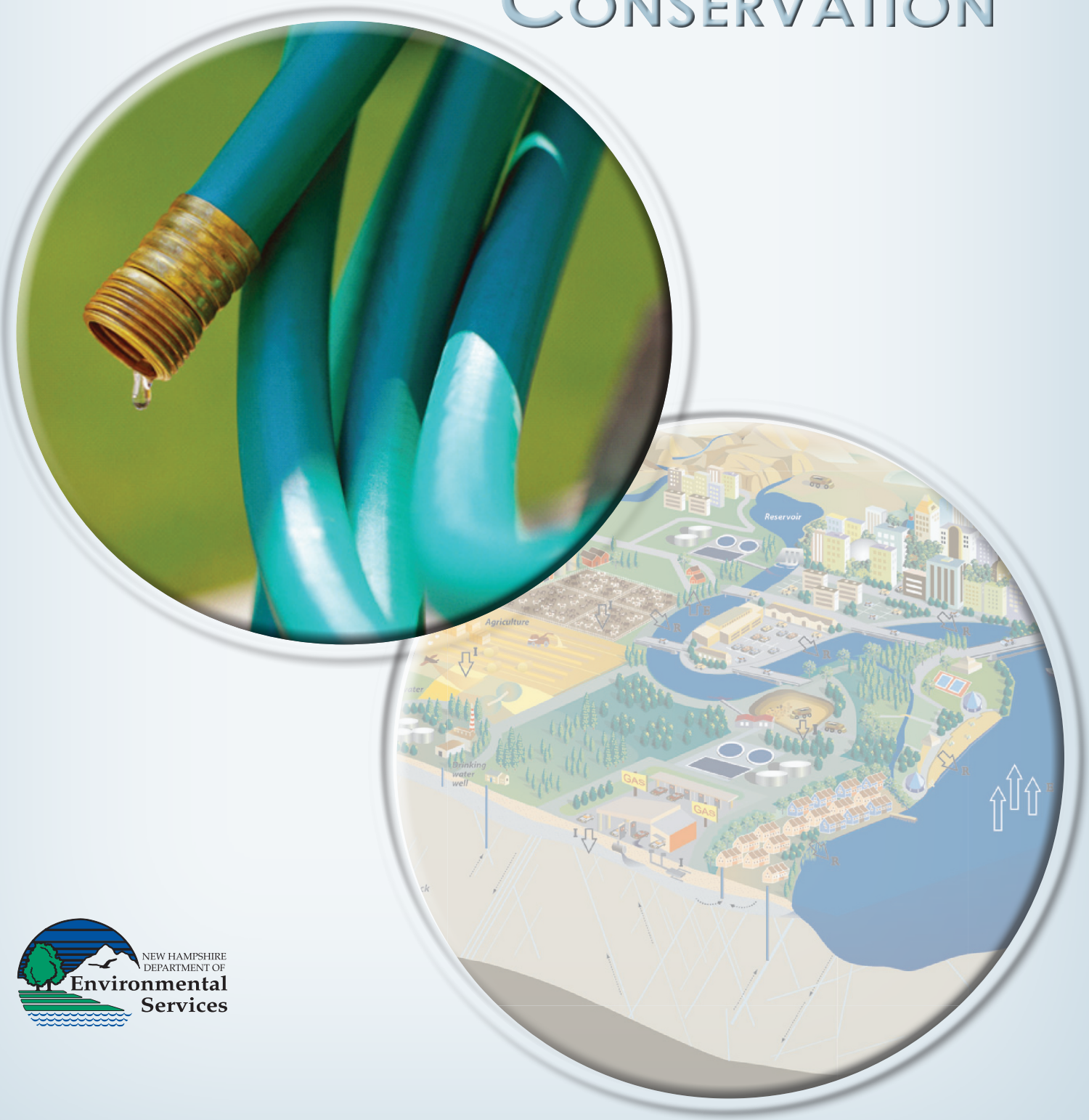
Chapter 7
Water Use and Conservation



NEW HAMPSHIRE
DEPARTMENT OF
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Services

Overview

New Hampshire is relatively water rich, yet using water efficiently is an important element of ensuring the sustainability of our water resources. Water use in New Hampshire continues to grow to support a growing population and economy. The per capita residential consumption of water has increased due to discretionary uses such as lawn watering. At the same time, climate change and an aging, leaking infrastructure put pressure on water availability.

