Building Operator *Water* Information Guide

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Water

Introduction

This document is intended to supplement the Water Conservation section of the training workshop. It contains all the material covered in the workshop and supplementary detail. Those who attended the workshop are encouraged to read this manual afterwards to reinforce the principles that were learned.

Goals

The goals of this of this Building Operator Information Guide are to:

- elaborate on why water conservation is beneficial and important.
- provide a basic understanding of the most common water conservation issues related to building facilities.
- discuss relevant maintenance issues.

Consequences of Water Efficiency

- Reduced water use and associated costs.
- Improved quality of equipment and fewer complaints.
- Less maintenance is required.
- Less chance of losing water pressure.
- Less likely to run out of hot water.
- Extended equipment life.
- Could avoid utility rate increases.
- Positive impact on climate change issues.

Water Costs

Water Metering

Water is measured in gallons, cubic feet, or m3:

- 1 cubic foot = 7.48 US gallons and 6.229 Imperial gallons
- 1 m3 = 264.17 US gallons
- 1 m3 = 220 Imperial gallons
- 1 m3 = 35.315 cubic feet
- 1 m3 of water has a mass of 1,000 kg or 2,200 lbs

Water Billing

Combined water and sewer costs usually range from $1.00 per m^3 to $1.80 per m3 ($3.79 to $6.81 per 1,000 US gallons). Sewage treatment charges make up about 50 per cent to 80 per cent of the water charge. Unless an irrigation system has a separate meter, sewage charges will normally be applied even though the water is not processed in the sewer system.

Calculating Water Costs

There are typically four parts to a water bill:

1. A flat fee for water service
2. A fee based on volume of water used
3. A flat fee for sewer service
4. A sewer fee based on volume of water used

Let's take a look at each fee in detail...

1. Flat Fee for Water Service

The flat fee for water service is based on the diameter of the water pipe entering the building.

On a sample water bill, the flat water fee is based on the size of water pipe entering the building:

5/8"	(16 mm) or 3/4" (19 mm)	$15.00
1"	(25.4 mm)	$20.00
1.5"	(38.1 mm)	$30.00
2"	(50.8 mm)	$40.00
3"	(76.2 mm)	$70.00
4"	(101.6 mm)	$100.00
6"	(152.4 mm)	$150.00

2. A Fee Based on Volume of Water Used

Water is priced on a varying scale, depending on the volume of water used. The cost for water used is calculated by adding up the blocks that apply to each building.

Sample Bill

First 80,000 US gallons	$1.65 per 1000 gallons	(First 303 m3 = $0.436/m3)
Next 80,000 US gallons	$1.80 per 1000 gallons	(Next 303 m3 = $0.476/m3)
Next 80,000 US gallons	$1.97 per 1000 gallons	(Next 303 m3 = $0.52/m3)
Next 80,000 US gallons	$2.12 per 1000 gallons	(Next 303 m3 = $0.56/m3)

Next 80,000 US gallons	$2.39 per 1000 gallons	(Next 303 m3 = $0..631/m3)
Above 400,000 US gallons	$2.66 per 1000 gallons	(Above 1,514 m3 = $0.703/m3)

If the main water service is 4" 101.6 mm) in diameter, then a flat fee per billing period of $100.00 would apply.

If 360,000 US gallons (1,362.8 m3) of water was consumed during the billing period, the bill would be calculated as follows:

First 80,000 US gallons	$1.65 per 1000 gallons	80,000 gallons X $1.65/1,000 = $132
Next 80,000 US gallons	$1.80 per 1000 gallons	80,000 gallons X $1.80/1,000 = $144
Next 80,000 US gallons	$1.97 per 1000 gallons	80,000 gallons X $1.97/1,000 = $157.60
Next 80,000 US gallons	$2.12 per 1000 gallons	80,000 gallons X $2.12/1,000 = $169.60
Next 80,000 US gallons	$2.39 per 1000 gallons	40,000 gallons X $2.39/1,000 = $95.60
Above 400,000 US gallons	$2.66 per 1000 gallons	not applicable

Total = $698.80

3. Flat Fee for Sewer Service
The flat fee for sewer service is based on diameter of sewer pipe leaving building.

Sample bill

4"	(101.6 mm)	$20.00
6"	(152.4 mm)	$70.00
8"	(2.3.2 mm)	$100.00

4. Sewage Fee Based on Volume of Water Used
The sewage fee is based on the volume of water used in a building. The fees are divided into blocks, similar to the cost of water in part 2 above.

