WATER LIFE

CANNONDESIGN

CANNONDESIGN SEEKS TO ANALYZE, DEVELOP, AND IMPLEMENT PROCEDURES AND BEST PRACTICES REGARDING WATER USE REDUCTION IN RELATION TO DOMESTIC, PROCESS, HVAC, IRRIGATION AND ANY OTHER WATER SYSTEMS AND USES.

PURPOSE

Climate change has brought energy efficiency to the forefront, but the issue of how to effectively deliver and use clean water has not been adequately addressed. There is currently no standard document that adequately and comprehensively addresses the issue of how to efficiently use water in the design, construction and operation of buildings. For this reason the Water Use Group developed the Water Life document, which is a best practices guide for addressing water use reduction in CannonDesign projects.

RESOURCE CHALLENGES

Less than 1% of the world's fresh water (~0.007% of all water on earth) is accessible for direct human uses. This is the water found in lakes, rivers, reservoirs and those underground sources that are shallow enough to be tapped at an affordable cost. Only this amount is regularly renewed by rain and snowfall, and is therefore available on a sustainable basis.

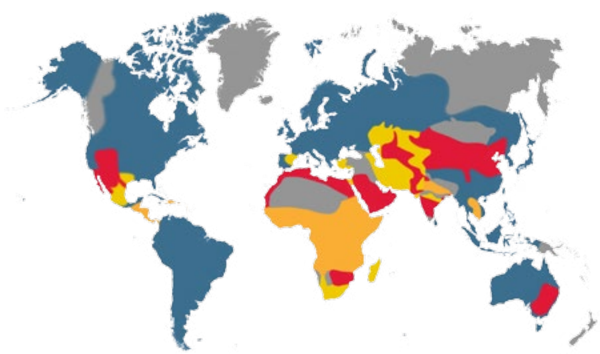
Approximately 41% of the world's population lives in water stressed areas. By 2025, the number of people suffering from water stress or scarcity could swell to 3.5 billion people, or 48% of the world's projected population. Action must be taken to efficiently manage this precious resource.

ENERGY AND WATER CHALLENGES

Energy production requires a reliable, abundant, and predictable source of water. The EPA estimates that approximately 8% of all energy use in the US is directly related to pumping, treating, or heating water.

Electricity production from fossil fuels and nuclear energy requires 19 billion gallons of water per day, accounting for 39% of all freshwater withdrawals in the nation. Producing electricity not only has a carbon footprint, but also a water footprint. Therefore, reducing a building's energy consumption will also reduce the utility's demand for fresh water.

PROJECTED WATER SCARCITY IN 2025



- Little or no water scarcity
- Economic water scarcity
- Approaching physical water scarcity
- Physical water scarcity
- Not estimated

Source: International Water Management Institute

PURPOSE

BUILDING CHALLENGES

Buildings consume 20% of the world's available water. Residential and commercial buildings use 12% of freshwater consumed in the US.

Building water usage will vary from one building type to another. This average water use graph indicates specific areas of consumption for different building types. A reduction in any one of the categories can have a profound effect on overall building water consumption.

As also seen in **Regional Life ▸**, geographical location can affect water use consumption immensely (i.e. rainfall vs. landscape requirements or cooling/heating requirements for a given area), therefore it is a good idea to review climatic conditions for any given project as well.

Every project presents an opportunity to minimize overall water consumption. Establishing water saving goals and determining long term environmental and cost implications can help achieve this goal.

GENERAL WATER USE CHECKLIST

The project team is aware of/understands:

– Central issues relative to water use in buildings

– Landscape regulations and constraints of the project site

– Baseline water use for the building type

– Water efficient systems:
  – Plumbing
  – HVAC
  – Process equipment
  – Food service

– Water efficient processes:
  – Operation and maintenance
  – Metering and sub-metering processes

AREAS OF OPPORTUNITY DISCUSSED IN THIS GUIDE INCLUDE:

– **Plumbing ▸**

– **HVAC ▸**

– **Process Equipment ▸**

– **Food Service ▸**

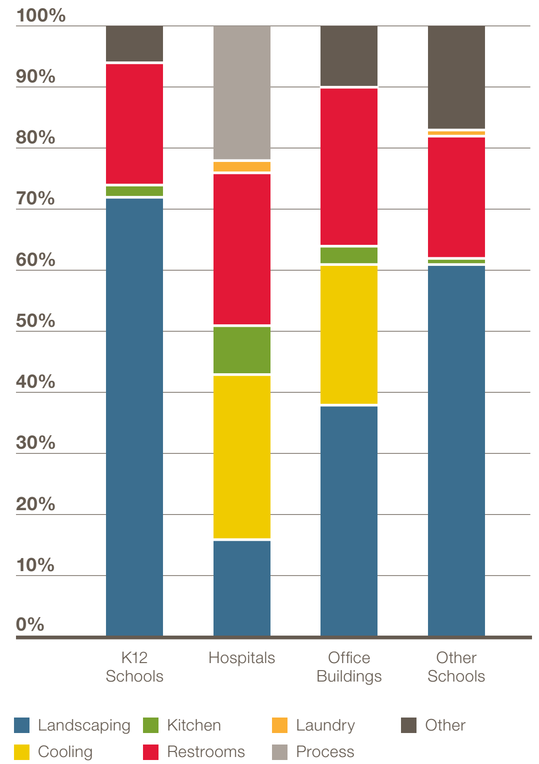
– **Operations and Maintenance ▸**

– **Metering and Submetering ▸**

– **Landscape and Site ▸**

– **Cities and Water ▸**

WATER USE DISTRIBUTION



Source: http://www.pacinst.org/reports/urban_usage/appendix_e.pdf

PLUMBING

Plumbing is the system of pipes and drains installed in a building for the distribution of water or the removal of waterborne wastes. Restrooms alone typically account for approximately one quarter of a given building's water consumption. Water conservation, reduction, and reuse in plumbing are most likely to occur in domestic hot and cold water, rainwater, and drainage systems.

CANNONDESIGN EXPERTS

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FACTORS

Low Consumption Plumbing Fixtures

Select plumbing fixtures that reduce domestic water use as much as possible, but still maintain functionality and ease of maintenance.

Water Efficient Appliances

Select appliances that meet or exceed Energy Star requirements.

Water Metering Plan

Develop a water metering plan for the building's domestic supply. Sub-metering of HVAC make-up, process equipment, irrigation, reclaimed, grey water, and rainwater systems should be considered. Special systems such as laundry, food service and pure water systems may also warrant sub-metering. All meters and sub-meters should have reporting capabilities and all metering data should support the Measurement and Verification plan set forth for the project.

Harvested or Captured Rainwater

If climatic conditions permit, consider utilizing rainwater as a supply for irrigation, toilet flushing, and HVAC make-up. Keep in mind that certain processes utilizing harvested rainwater may require treatment.

Grey Water

Consider utilizing grey water as a supply for toilet flushing, irrigation, HVAC make-up, and laundry. Keep in mind that certain processes utilizing grey water may require treatment.

Municipal Reclaimed Water Supply

Certain municipalities offer reclaimed water from storm runoff, snow melt, and water treatment plants as a building utility. This reclaimed water supply may be used much the same as grey water and harvested rainwater. Similar to grey water and rainwater, water treatment may be required.

System Design Tips

- Use of low flow fixtures and equipment will result in smaller flow demands, which in turn typically require smaller pipeline requirements for optimal operation.
- Diversity factors and reduced flow rates shall be used when sizing domestic water piping systems along with domestic hot water heating equipment.
- Oversized piping systems and equipment will result in the wasteful over use of water and energy.
- Certain provisions such as circulating systems, heat-traced piping, and pipe insulation should all be considered to achieve the highest efficiencies possible.
- Consider the placement of water heating equipment and distribution pipe routing to be in close proximity of end uses as to not create lengthy, inefficient plumbing systems.

HVAC

In typical office buildings, HVAC systems consume about one third of the building's total water consumption. In health-science buildings and restaurants or food service facilities, HVAC systems consume even more water. In order to significantly reduce water use in buildings, HVAC system water use must be addressed. Care must be taken to assure that reducing water use will not increase energy use.

