. water supply reservoirs and interbasin transfers.) While water conservation alone is not expected to fully meet future water needs, water conservation is recognized as an effective and efficient management practice to meet some needs for all water users in the state.[20] Of all the practices discussed in the SWP, water conservation is described as, "…a priority water quantity management practice implemented to help meet water needs in all areas of the state, and will be practiced by all water use sectors."[21]

The SWP calls on the Georgia Department of Natural Resources (DNR – www.gadnr.org) to lead the development of a water conservation implementation plan (WCIP), with assistance from stakeholders from multiple water use sector. The plan is to include elements, such as goals, benchmarks and practices that will help Georgia's diverse water use sectors achieve greater water use

[17] Georgia Comprehensive State-wide Water Management Plan. Section 1: Purpose
[18] Georgia Comprehensive State-wide Water Management Plan. Section 4: Water Quantity Policy (2)
[19] Georgia Comprehensive State-wide Water Management Plan. Section 2: Definitions
[20] Georgia Comprehensive State-wide Water Management Plan. Section 8: Demand Management Practices, Policy (1)
[21] Georgia Comprehensive State-wide Water Management Plan. Section 7: Water Quantity Management Practices, Policy (3)

efficiency. It is also to identify state resources and funding mechanisms to achieve water conservation goals and to provide guidance on flexibility in implementation and reporting for smaller permittees and resorting of progress toward water conservation goals.[22] Further emphasizing the importance of planning for more efficient water use, in October 2007 and October 2008, Governor Sonny Perdue issued Executive Orders directing the DNR to develop a water conservation plan to help state agencies and others conserve water.[23]

The SWP also anticipates that the WCIP will inform a water conservation rule-making process to be conducted by the DNR Board. It recommends that after the WCIP is completed, the DNR Board should consider amending its rules and regulations related to:

- water conservation requirements for applicants for non-farm water withdrawal permits or permit modifications to demonstrate progress toward water conservation goals initially identified in the WCIP;[24] and
- reporting requirements for water withdrawal permittees and drinking water providers.[25]

The SWP provides examples of three options that can be used to demonstrate progress toward water conservation goals.[26] The first option applies to those entities applying for a new permit and focuses on establishing a reasonable water conservation plan for the facility or service area. The second option applies to entities with existing water withdrawal permits and focuses on demonstrating or reporting results or levels of efficiency that have already been achieved through previous conservation investments. The third option also applies to entities with existing water withdrawal permits, allowing applicants to demonstrate that they are implementing conservation practices appropriate for their service area or operation (see page 23 for more information on how the WCIP will be used).

[22] Georgia Comprehensive State-wide Water Management Plan. Section 8: Water Demand Management Practices, Implementation Action (1)
[23] Executive Orders related to the WCIP were issued on October 24, 2007 and October 31, 2008, and can be found at http://gov.georgia.gov
[24] Georgia Comprehensive State-wide Water Management Plan. Section 8: Demand Management Practices, Implementation actions (2)a, (2)b, (2)c, and (2)d
[25] In accordance with DNR Rules 391-3-6-.07(4)(viii); 391-3-6-.07(15)(e) and 391-3-5-.17(7)
[26] Georgia Comprehensive State-wide Water Management Plan. Section 8; Implementation action 2(a)

WCIP – A comprehensive resource to guide Georgia to efficient water use and conservation

Major elements of the WCIP

The WCIP provides a framework of water conservation goals, benchmarks, practices and actions designed to foster a culture of conservation among Georgia's diverse water users. As demonstrated in each sector-specific chapter (chapters 2 through 8), the framework is flexible. It is designed to help water users within a particular sector choose the benchmarks and practices appropriate for their situation and current level of efficiency and to encourage multiple levels of assistance from a host of organizations and associations. The framework has four major elements:

- ***Water conservation goals***

  Water conservation goals are sector-specific, long-term aspirations for water use and efficiency. The goals are not one-size-fits-all targets for reductions in water use; they were designed to be flexible, so that they are applicable for users with differing circumstances and recognize prior investments in conservation.

- ***Benchmarks***

  Benchmarks are quantifiable metrics of efficiency. These measures can help determine progress toward a long-term water conservation goal. In cases where additional data are necessary, time-oriented activities are the benchmarks to help determine progress toward a particular water conservation goal.

- ***Best Practices: A Menu of Options***

  The best practices: menus of options are compilations of practices that those within the water use sector can implement to achieve benchmarks and reach goals. The water conservation practices included in the menus are considered to be generally cost-effective and applicable for Georgia water users. Inclusion of practices in the WCIP, however, does not imply that all users within a sector should implement each practice. Each water user should evaluate the practices in the menu to determine those that are cost-effective and beneficial to them.

- ***Implementation actions***

  The implementation actions identified throughout the WCIP include activities, such as providing technical guidance or financial assistance or evaluating general conservation trends. When resources are available, the implementation actions can be taken by state agencies, associations, organizations and other groups to support the implementation of practices.

How the WCIP will be used

The WCIP is a resource to guide decisions related to water use and water management. The elements described in this plan can be used by anyone who has a responsibility for or an interest in conserving water. As an implementation plan, the WCIP has four primary functions:

- Educating water users about water conservation practices and the goals they can accomplish,
- Informing regional water plan preparation that will be overseen by regional water planning councils,
- Helping water use sectors collectively improve water use efficiency, and
- Informing DNR rule-making regarding water conservation requirements in permitting.

Educating water users.

One function of the WCIP is to inform water users about attainable conservation goals they, individually, can strive to achieve. Each chapter contains a menu of water conservation practices that can be implemented to help water users within that sector achieve their benchmarks and goals. The menu provides individual water users many options that can conserve water and, in some cases, save money. As stated before, many of the benefits of water conservation are realized at the individual level.

Informing regional water plan preparation.

The WCIP provides information for the regional water planning councils as they oversee the preparation of regional water development and conservation plans (WDCPs).[27] The regional water planning councils will utilize the elements of the WCIP to inform forecasting efforts and the selection of appropriate regional water management practices.

The regional water councils will use the WCIP as they select a range of possible water demand forecasts for a water planning region. The range of projected demands will be based on a set of assumptions, including assumptions regarding regional water conservation goals. The goals in the WCIP can be used to initially define the low-end of the water demand forecast spectrum. From the range of projected water demand, regional water planning councils can select a realistic forecast for planning purposes, specifying the expected level of water conservation to be employed.

[27] Georgia Comprehensive State-wide Water Management Plan. Section 14: Regional Water Planning. For more information on regional water planning process, visit http://www.georgiawaterplanning.org/Documents/regional_water_planning.html

After the regional assessments and forecasting are completed, and a gap exists between the forecasted demand and available water supplies, the water planning council must decide which water quantity management practices can help close the gap.[28] In this situation, the WCIP can be used to identify additional water conservation practices or investments in efficiency that may not have been used in the forecasting exercise. The regional water councils will work through planning exercises to determine the mix of water management practices most appropriate for their region. Determining the appropriate mix of practices may include the consideration of cost of implementation to achieve a certain volume of water saved or developed. To assess the benefit of water conservation, regional councils should consider the cost per unit of saved water or reduced demand and compare it to the cost per unit of developed water that can be achieved from the other water quantity management practices. This analysis will allow planning councils to equitably consider water conservation in the analysis and select the most cost-effective mix of management practices for their region.

If a gap does not currently exist between forecasted demand and available supplies, there still may be shortfalls in supply or unexpected growth/demands in the future. The water planning councils can use the WCIP to identify activities that can help minimize the region's vulnerability in times of water shortage, if and when, they do occur. These types of activities can help sustain a region's water resources and ensure that resources will be available in the future.

Helping sector members work together.

The WCIP recommends implementation actions that can be taken by the associations and organizations affiliated with each sector. By including these actions, the WCIP serves as an educational and organizational tool for Georgia's major water use sectors by guiding the collective effort to improve water efficiency across the sector. Major water use sectors can benefit greatly not only from conserving on the individual level, but through a growing culture of conservation within their sector. When the majority of users within the sector join the effort to conserve water, new strategies and technologies for conserving water will be developed and adopted more quickly. In addition, as Georgians become aware of the importance of water conservation, water use sectors can benefit from showing themselves to be leaders in the drive to sustain water resources.

[28] The SWP identifies three major categories of water management practices: supply management practices (i.e. drinking water reservoirs), return management practices (i.e. interbasin transfers and sewage treatment options), and demand management practices (i.e. water conservation.)

Informing DNR rule-making regarding water conservation requirements in permitting.

The SWP recommends that after the WCIP is completed, the DNR Board should consider amending its rules and regulations related to water conservation requirements for entities with water withdrawal and drinking water permits. The WCIP will not be incorporated into DNR rules and regulations. As stated in SWP Section 8, implementation action (2), the WCIP can be used to initially identify water conservation goals or water efficiency standards that can be further refined in regional water development and conservation plans.[29]

The formal DNR rule-making process is scheduled to occur after the completion of the WCIP.[30] The rule-making process will be coordinated by EPD and will follow the public involvement protocol outlined by the DNR Board Public Involvement Task Force Resolution adopted in 2003, and updated in the report of the re-convened task force.[31]

Updating the WCIP and reporting progress

EPD will publish an annual report indicating the status of progress on implementing the elements of the WCIP. Also, the WCIP will be reviewed and revised every five years as part of the cycle to update the SWP, and new data and technology will be incorporated. The DNR will coordinate the revision process with assistance from other state agencies and Georgia's diverse water use sectors. Updated WCIPs will be made available to help regional water councils revise the regional WDCPs.

In addition the to the regular five year updates, EPD may periodically update the WCIP with supplemental information to ensure Georgia's water users and regional water planning councils have the most accurate information. Comments and/or suggestions regarding topics EPD might consider including in these updates and/or supplemental information may be addressed to WCIP@dnr.state.gov, with WCIP in the subject line.

[29] Georgia Comprehensive State-wide Water Management Plan. Section 8: Implementation action (2)
[30] Georgia Comprehensive State-wide Water Management Plan. Section 8: Implementation action (2)
[31] DNR Board Public Involvement Task Force Resolution, adopted August, 2003. Report of Re-convened Public Involvement Task Force presented in October, 2005.

Creating a Culture of Conservation

The WCIP is designed to foster a culture of conservation across the state, across water use sectors, and across generations. This culture of conservation is one that encourages Georgians to more fully appreciate our natural resources and actively participate in their protection. Georgia's culture of conservation should strengthen our individual and collective commitments to water conservation as an effective way to sustain water resources for current and future generations.

This culture of conservation can be realized through the pursuit of seven foundational water conservation goals, which are reflected throughout the sector-specific chapters. With all water use sectors working together, Georgia can conserve precious water resources. Taken together, these goals and resource strategies comprise a vision for Georgia's future in which water is used efficiently to help sustain Georgia's water resources.

The seven foundational water conservation goals that permeate each chapter of the WCIP are:

1. Educate and empower Georgia's water users

Educating and empowering Georgia's current and future water users is central to sustaining our water resources. The various activities in the WCIP related to water conservation education and outreach are intended to create in water users a deep understanding of the importance of conserving and to empower water users with the tools necessary to make better decisions about their water use.

Education and outreach efforts should foster an understanding, not only among those within the same water use sector, but also among the public at large. Educational efforts should also build appreciation for the multiple uses to which water is put in this state, the challenges to the water resources, and the steps that can be taken to use less water. This plan identifies many of the educational resources that are already available and that can be tailored to a community's specific situations. State agencies, non-governmental organizations, and professional associations all play a role in implementing educational programs and disseminating information to Georgia's diverse water users.

2. Create incentives to encourage water use efficiency

Water conservation can result in significant benefit for individual water users and for the community at large. In many cases, users lack the financial and technical resources to initiate a successful water conservation program or implement a water conservation practice. State agencies and organizations and associations affiliated with major water use sectors should consider instituting new programs or enhancing existing programs that provide financial incentives, funding or technical assistance to water users interested in water conservation. State-wide or regionally, such programs can help sustain water resources for the overall benefit and long-term protection of Georgia's farms, businesses, and industries. Financial incentives, such as conservation-oriented rate structures for customers of public water providers, can help Georgians understand the value and cost of sustaining healthy water supplies.

In addition, recognizing those water users within each water use sector who have made significant strides toward water conservation goals and achieved high levels of water efficiency can be highly effective at promoting a culture of conservation. While this plan recommends a variety of programs to certify and encourage advances in water efficiency, every effort should be made by state leaders, agencies and organizations to acknowledge the accomplishments of Georgia's efficient water users.

3. Enhance data collection, monitoring, research and evaluation

Improving the collective understanding of water use, efficiency and conservation is critical to improving how we manage our water resources. This plan encourages further study of water use, water conservation practices, and the effect of water conservation investments, so that water users are able to make the best possible decisions when managing water supplies. Throughout the WCIP, research institutions, professional associations and state agencies are encouraged to support building a stronger scientific foundation of the science of water conservation in Georgia.

4. Measure water use efficiency

In order to judge how water is being used and evaluate the effectiveness of water conservation practices, water users must have ways to measure water efficiency. Water efficiency metrics vary across water use sectors, so no single way to measure efficiency exists. For example, water users in the industrial and commercial sector are able to measure the amount of water used for each unit of output. However, this metric is not useful for the agricultural sector, since natural rainfall greatly affects the amount of irrigation that will be necessary.

This plan, in addition to recommending data needs and listing water conservation practices, discusses the optimal ways to measure the effect of water conservation practices.

5. Plan for the future

When properly integrated into a variety of management plans, water conservation can help prepare for an uncertain future. Water users within all sectors prepare various kinds of management plans so that they can be prepared to meet future challenges (such as resource limitations or growing demands for a particular product). The WCIP calls for water users within all sectors to integrate water conservation goals and practices, as well as their potential costs and benefits, into long-term plans to ensure all sectors continue to advance towards more efficient water use.

6. Integrate water conservation and energy conservation

Water use and production are intertwined with energy use and production. Large amounts of water are needed to produce energy at thermoelectric power plants, and significant energy is used to treat and transport water to customers. In our homes and businesses, much of the energy used for domestic purposes is to heat water in kitchens and bathrooms. Also, farmers can use large amounts of energy and fuel to pump and deliver water to crops. Each is dependent on the other, but energy and water are rarely integrated in state-wide plans and policies.

Today, our understanding of the relationship between energy and water is limited by a lack of data. There are efforts underway to fill this information gap.[32] During the development of the State Energy Strategy for Georgia, Energy Council members identified the interrelationship between water and energy as an important area of policy concern.[33] Also, one of the policy objectives identified by the State Energy Strategy is to minimize energy production's impacts on water supplies.

The WCIP is an opportunity to build on the State Energy Strategy in addressing issues related to water and energy, focusing specifically on the intertwined relationship of energy and water conservation efforts. Where appropriate, the WCIP addresses energy issues by encouraging 1) the assessment of the feasibility of integrating water and energy demand planning; 2) partnerships to build the information critical for make informed decisions related to the management of Georgia's finite natural resources; and 3) the education of Georgia citizens about the benefits of conserving Georgia's energy and water resources.

The relationship between energy and water is complex, and warrants further research. It is clear, however, that integrating energy and water solutions will become increasingly vital to help sustain resources

[32] For example, in the US Congress a bill, known as the "Energy and Water Integration Act of 2009," was introduced in early 2009 to provide for an in-depth analysis of the impact of energy development and production on the water resources of the United States. For a copy of the draft bill, visit: http://energy.senate.gov/public/_files/S531EnergyH2OIntegrationActIS0.pdf Similarly, the World Economic Forum's "Energy Vision Update 2009" acknowledges that while energy and water challenges are global, the water solutions are, in fact, local. The report states that translating global water worries into local solutions will require not only increasing awareness of the water challenge but also better understanding of the complex relationship between water and energy. See the World Economic Forum "Energy Vision Update 2009. Thirsty Energy: Water and Energy in the 21st Century.

[33] The Georgia Energy Strategy can be found online at http://www.georgiaenergyplan.org

and support a range of water uses in light of our state's growing population and economy.

7. Secure funding to implement water conservation

Implementing water conservation requires capital investment, and building a culture of conservation will require investment from all water use sectors and water users. State-level funding is necessary to provide consistent and reliable training and technical assistance to water users as well as financial incentives to encourage greater water efficiency. At the regional level, funds can be used to staff positions to help water planners and water users within a region implement water conservation practices in their homes and businesses. Locally, funding is critical to the implementation of a water conservation program (such as a retrofit program or change in billing structures).

Fortunately, there are a variety of funding sources and professional assistance programs available to help water users, agencies, and organizations implement water conservation practices. Federal funds are available through loans and grants issued by the Georgia Environmental Facilities Authority (GEFA – www.gefa.org). Specifically, water providers can take advantage of the Clean Water and Safe Drinking Water State Revolving Funds (SRF) to replace water meters, fix leaks and retrofit inefficient devices.[34] Homeowners and businesses throughout the state can purchase water efficient products (costing not more than $1,500.00) free of state and local sales taxes during designated sales tax holiday.[35] Also, manufacturing businesses are eligible for either tax credits or tax exemptions for upgrades or expansions to facilities designed to conserve water. Eligible projects are those that cost more than $50,000 and will result in a ten percent reduction in ground water use.[36] Also, state agencies, such as the Cooperative Extension, DNR and the Department of Community Affairs (DCA – www.dca.state.ga.us), and some state-wide professional associations, like the Georgia Water Wise Council (GWWC – www.gwwc.org), have experts available to assist with the implementation of water conservation efforts.[37]

Additionally, federal funds have recently been allocated to help communities and utilities invest in efficiency practices (both water and energy efficiency). The American Recovery and Reinvestment Act of 2009 provides competitive loans and grants to help communities and utilities

[34] EPA 2003. Fact Sheet "Funding Water Efficiency Through The State Revolving Fund Programs." EPA 816-F-03-022. Available online at http://www.epa.gov/OGWDW/dwsrf/pdfs/fact_dwsrf_water_efficiency03-09-02.pdf

[35] For a description of the 2008 sales tax holiday, visit http://www.etax.dor.ga.gov/salestax/holiday/energy_holiday.aspx

[36] O.C.G.A. §§ 48-7-40 and 48-8-3(36.1A) et seq.

[37] Cooperative Extension and DNR waterSmart program - www.ConserveWaterGeorgia.net, and the Pollution Prevention Assistance Division www.p2ad.org. DCA WaterFirst program -

throughout the country invest in water efficient programs. Of the $6 billion appropriated for local infrastructure improvements, 20% is designated for projects that "…address green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities." [38]

On-going investments in water conservation will require water users at all levels from all sectors to invest resources and time to gain from the many benefits water conservation can provide. Unfortunately, no general pool of funding is available to assist all Georgia water users interested in water conservation projects. Where funding sources are available, they are often sector-specific, and in many cases activity-specific. Where appropriate the WCIP identifies the funds and resources that are available to water users within the sector-specific chapters.

[38] For a copy of the Act, visit http://thomas.loc.gov/home/bills_res.html and type in "American Recovery and Reinvestment Act of 2009."

Water Use Data

Data Sources

The WCIP draws on two sources of data regarding water use in Georgia. The first and primary source of data is the January 2009 USGS report, *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*.[39] Although the USGS water use categories do not align with the water use sectors identified for the WCIP, the information presents a reliable and historical picture of water use and water use trends in Georgia.

The USGS report also presents estimates of the percentage of water withdrawals that are considered consumptive for some water use categories, including agricultural irrigation, electric generation, industrial and commercial, and self-supplied domestic uses. While the consumptive use estimates are calculated using water withdrawal amounts and coefficients specific to each water use category, the USGS estimates are state-wide and do not reflect the variations that occur among Georgia's diverse water users. In sectors in which the variations that can occur based on the type and location of use are exceptionally high, state-wide estimates are not available. In future iterations of the WCIP, this information gap is likely to be filled using data collected through the regional water planning efforts.

The secondary source of water use data is the Georgia EPD Watershed Protection Branch. These data are used to estimate water use for those water use sectors not included in the USGS Water Use Report (such as golf courses, landscape irrigation, state agencies). Georgia EPD estimates are calculated using data from water withdrawal reports and fact sheets submitted to EPD by permitted water users. EPD also supplemented gaps in information using similar data collected by resource agencies in other states.

Trends in Water Use

According to the USGS, total water use in Georgia in 1980 reached an all time high of 6.7 billion gallons a day. By 1990 water use had decreased to 5.4 billion gallons a day; and in 2000 had increased to 6.5 billion gallons a day.[40] By 2005, total water use had decreased to 5.5 billion gallons a day. The decrease between 2000 and 2005 is primarily due to declines in thermoelectric power generation and declines in demand for public supply.[41]

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[39] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

[40] Fanning, J. 2003. *Water Use in Georgia by County for 2000 and Water use trends for 1980-2000*. GA DNR, EPD and GGS in cooperation with U.S. Geological Survey. Information Circular 106. Atlanta, GA. 176 pgs.

[41] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

USGS also reports that since 1980, the water use sector that has consistently withdrawn the largest amount of water has been thermoelectric power generation. Water withdrawals for agricultural irrigation have changed with weather and hydrologic conditions, with greater volumes being withdrawn during dry years and decreased withdrawals during wetter years. Industrial water use decreased between 1980 and 2005.[42] This change is most likely due to increased efficiency within existing operations and to a shifting mix of industrial water users (e.g. Georgia has experienced significant growth in the information and telecommunications industries which are less water intensive than traditional industries which include pulp and paper, food processing and textiles/carpet manufacturing). [43]

The public sector, which includes domestic uses and some commercial and industrial uses, is the second largest water use sector in the state. Public sector withdrawals grew steadily between 1980 and 2000, increasing from 718 to 1,245 million gallons per day (mgd). In 2005, water withdrawals for public supply decreased slightly to 1,180 mgd, most likely due to increasing conservation efforts and a decline in outdoor water uses[44] (since 2005 was a normal year for precipitation compared to the drought year of 2000). This sector's water demands and withdrawals are expected to continue to grow as our state's population grows.

Water Use by Sector

All water users have a role to play in conserving Georgia's water resources, but the manner of conservation will vary based on the type of water use. Chapters 2 through 8 outline water use and water conservation efforts specific to Georgia's major water use sectors listed below.

Agricultural Irrigation (Chapter 2)

Agricultural water use includes water used on farms for the production of food or fiber, as well as the water used by commercial nurseries and greenhouses with agricultural water withdrawal permits.

State-wide agricultural water use is estimated to be about 752 mgd on an average annual basis.[45] USGS estimates that 100% of the water

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[42] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

[43] http://www.georgia.org/Business/Industries/ and U.S. Department of Commerce, Bureau of Economic Analysis - Gross Domestic Product by State www.bea.gov/regional/gsp

[44] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

[45] Ibid.

withdrawn for agricultural irrigation is consumptive,[46] however it is generally understood, that depending on the region, some amount of water does return to the source from which is was withdrawn. The majority of irrigated agricultural lands are located in the Coastal Plain of the state.

Agricultural irrigation needs vary by season, and the highest water use occurs during the crop-growing season, April through October. As a result, during these peak irrigation months in regions with a large amount of agricultural land, agricultural irrigation can be disproportionately large compared to other uses.

Electric Generation (Chapter 3)

This water use sector includes thermoelectric power plants (i.e. fossil fuel and nuclear power plants) that use heat to generate electricity. This plan does not address hydroelectric power plants, which do not remove water from the source.

Thermoelectric power plants withdraw about 2.7 billion gallons of water per day on an average annual basis from Georgia's water bodies. USGS estimates that for plants currently operating in Georgia, the amount of water consumed due to evaporation ranges from less than 1% to as much as 70%, depending primarily on the type of plant cooling system used.[47]

The activities outlined in this chapter are directed at two audiences, the utilities that provide electricity to customers and those customers who use electricity in their homes and businesses.

Golf Courses (Chapter 4)

The golf course water use sector includes water used for maintenance, management and construction of golf courses. Sod produced on farms for installation on golf courses is covered in the agricultural irrigation chapter.

The 242 golf courses in the state use an estimated 36 mgd on an average annual basis.[48] Although golf course water use only accounts for a small percent of total water withdrawals in the state, their use, like agricultural irrigation, varies seasonally. The growing season for turfgrass

[46] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

[47] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

[48] The formula and water use data for this estimation was provided by the Georgia Golf Course Superintendents Association (September 2007). Total permitted golf courses based on EPD permits = 242. CALCULATION: [(27,154 gallons/acre-inch)(100 acres/permitted golf course)(242 permitted golf courses)(20 inches/year)] / 365 days/year = 36 mgd. See Appendix A of the WCIP for more information.

is April through November, and during these months golf course irrigation can be disproportionately large compared to the other water use sectors within a region (especially in regions with a large number of golf courses). Water used by golf courses tends to be highly visible to the public and provide the golf industry the unique challenge and opportunity to demonstrate water conservation efforts.

Industrial and Commercial (Chapter 5)

The industrial and commercial water use sector includes large and small facilities that employ practices for cooling, heating and processing. This water use sector includes mining activities, but does not include institutions that are owned or operated by the state (like prisons or universities). Institutions are included in the state agencies' water use sector.

Industrial, commercial and mining facilities that supply their own water withdraw approximately 633 mgd on an average annual basis.[49] Actual water use by industrial and commercial facilities may exceed this amount since many facilities do not hold a withdrawal permit, but purchase water from a public or private water provider. Consumptive water use for industrial and mining facilities will vary depending on the type of industry or the type of mining activity.

Landscape Irrigation (Chapter 6)

Landscape irrigation includes water used to irrigate residential and commercial landscapes and is estimated to be 181 mgd on an average annual basis.[50] Like water use for agriculture and golf courses, landscape irrigation varies significantly season to season, with the greatest use occurring in summer months. To the extent that public or private water providers supply the water, landscape irrigation can cause peaks in water demand, stretching the capacity of water treatment and delivery and of water supplies. Also, numerous practices and high-efficiency technologies are emerging for landscapes and irrigation systems. For these reasons, landscape irrigation is addressed as a major water use sector in the WCIP.

[49] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002. This estimate includes USGS water use categories of industrial, commercial and mining.

[50] The estimated annual average water use for landscape irrigation is based on data reported to the EPD from the 55 counties under Drought Response Level 4. The estimate was calculated using reported annual average water use calculated as the difference between water use during Nov. 2006 – Oct. 2007 and water use during Nov. 2007 – Oct. 2008. The difference reflects the changes in water use as a result of the outdoor water use ban that became effective in Oct. 2007. The difference was multiplied by the population ratio of the whole state to the 55 counties, with an adjustment for estimated water use for outdoor non-irrigation purposes. See Appendix A of the WCIP for more information.

The activities that can help conserve water used for landscape irrigation are targeted at landscape and irrigation professionals involved in installing and maintaining landscape features, as well as businesses and homeowners who choose to irrigate their landscapes. Also, some of the activities in the landscape irrigation chapter pertain to water providers and local governments who may play a roll in supplying water used for irrigation.

Domestic and Non-Industrial Public Uses (Chapter 7)

Domestic and non-industrial uses included in this sector are primarily water uses for residential and commercial purposes, such as water used in bathrooms, kitchens, and laundries in homes and businesses.

Water use for domestic and non-industrial commercial purposes is often referred to as public supply water. About 1.1 billion gallons of water a day on an average annual basis is withdrawn for public supply and domestic uses. This estimate is reached using USGS numbers for both public supply water and water provided for domestic use through private wells or water systems (termed "self-supplied domestic uses")[51], and subtracting EPD's estimates for the volume of water used by state agencies and for landscape irrigation. However, this estimate is calculated using data from water providers that may also deliver water to industrial customers. Therefore, it is most likely an over-estimate of the volume used on an average annual basis.[52]

The activities outlined in this chapter are intended for water providers that supply water to the public (often referred to as municipal water providers) and local governments that have direct contact with the water customers and may play a role in setting water rates.

State Agencies (Chapter 8)

The state agency chapter addresses state-owned facilities (such as state office buildings, universities and prisons), with some provisions for property leased by agencies. Water used by these agencies totals approximately 11 mgd on an average annual basis.[53] The majority of

[51] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002.

[52] Data on water withdrawals for public uses in Georgia is gathered and reported collectively. Domestic and non-industrial uses are normally not broken out from large commercial uses, landscape uses or industrial uses that may be supported by water providers.

[53] Few state agency facilities hold water withdrawal permits. This estimate was calculated using water use data from the Dept. of Corrections (2002) and the University System of Georgia (2007). BLLIP data regarding total sq. footage of property occupied by state agencies was also used. State agency reference from the State of Texas was used to estimate water use for remaining agency sq. footage. See Appendix A of the WCIP for more details.

water used by state agencies is purchased from water providers.

State agencies are rarely considered a separate water use sector. However, when a state-wide water conservation effort is implemented, often state agencies are held to equal or higher standards than water users within other water use sectors. With this unique position, state agencies should be progressive in water conservation efforts and should lead by example. For this reason, the WCIP identifies state agencies as a separate water use sector.

CHAPTER 2:

CONSERVING WATER USED FOR AGRICULTURAL IRRIGATION

Applicability of this chapter

This chapter addresses water used on farms for the production of food or fiber, as well as the water used by commercial nurseries and greenhouses with agricultural water withdrawal permits.

This chapter does not address water used in the processing of food and fiber away from the farm or water used for irrigating residential and commercial landscapes; those uses are addressed in Chapters 5 and 6, respectively. Those landscape operations that have agricultural water withdrawal permit are covered under this chapter. But smaller retail plant production and management are addressed in Chapter 6. Similarly, sod produced on farms for installation on golf courses and athletic fields is considered agricultural irrigation, while water used for on-site golf course irrigation is discussed in Chapter 4.

Introduction

State-wide agricultural water use is estimated to be about 752 mgd on an average annual basis.[54] USGS estimates that 100% of the water withdrawn for agricultural irrigation is consumptive.[55] However, it is generally understood that, depending on the region, some amount of water does return to the source from which is was withdrawn.

Irrigation needs vary by season. The highest water use occurs during the crop-growing season, April through October. During these peak irrigation months, agricultural irrigation can be disproportionately large compared to other uses in regions with a large amount of agricultural land. This seasonal variation is especially large in the Coastal Plain of the state, where the majority of agricultural land is located.

The production of food and fiber is important to the state. In 2006, agricultural production added $10.4 billion to Georgia's economy. This amount does not include the indirect contributions of operations that process or manufacture food and fiber. Including these indirect revenues, agriculture revenues totaled about $55.2 billion for the state and created more than 366,000

[54] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

[55] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

jobs in Georgia.[56] Water is essential to sustaining this important aspect of Georgia's economy.

Historically, much of the water used within the agricultural water use sector has not been monitored, and few studies have been conducted to assess overall agricultural water use. However, knowledge of the amount of water use is improving due to the work of the Georgia Soil and Water Conservation Commission's (GSWCC – www.gaswcc.org) agriculture water use measurement program.[57] Available information does indicate that irrigation of crops is by far the largest use of water on farms in Georgia, while non-irrigation uses such as those in livestock operations and in small on-farm processing facilities are much smaller.