7.1 Description and Significance

7.1.1 Water Use

Water use includes elements such as water withdrawals by public water systems and private water users, consumptive use, wastewater discharge, the reuse or reclaiming of wastewater, return flows, and in-stream uses such as hydropower, recreation and aquatic habitat. In a narrow sense, water use refers to water that is actually used for a specific purpose, such as for domestic use, irrigation, or industrial processing. Water use is generally divided into two types: consumptive and non-consumptive uses.

Consumptive use represents water that evaporates, transpires, is incorporated into products or crops, is consumed by humans or livestock, or otherwise removed from the immediate water environment thereby making that amount of water unavailable for other potential users. Consumptive water use occurs when water is withdrawn or diverted from a ground- or surface-water source for public water supply, industry, irrigation, livestock, cooling for thermoelectric power generation, mining, and domestic purposes. Non-consumptive water use occurs when the water remains in or is immediately returned to the location in a stream or aquifer from which it was extracted. For example, hydroelectric power generation is considered to be a non-consumptive use of water.

How New Hampshire Uses Water

The ways in which water is used in New Hampshire have expanded since the native Americans and then colonists used waterways for transportation, fishing and hunting. In the late 1700s grist mills and sawmills began utilizing hydropower, which was harnessed on a much larger scale in the 1800s. The 1900s saw the increasing importance of domestic water use, drinking water, landscaping, industry, beverage manufacturing, recreation, and environmental protection. While studies have projected future water demands for New Hampshire based on current development trends, additional potential uses of water associated with new activities have not been assessed.

Based on an estimate made by U.S. Geological Survey (USGS) for water use in New Hampshire for the year 2000, New Hampshire uses approximately 211 million gallons per day (Hutson et al., 2004). This figure excludes approximately 236 million gallons per day of freshwater that is used at thermoelectric plants where water is generally not consumed and is returned to the location from which it was extracted. Of the 211 million gallons of water that is used, 127 million gallons