CANNONDESIGN EXPERTS

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Best Practices

- Analyze make-up water supplied to the HVAC systems and equipment. Incorporate results into system design and equipment selection requirements.
- No once-through potable water use.
- Recover condensate from air conditioning units and steam systems for reuse.
- Select make-up water valves for precise delivery of make-up water and basin level control (i.e. slow closing solenoid type electrically controlled valves).
- Equip cooling towers and evaporative heat rejection equipment, evaporative coolers and air washers, and steam and hot water boilers with makeup and blow down meters, conductivity controllers and overflow alarms.
- Recover cooling tower blow down stream for reuse (irrigation, building sewage conveyance, or ground water recharge).
- Confirm that equipment complies with ASHRAE 90.1-2010 Efficiencies-Standard Rating and Operating Conditions.

Definitions and Concepts

- Blow Down: amount of water removed from the cooling system circulating water to prevent mineral build-up which can foul the system and decrease efficiency.
- For evaporative cooling towers, closed circuit coolers, and evaporative condensers: 1% saved in building or process energy efficiency saves 1% of water usage.

Water Usage for Thermal Storage Systems

- Cold Thermal Energy Storage: Building and storing cool energy during off-peak electricity periods for use during peak electrical demand. Allows the building to shut down its mechanical system components.
- Partial Thermal Storage Systems: Typically require a chiller that is 10-40% smaller in size than a conventional chilled water system, which will run efficiently at full load to make the chilled glycol or water, rather than part load with a standard chilled water system. Reduced load requires a 10-40% smaller cooling tower, reducing make-up water requirements. Consider the use of high-efficiency systems that do not consume water like an earth-coupled heat rejection system (see Renew LIFE Geothermal Exchange section).
- Water Requirements for Thermal Storage Systems: Thermal ice storage requires, on average, 6 times less volume of water for the initial charge of the system, compared to chilled water storage. However, thermal ice storage requires more energy consumption than water. Water/energy analysis must be conducted when selecting a thermal storage system.

Additional information can be found in **Renew Life ▸**.

Air-Cooled Chilled Water Plant
King Faisal Specialist Hospital, Riyadh, Saudi Arabia

PROCESS EQUIPMENT

Process equipment can be defined as any equipment necessary for analysis, treatment, or alteration of a substance through a scientific process. Medical processes within a healthcare facility can account for approximately one quarter of the building's total water consumption, while processes performed within a laboratory facility can require substantially more water. These spaces typically have water intensive equipment and operations, but they also offer a unique opportunity for efficiency improvements that can lead to significant water use reduction.

CANNONDESIGN EXPERTS

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FACTORS

Best Practices

- Eliminate "once-through" potable water use unless it is required as direct contact process water.
- Estimate annual process water use and process wastewater discharge.
- Install meters to measure total laboratory process water use. Any individual use that is estimated at more than 30% of total process water use should be submetered.
- Capture and reuse laboratory process water. Process water can be filtered and stored with stormwater to be reused in a cooling tower.
- Use water efficient floor wash machines, disinfection and sterilization systems, work and hand washing sinks, glassware washers, and cage and rack washers.
- Work with scientists to modify process and operations to reduce water use where feasible.
- Capture cooling coil condensate water for reuse. Condensate can be used for cooling towers or irrigation (verify pH levels are appropriate).
- Apply segregation (especially in baths) to separate materials from process water

Water Treatment Systems

- Use pressure gauges that display when to backwash or change cartridges.
- For ion exchange and softening processes, set recharge cycles by volume of water or by conductivity or hardness.
- For reverse osmosis and nanofiltration equipment, reject water should not exceed 60% of the feed water and should be reused (scrubber feed water).

Medical and Health Care Systems

- Use film processor water recycling units and digital imaging and radiography systems where possible.
- Use a dry-hood scrubber system or a wet-hood scrubber system with a water recirculation system. For perchlorate hoods, equip with self-closing valves. Use dry vacuum pumps (if permitted).

Laboratory Facilities

- Use automatic animal watering systems that incorporate recycled water. Use discharge water for cleaning cage racks and washing down animal rooms.
- Use tunnel washers for small cages.