Water used for agricultural irrigation purposes*:*

Significant	Moderate	Relatively minor
-Row Crops and Small Grains	*-Orchards and Vineyards* *-Vegetables and Truck Crops* *-Greenhouses, Nurseries and Sod Farms*	*-Hay and Pasture Land*

Water used on farms for non-irrigation purposes:

Relatively minor

-Livestock watering and cooling, animal waste management
-On-farm processing, cleaning, cooling of produce
-On-farm vehicle washing, chemical mixing and shop use

Irrigation Technology

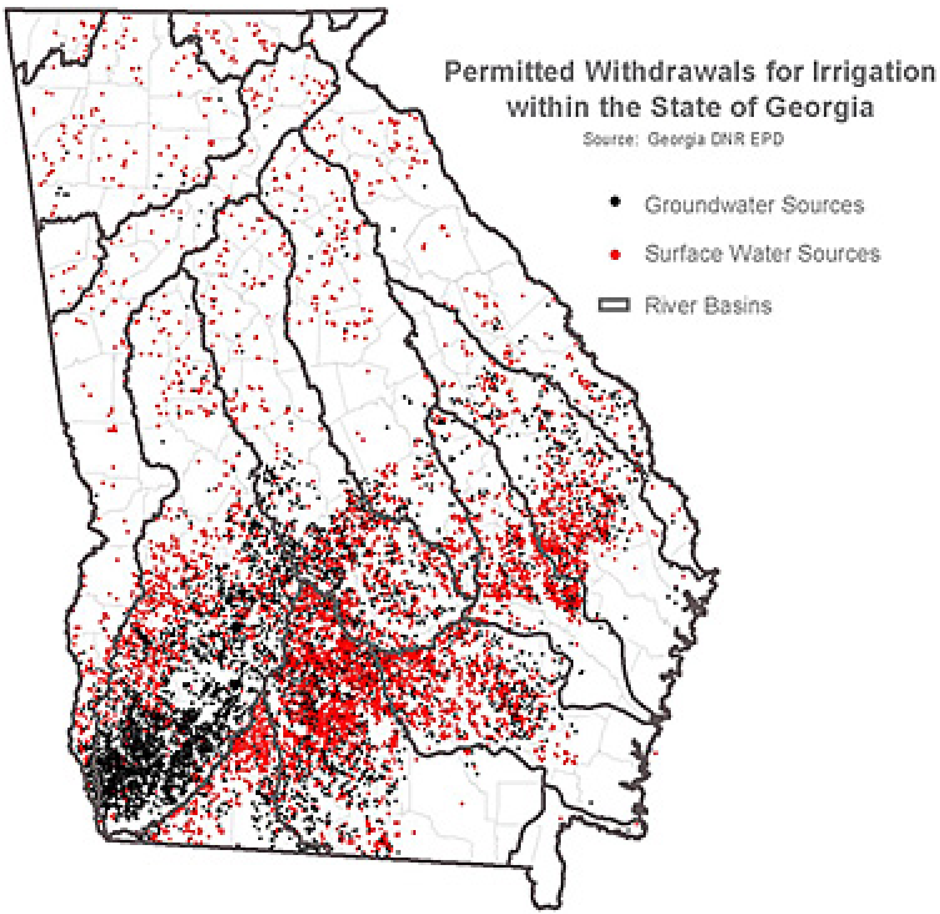
The efficiency of agricultural irrigation depends primarily on the technology employed. The technology used for agricultural irrigation has changed significantly during Georgia's history. Due to the state's soil and topography, the first irrigation systems used in Georgia were sprinkler systems, which are considered inherently inefficient compared to current technologies. Later Georgia farmers began to retrofit sprinkler systems and install equipment to support the

[56] This estimate is calculated as total farm gate value, which is net value of the product when it leaves the farm, after marketing costs have been subtracted. Source is Ag Snapshots – A Brief focus on Georgia's agricultural Industry. Online at: http://www.caed.uga.edu/publications/pdf/AG%20SNAPSHOTS%20for%20web.pdf

[57] The GSWCC agricultural water use measurement program was created through HB 579 in 2003. The program is designed to install water use meters on the approximate 21,000 permitted surface and groundwater agricultural irrigation systems in the state. Metering of all permitted users is to be completed by 2009. For more details on the program visit http://gaswcc.georgia.gov

use of travelers that could be used in a variety of conditions, using existing hardware and water sources.[58]

As labor costs mounted and labor availability decreased, center pivots became a preferred means of irrigating agricultural lands. Though higher in initial costs than travelers, center pivots are more reliable, have a longer operational life span, and take very little of a farmer's time. Center pivot systems have a 30% to 40% greater application efficiency than traveler systems, and the water used by these systems is applied to greater depths, helping plants become more tolerant to dry conditions. Center pivots systems are also more energy efficient. However, over the course of the growing season, center pivots apply more water on average than most other types of systems, since use of the system is less labor-intensive and so allows farmers to be more responsive to the needs of their crops.



[58] Although labor was needed for each setup, travelers allowed farmers to apply water for several hours with an unattended system. At one time Georgia farmers had over 5000 travelers deployed around the state.

Chapter Overview

This chapter first presents a set of goals that can be used by researchers, agencies and farmers to improve how efficiently water is used on Georgia farms. Following each goal is a set of benchmarks that can be used to measure progress toward these goals. Following each benchmark is a menu of the best practices that farmers can implement to help reach that benchmark or goal. The best practices are accompanied by implementation actions, which can be taken by outside organizations or government entities to assist farmers in implementing particular best practices.

Goals and Benchmarks
Agricultural Irrigation

The goals and benchmarks in this chapter are designed to help farmers and others assess current water use and identify the practices to improve a farm's overall efficiency. The first goal is designed to increase our knowledge about water use and current levels of water use efficiency on Georgia farms. The second and third goals focus on enhancing the efficiency of existing irrigation systems and choosing new cropping and irrigation systems that are high-efficiency. The fourth goal focuses on minimizing the amount of water lost from ponds and other systems that capture rainfall.

GOAL #1

Research institutions and state agencies, in cooperation with farmers, should enhance their understanding of water use and levels of efficiency of existing agricultural irrigation.

In order to make informed decisions about water use and irrigation, researchers and state agencies, in close cooperation with farmers, should make a concerted effort to gather more data about agricultural water use and crop needs. This information can improve our understanding of the timing of agricultural withdrawals, which can inform decisions related to managing stream flows or drought response.[59] This data can be aggregated at the county or watershed level and used to prepare summaries about Georgia's agricultural water use. It can also help farmers plan for farm water use and measure the success of their conservation efforts.

The first steps in this information-gathering effort should be to 1) determine the efficiency of current irrigation practices in Georgia and 2) establish a baseline of water use for agriculture irrigation. The water use information collected through the GSWCC metering program[60] provides a foundation for determining a how efficient Georgia's agriculture irrigation is and for establishing a state-wide baseline for agricultural water use.

GSWCC should continue to collect water use data after the metering program is complete and should partner with University of Georgia Cooperative Extension (UGAExt – www.caes.uga.edu/extension) to enhance data collection by conducting irrigation audits. Audits can provide information that is important for water planning purposes and can help farmers assess the efficiency of their system and identify problems that can be addressed. GSWCC and UGAExt should also gather information about the technologies (such as irrigation systems or devices) and water-using practices (such as the type of soil tillage practice or irrigation schedule) employed to produce food or fiber.

[59] Per Georgia Rules and Regulations.
[60] O.C.G.A. Sections 2-6-27(7.1), 12-5-31(m.1) and 12-5-105(b.1)

Research institutions should also initiate studies to determine the optimum levels of irrigation for different crop varieties, and then incorporate the results of their research into educational and outreach programs. Farmers can use this information to choose crop varieties (see Goal #3).

Benchmark 1A
By December 2009, state agencies and research institutions should determine the extent of water conservation implementation currently in place on Georgia farms.
See Best Practice 3

Benchmark 1B
By December 2010, GSWCC, EPD and other agencies should establish a state-wide baseline for agricultural water use, incorporating water use information collected from meters on agricultural irrigation systems.
See Best Practices 1 and 2

Benchmark 1C
By January 2011, research institutions should initiate studies to determine variability in water needs by crop variety.
See Best Practice 4

Benchmark 1D
By January 2020, GSWCC and UGAExt should establish water and energy auditing teams to conduct voluntary irrigation audits every 10 years for all Georgia farmers with agricultural water use permits.
See Best Practice 5

GOAL #2
Farmers should improve the efficiency of their irrigation systems.

Improving how efficiently irrigation systems apply water to crops is one of the most effective ways of conserving water used for agricultural irrigation. The measure most often used to describe irrigation system efficiency is application efficiency. It is defined as the ratio of the amount of water reaching the plant's root zone to the amount of water withdrawn from the source.[61]

Research in Georgia and throughout the Southeast shows that 85% application efficiency is obtainable by existing and new agricultural irrigation systems.[62] This measure provides an achievable level of efficiency for most

[61] Many industrial water users can establish similar quantifiable goals based on water input per unit of output. However, because of variations in natural rainfall, this kind of metric (i.e., inches of water applied per crop or gallons of water per pound of produce) are not useful for crop commodity outputs.
[62] Thomas, D.L. ed., 1998. *Irrigation Conservation Practices Appropriate for the Southeastern United States.* Project Report 32 by R.O. Evans, K.A. Harrison, J.E. Hook, C.E. Privette, W.I. Segars, W. B. Smith, D.L. Thomas, and A.W. Tyson.

irrigation systems on Georgia farms, but may be difficult and costly for some farmers to achieve. This level of efficiency is most applicable for moving or set irrigation systems with excellent application uniformity, located in cool or humid climates, with low winds. Average application uniformity for irrigation systems is usually lower than excellent, therefore 85% application efficiency may be difficult to obtain. However, using a variety of practices and devices, all agricultural water users can work to achieve this measure.

Greater application efficiency can be achieved by changing water-using practices and installing more water efficient irrigation devices. A systematic examination of the irrigation process (from the point of water withdrawal to the point of water uptake by the plant) and the devices used to deliver water can reveal potential improvements in efficiency. The examination should determine 1) the steps in the irrigation process and if any steps can be eliminated, 2) what water losses can be reduced, and 3) what water waste can be transferred into water use.[63]

Farmers can also realize greater application efficiency through irrigation scheduling. Irrigation scheduling is used to plan precisely when and how much water to apply to crops – ideally, no more and no less than needed to ensure optimal growth.[64] It can help farmers eliminate unnecessary and wasteful water use on farms. Irrigation scheduling can also help farmers ensure seed, fertilizers, agrichemicals, and land are used as efficiently as possible. Some studies have shown that improved scheduling does not always result in water savings.[65] Since irrigation scheduling will not conserve water on all farms, the irrigation scheduling benchmark only calls for 50% of farmers using irrigation in Georgia to adopt this conservation practice.

Benchmark 2A

By July 2010, UGAExt, GSWCC, local Soil and Water Conservation Districts (SWCDs — www.gacds.org), and other agricultural research entities should provide irrigation education to farmers with agricultural water use permits.

See Best Practices 1, 3, 4, 5, and 6

Benchmark 2B

By January 2012, all new, and by January 2020, all existing agricultural irrigation systems should have application efficiencies of 80% or greater.

See Best Practices 7 through 19

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[63] Florida, Texas, and other states have used a "BMP" approach to improve irrigation efficiency. The benchmarks and practices established under this goal are similar to the BMP approach form these states.

[64] Vickers, A. 2001. *Handbook of water use and conservation: homes, landscapes, businesses, industries, farms.* WaterPlow Press. 446 pgs, pg 359.

[65] Thomas, D.L. ed., 1998. *Irrigation Conservation Practices Appropriate for the Southeastern United States.* Project Report 32 by R.O. Evans, K.A. Harrison, J.E. Hook, C.E. Privette, W.I. Segars, W. B. Smith, D.L. Thomas, and A.W. Tyson.

Benchmark 2C

By January 2015, 25% of farmers using irrigation on their fields should adopt irrigation scheduling based on crop needs and available water supplies. By January 2020, 50% of farmers using irrigation on their fields should adopt irrigation scheduling based on crop needs and available water supplies.

See Best Practices 15, 16, 17, 18, and 19

GOAL #3

Farmers should choose appropriate crop varieties, cropping systems and irrigation systems to maximize the efficient use of water on farms.

While Goal #2 is to improve the performance of irrigation systems, this goal is to encourage farmers to incorporate water conservation into decisions about crops and management systems, like tillage and irrigation systems, that maximize the efficient use of water on farms and conserve water. Farmers can significantly reduce the amount of water needed for irrigating crops by planting water efficient crop varieties, practicing conservation tillage, and choosing water efficient irrigation systems.

Cropping systems is a term used to describe a specific crop or crop rotation and the associated cultural and mechanical practices used to grow that crop. For example, conventionally tilled cotton and conservation-tilled cotton describe two different cropping systems with the same crop. Conservation tillage systems provide a method of retaining rainfall on agricultural fields so as to decrease the amount of supplemental irrigation farmers must apply to crops. Scientific studies estimate that increasing the number of farms with conservation tillage systems by only 10% could result in water savings of 5 to 15 percent.[66] Not all agricultural land is suitable for conservation tillage systems, and certain weed pressures may also not allow for these practices as they may require deep soil tillage for effective control. However, researchers estimate that approximately 50% of all row-crop land may benefit from conservation tillage.[67] The selection of farm management practices is controlled by many external factors that are often more important to the farmer than conserving water. This aim of this goal is to make water use efficiency another factor in the decision process.

Benchmark 3A

By December 2012, farmers should use information developed pursuant to Goal #1 and incorporate water conservation into cropping and management choices.

See Practices 3, 4, 5 and 20

[66] Hawkins, G.L., D. Sullivan, and C. Truman, 2007. *Water Savings through Conservation Tillage.* University of Georgia Extension Circular 916. http://pubs.caes.uga.edu/caespubs/pubcd/C916/C916.htm

[67] Personal communication Jim Hook and Gary Hawkins, UGA College of Agriculture and Environmental Science

Benchmark 3B

By January 2020, farmers should increase the number acres managed under conservation tillage systems to 50% of all row-crop land, where such management practices are suitable.

See Best Practice 21

GOAL #4

Farmers should minimize water loss from farm ponds, reservoirs and other rainfall collection systems.

While it is probably the least understood or studied area, another opportunity for conserving water in agricultural irrigation is in improving the ability to efficiently store and collect rainfall. Losses from farm ponds, reservoirs and rainfall collection systems can occur due to sedimentation, evaporation, and seepage. One primary benefit of minimizing water loss from ponds and such is reducing the need for additional water withdrawals from rivers, streams and aquifers.

Many water losses from farm ponds, reservoirs and rainfall collection systems may occur before the water is pumped onto fields, not affecting the water use efficiency of the farm practices. This goal is most important for those farmers dependant on shared and limited water sources.

Benchmark 4A

By December 2010, UGAExt, GSWCC, the UGA Agricultural Experiment Stations (UGAAES – http://research.caes.uga.edu) and other agricultural research entities should develop a best management practice (BMP) guide that lists a variety of practices for reducing water loss from ponds.

See Best Practice 22

Benchmark 4B

By January 2015, farmers should implement one or more practices to reduce water loss from 50% of all farm ponds used for agricultural irrigation.

See Best Practice 23

Best Practices: A Menu of Options

There are several different kinds of practices that can be employed by farmers and others to meet the benchmarks and goals in this chapter. The information-gathering and educational practices are primary steps that should be taken at the beginning of an effort to conserve water used for the production of food and fiber. Following information gathering, farmers can choose from a variety of practices to minimize water lost to leaks, minimizing non-target application of water, minimizing wind drift and evaporative losses, minimize water loss from storage, schedule irrigation, and implement cropping and management practices such as conservation tillage.

Information-gathering and educational practices

BP 1 – Irrigation water metering

Historically, many agricultural withdrawals have not been metered. The GSWCC metering program has been established to help farms install, read, and maintain meters.

The data from meters can assist farmers with planning and farm management. Data from water metering allows farmers to verify the volume of water used, to compute water use efficiency field by field, and to plan for future water needs field by field. Farmers can also compare their data against regional summaries to evaluate their comparative water use.

Implementation Actions:

2.1 GSWCC should install flow meters that will measure water used by all permitted farmers, as required by law for all permitted agricultural systems. GSWCC should read these meters annually and establish a database of agricultural water use.

2.2 GSWCC, UGAExt, EPD and state-wide water planning centers should provide feedback reports to farmers for comparison of their water use with others.

BP 2 – Real-time metering

Farmers can monitor selected systems in real time. Real-time metering serves as an early warning system of increased seasonal demands on streams, reservoirs and groundwater.

BP 3 – Data collection on cropping and water conservation practices

Farmers can document the water conservation practices already in place on their farms, including the best practices in use and the number of acres under irrigation on their farms. Farmers can also participate in UGAExt surveys and field visits, and consider using voluntary databases of cropping and conservation practices such as Irrigator Gateway and Farmer Portal. These data can help to develop a state-wide water efficiency baseline and assist with research into the water needs of crops.

Implementation Actions:

2.3 UGAExt should survey county extension service agents for 2008 irrigation information as per prior surveys conducted on a biannual basis by Cooperative Extension.

2.4 UGAExt should update the triennial irrigation survey to include questions targeted at determining the extent of water conservation implementation on farms.

2.5 UGAExt, GSWCC, and UGAAES should conduct field visits and farmer surveys to gather more information about irrigation BMPs. Farms should be selected using random sampling, and participation should be voluntary.

2.6 GSWCC and UGAExt should report information about levels of water conservation practice implementation and examine ways to overcome barriers to implementation. This information should be used in regional and statewide water planning.

BP 4 – Determination of variability in water needs by crop variety

Because water use has not been monitored until recently, very little information currently exists on water needs by crop variety and production system. Such information could help farmers making management and cropping decisions, and can be incorporated into any educational efforts.

Implementation Action:

2.7 UGAAES, GSWCC, UGAExt, and the United States Department of Agriculture Agricultural Research Service (ARS – www.ars.usda.gov) should research and conduct outreach on drought resistant varieties, cultivation techniques, and other irrigation efficiency studies. Since available crop varieties continue to change, this must be an ongoing effort.

BP 5 – Irrigation audits

Irrigation audits are procedures to collect and present information concerning the uniformity of application, precipitation rate, and general condition of an irrigation system and its components. Irrigation audits can inform state-wide and regional water management decisions and can help farmers evaluate their water use and identify inefficiencies within their irrigation system. Farmers should consider participating in programs that offer audits.

Implementation Actions:

2.8 State agencies, such as GSWCC and the UGAExt, should offer on-farm audits of water and energy use on 5- and 10-year cycles.

The effort should use the following intermediary benchmarks as guidelines:

1. By 2010, establish water and energy audit team(s) and procedure.
2. By 2012 conduct on-farm audits of water and energy use for 20% of permitted farms
3. From 2012 to 2020 conduct audits on 10% of the systems each year.

2.9 GSWCC, Natural Resource Conservation Service (NRCS), and EPD should establish/expand financial assistance programs for cost share to farmers who use audited irrigation systems that are in compliance with pre-determined performance standards.

2.10 GSWCC should report farm-specific and average water use information to each farmer. Water use information should be organized by crop type and watershed.

2.11 GSWCC and other agencies should secure moneys for the auditing program.

2.12 State agencies and research institutions should develop new programs to measure application efficiencies and application uniformity on existing systems.

BP 6 – Irrigation workshops

Annual irrigation efficiency workshops and field days for farmers are essential to helping farmers recognize the changes needed to improve system efficiency. These efforts should include information about the practices listed under the other goals in this chapter. The conservation practices with the most rapid payback for farmers should be an educational priority.

Implementation Actions:

2.13 UGAExt, GSWCC, and other agricultural research entities should develop and offer annual irrigation efficiency workshops and field days.

2.14 EPD, GSWCC, and UGAExt should establish an interagency team to coordinate activities and outreach associated with agricultural irrigation. This will include all of the information-gathering and education practices listed covered by this plan.

Minimizing water lost to leaks

BP 7 – Inspecting pipes and plumbing

Water lost before it reaches the field does not help improve crop production. Farmers can eliminate leaks and losses in delivery of water by inspecting pipe and plumbing in the water transmission system.

Minimizing non-target application of water

BP 8 – End-gun shutoffs with pivots

Water applied to forests, field borders, waterways, fencerows, and roads surrounding irrigated fields, and water sprayed onto fields irrigated by other systems does not contribute to production of a crop. Often these areas fall under irrigation as farmers design and build pivots that attempt to reach the corners of irregularly shaped fields with their circular center pivots.

BP 9 – Subsurface drip irrigation or micro-sprinkler systems

In orchards, especially new orchards, there are traffic rows and other spaces between trees that lack tree roots needed in supplying water to the tree. Water that reaches these often grass-covered areas is wasted. Orchard studies show that it is not necessary to reach 100% of a tree's roots to supply all the water the tree needs. Subsurface drip and micro-sprinkler irrigation wet smaller areas of land, avoid spraying lower branches of the tree, and avoid wetting the rows in between the trees.

BP 10 – Variable Rate Irrigation (VRI) controls on center pivots

VRI can prevent water from being applied to areas where there are no crops (such farm ponds and streams), or vary the amount of water applied to areas with different water needs. When soils under a cropped portion of a pivot are highly variable, some water may fall on wet soil while in other areas fail to adequately wet a dry soil. Using computer systems, VRI enables each part of the system to receive the correct amount, and thus increase efficiency.

BP 11 – Enhanced pivot control panels

The water application efficiency of a center pivot irrigation system can often be improved by installing a pivot control box that adjusts the system's travel speed or shuts off an end gun or boom segment based on position in the field. These include some of the functionality of a VRI, but are less expensive to install.

BP 12 – Field arrangement

Conventional (non-VRI) center pivot booms wet a moving radius from one end of the boom to the other. If fields are arranged so that part of the boom is covering the target crop and another part is not, water applied to the non-crop portion is wasted. If the pivot field is split among crops or only partially irrigated, the wetted portion should be aligned with pie-shaped segments.

Minimizing wind drift and evaporative losses

<u>BP 13</u> – Low pressure irrigation systems

Where soil conditions permit, farmers can lower the system operating pressure of center pivot irrigation systems and install spray nozzles with pressure regulators on drops or on the boom. Many types of modern sprinklers apply water using large droplets and limited throw. Low pressure systems with pressure regulators reduce the droplet surface area-to-volume ratio and the time it takes for droplets to travel from the nozzle to the ground.

These systems use lower water pressure (depending on the designated nozzle rates) and position the nozzle as near to the ground as crop and other conditions allow. Both reduce the exposure of irrigation water to evaporation and wind drift so that more water reaches the ground. As long as the application rate does not exceed the infiltration rate of the soil, water use efficiency is improved. Also, reductions in system pressure are usually associated with lower energy requirements and pumping costs.

<u>BP 14</u> – Minimize or eliminate the use of high-pressure spray guns on fixed and traveler systems

High pressures are often used on fixed pipe systems and traveler systems just as they are on center pivot systems. These high-pressure systems spray water high into the air for effective coverage of land with as few sprinklers and pipe as possible. But a substantial portion of the water (often more than 50%) is lost to evaporation and wind drift. If these systems must be used, a lower angle of throw and lower pressures can improve application efficiency. Nozzles and lane or pipe spacing must be changed to assure complete and uniform coverage.

Scheduling practices

<u>BP 15</u> – Night-time irrigation

In Georgia, nighttime weather conditions include increased relative humidity, reduced wind speed, and lower temperature, as well as reduced thermal (sunlight) load. All of these changes reduce evaporative losses that occur, as compared with afternoon irrigation. Unattended night-time irrigation increases risks of undetected shut-down, breaks, or other system failures, but relatively inexpensive remote motoring can be added to sound alarms or place calls for corrective action.

<u>BP 16</u> – Eliminating timer-only irrigation controls

While convenient and inexpensive for drip systems, especially those with several watering zones, timer controls for automated irrigation systems are unresponsive to the actual water needs of the soil and crop. They apply water during, and in spite of, rainfall. They apply water whether or not the crop has already removed the previous application amount from the soil, and they may miss irrigation needed when evaporation exceeds anticipated water rates.

BP 17 – Rainfall shut-off devices

As in residential and commercial irrigation systems with timers, adding a rainfall shut-off device can eliminate some of the wasted water. Rainfall shut-off devices can be especially effective if the return interval (time before the irrigation timer cycle is restarted) is adjusted by the amount of the rainfall actually received.

BP 18 – Soil moisture sensor, evapotranspiration (ET) sensor, or crop water use model to timer cycles

New technologies allow both wired and wireless communication between devices that detect soil moisture and timer controls for automated irrigation systems. Soil moisture sensors can be used to initiate irrigation as a dryness threshold is reached, or can be used to cancel a scheduled irrigation cycle because the soil already has enough moisture.

Sensors can also confirm whether the irrigation water reached the necessary part of the root zone or added so much that a portion drained away unused. Sensor-based controls add complexity, cost, and some risk of failure. If designed correctly, systems failure will result in no water savings, not in loss of the crop.

ET sensors are devices that estimate the quantity of water that has evaporated from soil surfaces and has been transpired by plants during certain times of day. Generally, the sensors measure ET rates that represent water lost to the atmosphere.[68] ET sensors usually work through a series of weather stations or station networks that send advisories or data back to farmers who employ the technology.

Implementation Actions:

2.15 UGAExt, GSWCC, EPD, and other agricultural research entities should develop and make available an interactive irrigation website to be used by those farmers with access to the state environmental monitoring network. Models hosted by the Agricultural Environmental Monitoring Network at UGA, Georgia Water Planning and Policy Center (GWPPC – www.h2opolicycenter.org) Farm Portal, GSWCC Irrigator Gateway or other sites can facilitate individual farmer access to crop water use data and can retain individual farmer water use and planning data in secure web sites, for example.

2.16 GSWCC, EPD, and other agricultural research entities should make online ET data available to those farmers using ET sensors or other similar technologies.

[68] Vickers, A. 2001. *Handbook of water use and conservation: homes, landscapes, businesses, industries, farms.* WaterPlow Press. 446 pgs., pg. 331.

BP 19 – Real-time weather and soil data and models to aid scheduling decisions

Both farmer and consultant-operated scheduling tools are available. Many farmers use climate-based (historical) estimates of weekly water use to determine the amount of irrigation needed during the crop growing seasons. Others use regional weather measurements to estimate potential maximum daily evaporation. Those can be adjusted by the growth stage and crop species to estimate actual water to be consumed by the crop. Regardless of the method used to estimate water use, rainfall must be measured in or near individual fields to determine how much of the water used by the crop should be provided by irrigation.

Cropping and management practices

BP 20 – Water needs to inform cropping and management practices

Farmers can use information about crop water needs developed by GSWCC, UGAExt, and other agricultural research entities to determine cropping and management practices and plan for water needs based on crop variety and production system.

Implementation Action:

2.17 GSWCC, UGAExt, and other agricultural research entities should educate farmers on typical water use by crop.

BP 21 – Conservation tillage

Conservation tillage systems provide a method of retaining rainfall on agricultural fields so as to decrease the amount of supplemental irrigation farmers apply to crops.

Generally, conservation tillage systems can improve the soil so that rain or irrigation water can infiltrate the ground and be retained on-site. Interception of rain or irrigation water, i.e. the prevention of runoff, is accomplished by leaving plant residues from winter cover, grain crops, or prior crops on fields. This residual plant material can help improve the amount of growing plants can absorb from both rain and supplemental irrigation. Residues also minimize formation of crust on the soil that reduce the infiltration late season irrigation water. Conservation tillage also offers other benefits such as water quality protection and reduced inputs. Farmers growing corn, cotton, soybeans, and peanuts should especially consider converting land to rotations that primarily use conservation tillage systems with winter cover crops where effective.

Implementation Actions:

2.18 Georgia Conservation Tillage Alliance, UGAExt, GSWCC, and NRCS should offer education and demonstration programs, cost share programs and technical assistance.

2.19 GSWCC, NRCS and SWCDs should offer equipment sharing and equipment cost sharing to encourage and facilitate changeover.

Water loss practices

BP 22 – Water loss control

Very little research has been conducted on water loss from farm ponds, reservoirs or other rainfall collection systems. Losses from farm ponds, reservoirs and rainfall collection systems can occur due to sedimentation, evaporation, and seepage. Farmers can reduce losses by capturing runoff from a pond's catchment area. Farmers should consider implementing the practices discussed in the guidance developed by research organizations.

Implementation Action:

2.20 UGAExt, GSWCC, the UGAAES, and other agricultural research entities should develop a guidance document that recommends technologies and practices for more efficient detention of rainfall through controlled drainage, wetlands, and pond systems. Once the practices are defined, researchers should implement educational programs for farmers and encourage them to adopt practices appropriate to their operations.

CHAPTER 3:

Conserving water used for Electric Generation and Use

Applicability of this chapter

This chapter is applicable to thermoelectric power plants and individuals and businesses that use energy. Most of the practices described in this chapter focus on water use efficiency in existing and new thermoelectric power plants, which use water in the process of converting thermal energy into electric energy. Additionally, some practices focus on helping energy customers understand the energy savings that can be realized with certain water conservation efforts. This chapter does not address hydroelectric power generation.

Introduction

Thermoelectric power plants withdraw about 2.7 billion gallons of water from Georgia's water bodies per day on an average annual basis. USGS estimates that for plants currently operating in Georgia, the amount of water consumed due to evaporation ranges from less than 1% to as much as 70%, depending primarily on the type of plant cooling system used.[69]

The majority of the water withdrawn by thermoelectric power plants is needed for a particular purpose; in most facilities, that purpose is cooling the energy-producing equipment. Through the cooling processes, some volume of water is lost to evaporation, but the majority is returned to the source. Therefore, though a great deal of water is withdrawn and used, a much smaller amount is considered consumed.

The relationship between the amount of water an electric generating facility withdraws for cooling purposes and the amount that is consumed depends on the generating technology. For instance, a conventional pulverized coal plant with once-through cooling will withdraw a substantial amount of water, but will consume very little of it, sometimes returning more than 99% of the water it withdraws back to the water source. A coal or nuclear plant equipped with cooling towers operates quite differently. A nuclear plant with cooling towers may consume nearly 70% of the water it withdraws. But such a plant will withdraw only a fraction of the amount of water a plant with once-through cooling withdraws.

In 2004, the state's electric utilities sold about 130 million megawatt-hours of electricity. In that same year the state's overall energy consumption for the

[69] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

year totaled about 3,050 trillion British thermal units (TBtu).[70] The U.S. Bureau of Statistical Analysis reports that utilities in Georgia (including those entities that provide energy and water services) added approximately $8.9 billion to the Georgia economy in 2007.[71] Energy availability affects nearly all aspects of the state's economy.

The total volume of water that must be used in the state to generate energy is influenced by several factors. One factor is the type of energy-generating plant. Electric generating facilities that supply power to meet "peak" demand consume very little water. These types of electric generating facilities include combustion turbines. Electric generating facilities that provide "intermediate" power based on demand are primarily either once-through cooling plants, consuming virtually no water, or combined cycle natural gas facilities, which consume small amounts of water. The electric generating facilities that provide the significant "base load" of power and run almost continuously tend to be the large coal or nuclear plants with cooling towers; these consume the most water.

Another factor is the amount of demand from the energy customers. Energy customers play a role in how much thermoelectric power is generated. The greater the energy demand, the greater the energy generation. The more energy generated, the greater the amount of water needed to support the plant operations.

When determining appropriate water conservation and water management practices, those involved in the generation of energy must consider several issues, including 1) the availability of water supplies and how much water is consumed in generating energy; 2) the influence of energy demands on water withdrawals and 3) the affect of water demands on the amount of energy being generated.

The common thread in all three of these areas is the interconnection of water conservation and energy conservation. The availability of adequate water supplies has an impact on the availability of energy, and energy generation has an impact on the availability and quality of water. Energy and water each face increasing demand and growing limitations on supply.

[70] GEFA, Division of Energy Resources and Georgia EPD. "Georgia Energy Review 2005). March 2006. 81 pgs.

[71] According to the U.S. Department of Commerce, Bureau of Statistical Analysis, the Utilities NAICS sector, referenced here, comprises establishments engaged in the provision of the following utility services: electric power, natural gas, steam supply, water supply, and sewage removal. Within this sector, the specific activities associated with the utility services provided vary by utility, but may include: electric power includes generation, transmission, and distribution; natural gas includes distribution; steam supply includes provision and/or distribution; water supply includes treatment and distribution; and sewage removal includes collection, treatment, and disposal of waste through sewer systems and sewage treatment facilities. U.S. Department of Commerce, Bureau of Economic Analysis - Gross Domestic Product by State www.bea.gov/regional/gsp

The relationship between energy production and water use was identified as an important area of policy concern during the recent development of the State Energy Strategy for Georgia.[72] One of the policy objectives identified in the State Energy Strategy was to minimize energy production's impacts on water supply and water quality impacts. The developers of the strategy recognized that energy and water use are interrelated, and that reducing the use of one resource often reduces the use of the other. Support for this understanding came in large part from a 2005 study, which determined that cost-effective energy efficiency measures could save 159 million gallons per day by 2015 in addition to saving consumers energy and money.[73]

The relationship between energy conservation and water conservation is complex. Generally, reductions in water use will result in reductions in energy demand, but this relationship has not been quantified. When less water is used, less energy is required to transport and distribute it. Also, more efficient water-using appliances (such as showerheads) use less hot water, and so reduce the need for energy to heat the water. However, some water conservation practices, such as recycling reuse water, may increase energy use. Reductions in energy demand will also affect the amount of water needed to generate that energy. However, little is understood about this aspect of the relationship between water and energy, and further analysis and quantification is warranted.

Chapter Overview

This chapter first presents water conservation goals specific to utilities that provide electricity and their customers. Following each goal is a set of benchmarks that can be used to measure progress toward these goals. Following each benchmark is a list of the best practices from this chapter that thermoelectric facilities and other entities can choose to implement to help reach that benchmark or goal. The best practices are accompanied by implementation actions, which can be taken by state agencies, organizations and commissions to assist with the implementation of specific practices.

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[72] The Georgia Energy Strategy can be found online at http://www.georgiaenergyplan.org
[73] Jensen, V., & Lounsbury, E. (2005). A*ssessment of Energy Efficiency Potential in Georgia.* Retrieved May 12 & 19, 2006, from http://www.georgiaenergyplan.org/suppmat/AssessmentofEnergyEfficiencyPotentialinGeorgia.pdf

Goals and Benchmarks
Electric Generation

The goals and benchmarks in this chapter focus on improving water efficiency within thermoelectric facilities and encouraging conservation by energy customers. Because water conservation can save energy, the first goal is intended to assess the feasibility and benefit of integrating water conservation efforts into utilities' long-term energy management plans. The second goal focuses on partnering with energy customers to raise awareness and build an understanding of the impact water conservation practices have on energy demands. The third goal focuses on improving water efficiency at existing facilities and evaluating emerging technologies to reduce water use and consumption. Electric utilities should choose a mix of practices that are best suited to the specific conditions facing their facilities.

GOAL #1

Electric utilities should assess the feasibility and benefit of integrating water conservation efforts into utilities' long-term plans for meeting energy demands.

Water conservation efforts can affect the volume of water withdrawn from a source, thereby impacting water supplies available for energy generation. Conversely, water conserved by the customers of electric utilities can impact the energy demands supported by that utility.