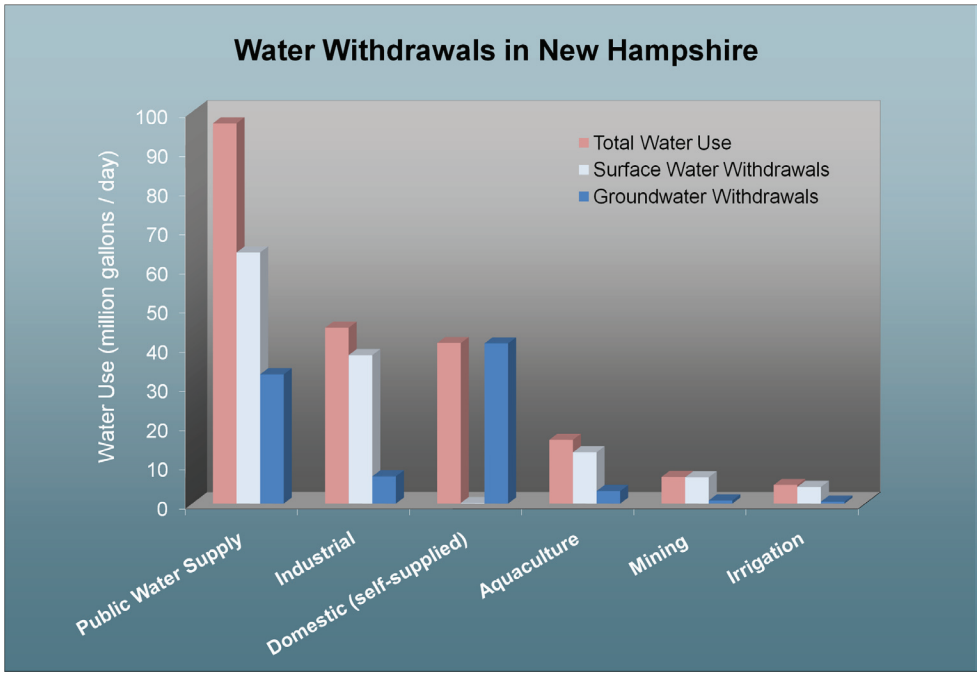

Figure 7-1. Water withdrawals in New Hampshire. ***Source: Hutson et al., 2004; NHDES, 2008a.***

per day (60 percent) is extracted from surface water and 84 million gallons per day (40 percent) is extracted from groundwater. Public water suppliers that provide water to homes, businesses and institutions are the largest users of all water and of surface water in the state. Cumulatively, domestic water users self-supplied with water obtained from private wells represent the largest use of groundwater in New Hampshire (Figure 7-1).

A detailed assessment of state-wide water use is currently being conducted. As part of a cooperative project with the New Hampshire Department of Environmental Services, the USGS is estimating all withdrawals, transfers, discharges, and consumptive uses of water throughout the state for each census block. These data will be coupled with work the New Hampshire Geological Survey (NHGS) is completing to estimate water availability at the sub-watershed (areas of about one-half of a square mile) level.

7.1.2 Water Conservation

Water conservation is any beneficial reduction in water loss, waste or use. Conservation measures include education that results in modified behavior, installation of water efficient hardware, infrastructure improvements and maintenance, and improvements in water use management and accounting. Efforts to conserve water are spurred by a number of factors including the following:

- Growing competition for limited water supplies.
- Increasing concerns regarding impacts of water withdrawals on other water users and on resources such as stream flows and wetlands.
- Cost and difficulty of developing new supplies.
- Costs associated with pumping and treating water.

- Costs associated with conveying, treating and discharging wastewater.
- Desire to delay or reduce capital investments for expanding the capacity of a water system.
- Desire to avoid developing less desirable sources of water that will require expensive treatment.
- Growing public support for the conservation of limited natural resources and overall environmental protection.

DES has summarized water conservation techniques for the largest users of water in the state through a series of fact sheets (New Hampshire Department of Environmental Services [NHDES], 2008b). Some of these techniques are highlighted below.

Water Conservation in the Home

A report studying water use in 44 New Hampshire Seacoast communities found that 72 percent of all water use was for household purposes (Horn et al., 2008). The study estimated the average per capita domestic water use to be 63 gallons per day during the winter months, representing indoor water use.

Domestic plumbing fixtures and appliances affect the amount of water utilized in a home. The 1992 U.S. Energy Policy Act (EPAct) established efficiency standards for water fixtures beginning in 1994. Fixtures manufactured before the effective date of the EPAct generally use 20-50 percent more water than new fixtures. Additionally, advances in technology have made available more water-efficient dishwashers and clothes washers, although lack of federal standards for these allowed water-inefficient appliances to remain on the market. The federal Energy Bill that passed in 2007 establishes water efficiency standards for dishwashers and clothes washers effective in 2010 and 2011 respectively.

A national residential indoor water use study completed in 2000 compared water use in non-conserving and conserving homes (U.S. General Accounting Office, 2000; Vickers, 2001). The national study revealed that indoor water use in a conserving home averaged 45.2 gallons per capita per day, while use in a non-conserving home is 69.3 gallons per capita per day. The distribution of and differences in water uses in a conserving versus non-conserving home are shown in Figure 7-2.