Definitions and Concepts

- Direct contact process water: water that comes into direct contact with any raw material, product, or waste.
- Process water: water used in a laboratory space.

eVap utilizes an existing building's chilled water or process system to reject the heat from laboratory experiments. For more information about the eVap please visit **evap.cannondesign.com**

FOOD SERVICE

The EPA estimates that kitchen water use in restaurants and food service facilities is about 50% of the building's total water consumption. In healthcare facilities, K-12 schools and universities, and commercial office buildings that have kitchen spaces, it can range from 10% to 15% of the total building water use. Reducing water use in these water intensive spaces is critical and requires not only efficient systems and fixtures, but also efficient operation procedures.

CANNONDESIGN EXPERTS

Food Service Consultants

FACTORS

Appliances

Dishwashers

- Standard size models (over 8 place settings and six serving pieces): 5.8 gallons per cycle.
- Compact size models (less than 8 place settings and 6 serving pieces): 4.0 gallons per cycle.
- Comply with the EPA Energy Star Program Requirements for Dishwashers.
- Comply with EPA WaterSense.

Ice Machines

- Use air-cooled ice machines that comply with the requirements of the EPA Energy Star Program for Commercial Ice Machines.

Food Steamers

- Use boilerless/connectionless food steamers that consume no more than 2 gallons per hour in full operational mode.

Ovens

- Use combination ovens that consume no more than 10 gpm in the full operational mode.

Metering

- Provide separate submeters for individual leased, rented, or other tenant or sub-tenant space within any building totaling in excess of 50,000 sf or for spaces used for restaurant/food service.

Fixtures

Kitchen faucets

- Maximum flow rate – 2.2 gpm when tested in accordance with ASME A112.18.1/CSA B125.1.
- Use hands-free faucet controllers (foot controllers, sensor-activated, or other) for all faucet fittings within the food preparation area of the kitchen and the dish room, including pot sinks and washing sinks.
- Use high-efficiency pre-rinse spray valves (i.e. valves which function at 1.3 gpm or less and comply with a 26-second performance requirement when tested in accordance with ASTM F2324).

OPERATIONS & MAINTENANCE

Proper management of interior and exterior water-using systems will lower costs and eliminate over-consumption of valuable resources. National studies indicate that, on average, 14% of the water treated by water systems is lost to leaks. Some water systems have reported water losses exceeding 60%. Work with clients to develop operational goals and maintenance plans to ensure appropriate use of potable water. Team to assist clients in developing a means by which to measure those goals and verify compliance with their maintenance goals.

CANNONDESIGN EXPERTS

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FACTORS

Best Practices

- Retrofitting Indoor Water Fixtures: Replace aerators on lavatories to reduce water flow.
- Meter Readings & Utility Bill: Develop a process to record building meter readings on a weekly or daily basis so that potential maintenance issues may be detected during the billing cycle. Track data in the EnergyStar Portfolio Manager tool so that trending can be developed and analyzed as part of a regular preventive maintenance program.
- Preventive Maintenance/Inspection: Develop a plan for building management to regularly inspect indoor plumbing fixtures and fittings for leaks.
- Occupant Feedback Mechanism: Institute a mechanism for building occupants to easily report water maintenance issues for further inspection or repair
- Stormwater Management: Develop scheduled maintenance plan to inspect and clean stormwater management components (i.e. sewer drains, downspouts, roof systems)
- Irrigation: Make use of weather-based controls or high-efficiency drip irrigation to ensure that potable water is used effectively for irrigation purposes. Consider rainwater capture as a source of non-potable irrigation water or, depending on geographic location, consider deactivating permanent irrigation systems to allow irrigation to occur only naturally.

Post Occupancy Evaluation/Research

The CannonDesign Research Team has been collecting actual water use data from residence halls in order to compare it against estimated water use data. The findings have provided conclusions that more precise water estimation methods are required. The analysis has also led to the development of some initial water use benchmarks for residence halls in the New England region.

LEED for Existing Buildings: Operations & Maintenance (EBOM)

Rating system that sets the standard for certifying sustainable operations of existing commercial and institutional buildings. It encourages building owners and operators to implement sustainable practices and reduce the environmental impacts of operations over the life of the building. It also outlines sustainable facilities operations practices and provides a method for documenting performance based on actual utility usage data.