Electric utilities have dual roles to play in helping sustain Georgia's water resources through water conservation efforts. First, electric utilities should invest in water conservation to help sustain available water supplies upon which every electric utility depends. Secondly, as a means to meet their responsibility to implement cost-effective demand side management (DSM) measures, electric utilities should also evaluate the impact that water conservation efforts by their customers can have on reducing energy demands.

To preserve existing supplies for all users, electric utilities should partner with other water use sectors, particularly industrial and commercial water users and water providers, to help minimize large or increasing water demands that may limit supplies available for energy generation. Water availability is an important factor for generating electricity, now and in the future. The suite of demands and withdrawals from all water sectors using a particular water resource impact the amount of water that may be available for energy generation, possibly creating competition between sectors. (This is especially true in regions where resources are found to be limited.) The role that electric utilities play in sustaining those resources is significant.

Electric utilities should initiate efforts to evaluate the impact that water conservation by customers with the greatest demands, may have on energy demands. Water conservation by energy customers can impact energy demands, however, different water use practices affect energy demands differently. Some water conservation activities can decrease energy demands (such as installing low-flow showerheads and water efficient dishwashers), while others activities may actually increase energy demands of customers (such as retrofitting a commercial facility to use recycled or reused water.) Because of the information gap regarding how energy demand responds to water conservation efforts, it is important that activities begin now to address the shortcomings of our knowledge.

Electric utilities should work with EPD to evaluate existing tools[74] or develop new tools to assess the relationship between water conservation and energy demands. Tools, such as computer-based models, should be able to estimate the impact various water conservation efforts may have on future energy needs and associated water supply requirements.

Once the appropriate tools are identified or developed they should be tested at the power plant level. Tests can help estimate possible reductions in energy demand and in water supplies necessary to meet that demand. Changing water needs can impact shared water supplies, thereby providing valuable information to regional and state-wide water planning efforts.

Benchmark 1A

By 2010, electric utilities and EPD should recommend existing tools or develop new tools, such as a model, capable of evaluating the impact various water conservation practices have on energy demands.

See Best Practice 1

Benchmark 1B

Once the model described in Benchmark 1A is developed, the electric utilities and the DSM work group should assess the feasibility of implementing beneficial water conservation practices and incorporate those results into long-term plans for meeting future generation energy needs.

See Best Practice 2

Benchmark 1C

Once the model described in Benchmark 1A is developed and beneficial results are assessed, electric utilities should implement the beneficial water conservation practices and monitor the results to provide for future plans.

See Best Practice 2

[74] An example of an existing tool comes from the Pacific Institute who developed two models to help water managers better understand the relationship between water management decisions, energy consumption, and air quality. The models are known as "Water to Air Models" and can be found at http://www.pacinst.org/resources/water_to_air_models/index.htm. The Santa Clara Valley Water District in California used the Water to Air Model to quantify the energy savings and air pollutant emissions reductions achieved through the their water conservation and water recycling programs. For a copy of this report, visit http://www.valleywater.org/.

GOAL #2

Electric utilities should educate customers about the energy savings from water conservation and, where practicable, the water savings from energy conservation (i.e., the water conservation - energy conservation interrelationship).

Understanding the energy savings, as well as other economic considerations, from any particular water conservation measure can help customers make informed decisions about cost-effective water conservation choices. Electric utilities should integrate information about energy savings from various water conservation measures into existing educational programs. Likewise, as more information becomes available, electric utilities should integrate the water conservation benefits from various energy efficiency measures into existing educational programs. Electric utilities and GEFA already have experience with conservation-related outreach and have extensive materials highlighting the benefits of energy efficiency.

Benchmark 2A

By December 2010, electric utilities should partner with their large customers, like water utilities, industrial facilities and commercial customers, in determining the energy savings resulting from water conservation measures that the customers are implementing at their facility.

See Best Practices 3, 4 and 5

Benchmark 2B

By July 2011, electric utilities, in coordination with water providers, should use the results from their efforts in Benchmark 2A to develop a model outreach program to all educate customers about the energy savings accrued from various water conservation practices.

See Best Practices 3, 4 and 5

GOAL #3

Electric utilities should implement practices to improve water efficiency at existing facilities and identify, to the extent practicable,[75] ways to minimize the amount of water necessary to generate electricity.

By minimizing the amount of water needed to generate electricity, electric utilities help optimize the overall efficiency and effectiveness of their operations. Many utilities have begun identifying opportunities for reducing water use within their facilities. However, in some areas, new technologies and/or practices are needed to further reduce the amount of water used to generate electricity.

[75] When determining what is practicable or what is the best available technology, consideration should be given to the cost-effectiveness and commercial availability of any technology, as well as any legal or regulatory constraints with regard to its application.

Currently, much of the research into new, water efficient technologies and practices is being conducted by the Electric Power Research Institute (EPRI – http://my.epri.com), which has reported environmental benefits as well as economic benefits of optimizing water use.[76]

Electric facilities can implement a variety of practices to improve water efficiency. For example, through potential new technologies and practices currently being studied, existing facilities may be able to minimize the amount of water lost due to evaporation from cooling and the amount of water needed for flue gas scrubbing. New facilities should use the best available technology to minimize the amount of water needed to be withdrawn from surface and groundwater sources. In addition, where the availability of clean water is a concern, lower-quality non-traditional water supplies (such as reclaimed water or storm water) should be considered as substitutes for high quality water. Electric utilities may consider conducting a comparative analysis of water use requirements in order to identify those practices that can minimize the amount of water that must be withdrawn from surface and groundwater sources.

Benchmark 3A

By 2012, electric utilities and research institutions should evaluate the practices appropriate for reducing water loss due to evaporation from cooling, and the amount of water needed for flue gas scrubbing.

See Best Practices 6, 7, 8, and 9

Benchmark 3B

By 2015, all new electric generation facilities should be designed and built so as to minimize, to the extent practicable, the amount of water used for electricity generation in Georgia.

See Best Practices 6, 7, 8, and 9

[76] Freedman & Wolfe. October 2, 2007. Thermal Electric Power Plant Water Uses: Improvements Promote Sustainability & Increase Profits

Best Practices: A Menu of Options

Electric utilities can implement a variety of practices to help meet the goals and benchmarks in this chapter. These practices fall into three major categories: practices that help electric utilities better understand the relationship between water conservation and long term energy needs, educational practices targeted at energy customers, and practices that minimize the amount of water necessary for electricity generation.

Quantifying water conservation/energy planning relationship

BP 1 – Tools that estimate the impact of water conservation on energy demands.

Currently a large information gap exists regarding the impact water conservation practices and programs may have on energy demands. Tools specific to Georgia or, more generally, to the Southeastern U.S. should be developed in an effort to fill this information gap. These tools should incorporate Georgia-specific data as necessary, and should help inform the water resource assessments conducted by EPD.

Implementation Action:

3.1 Electric utilities, EPD, and the demand side management (DSM) work group should collaborate to identify existing tools or develop new tools to quantify the impact water conservation practices (implemented by Georgia water providers and energy customers) have on energy demands.

BP 2 – Integrate water supply and water conservation impacts into long-term energy plans

Once electric utilities quantify energy demand impacts from water conservation practices, using the tools referred to in BP 1, these impacts should be incorporated into the long term energy planning.

Information regarding the impact water conservation efforts have on energy demand and subsequent water use (to support that energy demand) will be valuable to informing both energy utility planning and regional water planning efforts. All electric utilities develop long-term energy plans to help manage for future energy demands. These plans may assess customer energy use and forecast demands 20 years into the future and include an analysis of the capacity all water resource options.

Energy utilities should provide these long-term energy plans to the regional water planning councils to inform the development of the regional WDCPs. Such information can be helpful in evaluating the impact water conservation as a water management practice, may have on the water resources available for energy generation and other uses.

Educational practices

<u>BP 3</u> – Technical Assistance

Electric utilities can assist their customers to identify energy savings benefits of water conservation measures they implement.

<u>BP 4</u> – Integrate water conservation into educational programs

Most electric utilities have outreach programs that educate customers about the benefits of energy efficiency. These programs should be updated to include information about how water conservation can also result in energy savings. Education programs should provide tips for how customers can save energy through water conservation. And education programs should include information to share with local media to help raise awareness about how water conservation can save energy.

Electric utilities should coordinate their educational efforts with local or regional water providers.

Implementation Actions:

3.2 The Public Service Commission (PSC – www.psc.state.ga.us) and associations for Georgia water professionals should assist electric utilities in developing water and energy conservation education tools.

3.3 *Conserve Georgia* (www.conservegeorgia.org) should develop a model package of information to share with appropriate media outlets.

3.4 PSC and associations for Georgia water professionals should partner to establish a state-wide network of electric utilities and water providers to share information, discuss ideas and challenges, and explore opportunities for mutual benefit.

<u>BP 5</u> – Incentives for water conservation

Electric utilities and other appropriate groups can implement and/or support the following water conservation incentives to help customers conserve:

1) Electric utilities can widely publicize information about existing incentive programs, such as the sales tax holiday that applies to water efficient products (i.e., WaterSense), as well as energy efficient products.
2) Electric utilities, PSC, associations for Georgia water professionals, and local water providers should consider establishing financial assistance programs to help customers implement water conservation practices that have been shown to result in significant energy savings.

3) Electric utilities and water providers should consider identifying and implementing joint incentive programs to encourage water conservation as a means of energy conservation and vice versa.

Practices to reduce water used to generate electricity

BP 6 – Maximize efficiency of flue gas scrubbing

Electric utilities and research institutions should participate in the development and/or demonstration testing of methods and materials that minimize the amount of water needed for flue gas scrubbing.

BP 7 – Minimize evaporative losses

Electric utilities and research institutions should participate in the development and/or testing of new technologies to capture and return condensation currently being lost through cooling and or scrubbing operations.

BP 8 – Alternative water sources

Electric utilities can identify and utilize alternative sources of water for operations where practicable, recognizing that alternative sources do not in and of themselves reduce consumption. Potential sources of alternative supplies include treated urban wastewater, stormwater, mine drainage, and quarry dewatering.

BP 9 – Pilot projects for new technologies and practices

Electric utilities should consider piloting or implementing innovative practices that have the potential to save significant amounts of water and energy.

Implementation Actions (for all practices to reduce water used to generate electricity):

3.5 Electric utilities and research institutions should compile and publish a list of water efficiency best practices that are most appropriate to reduce water used to generate electricity in Georgia facilities. Electric providers should implement the practices that are practical for their facilities.

3.6 Electric utilities and related associations and groups can support the research and development of new technologies and management practices.

CHAPTER 4:

CONSERVING WATER USED BY GOLF COURSES

Applicability of This Chapter

The information in this chapter is designed as a resource to guide golf course superintendents (GCSs), golf course owners and managers, and professional organizations and associations involved in golf course development, maintenance, and management. This chapter principally addresses the agronomic practices associated with turfgrass water use efficiency. However, in the spirit of fostering a culture of conservation, it also addresses water use inside golf facilities and activities that extend beyond the golf community.

Domestic water uses such as those within the club-house or management facilities is addressed in the public water supply chapter. Lawn and landscape maintenance for homeowners and businesses is addressed in Chapter 6 of the WCIP.

Introduction

The 242 golf courses in the state use an estimated 36 mgd on an average annual basis. On average, each year, Georgia golf courses apply about 20 inches of irrigation water per 100 acres.[77]

Golf courses use most of their water to maintain healthy turfgrass along the course. Irrigation of turfgrass, like agricultural irrigation, varies seasonally. The turfgrass growing season is April through November, and during these months golf course irrigation can be disproportionately large compared to other uses within a region. Even during irrigation season, irrigation needs are heavily dependent upon weather conditions and precipitation.

When supplemental irrigation is needed, GCS and managers depend on both ground and surface water sources. The principal source on most courses is on-site ponds that are designed to capture runoff during rain events or store groundwater pumped from the underlying aquifer. These ponds provide nearby, non-potable water to help meet irrigation needs.

GCSs and golf course managers play a significant role in making sure golf courses are as water efficient as possible. To a large degree, the turfgrass plant is relatively efficient at utilizing water resources, but GCS and turfgrass managers can accentuate the natural efficiency of the turfgrass through many scientifically sound agronomic practices. They can also adopt a variety of best

[77] The formula and water use data used to calculate this estimate was provided by the Georgia Golf Course Superintendents Association. See Appendix A of the WCIP for details.

management practices (BMPs) to ensure the application and delivery of applied water is as efficient as possible, eliminating potential of loss and waste.

The development of course-specific BMPs is an important element of the GCSs' efforts to conserve Georgia's water resources. In 2004, the Georgia Golf Course Superintendents Association (GGCSA – www.ggcsa.com) entered into a conservation-focused memorandum of agreement with the Georgia DNR. The agreement outlined water management practices to be included in BMPs plans that would be developed by 75% of GGCSA members within three years. By August 2007, the association had exceeded their goal with nearly 90% of members having developed plans.[78] This step is important to enhancing our understanding of golf courses' water use and improving golf course water use efficiency. This agreement is also a model for the type of cooperative effort that can help build a culture of conservation in Georgia.

The appropriate practices for conserving water used on golf courses will vary depending on the local weather and soil conditions and the course circumstances. GCSs should develop and implement a best management practices plan (BMPs plan) that provides site-specific operating guidelines that can be used during periods of adequate and limited supply. In general, BMPs plans promote sound water and land management and can emphasize water efficiency. A key component of BMPs planning is gathering water use data, and using that information to inform future water management decisions.

Chapter Overview

This chapter presents a set of goals that can be used by GCSs and golf course managers to improve the overall water efficiency of their golf courses. Following each goal is a set of benchmarks that can be used to measure progress toward these goals. Following each benchmark is a menu of the best practices from this chapter that GCSs can choose to implement to help reach that benchmark or goal. The best practices are accompanied by implementation actions, which can be taken by outside organizations or government entities to assist GCSs and managers in implementing particular best practices.

[78] GGCSA press release – August 2007.

Goals and Benchmarks

Golf Courses

The goals and benchmarks in this chapter center around the development of course-specific BMPs plans and implementing the water-conserving practices identified in these plans. The goals also focus on building information and knowledge about baseline golf course water use and sharing that information with those inside and outside of the golf industry. The goals in this chapter recognize the unique nature of each golf course in Georgia and encourage GCSs and others to adopt practices appropriate to the specific circumstances facing the course, the community, and the water resources.

GOAL #1

Golf course superintendents or managers should develop and implement a site-specific Best Management Practices (BMPs) plan for turfgrass water conservation.

BMPs plans are general guidelines for golf course turf and water management. These plans can ensure that managers incorporate water conservation practices into their decisions. BMPs plans are operating guidelines that can guide the GCS's management of water during periods of both adequate and insufficient supply. BMPs plans can establish predetermined actions and water use responses in the event that water reductions are necessary. BMPs plans should be reviewed and revised every five years.

Since 2004, many GCS have implemented site-specific BMPs plans. Due to typical job loss and turnover, 100% participation is unrealistic. However, the industry should work toward 100% participation in this approach to managing and conserving water on golf courses.

Benchmark 1A

By December 2010, GCSs should be participating in educational activities regarding BMPs, planning and agronomic practices that affect water use.

See Best Practice 1

Benchmark 1B

By December 2010, GCSs should implement conservation practices that are cost-effective and develop an information base that can inform BMPs planning and decisions related to water management.

See Best Practices 5, 7, 8, 9, 10, and 11

Benchmark 1C

By December 2010, 97.5% of GGCSA members should have developed site-specific BMPs plans.

See Best Practice 1 and 5

Benchmark 1D
By December 2012, 75% of GCSs and golf courses that are not members of GGCSA or other professional trade association should be developing site-specific BMPs plans.

See Best Practices 1 and 5

Benchmark 1E
By December 2012, GCS, managers and owners should consider BMPs during the construction of new or the renovation of existing golf courses.

See Best Practices 5 and 12

Benchmark 1F
By the end of December 2012, GCSs should review and revise BMPs at least every five years, and resubmit these plans to the GGCSA.

See Best Practice 5 and 7

GOAL #2

Through a cooperative effort, research institutions and golf-related associations should determine a typical water use range for golf courses in Georgia that accounts for variations in rainfall and other climatic conditions.

In order to implement the BMPs plan to enhance water use efficiency on golf courses, reliable data is needed to help GCSs understand typical water needs. Reliable data can also help assess the success of water conservation practices.

GGCSA, EPD and UGA should develop a database of reliable, standardized golf course water use data. The database can help determine the typical range of golf course water use over multiple years. This would be a helpful tool for measuring the effectiveness of water conservation efforts, newly installed technology and BMPs. Many golf courses have already implemented conservation practices, so even the earliest data may reflect water use with some conservation practices in place.

When determining a typical water use range for golf courses in Georgia, calculations should account for variations in rainfall and other climatic conditions. Water use during drought years should also be considered an integral component of reasonable water use.

After preliminary calculations have been established, GCSs can use this database to measure their own water use more effectively. Since golf courses all face different conditions, direct comparisons should not be made between golf courses, and data should not be used in a punitive manner. GCSs can contribute their own data to the database and begin to assess any improvements in how efficiently water is used on the golf course.

Benchmark 2A

By December 2009, practitioners, research institutions, EPD, GGCSA, and other golf-related groups should standardize techniques and reporting information for monitoring golf course water usage and begin building a database which can be used to record reliable water use data specific to turfgrass maintenance practices for golf courses in Georgia.

See Best Practice 6

Benchmark 2B

By December 2013, and continuing through 2020, 90% of GCSs who are members of GGCSA should report water use information for their golf course facility to the database.

See Best Practice 6

Benchmark 2C

By 2015, an independent research collaborator should perform a cursory evaluation of collected data.

See Best Practice 6

Benchmark 2D

By December 2018, GGCSA and other golf industry groups should establish a typical water use range for golf courses in Georgia that accounts for variations in rainfall and other climatic conditions.

See Best Practice 6

Benchmark 2E

Beyond 2020, GGCSA and other golf industry groups should demonstrate and document progress toward improved water use efficiency.

See Best Practices 6 and 7

GOAL #3

GCSs, GGCSA, and other golf industry groups should help foster a culture of water conservation inside and outside of Georgia's golf industry.

Since 2004, GCSs in Georgia have been using BMPs plans and practicing the BMPs to improve water use efficiency on golf courses. Their knowledge and experience can be applied to other areas, including those specific to turfgrass management and others. This knowledge and expertise can be shared beyond the golf course.

Benchmark 3A

By December 2009, GGCSA and other golf industry groups should encourage golf course staff and members to improve water use efficiency inside golf course facilities and at their own homes.

See Best Practices 2 and 13

Benchmark 3B
By December 2009, GGCSA and other golf industry groups should assist with development of site-specific water conservation BMPs for other water users with similar water use patterns, such as sports and athletic field maintenance and professional lawn care.

See Best Practice 3

Benchmark 3C
By 2012, GGCSA and GCSs should participate in educational programs, such as those developed by water providers and landscape and irrigation professionals pursuant to Goal #1 in Chapter 6, that aim to educate homeowners about the importance of water conservation in landscape irrigation.

See Best Practice 2

Benchmark 3D
By 2020, GGCSA, GCSs and other golf industry groups should educate the non-golfing public regarding water use on golf courses across Georgia.

See Best Practice 4

Best Practices: A Menu of Options

Golf course superintendents and managers can employ a variety of practices to meet the goals and benchmarks in this chapter. These practices fall into four major categories: educational practices, planning practices, data and measurement practices, and water efficiency practices.

Educational practices

BP 1 – Education for GCSs

The GGCSA or other golf-related associations should regularly offer educational workshops on agronomic practices that affect water use, water management, water use conservation and BMPs. GCSs and golf course staff, whether or not they are members of the association, should take advantage of these opportunities.

Education material should also be developed for golf course architects and construction companies.

Implementation Action:

4.1 GGCSA, the Georgia State Golf Association (GSGA) or other organizations should offer scholarships to members and non-members to help them attend education events.

BP 2 – Education for staff, members, and the community about conservation

GCSs can develop programs to encourage course employees, club members, and others who use the facilities to conserve water both indoors and outdoors. Programs could include periodic classes at the facility and the distribution of articles, email bulletins, and other informational materials. GCSs should become more involved with local water issues. GCSs should write articles, speak at community events, and act as a local resource on water use efficiency.

Implementation Action:

4.2 The GGCSA and UGA turfgrass scientists should develop educational materials to assist GCSs in educating others on the facts of turfgrass and golf course water use.

BP 3 – Develop BMPs for others

Golf-related professionals should build partnerships with organizations representing water users with similar water use patterns but that have not adopted the BMPs approach to water conservation. These partnerships should develop BMPs templates for those water users.

Implementation Action:

4.3 The GGCSA should assist in developing these BMP templates.

<u>BP 4</u> – Educate the public about golf course water use and conservation efforts

The public at large is not aware of the benefits of golf courses and turfgrass systems. Concise, to-the-point information that speaks to the economic, water supply and environmental benefits of turfgrass systems, and corresponding consequences of maintaining these systems, would help to foster a larger culture of conservation.

Implementation Actions:

4.4 By 2010, GGCSA, GCSs, and other golf industry related groups should initiate a public relations campaign commending the environmental, sociological, and economic benefits of golf. This campaign should include information on how GCSs and courses are actively practicing water conservation, how water is used for turfgrass maintenance, and how turfgrass benefits the social and environmental health of our society. Information should be updated as additional research becomes available.

4.5 EPD should, when appropriate, acknowledge and commend water conservation successes achieved by those involved in the golf industry.

Planning practice

<u>BP 5</u> – Best Management Practices (BMPs) Plan

These plans consist of four parts:
1) Statement of goals, process, and water conservation philosophy,
2) Site assessment and information collection,
3) Identification of specific and reasonable BMPs for water-use efficiency, and
4) Implementation and review of BMPs plan.

To complete a BMPs plan, the GCS should review current water management practices and identify opportunities for improved water-use efficiency and conservation. The GCS should evaluate the elements, as described in detail in the 2007 document "BMPs and Water-Use Efficiency/Conservation Plan for Golf Courses: Template and Guidelines." by Carrow et al.[79]:

[79] Available online at http://www.commodities.caes.uga.edu/turfgrass/georgiaturf/Water/Articles/BMPs_Water_Cons_07.pdf

- Turfgrass and landscape plant selection
- Use of alternative (non-potable) irrigation water sources
- Irrigation system design and devices for efficient water use
- Irrigation guidance/operation for efficient water use
- Landscape and golf course design for water conservation
- Altering management practices to enhance water use efficiency
- Indoor and other landscape water conservation practices
- Education
- Development of written water conservation and contingency plans
- Monitoring, reviewing, and modifying conservation strategies

Technical resources already exist[80] to help golf courses select the best practices that can be implemented or enhanced to improve how efficiently water is used on courses. GCSs who have already completed BMPs plans should offer support and assistance to those who have not.

BMPs plans should be reviewed and revised every five years, beginning in 2012. Any improvements in efficiency that have been realized should be documented.

Implementation Actions:

4.6 GGCSA should create an archive of BMPs plans and maintain an up-to-date list of GCSs and golf courses that have completed and filed site-specific BMPs.

4.7 Golf industry associations (e.g. GGCSA, GSGA, etc.) should adopt a “code of participation” as criteria for being a member in good standing. This practice can demonstrate a commitment by the GCS and the golf course membership and administration to the BMPs approach to water management.

4.8 GGCSA should provide water conservation and BMPs educational material and workshops offered to members (see BP 1) to non-members.

4.9 GGCSA should encourage GCSs to publicize the successful implementation of BMPs at courses.

Data and Measurement Practices

BP 6 – Water use database

Research institutions, GGCSA and other associations should build a database of reliable water use data specific to turfgrass maintenance practices

[80] The most comprehensive manuscript specific to the agronomic practices associated with golf course water use and options for conserving water is “Golf Course Water Conservation: Best Management Practices (BMPs) and Strategies” it is available online at www.commodities.caes.uga.edu/turfgrass/georgiaturf/Water/Articles/BMP_GCSAA_05_Chapt_ALL_ref.pdf

for golf courses in Georgia, with assistance from golf courses and managers. This data could be managed by a third-party independent source (e.g. the University system or a research institution) that can guarantee a secure repository that will not be used for regulatory purposes.

This database would rely on GCSs to report data from their course, which they should be able to submit via a secure web site. GGCSA and other institutions, in order to establish consistency and uniformity in measurement, should establish and promote standard methods for collecting and calculating water use data.

Implementation Action:

4.10 GGCSA, EPD, and turfgrass scientists should recommend measurement methods, collection techniques, protocols for monitoring water use, and ways of demonstrating and documenting progress toward greater efficiency on golf courses. GGCSA and EPD should consider protocols and methodology established by the Irrigation Association (IA – www.irrigation.org). GGCSA and EPD should also use GCSs from various parts of the state and different types of courses to field-test measurement techniques and protocols.

BP 7 – Water conservation logs

Water conservation logs can help GCSs evaluate the effectiveness of water conservation practices and review and revise BMPs plans. Water conservation logs are records of all of the water management choices and water conservation practices that have been implemented at a golf course facility. The log should be ongoing and include data specific to water use and conservation, and justification of practices.

This log can be useful when GCSs need to demonstrate a golf course's water conservation efforts during times of limited supply or drought.

Implementation Action:

4.11 GGCSA should develop a model water conservation log.

Water efficiency practices

BP 8 – Leak detection and repair

Inspection and maintenance of irrigation equipment can prevent water loss due to leaks and faulty equipment.

BP 9 – Preconditioning turfgrass

GCSs should adjust agronomic programs (e.g. mowing, fertility, cultivation, pest management, irrigation, soil wettability, etc.) to precondition turfgrass for minimizing water needs.

BP 10 – Routine site surveys

GCSs can routinely conduct a site survey of golf course areas under irrigation. These surveys help GCSs identify areas that may not require regular irrigation to remain healthy.

BP 11 – Irrigation system audits

GCSs can perform an irrigation audit every five years. The audit can be performed internally (i.e., by GCS and staff), but documentation of methodology and results should be maintained in the water conservation log. Irrigation system audits should include assessments of irrigation devices, distribution uniformity, and delivery lines, etc. This practice works in tandem with routine irrigation system monitoring, adjustments, upgrades, and repairs.

Implementation Action:

4.12 GGCSA should work with irrigation manufactures to identify systems and technologies that improve distribution uniformity contributing to water conservation.

BP 12 – Alternative water sources

There are many ways golf courses can use non-potable water as a primary water source. Golf course architects and construction companies can design for capture and storage of storm water within the golf course facility, so that it can be reused for irrigation. Golf courses may also want to work with local water providers, municipal governments, and wastewater treatment plants to obtain suitable quality water for irrigation.

Implementation Action:

4.13 American Society of Golf Course Architects (ASGCA – www.asgca.org) should identify specific design elements that would improve water capture and reuse within a facility.

BP 13 – Improve efficiency inside golf course facilities

GCSs can work with the facility's general manager and others to identify methods and practices that reduce water use while maintaining sanitation and quality expectations. General managers may want to take advantage of incentives offered by local and/or regional water providers or the state (such as toilet rebates or other fixture replacement programs.)

Implementation Actions:

4.14 GGSCA should recommend BMPs for non-agronomic areas associated with golf course operations (e.g., clubhouse, kitchen, golf carts, pro shop, etc.) based on water conservation practices common to domestic water use (as discussed in Chapter 7).

4.15 Local water providers should work with golf courses to determine the most effective way to improve efficiency and share educational materials.

CHAPTER 5:

CONSERVING WATER USED IN INDUSTRIAL AND COMMERCIAL FACILITIES

Applicability of this chapter

This chapter addresses water uses and water conservation efforts specific to industrial and commercial (IC) facilities. IC facilities in Georgia are diverse and provide a wide variety of services and products (brief descriptions of the IC sub-sectors addressed by this plan can be found in Appendix D). Those addressed in this chapter include large and small facilities that employ water for cooling, heating and processing. Most of the practices in this chapter can be considered by all IC sub-sectors. Practices that apply only to specific sub-sectors are identified accordingly.

This chapter does not cover some water uses common to IC facilities. Water use for domestic purposes, such as in bathrooms and kitchens, is addressed in chapter 7 of the WCIP. Institutional water use, such as water used by universities and other state-owned facilities, is addressed in Chapter 8. Landscape irrigation is addressed in Chapter 6. Facilities should consider practices detailed in these other water use chapters for those practices that fall outside those addressed in this IC chapter.

Introduction

Industrial and commercial facilities and mining operations that have their own water withdrawal permits (i.e., facilities that are self-supplied) withdraw approximately 633 mgd from Georgia's water bodies on an average annual basis.[81] Actual water use by industrial and commercial facilities may exceed this amount since many facilities do not hold a withdrawal permit, but purchase water from a public or private water provider. Consumptive water use for industrial and mining facilities within this sector will vary depending on the type of industry or the type of mining activity.[82]

The industries covered in this chapter contribute significantly to Georgia's economy. The U.S. Bureau of Economic Analysis reported that in 2007, the NAICS industries classified as construction, mining, and manufacturing alone

[81] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002. This estimate includes USGS water use categories, which include industrial, commercial, and mining.
[82] Ibid.

added over $62 billion to Georgia's economy.[83] Water is used in nearly every aspect of IC operations, from cooling machines, to cleaning facilities, to actual production of goods. Water is vital to these businesses and our state's economic growth.

IC facilities can realize significant benefits from pursuing the water conservation goals, benchmarks, and practices outlined in this chapter. When properly researched and implemented, water conservation practices can improve facility operation, increase productivity, and reduce costs. Expenses incurred to implement water conservation practices are often off-set by the financial savings that may result from reduced utility bills or reduced water pumping and treatment costs. Many Georgia IC facilities are leading by example and have implemented innovative water-conserving practices to help sustain Georgia's water resources and enhance future economic development.[84]

IC facilities can conduct a cost-benefit analysis to identify the water conservation practices that offer the best opportunities for significant water savings. A cost-benefit analysis is a tool for evaluating new water efficient technologies and methods that compares the value of the benefits to the costs incurred for implementation. Water efficient practices should be compared to the cost of the alternatives to conserving water, including the costs of purchasing more water or the cost of developing new supplies. The analysis can help facilities select the practices that are best suited to their circumstances. When performing a cost benefit analysis, facilities should consider the practices listed in this chapter, practices used by similar facilities in their sub-sector and practices promoted by relevant trade and professional associations.

Conservation by IC facilities can benefit the larger community. In some areas, IC facilities may be the largest users of water. In those areas, reductions in this sector can have a large impact on an area's need to develop new water sources. In addition, conservation by IC facilities can help to foster a culture of conservation among their employees and the wider community.

IC facilities principally use water for cooling, heating, or processing. Some of these uses are non-consumptive, such as non-contact cooling water, and some are consumptive, such as steam generation. The most common water-using processes and activities in Georgia's IC facilities are:

1. Heating to initiate chemical reactions, maintain temperature, temper metal, press material, or other such needs. These operations usually require the continuous flow of hot water or steam to maintain or raise temperatures within the operation.

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[83] U.S. Department of Commerce, Bureau of Economic Analysis - Gross Domestic Product by State www.bea.gov/regional/gsp

[84] Examples include Weyerhauser's Flint River operations, Southwire in Carollton, Golden State Foods in Conyers and Advantis Technologies in Alpharetta. Case studies can be found online: http://www.p2ad.org/documents/ma_pubs.html .

2. Cooling to prepare a product for further processing, packaging, storage, or to complete a chemical process. Water may be used directly for product cooling or as a means to carry heat away from a process. Also, evaporative cooling towers are commonly used to transfer heat to the atmosphere and maintain a temperature-critical process environment.
3. Vacuum systems for conducting various operations and operating equipment. Vacuum pumps require water for cooling and to enhance the sealing characteristics of the vacuum pump.
4. Air compressors for operating equipment or maintaining the pressure in a process. Water is sometimes used to cool large compressors, but most small to mid-sized air compressors are air-cooled.
5. Mixing or liquefying chemicals with water to promote chemical reactions. Such water use may remain in the final product, or removed by drying or settling to reclaim the final product.
6. Material cleaning.
7. Transport and control of materials between processes.
8. Dilution for proper formulation necessary to achieve the final product properties.
9. Regulated emissions control.

Chapter Overview

This chapter first presents a set of goals that can be used by a wide range of IC facilities to improve their overall water efficiency. Following each goal is a set of benchmarks that can be used to measure progress toward these goals. The benchmarks in this chapter do not set fixed dates by which conservation efforts should be completed. Instead, the benchmarks identify the amount of time specific actions should take, **from the beginning of an effort to its completion**.

Following each benchmark is a menu of the best practices that IC facilities can choose to implement to help reach that benchmark or goal. The best practices are accompanied by implementation actions, which can be taken by government entities or outside organizations, when resources are available, to assist IC facilities in implementing particular best practices.

Goals and Benchmarks
Industrial and Commercial Facilities

The goals and benchmarks in this chapter establish flexible guidance for choosing and implementing practices, measuring improvements in water efficiency, and conserving water. The water use in IC facilities varies by facility type, product, location, water source, and other local circumstances. The actions identified in this chapter can be easily adapted to a variety of situations. At the center of the goals and benchmarks is the concept that for water conservation to be effective, practices should be 1) implemented in a carefully evaluated, facility-specific manner and 2) efficiency should be quantified before and after a conservation program is started.