Water Conservation Outside the Home

As discussed in Chapter 1 – Introduction and Overview, domestic water use increases dramatically during summer months, primarily to water lawns. The most efficient way to reduce the need for irrigation is to transition from expansive lawn areas to natural landscaping with native or other low water-demand shrubs, trees and other plants. Natural landscaping is also beneficial in maintaining water quality. Clearing less forest and maintaining mature trees around houses provide shade, reduce drying winds, and help minimize energy and water use. By minimizing the area of land requiring irrigation and by landscaping with plants and grass that can resist drought more easily, both maintenance and water demands decrease. Where lawns are to be established, water use can

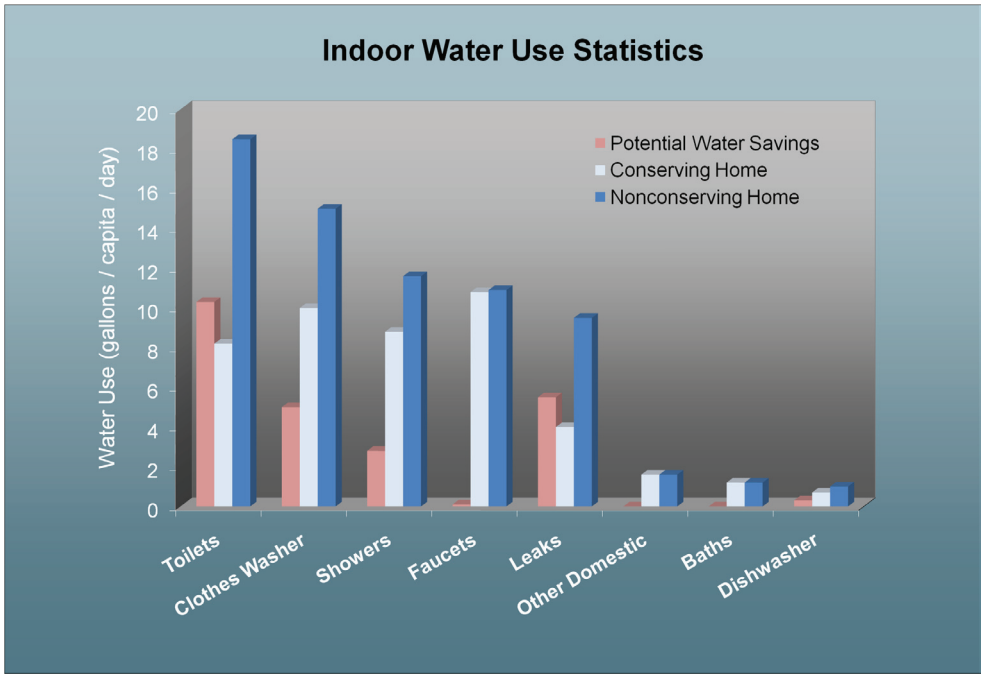

Figure 7-2. Indoor water use statistics. ***Source : U.S. General Accounting Office, 2000; Vickers, 2001.***

be minimized by reducing lawn area, ensuring lawns are established only where there are several inches of top soil, planting conservation ground cover mix, and optimizing watering schedules by utilizing sensors that ensure watering occurs only when necessary.

Public Water System Conservation Measures

In New Hampshire the largest customer of many public water systems is the water system itself via the water it loses through leaks in the distribution system, undocumented uses of water it does not bill for, or by not accounting for all of the water it pumps from sources.

The first step for a public water system owner to take when implementing a water conservation program is to conduct an audit of the system to assess the volume of water pumped from sources compared with the volume delivered to customers. The system owner can then determine the quantity of water pumped into the system that cannot be accounted for due to unauthorized water uses, leaks in the distribution system, or metering errors. The owner may then take measures to reduce unaccounted for water by conducting a system-wide leak detection and repair program, calibrating meters, and identifying and calculating uses of water that are not currently being accounted for. Another important conservation measure that public water system owners can implement is to ensure water customers are billed based on the volume of water that is used. Water use rate structures may encourage water use efficiency through surcharges applied to landscape watering as measured by an additional water meter (if allowed by the local sewer department), or through unit prices that increase as residential use exceeds certain water use thresholds.