Water reduction is addressed in 4 ways:

- Plumbing fixture and fitting efficiency
- Water performance measurement
- Water efficient landscaping
- Cooling tower water management

METERING & SUBMETERING

Measuring water use during operation is critical for verifying performance, ensuring efficient operation, and comparing to design predictions. The goal of metering and submetering is to educate our staff on the importance of measuring the performance of our work, educate our clients on the value of the information the data can provide, and establish standards for various sub-metering systems. Metering helps raise the bar for sustainability in our designs and helps our clients be better operators of their facilities.

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FACTORS

Tracking and Reporting Methods

- Whole Building: Track whole building water use either monthly or annually. This allows opportunity to quantify changes in consumption over time. Whole building tracking and reporting can be carried out via utility meter readings.
- End Use: Track consumption at the end use (equipment, space, etc.) to understand where water is being used. This applies to domestic hot and cold, process, and HVAC water.

Water Supply Source Metering

- Potable water
- Municipally-reclaimed water
- Alternative water sources

Water Subsystem Metering

- Separately leased or rented spaces
- Separate campus buildings
- Cooling towers
- Evaporative coolers
- Boilers
- Irrigation systems
- Any large water-using process

Remote Metering or Automatic Meter Reading Capabilities (AMR)

Provide at all supply sources. Ensures design conditions are met.

Meter Data Collection

Communicate water consumption data to meter management system. Provide a minimum of daily data and hourly usage of water.

Data Storage and Retrieval

- Capability of storing meter data
- Data used for reporting and notification
- Compare to water or natural gas measurement and verification plan

Benchmarking

Compare building's current water use performance to past performance, other buildings of comparable size and use, or to a theoretical baseline building (year-to-year performance).

LANDSCAPE & SITE

CANNONDESIGN EXPERTS

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Chicago

Demand for water in the United States is up 209% since 1950, yet many older cities and towns around the country treat rainfall as waste to be funneled directly from roof gutters and paved surfaces to sewers, leading to increased costs in stormwater management. Rather than getting rid of stormwater as quickly as possible, a sustainable approach to stormwater management involves finding ways to harvest it on site, using it for irrigation, ornamental water features, and groundwater recharge. As the value of water is recognized, the value of natural systems to store, clean, and distribute available fresh water must also be recognized.

EXAMPLES OF GOOD WATER PRACTICES FOR LANDSCAPE & SITE

Protect and restore existing hydrologic functions

- Avoid development and disturbance near streams and wetlands, and in sites with high risk of flooding.
- Plant native or appropriate non-native vegetation, re-grade soils where necessary, and use soft engineering techniques to restore the functions of floodplains, and riparian and wetland buffers.

Manage and clean water on-site

- Design a site to capture, slow, and treat stormwater runoff by reducing impervious surfaces, harvesting rainwater, and directing remaining stormwater runoff to soil and vegetation-based water treatment methods, such as vegetated bioretention facilities, rain gardens, wetlands, green roofs, and bioswales.
- Maintain and restore vegetation to ensure water can percolate into the soil or groundwater.

Design stormwater features to be accessible to site users

- Integrate multifunctional stormwater management features into site design to improve both water quality and aesthetics.
- Stormwater management features can provide calming views, spaces for restoration, and even opportunities for play and interaction with water.

Design the site to minimize or eliminate use of potable water for irrigation

- Selecting efficient irrigation systems, planting vegetation appropriate for site conditions and climate, and using captured rainwater or graywater can reduce water waste and conserve sources of potable water.
- Use native and appropriate non-native vegetation adapted to site conditions, climate, and design intent. Group plants with similar water needs to maximize irrigation efficiency.
- Climate-based controllers for irrigation systems can be used to lower water consumption.
- Non-potable water can be collected and used for irrigation from sources such as rainwater from rooftops, graywater, air conditioner condensate, or stormwater basins.

On-site wastewater treatment

- Design a wetland site to capture & treat wastewater for reuse in the form of toilet flushing or processes that only require non-potable water while also providing a natural ecosystem for plants and animals.
- A “Living Machine” is a micro-ecosystem that efficiently removes nutrients and solids from wastewater, resulting in high quality effluent. The effluent is then filtered and disinfected, leaving the water ready for reuse.