Each IC facility should first establish a baseline of current water use, using an efficiency metric such as water use intensity. Water use intensity is the ratio of water use to a measure of output, function, or service.[85] This metric can be employed by a wide variety of facilities to communicate a level of efficiency based on facility-specific information. Water use intensity, or other appropriate efficiency metrics, should be consistent, so, when appropriate, a facility's efficiency can be evaluated in comparison to other similar facilities in the region. The use of intensity measurements allows facilities to keep their individual water use and production information confidential, while providing a basis for comparison with similar facilities with different production levels or water use practices.

Once facilities have a baseline, they can identify prospective conservation practices, evaluate them according to their facility's circumstances, and select a suite of practices. When selecting the most appropriate water conservation practices, IC facility managers must consider several things, including:

1) the cost-benefit of implementing the practice;

2) available water supplies and whether the water use is consumptive;

3) the impact the practice may have on production safety, process yields and effectiveness, product quality and safety, and regulatory compliance, and

4) periods of drought and other extreme weather conditions.

After selecting a suite of effective practices, facilities should set reduction targets based on estimated water savings that the facility could achieve. The water conservation practices the facility plans to implement, as well as their reduction targets, should be compiled into a single water management plan that

[85] A variety of output measures (the denominator in the ratio calculation) can be to develop the ratio for this metric. To represent outputs, individual facilities can use units of production (volume of product or pieces of products, etc.) or functional units, such as service life or operational space. Where confidentiality is not a significant concern, facilities may also use profit margin to develop the water use intensity measure. If confidentiality is a concern, dollar value-added may be used to protect proprietary business information.

can be used by water managers and employees to guide decision-making. All facilities should adopt as a conservation practice an education program for their employees.

IC facilities can use improvements in water use intensity to demonstrate progress toward water conservation goals, as may be required in the future (see Chapter 1 for more information). Water use intensity requirements, however, will not be included in water withdrawal permits. Also, acknowledging that information regarding water use intensity may be proprietary; provisions should be made to maintain confidentiality, where necessary.

The WCIP should be used as a resource and is not intended to prevail over any federal, state, county or municipal regulations. Where possible, efforts to conserve water should be aligned with regulatory requirements. IC facilities should not violate any water or other regulatory requirements related to air quality, waste management or others in the process of implementing the elements of this plan.

Facility-specific best practices for water conservation should be continuously updated to reflect new facility conditions and new methods or technologies as they are proven in the marketplace. Current technologies that may not be justifiable at current production levels may become justifiable as production increases and technologies mature. As discussed in Chapter 1, the WCIP will be modified every five years to incorporate new data and information about innovative technologies. EPD may also periodically release supplemental information to provide users with the most accurate and up-to-date information. IC facilities can share the results of their efforts with the EPD to help improve the WCIP in future revisions.

GOAL #1

Industrial and commercial facilities should determine baseline water use, in terms of water use intensity or another efficiency metric.

The first step in an IC water conservation program is to determine the current level, or baseline, of water use. When a baseline is established at the beginning of a program, IC facilities are better able to evaluate and quantify the effect of water conservation practices, as well as communicate their conservation successes to the others.

Measuring water use in terms of water use intensity is an effective way to begin or enhance water conservation efforts at IC facilities. Creating a facility-specific water use intensity baseline can provide IC managers with a site-specific measure of how much water is used to accomplish a particular output, function, or service. This measure can be used for comparison when water conservation efforts are enhanced or introduced. In this way, when more efficient technologies or practices are implemented in the facility, managers will be able to accurately record how much water has been saved. IC water use baselines can be calculated in a variety of ways, depending on the conditions and operations of the facility.[86]

Benchmark 1A

IC facilities should collect data regarding water use and current water-using practices and technologies. Initial data gathering efforts should be completed within 9 months of inception. (This preliminary data collection effort should use existing data and best estimates. More detailed data should be collected once major use areas within the facility are identified as described in Goal #2.)

See Best Practices 1, 2, and 3

Benchmark 2B

IC facilities should adopt appropriate water use intensity metric(s) for their facility and begin to use them. This effort should be completed within 12 months of inception.

See Best Practice 3

GOAL #2

Industrial and commercial facilities should establish reduction targets for existing water uses and implement practices to achieve those targets.

Water use in IC facilities is not always efficient. For example, water may be used to move apples through the processes to produce applesauce. While this method of transporting the apples is beneficial, it is not water efficient. New, more water-efficient methods of transporting apples are available. Almost daily, innovative new technologies and conservation practices are emerging from facilities and researchers throughout the country that can reduce the amount of water necessary to accomplish certain tasks. Facilities should try to achieve greater water efficiency in a systematic way, and should be able to quantify the results of their efforts.

IC facilities at the initial stages of implementing water conservation practices should begin by selecting technologies that may be available to improve their water efficiency and evaluating them using cost-benefit analysis. The estimated savings from these technologies, compared against the established baseline (as discussed in Goal #1), can be used to set water use reduction targets for the facility.

Information about technologies and practices that have documented success in achieving greater water efficiency[87] can help IC facilities create realistic estimates of their water savings from these technologies. These

[86] Examples of measures of water use intensity include gallons of water used per unit of production or gallons of water used per unit of revenue, or gallons of water used per area of space occupied.

[87] Case studies can be found online at http://www.p2ad.org/documents/ma_pubs.html

reduction targets can be facility-wide, or particular to an area of water use within the facility (such as water lost to leaky pipes).

These reduction targets, and the practices that will be used to achieve them, should be included into a facility-wide water management plan. These plans can guide managers in making decisions about facility operations, and inform employees how they should perform specific water-using tasks within the facility. The plans can also show others how the facility is conserving water. In general, these plans serve to institutionalize the facility's commitment to water conservation.

The effect of water conservation efforts on facility processes and other facility resources should be a factor in evaluating alternatives to prevent negative effects on other facility and environmental resources. There are many operations within a facility where water use is superior to other "dry" technologies when operational efficiency and the environment are considered. Proper evaluation of alternatives should verify that water is the best choice for accomplishing the task at hand, and that it is used as efficiently as possible.

Benchmark 2A

IC facilities should conduct cost-benefit analyses to identify which water conservation practices are effective and could reduce the water use intensity of their facility. This effort should be completed within 18 months of inception.

See Best Practices 1, 2, 3, and 4

Benchmark 2B

IC facilities should identify the water reuse and water recycling practices that can help achieve reduction targets. This effort should be completed within 18 months of inception.

See Best Practice 5

Benchmark 2C

IC facilities should implement the practices, identified pursuant to Benchmarks 2A and 2B, that can help achieve reduction targets. This effort should be completed within 18 months of inception.

See Best Practices 5, 6, 7, 8, and 9

Benchmark 2D

IC facilities should develop or update water management plan(s) that incorporate reduction targets and the water conservation practices appropriate for each facility. This effort should be completed within 5 years of inception.

See Best Practice 11

GOAL #3

Industrial and commercial facilities should develop a program to educate employees and those contracted by the facility about water use and water conservation efforts.

As described in the foundational goals of the WCIP, education is critical to building a culture of conservation in Georgia. Therefore, efforts to educate employees and those on contract with IC facilities about water use and water conservation practices will help foster this culture of conservation.

Education can inform employees and contractors about the importance of water conservation and empower them to make better decisions about how water is used. Exercises that determine where water is being used inefficiently (through leaks or wasteful practices) require the commitment of the facility employees and management team. Educated employees can help change inefficient practices and repair areas where water is lost. They can also encourage their fellow employees and neighbors to understand the importance and benefits of water conservation.

See Best Practice 12

GOAL #4

Industrial and commercial facilities should integrate water and energy conservation practices, where practicable.

Water and energy use are closely connected; water conservation and energy conservation are also closely connected. Practices implemented to improve energy savings can also result in water savings, and likewise, water efficiency practices can improve energy efficiency.

New water- and energy-efficient technologies are emerging every year. IC facilities in Georgia should be leaders in testing these new technologies to determine the savings that can result and under which circumstances they should be implemented.

For IC facilities that develop energy management plans, water conservation efforts should be integrated into them, where practicable. Energy and water conservation efforts should be complimentary, and IC facilities should consider energy use when evaluating the cost and benefits of the water conservation options.

Benchmark 4A

IC facilities should consider piloting new state-of-the art technologies that are considered to be feasible and have the potential to offer significant water and/or energy savings.

See Best Practice 6

Benchmark 4B
IC facilities should update energy management plans, if applicable, to incorporate appropriate water conservation practices. This effort should be completed within 60 months of inception.

See Best Practices 10 and 13

Best Practices: A Menu of Options

IC facilities can select a set of water conservation practices that is tailored to their particular operations and conditions. Facilities may use this list of practices, which is not exhaustive, to meet benchmarks and goals.

Information-gathering practices, which help facilities to gain a better understanding of their water use and evaluate their water efficiency, can be useful for any facility. Planning and educational practices can also be implemented at any facility. The most effective water saving practices will vary from site to site.

Information-gathering practices

BP 1 – Water audits

Regular water audits can help facilities identify opportunities to improve water efficiency and evaluate beneficial water use within the facility. Water audits can document the tasks that require water, as well as the major points of water use and the volume used at each major point of use. Water audits can also, using methods appropriate for their sub-sector, document all water using practices and technologies. Water audits may also, where practicable, associate water use with units of production (such as gallons of water per square foot of carpet dyed).

Water audits should be conducted when initiating a water management plan, and when major process changes occur. The definition of a major process change will vary by facility. Generally, any change that results in more than a 20% increase or reduction in water use for that process should be re-measured.

Implementation actions:

5.1 Industrial or trade associations and the Pollution Prevention Assistance Division (P2AD – www.p2ad.org) should provide guidance on methods of documenting water use and/or conducting water audits at industrial and commercial facilities.

5.2 Georgia Environmental Partnership (GEP – www.p2ad.org/documents/gep_home) should offer assistance and training to IC facility managers in analyzing facility water use and cost savings potential.

BP 2 – Measuring water use

All water withdrawals should be measured. A water use measurement verification program can ensure that a facility's decisions regarding water conservation are based on sound data. Accurately measuring water use at specific points within an IC facility, and correlating this water use with plant production / operation, are critical to identifying areas of potential improvement and measuring improvements in efficiency.

Case studies from IC facilities in Georgia demonstrate that continuously monitoring specific water use areas in a facility uncovers a greater number of conservation opportunities than estimates or periodic measurements.[88] Facilities should at a minimum monitor key water use areas for several days using temporary measurement devices to see if process variations warrant closer monitoring to improve water efficiency in these areas. Many facilities have reduced water consumption with few, if any, process changes by simply posting recent water use at major use areas within a facility.

Measuring devices, such as meters, should be maintained, calibrated, and replaced according to the manufacturers' recommendations. Accuracy should be verified annually and any time measurements are in question.

Implementation Actions:

5.3 Applicable technical or industrial trade association(s) should provide guidance on appropriate water use measurement verification programs

5.4 Appropriate trade or professional associations should identify financial resources that can help facilities install devices (such as meters) needed to measure total water coming into IC facility, or where practicable.

<u>BP 3</u> – Water use efficiency metrics

Water use efficiency metrics, such as water use intensity, allow IC facilities to more precisely identify conservation opportunities and evaluate conservation practices. Water use intensity can be measured in a variety of ways. Each IC facility should evaluate the information generated by water audits, information related to the business output, function or service, and relevant information from other facilities within their sub-sector, to determine the ideal water use intensity measure(s) for their facility. A specific water use intensity measure may be best for a facility (i.e., gallons of water used per unit of carpet finished or gallons used to create a toaster). Or a variety of water use intensity metrics for different operations within the facility may be appropriate (i.e., gallons of water used to transport apples to be made into applesauce or gallons of water used for dying carpet in the facility).

Where possible or practical, IC facilities can compare their water use intensity measurements to those of other similar facilities. Through cooperative efforts, inefficient facilities can learn a great deal from similar facilities that are more efficient.

Implementation Actions:

5.5 IC professional and/or trade associations should work with IC facilities to determine the most appropriate water efficiency

[88] See "Georgia Success Stories" online at http://www.p2ad.org/documents/wa_home for examples.

metrics for their sub-sector. Associations should also develop guidance for calculating water use intensity or other relevant metrics.

5.6 GEP should offer assistance to associations and businesses working to develop water use intensity or efficiency metrics.

BP 4 – Cost-benefit analysis of water conservation practices

Cost-benefit analysis allows facilities to identify the water conservation practices that promise the most significant water savings for the cost incurred. The cost-benefit analysis should estimate the cost of a practice as well as the resultant reductions in water use (or water use intensity). The cost of the practice should also be compared to the cost of alternatives to conservation, such as purchasing more water or developing new supplies. To fully account for all costs and benefits, the analysis should consider the potential benefit to the operation, potential adverse impacts of the practice, feasibility of success, and steps to implement.

Facilities should consider using cost-benefit analysis to evaluate the practices listed in this chapter, as well as the practices used by similar facilities in their sub-sector and those promoted by relevant trade and professional associations. Also, IC facilities should consider the impact more water efficient technologies or practices may have on operational reliability and product quality, as well as the effect business growth may have on water demand for that region of the state.

Facilities can choose practices for this analysis based on current water-use data in the facility. Information gathered through data collection activities (BMPS 1, 2, and 3) to document those areas within the facility where water is being used inefficiently, including areas of water loss and water waste. Conservation practices that address these areas are most likely to be cost-effective and have the shortest pay back period.

Implementation Action:

5.7 Professional and trade associations as well as those IC facilities that have already implemented water conservation practices or installed new technologies, should inform those within their sub-sector about available cost-effective technologies.

Water-saving practices

BP 5 – Recycle and reuse water

IC facilities can minimize their need for new water withdrawals through water reuse[89] and recycled water. Water reuse and recycling can be especially

[89] Reuse is defined as the use of reclaimed water as a substitute for another, generally higher quality water source.

useful for facilities that are growing and are dependent on limited water resources, as it allows facilities to expand production without increasing water withdrawals. However, enhancing reuse and recycling may increase consumptive use of water (i.e., water may not be returned to the source).

IC facilities should conduct feasibility studies to identify opportunities to save water through reuse and recycling. These feasibility studies should consider the infrastructure requirements, such as tanks, pumps, piping, and treating equipment, and the cost for implementation. Studies should consider water volume, water quality, potential uses, and potential problems (such as with process operation, corrosion, product quality / purity, and other constraints). Studies should also consider water treatment costs that may be required for a discharge or delivery to a wastewater treatment facility.

IC facilities can document the volume of water reused and recycled and the accompanying improvements in water efficiency. This information can be recorded regularly and reported to EPD as needed, following guidance issued by the Director. Facilities should also adopt reuse plans that comply with the appropriate state guidelines for monitoring, system function and reliability, operation, storage and water quality standards.

Suggested methods for recycling or reusing water include: 1) using reclaimed water for 50% or more of total outdoor water needs where practical and reasonably available;[90] 2) implementing storm water capture to collect clean rainwater as a substitute for freshwater in and around the facility. Storm water ponds must be constructed according to local and state environmental regulations; and 3) Counter-flow cooling/rinsing methods (for manufacturing industries).

Implementation Actions:

5.8 GEP and professional and trade associations should identify possible applications for reused and recycled water, and verify the water quality, quantity and consistency required to maintain operations.

5.9 GEP and professional and trade associations should offer assistance in evaluating the cost-effectiveness and feasibility of using reuse or recycled water.

5.10 Local governments should consider regional investments in water reuse and recycling technologies, especially when multiple IC facilities within their jurisdiction may benefit.

5.11 GEP and professional and trade associations should identify possible applications for counter-flow systems, and verify the

[90] When determining the extent practicable, consideration should be given to the cost benefit and commercial availability of technologies, as well as any legal or regulatory constraints to its application.

water quality, quantity and consistency required. This effort should include evaluating the overall cost-effectiveness and feasibility of counter-flow processes.

BP 6 – Piloting innovative technologies

When appropriate, facilities should consider testing new technologies, including products and practices that can conserve water. Pilot projects provide a good opportunity for IC facilities to test water-conserving products and practices and discover potential problems. In order to accurately evaluate the methods, water use should be measured before and after pilot implementation. After pilot tests, these products and practices can be subjected to a cost-benefit analysis.

IC facilities should give special consideration to piloting methods that offer both water and energy savings.

Implementation Actions:

5.12 U.S. EPA, U.S. Department of Energy (U.S. DOE – www.energy.gov), GEFA, GEP, professional and trade associations, and educational institutions should provide financing for pilot systems and for facilities installing innovative technologies.

5.13 Industrial and commercial trade and/or professional associations should work with the water users from their sector to develop industry-specific practices that help IC facilities maximize water efficiency.

5.14 GEP and applicable technical or industrial trade organizations or associations should identify possible applications of new energy and/or water conserving equipment, and verify that any new equipment meets all state and federal requirements for safety, water quality, and water quantity.

BP 7 – Dry methods for cleaning and dust control

Cleaning and dust control methods that do not use water can be effective in many IC processes that do not involve contact with food. Dry methods should only be used if they can be employed safely and facilities can maintain compliance with the regulations of federal agencies, including U.S. Occupational Safety and Health Administration (OSHA), USDA, U.S. Food and Drug Administration(FDA), and U.S. EPA.

BP 8 – Leak detection and repair

Facilities do not benefit from water that does not reach its intended destination. Facilities can adopt a leak detection and repair program for pipelines, intakes, and discharge structures. Leak detection and repair is one of the simplest ways to improve a facility's efficiency and will usually be cost-effective.

Leak detection and repair programs could include a process to identify areas where water use in a facility is higher than can be accounted for by a water audit. In such a case, temporary meters can be used to verify water use and to locate areas where longer term monitoring may be needed. Leak detection and repair programs can help prevent small leaks from becoming serious and causing disruptions in operation that may greatly exceed the cost of the initial repair.

BP 9 – Discontinuing discretionary use of water.

Facilities should consider prohibiting activities that use a great deal of water but are not critical to the operation of the facility. Such practices include non-recycling decorative fountains, parking or loading dock wash down using fresh potable water, discharge of reusable process water, and use of inefficient water softeners.

BP 10 – Increasing the efficiency of cooling towers and boilers using performance-based contracting.

Two of the largest energy and water using-processes are cooling towers[91] and boilers[92]. These areas are therefore the most logical places for IC facilities to investigate integrating water and energy conservation. Facilities should consider using performance-based contracts for the operation of cooling tower and boiler operations. This type of contracting, also known as performance-based acquisition, is a technique for structuring all aspects of an acquisition around the purpose and outcome desired, as opposed to the process by which the work is to be performed.

When considering using this type of contracting, IC facilities should investigate the water quality and quantity needs for specific heating, ventilation and air conditioning (HVAC) equipment.

Implementation Actions:

5.15 Research institutions should verify water quality and quantity needs with vendor for HVAC equipment.

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[91] Cooling towers are used extensively from relatively small facilities such as office buildings and supermarkets to large facilities such as hospitals and manufacturing and industrial plants. Cooling towers can be among the largest water using systems in industrial and commercial settings. Generally, a cooling tower uses evaporation to lower the temperature of water that conveys heat from mechanical equipment such as air conditioning systems, heat exchangers, condensers, or process machinery.

[92] Boilers (and steam generators) are used in heating or processing steam. Boilers (and steam systems) vary in size and design, depending on the operation and function. Commercial boilers are primarily found in larger buildings, multiple-building institutions such as campuses, commercial cooking facilities, or in some cases where process steam is required. Industrial boilers are used for electric power generation for the facility or for processes or manufacturing needs, usually in large facilities.

5.16 GEP and professional and trade associations should prepare model contracts using examples from other performance-based contracts.

Planning and educational practices

BP 11 – Water management plans

A water management plan should outline a systematic, facility-specific approach to improving water efficiency. Water management plans should include current baseline water use (discussed under Goal #1), water reduction targets for the facility and the cost-effective practices the facility intends to use to reach those targets (discussed under Goal #2). Reduction targets, which should reflect reasonable water use reductions, can be stated in terms of either water use intensity or volume of water consumed (total gallons/yr, average gallon/month, etc).

Water management plans should also document the areas of inefficient water use and identify opportunities for increasing water use efficiency in the future. If appropriate, IC water management plans could reflect the benchmarks outlined in this chapter.

IC facilities should update water management plans regularly, especially after major changes in operations, to reflect new technologies and changing conditions related to growth projections, water availability and efficiency improvements. Facilities that purchase water from a regional or local water provider should share these management plans with the provider, when possible. This is especially important if the facility expects an increase in water use efficiency that may result in reduction in the amount of water purchased from the provider.

Implementation Action:

5.17 GEP should provide training for employees of IC facilities on developing and implementing a facility-specific water management plan.

BP 12 – Educational programs

Facility managers should engage employees in water conservation efforts and supply information regarding their water conservation efforts and water use. Facility managers can use many methods for educating employees, including displaying facility water use information in a conspicuous location and regularly circulating information about progress towards water reduction targets through information boards, break-room flyers, electronic notices or other means.

Implementation Actions:

5.18 GEP and public water providers should develop a model program of simple and effective methods for educating employees about the status of conservation initiatives.

5.19 GEP and EPD can participate in "train the trainer" instruction for IC facility personnel.

<u>BP 13</u> – Energy management plans

IC facilities should update each facility energy management plan to incorporate appropriate water conservation practices. Plans should include a timeline for installing new, efficient technology and other water conservation practices, as well as the anticipated energy savings from water conservation efforts.

Implementation Action:

5.20 GEP and applicable technical or industrial trade organizations or associations should provide guidance for IC facilities updating or developing energy management plans to include water conservation efforts.

CHAPTER 6:

Conserving water used for Landscape Irrigation

Applicability of this chapter

This chapter addresses landscape irrigation, which is one of many outdoor water uses. Landscape irrigation includes water used to irrigate residential and commercial landscapes. This chapter applies to landscape and irrigation professionals involved in installing and maintaining landscape features, water providers, and the businesses and homeowners who choose to irrigate their landscapes. Although water used for landscape irrigation normally is delivered by a public water provider, the unique nature of landscape irrigation separates it from other public uses. Other types of outdoor water uses and public water use are addressed in Chapter 7.

Introduction

Landscape irrigation includes water used to irrigate residential and commercial landscapes. Water used to irrigate landscapes is estimated to be 181 mgd on an average annual basis.[93] This estimate is based on water withdrawals and drought reports submitted to EPD from 2006 through 2007. It is difficult to measure precisely how much water is used for landscape irrigation. Most customers' water use is metered, but customer meters rarely segregate outdoor water use from total water use, and few water providers offer separate meters for outdoor uses. Therefore, most of the calculations of how much and when water is used outdoors in Georgia are estimates.

While there are many uses of water for outdoor purposes (such as car washing, power washing or recreation), outdoor water use is dominated by landscape irrigation. Like water use for agricultural irrigation and golf courses, landscape irrigation varies significantly from season to season, with the greatest use occurring in the summer. Researchers estimate that public water use outdoors increases about 30% to 50% in the summer months.[94]

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[93] The estimated annual average water use for landscape irrigation is based on data reported to the EPD from the 55 counties under Drought Response Level 4. The estimate was calculated using reported annual average water use calculated as the difference between water use during Nov. 2006 – Oct. 2007 and water use during Nov. 2007 – Oct. 2008. The difference reflects the changes in water use as a result of the outdoor water use ban that became effective in Oct. 2007. The difference was multiplied by the population ratio of the whole state to the 55 counties, with an adjustment for estimated water use for outdoor non-irrigation purposes. See Appendix A of the WCIP for more information.

[94] Waltz C., and G. Wade (2007). Best Management Practices for Landscape Water Conservation: Introduction Chapter. 52 pgs. Available online at http://pubs.caes.uga.edu/caespubs/pubcd/B1329/B1329.htm. K. Nguyen, water efficiency coordinator Cobb County Water System. Personal communication. February 2009.

When water is supplied by a public or private entity, outdoor water use, including landscape irrigation, can cause peak water demands. Peak demands stretch the capacity of water treatment and delivery. Significant peaks can make it difficult for water providers to supply water to all customers because, among other things, it reduces water pressure within the system. Water providers must be able to maintain adequate water pressure to support basic functions, such as drinking water and toilet flushing; to supply tall buildings, such as hospitals and office towers; and especially to provide sufficient flow and pressure for firefighting.[95] Increasing the efficiency of landscape irrigation can help reduce peak water demands.

Often, when water supplies become limited, outdoor water use is banned or restricted. Such actions can have a negative impact on the landscape industry, the water providers, and the overall economy of the state, region, or independent community.[96] By implementing somewhat permanent practices to increase the efficiency of landscape irrigation, communities may be able to minimize the need for emergency measures, such as watering bans, in times of drought.

Maintaining healthy urban landscapes is important for a number of reasons. If properly installed and maintained, landscapes can mitigate the environmental impact of urbanization by improving air quality, reducing energy consumption and providing groundwater recharge. Urban landscapes also can serve to improve water quality by reducing storm water runoff and soil erosion.[97] If the proper steps are taken when designing, installing residential and commercial landscapes, they can be maintained and irrigated while still protecting natural resources, environmental quality and economic vitality.

An important and often overlooked element of landscapes is the condition of the soils. Traditional development practices can strip away topsoil and organic material that is critical to maintaining a healthy and water-efficient landscape. Organic and inorganic amendments can be added to soils that have been compacted or altered during development. These amendments can improve the physical, chemical, and biological properties of the soil. Amendments help the soil hold water and improve water and nutrient movement throughout the soil.

The landscape industry contributes significantly to the state's economy. According to the UGA College of Agriculture and Environmental Sciences (UGA CAES – www.caes.uga.edu), greenhouse and nursery businesses, landscape installation and maintenance, retail garden centers, and plant wholesalers generated approximately $4.8 billion in revenue in Georgia in 2005.[98] (This estimate does not include the sod-producing farms or the indirect contributions of

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[95] Vickers, A. 2001. *Handbook of water use and conservation: homes, landscapes, businesses, industries, farms.* WaterPlow Press. 446 pgs., pg. 140.

[96] Bauske, E.M. and G. Landry. 2007; Bauske, E.M., W. Florkowski, and G. Landry. February, 2008; Flanders, A., E. Bauske, and J. McKissick. March, 2008.

[97] Environmental Fact Sheet: *How Green Spaces Benefit the Environment.* Project Evergreen. http://www.projectevergreen.com/pdf/EnvironmentalFactSheets.pdf

[98] UGACAES "Size and value of the Professional Turfgrass and Environmental Horticulture Industry in Georgia" Online http://apps.caes.uga.edu/urbanag/indeconomics.cfm

the landscape and irrigation businesses, landscape architecture and irrigation equipment sales). UGA CAES also reports that these businesses employed approximately 57,000 individuals in 2005.[99] From growing plants, to installing landscape plants and irrigation systems, to maintaining sustainable landscapes, water is essential for the continued operation of Georgia's landscape and irrigation businesses.

Many of the practices described in the chapter will be easier to implement if there are additional financial incentives to saving water used for landscape irrigation. The conservation-oriented water rates discussed in Chapter 7 are some of the most effective means of providing a financial incentive for conservation. Conservation-oriented rates may also provide additional revenues that can be used to support conservation programs aimed at landscape irrigation.

Chapter Overview

This chapter presents a set of goals that can improve the overall water efficiency of residential and commercial landscape irrigation. Following each goal is a set of benchmarks that can be used to measure progress toward these goals. Following each benchmark is a menu of the best practices that can be implemented by homeowners, business owners, or landscape and irrigation professionals to help reach that benchmark or goal. The best practices are accompanied by implementation actions, which can be taken by outside organizations or government entities to assist in improving landscape irrigation efficiency.

Much of the following information was drawn from successful programs in Florida, Texas and California. The information from these states was modified to address the differences in climate and demographics between those states and Georgia.

[99] Because golf courses are addressed in Chapter 4, and sod/turf production is addressed in Chapter 2, this estimate does not reflect the revenues generated by golf courses and golf-related businesses or sod/turf production. Source: UGACAES online http://apps.caes.uga.edu/urbanag/indeconomics.cfm

Goals and Benchmarks
Landscape Irrigation

These goals, benchmarks, practices and actions can improve our understanding of and increase the efficiency of landscape irrigation in Georgia. The elements center on the following areas: establishment of landscape and irrigation standards; documentation of professional proficiency through certification; reducing summer water use peaks; and, of critical importance, consumer education for all water users regarding sound water conservation practices and the value of water efficient landscapes.

GOAL #1
Landscape and irrigation professionals and water providers should educate their customers on proper and efficient landscape water use practices.

Landscape and irrigation professionals and water providers should cooperatively engage in a comprehensive water conservation education program to influence how customers use water for landscape irrigation. The educational materials should provide a consistent educational message about the importance of using water efficiently outdoors. Landscape and irrigation professionals can deliver the educational message through garden centers, nurseries or landscape maintenance employees. Water providers can deliver the educational message to the customers through water bills or existing educational programs. The information used should be based on Best Management Practices (Appendix E).

Education is a three-step process of 1) creating awareness of the issue(s); 2) providing information to address the issue(s); and 3) providing the tools needed for action. To be comprehensive, an education program on proper and efficient landscape water use practices should include:

- Information about their water sources and the challenges facing those sources,
- Information about the economic, health, recreational, aesthetic and environmental benefits associated with water resources and water efficient landscapes,
- Information about water efficient landscape designs and plants, and
- Information about proper landscape installation and maintenance.

Some educational materials should be targeted at high-water use customers, who often drive peak water demands. These customers have the opportunity for the greatest reduction in water consumption by improving landscape irrigation practices.

Benchmark 1A
By January 2010, landscape and irrigation professionals and water providers should implement a comprehensive educational program to inform their customers of the importance of proper and efficient water use practices.

See Best Practices 1, 2, 3, 4 and 5

Benchmark 1B
By June 2011, water providers should target education programs and distribute materials to high water use customers. *This benchmark is related to Benchmark 4A and Appendix G, which details the calculation of indoor water use.*

See Best Practices 3 and 5

Benchmark 1C
By 2011, landscape and irrigation professionals should promote a sustainable approach to landscaping by offering citizens a checklist of practices, instruction on how to implement the practices and a process for certifying a water efficient landscape.

See Best Practice 4

GOAL #2

Landscape and irrigation professionals and professional associations should establish state-wide standards for design, installation and maintenance of Georgia landscapes, landscape irrigation systems, and other systems dealing with landscape water conservation, such as rainwater catchments systems.

State-wide standards for design, installation and maintenance of landscapes and landscape irrigation systems can help reduce landscape water use. These standards can also help homeowners and business owners understand the importance of proper landscape water use and avoid problems from faulty irrigation systems or inefficient landscapes.

Standards for design, installation and maintenance of landscapes and irrigation systems should be developed through a cooperative effort of landscape and irrigation professionals, professional associations and researchers. Standards should also address the use of alternative sources for landscape irrigation, such as rainwater harvesting. As part of this effort, the committee should develop a process for certifying professionals as proficient in the state standards.

Standards should be incorporated into state-wide rules and regulations where it is reasonable to do so. A number of existing standards are available and may be incorporated in Georgia's standards or used as a model.

It is important that at least one employee of landscape and irrigation businesses is certified as proficient in the state-wide or regional standards developed for their operations. Because these individuals direct and train the employees responsible for landscape and irrigation system installation and maintenance, they can impact how efficient and effective of the work is.

Continuing education is also critical to ensure that employees have the latest information regarding landscape and irrigation system design, installation and maintenance. Standards may change and every year new technologies emerge. Individuals engaged in continuing education programs are more likely to commit to establishing water efficient landscapes and enhancing the water efficiency of existing landscapes. Business owners that employ certified professionals can offer consumers confidence in their services and equipment.[100]

Benchmark 2A

By 2010, landscape and irrigation professionals, water providers, researchers and others should convene as a state-wide advisory committee to develop state-wide and/or regional standards for design, installation and maintenance of landscapes and landscape irrigation systems in Georgia.[101]

See Best Practice 7

Benchmark 2B

By 2011, the state-wide advisory committee should develop state-wide and/or regional standards for design, installation and maintenance of landscapes and irrigation systems in Georgia, as well as professional certification standards for the industry.

See Best Practice 7 and 8

Benchmark 2C

By 2012, the state-wide advisory committee and the Georgia EPD should recommend that the state-wide standards for design, installation and maintenance of landscapes and irrigation systems in Georgia and professional certification be incorporated into rules and regulations.

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[100] In other states (such as Florida and New Jersey) legislation has been passed to require professional certification proficiency for landscape and irrigation contractors. In many communities ordinances have been used to attain a similar goal. Ordinances have also been used to require a landscape plan and installation review process.

[101] Florida with "Landscape Irrigation & Florida-Friendly Design Standards" provides a good example of such landscape and irrigation design standards. http://www.dep.state.fl.us/water/waterpolicy/docs/LandscapeIrrigationFloridaFriendlyDesign.pdf .

Benchmark 2D
By 2020, all landscape and irrigation businesses operating in Georgia should employ appropriately certified professionals who can ensure compliance with state-wide or regional standards.

See Practices 7, 8, 9, and 10

GOAL #3

Landscape and irrigation professionals, water providers and local governments should help water customers reduce summer peak use.