An essential water conservation measure for public water systems is establishing an education and outreach program to promote how and why its customers should conserve water. Water systems can offer water audits to residential, industrial, commercial and institutional customers to identify

cost-effective water conservation measures. Water systems can also establish financial incentives such as rebates for customers that invest in conservation measures, for example replacing older high volume toilets with more efficient models.

Water use restrictions are often used during summer months when outdoor water use for lawn irrigation places a high demand on water systems. Enforcing restrictions on outdoor watering can help to alleviate high demand in periods of reduced supply. Encouraging changes in the ways customers use water can help especially in the long term to create a sense of value and efficiency regarding water resources.

Industrial, Commercial, Institutional and Agricultural Water Conservation Measures

Industrial, commercial and institutional water users can perform audits similar to those used to assess households and public water systems. The most common conservation measures in the industrial sector are site-specific engineering modifications to water-using equipment and processes. These modifications may include optimization and recycling of cooling and process water, sequential reuse, improved control systems, and process adjustments. At most commercial and institutional sites, the greatest water savings is generally achieved by reducing irrigation of lawns and landscaping and replacing plumbing fixtures with low-volume toilets, urinals, showerheads and faucets. For agricultural water users, the greatest water savings may be achieved through the choice of crops, optimizing irrigation practices for crop production, and ensuring water is efficiently used for sanitation practices associated with food preparation.

Water Use and Energy Use Are Intrinsically Connected

Although many people today associate energy use with climate change, the relationship between water use and climate change is often overlooked. The pumping, treatment, distribution, heating and cooling of water require considerable inputs of energy. A national expert on water conservation at the EPA has estimated that approximately 3-10 percent of energy use in the United States can be related to pumping, treating, conveying and using water (U.S. Environmental Protection Agency [USEPA], 2008a).

7.2 Issues

7.2.1 Residential Development Patterns and Lawn Watering Lead to Water Supply Restrictions in Many Areas of the State

Outside of New Hampshire's cities, homes and businesses are built on lots that are usually at least an acre and are typically developed with lawns and other landscaping features. Extensive clearing and grading of new lots is now the norm. The maintenance of these manufactured landscapes creates a pronounced increase in water demand during the summer (Figure 7-3). Water use more than doubles in some New Hampshire municipalities that have undergone significant growth in the last few decades.