Sample bill

First 80,000 US gallons	$1.58 per 1000 gallons	(First 303 m3 = $0.417/m3)
Next 80,000 US gallons	$1.73 per 1000 gallons	(Next 303 m3 =$0.457/m3)
Next 80,000 US gallons	$1.88 per 1000 gallons	(Next 303 m3 = $0.497/m3)
Next 80,000 US gallons	$2.04 per 1000 gallons	(Next 303 m3 = $0.539/m3)
Next 80,000 US gallons	$2.29 per 1000 gallons	(Next 303 m3 = $0.605/m3)
Above 400,000 US gallons	$2.54 per 1000 gallons	(Above 1,514 m3 = $0.671/m3)

A building with a 6" (152.4 mm) sewer pipe will pay a flat fee of $70.00 per billing period. If consumption was 360,000 US gallons (1,363) of water in this billing period, the bill would be calculated in the same way as in part 2 above. The total cost for sewage based on the volume of water used would be $670.00.

Total Bill
The total bill for this school for this billing period is:

Flat fee for water service	$100.00
Fee based on volume of water used	$698.80
Flat fee for sewer service	$70.00
Fee based on volume of water used	$670.00
Total bill	$1475.80

Ascending and Descending Fee Structures

Water and sewage fees may be either ascending or descending. In an ascending fee structure, costs increase as water use increases. The sample rate structure listed above is an example of an ascending rate structures. Ascending rate structures encourage water conservation, as customers pay more as the water usage increases.

In descending rate structures, costs decrease as water use increases. Descending rate structures are very common, particularly for large industrial customers that use large volumes of water.

Typical Water Use

- A regular garden hose running for one hour equals about 290 US gallons (1,100 litres) of water.
- A 10-minute shower can use up to 40 US gallons (151 litres) of water.
- An old tank-type toilet uses 4 to 6 US US gallons (15 to 23 litres) per flush.
- A new water-conserving toilet uses 1.6 US gallons (6 litres) per flush

Leaking Fixtures

- A leaking toilet can waste as much as 100 US gallons (400 litres) of water per day and cost $200 per year. The rubber on flapper valves eventually wears, resulting in leaks.
- A dripping faucet could waste 1,300 US gallons (343 m3) of water per year.
- Hot water leakage will also result in additional hot water heating costs.

Use food dye tablets or food colouring to check for leaks in tank-type toilets. Drop one food dye tablet or a few drops of food coloring into the toilet tank. Check the toilet bowl about 20 minutes later. If there is color in the bowl, there is a leak. All fixtures should be inspected regularly for leaks.

Showers

Low Flow Showerheads

Low flow showerheads provide an effective shower with far less water by increasing the water velocity and focusing the spray pattern. This principal can be demonstrated with a garden hose and a nozzle; simply restrict the flow of the water and watch what happens. Cleaning anything is easier with higher velocity water spray.

Efficient showerhead design also results in a narrower spray pattern such that the water is directed on the person and not distributed widely against shower stall walls and adjacent areas.

Typical old style showerheads consume from 3 to 6 gallons per minute (11 to 23

litres/minute), in contrast to a low flow design of 2.5 US gallons (9.5 litres/minute) or less per minute.

Efficient showerhead design includes the following additional advantages:
- The narrower spray cone reduces water spray onto walls, floors, ceilings, and spillage into adjacent areas, helping to prevent additional cleaning, maintenance, and water damage.
- An even spray pattern improves user satisfaction.
- The self-cleaning characteristic results because of the higher velocity water stream. There is less chance of plugging with minerals, thus avoiding subsequent complaints and maintenance problems.

Shower Control Devices

Several automatic shut-off devices are in common use in multiple shower areas:
- spring-type
- infrared
- timers

Regularly check that the control devices are adjusted and functioning correctly. For gang-type showers, each shower should remain on for about 90 seconds. Ensure that automatic shut-off devices have been used wherever possible and are operating properly.

One shower inadvertently left on over a weekend could waste as much as 9000 gallons (2,395 litres) of water and cost up to $50.