Peak use refers to the maximum demand for water that occurs over a given time period, such as hourly or daily during summer months (May to September). Peak water use is normally associated with landscape irrigation and other outdoor water uses, because most water providers experience peak use in summer months when customers are most likely to use water outdoors. Water providers should help customers reduce peak use, because peaks can limit the provider's ability to serve customers with basic water needs.

Reducing peak use can help water systems become more efficient. Water providers must design and size their water treatment, pumping and delivery systems so that they have the capacity to meet peak use. If the peak use is close to normal demand, water facilities can be smaller, more efficient, and less costly. In addition, peaking can reduce pressure in the water delivery system, so reducing peaks in demand also protects human health and safety.

A first step in helping customers reduce high summer water use is for water providers to determine their baseline peak use and peaking factor. A water system's peaking factor is a ratio of peak daily water use by customers to average daily water use by customers. The higher the peaking factor, the higher the peak use, and the more likely a water provider will experience difficulty in meeting the demands of their customers.

As discussed in Chapter 5, a baseline can be considered a starting point used for comparison when conditions are altered, such as the introduction of educational efforts or incentives to reduce peak water use. Water providers can use the baseline to evaluate the effect of water conservation practices after implementation.

Water providers can employ a variety of practices to reduce peak use, including financial and technological incentives/disincentives for customers to conserve. Changing to more water efficient devices or switching to alternative sources such as rainwater harvesting for irrigation purposes can offer somewhat permanent water savings. Strategies related to conservation billing have also proven effective in many areas.[102]

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[102] AWWARF Report, 91205. 2008. Water Budgets and Rate Structures--Innovative Management Tools. www.awwarf.org

This goal encourages all water providers to plan for future water supply issues by understanding their peak water use and peaking factor.

Benchmark 3A

By 2011, water providers should improve their understanding of outdoor water use for landscape irrigation by calculating their baseline peak use and peaking factor and, where appropriate, establish a peak reduction target.

See Best Practices 5 and 6

Benchmark 3B

By 2012, water providers with high peaking factor and peak reduction targets (as identified in benchmark 3A) should, with assistance from local governments, offer incentives to customers implementing practices to reduce system's peaking factor.

See Best Practices 11, 12, 13, 14, and 15

Benchmark 3C

By 2015, and every five years thereafter, water providers should evaluate the success of their outdoor water conservation efforts and revise incentives and programs, as needed. *This benchmark should be coordinated with Benchmark 1C in Chapter 7 – Domestic and Non-Industrial Uses, which calls for an assessment of the overall water conservation program.*

See Best Practice 6

Best Practices: A Menu of Options

Many kinds of practices can be employed to help landscape and irrigation professionals, water providers and local governments meet the goals and benchmarks in this chapter. These practices fall into four major categories: educating water users about water efficient landscape practices, measuring the efficiency of landscape irrigation in the community, setting standards for landscapes and irrigation systems and the professionals who install them, and incentives that can be implemented to encourage customers to implement water efficient landscape design and maintenance.

Educational practices

BP 1 – Adapt existing educational programs

Landscape and irrigation professionals and water providers can adopt or adapt educational programs available through, but not limited to: UGAExt, UGA Center for Urban Agriculture (http://apps.caes.uga.edu/urbanag), DNR waterSmart, GWWC, Georgia Green Industry Association (GGIA – www.ggia.org), Metro Atlanta Landscape and Turf Association (MALTA – www.maltalandscape.com), the Georgia Turfgrass Association. Any education program adopted should involve:

1) Distributing information to homeowners and business owners about water efficient landscaping and irrigation practices (See Appendix E for examples such practices) and providing additional tools and resources to help customers make good decisions about irrigating.[103]
2) Coordinating educational efforts between water providers and the landscape and irrigation professionals to ensure that they contain a consistent message.

In communities where summer water use is very high, educational programs should also focus on reducing peak water use.

Implementation Actions:

6.1 Associations for landscape/irrigation professionals (such as Urban Agriculture Council (UAC)), associations for Georgia water providers, UGAExt, and state agencies should formalize a cooperative outdoor water use education program.

6.2 State agencies, U.S. EPA, and UGA College of Agriculture and Environmental Science (UGA CAES) should coordinate and enhance water conservation programming and educational material regionally.

[103] See www.ConserveWaterGeorgia.net for more information.

6.3 UAC and DNR should assess the success of existing programs designed to educate Georgia citizens and offer incentives to customers to irrigate landscapes more efficiently (e.g. Outdoor Water Use Registration Program and the waterSmart state-wide education campaign.) If existing programs prove successful, UAC and DNR should enhance them.

BP 2 – Conservation educators

Landscape and irrigation businesses or water providers can hire or contract with an educator to implement a sustainable, water efficient landscape program locally or regionally.

BP 3 – Distribute information to high-use customers

Water providers can distribute information through direct mail, websites, or customer water bills. Information should encourage high-use customers to implement more efficient irrigation practices or to consult an irrigation professional to identify why water use is high and make recommendations for improvement.

Implementation Action:

6.4 GWWC and landscape and irrigation professionals' associations should regularly update the information available for water providers to distribute to high use customers.

BP 4 – Checklists and certification for sustainable landscapes

A sustainable approach to landscaping refers to the use a variety of best practices that, when implemented together, can conserve significant amounts of water. Landscape and irrigation professionals should promote a sustainable approach through the distribution of checklists outlining all the specific practices and ways to implement them. (An example of such a checklist can be found in Appendix F).

Certification of a water efficient or sustainable landscape could occur through a ranking system in which the homeowner or business is awarded points for implementing certain best practices on their property. The more points accumulated, the more "efficient' or "sustainable" the landscape is determined to be. Landscape and irrigation professionals (ideally those certified, once the professional certification process is established), such as the Master Gardeners of Georgia, could be used to verify the certification.

This effort is already offered in several states to promote long-term landscape health and environmental sustainability.[104] Some water providers offer

[104] California, New Jersey and Texas offer certification for sustainable landscaping.

rebates for implementing efficient landscape irrigation practices, and have also used the certification checklist as a tool in determining which customer should receive the rebates.

Implementation Actions:

6.5 Associations for landscape and irrigation professionals should develop or enhance a "Sustainable Landscape Certification Checklist" of conservation practices for landscapes (see an example in Appendix F) that includes, but is not limited to, the following topic areas:

- Water efficiency
- Mulching
- Recycling
- Wildlife habitat
- Right plant- right place
- Fertilization
- Pest control
- Composting
- Stormwater runoff control
- Protection of riparian areas
- Yard maintenance techniques
- Alternative sources of water

6.6 Landscape and irrigation professionals and associations should distribute the checklist through the UGAExt and state water conservation Web sites, county offices, local landscape retail centers, and local water providers.

6.7 Landscape and irrigation professionals and/or researchers should train county extension agents, county officials or volunteers (e.g. Master Gardeners) on checklist components, scoring, and certification verification.

6.8 Landscape and irrigation associations, local businesses, or non-government organizations should provide incentives to homeowners who participate in the checklist program and implement the practices (or attain a pre-determined level of efficiency or sustainability).

6.9 State agencies should develop a state-funded rebate program that is dedicated to individuals that meet a set level of conservation.

Water use assessment practices

BP 5 – Assess outdoor water use

Residential outdoor water use can be measured directly or estimated by water providers using their customers' billing data. Water providers may employ both indoor and outdoor meters to directly measure customers' indoor and outdoor water use, though dual meters are not economically feasible in most areas. Using the single meter approach, the water provider must indirectly calculate residential outdoor water use.

There are a variety of methods for calculating outdoor water use estimates. (Discussion of calculating outdoor water use is included in Chapter 7, BP 8, and a sample method of calculation is included in Appendix G). Water providers may also estimate outdoor use using representative samples of the customer base.

These estimates can be used to gain a better understanding of outdoor uses and encourage more efficient practices and to identify high-use customers.

Implementation Action:

6.10 EPD and associations for Georgia water professionals should provide a template and protocol for calculating indoor and outdoor water use.

BP 6 – Calculate peaking factor

A water system's peaking factor is the ratio of peak daily water use by customers to the average daily water use by customers (for example, if a water system peak daily water use is 5 million gallons a day and average daily water use is 3 million gallons a day; the peaking factor would equal 1.67).

The baseline peaking factor should be measured before water conservation practices are implemented. Water providers can calculate this factor for their system, and assess changes in their peaking factor, using guidance provided by DNR and associations of Georgia water professionals. Baseline peaking factors should account for high water use during drought conditions and average demand during non-drought conditions.

After a baseline is calculated, water providers should continue to calculate the system's peaking factor, and incorporate results into water management plans.

Implementation Actions:

6.11 DNR and associations of Georgia water professionals should develop guidance on calculating baseline peaking factors.

6.12 DNR and associations of Georgia water professionals should offer technical assistance to water providers evaluating changes in their peaking factors.

Standards and certification

<u>BP 7</u> – State-wide standards for landscape and irrigation systems

Professionals involved in landscape, irrigation and water management should participate in an advisory committee to develop state-wide and/or regional standards for the design, installation and maintenance of landscapes and irrigation systems in Georgia. Collaboration of a diverse group of individuals will help build an acceptable and equitable set of standards that can be implemented state-wide or regionally.

The advisory committee should consider creating standards related to:

1) Irrigation system technologies and installation and maintenance practices that can increase landscape water use efficiency, and techniques for capturing and using rainwater for irrigation,
2) Landscape design and maintenance practices including, but not limited to, low impact landscape design practices (such as preserving native plants or grouping plants according to water needs) and stormwater management practices that can help enhance water efficiency, and
3) Certification requirements for those professionals committed to following the landscape and irrigation standards. (Consideration should be given to existing certification programs such as those offered through the Georgia Center for Urban Agriculture, the Irrigation Association, and EPA WaterSense.)

Standards will be most effective if adopted by local and/or state governments as rules and ordinances. Standards should be regularly updated as new information and technologies emerge.

Implementation Actions:

6.13 Georgia EPD should commission a state-wide advisory committee to develop landscape and irrigation standards. EPD should provide administrative and technical support for the state-wide advisory committee formed to develop landscape and irrigation system standards.

6.14 State agencies, landscape and irrigation organizations, and irrigation and other appropriate equipment manufacturers should fund research and education to refine the landscape BMPs for irrigation efficiency.

6.15 Landscape and irrigation associations, in coordination with EPD, associations for local governments, and associations for Georgia water professionals should develop model ordinances and recommend incentives for local water providers and local governments to consider.

6.16 DNR Board should amend state rules and regulations to include irrigation system design, installation, and maintenance standards.

6.17 Local governments should incorporate irrigation system efficiency standards in construction codes.

6.18 Landscape and irrigation professionals, water providers and local governments should encourage water customers to implement the landscape and irrigation system standards

<u>BP 8</u> – Certification of landscape and irrigation professionals

At least one employee per landscape and irrigation businesses, and other professionals involved in water issues, should be certified as proficient in the state-wide standards for landscape and irrigation system design, installation and maintenance. Landscape and irrigation professionals should document and publicize their training and certification.

Medium and large water providers should also consider having at least one representative participate in certification programs.

Implementation Actions:

6.19 Landscape and irrigation businesses and water providers can disseminate educational material to customers informing them of the benefits of choosing certified landscape and irrigation professionals.

6.20 Landscape and irrigation associations should endorse the certification programs and offer low-cost trainings for landscape and irrigation maintenance workers.

6.21 University system and research institutions should develop and implement post high school degree programs that cover irrigation science that could be used as part of a certification program.

6.22 Landscape and irrigation associations, in coordination with local government association, should develop model ordinances for local governments to consider (i.e. ordinances requiring certification for operating a landscape or irrigation business, or requiring certification for occupying a business license.)

<u>BP 9</u> – Irrigation system certified auditors

Landscape and irrigation professionals can offer homeowners and business owners the service of an irrigation audit to help ensure that installed systems are working correctly and according to standards.

Auditors, which are certified by the Irrigation Association, are trained in gathering water-use data and testing irrigation systems. Auditors can determine irrigation uniformity and efficiency, and can identify malfunctioning equipment.

Implementation Action:

6.23 Local governments can adopt ordinances requiring irrigation installation businesses to use a certified irrigation auditor.

<u>BP 10</u> – Continuing education for landscape and irrigation professionals

Standards and technologies change. Continuing education programs can help landscape and irrigation professionals stay current. Participating in these programs can also encourage a commitment to water conservation.

Implementation Action:

6.24 UGAExt and others should offer continuing education courses and programs for foremen, crew leaders, and employees of landscape and irrigation businesses. These courses should provide up-to-date information about landscape and irrigation system design, installation and maintenance standards, including information regarding new emerging technologies.

Incentives

<u>BP 11</u> –Innovative technologies

There are many innovative landscape and irrigation technologies that can help save water, such as:

1) Micro-irrigation, or other certified water application technologies that can automatically adjust irrigation based on plant needs and environmental conditions. Technologies should meet the EPA Water Sense standards or the Irrigation Association Smart Water Application Technologies (SWAT) standards.
2) Using non-potable water for irrigation (reuse water, captured rainwater, captured stormwater, graywater, air conditioner condensate, etc.),
3) Improving soil quality by saving the top soil or adding organic and/or inorganic amendments.

4) Using irrigation inhibitors, such as rain or soil moisture sensors, for automatic irrigation systems.

Implementation Action:

6.25 Local governments, water providers, and/or state agencies should consider offering incentives or adopting ordinances promoting innovative technologies.

BP 12 – Monitoring and offering assistance to high water users

Water providers should monitor high water users and provide them information and resources encouraging them to have their irrigation system evaluated by a certified professional. These water audits should evaluate changes in landscape and changes in technology, particularly if water use increases dramatically.

BP 13 – Guidelines for pre-construction practices

Often, inefficient water use is the result of extensive grading and soil compaction that occurs during construction, before plants and irrigation systems are installed. These practices should be minimized or corrective actions taken to prepare a high quality, functional soil system that provides a proper planting site. Guidelines might include low impact development (LID) techniques and landscape designs associated with the U.S. Green Building Council's (GBC – www.usgbc.org) Leadership in Energy and Environmental Design (LEED) certification program or other water conservation programs in early development.

BP 14 – Water budget-based rates

Water budget-based rates, also known as individualized rates (see Appendix F) are a version of inclining block rates in which the blocks or tiers are determined for each customer by the customer's usage history, and are usually set based upon the quantity of occupants and the square footage of landscape. Water budget-based information can be an educational tool for the system's highest users even if it is not tied to billing.

According to the Alliance for Water Efficiency (AWE – www.allianceforwaterefficiency.org):

> "Water budget based rate structures are very effective in promoting conservation, though more difficult to implement. In this design, each residence has an inclining block rate structure designed according to its individual needs. The rate tiers are usually set based upon the quantity of occupants and the square footage of landscape; known to be the two most significant factors in residential water use. The prices of the tiers increase significantly (greater than 50%) after the base usage tier is established. This rate system requires a robust billing system to accommodate the

quantity of individual rate structures (possibly equal to the quantity of customers); and the system requires a formal process to establish each homes base water usage, and respond to the many customers likely to appeal their base tier allotment. Water budget based rates are not only an effective water conservation strategy; the rate structure is the most equitable means to base rate on needs of each individual household. This rate structure can also be adapted for non-residential customers."[105]

A detailed guidance document about the use of water budgets is available from the AWWA Research Foundation (AWWARF).[106]

Implementation Action:

6.26 Water providers, with assistance from UGACAES, GWWC, UAC, and GGIA should implement pilot water budgeting projects that target large landscapes. These projects could determine water needs for specific landscapes and evaluate potential water savings from landscape and/or irrigation standards or new state-of-the-art efficiency technologies. If pilot projects prove successful, wider application may be considered.

BP 15 – Conservation-oriented rates

This best practice is discussed in detail under Goal # 3 of Chapter 7. Water conservation oriented rates are designed to encourage customers to use water more efficiently.

[105] For more information on water budget based billing, visit the Alliance for Water Efficiency at http://www.allianceforwaterefficiency.org/ - search for "water budget billing" in the Resource Library.
[106] AWWARF Report, 91205. 2008. *Water Budgets and Rate Structures--Innovative Management Tools*. www.awwarf.org

CHAPTER 7:

CONSERVING WATER FOR DOMESTIC AND NON-INDUSTRIAL PUBLIC USES

Applicability of this chapter

This chapter addresses water providers that supply water to the public for domestic and non-industrial uses. These providers include entities that are privately and publicly owned, as well as those entities that hold drinking water permits.[107]

Domestic water use includes indoor water that flows through fixtures, such as toilets, faucets, and showerheads, and is used by appliances, such as clothes washers and dishwashers. These uses occur in residential and non-residential settings. Non-industrial uses include water used for business purposes but not related to industrial and commercial cooling, heating, and processing (these uses are addressed in Chapter 5 of the WCIP).

A large amount of the water supplied by water providers is used outdoors, especially in the summer months. This chapter includes outdoor water uses such as operating pools and washing cars, but excludes water used for landscape irrigation. Water used outdoors for landscape irrigation is addressed in Chapter 6 of the WCIP.

This chapter addresses local governments as well as water providers. Many local governments are themselves water providers, but even those who are not have a direct connection to both water customers and water providers. Water customers depend on local governments for assurance of quality public water services. Local governments often provide oversight to water providers' rate setting efforts. They also have the power to institute water-related ordinances and incentive programs. Due to the integral role local governments usually have in the provision of water, local governments have a responsibility to work closely with those providing water and their citizens to communicate the importance of sustaining water resources and the role everyone plays in helping conserve public water for domestic and non-industrial public uses.

Introduction

Water use for domestic and non-industrial commercial purposes is often referred to as public supply water. About 1.1 billion gallons of water a day on an average annual basis is withdrawn for public supply and domestic uses. This estimate is reached using USGS numbers for both public supply water and water provided for domestic use through private wells or water systems (termed "self-

[107] O.C.G.A. Section 12-5-170 (et seq) requires that a public water system providing water to the public for human consumption with at least 15 service connections or at least 25 individuals obtain a drinking water permit from the Director of EPD.

supplied domestic uses")[108], and subtracting EPD's estimates for the volume of water used by state agencies and for landscape irrigation. However, this estimate is calculated using data from water providers that may also deliver water to industrial customers. Therefore, it is most likely an over-estimate of the volume used on an average annual basis.[109]

Because water providers deliver water to a variety of customer types, USGS does not report state-wide consumptive use estimates. The USGS does provide estimates, however, for self-supplied domestic water. Self-supplied domestic uses are estimated to be about 18% consumptive.[110] This state-wide estimate is calculated using water withdrawal amounts and coefficients specific to the water use category. The UGGS estimates do not reflect the variability we know to influence Georgia's domestic water users.

The public water use sector has steadily grown since 1980, concurrent with increasing population. However, in 2005 USGS reports a slight decrease in public supply use. This decrease can most likely be attributed to conservation methods such as improved metering and reporting, as well as a decrease in outdoor water use.[111] Conservation of domestic and non-industrial water can help sustain public water supplies by helping to accomplish the following objectives:

1. Reducing waste of quality drinking water.
2. Minimizing the cost of water production and treatment. If produced water is used more efficiently, water providers may be able to continue to meet demand as the population grows. Such efficiency may contribute to off-setting the development of some new water supplies. [112] Facilities can also reduce their own costs by reducing water waste and loss.
3. Redistributing saved water. The volume of water saved through increased efficiency can be redistributed to support other needs in the community, such as a new industrial facility or environmental protection.
4. Helping customers appreciate the value of water. Often, when conservation programs are implemented and water use diminishes, water rates must be raised to cover the utility's fixed costs. Customers can

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[108] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002.

[109] Data on water withdrawals for public uses in Georgia is gathered and reported collectively. Domestic and non-industrial uses are normally not broken out from large commercial uses, landscape uses or industrial uses that may be supported by water providers.

[110] Fanning, J.L. and Trent V.P., 2009. *Water Use in Georgia by County for 2005; and Water-Use Trends, 1980-2005*: U.S. Geological Survey Scientific Investigations Report 2009-5002, 186 p., Web-only publication available at http://pubs.usgs.gov/sir/2009/5002

[111] Ibid.

[112] Case studies from around the country demonstrate that efforts to use existing sources more efficiently can reduces or eliminates the need for new sources of water. Examples include Boston, Massachusetts and New York City, New York. For other examples see "Hidden Reservoir – Why Water Efficiency is the Best Solution for the Southeast" by American Rivers, Inc. October 2008 - www.AmericanRivers.org/WaterEfficiencyReport and "Cases in Water Conservation" by the US EPA - http://www.epa.gov/owm/water-efficiency/docs/utilityconservation_508.pdf

mitigate the impact of the new rates by taking steps to reduce their own water use.

Chapter Overview

This chapter focuses on increasing the efficiency of domestic and non-industrial water uses. The goals and benchmarks address the efficiency of customers' uses, as well as the efficiency of the water provider's own treatment and delivery system. This chapter consists of a series of specific goals designed to guide this sector toward greater water efficiency. The goals are not one-size-fits-all targets for reductions in water use; they were designed to be flexible, so that they are applicable for users with differing circumstances and recognize prior investments in conservation. Each goal is accompanied by benchmarks that can be used to measure progress toward those goals. The benchmarks specify the different best practices that can be implemented to help a water provider or local government achieve the benchmark.

A menu of best practices follows the goals and benchmarks. The best practices are accompanied by implementation actions, which can be taken by outside organizations or government entities to assist water providers and local governments in implementing particular best practices.

Goals and Benchmarks
Domestic and Non-Industrial uses

In order for conservation efforts to be successful, water providers and/or local governments must influence the choices available to water customers. The amount of water required to support domestic and non-industrial uses is determined largely by the characteristics of existing housing stock, customers' behavior and economic condition and the technologies customers employ. Water providers can encourage efficiency among their customers through educational programs that stress the importance of water conservation and give customers tools for maximizing efficient water use. Water providers and local governments can also institute programs and incentives that foster more efficient water use, such as retrofit or rebate programs, incentives for Green Building, and conservation-oriented rates. Water providers and local governments should encourage efficient use both indoors and outdoors.

The goals and benchmarks in this chapter also address the efficiency of water providers' treatment and delivery systems. The level of efficiency within a water system is greatly affected by the type and age of technologies, infrastructure employed (such as methods of water treatment, water meters and distribution pipes), and maintenance procedures. Maximizing efficiency within water treatment and delivery systems is critical to protecting finite water resources and maintaining water services. It can also help water providers set an example for their customers.

Water conservation efforts work best when they are approached systematically, with quantifiable goals and a way to measure the progress toward those goals. Water providers should make an effort to measure customers' per capita water use. Thorough data about water use will help providers educate their customers and, where necessary, set reduction targets to evaluate whether or not the practices they have implemented have had the desired effect and are cost-effective. Likewise, water providers should be able to quantify their own efficiency. The best way to evaluate water system efficiency is to measure the system's non-revenue water, defined as the volume of water going into a system that is not billed or producing revenue for the water provider.[113] Once a system has quantified the current losses within the system, they can set targets for reducing water loss.

All of the practices for improving efficiency within a water system and among customers should be compiled into a comprehensive water conservation program. While the general components of a comprehensive water conservation program are the same, the manner in which each component is implemented is dependent on the unique characteristics and challenges facing the community. When developing a water conservation program, water providers and local governments should consider the behavior and water use patterns of water

[113] IWA Water Audit Method. Available online at www.awwa.org/waterwiser/waterloss

customers, the technologies employed within the water system, the commitment of the local elected officials, and the condition of the water sources[114]. Achieving water conservation goals across a unique community of varied users requires that water providers and local governments implement a cost-effective water conservation program that reflects the community's values and characteristics.

GOAL #1

Water providers and local governments should implement a comprehensive water conservation education and outreach program.

One of the most critical components of a local water conservation program is a robust education and outreach program.[115] An education and outreach program should raise awareness about the value of local water resources and the need to conserve water. It should also empower individuals and businesses to make informed decisions about their water using behavior and the fixtures and appliances they employ.

Each local community in Georgia is unique, so water providers and local governments should develop and initiate a water conservation education and outreach program that fits the unique values and characteristics of their community. Programs should provide information about the local water source and the challenges facing the source, and make a clear connection about how conserving will affect the local water source. An education and outreach program should also provide information about the associated economic, health, recreational, aesthetic and environmental benefits of water conservation, as well as the benefits that conserving offers to individuals and a broader set of users. Programs that are targeted at the most inefficient users are usually the most successful.

Because conservation education and outreach programs can build acceptance among water users, education and outreach efforts should begin before the full water conservation program is implemented. For example, public acceptance of and compliance with watering schedules can be enhanced if preceded by an outreach effort that articulates the need for such restrictions in terms of maintaining system reliability and safeguarding environmental resources. In addition, outreach efforts that educate consumers and public officials about the true cost and value of water can help with acceptance of new conservation-oriented rate structures.

As an education and outreach program progresses, water providers and local governments should assess the effectiveness of the program. This assessment is critically important in informing if, and what types of, adjustments

[114] When water supplies are abundant, a water conservation program may not include aggressive practices, like those necessary for an area where water supplies are limited.

[115] Researchers found that investments in targeted education and outreach have high water conservation returns, and that public awareness tends to build political support and participation. Keyes, A., M. Schmitt, J. Hinkle. 2004 "Critical Components of Conservation Programs That Get Results: A National Analysis." AWWA – Water Sources Conference Proceedings.

are needed to ensure that the program is affecting the changes desired in customer behavior and water use patterns. Adjustments may also be needed to meet any changing needs of the community.[116]

Benchmark 1A

By January 2010, water providers and local governments should assess their water customers' demands to help develop an education and outreach program. *This benchmark should be coordinated with Benchmark 1B in Chapter 6 – the Landscape Irrigation chapter, which calls for an outdoor water conservation education program for customers.*

See Best Practices 1 and 2

Benchmark 1B

By December 2010, water providers and local governments should initiate a water conservation education and outreach program that reflects local values and characteristics and communicates the long-term benefits of conservation.

See Best Practices 9, 10, 11, 12, 13

Benchmark 1C

By 2015, and every five years thereafter, water providers and local governments should assess and adjust their program(s) as needed. *This benchmark should be coordinated with Benchmark 3C in Chapter 6 – the Landscape Irrigation chapter, which calls for an evaluation of the outdoor water conservation efforts.*

See Best Practices 1, 2, 9, 10, 11, 12, and 13

GOAL #2

Water providers should maximize the efficiency of the systems that treat and deliver water to customers.

Maximizing efficiency within water treatment and delivery systems is critical to protecting finite water resources and maintaining water services. It can also help water providers set an example for their customers.[117]

The cost of inefficiency within a water system can be high. Water lost to leaks and faulty equipment and water wasted through inefficient operations produces no revenue for water providers, and can increase a water system's costs for water supply development, pumping, treatment, and delivery. Additionally, water lost to leaks can be the cause of washed out roads and/or

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[116] San Antonio adjusts its program annually, while some areas, like California, require adjustments every 3 to 5 years. See the California Urban Water Conservation Council Memorandum of Understanding, June 2007 for more information – www.cuwcc.org

[117] Water providers that invest in their own system's efficiency can expect better response from conservation efforts targeted at their customers. Vickers, A. 2001. *Handbook of water use and conservation: homes, landscapes, businesses, industries, farms.* WaterPlow Press. 446 pgs.

sink holes, both of which can require expensive remedial actions.

The first step water providers must take is to ensure that they are accurately accounting for the water moving through the treatment and distribution systems. In Georgia, water providers have traditionally measured system efficiency using the expression "unaccounted for water" (UAW). The measure, expressed as a percent, is calculated as the difference between the amount of water pumped into the front end of the water treatment plant from the source(s), and the amount of water actually delivered to metered water use customers.[118] UAW generally includes system leakage and un-metered water uses, such as fire fighting, flushing, broken water mains, etc.

The International Water Association (IWA – www.iwahq.org) water audit method, which is recommended by the American Water Works Association (AWWA – www.awwa.org) and being adopted by water systems across the country, is considered a more accurate method of identifying and accounting for system leaks and un-metered uses.[119] The IWA/AWWA water audit method provides detailed guidance for all water providers on measuring a water system's water treatment and delivery performance based on system-specific features. The IWA/AWWA method outlines seven major components to be assessed within each system: 1) system input volume, 2) authorized consumption, 3) water losses, 4) apparent losses, 5) real losses, 6) revenue water, and 7) non-revenue water. Measuring non-revenue water, defined as the volume of water going into a system that is not billed or producing revenue for the water provider, provides a clearer understanding of water losses in the system than prior methods that measured UAW.[120]

Once a system has an accurate picture of their water loss, water providers can set system-specific targets for the reduction of non-revenue water. Reduction targets can help focus a water provider's efforts to minimize water loss and maximize their system efficiency. Many practices are available to help facilities progress toward their targets.

Benchmark 2A

By 2010, water providers should adopt the IWA/AWWA water audit method and conduct the audit annually thereafter. Water providers should try and gather the most accurate data possible for these audits.

See Best Practices 3, 4 and 5

[118] EPD Rules and Regulations

[119] An August 2003 report of the American Water Works Association's (AWWA) Water Loss Control Committee supports the use of the IWA water audit method, "Applying Worldwide Best Management Practices in Water Loss Control." AWWA Journal, August 2003. pgs. 65-79.

[120] For more information on the IWA methodology, visit http://www.awwa.org/Resources/Content.cfm?ItemNumber=588

Benchmark 2B

By 2012, water providers should set system-specific reduction targets for non-revenue water. Reduction targets should focus on minimizing both real and apparent losses within the water system.

See Best Practices 3, 4, and 5

Benchmark 2C

By 2013, water providers should implement practices to meet their non-revenue water reduction targets and verify their reductions.

See Best Practices 14, 15, 16, and 17

GOAL #3

Water providers and local governments should implement conservation-oriented rates to encourage citizens to conserve, and to help maintain the water system's financial stability.

Recent research in Georgia shows water rates can be one of the most effective tools water providers have to promote water conservation.[121] Specifically, conservation-oriented rates are designed to encourage customers to choose more efficient ways to meet their water needs.

Conservation-oriented rates can also help maintain the financial stability of water systems by more accurately reflecting the true cost of water, including a) the future costs for additional water supplies for growing communities and b) funds required to cover capital improvements and replacement of aging water infrastructure for enhancing the system's efficiency. Conservation-oriented rates can be structured to help water providers and local governments control revenue fluctuations that may occur when supplies are limited or when water use decreases. In most cases, rate structures discourage the use of large volumes of water within a particular customer class by charging more for each unit above baseline use.

Equitable pricing is critical to the success of a conservation program and the basic operation of a water system. It is important to set rate structures in a way that does not undermine the ability of all users, regardless of income or location, to have access to affordable water and water services. Before a rate structure is selected, a utility should spend a great deal of time researching its community's needs to avoid imposing rates that are inequitable.

Benchmark 3A

By January 2010, water providers should categorize customers by class. At a minimum, residential and non-residential customer classes should be defined.

See Best Practice 6

[121] Environmental Finance Center. "Water Price Signals in Georgia." November 28, 2007. Online at http://www.efc.unc.edu/ga/rates.html

Benchmark 3B
By 2012 water providers should eliminate decreasing block rate structures.

Benchmark 3C
By 2015, water providers should evaluate different conservation-oriented rate structures and adopt the most appropriate one for their customers.

See Best Practice 18

GOAL #4

Water providers and local governments should help customers maximize the water efficiency of indoor residential and domestic uses.

Water used indoors accounts for approximately 70% of average residential water use in the U.S.[122] In Georgia, data from a study of water use in eight representative communities across the state shows annual average residential water use to range from 60 to 88 gallons per capita per day (gpcd). Indoor water use accounts for about 82% of average use.[123] Therefore, a significant amount of savings can be realized by even modest improvement in water efficiency in this area. The greatest amount of savings can be gained from residential areas with a large number of homes built before 1992.[124]

Most indoor residential and domestic water use is for cleaning and sanitation, but many factors affect the amount of water used for these purposes. Individual behavior, the type of fixtures and appliances employed, the cost of water, household income, and the age and lifestyle of residents all contribute to the amount of water used by residences and domestic purposes.[125]

Water providers and local governments should, at the beginning of any water conservation program, try to more precisely measure water efficiency within the community, and set their own quantifiable and achievable goals for the program. One of the best ways to do this is to estimate or calculate average per

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[122] Vickers, A. 2001. *Handbook of water use and conservation: homes, landscapes, businesses, industries, farms.* WaterPlow Press. 446 pgs.
[123] Average indoor water use derived from data presented "Georgia Water Use and Conservation Profiles" Technical Memorandum 2." Prepared for GA EPD on October 12, 2007. Online at http://www.conservewatergeorgia.net/documents/govt_tools.html
[124] The federal Energy Policy Act was passed in 1992 requiring low-flow fixtures to be installed in new homes. Homes built prior to 1992 would most likely have inefficient fixtures, such as toilets that could use up to 7 gallons per flush (as compared to the 1.6 gallons per flush required after 1992.)
[125] Vickers, A. 2001. *Handbook of water use and conservation: homes, landscapes, businesses, industries, farms.* WaterPlow Press. 446 pgs.

capita indoor water use. Simply calculated, residential indoor water use is a water provider's total residential winter demand divided by the total residential population served. This metric enables water providers to assess the potential of indoor efficiency programs and to evaluate those programs after implementation.