CITIES & WATER

CANNONDESIGN EXPERTS

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As freshwater sources are becoming exhausted, cities around the world are struggling to access water supplies to support their continued growth. Water development typically begins with the exhaustion of local surface and groundwater supplies, continues with importation of water from other basins, and then turns to recycling of wastewater or stormwater, or the desalination of either seawater or brackish groundwater. This typical water development pattern is usually associated with serious ecological and social impacts as well as sub-optimal cost effectiveness. When CannonDesigners are in a position to advise clients about water reuse, conservation and policy at a municipal scale, consider these three strategies as a starting point.

OPPORTUNITIES TO INVEST

Green Infrastructure

- Green roofs, bioswales, bioretention ponds, permeable pavements, mini wetlands are a few key examples of local green infrastructure, and all work by turning hard asphalt surfaces into green, absorbent ones.
- These design strategies can capture, naturally treat and filter stormwater back into the ground, preventing overflows and reducing reliance on treatment centers, to create very significant cost savings
- When designed well, green infrastructure go beyond stormwater management, providing aesthetic and recreational value, both of which are increasingly valued as our cities experience increasing density.
- When well managed, green spaces have shown to boost values of nearby properties and lead to increased property tax revenue.

Integrated Resource Planning:

- Water planning must address the interconnected nature of water supply, wastewater, and stormwater management. IRP is a planning methodology that works to recognize these relationships from a least-cost, publicly transparent, and scenario-based planning perspective.
- Data drives IRP and typically falls into one of these four categories:
  - Existing water service infrastructure information including water supply, wastewater and stormwater maps, age, data, performance, etc.
  - Current financials related to water services including value of assets, costs of maintaining infrastructure and service, bond obligations and/or related debt, current and past rate structures
  - Existing land use policies and ordinances that relate to water resources; these could include parking requirements, zoning codes, building codes, landscaping-related ordinances, buffer zones
  - Current water education and outreach materials within the municipality including any brochures, advertisements, workshops, rebate incentives, school programming
- IRP policies can include: pricing and meter reform, technical assistance programs (leak detection and repair), conservation standards by land use designation, public education outreach, efficient landscape and irrigation measures, wastewater reclamation strategies.

Urban-Rural Partnerships

- Agricultural irrigation, in which more than half of withdrawn water is consumed is the dominant cause of water depletions and scarcity,
- Based on population distribution, it is expected that at least half of all agricultural production is consumed in cities; some recent research suggests that it might be closer to two-thirds.
- Untapped potential exists for cities to form partnerships with agricultural water users to reduce water consumption on farms, thereby freeing up additional water supply for urban use while potentially reducing the water-related costs of farming, as well as farming's vulnerability to water shortages.
- Urban–rural partnerships can be a highly cost-effective water-supply strategy for both cities and farms, with long-term savings for cities accruing from reduced infrastructure construction costs and energy use

CASE STUDIES

GENERAL

California Institute of Technology
Linde + Robinson Lab for
Global Environmental Science
Pasadena, CA

View Case Study ▸

CannonDesign Regional Offices
Power House Restoration/Renovation
St. Louis, MO

View Case Study ▸

The Universities at Shady Grove
Camille Kendall Academic Center
Rockville, MD

View Case Study ▸

City of Richmond
Richmond Olympic Oval
Richmond, BC

View Case Study ▸

ADDITIONAL INFORMATION

GENERAL

IWMI Projected Water Scarcity in 2025
http://www.zonu.com/fullsize-en/2009-09-18-7108/Projected-world-water-scarcity-2025.html

PLUMBING

Commercial Water Use and Potential Savings: Appendix E
http://www.pacinst.org/reports/urban_usage/appendix_e.pdf

HVAC

Standard for the Efficient Use of Water in Building, Site and Mechanical Systems
http://spc191.ashraepcs.org

EPA Water Sense Best Management Practices – Mechanical
http://www.epa.gov/watersense/commercial/bmps.html#tabs-mechanical

EPA Water Sense Best Management Practices for Commercial and Institutional Facilities
http://www.epa.gov/watersense/commercial/docs/watersense_at_work/

PROCESS EQUIPMENT

CannonDesign's eVap Cooling System
http://evap.cannondesign.com

EPA Water Sense Best Management Practices – Laboratory and Medical Equipment
http://www.epa.gov/watersense/commercial/bmps.html#tabs-labs_medical

EPA Water Sense Types of Facilities – Hospitals
http://www.epa.gov/WaterSense/commercial/types.html#tabs-hospitals

EPA Water Sense Best Management Practices for Commercial and Institutional Facilities
http://www.epa.gov/watersense/commercial/docs/watersense_at_work/

FOOD SERVICE

EPA Water Sense Program for Commercial Buildings
http://www.epa.gov/watersense/commercial/

OPERATIONS AND MAINTENANCE

EPA Sustainable Water Infrastructure Research and Resources
http://water.epa.gov/infrastructure/sustain/index.cfm

EPA ENERGY STAR Portfolio Manager (used to track and benchmark energy and water consumption)
https://www.energystar.gov/istar/pmpam/

METERING & SUBMETERING

Submetering of Building Energy and Water Usage
http://www.whitehouse.gov/sites/default/files/microsites/ostp/submetering_of_building_energy_and_water_usage.pdf

Water Submetering Wireless Systems
http://www.automatedbuildings.com/news/jul08/articles/spinnwave/080623010202inge.htm

LANDSCAPE & SITE

Living Machines
http://livingmachines.com

ASLA Water and Stormwater Management
http://www.asla.org/waterandstormwater.aspx

Water Environment Research Foundation
http://www.werf.org/i/ka/Stormwater3/a/ka/stormwater.aspx?hkey=546c9533-fde0-4e07-99bc-e4f1caeb6c0f

EPA Stormwater Management
http://water.epa.gov/polwaste/nps/section438.cfm

Whole Building Design Guide – Protect and Conserve Water
http://www.wbdg.org/design/conserve_water.php

ADDITIONAL INFORMATION

CITIES & WATER

Philadelphia's Green Infrastructure Plan
http://dirt.asla.org/2010/05/10/philadelphias-cutting-edge-green-infrastructure-plan/

Urban Water Management
http://www.water.ca.gov/urbanwatermanagement/

EPA Stormwater Program
http://cfpub.epa.gov/npdes/home.cfm?program_id=6

International Stormwater Best Management Practices Database
http://www.bmpdatabase.org

JIVE RESOURCES

Smart Water Use: Developing an ASHRAE Water Standard
https://jive.cannondesign.com/docs/DOC-12209

The 5 Minute Shower and Other Myths: Actual vs. Estimated Water Use
https://jive.cannondesign.com/docs/DOC-12612

Residence Hall Water Use – Estimated vs. Actual Performance
https://jive.cannondesign.com/community/research/blog/2012/12/20/residence-hall-water-use--estimated-vs-actual-performance

Residence Hall Energy Use – Estimated vs. Actual Performance
https://jive.cannondesign.com/community/research/blog/2013/02/14/residence-hall-energy-research-actual-vs-estimated-performance

MARKET RESOURCES

LEED Rating Systems
http://www.usgbc.org/leed/rating-systems

Labs for the 21st Century
http://www.labs21century.gov

Green Globes
http://www.greenglobes.com

A Comparison of "Green"
http://www.map-testing.com/assets/files/Comparison%20of%20Green%20-%20April%202012b.pdf

EPA Sustainable Water Infrastructure
http://water.epa.gov/infrastructure/sustain/index.cfm

EPA Water Sense
http://www.epa.gov/watersense/

LEED CI – Water Efficiency
http://www.usgbc.org/credits/commercial-interiors/v2009/water-efficiency

LEED CS – Water Efficiency
http://www.usgbc.org/credits/core-and-shell/v2009/water-efficiency

LEED EBOM – Water Efficiency
http://www.usgbc.org/credits/existing-buildings/v2009/water-efficiency

LEED Healthcare – Water Efficiency
http://www.usgbc.org/credits/healthcare/v2009/water-efficiency

LEED NC – Water Efficiency
http://www.usgbc.org/credits/new-construction/v2009/water-efficiency

LEED ND – Water Efficiency
http://www.usgbc.org/credits/neighborhood-development/v2009/green-infrastructure-%26-buildings

LEED Retail NC – Water Efficiency
http://www.usgbc.org/credits/retail---new-construction/v2009/water-efficiency

LEED Schools NC – Water Efficiency
http://www.usgbc.org/credits/schools---new-construction/v2009/water-efficiency