Toilets

Flush-Valve Toilets

Flush-valve toilets require regular adjustment and maintenance. Flush-valves that are operating properly will:

- save water
- result in fewer complaints
- reduce spills and flooding

Is the volume and pressure appropriate? Reduce if it is too high. Flush-valve toilets should flush for no more than 4 seconds; if out of adjustment, they could be using too much water – more than 4 gallons.

Tank-Type Toilets

Older 4 to 5 gallon (15 to 19 litre) tank-type toilets can often be retrofitted to save 30 per cent on water use by installing displacement devices. Less water is used but with the same pressure. It is best to test one toilet for each model and evaluate before retrofitting all toilets. In some cases, and for a variety of reasons, water savings devices may not be effective.

The most common displacement devices are:

- toilet dams
- flapper valves with early shut-off devices
- a plastic bottle filled with sand and placed in the toilet tank – this may be a good project for students to try.

When old tank-type toilets or flush-valves need replacement, consider the new water-conserving models. The extra cost usually results in a simple payback within three years or less.

Urinals

Tank-Type Urinals

Tank-type urinals are designed to function on a regular flushing cycle. During periods when restrooms are vacant, the flushing cycle should be reduced to the minimum. This can be achieved by controls such as:

- timers and solenoid valves
- light-switch interlocks
- infrared sensors

The effectiveness of these controls can be assessed by checking by asking the following:
- Is the flushing cycle reduced to the minimum or shut off during non-vacant periods?
- Is the flushing schedule appropriate? Is it too frequent?
- Are there any leaks?

Flush-Valve Urinals
- Flushing duration should last 4 seconds
- Check for leaks
- Regular adjustment and maintenance is required to maintain optimum performance
- Is the water volume per flush too high?

Faucets

Many sinks are equipped with spring-return taps and/or timed devices that help to save water. A typical maintenance checklist includes:
- repairing taps that are not shutting off
- adjusting on time to 5 seconds
- replacing worn springs and parts
- fixing leaks as soon as possible

Faucet Aerators
With faucet aerators, overall water use can be reduced by up to 25 per cent when rinsing hands or dishes. Aerators work on the same principal as low flow showerheads: The area of flow is reduced causing higher velocity and lower volume. Higher velocity flow results in more effective use of less water. Faucet aerators are especially effective where water pressure is high. The flow rate is typically reduced from 3 gallons per minute (11.3 litres) to about 1 gallon (3.75 litres) per minute. Another advantage of faucet aerators is that they tend to smooth the flow of water that can otherwise be quite turbulent. Less water splashes out of the sink, meaning less cleaning is needed.

Hand Wash System
Hand wash systems are often seen in industrial arts shops and consist of a 360-degree spray system with a foot pedal where about five people can wash their hands at one time. These are not efficient if used by less than five people. If only one person is washing his/her hands, a faucet should be used. Check to see if the flow rate can be reduced.

Domestic Hot Water (DHW)

Domestic hot water has two cost components:
1) water and sewer changes, and
2) fuel required to heat the water.

It takes a considerable amount of energy to heat cold water. Reduce the thermostat setting to 140 ºF 60 ºC. Advantages include:

- save on heating fuel costs: the higher the water temperature the more fuel is required.
- reduce waste heat from standby losses
- improve comfort during cooling season
- reduce building cooling load

Domestic Hot Water Safety

Water temperatures above 105 ºF (40.6 ºC) can cause burns to children's hands; there is less chance of burns with a lower temperature. Water that is too hot at the faucets will inevitably be mixed with cold water anyway. Many buildings have thermostatic mixing devices upstream of the faucets in order to automatically provide safe water temperature in restrooms and showers.

Dishwashers

Depending on the configuration, dishwashers may require hotter water. Dishwashers require 120 ºF (40 ºC) water if a chemical sanitizer is used. If no sanitizer is used, the final rinse must be with 180 ºF (82.2 ºC)water, usually provided by a local booster heater.

Pipe Insulation

Often, domestic hot water piping is not insulated. This leads to excess heat loss through the exposed pipe. Pipe insulation will greatly reduce heat loss and allow for a lower hot water heater or boiler temperature setting. Other advantages include reducing excess heat during the cooling season, extra protection against pipe freeze-up, and saving water by reducing the need to run water at faucets until it warms up.