After residential indoor water use is calculated, water providers should compare their customers' use to the use in a water-efficient home. Sharing this information with customers can be an effective educational tool. Research conducted in the late 1990s by the American Water Works Association (AWWA) found that conservation could reduce indoor water use from about 69 gpcd to 45 gpcd for single-family homes.[126] Since that original study was published, other researchers and agencies have considered 45 gpcd an achievable level of indoor water use for homes with efficient fixtures and appliances as well as pressure adjustments for efficiency.[127] The degree to which 45 gpcd can be achieved by individual providers in Georgia should be evaluated.

Comparisons of customers' residential water use to that of a water-efficient residence can also be used to guide the development of system-specific benchmarks. Indoor water use cannot be reduced indefinitely; benchmarks can be developed to set reasonable targets for reduction. Where reduction targets would be beneficial, water providers should consider reducing water use by an equal amount or percentage each year based on the amount by which they exceed the desired level of efficiency.[128]

In most cases, the most effective way for customers to maximize water efficiency is to replace inefficient fixtures and appliances with newer high-efficiency fixtures and appliances (e.g., toilets, showerheads, and washing machines). Research has shown that water providers and local governments can increase water efficiency by providing incentives for replacing less-efficient fixtures and appliances with newer more-efficient models.[129] Often a low cost incentive, such as free low-flow faucet aerators to residential customers, can save thousands of gallons of water per residence per year.[130] Once water

[126] Mayer, P.W. et al, Residential End Uses of Water, AWWA Research Foundation and AWWA, Denver, CO, 1999, p. 114.

[127] The original report of residential end uses of water and water efficiency was published in 1999, but information from the study was made available earlier through presentations and preliminary reports. The U.S. EPA Water Conservation Plan Guidelines (1998) estimates water use in a water efficient home to be 44.7 gpcd and encourages water providers to use system-specific assumptions and estimates, where possible. Comparably, Vickers (2001) *Handbook on Water Use and Conservation*, built off the original 1997 study, reported that after installing water efficient fixtures and appliances and adjusting water pressure to 80 psi, indoor water use can reach 45.2 gpcd.

[128] For example, with the desired level of indoor residential efficiency is 45 gpcd, and a water provider's is 75 gpcd, their goal would be to reduce indoor residential use by 2 gpcd each year (calculated by subtracting 45 from 75 and then dividing by 15 years).

[129] Cobb County Water Authority, GA, San Diego County Water Authority, CA; Seattle Public Utilities, WA; and Town of Cary, NC provide good examples of successful incentive programs targeted, in part, to help reduce indoor residential water use.

[130] Vickers, A. 2001. *Handbook of water use and conservation: homes, landscapes, businesses, industries, farms.* WaterPlow Press. 446 pgs.

efficient fixtures and appliances are installed, water savings and improved efficiency last for the life of the fixture or appliance. Incentive programs also have the tangential effect of sensitizing customers to the need to be more efficient water users in all facets of their daily life.

Benchmark 4A
By 2010, water providers should calculate or estimate average per capita residential indoor water use within the community.
See Best Practices 6 and 7

Benchmark 4B
By 2011, water providers and local governments should compare their average per capita residential indoor water use to an achievable level of efficiency and, where necessary, set water use reduction targets.
See Best Practices 7 and 25

Benchmark 4C
By 2015, water providers and local governments should evaluate potential water-saving practices and incentives with a cost-effectiveness analysis,[131] then implement those practices and offer incentives that help customers maximize indoor water use efficiency.
See Best Practices 8, 12, 18,19, 20, 21, 22

GOAL #5

Water providers and local governments should help customers and citizens maximize efficiency of outdoor water uses, such as pools, spas, pressure washing, and non-commercial car washing.

Water providers and local governments play an important role in helping water customers use water more efficiently outdoors, as well as indoors. Water used outdoors accounts for about 20% of average non-commercial water use in Georgia.[132] The majority of outdoor use is for landscape irrigation (which is covered in Chapter 6.) The other outdoor uses addressed in this chapter include

[131] Cost- effectiveness (CE) analysis is a comparison of water management alternatives that work differently to achieve the same end result, such as water savings. Generally, the comparison is performed by calculating the costs required to achieve one unit of water savings. The potential water savings that result from water conservation practices or an array of practices can then be compared on a per unit basis to the alternative to saving water—developing new water supply or expanding existing water supplies. Therefore, the conservation practices that are lower cost than developing new water supply or expanding existing water supplies can be considered cost effective.

[132] Average outdoor water use derived from data presented "Georgia Water Use and Conservation Profiles" Technical Memorandum 2." Prepared for GA EPD on October 12, 2007. Online at http://www.conservewatergeorgia.net/resources/TM2_Data_Analysis.pdf

uses such as pools, spas, pressure washing, and non-commercial car washing. (Commercial car washing is covered in Chapter 5.)

Benchmark 5A
By 2010, water providers, local governments and the appropriate trade/professional associations should develop educational materials related to efficient water use for pools, spas, pressure washing and non-commercial car washing.

See Best Practices 23 and 24

Benchmark 5B
By July 2010, local governments and water providers should distribute information to homeowners and professionals through service providers and local business bureaus.

See Best Practice 13

Best Practices: A Menu of Options

Water providers and local governments can select a set of water conservation practices that is tailored to their community's needs. This list of practices, which is not exhaustive, can be used to meet benchmarks and goals.

There are four major categories of practices that can be employed by water providers and local governments. The first is information-gathering and measurement practices. These practices, which lay the foundation of a water conservation program, help water providers and local governments to better understand water use and demand within their facility and community. Information-gathering practices give water providers and local governments the means to measure efficiency and evaluate progress.

The second category of practices includes education and outreach practices, which should be some of the first practices employed to gain acceptance and understanding for water conservation within the domestic and non-industrial sector. A third category is made up of practices that can reduce water use within a water system and within the broader community. The last category focuses on the practice of systematic planning water conservation programs and integrating water conservation into local plans.

Information-gathering and measurement practices

BP 1 – Analyzing water use data

Detailed information about customer water use can be used to develop targeted educational programs, as well as to evaluate the effect of those programs. There are a number of ways to assemble a more complete picture of a community's water use and water needs. One approach is for water providers to evaluate water production and water distribution data. Water providers can also use current and historic customer bills to gain insight into the water use patterns and trends of customers before and after a conservation program is implemented.

In order to accurately assess the effect of conservation efforts, water providers and local governments can use ten years of data. This amount of data will most likely include a variety of weather conditions, such as drought years and wet years. Weather conditions should be considered when assessing changes in water use.

BP 2 – Listening to customers

Water providers and/or local governments may also want to create water conservation 'citizen's councils', which can provide advice on community water needs and help plan conservation programs and assess the affect of those programs.[133] Cnservation forums may also be helpful in some areas. Customer surveys can also provide valuable information about customers' water use and acceptance of education and outreach programs. This information can be used to retarget conservation programs or incorporate new program elements.

BP 3 – IWA/AWWA water audit method

The IWA/AWWA water audit method gives water providers a detailed way of calculating efficiency that is specific to their system, yet consistent with calculations used by other providers.

The IWA/AWWA water audit method accounts for all water moving through the water treatment and distribution system, through direct metering or estimation. All water is categorized as either consumed or lost. Hence no water is "unaccounted-for". The AWWA Water Loss Control Committee recommends water providers replace UAW with the specifically defined term "non-revenue water" defined as the volume of water going into a system that is not billed or producing revenue for the water provider.[134]

The IWA/AWWA water audit method provides a process for determining and understanding real losses and apparent losses, the two major categories of non-revenue water. Real losses are the physical losses of water from the treatment and distribution system, including leakage and storage overflows. Because real losses represent water that is withdrawn and treated yet never used, they inflate production costs and contribute to undue stress on water resources. Apparent losses are the "paper losses" that occur within system operations due to customer meter inaccuracies, billing system errors and unauthorized consumption. In other words, this water is consumed but is not properly measured, accounted or paid for. These losses cost water providers revenue and distort data on customer water use patterns and trends.

In early 2009, AWWA released a manual of water supply practices *M36: Water Audits and Loss Control Programs, Third Edition*.[135] The Third Edition of the M36 is the first publication in North America to provide detailed and comprehensive instructions on the IWA/AWWA Water Audit Method. This manual, and the free software that accompanies it, can be a valuable tool for water providers trying to maximize their system efficiency.

Water providers should strive to reduce water losses to the lowest attainable level. Water providers can establish reduction targets as a way to demonstrate how they are progressing toward the goal of maximizing water efficiency within their system.

[133] San Antonio Water System (SAWS) has a successful citizens council. Go to www.saws.org for more information.
[134] IWA/AWWA Water Audit Method. Available online at www.awwa.org/waterwiser/waterloss
[135] To read a review or to order a copy of the M36 Manual, go to www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=47957

Implementation Actions:

7.1 EPD should update and revise the water loss control provisions of the Coastal Georgia Water and Wastewater Permitting Plan Guidance.[136]

7.2 DNR should update the rules and regulations related to water conservation planning to replace the term "unaccounted-for water" with the term "non-revenue water", as defined and supported in the IWA water audit method.

7.3 Associations for Georgia's water professionals should enhance and expand technical guidance on conducting the IWA water audit method.

<u>BP 4</u> – Improving customer metering

Water providers can improve the accuracy of their metering by implementing a meter repair and installation program in accordance with the AWWA guidelines.[137] Water providers should consider replacing meters that have exceeded the manufacturer's recommended lifetime. Water providers should consider metering all connections, with the exception of fire services, and aggressively pursue and minimize unauthorized water service connections. Water providers may also improve their metering by adopting automatic meter reading (AMR) technology.

These programs may be funded by the USDA Office of Rural Development (www.rurdev.usda.gov) rural development loans, grants, and partial grants, as well as low-interest loans from the drinking water state revolving fund (DWSRF).[138]

Implementation Actions:

7.4 GEFA should continue to use DWSRF funds for the installation of water meters, and where possible increase the amount of funding available.

7.5 USDA Office of Rural Development in Georgia should promote the use of Rural Development loans and partial grant opportunities for utilities installing water meters.

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[136] EPD – Guidance for Coastal Management Plan Implementation. Available online at http://crd.dnr.state.ga.us/assets/documents/GCMP.pdf

[137] AWWA, 2001. Water Meters: Selection, Installation, Testing, and Maintenance (M6), Fourth Edition. For more information go to http://www.awwa.org/Bookstore/productDetail.cfm?ItemNumber=4531

[138] These are funds provided through the federal Safe Drinking Water Act. In order to repay such a loan, the utility will have to find a sustainable and predictable funding source, such as altering water rates etc. The DWSRF can also fund incentive programs for water conservation (provided that the costs are included as part of a larger project).

BP 5 – Accurately measuring source withdrawals

It is important to be able to account for water withdrawn from the source. Water providers should calibrate and maintain the source water meters at the point of water withdrawal on a semi-annual or quarterly schedule.

BP 6 – Categorizing customers by class

By categorizing customers by customer class, water providers can better understand which water users are demanding the most of the system and when. Water customers ultimately determine how much water is produced and delivered by water providers. Simple assessments of water use by customer class can often reveal water use patterns and trends that may lead to inefficient operations and use. Water providers can use this information to inform the selection of the most appropriate rate structure to meet the needs of the community and the water provider. Because almost all water systems in Georgia serve some residential and non-residential customers, these two classes should be categorized first.

There are a variety of methods to categorize water customer classes, and some are more precise than others. The most straightforward and accurate method of classification is through direct observation and information about the type of customer, such as residential, commercial, institutional or industrial.

Indirect methods, like using water meter sizes or the customer codes, commonly used for solid waste services, can also be used. However, these indirect methods are not as accurate as actually classifying the users by use type. Water providers can back up these indirect methods by surveying water customers.

Water providers can also employ billing software that recognizes and functions under rate structures with different customer classes.

BP 7 – Calculating average utility-specific per capita residential indoor water use

Residential indoor water use,[139] measured in gallons per capita per day (gpcd), is a metric that can be used to describe how efficiently residential customers use water. Residential indoor water use can be measured directly or estimated using billing data. Water providers may employ both indoor and outdoor meters to directly measure customers' indoor and outdoor water use, though dual meters are not economically feasible in most areas. Using the single meter approach, the water provider is therefore left to indirectly calculate residential indoor water use.

There are a variety of methods for calculating residential indoor water use. An example method is included in Appendix G. Providers may also estimate

[139] Simply calculated, residential indoor water use is a water provider's total residential winter demand divided by the total residential population served.

indoor and outdoor use using representative samples of the customer base. Estimates of residential indoor water use will be more useful if they are consistent and comparable to one another.

Research conducted in the late 1990s by the AWWA found that conservation could reduce indoor water use from about 69 gpcd to 45 gpcd for single-family homes.[140] Since that original study was published, other researchers and agencies have considered 45 gpcd an achievable level of indoor water use for homes with efficient fixtures and appliances as well as pressure adjustments for efficiency.[141] Comparisons of existing customer water use to that of a water-efficient home can also be used to guide the development of system-specific benchmarks.

Implementation Actions:

7.6 EPD and associations for Georgia water professionals should provide a template and protocol for calculating indoor and outdoor water use.

7.7 EPD, in partnership with an independent third party such as a research institution or university, should conduct a statistical study of Georgia's indoor residential water use and publish this information for the broader use of Georgia's water providers. This study should examine a statistically meaningful sample of residential water bills from large and medium water systems. The sampling diversity should allow an analysis including, but not limited to, the following parameters:

- Size and type of water supply system (ground or surface water)
- Water system conservation efforts (toilet rebates, etc.)
- Type of structure (single family, multi-family, etc.)
- Quality of structure (Leadership in Energy and Environmental Design (LEED) certified, waterSense certified, etc.)
- Age of structure
- Type of toilets
- Size and average age of household
- Household income
- Location (urban, suburban, exurban, rural, etc)

[140] Mayer, P.W. et al, Residential End Uses of Water, AWWA Research Foundation and AWWA, Denver, CO, 1999, p. 114.

[141] The original report of residential end uses of water and water efficiency was published in 1999, but information from the study was made available earlier through presentations and preliminary reports. Such is the case for the reference in the U.S. EPA Water Conservation Plan Guidelines (1998) that estimates water use in a water efficient home to be 44.7 gpcd and encourages water providers to use system-specific assumptions and estimates, where possible. Comparably, Vickers (2001) *Handbook on Water Use and Conservation*, built off the original 1997 study, to report that after installing water efficient fixtures and appliances and adjusting water pressure to 80 psi, indoor water use can reach 45.2 gpcd.

- Cost of water
- Wastewater disposal (municipal system or septic tank)
- Other (this list is not meant to be all-inclusive)

7.8 The GWWC should help create and review for EPD a detailed description of a possible residential indoor water use efficiency study design.

BP 8 – Cost-effectiveness analysis

Cost-effectiveness (CE) analysis is a comparison of water management alternatives that work differently to achieve the same end result, such as water savings. Generally, the comparison is performed by calculating the costs required to achieve one unit of water savings. The potential water savings that result from water conservation practices or an array of practices can then be compared on a per unit basis to the alternative to saving water—developing new water supply or expanding existing water supplies. Therefore, the conservation practices that are lower cost than developing new water supply or expanding existing water supplies can be considered cost effective. Also, it is important to note that while certain conservation practices may be less costly than new or expanded water supply, other water management options may be necessary to meet the needs of Georgia's communities.

Cost-effectiveness analysis can help water providers select the best set of practices for conserving water uses within their community.

Implementation Actions:

7.9 DNR, associations of Georgia water professionals, and associations for local governments should provide cost-effectiveness evaluation training to water providers and local governments to help determine the most effective water conservation practices for their community.

7.10 DNR and associations of Georgia water professionals should provide timely guidance on cost-effectiveness evaluation, and information on available, cost-effective programs and technologies.

7.11 Georgia Department of Community Affairs (DCA – www.dca.state.ga.us) should encourage communities to utilize free tools available to perform some cost-effectiveness analysis when developing comprehensive and land use plans.[142]

[142] EPD has a water conservation cost-effectiveness evaluation tool available to water providers. For more information about the study and the tool, visit http://www.conservewatergeorgia.net/resources/TM2_Data_Analysis.pdf

Educational programs

BP 9 – Targeted education and outreach programs

Education and outreach programs can be targeted towards a community's most inefficient uses and users, to produce the greatest results quickly.

Common components of successful education and outreach programs include, but are not limited to: 1) educational lessons and material for kindergarten through high-school children, 2) informational material for adults distributed through the media and public water providers, 3) training and educational opportunities for government and public service employees, and 4) targeted outreach efforts designed to influence high water users within the community.

Water providers and local governments can create a water conservation education media campaign to engage newspapers, television stations, and radio stations in efforts to educate and inform the community. These campaigns should include practical information, such as daily tips on ways to conserve water. Water providers can offer information and instruction to customers on how to read meters and check for leaks, as well.

Resources are available to help local governments and water providers develop targeted education and outreach programs, including:

1) U.S. EPA's WaterSense Program (www.epa.gov/watersense) provides educational material, special labeling and media relations packets to its partners, making it easier for the public to choose water-efficient products.
2) AWWA's "M52 Water Conservation Programs—a Planning Manual" provides guidance for water system managers on developing local water conservation plans. The manual describes goal-setting, water use analysis, potential savings, costs and benefits, conservation rate setting, program implementation, success measurement, and others.
3) The DNR and UGA Cooperative Extension, with assistance from the Cobb County-Marietta Water Authority (CCMWA), have implemented a state-wide *waterSmart* education campaign (www.conservewatergeorgia.net) to provide Georgia citizens with information related to drought and saving water.
4) The DCA Local Government Environmental Technical Assistance Program (www.georgiaplanning.com/watertoolkit) pulls together a wide variety of resources that can assist local governments new to water resource management.
5) The Alliance for Water Efficiency (AWE – www.allianceforwaterefficiency.org) provides a variety of information about water efficiency programs, products, and practices.

These resources can be customized to address local conditions. Education and outreach programs should be updated every five years based on its success within the community and to incorporate new information.

Water providers and local governments can use existing funding mechanisms to develop and implement public education programs on water efficiency. For example, the Clean Water state revolving fund (CWSRF)[143] provides low-interest loans for such efforts.

Implementation Actions:

7.12 Georgia Water Wise Council, associations for Georgia water professionals, DCA, local government associations, and DNR should provide a model water conservation education and outreach program and provide guidance on developing community-specific water conservation education and outreach programs.

7.13 EPD and U.S. EPA should enhance the availability of media packets and promotional materials related to waterSmart, waterSense and Energy Star.

7.14 DNR and U.S. EPA should provide guidance on education and outreach program evaluation.[144]

<u>BP 10</u> – Integrating water conservation into existing educational programs

Water providers and local governments can offer teacher's training to kindergarten through 12th grade educators in the community. "Georgia Project WET" (Water Education for K-12 Teachers) provides classroom-ready teaching aids on stewardship of water resources: www.eeingeorgia.org.

Water providers and local governments can also incorporate water conservation into school curricula and into non-traditional educational programs, such as those offered at nature centers and zoos.

<u>BP 11</u> – Water conservation coordinators or educators

Coordinating an education and outreach program can be challenging and time-consuming. Water providers and local governments should consider employing a professional to coordinate efforts and to ensure citizens and customers are receiving accurate and consistent messages and information. Multiple service areas should consider using a regional coordinator to take advantage of economies of scale, and to ensure a consistent message.[145]

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[143] These are funds provided through the federal Clean Water Act.

[144] Texas' WaterIQ program is a state-wide education campaign that has conducted similar assessments to determine effectiveness. For more information go to www.wateriq.org

[145] Numerous communities around the country have hired conservation coordinators, including Athens/Clarke County, Cobb County, Chatham County and City of Savannah. Some cities, like San Antonio and Austin TX, have multiple staff to manage conservation education efforts.

BP 12 – Informative water bills

Bills that reflect a customer's monthly use can help customers better understand their water use. Providing simple price information to customers about their water usage and water rates causes demand to be more responsive to rate changes. Ideally, water bills can be structured to reflect the marginal cost of water, which can be calculated using estimates of the cost of developing the new supply needed to satisfy an increase in water usage, Research has found that, all other factors equal, when marginal prices are included on a water bill a water provider can achieve the same level of conservation as a 30 to 40% higher rate increase.[146]

Implementation Action:

7.15 GWWC should develop a model water bill that includes information about conservation-oriented rates, as well as clear information about the volume of water used and the charge per unit used.

BP 13 – Distributing information about efficient outdoor water use

Water providers and local governments can distribute any guidance on non-commercial outdoor water uses, developed according to best practice 24, through their website, the local water provider water bills, electronic lists (via email) or through the following venues:

1) Pressure washing BMPs can be distributed with information from the local storm water utility or through local venues that rent pressure washers (such as hardware stores or garden centers).
2) At-home car washing BMPs can be distributed through local car-related retailers (automotive stores like Autozone, Pepboys, etc.).
3) Pool and spa BMPs can be distributed through the local department of health or through local pool/spa service providers.

All materials can be distributed as a part of the larger educational efforts described in *Best Practice 10*.

Reducing waste and loss within the water system

BP 14 – Leak detection, repair, and prevention

A great deal of water can be lost through system leaks. Practices such as pipe and fixture inspection, lining, cleaning, and basic maintenance tasks can identify existing leaks and prevent future leaks and ruptures from occurring. Water providers should include in a leak response plan efforts to reduce the time between locating a leak and repairing it, and should continually conduct field audits of water distribution system leak detection.

[146] Gaudin, S. (2006). "Effect of price information on residential water demand." *Applied Economics*, 2006, 38, pgs. 383-393.

Implementation Action:

7.16 Associations for Georgia's water professionals should enhance and expand technical guidance on leak detection and repair programs.

BP 15 – Reducing water waste within the water system

Water waste is considered the inefficient use of water for a specific function or task, and can be eliminated when more efficient alternatives are implemented. For example, cleaning the floor of a water treatment plant can be accomplished using a wet broom, rather than using a high-pressure water sprayer. Water providers can evaluate their operations to identify areas of water waste.

Implementation Action:

7.17 Associations for Georgia's water professionals should enhance and expand technical guidance on reducing water waste with water systems.

BP 16 – Installing efficient fixtures

Water systems can realize savings from replacing the fixtures used within the system itself. Water providers or local governments can apply for funding through the USDA rural development program to support the installation or retrofitting of water-efficient devices, provided these are within the water system and not on private property.

BP 17 – Considering new practices from AWWA

The AWWA recently released the third edition of their Water Loss Control Manual (M36).[147] Water providers should consider the new practices listed in the new edition, as well as those included in any subsequent updates.

Reducing customers' water use

BP 18 – Conservation-oriented rates

Many types of conservation-oriented rate structures are available for consideration (see Appendix H of this chapter for a list of possible rate structures). The type of conservation-oriented rate structure selected for a community should reflect the unique characteristics of the water system and the mix of customers served. Water providers can use guidance developed by state agencies to help research customer demands and determine the most

[147] To read a review or to order a copy of the M36 Manual, go to www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=47957

appropriate conservation-oriented rate structure for their community.[148] Water providers should also consider using data gathered through information gathering practices to evaluate different rate structures.

Water providers should consider re-designing customer bills to reflect new rate and customer usage. Redesigning bills is covered in more depth by *Best Practice 13.*

Regardless of the type of conservation-oriented rate structure adopted, the rate should have three important characteristics:

1) Reflect the true cost of water. Often the price of water (i.e. the price paid by water customers) only reflects the cost of continuing to pump, treat and deliver the same amount of water to the same number of customers. In fact, research shows that the price should reflect the true cost of water, including a) the future costs for additional water supplies for growing communities and b) funds required to cover capital improvements and replacements of aging water infrastructure and for enhancing the system's efficiency.[149] By failing to reflect such true costs, a water provider is subject to financial instability when changes occur in customer demands or infrastructure breaks down.

2) Send a price signal to customers. Recent research in Georgia finds that effective conservation-oriented rate structures are not restricted to one single type. However, all rate structures can be designed to send customers a strong price signal about the value of water and water services and encourage them to use water more efficiently. For example, water providers can set steep rates that send strong signals to all customers. But establishing an equitable structure for all customers is important (low water using customers should not be penalized for using minimal amounts of water to meet basic needs.)[150] According to some, the strongest price signals can be sent by handling revenue requirements separately from, but not unrelated to, the volume of water used.[151]

3) Help stabilize a water system's revenue. Often times a conservation-oriented rate structure with a strong price signal will generate additional revenues for the water provider (i.e. during times of high water use like summer months when landscape irrigation is practiced.) These sources of additional revenues can be set aside and used to help a water system

[148] The most recent guidance was developed to accompany the Georgia Coastal Water Management and Permitting Plan http://www1.gadnr.org/cws
[149] Chesnutt, T.W., J.A. Beecher, P.C. Mann, D.M. Clark, W.M Hanemann, G.A. Raftelis, C.N. McSpadden, D.M. Pekelney, J. Christianson, and R. Krop (1997). *Designing, Evaluating, and Implementing Conservation Rate Structures.* Available at www.cuwcc.org or www.awwa.org .
[150] Environmental Finance Center. "Water Price Signals in Georgia." November 28, 2007. Online at http://www.efc.unc.edu/ga/rates.html
[151] Raucher, B. (2005). "The Value of Water: What it Means, Why it's Important, and How Water Utility Managers Can Use It." *Journal AWWA* 97:4. April 2005. Pages 90-98.

stabilize revenues when water uses by customers fluctuate. Additional revenues can also be invested into a fund to help improve efficiency in the water plant and delivery system or to help customers reduce water use.[152]

Implementation Actions:

7.18 EPD should update the guidance on conservation-oriented rates that was developed to support the Coastal Georgia Water and Wastewater Permitting Plan. This guidance should be applied state-wide.

7.19 DCA, DNR, Keep Georgia Beautiful Affiliates and associations for Georgia water professionals should develop educational material for elected officials and the public regarding the value and cost of sustaining healthy water supplies.

7.20 DCA, DNR, Keep Georgia Beautiful Affiliates and associations for Georgia water professionals should provide educational material to water providers and local governments to help build public understanding and acceptance of conservation-oriented rate structures.

7.21 Associations for Georgia water professionals and associations for Georgia local governments should offer training and guidance to water system employees and managers, local governments' employees, and elected officials on the benefits of conservation rates and methods for implementing them.

BP 19 – Retrofit and rebate programs

Retrofit program or rebate programs can be effective in replacing older plumbing fixtures, such as toilets, showerheads, and faucets, and older water-using appliances, such as dishwashers and clothes washers, with high efficiency fixtures. Replacing inefficient fixtures and appliances can be an effective and long-term way to save water. [153]

Water providers or local governments could also consider offering rebates for state-of-the-art water conservation products such as "toilet repair" or "toilet improvement" parts and technologies.

Water providers or local governments can also apply for low-interest rate loans from the DWSRF for the installation or retrofitting of water-efficient devices.

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[152] San Antonio has developed such a fund, which allows them to develop and implement conservation programs for all their customer classes. www.SAWS.com

[153] Replacing older toilets with high-efficiency toilets (HET) can save about 4,000 gallons per year New water and energy efficient clothes washers can save 8,000 to 10,000 gallons per year compared to a 12 - 15 year-old traditional top-load washer. Also, new high efficiency Energy Star dishwashers can save 1,200 to 1,300 gallons per year compared to a 10 - 12 year-old dishwasher. For information about high-efficiency fixtures and appliances, visit the EPA WaterSense website: www.epa.gov/watersense

In order to repay such a loan, the water provider will have to find a sustainable and predictable funding source, such as altering water rates.

BP 20 – Incentive programs

Local governments and water providers can offer a variety of incentives to their customers, such as distributing free low-flow faucet aerators to residential customers. Water providers can provide leak detection tablets to customers to encourage them to check for leaky toilets within their home or business. Local governments and water providers should also encourage citizens to take advantage of the tax-free holiday provided by the State. For several years the State of Georgia has provided for an exemption from both state and local sales and use taxes for specific energy and water efficient products (specifically products certified as WaterSense and Energy Star.)[154]

Local governments and water providers can also offer incentives to commercial and industrial customers to maximize their non-industrial use. For example, these customers can be encouraged to collect condensate and use it within the business, use water quality ponds for permanent storage for irrigation use or use process water for irrigation.

BP 21 – Sub-metering

It is easier to convince customers to conserve water when their personal water use is measurable. Frequently, tenants in multi-family buildings do not receive water bills.

Local governments can require new customers serving multi-family housing units to provide sub-meters on individual units. Water providers and local governments can also encourage sub-metering through the use of water audits, and by offering financial incentives for retrofitting existing apartment buildings with sub-meters. To help reduce financial impacts on tenants, guidance could be adopted that specify acceptable methods of metering and billing.[155]

BP 22 – Building codes and local ordinances

There are several changes that local governments can make to ordinances and codes to permit or encourage innovative technologies. For example, gray water, defined as water that has been used in the home in sinks, showers, or other non-toilet uses, may be reused in toilets if allowed by local ordinances and codes. Local governments can change plumbing codes to require the installation of high efficiency toilets in new homes or business, or to prohibit fixtures that are wasteful and designed to skirt current efficiency codes.

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[154] For more information on “tax-free” holidays, go to http://www.etax.dor.ga.gov/

[155] For an example of equitable metering and billing visit http://www1.gadnr.org/cws/ or http://www.northgeorgiawater.com/files/WSWC_SECTION5.PDF

Local governments can also alter codes or provide incentives to encourage Green Building.

Implementation Actions:

7.22 Homebuilders associations, US EPA, DCA, and Green Builders should offer water efficiency certification for developers and/or homes/businesses that have certified or approved indoor water efficiency fixtures installed (LEED or EPA WaterSense certification).

7.23 DCA should consider a proposed amendment to the state plumbing code that prohibits the use of multiple showerheads and shower tower systems[156] that are wasteful and designed to evade current regulations and efficiency codes.

<u>BP 23</u> – Guidance documents for outdoor water uses

Water providers and local governments can develop a best management practices guidance document for key outdoor uses, including:

1) Water used in pools and spas. These guidelines can be developed in cooperation with local health departments, DNR and appropriate professional associations. Guidelines could include a leak test protocol for pools and spas.
2) Pressure washing. These guidelines can be developed in cooperation with professional power washers.[157]
3) Non-commercial car washing. This guidance should consider limiting the amount of water used and minimizing water lost due to evaporation. Guidance may recommend using a bucket or shut off nozzle, or washing cars on grass to maximize the water use and minimize runoff.

Implementation Actions:

7.24 Appropriate professional organizations should help local governments develop best management practices and distribute them to water customers.

7.25 Associations of Georgia's local governments, GWWC, and the appropriate professional and trade associations should offer technical assistance to develop guidance documents.

[156] Multiple showerheads and shower towers can deliver up to 21 gallons per minute. For more information go to www.Allianceforwaterefficiency.org

[157] Gwinnett County has already created guidance on this topic and it could be used as a model for other areas. See Gwinnett County Stormwater Management Division. WQ-01 : Water Quality Protection Guideline, Surface Cleaning. www.gwinnettcounty.com/departments/publicutilities/pdf/WQ-01%20Surface%20Cleaning.pdf

<u>BP 24</u> – Water waste ordinances

Local governments can adopt water waste ordinances that minimize losses from non-commercial outdoor water uses not related to landscape irrigation. Such ordinances could include, but not be limited to 1) requiring pool covers be placed on pools during the off-season or 2) prohibiting the use of hoses without shutoff nozzles for washing cars.

Implementation Action:

7.26 EPD and/or the GWWC should develop a model water waste ordinance addressing outdoor water uses.

Planning

<u>BP 25</u> – Incorporating water conservation into plans

Reduction targets, and the practices implemented to achieve those targets, can be incorporated into a provider's water management and conservation plan. The results from conservation programs can also be incorporated into land use and capital improvement plans.[158]

Implementation Actions:

7.27 EPD should offer training to DCA and the regional commissions[159] throughout the state to inform them of the elements of the WCIP and encourage them to consider water conservation when reviewing local land use and comprehensive plans.

7.28 DCA and the regional commissions should offer technical assistance guiding local governments responsible for land use planning on ways to incorporate water conservation into those plans.

[158] Every water provider and local government in Georgia is required to complete various plans (i.e. land use plans and comprehensive plans) to meet state requirements. Some city/county governments follow these plans when making decisions regarding zoning, growth, and infrastructure. In addition, some governments and water providers develop capital improvement plans to show how they plan to address infrastructure needs for the next 5 to 10 years. To accurately represent the needs of the community, these plans should incorporate the information and data related to any changes that may result from water conservation programs. These plans address growth and expansion; if water is saved, then the growth or expansion of infrastructure may not be needed. Water savings can reduce the need for new infrastructure or delay the need for expansion of another, more expensive water source.