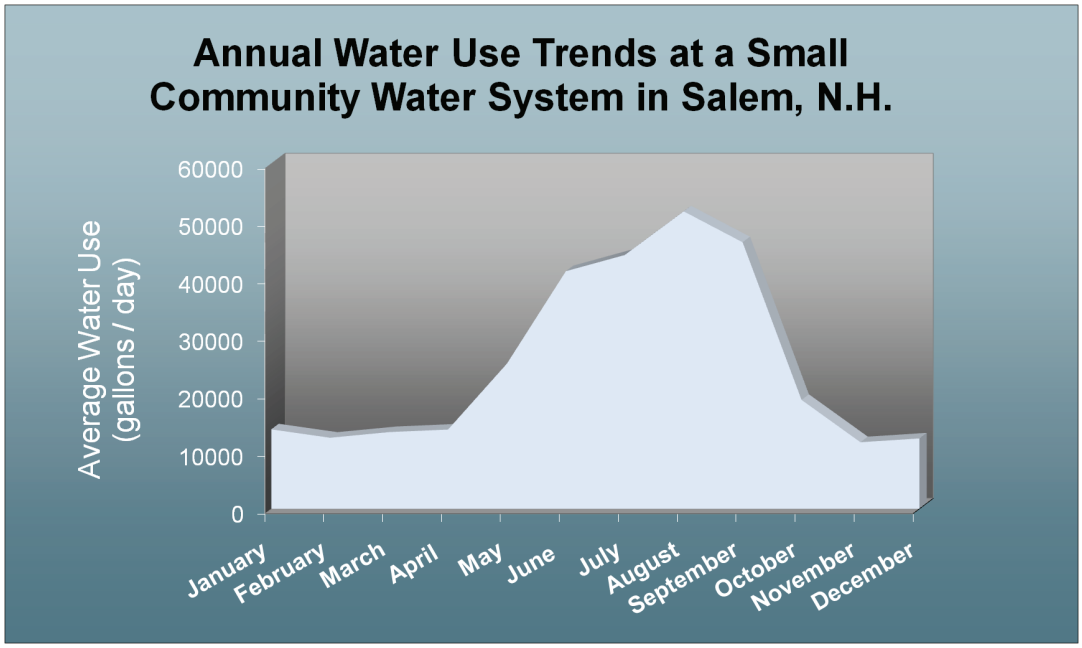

Figure 7-3. Annual water use trends at a small community water system in Salem, N.H. ***Source: NHDES, 2008a.***

In addition to the irrigation issue, today's new homes are typically much larger than in the past, with more bathrooms, hot tubs, dishwashers and garbage grinders that increase water demands. As previously described in section 7.1.2, newer homes have more efficient fixtures than older homes, but the large size of the homes and irrigated grounds more than offset the savings. As land is cleared for home construction, trees are removed and topsoil is often carried away from the lot to be sold. Removing this organically rich soil reduces the lawn's ability to retain moisture and nutrients, creating excess needs for both water and fertilizer. The removal of mature trees increases the lawn's exposure to drying winds and sunlight. All of these factors lead to the increased water demand during the summer months, primarily created by irrigation.

7.2.2 Climate Change

The amount of water used in the summer and fall for irrigation of lawns, crops or golf courses is significantly affected by temperature and precipitation trends. As temperatures increase, so will water use for these activities to offset increased evapotranspiration. Longer growing seasons will affect water use habits, and the increase in intense rainfall events could reduce the potential for rain to infiltrate into the ground, reducing water availability.

7.2.3 Aging Water Systems Increase Water Losses

Leaks can be major sources of water loss in a distribution system, especially in old communities that still have some asbestos cement pipes. Some systems also have water lines at shallow depths due to bedrock. These shallower lines are more susceptible to freezing during colder months. Water systems can elect to "blow off" water by opening an extra valve in the line and discharge water onto the ground to prevent the lines from freezing. With some of the older community systems in New Hampshire, the continuous discharge through these blow-off valves provides a quick fix for a persistent problem. The costs of losing large volumes of water through leaks or blow-off valves may be alleviated by investing in repair or reconstruction of water lines to current design standards.

7.2.4 Lack of Public Understanding of Finite Water Resources

Public support for water conservation is essential in order to reduce household use. Given the plethora of lakes and ponds and the extensive networks of rivers and streams in New Hampshire, it is difficult for the public to see the finite nature of water resources. Nevertheless, the availability of new water sources is diminishing, the cost of treating water from existing sources is climbing, and some water sources are unavailable due to contamination. These facts need to be brought to the attention of the public if they are going to be expected to support water conservation efforts.

7.2.5 Conservation Investments: Lack of Long-Term Thinking

The goal of conserving water in order to save money requires a vision beyond the up-front costs associated with the initial investment in water efficient fixtures and equipment. Because of the initial costs, many businesses and residents are reluctant to undergo retrofits, especially when water is so inexpensive. Water systems may also be concerned about losing revenue if they are unsure about how to implement conservation programs in a revenue-neutral manner.

7.2.6 Conservation Rates: A Difficult Sell

Compared to many other products that people regularly purchase, water is relatively inexpensive. A typical consumer in New Hampshire pays less than a few hundred dollars per year – not even enough to buy groceries for a family for more than a week or two. Yet many residents feel that water should be free. Conservation rate structures, which charge increasing rates for greater water use, can be effective tools in encouraging residential water conservation. However, asking customers to choose between paying more and using less of a product is a difficult case to make. Resistance from customers may present an obstacle to implementing conservation rate structures.

7.3 Current Management and Protection

7.3.1 Water Use Registration and Reporting

The Water Use Registration and Reporting program is a key component of the state's efforts to comprehensively manage water resources. The objective of the program is to gather data on the major uses of the state's water and the demands placed upon individual aquifers, streams and rivers. All facilities that use more than 20,000 gallons of water per day, averaged over a seven-day period, must register with DES. Under the program "use" of water means the withdrawal of water from a source, transfer of water from one location to another, or return of water to the environment. Each withdrawal, discharge or transfer must be accurately measured and monthly water usage for each registered source, destination and transfer is reported quarterly to the NHGS.

Affected uses include, but are not limited to, the following examples.

- Water supply for domestic, commercial, industrial or institutional use.
- Treated or untreated municipal or industrial discharges.
- Contact and non-contact cooling water.
- Water for irrigation and snow making.
- Water used in the production of either electrical or mechanical power.
- Water transferred into and transported in bulk tanker trucks.

The collected baseline information regarding major water uses in New Hampshire is critical for managing water resources in an integrated manner. The information helps provide policy makers, regulators and stakeholders with an understanding of how cumulative water use affects overall demands and water budgets of aquifers and watersheds, which in turn supports the environmentally sound management of industrial, energy and overall development. The program also provides a tool for ensuring compliance with laws, regulations and water rights. Understanding the location, quantity and timing of water used enables DES to determine which water users are subject to laws passed by the Legislature in addition to understanding the many stresses on groundwater and surface waters.

7.3.2 Water Conservation

State Water Conservation Regulations

In 2003 the Legislature enacted RSA 485:61 to establish water conservation standards that apply to:

- New sources of groundwater for community systems.
- New sources of water for bulk and bottled water operations.
- New large groundwater withdrawals.
- New surface water withdrawals that require a water quality certification.

The rules (Env-Ws 390) adopted pursuant to RSA 485:61 require community water systems to develop and implement plans that address items such as metering, water audits and leak detection, estimating unaccounted for water, pressure reduction, rate structures, and outreach to consumers.

Industrial, commercial and institutional (ICI) water users need to replace single-pass cooling (if applicable), modify processes that result in the waste discharge of unused water, and implement appropriate best management practices (BMPs) for the facility. The initiatives and BMPs relevant to ICI facilities must be implemented when an economic analysis yields a payback period of less than four years.

Restriction of Residential Lawn Watering During a Drought

During a state- or federally-declared time of drought for the region, House Bill 457 gives authority to a local governing body of a municipality to limit lawn watering. The bill, passed in 2007, allows municipalities to develop regulations that restrict the use of water from private wells or connections to public water systems for outdoor lawn watering purposes with an obligatory three-day public notice prior to implementation.

Water Efficiency Standards for Appliances and Plumbing Fixtures

The Federal Energy Policy Act of 1992 addressed water conservation by mandating water efficiency standards for indoor water fixtures. In December 2007 federal legislation was signed into law establishing new water efficiency standards for residential dishwashers and clothes washing machines effective in 2010 and 2011, respectively.

The EPA has also developed a program called WaterSense that enables consumers to easily identify water-efficient products that do not sacrifice performance or quality. The program website provides directories of service providers and partnered manufacturers, retailers and distributors of water-efficient products. Similar to the Energy Star program for energy-efficient products, WaterSense endorses water-efficient products using a unique logo (Figure 7-4) (USEPA, 2008b). DES has joined the WaterSense program as a partner and promotes the program within New Hampshire. Water utilities are encouraged to become partners to receive valuable outreach materials that may supplement existing demand management efforts.

Figure 7-4. When using products bearing the WaterSense label, consumers can expect exceptional performance, savings on water bills, and assurance water is being conserved for future generations.

Innovative Water Management Projects

Innovative water use and reuse projects are already being implemented throughout the state. Treated wastewater is currently being used to recharge upper watersheds and to irrigate golf courses. Other projects have evaluated the feasibility of using highly treated wastewater for industrial processes. Lastly, communities are skimming high river flows to artificially recharge and store water in aquifers. DES promotes and has developed technical and regulatory guidance documents for these types of innovative projects (NHDES, 2007). However, these projects are only being pursued where existing water resources are inadequate to supply additional water or provide an appropriate assimilative capacity for additional wastewater discharges.

In early 2006 the Groundwater Discharge Permit Program developed comprehensive guidance for wastewater projects designed to recharge groundwater (NHDES, 2006). The guidance focuses on establishing baseline information needed to determine whether a given site is adequate for groundwater recharge. The guidance also addresses the design and implementation criteria needed to successfully operate and monitor the performance of a wastewater recharge-disposal method.

7.4 Stakeholder Recommendations

This section contains key recommendations that have been developed in concert with a group of volunteer stakeholders that have reviewed and contributed to this chapter.

7.4.1 Improve Per Capita Water Efficiency

New developments need to be designed to reduce outdoor discretionary water uses. Incentives should be created that encourage landowners to convert high water demand landscapes to natural or other types of low water demand landscapes. Additionally, the public should be educated and encouraged to reduce discretionary outdoor watering.

While federal regulations will ensure that new plumbing fixtures and appliances meet existing or new water efficiency standards, over half of the population of the state will reside in homes that predate these federal regulations. Programs should be developed that encourage the replacement of inefficient water fixtures and appliances.

Municipalities should adopt local ordinances to address landscape water efficiency measures. The ordinances may address limits on the amount of turf grass area, utilization of xeriscaping (landscaping that requires little or no irrigation) principles, retaining mature trees, ensuring adequate loam, water conservation controls on in-ground irrigation systems, proper irrigation design, establishment of water budget goals, and limitations on the times during which irrigation can occur. DES is currently developing model water conservation landscaping ordinances to curb the effects of landscaping techniques that result in inefficient uses of water.

7.4.2 Provide Incentives for Community Water Systems

Water systems face the difficult task of promoting something that they fear will reduce revenue. Additionally, investing in water conservation initiatives is generally secondary to investments in capital improvement projects. Water system managers more readily see the benefit of purchasing equipment or developing a water source versus spending funds to reduce water demand. Those water systems that are not required to implement efficiency measures because they are not developing new sources should be encouraged to perform comprehensive water audits to minimize and more accurately account for water use.

Upgrades to systems and hardware for more efficient water use have surprisingly short payback periods and can reduce energy costs for pumping and treatment if less water is lost following system rehabilitation. Making a case for the value of water conservation investments is necessary to reduce excess water use.

The value of saving water goes far beyond the smaller water bills and the extra supply created by conservation. Decreasing excess water use can also provide payback in the form of less stress on the water system and, consequently, less need for repair in the future. Relieving strain on water resources also helps to preserve existing water resources at the current quality and quantity so that an additional source, one in a finite supply set aside for future needs, does not need to be utilized. It is critical that water systems focus on selling less water more efficiently and charging rates that reflect the entire cost and value of water.

7.4.3 Continue Water Use Registration and Reporting Requirements, Fully Enforced and Implemented

Maintaining a database of withdrawal and use statistics for water systems is critical to the state's effective management of water resources. Non-reporting facilities and inaccurately measured uses may require enforcement. It is crucial that the Water Use Registration and Reporting Program be fully implemented over time.

7.4.4 Develop Innovative Water Resource Projects

Water resource projects should be promoted to: 1) skim high river flows to artificially recharge aquifers; 2) reuse highly treated wastewater in industrial settings to recharge upper watersheds; and 3) re-use treated graywater to irrigate landscaping. Although these projects are technically feasible and reasonable in cost, they are often not the least-cost alternative. However, in the long-term, these types of projects maximize the beneficial uses of water and will improve New Hampshire's quality of life, environment and economy as resources will be preserved.

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