Oversized Systems

Sometimes, domestic hot water systems are oversized. For example, in cases such as schools, systems were originally designed to supply showers that are now used very little, if at all. It is quite common to see elementary schools that never use their showers at all. Junior high schools tend to have higher shower use, but rarely at full capacity.

Consequently, there may be more hot water heaters operating than are actually needed to meet the maximum hot water load. Sometimes systems are equipped with large storage tanks. There have been cases where large hot water storage tanks have been disconnected while existing hot water heaters alone supply the hot water demand. This further saves on standby heat losses from the tank and pump electrical energy.

A Systems Approach

Water conservation initiatives may also save enough water such that the DHW system becomes oversized. Altering one component in a system in order to improve efficiency can result in energy savings opportunities in other parts of the system. A systems approach is a fundamental principle in achieving the most energy savings.

Electric Hot Water Heaters

Electric domestic hot waters typically cost twice as much as natural gas. In addition to all the conservation strategies mentioned above, there are number of possible options to deal with the higher cost of electricity.

- Avoid using hot water during peak demand periods. This minimizes the effect of electrical demand charges, especially if demand charges are high.
- If the capacity or hot water recovery rate* of the water heater is greater than what is needed, consider disconnecting some of the heater elements or reducing the voltage. Most water heaters have dual single-phase voltage capability such as 120 volts and 230 volts.
- Consider converting to a natural gas-fired unit. This can be a viable financial alternative, especially if natural gas lines are nearby and/or if the existing electric unit requires replacement or extensive repair.
- Hot water recovery rate describes how quickly a hot water heater can supply hot water once the existing hot water in the tank has been used.

Water-Cooled Equipment

Occasionally, an older water-cooled compressor is found in buildings. In a once-through system, municipal water is circulated through a heat exchanger and discharged to the sewer drain. The operating costs of such a system are quite high because of the large quantities of water used.

Converting to an air-cooled system usually has a simple payback of three years or better.

For existing systems, the following should be checked:

- Is the water supply actually shut off when the equipment is off? Solenoid shut-off valves can become worn or clogged with minerals and unable to close fully.
- Are there any leaks when the water supply is shut off?
- Is the flow rate correct for the application? If the discharge water is not warm, then too much water is being used. Make adjustments accordingly.

Landscape Irrigation

Lawns need 1 inch (25.4 mm) of water per week. Measure with a can under the sprinkler to see how long it takes to fill 1 inch (25.4 mm) and adjust timers accordingly. Lawns do not need to be watered every day; if there has been no rain, watering every 3 to 5 days is enough. The soil should be almost dry before watering. Soak thoroughly to assist in deep root development and healthier grass. Daily and superficial watering causes shallow roots and weaker grass.

Water in early morning or evening when it is cooler and less windy. This reduces evaporation and minimizes sunburn on grass and plants. Water droplets tend to magnify the effect of the sun's rays, increasing the likelihood of damaging plant foliage. If grass is green, no watering is required.

Irrigation timers can be programmed to automatically start at optimum times and for the correct amount of time.

Taller grass has greater drought resistance; cut grass no shorter than 2 to 2.5 inches (50.8 to 63.5 mm); 3 inches (76.2 mm) is optimum. Grass that has been cut too short exposes roots to the sun and increases water evaporation.

De-thatch and aerate every two years. This reduces water run-off and evaporation. Increased aeration and water infiltration lead to healthier turf.

If sprinklers are observed to be on when it is raining, it can be perceived as wasteful by the public.

Sprinkler Hardware

- Hydraulic efficiency is lost when sprinkler heads are blocked. Therefore, sprinkler heads should be inspected routinely. Any damaged heads should be replaced promptly. Clean regularly to remove mineral deposits.
- Regularly check for leaks in piping system.
- Are there any unnecessary sprinklers?
- Do obstacles block the spray system?
- Sprinklers should be adjusted so that they do not spray on buildings and non-landscaped areas such as pavement and sidewalks.

Grass Fertilizer

- Avoid over-fertilizing. Over-fertilizing can cause grass to turn brown, which can result in the need for increased watering to correct the problem.
- Decreasing nitrogen fertilizer and increasing potassium levels can improve drought resistance.
- Use a time-release fertilizer that does not require immediate watering.