[159] The Regional Commissions, formerly known as "Regional Development Centers"

CHAPTER 8:

Conserving water used by State Agencies

Applicability of this chapter

The goals in this chapter apply to state agencies that own and operate facilities (such as office buildings, laboratories, and universities) and those that lease facility space. State agencies who own their facilities have greater control over the water use in a building since they are responsible for the water using fixtures and equipment. However, due to the complex relationship between lessee and lessor, certain conditions apply for leased space:

- If an agency receives bills for actual water use (not estimated or allocated) in a leased space, that space should be subject to the goals in this chapter. Agencies should work with landlords to receive water/sewer bills, where practical, for leased space.
- In the event that a state agency (the lessee) is leasing space from another state agency (the lessor), as in the case of DNR leasing space from Georgia Building Authority (GBA – http://gba.georgia.gov), the lessor should be responsible for the water conservation efforts and expectations as outlined in this chapter, unless the lessee receives bills for actual water use.
- In the event that a state agency leases space to an entity that is not part of the state government, the lessor shall still be responsible for meeting the expectations of this WCIP. The lessor shall work with the tenants to develop and implement long-term water conservation plans (see Benchmark 1D).

State agencies who are tenants in leased facilities, and are not able to collect water bills for actual use, are not subject to the goals of this WCIP.[160] Unoccupied space or space that otherwise uses a negligible amount of water (sheds, parking decks, picnic shelters, etc.) should not be counted in the scope of an agency's efforts for water conservation.

[160] Even though tenants that do not receive water bills are not subject to the goals in the WCIP, they should submit and follow an abbreviated long-term water conservation plan including elements such as employee education and behavioral best practices. Tenants should also work to incorporate water conservation into new and renewed lease agreements (ex: negotiating for plumbing retrofits).

Introduction

Water used by state agencies totals approximately 11 mgd on an average annual basis.[161] The majority of water used by state agencies is purchased from water providers, so this volume is estimated based on data provided by state agency representatives.

State agencies are rarely considered a separate water use sector. However, when a state-wide water conservation effort is implemented, often state agencies are held to equal or higher standards than water users within other water use sectors. From this unique position, state agencies should be progressive in water conservation efforts and should lead by example.

The State of Georgia is a major and visible water user in Georgia. The State employs over 130,000 citizens in over 120 agencies and owns and operates nearly 14,000 buildings occupying approximately 135 million square feet. Estimating that state agencies use at least 4 billion gallons per year, annual water and sewer charges are significant.[162] Water conservation within government agencies has the added benefit of saving taxpayers money.

Most state agencies have taken steps to conserve water in response to the current drought. The Executive Order (EO) issued by Governor Sonny Perdue on October 24, 2007, calls for Georgia state agencies to "lead by example" and take immediate actions "to reduce non-essential water use, water waste and water loss" at state-owned facilities."[163] On the day the Order was issued, the Governor also called for state agencies to reduce water consumption by 10 to 15% at state-owned facilities. It is assumed that when normal, non-drought operations resume, some of the 10 to 15% reductions achieved through emergency measures (such as not installing and therefore not watering new landscapes) would be lost. However, these savings can be captured again through long-term water conservation planning and implementation of practices.

On October 31, 2008 Governor Perdue issued another EO charging state agencies and authorities to reduce water usage by 5% over the next two years, and 2% annually through 2020.[164] This goal is captured within this chapter and embodies the spirit of water conservation. It extends state agencies existing efforts beyond drought emergency response to long-term water conservation efforts incorporated into everyday operation of state-owned facilities.

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[161] Estimate calculated using water use data from the Dept. of Corrections and the University System of Georgia. Also BLLIP data regarding total sq. footage of property occupied by state agencies was used. State agency reference from the State of Texas was used to estimate water use for remaining agency sq. footage. http://www.seco.cpa.state.tx.us/waterconservation.pdf See Appendix A of the WCIP for more details.

[162] Personal communication with PJ Newcomb, State Utilities Program Engineer, P2AD, October 28, 2008.

[163] Governor Sonny Perdue Press Release "Governor Perdue Asks State Government to Lead Water Conservation Effort." October 24, 2007. Available online: http://gov.georgia.gov/00/press/detail/0,2668,78006749_96092834_96285033,00.html

[164] Governor Sonny Perdue Issues Water Conservation Challenge. Online at http://gov.georgia.gov/vgn/images/portal/cit_1210/13/50/12691895710_31_08_01.pdf

Chapter Overview

This chapter presents a set of goals that can be used by state government agencies to improve their overall water efficiency. Following each goal is a set of benchmarks that can be used to measure progress toward these goals. Each benchmark is accompanied by list of the best practices from this chapter that state government agencies can choose to implement to help reach that benchmark or goal. The best practices are accompanied by implementation actions, which can be taken by outside organizations or government entities to assist state government agencies in implementing particular best practices.

Goals and Benchmarks
State Agencies

The goals and benchmarks in this chapter focus on establishing a baseline measure of and reductions in water use intensity, constructing any new facility to be water and energy efficient, and minimizing water loss. Water use intensity, as discussed in this chapter, is a measure of water use per square foot of occupied space. This measure of water use intensity accounts for both attrition and addition within agencies and the state-wide building industry. Not all agencies or agency function/services are the same, so water use per square foot may not always be a good measure for comparing buildings, campuses, or agencies. However, this type of measure can provide state agencies with a standard method for determining an agency's water use and assess any progress that agency makes toward being more efficient. It can also generate questions that may help pinpoint points of water loss or waste (such as why dormitory A has twice the use per square foot as dormitory B). Establishing a state agency water conservation goals based on water use intensity per square foot and setting the baseline of fiscal year 2007 is comparable to a goal established for federal agencies in January 2008.[165]

GOAL #1

State agencies will reduce water use intensity, relative to a 2007 baseline, by five percent by July 2011, and two percent annually through the year 2020.

Setting a quantifiable goal for reducing water use intensity through 2020 positions Georgia state agencies to lead the water conservation effort by example. The EOs from 2007 and 2008 encouraged state agencies to begin considering short and long term water conservation efforts. This goal builds on that encouragement to calling agencies to document the results of their conservation efforts. Five percent in two years, and 2% each year through 2020 equates to over 20% reduction in water use intensity. A 20% reduction in water use intensity per square foot has the potential to reduce water and sewer bills significantly, resulting in up to $3 million of savings annually.[166]

State government agencies have the flexibility to determine how individual facilities and campuses can meet this goal. Some agencies have made considerable efforts and achieved significant success with water conservation efforts. This goal is intended to acknowledge such efforts and outcomes so as to not penalize agencies that have already invested in water conservation. In

[165] Executive Order 13423. "Strengthening Federal Environmental, Energy, and Transportation Management. Available online: http://www.ofee.gov/eo/eo13423_main.asp

[166] Water and sewer charges are estimated based on water costs of $3.00 per 1000 gallons. Personal communication with PJ Newcomb, former State Utilities Program Engineer, P2AD, October 28, 2008.

addition, water use intensity is a flexible metric and can account for local and regional differences in water sources and weather. For example, it can be adjusted for weather conditions using cooling degree days, quantitative indices designed to reflect the demand for energy needed to cool a home or business.

Agencies should target water conservation at facilities that use the most water. A cursory review of the state's facility inventory in state buildings, land, and lease inventory of property (BLLIP – www.realpropertiesgeorgia.org) shows that about 3,200 facilities accounts for 80% of the 135 million square feet of space.[167] Many of the top water users will be the largest buildings.

State agencies should develop long-term water conservation plans to assist them in meeting this goal. Long-term water conservation plans are needed to ensure conservation practices permanently affect water use by state agencies. It is important for agencies to determine the appropriate level for plan development (for example, the Board of Regents may choose to develop plans by campus, whereas other agencies may choose to develop one plan per building).

This goal aligns with the Governor's energy challenge, which requires agencies to reduce energy usage per square foot by 15% by 2020.[168] This alignment is intended to help streamline information collection and sharing for the overall conservation efforts (as discussed in Chapter 3, which addresses water used for electricity generation).

Benchmark 1A
By September 30, 2009, state agencies should develop an inventory of facilities.

See Best Practice 1

Benchmark 1B
By December 31, 2009, state agencies will develop 2007 water use baselines for their facilities.

See Best Practices 2, 3, and 4

Benchmark 1C
By December 31, 2011, state agencies accounting for the top 80% of water use in state government should conduct water audits of their own facilities to identify the areas of highest water use.

See Best Practice 3

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[167] State of Georgia "Building, Land, and Lease Inventory of Property. Online at https://www.realpropertiesgeorgia.org

[168] Georgia Environmental Facilities Authority: Governor's Energy Challenge. http://www.gefa.org/index.aspx?page=385

Benchmark 1D

By December 31, 2009, and in accordance with the Executive Orders issued in 2007 and 2008, state agencies will develop long-term water conservation plans.

See Best Practice 5, 6, 7, 8 and 9

Benchmark 1E

After baselines are established and audits conducted, state agencies should annually verify water use reductions where appropriate.

See Best Practice 4

GOAL #2

State agencies should ensure that new or renovated major facility projects are water efficient.

A great deal of water savings can be realized by ensuring new or renovated facilities are designed toward efficiency and have efficient plumbing fixtures. The details of this goal are taken from the 2008 Georgia Senate Bill 130,[169] also known as the "Efficiency and Sustainable Construction Act of 2008," passed during the 2008 Legislative Session and signed by the Governor on May 6, 2008. A "major facility project" means a state-funded project that meets one of the following criteria:

- New construction building project of a building exceeding 10,000 square feet;
- A renovation project that is more than 50 percent of the replacement value, as determined by the Department of Administrative Services Risk Management Division, of the facility, a change in occupancy, or any roof replacement project exceeding 10,000 square feet; or
- A commercial interior tenant fit-out project exceeding 10,000 square feet of leasable area where the state is intended to be the lessor of such property.

A major facility project shall not include a building, regardless of size, that does not have conditioned space as defined by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE – www.ashrae.org) and shall not include a state owned building that is on the historical registry or any local, county, or municipal building."

Benchmark 2A

By 2010, state agencies should ensure that major facility projects are 15% more water efficient than required in the Energy Policy Act of 1992.

See Best Practice 8

[169] "Efficiency and Sustainable Construction Act of 2008," Senate Bill 130 of the Georgia General Assembly: http://www.legis.state.ga.us/legis/2007_08/sum/sb130.htm

GOAL #3

State agencies should reduce water loss as much as practical.

Significant amounts of water can be lost through leaks. Agencies may want to approach this goal by first quantifying their amount of water loss, by calculating water loss as a percentage of water purchased or withdrawn. Agencies that are not experiencing significant water loss would not be expected to aggressively pursue this goal.

Benchmark 3A

By December 2011, state agencies will adopt leak detection and repair programs as outlined in the long-term water conservation plans.

See Best Practice 9

Best Practices: A Menu of Options

There are many practices that state agencies can implement in order to meet the goals and benchmarks in this chapter. These practices fall into four major categories: information-gathering practices that help facilities understand their water use and verify the results of conservation programs; planning and training practices, which help facilities approach conservation in a methodical manner; and water loss reduction practices.

Information-gathering practices

BP 1 – Facility inventory

State agency's inventories of their facilities should include information regarding type of facility, whether it is leased or owned, square feet of space, water source, water rates, and any other information relevant to water use efficiency within the facility. Agencies should also develop a system for updating this inventory when changes are made.

Implementation Actions:

8.1 The State Property Office (SPO – http://gspc.georgia.gov) should continue to provide other agencies with on-line forum for property data and information – as provided through BLLIP (www.realpropertiesgeorgia.org)

8.2 Agencies should regularly update facility information using BLIPP.

BP 2 – EnergyCAP

GEFA's EnergyCAP program is a state-of-the-art energy management software program that enables the State to track multiple commodities and perform a detailed analysis of consumption and pricing. State agencies should use this software or the state BLLIP to track actual water usage and develop a water use baseline.[170]

Implementation Actions:

8.3 DNR should provide guidance on developing baselines for both metered and non-metered facilities. This guidance could be developed using the U.S. DOE guidance for implementing the federal Executive Order 13423.

8.4 GEFA and DNR should support the baseline, inventory, and tracking effort using EnergyCap or BLLIP. This may require significant staff time, and a dedicated full-time employee may

[170] Information on Energy Cap available online at http://www.gefa.org/Index.aspx?page=184.

be justified considering the significant financial savings this goal could afford.

<u>BP 3</u> – Water audits

Water audits, which assess water use and water needs, as well as the water management practices and technologies in place at a facility, can help agencies identify the best opportunities for conserving water.

Implementation Action:

8.5 P2AD, with assistance from the Georgia Association of State Facilities Administrators (GASFA), should develop water audit training for state facilities managers.

<u>BP 4</u> – Metering and measurement

State facilities can install meters at facilities to help quantify water use and water loss within facilities. State agencies should budget for meter installation where it is cost-effective.

Implementation Actions:

8.6 EPD should develop guidance for facilities' managers and key employees on measuring and verifying water use and water loss through metering and other methods.

8.7 GASFA should provide guidance and training on meter calibration and reading.

Planning and training practices

<u>BP 5</u> – Practice analysis

State agencies should assess possible water conservation practices by using either cost-benefit or cost-effectiveness analysis. These analyses help identify which practices deliver the most water savings for the cost of implementation. As new information and technologies become available, facilities should explore new opportunities for conserving water.

<u>BP 6</u> – Long-term water conservation plans

Long-term water conservation plans establish a methodical, site-specific approach to water conservation. The following elements may be included in a long-term plan, as well as others that may be appropriate:

1) Statement of commitment
2) Water conservation manager and team (including qualifications or planned training)

3) Scope of plan (one facility, an entire campus, etc.) Note which facilities are excluded and why (leased space, unoccupied space, space that uses negligible water such as parking decks, etc.)
4) Water source(s)
5) Baseline water use for 2007
6) Meter installation and calibration program
7) Previous water conservation measures, including response (and results of response) to the 2007 and 2008 Governor's Executive Orders. This section should provide information on which conservation practices are permanent and which are to be flexible based on water availability, as well as a determination of which water uses are considered essential and non-essential.
8) Prioritized water conservation opportunities
9) Timeline for implementing actions
10) Employee education and awareness program
11) Maintenance program
12) Leak detection and repair program
13) Performance-based contracting
14) Important contacts (water providers, etc.)
15) Essential and non-essential water uses
16) Drought response plan – using distinction of non-essential water uses as well as responses to various levels of drought

Tenants in leased facilities who cannot collect water bills for actual use should submit and follow an abbreviated long-term water conservation plan including elements such as employee education and behavioral best practices. Tenants should also work to incorporate water conservation into new and renewed lease agreements.

State agencies should update long-term water conservation plan on a regular basis (e.g., every 3 years) to account for changes in building stock, technology, staff and to account for progress from previous efforts.

Implementation Actions:

8.8 DNR should provide guidance to state agencies on development of long-term water conservation plans. The guidance should include information regarding:

- Ways to document previous water conservation efforts.
- Ways to document the results of the agencies' response to the October 2007 Executive Order and how credit could be given for successful response.

- o Recommendations about which water conservation practices should be permanent and which could be flexible based on the condition of the water resources. For example, plumbing retrofits provide more permanent water savings than a temporary ban on washing fleet vehicles.
- o Methods for determining and identifying essential and non-essential water uses and the level at which this decision should be made (i.e. in some cases, such as in the University System, these decisions may be made on a sub-agency level.

8.9 DNR should maintain a repository of best practices and success stories at state facilities.

BP 7 – Training

State agencies and facilities' managers should, through an ongoing effort, ensure that staff members have the appropriate training to comply with the goals and benchmarks in this plan and in the long-term water conservation plans for each agency.

Implementation Action:

8.10 P2AD, in cooperation with the Department of Technical and Adult Education (DTAE – http://www.tcsg.edu) should develop water efficiency extension service.

Reducing water use

BP 8 – Efficiency standards

State agencies should ensure that any new construction meets expectations of the Efficiency and Sustainable Construction Act of 2008.[171] State agencies may want to consider additional certification standards, such as LEED and U.S. EPA WaterSense.

Reducing water loss

BP 9 – Leak detection and repair

Facilities should develop a program for detecting and repairing leaks. State agencies should set aside funding for leak repair as appropriate.

Implementation Action:

8.11 DTAE, P2AD, and GASFA should develop leak detection services as part of water efficiency extension service at DTAE.

[171] "Efficiency and Sustainable Construction Act of 2008," Senate Bill 130 of the Georgia General Assembly: http://www.legis.state.ga.us/legis/2007_08/sum/sb130.htm

List of Organizations associated with Implementation Actions in the WCIP

American Society of Golf Course Architects	4.13
Associations for landscape and irrigation professionals	6.1, 6.5, 6.6, 6.7, 6.8, 6.14, 6.15, 6.20, 6.22, 6.26
Associations for local governments	6.15, 6.22, 7.9, 7.12, 7.25
Associations for Georgia water professionals	3.2, 3.4, 6.10, 6.11, 6.12, 6.15, 7.3, 7.6, 7.9, 7.10, 7.12, 7.16, 7.17, 7.19, 7.20, 7.21
Associations for Georgia water providers	6.1
Conserve Georgia	3.3
Demand Side Management Work Group	3.1
Department of Technical and Adult Education	8.10, 8.11
Educational and research institutions	2.12, 2.13, 2.15, 2.16, 2.17, 2.20, 5.12, 5.15, 6.21
Electric utilities	3.1, 3.5, 3.6
Georgia Association of State Facilities Administrators	8.5, 8.7, 8.11
Georgia Conservation Tillage Alliance	2.18
Georgia Department of Community Affairs	7.11, 7.12, 7.19, 7.20, 7.22, 7.23, 7.27, 7.28
Georgia Department of Natural Resources	6.3, 6.11, 6.12, 6.16, 7.2, 7.9, 7.10, 7.12, 7.14, 7.19, 7.20, 8.3, 8.4, 8.8, 8.9
Georgia Environmental Facilities Authority	5.12, 7.4, 8.4
Georgia Environmental Partnership	5.2, 5.6, 5.8, 5.9, 5.11, 5.12, 5.14, 5.16, 5.17, 5.18, 5.19, 5.20
Georgia Environmental Protection Division	2.1, 2.14, 2.15, 2.16, 3.1, 4.5, 4.10, 5.19, 6.10, 6.13, 6.15, 7.1, 7.6, 7.7, 7.13, 7.18, 7.26, 7.27, 8.6
Georgia Golf Course Superintendent's Association	4.1, 4.2, 4.3, 4.4, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12, 4.14
Georgia Green Industry Association	6.1, 6.5, 6.6, 6.7, 6.8, 6.14, 6.15, 6.20, 6.22, 6.26
Georgia Public Service Commission	3.2, 3.4
Georgia Soil and Water Conservation Commission	2.1, 2.2, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15,

	2.16, 2.17, 2.18, 2.19, 2.20
Georgia State Golf Association	4.1, 4.7
Georgia Water Planning and Policy Center	2.15
Georgia Water Wise Council	6.4, 6.26, 7.8, 7.12, 7.15, 7.25, 7.26
Green Builders	7.22
Homebuilders associations	7.22
Irrigation and related equipment manufacturers	6.14
Keep Georgia Beautiful Affiliates	7.19, 7.20
Landscape and irrigation professionals	6.18, 6.19
Local governments	5.10, 6.17, 6.18, 6.23, 6.25
Pollution Prevention Assistance Division	5.1, 8.5, 8.10, 8.11
Soil and Water Conservation Districts	2.19
State agencies	2.8, 2.12, 6.1, 6.2, 6.9, 6.14, 6.25, 8.1
State Property Office	8.1
Trade associations	5.3, 5.4, 5.5, 5.7, 5.8, 5.9, 5.11, 5.12, 5.13, 5.14, 5.16, 5.20, 7.24, 7.25
UGA Agricultural Experiment Station	2.5, 2.7, 2.12, 2.20
UGA College of Agriculture and Environmental Science	6.2, 6.26
UGA Extension	2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.13, 2.14, 2.15, 2.17, 2.18, 2.20, 6.1, 6.24
Urban Agriculture Council	6.1, 6.3, 6.5, 6.6, 6.7, 6.8, 6.14, 6.15, 6.20, 6.22, 6.26
USDA, Agricultural Research Service	2.7, 2.12
USDA, Natural Resource Conservation Service	2.9, 2.18, 2.19
USDA Office of Rural Development	7.5
U.S. Department of Energy	5.12
U.S. Environmental Protection Agency	5.12, 6.2, 7.13, 7.14, 7.22
Water utilities	4.15, 5.18, 6.18, 6.19, 6.25, 6.26

Acronyms and Definitions

Where possible, the acronyms and definitions in the WCIP align with those used by professional associations, organizations and experts in the field. The sources are referenced in parentheses after the term. Where no source is referenced, the term is defined in the WCIP. Most common sources referenced:

- AWE – Alliance for Water Efficiency Glossary of Common Water Related Terms, Abbreviations, and Definitions www.allianceforwaterefficiency.org
- SWP – Georgia Comprehensive State-wide Water Management Plan. January 8, 2008. www.GeorgiaWaterPlanning.org
- Vickers – *Handbook of water use and conservation: homes, landscapes, businesses, industries, farms.* WaterPlow Press. 446 pgs.
- EPA – Water Conservation Plan Guidelines. August 6, 1998. http://www.epa.gov/WaterSense/pubs/guide.htm

AMR	Automatic meter reading
BMP	Best management practice
BP	Best practice
CE	Cost effective
CWSRF	Clean water state revolving funds
DSM	Demand side management
DWSRF	Drinking water state revolving funds
EO	Executive order
ET	Evapotranspiration
GCLP	Georgia certified landscape professional
GCS	Golf course superintendent
GDP	Gross domestic product
HET	High efficiency toilet
HVAC	Heating, ventilation, and air conditioning
IC	Industrial and commercial
KWh	Kilowatt-hour
LEED	Leadership in Energy and Environmental Design
LID	Low impact development
MGD	Million gallons per day
MWh	Megawatt hours
NAICS	North American industry classification system
NGO	Non-government organization
SIC	Standard industrial classification
SRF	State revolving funds
SWAT	Smart water application technologies
TBtu	Trillion British thermal units
UAW	Unaccounted for water
ULFT	Ultra low-flow toilet
VRI	Variable rate irrigation
WCIP	Water conservation implementation plan
WCDP	Water conservation and development plan

Agronomic (Merriam-Webster's Dictionary) - a term describing a branch of agriculture dealing with field-crop production and soil management.

Apparent losses (www.awwa.org) - the paper losses that occur in utility operations due to customer meter inaccuracies, billing system data errors and unauthorized consumption. In other words, this is water that is consumed but is not properly measured, accounted or paid for. These losses cost utilities revenue and distort data on customer consumption patterns.

Application efficiency - the ratio of the amount of water entering the soil to the amount of water withdrawn from the source.

Base rate - refers to the base price charged for a standard volume of water a household uses, and the investment needed to treat and deliver that water (derived from aggregate estimates or individualized usage). The base rate is usually set during winter months when water usage is almost exclusively indoor use.

Baseline (Vickers) – an established value or trend used for comparison when conditions are altered, as in the introduction of water-efficiency measures.

Benchmark (WCIP) – quantifiable metrics of efficiency. These measures can help determine progress toward a long-term goal. In cases where additional data are necessary, time-oriented activities are used to help determine progress toward a particular water conservation goal.

Beneficial water use (Vickers) – The use of water to benefit people or nature.

Blowdown (AWE) - Draining off the water in a cooling tower reservoir to avoid the buildup of excess dissolved solids. Also referred to as bleed-off.

BMPs plan - an operating document that can guide the GCS's management of water during periods of both adequate and insufficient supply. The BMPs can establish predetermined actions and water use responses in the event that water reductions are necessary.

Boilers (Merriam-Webster's Dictionary) – 1) a vessel used for boiling 2) the part of a steam generator in which water is converted into steam and which consists usually of metal shells and tubes 3) a tank in which water is heated or hot water is stored.

Commercial user (AWE) – customers who use water at a place of business, such as hotels, restaurants, office buildings, commercial businesses or other places of commerce. These do not include multi-family residences, agricultural users, or customers that fall within the industrial or institutional classifications.

Conservation tillage - a method of improving the soil so that rain can infiltrate and be retained. Residues left from properly managed winter cover or grain crops, and to some extent the prior crop, improve water intake from both rain and irrigation.

Conservation-oriented rate structure (SWP) – a rate structure adopted by a water utility or water provider that is designed to reflect the cost of providing water and encourage efficient use of water by customers. (AWE) A pricing structure billed by the quantity of commodity delivered and tied to the costs associated with that delivery, designed to provide an accurate price signal to the consumer.

Consumptive use (SWP) – the difference between the total amount of water withdrawn from a defined hydrologic system of surface water or groundwater and the total amount of the withdrawn water that is returned to that same hydrologic system over a specified period of time.

Cooling degree days - quantitative indices designed to reflect the demand for energy needed to cool a home or business.

Cooling towers (AWE) - A mechanical device that cools a circulating stream of water by evaporating a portion of it. A cooling tower is part of a system that provides air conditioning or equipment cooling. It usually includes a heat exchanger, recirculating water system, fans, drains, and make-up water supply.

Cost-benefit analysis (EPA) – a comparison of total benefits to total costs, usually expressed in monetary terms, used to measure efficiency and evaluate alternatives.

Cost-effectiveness (EPA) – a comparison of costs required for achieving the same benefit by different means. Costs are usually expressed in dollars, but benefits can be expressed in another unit (such as quantity of water)

Counter-flow cooling or rinsing – where water needed for cooling or cleaning of a product is introduced counter to the flow of the product, such that the product enters the basin near the water exit, where the water is the dirtiest/warmest, and product exits the basin near the water entrance, where the product contacts the cleanest/coolest water before leaving the process.

Counter-flow equipment – equipment required to facilitate or initiate counter-flow rinsing within a process. Such equipment usually consists of an elongated basin that provides some residence time for the product to contact the water, and a means to provide clean water at one end, and discharge dirty or hot water at the opposite end.

Cropping systems is a term used to describe a specific crop or crop rotation and the associated cultural and mechanical practices used to grow that crop. For example conventionally tilled cotton and conservation-tilled cotton describe two different cropping systems with the same crop.

Culture of conservation – a culture of citizens encourages individuals to more fully appreciate our natural resources and actively participate in their protection. Georgia's culture of conservation should strengthen our individual and collective commitments to water conservation as an effective way to sustain precious water resources for current and future generations.

Customer class (AWE) – a group of customers (residential, commercial, industrial, wholesale, and so on) defined by similar characteristics or patterns of water usage.

Declining block rate (AWE) - A commodity rate whose unit price decreases with increasing water use.

Demand management (AWE) - Measures, practices or incentives deployed to change the pattern of demand for a service by its customers/users within a particular sector or slow the rate of growth for that service.

Dollar value-added, generally defined as the difference between sales revenue and the costs of raw materials and utilities

Domestic water use (Vickers adjusted) - water used by sanitary plumbing fixtures (toilets, urinals, faucets, and showerheads) and appliances (clothes washers and dishwashers) in non-residential settings such as industrial, commercial, and institutional properties and water used for residential purposes such as drinking, food preparation, bathing, washing clothes and dishes, and flushing toilets.

Drought (Vickers) – an extended period of below-normal precipitation that can result in water supply shortages, increased water demand, or both.

Efficient (Vickers) – (1) performing or producing effectively with a minimum of waste, expense or unnecessary effort; competent (2) satisfactory and economical use.

Efficient water use (SWP) - considered the minimal amount of water that is technically and economically feasible to achieve an intended water use function. Efficient water use reduces water waste.

End user (Vickers) – a consumer of water (e.g. residential, commercial, industrial, or agricultural water customer)

Evapotranspiration (AWE) – the quantity of water evaporated from soil surfaces and transpired by plants during a specific time.

Flue gas scrubbing – also known as flue gas desulfurization, can be accomplished with either dry or wet systems. Wet scrubbers entrain flue gas in water spray, capturing sulfur dioxide and other pollutants, which are then removed by creating an alkaline slurry. Dry scrubbing injects the alkaline particles directly into the flue gas stream, using a smaller amount of water, but the more limited contact between reactants in the absence of water results in lower pollutant removal efficiencies. (Note: Most "dry" scrubbers are not really dry in that they involve the use of water in the lime injection system; that water evaporates in the scrubber. The water use is less than that of "wet" scrubbers but it is not zero.)

High efficiency toilet (AWE) – a fixture that flushes at 20 percent below the 1.6 gallons per flush maximum or less, equating to a maximum of 1.28 gpf.

Implementation actions (WCIP) – actions, such as providing financial assistance or developing technical guidance, that when resources are available can be taken by state agencies, associations, organizations and other groups to support the implementation of practices. activities to be performed by an agency, association, organization or other group to support water users and/or water or electric providers implementing the

Inclining block rate (AWE) – a commodity rate whose unit price increases with increasing water use.

Individualized rate - also known as budget-based rates, are a version of inclining block rates in which the blocks or tiers are determined for each customer by the customer's usage history, and are usually set based upon the quantity of occupants and the square footage of landscape.

Irrigation audit - concerning agricultural irrigation, an irrigation audit is considered a procedure to collect and present information concerning the uniformity of application, precipitation rate, and general condition of an irrigation system and its components. Also see "Water audit."
Management practices (SWP) – reasonable methods, considering available technology and economic factors, for managing water demand, water supply, return of water to water sources, and prevention and control of pollution of the waters of the state.
Marginal cost (Chesnutt, et al 1997) - also known at incremental costs reflect an estimate of the cost of developing the next increment of supply needed to satisfy an increase in water usage.

Marginal cost analysis can be used to estimate the savings (or avoided cost) from not developing new supply sources to meet additional usage.

Marginal cost pricing recognizes that future costs may be very different than historical costs.

NAICS – (formally SIC codes) North American Industry Classification System. A consolidation of the codes for the U.S., Canada and Mexico. Produced by the U.S. Office of Management and Budget.
Non-contact cooling water - water used to reduce temperature that does not come into contact with any raw material, intermediate product, waste product (other than heat), or finished product. Non contact cooling water does not include any process waters or other type of wastewaters, nor is it exposed to anything but the inside of the pipe.
Non-industrial water use - water used to support activities within industrial and commercial facilities that are not related to cooling, heating and processing.
Non-potable water (AWE) – water that does not, or may not, meet drinking water quality standards.
Non-revenue water (AWE) –for water providers, (1) the volume of unbilled authorized consumption (water for fire fighting, system flushing and similar uses) added to real losses and apparent losses; or (2) the difference between system input volume and billed authorized consumption.
Overall gpcd – volume of water used per capita per day. In the WCIP, overall water use estimates are calculated by dividing the total volume of water withdrawn by public water provider(s) by the population served by public water supply.
Peak water demand or use (AWE) – The maximum demand occurring in a given period, such as hourly, daily or annually.
Performance based contracting (www.gsa.gov) – also known as performance-based acquisition is a technique for structuring all aspects of an acquisition around the purpose and outcome desired as opposed to the process by which the work is to be performed.
Potable water (AWE) – Water that meets federal and state water quality standards for water delivered to utility customers.
Real losses (www.awwa.org) - the physical losses of water from the distribution system, including leakage and storage overflows. These losses inflate the water provider's production costs and stress water resources since they represent water that is extracted and treated, yet never reaches beneficial use.
Recycled water (AWE) – a term used to describe reclaimed water.
Residential gpcd – volume of water used per capita per day for residential purposes only.
Retrofit – (AWE) (1) Replacement of existing water using fixtures or appliances with new and more efficient ones. (2) Replacement of parts for a fixture or appliance to make the device more efficient.
Reuse (SWP) - is the use of reclaimed water as a substitute for another generally higher quality water source. Reclaimed water can be reused for the beneficial irrigation of areas that may be accessible to the public (such as golf courses, residential and commercial landscaping, parks, athletic fields, roadway medians, and landscapes) and for other beneficial uses such as human uses, cooling towers, concrete mixing, and car washes.
SIC Code (AWE) - A system devised by the federal government to classify industries by their major type of economic activity. The code may extend from two to eight digits. This term has been superceded by the NAICS.
Submetering (AWE) – the practice of using meters to measure master-metered utility consumption by individual users. Including

total-capture submetering which is a type of submetering where all of the actual water consumption in each unit is measured, and

partial-capture submetering which is a type of submetering where only a portion of the total water consumption in each unit is measured and

Supply-side management (AWE) - Increasing water supply by developing more raw water, generally building reservoirs and canals or drilling groundwater wells.

Travelers - agricultural irrigation systems which pumps water from a sources and through a flexible hose or permanent buried plastic pipe could connect the pump to a number of different staging locations in the field.

Turfgrass (AWE) - Hybridized grasses that, when regularly mowed, form a dense growth of leaf blades and roots.

Ultra Low Flush Toilet (AWE) - a toilet that flushes with 1.6 gallons or less.

Unaccounted for water (EPD rules and regulations) – (1) the difference between the total amount of water pumped into the system from the source(s) and the amount of metered water use by the customers of the water system expressed as a percentage of the total water pumped into the system. UAW generally includes system leakage and unmetered uses such as fire fighting, flushing, broken water mains, etc. (2) (Vickers) water that does not go through meters (e.g., water lost from leaks or theft) and thus cannot be accounted for by the utility.

Uniform block rate (AWE) - A commodity rate that does not vary with the amount of water use.

Urban agriculture (www.urbanagcouncil.com) – the creation, growth, introduction and management of constructed landscapes designed to support and enhance natural environmental systems and a sustainable quality of life through mitigation of land altering activity

Water audit (AWE) – (1) An on-site survey of an irrigation system or other water use setting to measure hardware and management efficiency and generate recommendations to improve its efficiency. (2) For water distribution systems, a thorough examination of the accuracy of water agency records and system control equipment to identify, quantify, and verify water and revenue losses.

Water budget based rates (AWE) – also known as individualized rates, are a version of inclining block rates in which the blocks or tiers are determined for each customer by the customer's usage history, and are usually set based upon the quantity of occupants and the square footage of landscape.

Water conservation (SWP and Vickers) - the beneficial reduction of water use, water waste and water loss.

Water conservation goal (WCIP) – sector-specific, long-term aspirations for water use and efficiency. The goals are not one-size-fits-all targets for reductions in water use; they were designed to be flexible, so that they are applicable for users with differing circumstances and recognize prior investments in conservation.

Water conservation practice (Vickers) – activities to be implemented by water users and/or water or electric providers to reach benchmarks and goal(s).

Water loss - water that does not make it to the point of intended use. This is generally in the form of leaks, but could take other forms such as the routing of spring water directly to a stormwater drain or a treatment system. Concerning agricultural irrigation, water loss is considered water lost to leaks in the system or that is not accounted for out the end of the system. Where ponds are used to temporarily store pumped ground water for later use, losses can include evaporation or seepage losses from the pond.

Water management practice (SWP) – reasonable methods, considering available technology and economic factors, for managing water demand, water supply, return of water to water sources, and prevention and control of pollution of the waters of the state.

Water recycling - within an IC facility or process, the use of water that has already been used at least once as a substitute for fresh water supply to that facility.

Water use (SWP and Vickers) – the utilization of water for natural and human uses. In a restrictive sense, water that is actually used for a specific purpose (end use) or by a particular group, such as residential, industrial or agricultural users. Concerning agricultural irrigation, water use is considered the total amount of groundwater or surface water pumped by the irrigation system.

Water use efficiency (SWP and AWE) – (1) generally addresses how efficiently water is used or the acct of achieving a water use function with the minimal amount of water that is technically and economically feasible (2) a measure of the amount of water used versus the minimum amount required to perform a specific task.

Water use intensity - a measure of how efficiently water is used in industrial, commercial and business operations. It can be calculated as a ratio between total water use or consumption and a unit of product, function, or service delivered by an industrial, commercial, or agency. For Georgia state agencies it is calculated as water use per square foot.

Water use profile (AWE) - a quantitative description (often displayed graphically) of the different water uses at a residence, business site, or utility service area.

Water waste – a volume of water that meets an intended use, but may not be considered efficient concerning agricultural irrigation, water waste is considered water not used by the plants or animals being produced, including (1) water that directly evaporates from ponds, (2) water that directly evaporates from soaked soils or leaches past the root zone, and (3) water that is applied to non-target areas.

Agencies, Associations and Organizations

ARS	Agricultural Research Service, United States Department of Agriculture – www.ars.usda.gov
ASGCA	American Society of Golf Course Architects - www.asgca.org
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers – www.ashrae.org
AWE	Alliance for Water Efficiency – www.allianceforwaterefficiency.org
AWWA	American Water Works Association – www.awwa.org
AWWARF	American Water Works Association Research Foundation – www.awwarf.org
DCA	Georgia Department of Community Affairs – www.dca.state.ga.us
DNR	Georgia Department of Natural Resources – www.gadnr.org
DTAE	Georgia Department of Technical and Adult Education - http://www.tcsg.edu
EPD	Georgia Environmental Protection Division – www.gaepd.org
EPRI	Electric Power Research Institute – http://my.epri.com
GASFA	Georgia Association of State Facilities Administrators - www.gasfa.net
GAWP	Georgia Association of Water Professionals – www.gawp.org
GBA	Georgia Building Authority - http://gba.georgia.gov
GBC	Green Building Council - www.usgbc.org
GCTA	Georgia Conservation Tillage Alliance – www.gcta.org
GEFA	Georgia Environmental Facilities Authority – www.gefa.org
GEP	Georgia Environmental Partnership - www.p2ad.org/documents/gep_home
GGCSA	Georgia Golf Course Superintendents Association - www.ggcsa.com
GGIA	Georgia Green Industry Association – www.ggia.org
GRWA	Georgia Rural Water Association – www.grwa.org
GSGA	Georgia State Golf Association – www.gsga.org
GSWCC	Georgia Soil and Water Conservation Commission – www.gaswcc.org
GWPPC	Georgia Water Planning and Policy Center - www.h2opolicycenter.org
GWWC	Georgia Water Wise Council – www.gwwc.org
IA	Irrigation Association – www.irrigation.org
IWA	International Water Association - www.iwahq.org
MALTA	Metropolitan Atlanta Landscape and Turf Association – www.maltalandscape.com
MNGWPD	Metropolitan North Georgia Water Planning District – www.northgeorgiawater.com
NRCS	Natural Resources Conservation Service - www.nrcs.usda.gov
PSC	Public Service Commission – www.psc.state.ga.us
SPC	State Property Officer - http://gspc.georgia.gov
SWCD	Soil and Water Conservation Districts - www.gacds.org
SWP	Georgia's state-wide water management plan – www.georgiawaterplanning.org
UAC	Urban Agriculture Council - www.urbanagcouncil.com
USDA	United States Department of Agriculture, Rural Development – www.rurdev.usda.gov
U.S. DOE	United States Department of Energy – www.energy.gov
U.S. EPA	United States Environmental Protection Agency – www.epa.gov
USGS	United States Geological Survey – www.usgs.gov
UGAAES	University of Georgia Agricultural Experiment Stations - http://research.caes.uga.edu/
UGACAES	University of Georgia College of Agriculture and Environmental Science – www.caes.uga.edu
UGAExt	University of Georgia Cooperative Extension - www.caes.uga.edu/extension

Appendices

Appendix A

Estimated water use data, sources and basis of estimation

Sector	Annual average water use or withdrawal (mgd)	Source of Data	Basis of estimation
Golf courses	36	Georgia Golf Course Superintendents Association (provided Sept. 2007)	The formula and water use data for this estimation was provided by the Georgia Golf Course Superintendents Association. Total permitted golf courses based on EPD permits = 242 CALCULATION: [(27,154 gallons/acre-inch)(100 acres/permitted golf course)(242 permitted golf courses)(20 inches/year)] / 365 days/year = 36 mgd
Landscape irrigation	181	Georgia EPD Watershed Protection Branch - Estimates based on reported data on actual water use	The estimated annual average water use is based on data reported to the EPD from the 55 counties under Drought Response Level 4. The estimate was calculated using reported annual average water use calculated as the difference between water use during Nov. 2006 – Oct. 2007 and water use during Nov. 2007 – Oct. 2008. The difference reflects the changes in water use as a result of the outdoor water use ban that became effective in Oct. 2007. The difference was multiplied by the population ratio of the whole state to the 55 counties, with an adjustment for estimated water use for outdoor non-irrigation purposes. Reported annual average water use from Nov. 2006 to Oct. 2007 = 773 mgd Reported annual average water use from Nov. 2007 to Oct. 2008 = 644 mgd Population of state = 9,544,750[172] Population of 55 counties = 6,465,821 CALCULATION: [773 mgd – 644 mgd] [9,544,750/6,465,821] = 191 mgd Assuming 5% is not landscape irrigation use, adjust = 181 mgd annual average

[66] Georgia population estimates (Census Bureau): http://www.census.gov/popest/states/tables/NST-EST2007-01.xls

State agencies	11	Pollution Prevention Assistance Division. Estimates based on data from BLLIP,[173] some reported water use and assumptions for average water use by state-owned facilities.	Estimate calculated using water use data from the Dept. of Corrections (2002) and the University System of Georgia (2007). Also BLLIP data regarding total sq. footage of property occupied by state agencies was used. State agency reference from the State of Texas was used to estimate water use for remaining agency sq. footage. Dept. of Corrections water use = about 2 billion gal/year; occupied space = about 11 million sq. feet. University System water use = 1.4 billion gal/year; occupied space = 70 million sq. feet Total property owned by the state = 135 million sq. feet (135 mill – 11 mill – 70 mill = 54 mill sq. feet owned by other agencies) Estimated indoor water use by other agency facilities = 12 gal/sq.foot/year[174] CALCULATION: 2 bill gal/year + 1.4 bill gal/year + [(12gal/sq.foot)(54 mill sq.feet) = 648 mill gal/year] / (365 days/year) = 11 mgd

[173] For information, go to www.realpropertiesgeorgia.org

[174] Value derived as an average from the range of water use per square foot of office space documented in the Texas State Energy Conservation Office. "Suggested Water Efficiency Guidelines for Buildings and Equipment at Texas State Facilities." SECO/CPA June 2002. http://www.seco.cpa.state.tx.us/waterconservation.pdf

Appendix B

Process of Developing the WCIP

The WCIP is the result of many individuals volunteering their time, expertise and information. The development process was open to water users and water use sector representatives. Georgia EPD, with essential assistance from other state agencies,[175] coordinated input from volunteers. The process succeeded with wide participation by concerned citizens and activist groups, industrial and commercial facility managers, power producers, water providers, environmental groups, farmers and agri-business representatives, landscape professionals and others.

The SWP calls for the DNR to develop a WCIP with assistance from stakeholders from multiple water use sectors. Georgia EPD coordinated and administrated the development of the WCIP with assistance from other state agencies involved in water planning and research. The planning began in September, 2007 and will continue through public comment period and a final plan adoption in early 2009.

Developing the first draft of the WCIP was an open process, heavily dependent on input and information provided by volunteers representing the diverse water use sectors in Georgia. In May 2007, EPD began soliciting volunteers to help with the development of sector-specific elements of the WCIP. After an initial orientation meeting, volunteers self-assigned themselves to "sector teams" to discuss water conservation opportunities. Each sector team discussed water conservation within a particular water use sector and included between 10 to 45 team members. A full list of the individuals involved in the development process is available in the Acknowledgements section on page 11.

The sector teams were lead by "team leaders" from state agencies involved in water planning and research. The team leaders conducted and compiled initial research on state-wide water conservation programs to serve as a starting point of discussion within their sector team. Team leaders engaged the volunteers, collected ideas, data and feedback from volunteers, and provided technical assistance to EPD throughout the drafting process. Team leaders included:

- Deatre Denion, Georgia Department of Community Affairs – Domestic and non-industrial public uses
- Gil Landry, University of Georgia Urban Agriculture Center – Landscape irrigation
- Dan Loudermilk, Pollution Prevention Assistance Division – Industry and commercial uses
- Chuck Mueller, Georgia Environmental Protection Division – Electric generation and use

[175] The state agencies who contributed staff time and expertise to leading the developing the WCIP include the Environmental Protection Division (EPD), the Department of Community Affairs (DCA), the University of Georgia (UGA), and Pollution Prevention Assistance Division (P2AD),

- PJ Newcomb, Georgia Environmental Facilities Authority (formerly with Pollution Prevention Assistance Division) – State agencies
- Mark Risse, University of Georgia Biological and Agricultural Engineering – Agricultural irrigation
- Clint Waltz, University of Georgia Crop and Soil Sciences – Golf course irrigation

The team leaders compiled their initial research into strawman material. The strawman material included "best in class" conservation strategies originating from successful conservation-related programs, incentives, legislation and policies from Georgia and around the country. Programs investigated included, but were not limited to, Arizona, California, Florida, Texas, North Carolina, and, Massachusetts, as well as Australia. The strawman material for each sector was structured similarly, with ideas for water conservation goals, benchmarks, and practices for their sector and the rationale for inclusion. Over the course of 3 months, sector teams reviewed and revised the strawman material through meetings, teleconferences, or e-mail discussions coordinated by the sector team leaders. EPD also developed a webpage to house resource material to support WCIP development.[176] EPD hosted two public meetings in May and August 2008, to help volunteers understand the progress and to present the opportunity to ask questions or make comments on the material being developed.

From September to November 2008, EPD worked with a technical writer to compile and consolidate a comprehensive Draft WCIP. A preview of the Draft WCIP was distributed to sector team members in early December 2008. From mid-December 2008, to late January 2009, EPD solicited and accepted public comments for 45 days. Public comments were submitted by the public primarily through an interactive website (www.GeorgiaWCIP.org) that was developed to organize comments on the different chapters of the WCIP.

After the public comment period, EPD utilized the expertise of the team leaders to help respond to technical questions and comments. Revisions to the Draft were made and a summary of responses was compiled in a companion document. A final WCIP was completed in May 2009.

EPD is greatly appreciative of the time, expertise, and energy expended by all of the team leaders and volunteers. The elements of the WCIP are immensely stronger and more practical as a result of their participation than they otherwise would be.

[176] For a copy of the resource material, visit http://www.ConserveWaterGeorgia.net

Appendix C

References used to develop Chapter 4, Conserving water used by Golf Courses

The references listed below were used to develop the Golf Course Chapter. For additional references visit www.GeorgiaTurf.com and follow the "Environmental and Water Issues" link to the "Water Conservation and Use-Efficiency" page.

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Appendix D

Sub-sectors of industrial and commercial facilities addressed in the WCIP

The following sub-sectors are considered a part of the industrial and commercial water use sector addressed by this chapter of the WCIP. They are identified using the North American Industry Classification System (NAICS) and are accompanied by a brief introduction to each.

NAICS 21: Mining

Mining is the extraction of valuable minerals or other geological materials from the earth, usually from an ore body, vein or (coal) seam. The primary industries in Georgia under this sub-sector include granite and rock quarries and kaolin mining.

NAICS 23: Construction Sector

The construction sector ranges from large-scale projects, including buildings and manufacturing facilities, down to single-family residential construction.

NAICS 311: Food Manufacturing

Food manufacturing includes the processing of farm products (poultry, eggs, beef, pork, etc…) into food for wholesale or retail distribution. Poultry and egg products are the dominant foods processed in Georgia. Farm practices for the food industry will be addressed under the agricultural chapter.

NAICS 313: Textile Mills and
NAICS 314: Textile Product Mills

Georgia contains one the highest concentration of textile manufacturers in the United States. The vast majority of textile manufacturing capacity is centered near Dalton, Georgia in the northwest quadrant of the state.

NAICS 321: Wood Product Manufacturing and
NAICS 322: Paper Manufacturing

The state of Georgia is one of the leading manufacturers of pulp and paper in the United States.

NAICS 325: Chemical Manufacturing

The chemical manufacturing sub-sector formulates products from organic and inorganic raw materials by chemical processes. “Basic Chemicals” comprise the first industry classification under this sub-sector, and is concerned with producing the raw materials. These materials are further processed into intermediate and end products, by the other industry groups in this sub-sector.

NAICS 326: Plastics & Rubber Products Manufacturing

Industries in the plastics and rubber products manufacturing sub-sector make goods by processing plastics and raw rubber. Plastics and rubber are combined in the same sub-sector because plastics are increasingly being used as a substitute for rubber; however, this sub-sector is generally restricted to the production of products made of either solely plastics or rubber.

NAICS 327: Nonmetallic Mineral Product Manufacturing

The nonmetallic mineral product manufacturing sub-sector includes establishments that manufacture products such as bricks, refractories, ceramic products, glass or glass products (such as plate glass and containers), cement or concrete products, lime, gypsum, abrasive products, ceramic plumbing fixtures, statuary, cut stone products, and mineral wool. The primary industries in Georgia under this sub-sector include granite and rock quarries and kaolin mining.

NAICS 332: Fabricated metal product manufacturing;
NAICS 333: Machinery manufacturing;
NAICS 335: Electrical equipment, appliance, and component manufacturing; and
NAICS 336: Transportation equipment manufacturing

These sub-sectors are the least water-intensive industries in this sector and as such will be encouraged to adopt the basic practices that apply to any facility for efficient water use. Many of the practices adopted for Domestic and Non-Industrial Public Uses, Chapter 7, will also apply to these sub-sectors.

NAICS 42, 44 & 45: Wholesale trade and retail trade

These sectors include many commercial businesses in Georgia, and will be encouraged to adopt many of the practices developed for Domestic and Non-Industrial Public Uses, Chapter 7. Specific practices may be developed in the future if new data uncovers niche operations that have high water use.

NAICS 54: Professional, scientific, and technical services

These operations should be addressed in Chapter 7 – Domestic and Non-Industrial Public Uses.

NAICS 56: Administrative and Support and Waste Management and Remediation Services

These operations should be addressed in Chapter 7 – Domestic and Non-Industrial Public Uses.

NAICS 62: Health care and social assistance

This sector includes many commercial businesses in Georgia, and will be encouraged to adopt many of the practices identified in Chapter 7 – Domestic and Non-Industrial Public Uses. Specific practices should be developed for Hospitals and Medical facilities that use specialized equipment that have significant water use such as laboratory equipment. Additional practices may be developed in the future if new data uncovers niche operations that have high water use.

Appendix E

Examples of best management practices that can be distributed as educational material to homeowners and businesses

The following are simple landscape Best Management Practices (BMPs) that homeowners and businesses may adopt. They range from planning a water-efficient landscape to daily and seasonal landscape management practices.

- The first step when planning a landscape should be to test the soil. A soil test will tell how to improve the soil quality so as to enhance nutrient uptake by plants, water infiltration and retention. Soil testing is available through the local county Extension office, some retail garden centers and reputable soil testing labs. To locate a Cooperative Extension county office, visit http://www.caes.uga.edu/extension or call **1-800-ASK-UGA1**.
- Explore alternative ways of obtaining water for irrigating plants, such as rainwater harvesting and storage, collecting air-conditioner condensate, and rain gardens.
- Have an irrigation audit performed by a professional to maximize the efficiency of the existing irrigation system.
- When selecting plants for any landscape, choose plants that will thrive in the conditions of the particular landscape area they will be placed. Document the water and sunlight needs of the plants, and group plants with similar needs together in the landscape. Each group of plants can receive the amount of irrigation they require, and no surplus.
- Amendments, such as organic compost, added at the manufacturer's recommendations, will improve the physical and chemical properties of the soil. These amendments help the soil hold water and improve water and nutrient movement throughout the soil. This results in a healthier plant environment that requires less water, fertilizer, and pesticides and allows easier root development and fewer soil-related problems during plant establishment.
- If soil amendments are not feasible, tilling clay soils will increase water infiltration and air space, and lead to quicker establishment and increased root growth.
- For trees and ornamentals, apply 2 inches (bark or compost) to 4 inches (pine straw) of mulch on the soil surface after planting. Mulch not only conserves moisture, it also maintains a uniform soil temperature and reduces weeds which compete for light, water and nutrients. The roots of established trees and shrubs extend two to three times their canopy spread, so mulch as large an area as possible to trap the maximum amount of moisture in the soil. Maintain an average mulch depth of 2 to 4 inches by adding 1 to 3 inches of additional mulch each year, depending on mulch type.

- Watch for moisture stress symptoms before deciding when to irrigate. An abnormal gray-green color or obvious wilting is a good indicator that a broadleaf plant needs moisture. ***Confirm*** this by digging a small hole to see if the soil is wet, moist, or dry. Watering plants only when they require it will result in a deep, strong root system that preconditions the plant to tolerate dry periods.
- The best time to irrigate is at night or early morning (9 P.M. to 9 A.M) to conserve moisture and to reduce evaporative losses of water. Contact the local water provider for authorized watering times.
- When properly planted and managed, turfgrass is more resilient to periodic drought conditions than many people assume. Regardless of drought conditions, allow established turfgrass to dry and become stressed before applying irrigation. Stressed plants will explore deeper soil depths for moisture and nutrients. Periodically (as infrequently as every other growing season) aerate to improve water and air entry into the soil. To encourage deep rooting during periods of heat or drought stress, raise the mowing height to the upper limits of recommended mowing heights. Similarly, during periods of stress, use the lower end of nitrogen fertility recommendations and be sure other nutrients, like phosphorus and potassium, are adequate for turfgrass growth.
- To avoid wasting water, use a hand-held hose, soaker hose or drip irrigation to water trees, shrubs and flowers, especially those planted on slopes. To avoid runoff, apply water gently and slowly at a rate the soil can absorb. When using sprinklers, make sure that the water reaches your lawn and planting beds, not the house, sidewalk, driveway or street. Retrofit your irrigation system with low volume emitters and a rain sensor that will prevent irrigation if moisture level is sufficient.

Appendix F

Example of a "Sustainable Landscape Certification Checklist" that may be used to certify residential and commercial water efficient landscapes

Yard Certification Checklist: Does Your Yard Measure Up?

To be recognized as a "certified" Georgia Green Yard, the new or existing home or commercial landscape must:

• Accumulate at least 36 inches on this Yardstick Checklist.
• Obtain the required minimum number of inches in each category.
• Comply with all existing codes, laws, and ordinances.

Water Efficiently (15 inches possible - 5 minimum)

For a yard that does not use an irrigation system	
The landscape is designed to subsist predominantly on rainfall once plants are established.	15"
For a yard that does use an irrigation system (in-ground or automatic overhead sprinklers or drip irrigation)	
Irrigation system has been audited within the past 24 months.	2”
Irrigation system is designed and installed by an EPA WaterSense partner individual/company.	2”
Installed irrigation system meets or exceeds all local regulations or WaterSmart/ WaterSense standards (in areas without regulations).	2"
Rain shut-off device installed and operational for in-ground irrigation systems.	1"
Innovative irrigation technology (soil moisture sensors, ET controllers, or other automated method) installed to manage irrigation.	3"
Turf and landscape areas zoned separately based on plant water requirements.	2"
Micro-irrigation installed in plant and flower beds.	2"
Irrigation system does not water hardscape surfaces.	1"

Mulch (7 inches possible - 4 minimum)

By-product/alternative mulches used such as pine bark, pine needles, compost, or shredded wood debris.	2"
Mulch is applied correctly to a depth of 2" to 4" (depending on mulch type).	2"
Four-inch clear space left for air between plant bases and the mulch.	2"
Self-mulching areas created under trees where leaves can remain as they fall.	1"

Till/incorporate 2 to 3 inches of organic amendment (compost) to a depth of 6-8 inches.	2-3"

Recycle (7 inches possible - 1 minimum)

All of removed topsoil was saved and reused on existing site.	1-2"
50% of cleared material reused for mulch/landscape.	1-2"
The homeowner utilizes a compost bin to dispose of/reuse yard waste.	1"
Off-site salvage materials or remanufactured materials used to construct landscape features such as retaining walls, paved areas, decks, gazebos, trellises or furniture.	1-2"

Wildlife (4 inches possible -2 minimum)

Non-invasive plants, vines, shrubs and trees planted to provide cover, nesting areas or food sources for birds, butterflies and wildlife.	1-3"
Water source provided for wildlife such as a small pond, fountain, or bird bath.	1"

Right Plant Right Place (24 inches possible - 12 minimum)

Landscape does not contain invasive plants identified as Category 1 or Category 1 Alert by the GA-EPPC.	2"
Trees and shrubs used to shade the eastern and western walls of a home/building and the area surrounding air conditioner compressor.	1"
Deciduous trees used on southern exposures to allow the sun to passively heat the home in winter.	1"
Wind resistant trees planted in areas where falling trees could impact the home/building.	1"
Native plants that are water efficient are preserved during building construction and included in landscape. (Tree protection zones maintained during construction)	1-3"
Credit for heritage trees, trees with greater than 4"dbh (diameter at breast height), groups of trees, and native shrubs and groundcovers.	1-3"
Plants selected for the yard are suited for site conditions, reducing the need for water, fertilizer, pesticides, and pruning.	1-3"
Amount of turf area is appropriate for the site. Low maintenance groundcovers, shrubs and mulch installed in remainder of yard. Turf avoided in shady areas. Turf area complies with local regulations.	1-3"
Evenly shaped turf areas with no turf on steep berms or in long, narrow areas (less than 4' wide).	2"
In wildfire prone areas, low flammability plants installed. Minimum 30' of defensible space present around home or building.	1-3"
Plants installed at least 2'-3' from the foundation and roof overhangs.	1"
Georgia Green Industry BMPs followed for landscape installation.	1"

Fertilizing (9 inches possible - 2 minimum)

Soil tested for pH, lime requirements, and soil fertility. Testing of soil water infiltration rates also recommended. Results provided & explained to the buyer.	1-2"
Soil amendments used to improve selected areas for landscaping (if needed).	2"
Measures were taken to avoid unnecessary soil compaction during construction.	2"
Controlled-release fertilizers used as needed (preference for CR over soluble forms)	1”
Cultivate any previously compacted areas to increase porosity.	1"

Stormwater Runoff (12 inches possible - 5 minimum)

Show that best management practices for erosion control were followed during construction.	2"
Downspouts and gutters have been directed to drain onto the lawn, plant beds, or containment areas. Outfall must be 2+ feet from foundation.	1"
Swales, terraces and/or rain gardens created to catch and filter stormwater.	1-2"
Storage provided for harvested water in a rain barrel, cistern or above ground tank.	1-2"
Underground distribution tanks installed to collect stormwater.	2"
Mulch, bricks, flagstones, gravel, or other porous surfaces used on walkways, patios or drives.	2"
All rain and storm water drains away from the building foundation using legal drainage conveyance systems on-site	2"

On the Waterfront - Seashore, Canals, Ponds, Lakes, Rivers (9 inches possible - 2 minimum if applicable)

Invasive exotic aquatic plants removed or not present.	2"
A border of low maintenance plants established between the lawn and shoreline/seawall to absorb nutrients and provide wildlife habitat.	2"
Native vegetation planted along part or the entire littoral zone in front of the seawall or along the shoreline. (May require permit or SSL authorization.)	1-3"
Clean, native limestone rock (rip rap) placed in front of the seawall to decrease wave action and increase habitat. (May require permit or SSL authorization.)	2"

Yard Care (8 inches possible - 5 minimum)

For yards where a homeowner association or contractor provides yard maintenance

Language in homeowner association covenants or legal contracts requires landscape maintenance contractors to follow Georgia Green Industries Best Management Practices for:

- o Operation and maintenance of the in-ground irrigation system
- o Mulching, mowing, and pruning of turf and plants

o Fertilizing

o Pest control including Integrated Pest Management (IPM).

Points awarded for requiring that landscape maintenance contractors be certified per accepted terminology in the WCIP. Extension staff can assist in providing language for covenants and contracts.	1-6"
Homeowner association covenants allow backyard composting (if applicable).	1"
Homeowner association covenants allow residents to have yards with no turf.	1"
For a yard where the homeowner is responsible for maintenance	
Owner provided with a copy of the as-built irrigation plan, operating manual, and instructions on how to operate the irrigation system's timers/controllers.	2"
Educational materials provided to owners on wildlife present in subdivision.	1"
Educational materials and/or workshops provided to owners on recommended Georgia Green Yard practices:	
o watering	1"
o mowing (including grasscycling), mulching, and composting	1"
o maintenance of shrubs and trees including pruning	1"
o pest control including integrated pest management (IPM)	1"
o fertilizing methods	1"
o stormwater runoff	1"

Extension staff can provide assistance with educational materials and workshops.

TOTAL INCHES --- ________

Remember, to be recognized as a “certified” Georgia Green Yard, you must have at least 36 inches totaled from this Yardstick Checklist.

Appendix G

Calculating Indoor and Outdoor Water Uses

This appendix describes one method of calculating both indoor and outdoor water uses. In simple terms, this is the residential winter water demand divided by the population served.

Population Served:

Decennial Census data are typically available at least a year or so after the April count day. These data are provided with a high degree of detail. Data should be used to calculate the service population. Service areas usually do not follow jurisdictional lines, so census block data should be considered the best available data point. This service population number can then be expressed as a percent of county (or counties) population. The Decennial Census can also assist in estimating the number of persons using private wells in the service area.

Annual Census Estimates for July 1 are normally available in April of the following year, but only on a county basis (no census tract or block data are provided). Estimates also may be available from the Georgia Regional Commissions, formerly known as the Regional Development Centers.

Calculation of Population Served in January (the assumed reporting month): The prior year data will not be available at this time. To create a current estimate, take the county population of two years back and increase it linearly, reflecting history. Then adjust for proportion of service population to county population and number persons on private wells.

Residential Water Consumption

Any utility should have a break-out for all residential consumption (e.g., single family, apartments, group quarters). This number would include dormitories and penal institutions, but not facilities with transient residents, such as hotels. If the former are dominant, e.g., in Athens or Reidsville, this number warrants further review. Also, bi-monthly billing should be discouraged.

Indoor Water Demand

Indoor water demand should be the demand during the months of lowest consumption, which are usually the winter months of December, January and February.

To judge indoor consumption, one should calculate the monthly winter demand from water pumped to the system using residential billings and commercial billings. This data should be available for several years, and should be examined for aberrations. Billing data often is based on a 4-week meter reading cycle that can easily distort data. It is not always obvious where the extra week per quarter shows up. Water pumped data is date specific. Having all three data sets allows some judgment on data selection. Calculating the winter versus average ratio is the most reliable number for calculating indoor use.

The final per capita calculation is trivial; however, differences in 3% to 5% range should not be surprising.

Summary:

1. Population: Use Decennial Census data for accurate service population assessment. Update these numbers annually with either the U.S. Census or Regional Commission estimates.
2. Water Use: Use billing data for all residential uses on an annual basis to calculate year-round average monthly residential demand per capita.

   Calculate winter/ average monthly ratio for water pumped, residential and commercial accounts to judge data and select most appropriate data set. This selection will be system specific and should not be prescribed. This calculation also gives the outdoor demand as the difference between annual average and indoor demand. Ideally, both indoor and outdoor numbers should be reduced.

Appendix H

Examples of conservation-oriented rates

The following examples of conservation-oriented rates include discussions of “base rates”. This term refers to the base price charged for a standard volume of water a household uses, and the investment needed to treat and deliver that water (derived from aggregate estimates or individualized usage). The base rate is usually set during winter months when water usage is almost exclusively indoor use. These four examples of conservation-oriented rates should be assessed to determine the most appropriate rate structure for your service area.

Uniform rate plus seasonal surcharge for high usage.

A uniform block rate is a commodity rate that does not vary with the amount of water use. A uniform rate plus seasonal surcharge focuses on conservation in peaking and average use system-wide. All residential customers pay a base charge, plus a uniform rate for each 1000 gallons of water used. Over a certain level of use, the surcharge is applied and the user pays a higher rate per 1000 gallons over the set level of use. Typically this surcharge takes effect in warm-weather months (May, June, July and August). It is the easiest method to implement, and can encourage businesses and industry to reduce their use during seasonal peaks and thus extend the capacity of existing assets. Well-designed uniform rates that reflect the full cost of providing water service can sometimes be very effective in sending price signals to customers. This type of rate structure is also simpler and therefore easier to work with in terms of revenue predictions etc., than more complicated rate structures.

Inclining Block Rate Structure.

Inclining block rate is a commodity rate whose unit price increases with increasing water use. This option targets conservation at peaking and average use within customer classes. All customers in the same class (residential, commercial, industrial etc.) pay a base rate per unit of water used, under a certain threshold of water use. For any use above the set threshold, a higher rate per unit of water used is charged. Additional volume blocks can be defined in which higher rates are charged. The inclining block for residential customers may be different from of the structure used for commercial and industrial customers. This option can target high volume users better than using individualized rates; it is effective throughout year; and it works best when customer classes are fairly homogenous. Three or more pricing tiers are recommended.

Individualized rates (also known as water budget-based rates).

Individualized rates, also known as water budget-based rates, are a version of inclining block rates in which the blocks or tiers are determined for each customer by the customer’s usage history, and are usually set based upon the quantity of occupants and the square footage of landscape. It targets individual customers' peaking and average use. The first block/tier is generally set based on the customer's usage during the winter months and is typically re-evaluated annually. Individualized rates can encourage conservation even at the lower volume range. Potential drawbacks are that software modifications may be more extensive than for other methods, and individuals can artificially raise their winter average to gain a higher block/tier structure. Also, this option may not successfully capture high-end water users.[177]

Lifeline Rates.

This option applies to a provider using the inclining rate structure, but adds a volume block lower than the base volume block (for example, 0 – 3 CCF or 0 – 2000 gallons). It thus provides relief for low-income customers. Low-income households are charged lower rates on that portion of water consumption that provides basic needs for cooking and cleaning but then higher charges are levied on water consumption beyond that amount. The difference in revenues must be made up in the remaining blocks. Lifeline rates could apply to all customers regardless of income levels unless a process is developed to identify and maintain a database on low-income users.

Hybrid Rates.

A conservation rate structure may use a combination of the above listed rate structures. An example would include having an inclining block rate structure with a summer surcharge. Additionally, an analysis of the customer class consumption may show a need for different conservation rate structures for different customer classes.

Customers need to be given the message that they should be prepared to pay more for water, even if their use decreases. Water has historically been a very small percentage of the average household's expenses. But, as rates increase, the proportion of a household's income spent on water will become more significant. Since water is such a basic need, the affordability for low income customers must be considered. In addition to considering the "lifeline rates" discussed above, utilities should be able to at least refer low-income customers to assistance programs, whether these be local churches and charities or government human services programs.

Regardless of the rate structure, small but frequent rate increases are generally a good practice. Mustering the political will to approve these rate increases can be a challenge. There are a few examples of utilities in Georgia where the local code allows for automatic annual rate increases. Other utilities have surcharges that go into effect automatically when certain conditions are met. These provisions allow for the financial stability of the utility.

[177] For more information on water budget based rates, visit http://www.allianceforwaterefficiency.org

References were used in the development of Appendix H:

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