Landscaping Alternatives

Choose Plants Suitable to Climate

For most habitats, there exists an ample supply of superbly designed drought-resistant perennial flowers and shrubs that are well adapted to climate extremes of heat, cold, or drought. These plants are equipped with deep root systems and tough leathery leaves that can tolerate temperature extremes. Once established, they require little maintenance and upkeep and can usually thrive on existing rainfall. Many of these plants can been seen growing wild in city ravines, river valleys and old farmyards. This naturalization is evidence that they can even thrive without any cultivation; no surprise since many cultivated varieties were derived from existing wild species----both locally and from similar environments around the world.

Check with your local garden center or horticultural office for recommended species for your area or other climatic zones. Each climatic zone has plenty of species derived from local wild plants or from many exotic locations around the world that have similar climates to your own.

Xeriscaping

Consider a complete alternative to lawns and grass such as xeriscaping; replacing grass with native ground covers, perennials, and shrubs which require minimal maintenance and are drought resistant.

Perennials Versus Annuals

Annuals, if purchased, are costly and require a lot of water before they become established; every spring, the process must be repeated. Perennials, once established, can last for many years.

Mulching

Mulching is the covering of bare ground with sawdust, wood chips, or partially decomposed compost or plant material. This reduces soil water evaporation, slows weed growth, maintains a more constant soil temperature, encourages a healthy population of microorganisms, and improves overall soil health.

Location of Plants

Plants that require more moisture can be located where there tends to be more runoff. Other plants such as cactus and sempervivum thrive next to a hot, dry, sunny south-facing foundation wall. Shade-loving plants should be placed north of buildings and closer to trees, where there is less exposure to the sun and the temperature is lower.

Compost

Compost greatly improves the water-holding capacity of soil. When it rains, soil with compost absorbs a lot more water, resulting in less run-off, erosion, and flooding. Other benefits include a healthier environment for both plants and microorganisms and less need for chemical fertilizers and insecticides.

A Balanced and Sustainable Eco-System

Developing a sustainable eco-system is possible, even on a small scale such as in a back-yard or school perennial garden. Once plants, soil, and microorganisms reach a balanced condition, there will lessneed for chemical fertilizers, herbicides, and insecticides.

If the soil is rich in compost and organic matter, plants will be vigorous, healthy, and disease resistant. Healthy soil provides natural antibiotics that plants can absorb.

A healthy population of insects and microorganisms will thrive where there is a variety of plant life and sufficient organic matter both in the soil, and as a mulch layer on the surface. Insects such as aphids, which feed on plants, can be quite destructive unless kept under control. The conventional method of killing these plant eaters by spraying insecticide can be self-defeating because insects such as lady beetles and centipedes, which eat plant-destroying insects, will also be harmed or will have no remaining food supply. This may cause them to disappear from the garden. The process of using insecticides will then have to be repeated every year, costing money and causing environmental damage.

A superior alternative is to create a habitat where microorganisms and insects thrive in a healthy and balanced environment: For example, a thriving population of lady beetle and

daddy long leg insects will consume aphids and prevent them from overpopulating, minimizing plant damage while keeping them from getting out of control, eliminating costly and toxic insecticides. Where there is an adequate and stable food supply, predatory insects will reproduce and multiply proportionately. They will over-winter and repeat the process year after year.

A high level of organic matter in the soil is also ideal for earthworms since organic matter is what they eat. Earthworms are key players in the recycling process because of their consumption of decaying plant material, converting it into nutrients that plants can assimilate. A mulch keeps surface soil from cool and moist, further attracting earthworms. Earthworms, in turn, dig a vast network of underground tunnels that aerate the soil, improving water retention and increasing aeration.

A garden with a healthy population of insects and earthworms also attracts birds, which, through their foraging, help to cull larger garden pests including caterpillars, beetles, and slugs. The inevitable scratching and digging that birds engage in also aerates and cultivates the soil.

Other Water-Saving Tips

Cleaning detergents
Select cleaning detergents which require lower temperature water and less water.

Dishwasher and other equipment
Consider booster heaters for dishwashers or specific equipment that requires higher temperature water.

Drinking fountains
Arrange for repair of drinking fountains that do not shut off properly or have leaks.

Water pipes, hoses, and connections
Check all water pipes, hoses, connections, and valves for leaks.

Water Notes:

