Water Matters

A Design Manual for Water Conservation in Buildings

Water **Matters**

Preface

Of all our resources, water is the most precious. New York City is famed both for the quality and reliability of its water supply as well as for the economy of its largely gravity-fed delivery. However, a number of unavoidable challenges face our water network. The need for system repairs and upgrades is continual, yet the shutdown of a major aqueduct or tunnel could cause unacceptable shortages. Treatment of wastewater leaving the system consumes energy and generates greenhouse gas emissions. Finally, by 2030, the City's population is projected to grow by 14% over the 2000 population, increasing demand and adding further strain to infrastructure.

Rather than begin the long, complicated, and costly process of expanding the water system, simpler and more sustainable alternative measures must be taken. PlaNYC 2030, the City's comprehensive strategy for sustainability, identifies conservation efforts as fundamental to protecting the reliability of our water network. As a City leader in sustainable design, The New York City Department of Design and Construction (DDC) is pleased to support this effort with *Water Matters: A Design Manual for Water Conservation in Buildings*, our ninth in a series of manuals and guidelines dedicated to promoting greater environmental responsibility in the projects we build.

Promoting efficient water use in buildings is instrumental to lowering overall system usage. At DDC, we have ten years' worth of high performance projects that prove meaningful results can be achieved with little or no cost increase. Typical DDC high performance buildings reduce their potable water consumption anywhere from 20-80% over baseline performance by using the strategies recommended in the pages that follow. That said, *Water Matters* will be a useful tool for design and construction professionals, building operators, and anyone who has a stakehold in New York City's water supply.

Since its creation in 1996, DDC has made environmental responsibility a priority. To date, we have nearly ninety completed and ongoing sustainable building projects, a robust green infrastructure program, and a vibrant research and development program. With the publication of *Water Matters*, DDC is once again reaffirming our committment to the greater, greener New York conceived of by PlaNYC 2030, and to making the visionary blueprint a concrete reality.

David J. Burney, FAIA
Commissioner, New York City Department of
Design and Construction
June 2010

Water **Matters**

A Design Manual for Water Conservation in Buildings

NEW YORK CITY DEPARTMENT OF
DESIGN + CONSTRUCTION

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1.0 NYC Water

Introduction

Ready access to potable water has historically been one of the most important factors in the siting, growth, and stability of human settlements. For much of the last century and a half, New York City has enjoyed clean, fresh, and consistently available water thanks to its strong supply system. However, as noted in PlaNYC, the city's comprehensive sustainability plan, the continued reliability of this complex system faces a number of challenges, and as the population continues to grow and the system ages, addressing them becomes ever more crucial. Conserving water on the demand side of the supply system in buildings and building sites is one of several vital measures to ensuring pure and reliable water for all New Yorkers.

A Short History of Potable Water in NYC

By all accounts, the precolonial island of Mannahatta's numerous springs, freshwater ponds, and aquifers originally flowed with water that was abundant, good tasting, and clean. In the Dutch settlement of New Amsterdam, then followed by New York, the English colony, water for domestic uses and extinguishing fire was collected from natural sources and distributed to the rapidly growing populace via a system of local reservoirs, public wells, and even conveyed through hollowed-out logs. However, no complementary system for isolating and disposing of human waste was constructed, and the streets and environs of the future City of New York were soon filthy. Wells and reservoirs became cross-contaminated by runoff and sewage pits, and by the time of the Revolution, city water was notorious for its foulness. Moreover, as the population continued to grow into the hundreds of thousands the demand for water far exceeded availability, and there simply was not enough water to drink, wash, and fight fires. By 1830 the population was nearing 200,000, cholera and other epidemics were rampant, and uncontrollable fires ravaged the city with unremitting frequency.

It is no wonder, then, that in 1842 the first drops of water to travel the 40 miles of the newly constructed Croton Aqueduct were met in the city by a thirty-eight gun salute, grand military and civic fanfare, silver medals, and an ode commissioned expressly for the occasion. Pure and abundant water from pristine upstate watersheds was readily available to all. However, by the turn of the 20th Century, NYC had again grown beyond system capacity, and the Catskill Water Supply System was constructed to meet demand. The system was further expanded in the 1940s and 1950s with the addition of the Delaware System.

PlaNYC, A Greener, Greater New York
http://www.nyc.gov/html/planyc2030/html/downloads/pdf/full_report.pdf

1.1
NYC Water Supply System Today

Today the NYC water supply system is comprised of 19 reservoirs and three controlled lakes in a 1,972 square mile watershed extending about 125 miles north and west of the city in New York State. From the reservoirs, water flows to the city through three large aqueducts, the majority of it entering through two enormous tunnels connected to a 6,000 mile network of water mains. This system delivers about 1,225 million gallons of water per day (MGD) to approximately eight million users in the city and one million in four counties north of the city. Pumping is required for only a small percentage of consumers thanks to a favorably sloping topography. From the Hillview Reservoir, nearly 300 feet above sea level, water enters the distribution mains with a pressure head sufficient to bring water to the sixth floor of most buildings.

The NYC system supplies water to different building types for different purposes:

Domestic consumption: drinking, cooking, washing, and sanitary needs.

Commercial buildings and office buildings: domestic consumption plus heating and cooling systems.

Fire protection: fire hydrants in streets, sprinkler and fire standpipe systems in buildings.

Industrial processes: cooling, cleaning, equipment wash down.

Institutions: hospitals, schools, colleges, correctional facilities, and shelters.

Government: city, state, and federal facilities, police stations, firehouses, libraries, and parks and recreational facilities.

Food service: restaurants, cafeterias, and food distribution.

Transportation systems: subways, bus systems, and suburban rail transit.

Despite the relative simplicity and economy of this largely gravity-fed system, due to its age and size, repairs and maintenance must be performed on a continuous basis by the city agency stewarding the water supply, the New York City Department of Environmental Protection (DEP). Currently DEP is in the midst of completing two massive water infrastructure projects designed to improve system reliability and adequacy. The first of these projects, City Tunnel No. 3, under construction since 1970 and scheduled for completion in 2020, will improve the dependability of the entire water supply system as well as improve service to the outer boroughs. For the first time since they first flowed with city water, City Tunnels No. 1 and 2 will be able to be inspected and repaired by DEP. Concurrently, in the Bronx, DEP is constructing the city's first drinking water filtration plant to filter the relatively small percentage (10%) of water entering NYC today from the Croton System. The remaining 90% flows from the Catskill and Delaware watersheds, where more stringent natural watershed protection measures, such as agricultural runoff protection, open space preservation, and filtration planting are being implemented. The U.S. EPA has granted the Catskill/Delaware supply a filtration avoidance waiver, which is renewable in five-year terms.

NYC Water Supply System

Detail of NYC Water Supply Tunnels and Wastewater Treatment Plant Locations

Plant Location	Capacity (MGD)
North River	170
Wards Island	275
Hunt's Point	200
Newtown Creek	310
Red Hook	60
26th Ward	85
Owls Head	120
Coney Island	110
Bowery Bay	150
Tallman Island	80
Jamaica	100
Rockaway	45
Port Richmond	60
Oakwood Beach	40
Total	**1805**

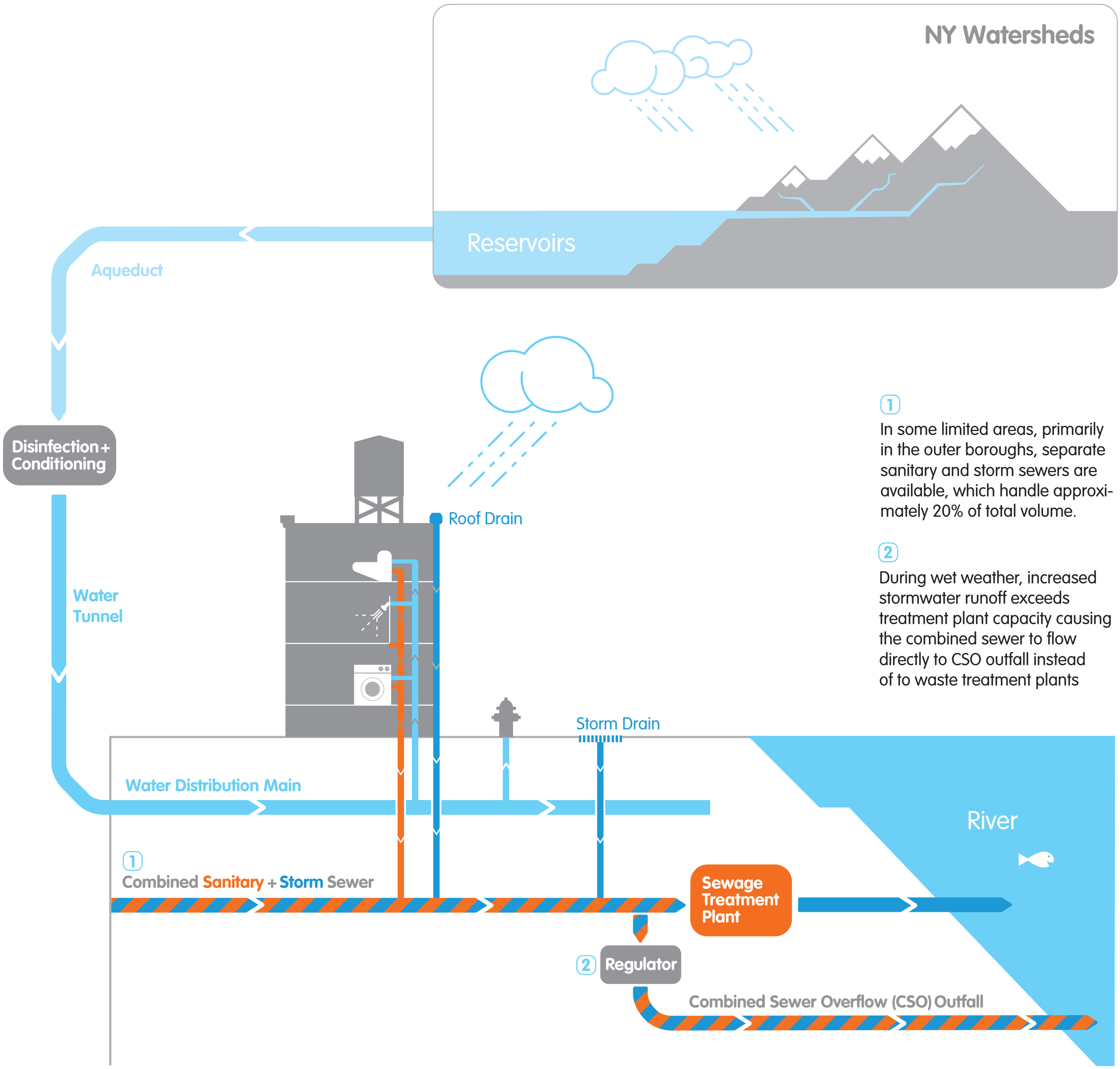
1.2
Challenges Facing NYC's Water System

By 2030, the population of NYC is projected to increase by 14% over the population of 2000, bringing the city to nearly 9.1 million people and straining the capacity of the current municipal infrastructure. While public transportation can be expanded, new schools can be built, and new utility lines laid down, an increase in demand for potable water cannot easily be satisfied. The capital costs associated with acquiring new watershed land area and building new reservoirs and aqueducts would severely strain the city's funding capacity for other capital projects. Increases in total water use could also affect the filtration avoidance waiver agreement with the U.S. EPA resulting in the need for costly filtration facilities and maintenance.

Equally prohibitive to system expansion are the physical limits imposed by increased population density in the traditionally suburban and rural areas near the upstate watersheds. Furthermore, none of the current city-managed watersheds exist within political boundaries controlled by the city, and there is mounting pressure in those localities to develop land close to and within the watershed, which could adversely impact water quality. In more rural areas of the watersheds, water quality is additionally threatened by agricultural runoff, though DEP continues to work with upstate communities and has developed a best management practice strategy to preserve the city's excellent water quality.

Additionally, as mentioned, repairing and maintaining the city's water supply system is a perpetual endeavor. Any interruption or shutdown of the flow in a major aqueduct or tunnel could cause system-wide shortages. However, as would be expected of infrastructure of this age and size, repairs are necessary. City Tunnel No. 3, when completed, will allow DEP to make much needed system repairs. Yet the city must find a way to make other parts of the system available for the work needed to keep it in good repair, while continuously delivering water to all ends of the system.

Overview of NYC Water Use System



1
In some limited areas, primarily in the outer boroughs, separate sanitary and storm sewers are available, which handle approximately 20% of total volume.

2
During wet weather, increased stormwater runoff exceeds treatment plant capacity causing the combined sewer to flow directly to CSO outfall instead of to waste treatment plants

1.3
Additional Environmental Challenges

Potable water, energy, greenhouse gas (GHG) emissions, and stormwater runoff — these are all very much interconnected. Gravity fed, the NYC water supply system is very efficient, using relatively little energy to move water to and within NYC (though booster pumps and hydropneumatic systems in tall buildings do require some electrical energy). However, much of the potable water used ultimately ends up in the City's 14 wastewater treatment plants located throughout the five boroughs; as goes the demand for potable water, so goes the need for wastewater treatment capacity. Over the course of the treatment process, significant amounts of energy and GHG emissions are generated. Reducing the amount of potable water entering the wastewater system means less energy is required to treat it and no energy is expended to construct new conveyance and treatment facilities. Also, given that the digestion process in wastewater treatment plants generates methane, a GHG 20 times more destructive than carbon dioxide, potable water use reduction has a significant impact on GHG reduction.

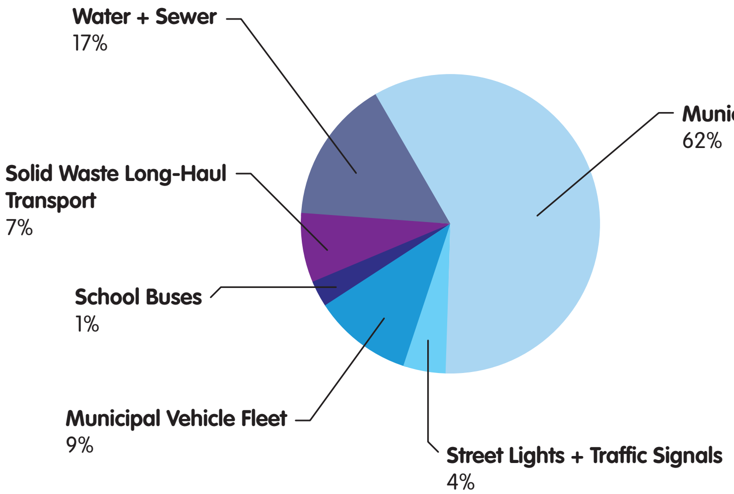
Potable water use in the city also directly impacts the quality of surrounding estuaries, harbors, and other shoreline bodies of water. Over 6,000 miles of sanitary sewers run underneath the city, most of which are combined. In addition to conveying sanitary flow from toilets, sinks, and showers, during wet weather combined sewers must do double duty also conveying stormwater runoff from the 135,000 street-level catch basins to wastewater treatment plants. During wet weather events, treatment plant capacity can easily become overburdened, causing combined sewers to overflow and release untreated sewage, trash, oil, and other pollutants from the street directly into NYC waterways, severely degrading the local water quality and ecology. Though the main culprit of combined sewer overflows (CSOs) is stormwater runoff, reducing the amount of potable water entering sewers during both wet and dry weather can mitigate the adverse impacts.

Reduction of stormwater runoff to the wastewater system by storing and recycling for nonpotable uses, or returning stormwater to the ground has many positive effects:

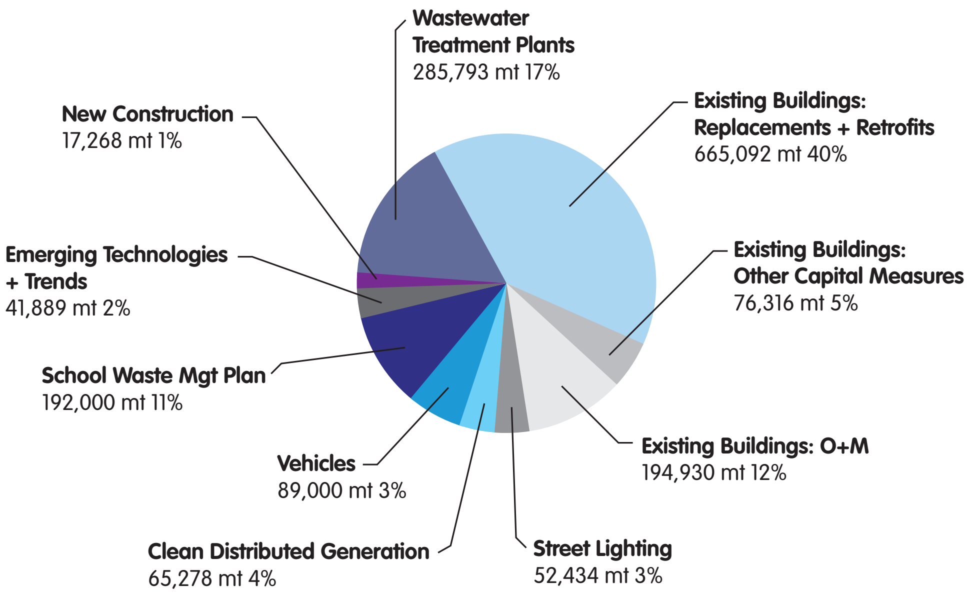
- Less energy needed to move and treat wastewater.
- Less carbon dioxide and methane GHG emissions produced in the cleansing process.
- Less effluent and CSOs going into the waterways.
- Less embedded energy needed to expand and build new wastewater treatment plant capacity, and less energy required to operate and maintain larger plant capacity over the long term.

Water Conservation, Energy and Greenhouse Gas Reduction

CO_2 Emissions for City Government by Source (FY '06) Total: 3.8 million metric tons



Potential for Annual Greenhouse Gas Reductions by Project Group 1.68 million metric tons (mt) per year



1.4
Sustainable Alternatives to Expansion

Financial, political, and environmental arguments against system expansion are very powerful. At the same time, NYC needs a reliable and adequate supply to meet the challenges of the coming decades. Rather than begin the long, complicated, and costly process of system expansion, simpler and more immediate measures must first be taken. Improving the efficiency of the current system at the user end begins to meet these challenges with little to no cost impact, and is the strategy governing the majority of the recommendations made within this manual. From low flow plumbing fixtures to more efficient building level civil systems, *Water Matters* advocates for more intelligent and responsible use of water in city buildings. Simultaneously, the manual begins to examine strategies to reduce system demand through public awareness and water conservation visibility, recommending practices such as public metering and signage.

This manual also contains recommendations on how NYC can continue to consume fresh and clean water, yet reduce the impact of this consumption on the local watershed, ecology, and, by extension, the planet. For further information on how NYC can reduce the overall environmental impact of its buildings and building sites, please visit the DDC Office of Sustainable Design's reports and manuals.

Strategies are being implemented to:

- Integrate efforts of design professionals, city managers, and building operators to conserve water.
- Reduce domestic water usage and sewage flow.
- Reduce site runoff into the sewer system.
- Reduce commercial and process water usage.
- Recycle stormwater, graywater, and blackwater for nonpotable uses such as toilet flushing, air conditioning cooling towers, landscape irrigation, and industrial processes.
- Monitor and fix water supply system infrastructure leakage.
- Monitor and fix consumer water leakage.
- Increase use of individual consumer water metering.

For more information go to: http://www.nyc.gov/html/ddc/html/design/reports.shtml

How To Use This Manual

2

2.0
Purpose, Organization + Building Types

Purpose

Water Matters is primarily concerned with efficient water use within the design, construction, and operation of New York City buildings. The manual presents guidance to enable design professionals, NYC client agencies, DDC project managers, and building operators to better manage their efforts to reduce water usage, to reduce energy consumed and carbon emitted to treat water, and to reduce the volume of combined sewer overflow discharged into the waterways surrounding NYC. The manual, specifically the *Strategy Matrix* contained within, provides tools to help combine different technologies into effective water efficiency strategies, taking into account the particular building type, function, and occupancy pattern of the building.

The manual also emphasizes the importance of approaching all projects with an integrated design team comprised of designers, DDC project managers, client agency representatives, and operations and maintenance staff. To be fully effective, each team member must first understand the requirements, opportunities, and limitations of the available technologies in order to set water efficiency goals for each project in relationship to Local Law 86 (LL86) and U.S. Green Building Council LEED® certification requirements. The team must then work together to choose appropriate strategies that will achieve the agreed upon goals in a cost-effective manner and that will contribute to the reliable and economic operation of the proposed new building or renovation over the long term.

Although the manual is primarily concerned with water conservation, compliance with other regulations is required.

It is the responsibility of the design team to ensure that all regulations and standards promulgated by the various agencies are met, including (but not limited to):

NYC Local Law 86 of 2005

NYC Construction Codes

NYC Department of Health

NYC Department of Environmental Protection

City Environmental Quality Review (CEQR): identifies and assesses the potential environmental impacts of certain actions that are proposed in New York City by public or private applicants and funded or approved by a city agency.

Urban Land Use Review Procedure (ULURP): the public review process, mandated by the City Charter, for all proposed zoning map amendments, special permits and other actions such as site selections and acquisitions for city capital projects and disposition of city property.

New York State

NYS Energy Code (including NYC revision)

NYS Department of Environmental Conservation

Federal

U.S. Energy Policy Act of 1992, and amendments: regulates water efficiency standards for plumbing fixtures.

U.S. Clean Water Act (CWA): formerly referred to as the Federal Water Pollution Control Act or Federal Water

Local Law 86: http://www.nyc.gov/html/ddc/html/design/reports.shtml
U.S. Green Building Council LEED: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1970

Pollution Control Act Amendments of 1972, is the primary federal law controlling water pollution; specific sections of the CWA seek to eliminate the release of pollutants to waterways.

National Pollutant Discharge Elimination System (NPDES): authorized by the Clean Water Act, controls water pollution by regulating point sources that discharge pollutants into waters of the U.S.; industrial, municipal, and commercial facilities must obtain permits if their discharges go directly to surface waters.

U.S. Energy Policy Act of 2005

U.S. Energy Independence and Security Act (EISA 2007)

WaterSense: a national water efficiency program managed by U.S. EPA that sets certification criteria for water-using products.

Energy Star: a joint program of the U.S. EPA and U.S. DOE to develop energy performance criteria and certification programs for energy efficient products and practices; for water-using products see certifications for appliances, heating and cooling equipment, commercial kitchen equipment, and water heaters.

Organization

The recommendations included in *Water Matters* take into consideration parameters such as common building types, levels of water efficiency, and technologies and design strategies. The building types discussed in the manual were selected based on current and anticipated building program requirements of the DDC. The list of building types is provided on page 20.

Descriptions of the four levels of water efficiency for new construction are contained in Section 2.1. They are: Efficient, More Efficient, Ultra Efficient, and Innovative.

In addition to new construction efficiency levels, a separate category has been provided for Renovation. (A short overview is provided in Section 2.1). Renovation of existing buildings presents a special set of challenges. Each renovation project is different, building documentation may be incomplete, and work on one system or building element may have unintended or costly consequences to other systems. It may not be possible to set water efficiency goals as high as in new buildings, and implementation of technologies is often limited to those associated with Efficient buildings. But, every increase in the efficiency of a building's water supply and waste removal systems helps move NYC closer to its overall water conservation objectives.

Once the building type and efficiency goals are identified, strategies can be selected that will enable the team to reach its set goals. The *Strategy Matrix* in Section 2.3, will help design professionals integrate different technologies into effective water efficiency strategies, taking into consideration the particular type and function of the building. A step-by-step explanation of the *Strategy Matrix* can be found in Section 2.2.

Generic descriptions of the technologies are provided in Section 3. In practice, the technologies may be used differently to match the particular water demands of specific buildings. It is the responsibility of the design team to obtain detailed information. In all cases, the successful design, installation, and operation of water systems requires a whole building approach. Some elements that must be considered for integration into a whole building system are:

- Community around the building
- The natural environment
- NYC sustainability goals and regulations
- Other building water systems
- City and community water supply and wastewater systems
- Other building systems, including mechanical, fire protection, and architectural systems and elements
- Building design schedule
- Building construction schedule
- Estimated construction budget
- Building operations and maintenance procedures
- Education of building operations and maintenance (O&M) personnel as to new products, materials, and procedures

Successful projects rely on the team to implement strategies with the appropriate mix of technologies that will meet the requirements of the building and water efficiency goals for the facility. The following recommendations will help the team to integrate water efficiency strategies into the building systems:

- Each design professional involved with water systems should refer to the NYC Local Law 86 of 2005 *LEED Project Timeline* and determine the information required for proper reporting of water technologies data and water reduction strategies in accordance with the applicable stage of the project development.
- The DDC should clearly communicate the type of building, its size and occupancy, and the level of water efficiency the building should achieve to the building team at the beginning of the design process.
- The team should refer to the Strategy Matrix to develop a list of technologies that can be implemented to meet the agreed upon building efficiency goals.
- The team should review the background of selected technologies and obtain additional detailed information as required.
- Each design professional should refer to the tasks listed for each technology and include these tasks in their scope of work for the project.
- Each design professional should refer to the tasks listed for each phase of project development in the NYC Local Law 86 of 2005 *LEED Project Timeline* and include these tasks in their scope of work for the project.
- To facilitate integration of water efficiency strategies, the DDC project manager should develop a schedule for the required and suggested meetings and coordination listed under the technology tasks and LL86 in the earliest phase of the project.
- In the pre-preliminary or schematic design (SD) phase, the team should develop its preliminary list of technologies and provide a narrative describing how these technologies will be integrated with other building systems and their cost impacts.
- At the beginning of design development (DD), the DDC project manager should develop a design, construction, and operations schedule that includes the tasks listed under each selected technology.

Purpose, Organization + Building Types

During design and construction coordination meetings, the appropriate team members should review the development of the technology and verify that the technology is on track for installation in the facility.

Building O&M should be involved in the early stages of a project to provide input on the design of the facility from an operations point of view.

Building O&M personnel should be educated in the technologies implemented and trained in proper operations and maintenance procedures to ensure that systems are operating as intended.

At building start up, the O&M team should incorporate the technology tasks into their operations' schedules and procedures.

Building Types

The building types included in the manual and the Strategy Matrix were selected based on current and anticipated DDC building projects. For building types not listed, follow recommendations for similar functions. Also, bear in mind that some projects may contain combinations of building types or be an adaptive reuse of another building type.

Office

Library

Public Assembly

Community Facility

Health Facility

Parks & Recreation Facility

Police Precinct

Firehouse

Courthouse

Correction/Juvenile Detention

Warehouse/Maintenance Shop

Vehicle Wash

A detailed description of these building types, along with several case studies, can be found in Section 4, Integrated Application Examples.

2.1
Efficiency Strategies

The water conservation technologies are grouped in nine categories:

- PF Plumbing Fixtures
- MS Mechanical Systems
- CS Civil Systems
- PS Plumbing Systems
- EN Energy
- OP Operations
- OFE Owner Furnished Equipment
- FP Fire Protection
- NT New Technologies

Strategies can (and should) be combined from a mix of different water efficiency technologies to meet sustainability goals for each building. Some building owners and designers will meet the minimum New York City efficiency requirements, while others will strive to raise the bar to More Efficient or Ultra Efficient levels. When reviewing and selecting strategies, the team should strive to maximize water conservation within the overall goals set for the project. Care should be taken to evaluate the interactions of various efficiency strategies to ensure they do not work against each other. The team should always practice an integrated design approach.

Efficient

In general the Efficient approach includes strategies which are readily available and are intended to meet the requirements of Local Law 86, which states that plumbing systems are to be: "constructed to reduce potable water consumption in the aggregate by a minimum of thirty percent (30%), as determined by a methodology not less stringent than that prescribed in LEED…." Efficient buildings will generally achieve LEED Silver certification.

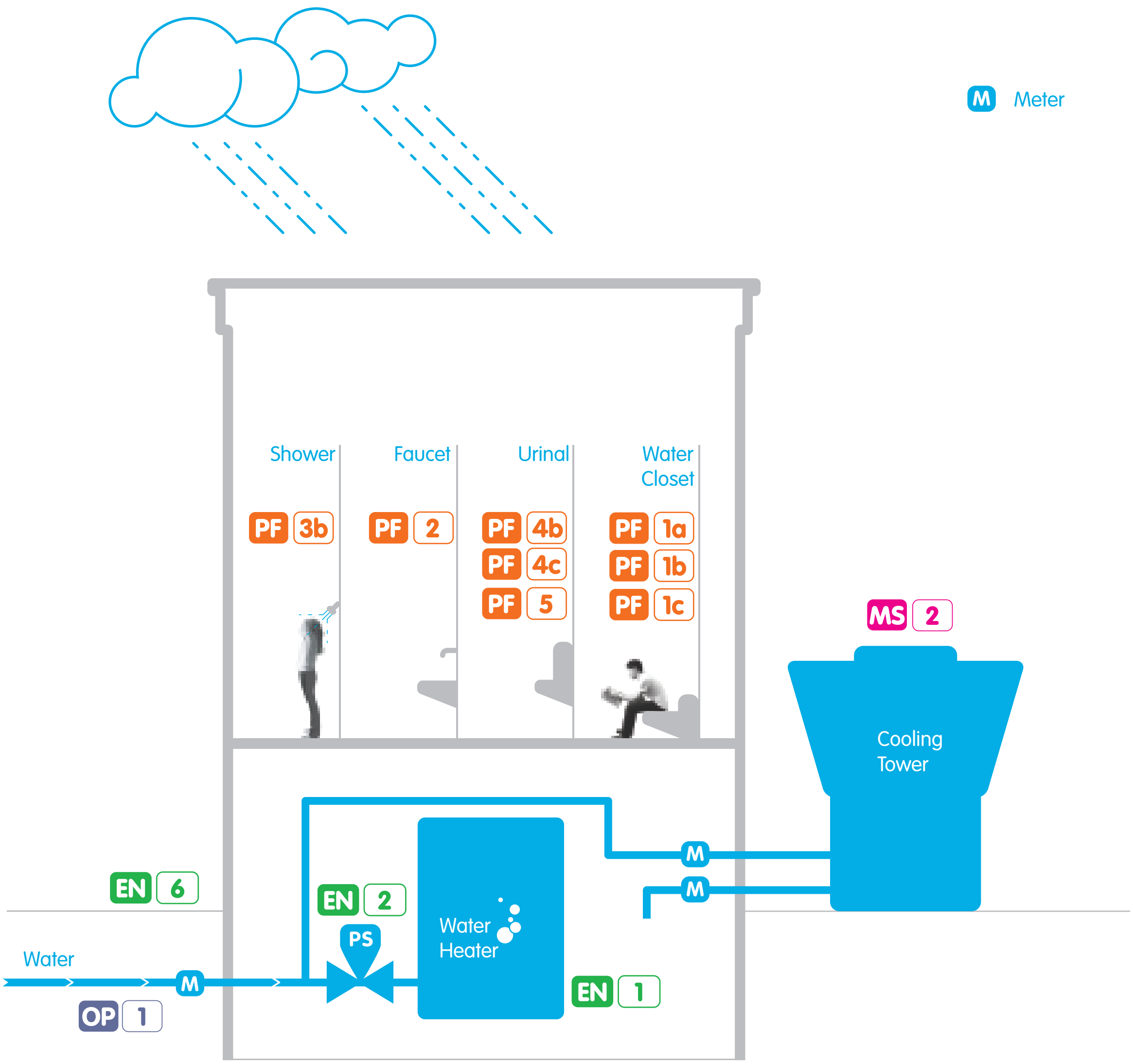
For example, for building types that have a high percentage of water usage in plumbing fixtures, the team should consider using non-water urinals instead of conventional fixtures after reviewing the recommendations in PF 5.* If non-water urinals are not used, high efficiency urinals or ultra high efficiency urinals should be used.

Another water reduction strategy might be specifying dual flush water closets PF 1c in some buildings (e.g., office buildings) where the same people use the same plumbing fixtures throughout the day. Ultra high efficiency lavatory faucets PF 2c and high efficiency sink faucets PF 6b are also effective in office buildings, as only light hand washing is required. Buildings with a high occupancy load may consider upgrading the type of air conditioning system used since mechanical air conditioning and space heating systems can use large amounts of water MS.

Water heating systems can use large amounts of energy in buildings. When there are smaller capacities required, point of use or tankless water heaters EN 1b can be used to reduce the amount of energy used to heat and store hot water. Architects and building project managers should try to locate fixtures using hot water close to the core of a building EN 5, reducing the amount of piping material and heat loss through long runs of pipe.

* Note that there is a provision of Local Law 86 that states: "such percentage shall be reduced to a minimum of 20% if the department of buildings rejects an application for the use of waterless urinals for the project."

Efficient Strategy System Diagram



Efficiency Strategies

More Efficient

The strategies applicable for More Efficient buildings include proven, reliable technologies that may have higher upfront costs when compared to code minimums. In general, these are strategies that should be specified in buildings achieving LEED Gold certification. Plumbing fixtures categorized as "High Efficient" are generally 20% more efficient than the plumbing fixtures mandated in the Energy Policy Act of 1992. The term is also used by the U.S. EPA in its WaterSense rating guide. More Efficient buildings will require extra effort on the part of the building design team. Graywater, condensate and stormwater recovery systems PS 3a that capture water and reuse it in irrigation, mechanical, or plumbing flush fixtures should be considered.

In addition to specific fixtures, water recovery systems, and irrigation strategies, water use can be further reduced in More Efficient buildings by focusing on upgrading the mechanical and building space cooling systems MS. These systems will likely require a higher upfront cost to install and are typically beyond the scope of the Efficient approach described previously. Energy upgrades should be considered with high efficiency pumps EN 2 and heat recovery systems EN 3.

With added system complexity, it is especially important to provide robust commissioning services OP 3 to ensure proper operation of all systems. Operations will need to develop procedures for retro-commissioning OP 4 buildings on a regular basis, usually every five years.

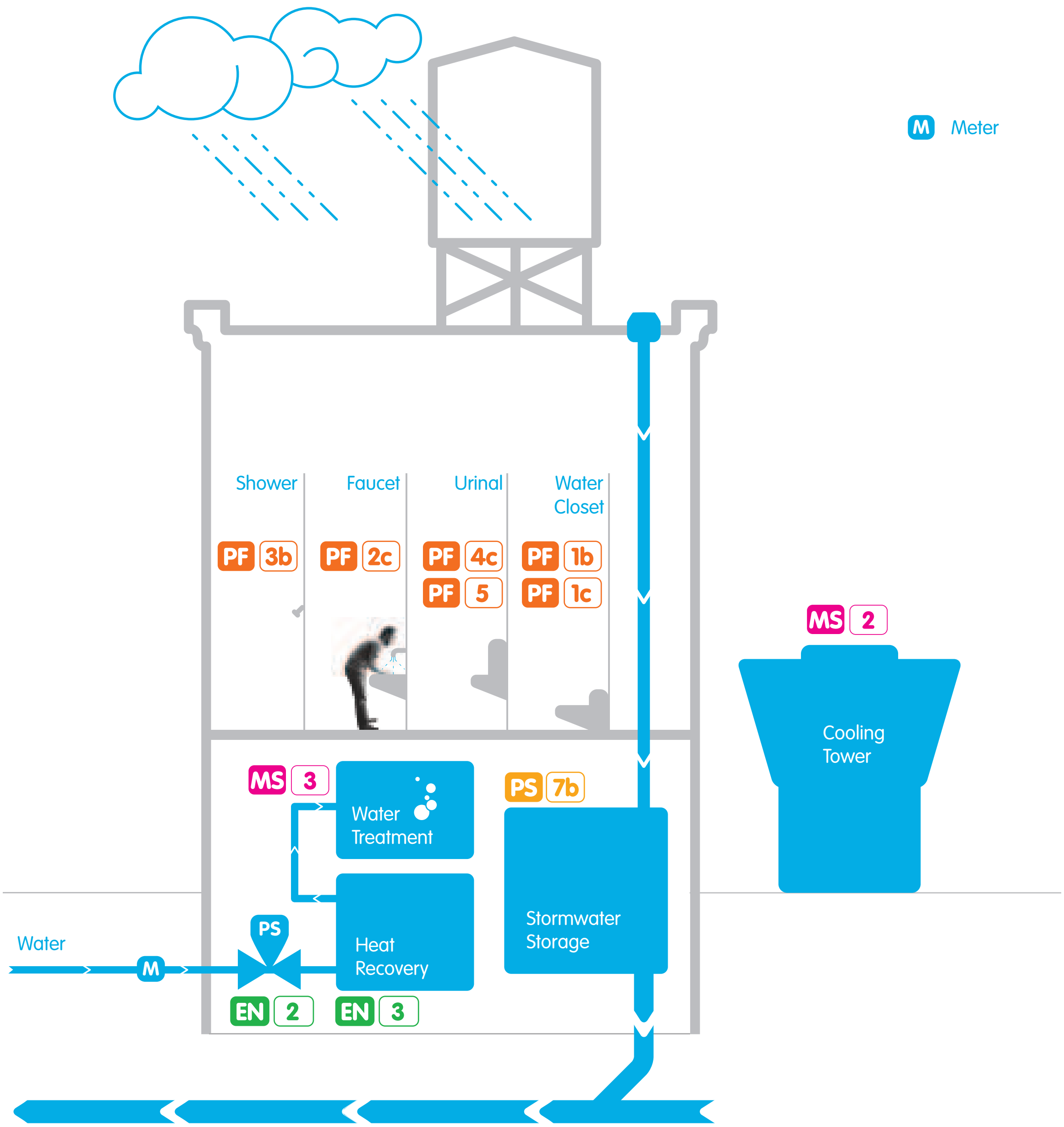
Ultra Efficient

Strategies specified for Ultra Efficient buildings will typically include technologies that are available from most manufacturers, but, because they are new and not as common, they may require special design, installation, and operation. The entire design, construction, and management team needs to agree to the special effort it may take to achieve these levels and commit to the additional operation and maintenance procedures that may be necessary. In general these are strategies that will be used in buildings achieving LEED Platinum certification.

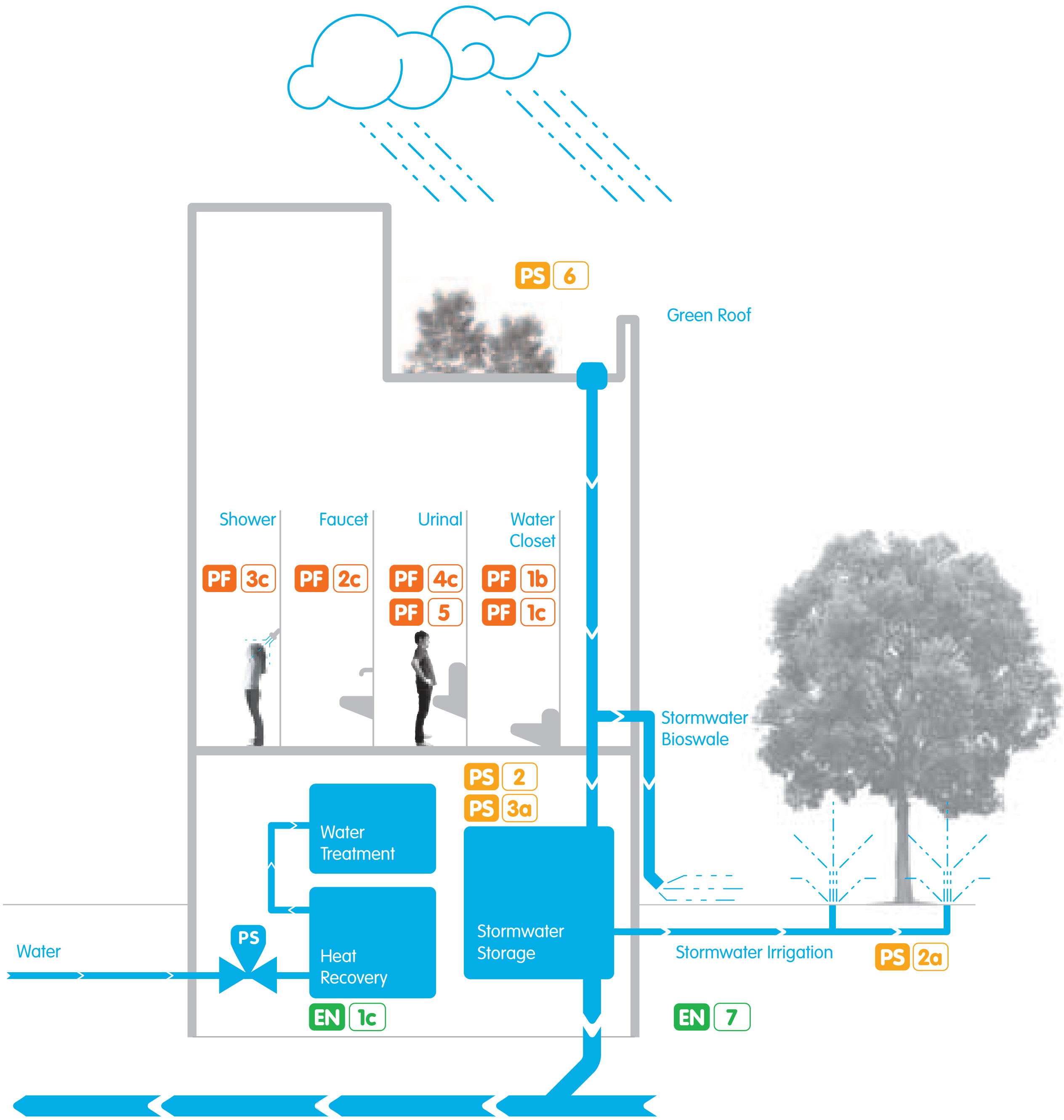
Ultra Efficient buildings are meant to be examples of state of the art efficiency, from the choice of plumbing fixtures PF to implementation of blackwater PS 3b systems that employ onsite treatment systems or onsite biotreatment outside the building. Strategies can include energy pods EN 6 and electrical connections installed to provide accommodation for future alternative power generators tied to water heating or pumping systems. A water pod PS 7b can provide space for a future condensate, graywater, potable water, or irrigation system. During building design, water supply piping is separated for future installation. Waste Pods PS 7a are similar and can be installed during construction to accommodate future blackwater, graywater, and condensate systems, which will be piped separately throughout the building for treatment systems.

For more information go to: http://epa.gov/watersense

More Efficient Strategy System Diagram



Ultra Efficient Strategy System Diagram



Efficiency Strategies

Innovative

Designers and owners should be encouraged to go beyond Ultra Efficient building technologies. Some Innovative strategies exist now and have been proven to be healthy and safe for building occupants and the community at large. However, such strategies may require special effort by the design team to ensure that code officials and plumbing, health, and safety officials are fully aware of the system capabilities and limitations. Special pilot or research programs may be employed. In general these are systems that exceed the current LEED certification process.

In general, these Innovative buildings go beyond state of the art into experimental or innovative sustainable solutions. For example, there are toilet systems that require little or no water PF 7 and process waste that can later be used for landscaping PS 3b. There are air conditioning systems that use little or no domestic water.

Renewable energy systems such as solar panels EN 1d, windmills, or other alternative power sources can be used to pump, treat, or heat water. Stormwater collection and storage systems can be incorporated into the structure of a building and the water reused in other systems.

Renovation

Water efficiency strategies for Renovation projects will need to be approached differently from new construction and are generally not applicable to the existing building stormwater, plumbing distribution, and mechanical systems. Water audits OP 2 should be conducted and recommendations should be included in the renovation project scope of work. Larger renovation projects that resemble new construction with larger scopes of work may refer to the strategies for new construction projects in the matrix.

The strategies identified for renovation are intended to help the design team reach LEED for Existing Buildings: Operations & Maintenance (EBOM) certification. If achieving LEED Gold or Platinum certification, the building team should look to the More Efficient, Ultra Efficient, and Innovative strategies.

Each strategy lists the minimum level of technologies that should be specified for a project. It is recommended that the project team use More Efficient or Ultra Efficient technologies if they can be incorporated into the existing building systems. Some of the higher level technologies will not add to the cost of the project. For example, when plumbing fixtures are replaced, there is little cost increase to install ultra high efficient fixtures compared to standard fixtures.

Some renovation projects may not initially include plumbing fixtures in the scope of work because of the perceived expense. As a result, old inefficient plumbing fixtures may not be replaced. However, higher water and sewer usage costs will result. The total cost should be evaluated and smart choices should be made.

The 2009 Greater Greener Building Legislation requires the approximately 22,000 existing buildings exceeding 50,000 gross sq.ft. in NYC to benchmark energy consumption, perform energy audits, and install energy conservation measures (ECMs) and lighting upgrades. This legislation was passed to support the following six point plan:

1. Establish a NYC Energy Code that eliminates key loopholes in the previously used NYS Energy Code such as the 50% rule referring to the exclusion of a project if its defined area was less than one half of the total area of the building and the exclusion of certain historic structures.

Efficiency Strategies

2. Upgrade lighting in any proposed building renovations.

3. Benchmark existing building performance using U.S. EPA online tools and protocols (includes municipal buildings of 10,000 sq. ft. or more).

4. Conduct energy audits at least every ten years and undertake retrofits to improve energy efficiency.

5. Development of 19,000 permanent green workforce jobs.

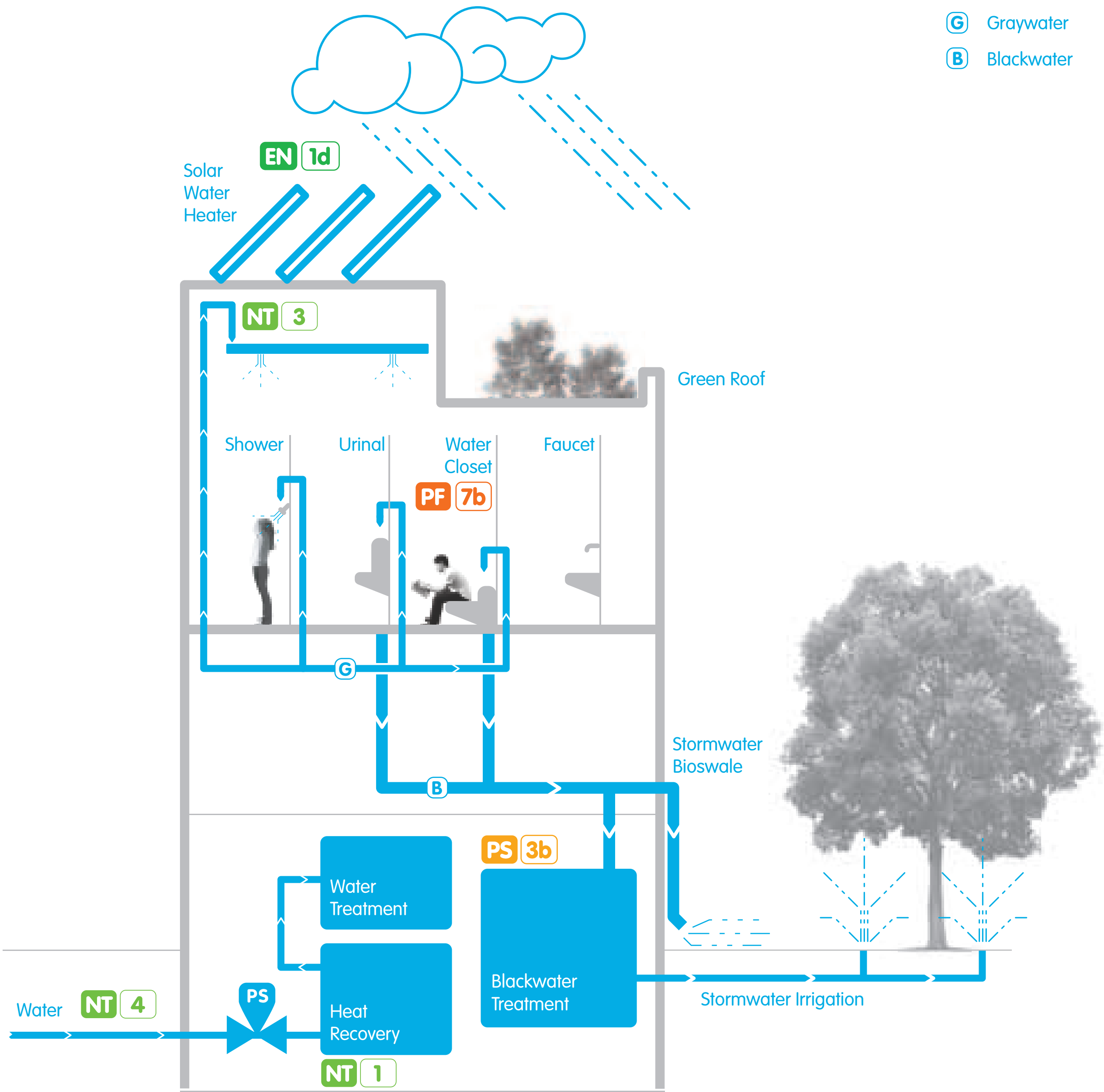
6. Assist small private property owners with stimulus funded financing for retrofits and upgrades.

Water related conservation measures and their respective estimated* payback periods are:

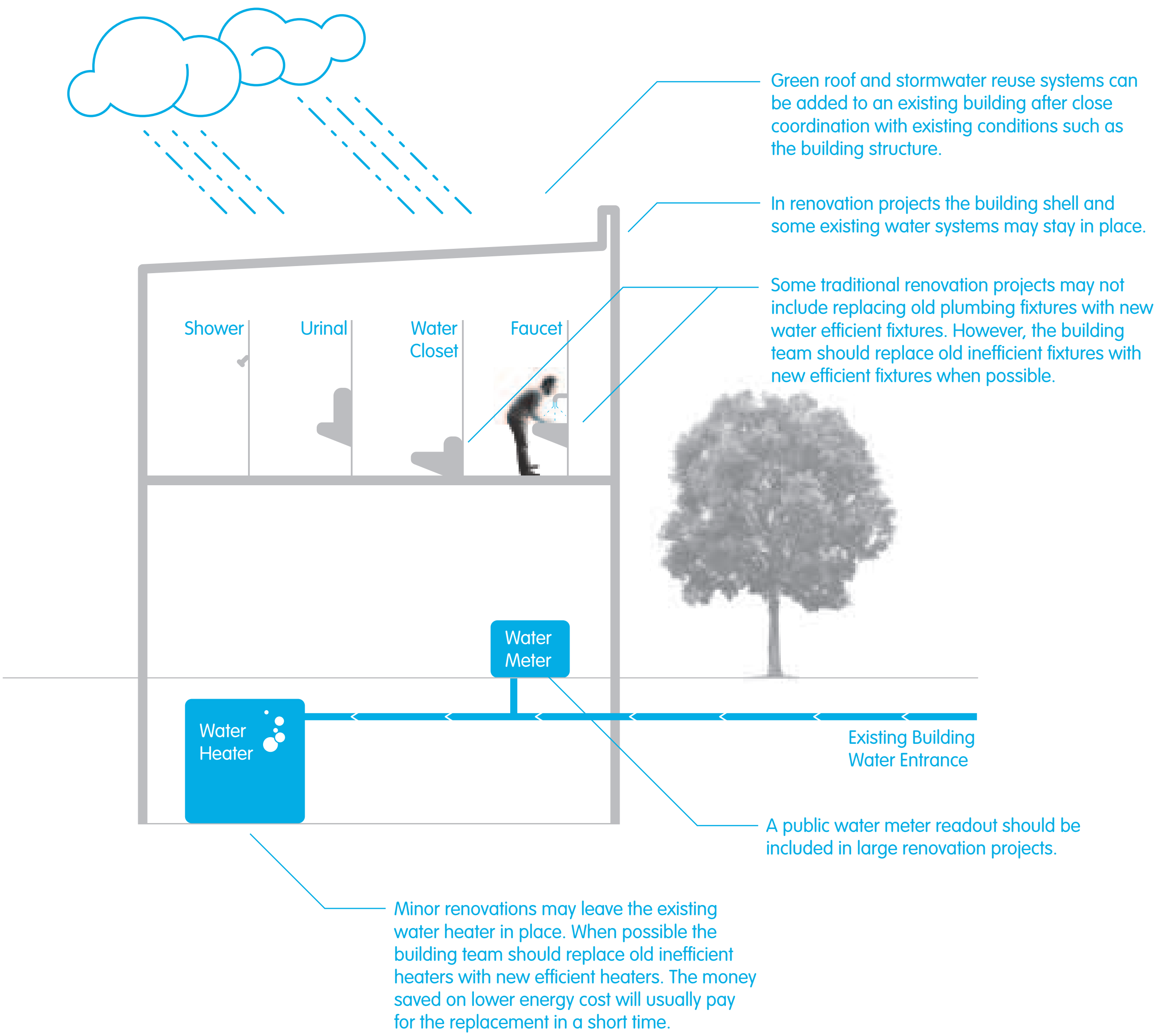
Efficient faucets and showerheads	1.3 yr.
Domestic hot water controls	1.1 yr.
Insulated hot water piping	2.0 yr.
Energy management systems	2.0 yr.
Boiler cleaning and tuning	1.0 yr.

* Payback estimates are from PlaNYC and New York State Energy Research and Development Authority data on multi-family buildings.

Innovative Strategy System Diagram



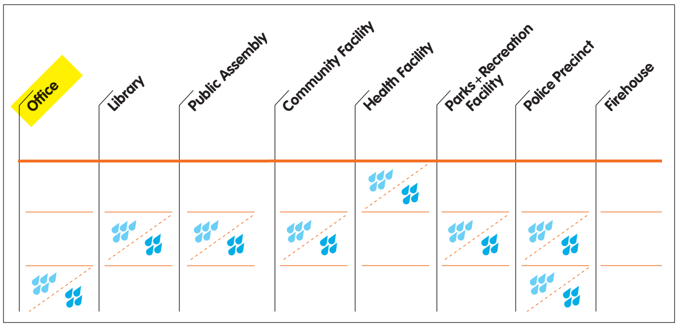
Renovation Strategy System Diagram



2.2
Using the Strategy Matrix

Step 1
Find the column with your **Building Type**.

Example: You are working on an office building. Look down the office column.



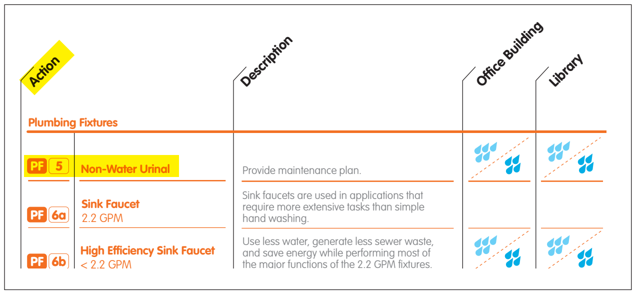
Step 2
Determine your building **Strategy** goal or level of efficiency.

Example: The office building is to be built to the Efficient level, meeting LEED® Silver certification.

The relative water efficiency of each technology (or action) is represented in the matrix using a graphic device consisting of number and shade of water droplets. Five light blue droplets identify technologies appropriate for Efficient buildings; four darker droplets for Renovation projects, three for More Efficient, two for Ultra Efficient, and one darkest blue droplet identifies technologies appropriate for Innovative buildings.

Step 3
Look down the list and take note of the **Technologies (or Actions)** listed by category and by number. Each category can be quickly located by color and two-letter identifier. In addition, each technology has a specific number.

Example: In the office building column under the Plumbing Fixtures section, **PF 5 Non-Water Urinal** is listed.



Step 4
Review the technology in Section 3. Then refer to the **Required Tasks** section on the technology page for **Efficient**.

Example: You will notice there are several tasks listed under the Efficient building heading.

Step 5
Look for the Tasks with your **Building Profession Task Designations**. These are specific tasks you will need to perform for this particular project. **A key to designations can be found below and is also included in each technology write up in Section 3.**

Example: As a **plumbing engineer (PE)**, one of the first tasks is to coordinate with the DDC Project Manager to determine if non-water urinals are feasible and will

Using the Strategy Matrix

be included in the office building project. If so, continue down the tasks listed with the **PE designation**. If non-water urinals are not feasible, go to the PF 4 Urinal technology page (the next best technology) and follow the Efficient tasks.

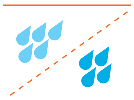
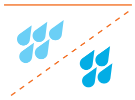
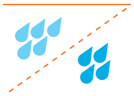
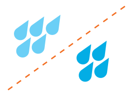
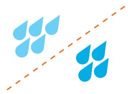
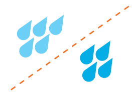
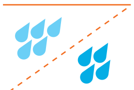
NOTE:
The matrix includes the broadest range of technologies, so it may, over time, conflict with updated regulations. For example, the NYC PC reduces flow to water closets to 1.28 GPF in July 2012. To the extent possible, these updates are indicated in both the matrix and technology section. When using this manual, referencing the latest regulations is a must.

Building Profession Task Designations
Before the building professional team can use a technology it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
BO Building Operator
ME Mechanical Engineer
CE Civil Engineer
LA Landscape Architect
CM Construction Manager

Note that additional tasks are assigned, based on need, for some technologies. Refer to the write ups in Section 3.

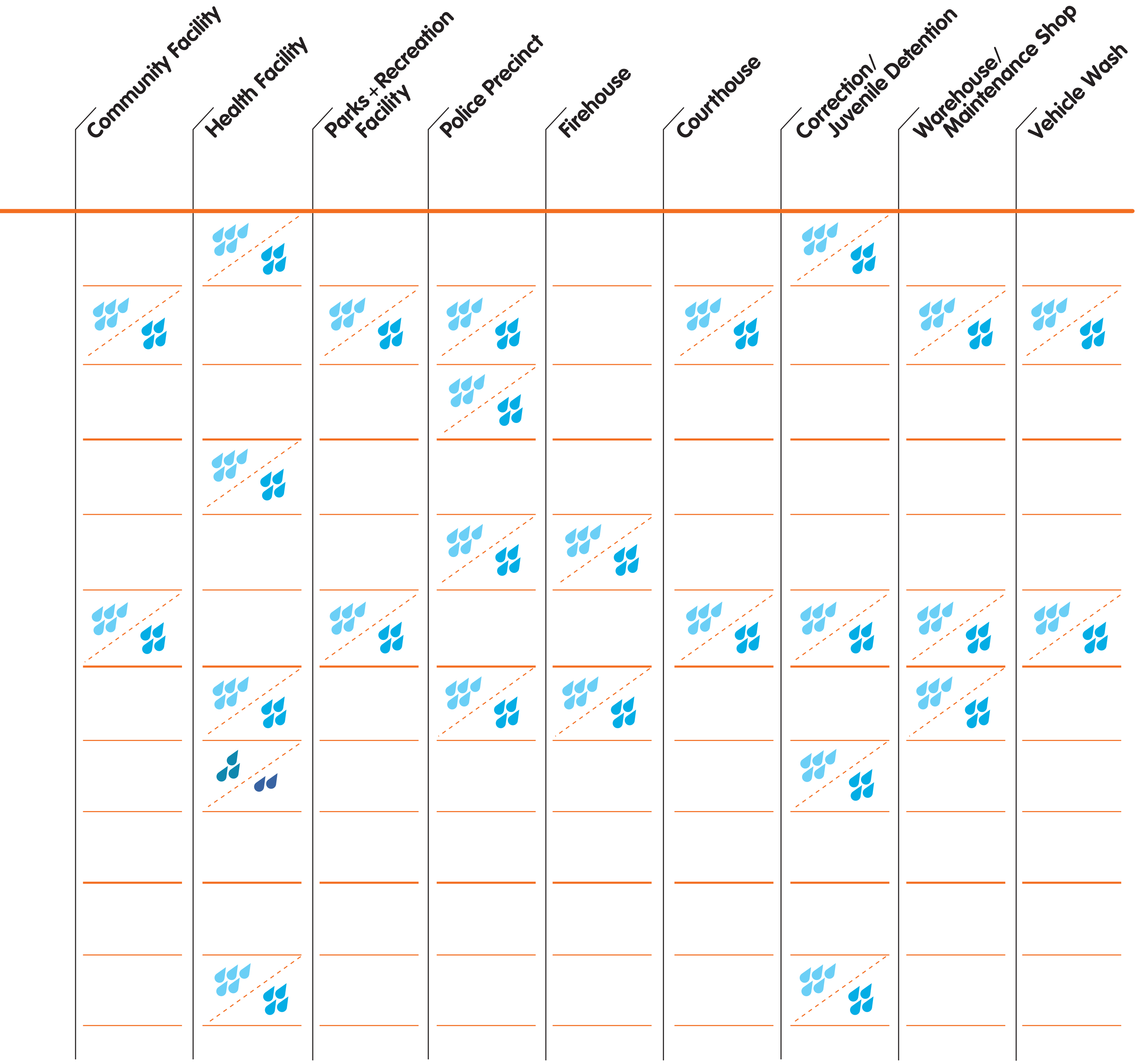
2.3
Strategy Matrix

Action		Description	Office	Library	Public Assembly
Plumbing Fixtures					
PF 1a	**Water Closet** 1.6 GPF	As required by the Energy Policy Act of 1992. Will not comply with NYC PC after July 2012.			
PF 1b	**High Efficiency Water Closet** 1.28 GPF or less	Further reduce water use for fixtures and comply with NYC PC after July 2012; obtain LEED credits under the WE category.			
PF 1c	**Dual Flush Water Closet**	Further reduce water use for fixtures beyond that required by the Energy Policy Act of 1992; obtain LEED credits under the WE category.			
PF 2a	**Lavatory Faucet** 2.2-1.8 GPM	As required by the Energy Policy Act of 1992. Will not comply with NYC PC after July 2012.			
PF 2b	**High Efficiency Faucet** 1.8-.5 GPM	Use less water, generate less sewer waste, save energy, and comply with NYC PC after July 2012.			
PF 2c	**Ultra High Efficiency Faucet** <.5 GPM	Required for public toilets.			
PF 3a	**Shower** 2.5 GPM	As required by the Energy Act Policy of 1992. Will not comply with NYC PC after July 2012.			
PF 3b	**High Efficiency Shower** <2.5-2.0 GPM	Use less supply water, generate less sewer waste, save energy, and comply with NYC PC after July 2012.			
PF 3c	**Ultra High Efficiency Shower** <2.0 GPM	Use less supply water, generate less sewer waste, and save energy compared to the standard 2.5 GPM and 2.0 GPM shower fixtures.			
PF 4a	**Urinal** 1 GPF	As required by the Energy Policy Act of 1992. Will not comply with NYC PC after July 2012.			
PF 4b	**High Efficiency Urinal** .5 GPF	Use less water, generate less sewer waste, save energy, and comply with NYC PC after July 2012.			

Strategy + LEED Level Key

Efficient	Renovation	More Efficient	Ultra Efficient	Innovative
LEED Silver	LEED Silver	LEED Gold	LEED Platinum	For Pilot Efficiency Programs

Chart 01



*Empty blocks with no designation indicate technologies not appropriate for building type.

Strategy Matrix

Action		Description	Office	Library	Public Assembly
PF 4c	**Ultra High Efficiency Urinal** < .5 GPF	Use ultra low flow when non-water urinals are not approved.			
PF 5	**Non-Water Urinal**	Provide maintenance plan.			
PF 6a	**Sink Faucet** 2.2 GPM	Sink faucets are used in applications that require more extensive tasks than simple hand washing.			
PF 6b	**High Efficiency Sink Faucet** < 2.2 GPM	Use less water, generate less sewer waste, and save energy while performing most of the major functions of the 2.2 GPM fixtures.			
PF 7a	**Foam Flush Toilet**	Eliminate (or nearly eliminate) toilet waste into the municipal sewer system.			
PF 7b	**Composting Toilet**	Eliminate (or nearly eliminate) toilet waste into the municipal sewer system.			
PF 8	**Drinking Fountain**	Reduce the use of plastic drinking bottles.			

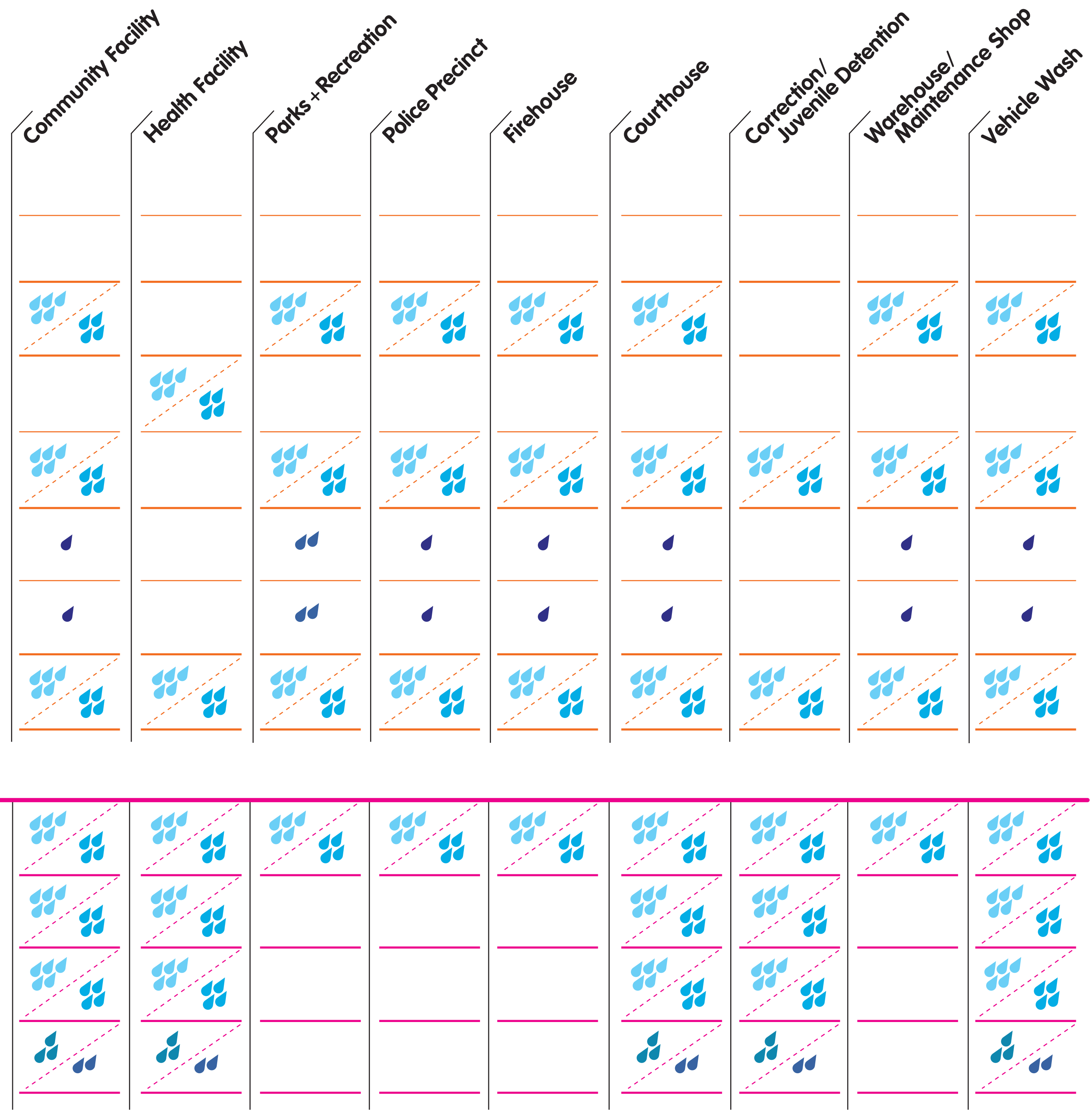
Mechanical Systems

Action		Description	Office	Library	Public Assembly
MS 1	**Equipment Cooling** No Potable Water	Reduce water, sewer, and energy use in a building by eliminating “once through” use in cooling equipment. Meets NYC PC.			
MS 2	**Cooling Tower**	Reduce process water supply.			
MS 3	**Water Softener + Filtration**	Sensors will backwash when system needs cleaning (not set on a timer).			
MS 4	**HVAC Condensate Water Reuse**	Reuse collected condensate to offset domestic water usage.			

Strategy + LEED Level Key

Efficient	Renovation	More Efficient	Ultra Efficient	Innovative
LEED Silver	LEED Silver	LEED Gold	LEED Platinum	For Pilot Efficiency Programs

Chart 02



*Empty blocks with no designation indicate technologies not appropriate for building type.

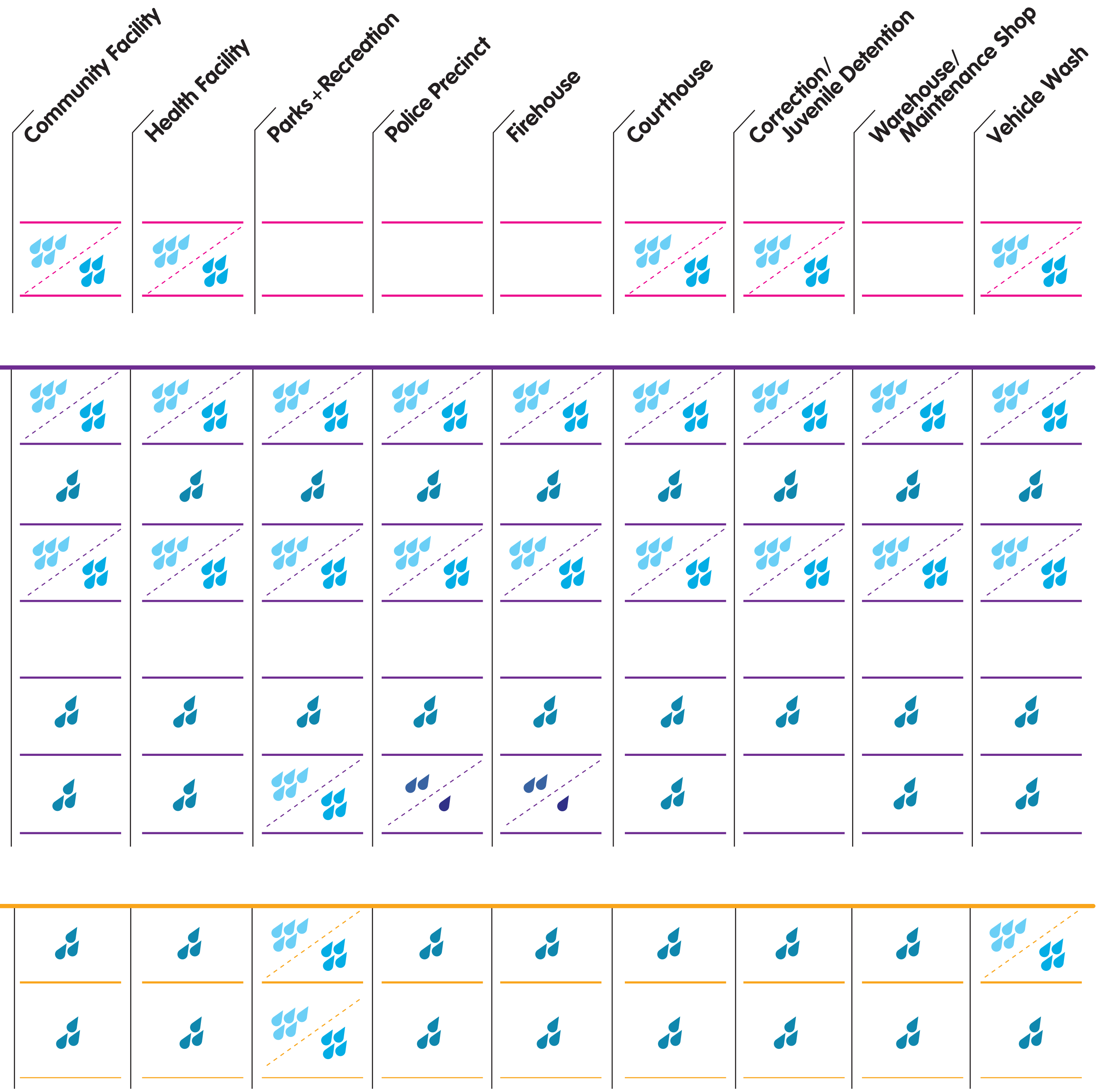
Strategy Matrix

Action		Description	Office	Library	Public Assembly
MS 5	HVAC Equipment	Reduce water supply to HVAC equipment.			
Civil Systems					
CS 1	Stormwater Detention/ Retention Practices	Provide treatment and attenuation of stormwater runoff.			
CS 2	Infiltration Practices	Capture stormwater runoff from impervious surfaces and exfiltrate a volume of water to the subsoil.			
CS 3	Filtering Practices	Provide treatment, attenuation, and infiltration of stormwater runoff where feasible.			
CS 4	Supplemental/Pretreatment Practices	Provide treatment and infiltration of stormwater runoff where feasible.			
CS 5	Irrigation Systems	Reduce potable water use and stormwater runoff where feasible.			
CS 6	Green Roof	Provide attenuation of stormwater runoff through infiltration.			
Plumbing Systems					
PS 1	Water Balance	A water balance tracks the water sources and usage on a site.			
PS 2a	Building Water Reuse Irrigation	Reduce potable water used for irrigation and design a system that more closely matches the natural water usage at the site prior to development. Refer to DDC Landscape Manual.			

Strategy + LEED Level Key

Efficient	Renovation	More Efficient	Ultra Efficient	Innovative
LEED Silver	LEED Silver	LEED Gold	LEED Platinum	For Pilot Efficiency Programs

Chart 03



*Empty blocks with no designation indicate technologies not appropriate for building type.

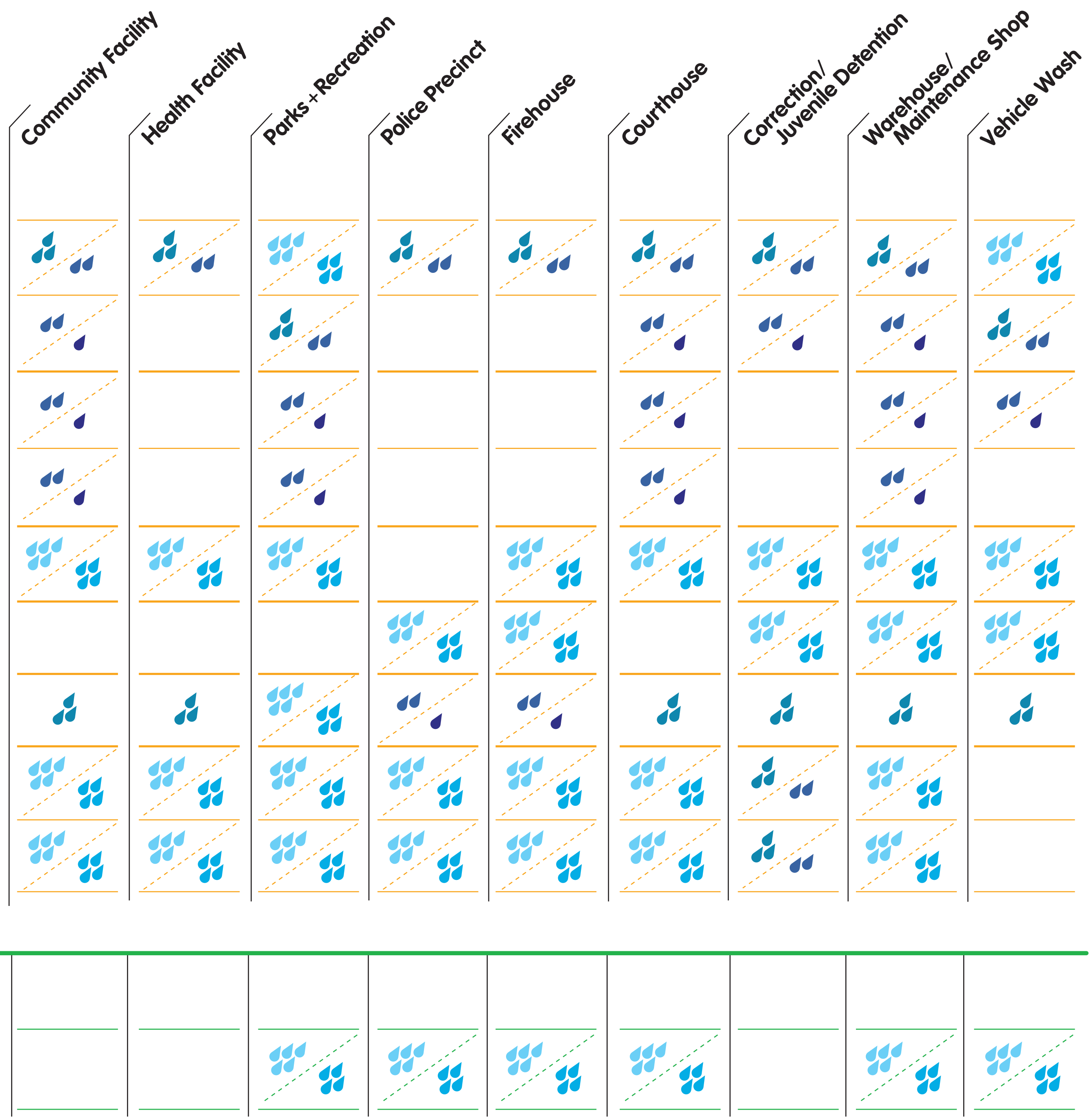
Strategy Matrix

Action		Description	Office	Library	Public Assembly
PS 2b	**Building Water Reuse** Mechanical Use	Reduce potable water use to mechanical systems and reuse water from mechanical system discharge.			
PS 2c	**Building Water Reuse** Flush Fixtures	Reduce potable water use to plumbing flush fixtures.			
PS 3a	**Graywater + Water Reuse** Building System	Reduce potable water use with the installation of a graywater system that will reuse wastewater from fixtures for other water uses in a building.			
PS 3b	**Blackwater** Building System	Reduce facility potable water use with a blackwater system that will reuse the wastewater from fixtures to other water uses in a building.			
PS 4	**Waste Sample Pits**	Install monitoring pits in stormwater and sewer mains for operations to monitor potential harmful material.			
PS 5	**Graywater + Water Reuse** Vehicle Wash	Install vehicle wash system using little or no potable water.			
PS 6	**Green Roof** Building System	Reduce and improve quality of stormwater discharge while reducing building energy loads and heat island effect.			
PS 7a	**Waste Pod** Multiple Pipe System	Provide for the future installation of water reuse systems.			
PS 7b	**Water Pod** Two Pipe System	Install piping system and space for future water reuse systems.			
Energy					
EN 1a	**Water Heater** Small Storage < 100 gal and 10 KWh	Install water heater with an energy efficiency (EF) rating of .62 or higher.			
EN 1b	**Water Heater** Small Tankless < 10 GPM	Reduce building energy load by eliminating losses associated with hot water storage.			

Strategy + LEED Level Key

Efficient	Renovation	More Efficient	Ultra Efficient	Innovative
LEED Silver	LEED Silver	LEED Gold	LEED Platinum	For Pilot Efficiency Programs

Chart 04



*Empty blocks with no designation indicate technologies not appropriate for building type.

Strategy Matrix

Action		Description	Office	Library	Public Assembly
EN 1c	**Water Heater** Large Condensing	Reduce building energy load (99% efficient) without the heat loss associated with hot water storage.			
EN 1d	**Water Heater** Solar	Reduce building energy load using renewable power.			
EN 2a	**Pumps** High Efficiency	Energy efficient pumps with a 94% or higher rating as per EPA ratings.			
EN 2b	**Pumps** Variable Frequency Drive	Reduce building energy with pumped systems to match building load.			
EN 3a	**Energy Recovery** Mechanical Systems Preheat	Preheat hot water systems with heat recovery systems from boiler stacks, hot water discharge, or other system.			
EN 3b	**Heat Recovery** Domestic Hot Water	Preheat hot water systems with heat recovery systems from hot water drain piping.			
EN 4	**Piping Insulation** Domestic Hot Water	Reduce energy use by reducing heat loss through piping.			
EN 5	**Piping Layout** Domestic Hot Water	Building plumbing fixtures located near building services. Reduce long runs of piping to remote fixtures.			
EN 6	**Energy Pod**	Power connections that are hardwired to water heaters or pumps can be used for future alternative energy sources.			
EN 7	**Geothermal**	Connect to building geothermal system for water heating.			

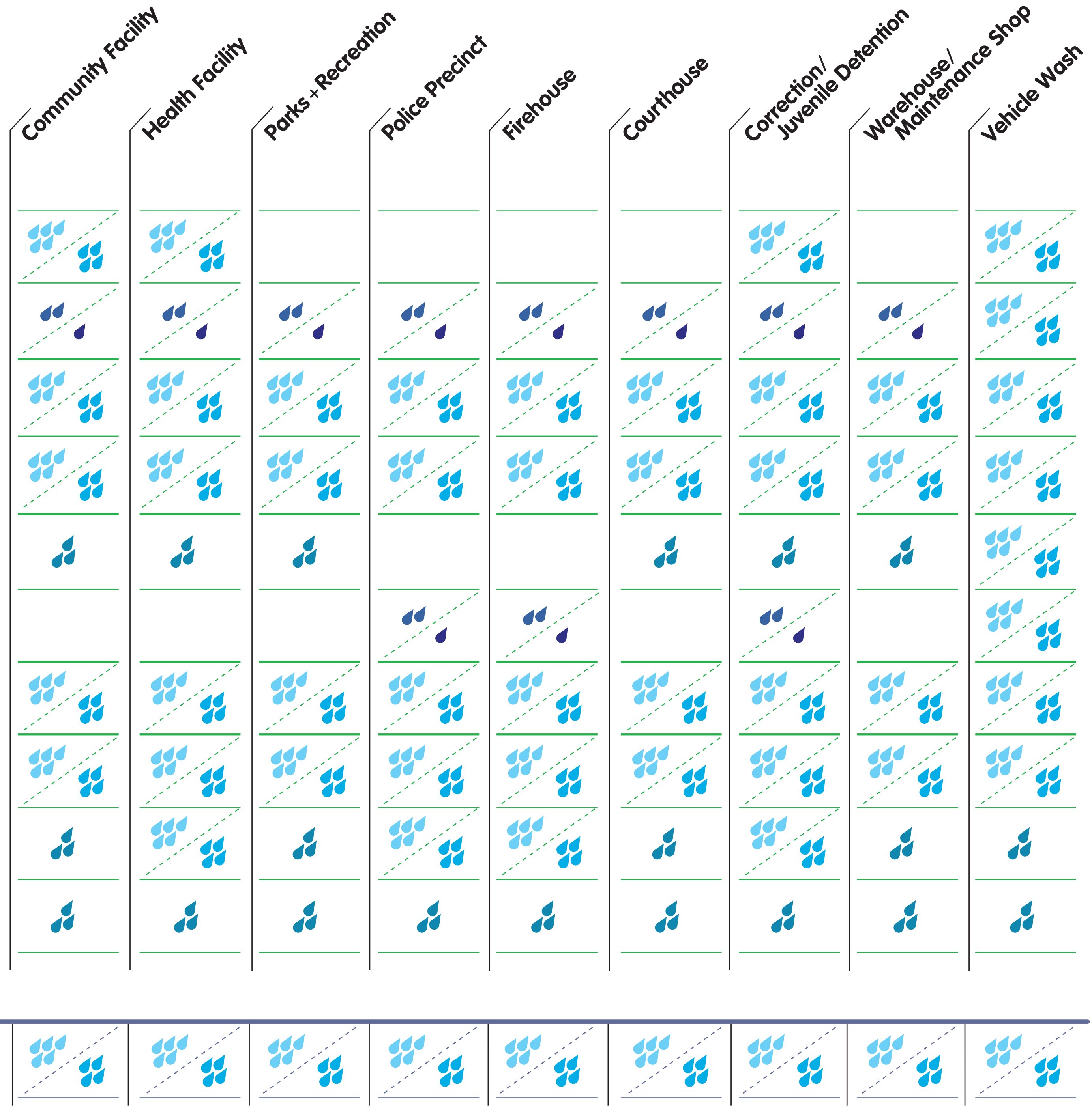
Operations

Action		Description	Office	Library	Public Assembly
OP 1a	**Water Meter** Measurement + Verification	Provide for the ongoing accountability and optimization of building water consumption performance over time.			

Strategy + LEED Level Key

Efficient	Renovation	More Efficient	Ultra Efficient	Innovative
LEED Silver	LEED Silver	LEED Gold	LEED Platinum	For Pilot Efficiency Programs

Chart 05



*Empty blocks with no designation indicate technologies not appropriate for building type.

Strategy Matrix

Action		Description	Office	Library	Public Assembly
OP 1b	**Water Meter** Public Monitoring	Provide ongoing accountability and optimization of building water consumption performance for the general public.			
OP 2	**Water Audit**	Provide water use data to the building operator and design team so actions can be taken to reduce water usage.			
OP 3	**Commissioning**	Verify that the project's water related systems are installed, calibrated, and performing according to the owner's project requirements, basis of design, and construction documents.			
OP 4	**Retro-Commissioning**	On existing buildings verify that the project's water related systems are installed, calibrated, and performing according to the owner's project requirements, basis of design, and construction documents.			
OP 5a	**Harmful Material Waste Stream Prevention**	Protect natural habitat, waterways, and water supply from pollutants carried by building discharge water.			
OP 5b	**Harmful Material in Stormwater**	Incorporate grounds/site/building exterior management practices that preserve ecological integrity, enhance biodiversity, and protect wildlife.			

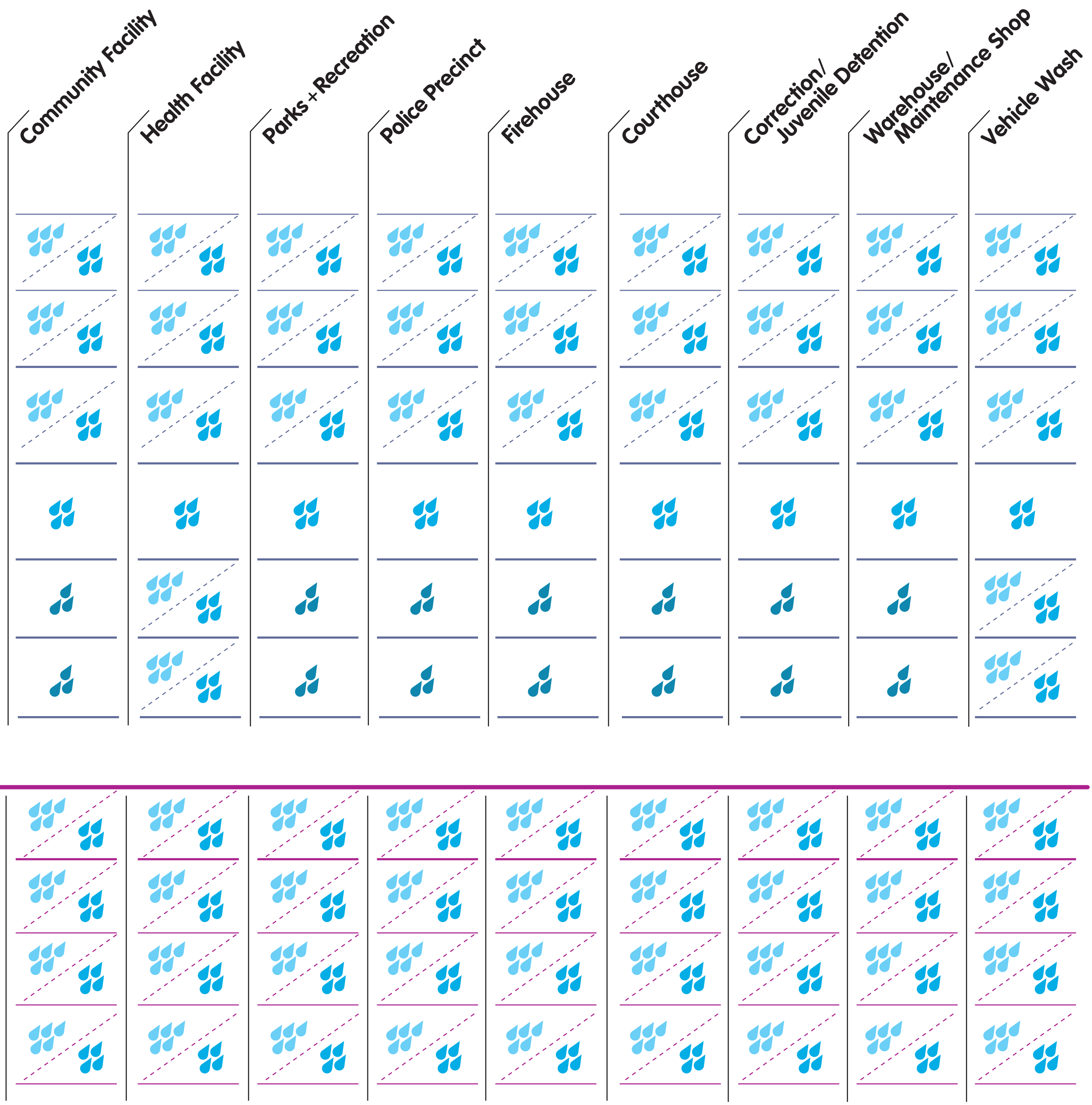
Owner Furnished Equipment

Action		Description	Office	Library	Public Assembly
OFE 1	**Ice Maker**	No potable water cooling. Install air cooled or chilled water cooled ice maker.			
OFE 2	**Energy Star**	Install Energy Star approved equipment.			
OFE 3a	**Food Service** Dishwasher Pre-Rinse	Low flow pre-rinse sprays reduce water usage while maintaining function and safety.			
OFE 3b	**Food Service** Dishwasher	Water efficient dishwashers reduce water usage while maintaining function and safety.			

Strategy + LEED Level Key

Efficient	Renovation	More Efficient	Ultra Efficient	Innovative
LEED Silver	LEED Silver	LEED Gold	LEED Platinum	For Pilot Efficiency Programs

Chart 06



*Empty blocks with no designation indicate technologies not appropriate for building type.

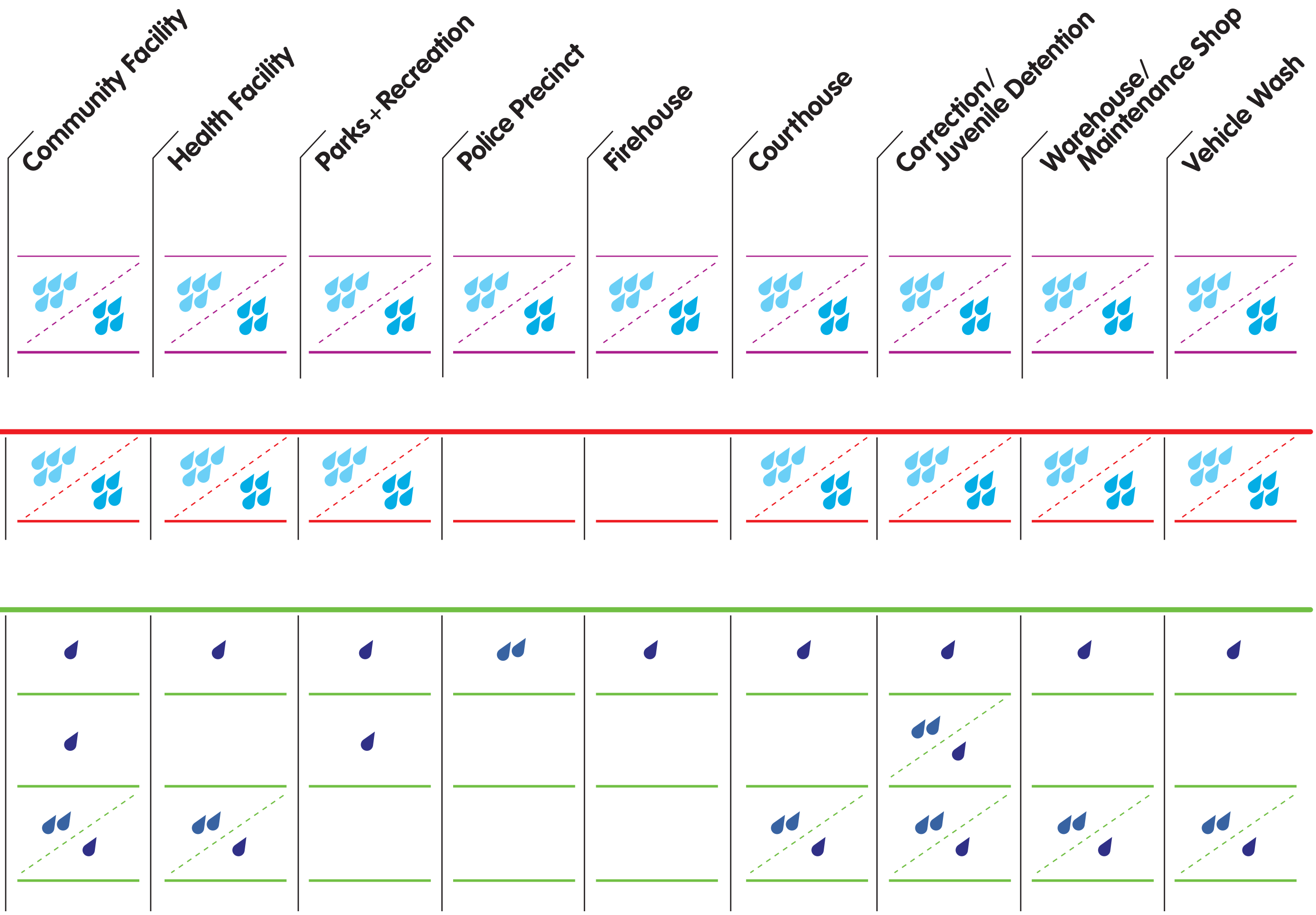
Strategy Matrix

Action		Description	Office	Library	Public Assembly
OFE 4	Laundry Washer	Use Energy Star washers and CEE Tier 3 for residential and Tier 2 for commercial washers.			
Fire Protection					
FP 1	Fire Pump Testing	Design fire pump to recycle water used for testing.			
New Technologies					
NT 1	Fuel Cell	Provide alternative onsite power generation with the byproduct of hot water.			
NT 2	Vacuum Plumbing System	Use a vacuum plumbing system.			
NT 3	Water System Start Up	Reduce the amount of water used during chilled water and sprinkler system start up.			

Strategy + LEED Level Key

Efficient	Renovation	More Efficient	Ultra Efficient	Innovative
LEED Silver	LEED Silver	LEED Gold	LEED Platinum	For Pilot Efficiency Programs

Chart 07



*Empty blocks with no designation indicate technologies not appropriate for building type.

Methods and Technologies

3

Overview

The technologies are divided into nine categories. Each category lists different technologies that can be used in combination to increase the efficiency of a building's water systems.

PF
Plumbing Fixtures

MS
Mechanical Systems

CS
Civil Systems

PS
Plumbing Systems

EN
Energy

OP
Operations

OFE
Owner Furnished Equipment

FP
Fire Protection

NT
New Technologies

PF Plumbing Fixtures

Plumbing fixture technologies that reduce water flow are readily available and can play an important role in water efficiency plans. Plumbing fixture technology, similar to electricity, is a technology that has historically improved quality of life. The simple flush toilet is seen as one of the primary technologies for a modern developed society. Plumbing fixtures bring health and safety to communities.

Plumbing fixtures are at the heart of a complex infrastructure that both supplies fresh water to the fixture and removes waste from the fixture. This vast municipal infrastructure must supply fresh, safe potable water constantly and remove the wastewater from the point of use in the same quick, safe, and efficient way.

During the 20th century, overall water use increased dramatically, but varies greatly between the United States, Europe, and developing countries. For example currently, per capita water consumption in the United States runs as high as 100 gallons/day (USGS, 2004); in Germany, 34 gallons/day; and in developing countries 5-7 gallons/day, just enough to meet basic human needs.[1]

The maximum amount of water used by a plumbing fixture in the U.S. is set by the Energy Policy Act (EPAct) of 1992 and subsequently the EPAct of 2005.[2] The introduction of compliant fixtures has made a noticeable impact on water use in the city. Based on the US Census Data, the New York City Department of Environmental Protection (DEP) has tracked a continuing downward trend in gallons/capita/day since 1991. Today, with a population of over 8 million, just over 1 billion gallons of water is used in a day.[3]

Now, in the second decade of the 21st Century, NYC is passing legislation to further reduce water usage. For example, Local Law 57 will further restrict the flow rate to the most commonly installed plumbing fixtures.[4] This new law preempts EPAct of 2005. Other laws and requirements may pass after the publication of this manual. It is the responsibility of the building team to include these changes in each specific project.

When developing a water efficiency strategy it is important to realize that water efficiency technologies are based on the number of people in a facility and how many times the plumbing fixtures will be used. For example, the use of low flow shower systems in a housing facility will reduce the amount of water used where large populations take showers each day. Compare this to an office building with showers that are rarely used. Specifying low flow showerheads in the office building will not reduce the percentage of building water used to the same extent as in a residential building. It is important to use the technologies that comprise an overall building strategy to maximize water usage reduction.

For more information go to:

1 United Nations Water for Life, Factsheet On Water And Sanitation http://www.un.org/waterforlifedecade/factsheet.html

2 EPAct, 2005 Flow Rate Matrix http://www.epa.gov/WaterSense/docs/matrix508.pdf

3 NYC Department of Environmental Protection, History of Drought and Water Consumption http://www.nyc.gov/html/dep/html/drinking_water/droughthist.shtml

4 NYCDOB Amendments http://www.nyc.gov/html/dob/html/reference/recent_code.shtm

Water Closet

1.6 GPF

PF **1a**

Operations **Plumbing Systems**

OP 1 OP 3 PS 2c PS 3a

Objective

Reduce the amount of supply water, wastewater and sewer flow, and energy used in new facilities.

Benefits

- Universal fixtures in various styles and with various functions are available for all building types.
- Reliable and proven technology
- Variety of sizes and options
- Good parts distribution and product support
- Current state of the art
- Effective for use in health care institutions
- Reduce water use in renovated buildings (built before 1992).

Limitations

The 1.6 gallons per flush (GPF) fixture has had an impact on reducing water and sewer flows for 20 years. These fixtures are used as the benchmark for water efficiency calculations required by regulation, such as Local Law 86. Prior to the 1.6 GPF requirement, fixtures used as much as 3.5 to 7 GPF. Many of these fixtures are still in operation. Renovation or regular O+M standards and procedures should specify that older fixtures be removed and replaced with water efficient fixtures. Note that specifying the 1.6 GPF fixture will not help the design team obtain LEED WE credits and in most cases using this fixture can make it harder to obtain the LEED prerequisite. It should also be noted that newer technologies are currently available that can further reduce water flow while maintaining function.

Note: These fixtures will not comply with NYC Plumbing Code requirements in Local Law 57 after July 2012.

Background

The current standard of 1.6 GPF maximum is required by the Energy Policy Act of 1992. (Note: After July 2012 the standard will be 1.28 GPF as governed by the NYC Plumbing Code (NYC PC). There are many types of water closets on the market available from a variety of manufacturers. Each fixture is designed for a particular building type or purpose. Examples of the most common are provided below, including references to the NYC PC terminology as appropriate:

Tank Type (NYC PC) sometimes referred to as Gravity-Fed, are the most common types in residential applications. Water is stored in a tank above the bowl. When flushed, an elastomeric flush valve seal (flapper) opens, sending the water from the tank by gravity into the bowl in order to clear all liquid and solid waste. Tank Type fixtures can be used at line and pressures up to 80 psi, but are especially useful when the building pressure is below 20 psi, when recovery time is not an issue, and when noise is a concern. Because the tanks can take a long period of time to refill they may not be practical in non-residential applications.

Flushometer Valve (NYC PC) fixtures are the most common type fixtures in non-residential applications. The available water pressure and flow is used to clear the bowl of liquids and solids, but larger diameter water supply piping is required. There are two popular technologies. One uses a rubber diaphragm to regulate the flow through the fixture and shut off flow through the fixture when the flushing cycle is complete. The second type uses a piston type operation. Both have a powerful flushing action and quick recovery time. However, Flushometer fixtures are slightly louder than gravity-fed tank type fixtures and should not be used in applications where noise is a factor.

Flushometer Tank (NYC PC) sometimes referred to as Pressure Assist fixtures, combine the powerful bowl cleansing capabilities of flushometer valve fixtures in applications where large diameter supply piping is not available. Flushometer tank fixtures use the available building pressure to fill a pressure vessel inside the fixture tank. Flushing uses the air compressed within the vessel by the refilling water to evacuate the bowl and clear the trap. These fixtures have a powerful flushing action with a fairly rapid recovery time.

There are also vacuum assist toilets and non-water toilets. For further information see PF 7 and NT 2.

Operation

Manually operated fixtures, which operate only when the user activates the handle, are common. These fixtures are not always flushed after use, leading to cleanliness concerns. Sensor-activated fixtures, which do not require the user to touch the fixture, are designed to operate after every use. There can be water efficiency concerns with sensor operated fixtures because they sometimes flush several times with one use. In fact, generally speaking, sensor-activated fixtures have been proven to be quite water inefficient when compared to manually activated fixtures, due entirely to the occurrence of phantom flushes. Sensor malfunction can be overcome by specifying a better sensor. For example, an infrared sensor with a three-second delay should be considered. Battery operated fixtures should also be considered as they will continue to operate even if power is lost. There are some battery operated fixtures that recharge through solar cells and water flow. These types do not require as many battery changes and operate when there is no power.

It is important to coordinate cleaning chemicals and methods with sensors, as some will damage sensor lenses and cause them to fail. Also when specifying automatic flush valves, attention should be paid to installation and commissioning issues. Improper design and/or installation can result in excessive activation of these valves and water waste.

Configurations

The 1.6 GPF fixtures are available in many configurations, including various heights, which meet the requirements of the American with Disabilities Act (ADA), as well as smaller fixtures for children. Some fixtures can be mounted to the wall for ease of floor cleaning or, alternatively, floor mounted. Construction materials include both vitreous china and stainless steel. It is important to use the manufacturer- and code-specified, hydraulically matched configurations for fixtures so that the correct bowl is matched with the correct tank and flush valve.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent

Water Closet

PF 1a

Required Tasks

Efficient

The 1.6 GPF fixtures will be prohibited after July, 2012 by the NYC PC. Furthermore they should not be used when obtaining LEED certification. Other more efficient fixtures should be used.

The main water efficiency concern with water closets is leaks in the plumbing, which can add 20% or more to the water consumption of a building. Proper maintenance is necessary to ensure that leaks are prevented or repaired.

Tank type, gravity-fed fixtures employ a flush valve flapper type seal that has a limited life span. Older sealing materials can degrade over time causing water to run from the tank into the bowl. This type of leak can be hard to detect. However, recent developments in material compounds by seal manufacturers, together with the durability requirements incorporated into the national standard in 2005, have led to much longer lifetimes for all flush valve seals and leakage through the seal is now a rare occurrence. Changing out flush valve seals (flappers) as per the manufacturer recommendations is important. Building operations should maintain a schedule to check and replace seals on a regular basis. BO

Most flushometer valves installed in buildings today employ diaphragm type valves that require maintenance and replacement at regular intervals. Small particles in the water supply lines can clog the small opening in the diaphragm, causing the valve to stick in the open position. Loss of water pressure or turning off water supply to the building may also cause flushometer valves to get stuck in an open position. If this occurs, hundreds of gallons of supply water can flow though the fixture in just a few minutes. In addition to this, some fixture drains cannot handle the increased flow, resulting in a flooded toilet room within minutes. Water may leak into areas below if left unchecked. Water damage can lead to other problems, including mold growth and compromised indoor air quality. Piston-type flushometer valves are not generally subject to the same issues. However, the upfront cost is typically higher.

Some manufacturers provide valves specially designed for use with recycled (reused) water. It should be noted that the quality of the water introduced into those fixtures is imperative to their function and flush performance. For example, special valves may need to be specified.

The use of treated graywater or blackwater (or any other alternate nonpotable source, such as cooling condensate, foundation drain water, etc.) for flushing toilet fixtures may void the manufacturer's warranty.

Buildings where diaphragm type valves are used should have on-call operation personnel at all times (24 hours a day/seven days a week) to repair valves that become stuck in the open position. Building operations must have a regular schedule to check and replace diaphragms in the valves. Building operations must develop a procedure to monitor the water meter system and identify high flows that may indicate failed flush valves. BO

More Efficient **Ultra Efficient** **Innovative**

The use of 1.6 GPF fixtures will not contribute credits under the LEED WE category. Also, their installation will be prohibited after July 2012 in NYC. Until then, however, in some buildings striving for more efficiency, the 1.6 GPF fixtures may have to be used. In such cases, follow the tasks listed for efficient buildings.

Integration

In general, when 1.6 GPF fixtures are used, the addition of other water efficiency methods will be necessary in order to reduce total water flow to the building. Other strategies to be examined include:

OP 1 Water Meter

When water meters track high water use, water closet leaks should be checked.

OP 3 Commissioning

Water closets should be checked on a regular basis for leaks.

PS 2c Building Water Reuse (Flush Fixtures)

PS 3a PS 3b Graywater and Water Reuse and Blackwater

1.6 GPF fixtures can be used with graywater and black-water systems that provide nonpotable water to the fixtures for flushing. Note that graywater processing and storage systems will need to be larger when 1.6 GPF fixtures are used.

High Efficiency Water Closet

1.28 GPF or less

PF 1b

Plumbing Fixtures

PF

Operations

OP 1 OP 3

Plumbing Systems

PS 2c PS 3a PS 3b

Objective

Further reduce water use for fixtures beyond that required by the Energy Policy Act of 1992; comply with NYC PC as of July 2012 when 1.28 GPF becomes the maximum allowable flow; obtain LEED credits under the WE category for water use reduction beyond 20%.

Benefits

Reduces supply water, wastewater and sewer flow, and energy consumption compared to 1.6 GPF fixtures.

Fixtures can be used with other technologies to obtain LEED credits.

Limitations

Fewer fixtures are currently available as compared to the wide variety of 1.6 GPF fixtures.

Fixture manufacturers may require specifying matched flushometer valve and bowl combinations because of close tolerances when compared to 1.6 GPF where valves and bowls can be mixed and matched.

Fixtures may not be able to be specified in some facilities, such as health care, based on the amount of water required to clear the trap, although after July 2012, 1.28 GPF becomes mandatory.

Background

Manufacturers are responding to the market demand for fixtures that are more efficient than 1.6 GPF fixtures. As a result, there are currently many types available designed for particular building types and purposes. High Efficiency Toilet (HET) fixtures typically include those that effectively operate at no more than 1.28 GPF (20% less than 1.6 GPF).

High efficiency toilet fixtures are included in the U.S. EPA sponsored WaterSense program. A WaterSense label is required for most fixtures by NYC PC after July 2012. Labeled fixtures are third party tested, ensuring compliance with both the required effective flush volume and solid waste removal. Make certain that all fixtures specified and installed have the WaterSense label.

Technology

Refer to PF 1a for a description of the different types of fixtures. The following provides specific information on high efficiency fixtures:

Tank Type (gravity fed) valve assemblies for high efficiency fixtures are sometimes different than the standard 1.6 GPF assemblies. Whereas most 1.6 GPF fixture valves from one manufacturer can be installed on a tank from a different manufacturer, this is not always true with high efficiency fixtures that include certain proprietary design features. Since high efficiency tank type fixtures have been on the market in the U.S. for over 10 years, spare parts are readily available in the marketplace. Properly installed, they will provide years of good service.

Flushometer valve and bowl combinations are different than their 1.6 GPF counterparts and are not interchange-

For more information go to: http://www.epa.gov/watersense/pp/het.htm able. Currently, manufacturers are using piston type valves in order to achieve the necessary flush volume tolerances (not generally present with diaphragm valves). This has the added benefit of avoiding flooding risks occasionally found with diaphragm type valves. Most of the fixture combinations available employ sensor-activated valves, although sensors are known to increase water consumption over traditional manual activation.

Flushometer tank technology for high efficiency fixtures is not much different than 1.6 GPF fixtures and there are many configurations available.

Configurations

The residential market leads product development for high efficiency fixtures, so there are more residential fixture options available. Products for the commercial market are now being developed and released to the marketplace.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist

Required Tasks

Efficient

High efficiency fixtures may not be available for all building types. During the schematic design (SD) phase, the design team must determine if these fixtures are appropriate. DDCPM BO PE

Owners and operators have many fixture choices, for example, dual or single flush, wall hung or floor mounted, manual or sensor-operated flush valves. If the DDC is not clear which type to specify for particular applications, it may be desirable to try out different fixture types in different applications. DDC preferences should be sent to the design team early in the SD phase of the project. DDCPM BO PE

Credits can be obtained under the LEED Credit WE 3 Water Use Reduction by specifying high efficiency (less than 1.28 GPF) fixtures. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED credit calculation is correct and that all the submittal requirements and documentation are complete. PE LS

Coordinate with regulatory agencies and confirm that the specification of high efficiency fixtures is acceptable for the building type. DDCPM PE

At this time, high efficiency fixtures are not as common as 1.6 GPF fixtures. Therefore, extra parts should be made available to expedite repairs. This should ease up after July 2012 when 1.28 GPF becomes the standard. When specifying fixtures, one brand and model should be set up as the standard for the building or facility to minimize the number of spare parts required for repairs. BO

High Efficiency Water Closet

PF 1b

Specify only fixtures certified as compliant with the WaterSense specification. After July 2012 this is mandated for certain fixtures by NYC PC. When possible use one type of fixture in the entire building. (**Note**: At this time, WaterSense is in process of developing a specification for flushometer valve fixtures and, as such, no qualified fixtures for water closets are currently listed. The WaterSense website should be checked for updates. PE

More Efficient Ultra Efficient

High efficiency toilets should be used in more efficient and ultra efficient buildings. When they are used, follow the tasks outlined above for efficient buildings.

Close integration amongst the design team is required when the fixtures are part of a building water reuse system. Data from the fixtures will be required to prepare the water balance. PE

Innovative

In innovative buildings, the most water conservative fixtures should be specified. This may include the use of dry toilets where permitted and found to be feasible. See section PF 7a and PF 7b.

Integration

PF Plumbing Fixtures

High efficiency toilets can be used with other high efficiency fixtures.

OP 1 Water Meter

When water meters track high water use, water closet leaks should be checked.

OP 3 Commissioning

Water closets should be checked on a regular basis for leaks.

PS 2c Building Water Reuse (Flush Fixtures)

PS 3a Graywater and Water Reuse

The treated water from a building graywater system can also supply water to the HE water closet. Using HE water closets reduces the storage and processing volume for the graywater system.

PS 3b Blackwater

The discharge can supply the blackwater system. The treated water from the blackwater system can be used to supply water to HE water closets. It is best to use HE or ultra high efficiency PF 1c water closets to reduce the storage and processing volume for the blackwater system.

For more information on EPA WaterSense go to: http://www.epa.gov/watersense/pubs/toilets.htm

PF 1c Dual Flush Water Closet

Plumbing Fixtures

PF

Operations

OP 1 OP 3

Plumbing Systems

PS 2c PS 3a

Objective

Further reduce water use for fixtures beyond that required by the Energy Policy Act of 1992; comply with NYC PC after July 2012; obtain LEED credits under the WE category.

Benefits

Reduces supply water, wastewater and sewer flow, and energy consumption compared to standard 1.6 GPF fixtures.

Full flush for solid waste.

Limitations

Dual flush fixtures are best suited for use in applications in which the same people use the same toilet room on a regular basis, for example staff or residential toilet rooms. Dual flush fixtures are not as effective when installed in public toilet rooms where individuals may not be familiar with their operation and typically do not take time to use the flush options. This limitation may disappear over time if and when the dual use fixture becomes more familiar.

Dual flush fixtures are recommended for use only in women's or unisex toilet rooms. Typically, in men's toilet rooms, urinals are used for liquid waste and water closets are used for solid waste.

Dual flush fixtures are not available in as many configurations as typical 1.6 GPF fixtures.

Flush valves are often proprietary and cannot be interchanged.

Background

A dual flush fixture is classified as an HET. The dual flush fixture is comprised of two different flushing options. One option uses the full flush (1.6 or 1.28 GPF) to clear the trap, similar to a standard fixture. The second option uses less water (maximum 1.1 GPF), enough to clear the trap of liquid waste. Users realize that the full flush option is not needed for every use and generally like the opportunity to use less water.

Dual flush fixtures are included as an HET in the U.S. EPA sponsored WaterSense program with an effective flush volume not to exceed 1.28 gallons (4.8 liters). The effective flush volume is defined as the composite, average flush volume of two reduced flushes and one full flush. NYC PC has a smiliar definition making it comply with the July 2012 requirements. Labeled fixtures are third party tested, ensuring compliance with both the required effective flush volume and solid waste removal requirements. Make certain that all fixtures specified and installed are WaterSense certified.

Technology

Refer to PF 1a for a description of the different types of fixtures. The following provides specific information on dual flush fixtures:

Tank Type (gravity fed) flush valve flapper assemblies are usually a different design from those installed in standard

For more information go to: http://www.epa.gov/watersense/pp/het.htm

Dual Flush Water Closet

PF 1c

1.6 GPF fixtures and are not generally interchangeable. While most 1.6 GPF fixture valves from one manufacturer can be installed in a tank from another manufacturer, this is not generally true with dual flush fixtures, which often have proprietary flush valves. When various types and models are installed in one facility, it may be necessary to maintain a stock of replacement parts for each of the different models, which is a problem. Dual flush products are readily available and, when properly installed, will provide years of good service. Most manufacturers offer units in a wide price range from basic to luxury.

Flushometer valves can be retrofitted on diaphragm type valves by replacing the standard 1.6 GPF handle with a dual flush handle. These retrofits are designed for existing valves and bowls, and work well in most situations. This is an excellent application for renovations. It is good practice to test the handles on sample fixtures to ensure that they operate efficiently with the available water pressure and flow. When handles are replaced, signs should be installed near the fixture to educate the users on how to use the dual flush handles.

Dual Flush Systems work best when the valves are hydraulically matched by the manufacturer with a specific bowl. When specifying fixtures, one brand and model should be set up as the standard for the building or facility to minimize the number of spare parts required for repairs.

Flushometer Tank dual flush technology is similar to that used in the single flush fixture.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist

Required Tasks

Efficient

Dual flush fixtures may not be applicable for all building types. Therefore, during the schematic design (SD) phase, the design team must determine if dual flush fixtures are appropriate. DDCPM BO PE

Similar to other single flush high efficiency fixtures, a full line of these fixtures is readily available in the marketplace.

Once the mandatory 20% water use reduction is achieved, LEED credits can be obtained under the LEED WE Credit 3 Water Use Reduction by specifying dual flush fixtures. Note that credit cannot be taken for installation of dual flush fixtures in men's toilet rooms if urinals are present. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculation is correct and that all submittal requirements and documentation are complete. PE LS

Coordinate with regulatory agencies and confirm that specification of dual flush fixtures is acceptable for the building type. DDCPM PE

Dual Flush Water Closet

Dual flush fixtures are not as common as 1.6 GPF fixtures and extra parts should be available to expedite repairs. When specifying fixtures, one brand and model should be set up as the standard for the building or facility to minimize the number of spare parts required for repairs. BO

All dual flush fixtures should bear the EPA WaterSense label which is a requirement of the NYC PC after July 2012. When possible use one type of fixture in the building. PE

More Efficient Ultra Efficient

Dual flush fixtures should be specified. Follow the tasks outlined above for efficient buildings.

Close integration is required when the fixtures are part of a building water reuse system. Data from the fixtures will be required to prepare the water balance. PE

Innovative

In innovative buildings, the most water efficient fixtures should be specified. This would include the use of dry toilets. See PF 7a and PF 7b.

Integration

PF Plumbing Fixtures

Dual flush water closets can be used with other high efficiency fixtures.

OP 1 Water Meter

When water meters track high water use, water closet leaks should be checked.

OP 3 Commissioning

Verify dual flush is installed correctly and is operational.

PS 2c Building Water Reuse (Flush Fixtures)

PS 3a Graywater and Water Reuse

The treated water from a building graywater system can supply water to the HE water closet, provided that the fixture manufacturer agrees to accept nonpotable water. It is best to use HE PF 1b or dual flush PF 1c water closets to reduce the storage and processing volume for the graywater system.

References

EPA WaterSense, a partnership program sponsored by the U.S. Environmental Protection Agency
http://www.epa.gov/watersense/pubs/toilets.htm

Lavatory Faucet

2.2 to 1.8 GPM

PF 2a

Objective

Lavatory faucets are primarily used for handwashing and some light bathing, while sink faucets PF 6 are used for tasks such as utensil washing, culinary, cleaning, laundry, scrubbing, or building maintenance. Building design teams must match the proper low flow lavatory faucet with the correct application

Benefits

Reduces water, energy, and sewer flow when fixtures properly match application.

The fixtures are available in different configurations and options.

The higher flow fixtures work well in health care, food service and other heavy hand washing applications, where lower flow fixtures do not provide adequate water flow (see PF 6).

Limitations

Using these lavatory fixtures may not add LEED credits or help meet the water efficiency goals of the facility, however, 2.2 GPM is the LEED baseline. The flow requirements for these fixtures continue to change requiring frequent reference to code updates.

Out of the three lavatory faucet choices in this chapter, these faucets use the most water. Consequently, the design team shall only use these type fixtures as a necessary exception.

Note: These fixtures will not comply with NYC Plumbing Code in Local Law 57 after July 2012 when the maximum flow to private lavatories will be 1.5 GPM.

Background

Lavatory faucets are used in three broad categories of applications. The first category is public hand washing in public toilet rooms or areas. In public toilet rooms the New York City Plumbing Code requires the fixtures touse .5 gallons per minute (GPM) flow PF 2b and PF 2c. Fixtures using 1.5 GPM cannot be used in public toilets.

The next category is for moderate hand washing and light bathing (face washing, shaving or teeth brushing). The NYC Plumbing Code usually refers to these facilities as private lavatories. Fixtures using 1.8 GPM or less are typically specified. (Note: After July, 2012 the maximum flow rate becomes 1.5 GPM.) These fixtures are covered in PF 2b. Private lavatories may have many different applications and the DDC will have preferences on which fixtures should be used in each particular application.

The third category is for heavy hand washing, such as medical, culinary, and maintenance. In these applications more water is required and as a result, 2.2 GPM to 1.8 fixtures can be used. Scrub sinks or sinks used in clinical applications could use these faucets. The NYC Plumbing Code does restrict these fixtures to less than 2.2 GPM. The design team should monitor code changes to verify current acceptable flow rates. There are other regulations, such as for individual infection control of staff in a particular municipal facility that may also require these higher flows. NYC and NYS departments of health have detailed requirements for medical facilities. The design team must monitor and comply with these standards, which can be exempt in possible LEED credits calculations in these applications.

In culinary applications, code authorities may require .5 GPM faucets in public toilet rooms as does the NYC PC after July, 2012. However, in the staff areas where heavier handwash applications are necessary, the higher flow (2.2-1.8 GPM) faucets may be required. Maintenance areas and vehicle repair areas where heavy washing is necessary, may also require these higher flow fixtures.

In certain applications, users may be required to actively clean and scrub the hands for a predetermined amount of time. However, in most cases the water does not have to remain flowing during scrubbing. If this is true, sensor-, foot-, or knee-operated fixtures can be specified. The user turns the water on only when wash down is required. It is important to note that these fixtures are exempt from the LEED energy and water calculations in some situations. This is particularly true for clinical applications.

Lead Content

Lead is used in the faucet manufacturing process. While fixtures do not contain the high levels of lead as in years past, they can contain levels that exceed some health concerns. Several states have passed laws to reduce the amount of lead in fixtures from 8% to less than 1/4 of a percent. In response, manufacturers now typically offer fixtures that meet current requirements.

The DDC design team should specify faucets that meet the lower lead requirement in cases where water could be ingested, such as in food preparation areas, lavatories that have spouts to fill drink containers, or lavatories with drinking water bubblers. These fixtures are new to the market and may not be available with all the accessories required for particular applications. Facilities for children or those with compromised health should be the first priority to receive these faucets. When fixture models are available, they should be used first in the following types of facilities:

- Schools and universities
- Restaurants and food service facilities
- Hospitals and health facilities
- Assisted living and nursing care facilities.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist

Required Tasks

Efficient

The DDC PM, architect, building owner, and plumbing engineer shall monitor regulatory requirements for lavatory applications. When lavatories with greater than .5 GPM are under consideration, the building design team shall coordinate with the appropriate regulatory agencies to confirm that the lavatory application is acceptable.

During the schematic design (SD) phase, the DDC PM, architect, building owner, and plumbing engineer should meet to determine which applications, if any, will need to use higher flow (2.2 - 1.8 GPM) fixtures. During this time, proper faucet controls will be determined.

DDCPM A BO PE

Lavatory Faucet

PF 2a

The plumbing engineer should specify faucets with a lead level of less than 1/4 of a percent. Refer to lead section above. PE

Specifying 2.2 to 1.8 GPM faucets on lavatories can be included in the calculation for LEED WE Credit 3, Water Use Reduction. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculation is correct and that all submittal requirements and documentation are complete. PE LS

Commissioning should verify that the specified faucet is installed and the faucet controls are operating properly. CX

More Efficient **Ultra Efficient** **Innovative**

More efficient buildings or buildings with more aggressive sustainable standards should only use higher flow fixtures where applicable. These fixtures should not be specified without consulting the client. DDCPM A BO PE

PF 2b

High Efficiency Faucet

1.8 to .5 GPM

Plumbing Systems PS 3a

Energy EN 1

Operations OP 3

Objective

Use less water, generate less sewer waste, and save energy while performing most of the major functions of the higher flow fixtures.

Benefits

Private lavatory faucets are available with the EPA WaterSense labeling that specify 1.5 GPM maximum and .8 GPM minimum flow rates This is required by the NYC PC after July 2012.

These fixtures are very common and are available in a variety of options.

The fixtures work very well in most hand washing areas in health care facilities such as exam rooms, but may not be recommended for major washing such as scrub sinks. See PF 6.

The faucets are available in most correctional, vandal resistant, and institution type fixtures.

Users usually do not notice the lower flow rate.

Limitations

The NYC Plumbing Code requires .5 GPM faucets in public lavatory applications.

May not provide enough flow for some washing needs.

Technology

These I.8 to .5 GPM fixtures are readily available in many price ranges and options. Water usage is reduced in some fixtures with a simple flow restrictor in the spout, which can be easily removed. Better made fixtures used in DDC facilities integrate the flow restricting device into the fixture. Vandal resistant options are available and should be used in public areas.

Manual and electronic metering fixtures that control the amount of time a fixture operates are available and are recommended in public installations.

Sensor activated valves are available as battery operated, hardwired, hydro, and solar powered options. In general, the hardwired type fixtures are best in heavy traffic areas, as most manufacturers use a higher quality system in these units. However, hardwired low flow fixtures are not offered by many manufacturers. The valves should be connected to backup electric generator power and should be verified against failure if power is lost to the fixture.

The quality of battery operated fixtures is improving, and may be the best application for some facilities. Operators will have to develop a battery changing schedule to ensure against failure. Nonetheless, fixtures that fail in the off position should be used. Fixtures that fail in the on position should never be specified. It should be noted that water flow may increase as the battery ages.

Facility staff should not use cleaning methods or chemicals that scratch or compromise the covers over the sensors. Scratches can cause the fixtures to run longer and waste water.

However, sensor activated faucets have been found in numerous field applications to waste significant amounts of water when compared to manually activated faucets, increasing water consumption by 30% to I00%. These fixtures should not be recommended or specified as a

High Efficiency Faucet

PF 2b

water saving measure. Instead, they provide sanitary benefits that generally outweigh the additional water used in some applications.

There are many options on temperature control. Fixtures where the user sets the temperature above the counter are recommended in staff locations such as health care facilities, where a touchless feature is appreciated. Users in public toilets will usually not notice the temperature control and will seldom use it.

Inline check valves should be installed with mixing valves. In some cases the hot and cold water is mixed at the fixture. Inline check valves should be installed to ensure that the hot water distribution system and temperature maintenance system operate properly in a facility. The check valves will allow the water to flow only in one direction.

The faucets in this category work best with moderate hand washing, light bathing (e.g., face washing, shaving or teeth brushing). Faucets specified between 1.8 (1.5 after July 2012 in NYC) - .5 GPM flow work very well in these applications. For example, these fixtures should be used in toilet rooms where people will be housed for extended periods of time such as dormitories. Gyms, locker rooms and work-out areas, where users may shave or brush their teeth, are also good applications. These fixtures are also a good match for clinical areas where staff must wash their hands on a regular basis before seeing patients.

There are over 750 different EPA WaterSense certified private lavatory faucets that meet the 1.8 - .5 flow rate. This now includes commercial grade faucets allowing the NYC PC to mandate WaterSense certification for most fixtures (effective July 2012).

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist

Required Tasks

Efficient

During the schematic design (SD) phase the DDC PM, architect, building owner, and plumbing engineer should meet to develop a list of acceptable products to use on the project. The team shall use quality commercial grade fixtures and inline check valves on sensor activated fixtures. Sensor activated faucets should be used only for sanitary purposes. DDCPM A BO PE

During the SD phase the DDC PM, architect, building owner, and plumbing engineer should meet to determine which type of fixture will be used at each application. During this time, proper faucet controls will be determined. DDCPM A BO PE

Using these faucets on lavatories can be included in the calculation for LEED WE Credit 3, Water Use

Reduction. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculation is correct and that all documentation and submittal requirements are complete. PE LS

Commissioning should verify that the specified faucet is installed and faucet controls are operating properly. CX

More Efficient **Ultra Efficient** **Innovative**

More efficient buildings or buildings with more aggressive sustainable standards should only use 1.8 (1.5 after July 2012 in NYC) - .5 GPM fixtures where applicable. During the SD phase the DDC PM, building owner, architect, and plumbing engineer should specify these fixtures after consultation with the client. DDCPM A BO PE

During the SD phase the DDC PM, architect, building owner, and plumbing engineer should meet to determine if a graywater, blackwater, or other water reuse system is acceptable by the regulatory agencies, and is feasible for use in the facility. Refer to the PS 3 Graywater and Blackwater sections for important limitations. The supply water to all lavatories shall be from the building potable water system. The supply water shall not connect to any of the building recycled, graywater or blackwater discharge. The drains from lavatories can go into a building recycled water, graywater or blackwater system if there are no excessive chemicals used in the building or if food waste will not enter the system. The team shall coordinate with the water reuse filter manufacturer to verify that no adverse materials are entering the waste stream that could compromise the safety of the reuse system. DDCPM A BO PE

If it is determined that a water reuse system will be specified, the plumbing engineer will include the lavatory flows in the water balance. PE

Integration

PS 3a Graywater and Water Reuse

Water from the lavatory drain can provide water to a graywater system. The building drinking water supply water is always connected to lavatories.

EN 1 Water Heater

Low flow faucets lower energy uses at the water heater. In applications with multiple systems, water heater sizing can be reduced.

OP 3 Commissioning

Verify that HE faucets are installed.

Ultra High Efficiency Faucet

.5 GPM

PF 2c

Plumbing Systems PS 3a

Energy EN 1

Operations OP 3

Benefits

Reduces water, sewer, and energy demands to the current limit of technology.

These fixtures are required in public applications (as per the NYC Plumbing Code).

Limitations

Selection of manufacturers and options may be limited.

May not be applicable in health care or other heavy to medium hand washing situations.

The fixture should not be located far from the recirculated hot water supply main to reduce the amount of time-to-tap a user will have to wait for hot water.

Background

Lavatory faucets are used in three broad categories of the NYC Plumbing Code and newer versions of LEED generally requiring .5 GPM for public lavatory faucets and .25 gallons per cycle for metering faucets. Fixtures with greater flow should not be used in public areas.

The NYC Plumbing Code defines "public" as follows:

> In the classification of plumbing fixtures,"public" applies to fixtures in general toilet rooms of schools, gymnasiums, hotels, airports, bus and railroad stations, public buildings, bars, public comfort stations, office buildings, stadiums, stores, restaurants and other installations where a number of fixtures are installed so that their utilization is similarly unrestricted.

It is important to note that this does not require that .5 GPM flow faucets must be specified in all lavatories. In DDC facilities, toilet rooms open to the public are required to have .5 GPM faucets. In areas restricted to the public, higher flow fixtures can be installed. These applications are discussed in detail earlier in this section (see PF 2a and PF 2b). When not using a UHE faucet in a toilet room, the design team will coordinate with the regulatory official to verify its acceptance.

Water efficiency is an important issue for DDC buildings. However, public safety is often of higher importance. Ultra high efficient lavatory faucets are safe for public toilet rooms where light hand washing is required. However, UHEs may not be the best match for other applications.

Hand washing is a very important public health issue and should not be discouraged in procedure or by access to those who should wash hands. DDC PM and architects should not reduce the number of lavatories in a facility to reduce the amount of water used. The number of lavatories should not be limited to code minimums. On the contrary, DDC PM, architects, and building operators should identify locations for public lavatories that encourage hand washing.

Lavatories need not only be limited to toilet rooms, but can be installed in open work areas or dining areas where people may want to wash without entering the toilet room. LEED and water efficiency guides do not restrict the number of fixtures, rather they encourage installing efficient fixtures. LEED calculations are keyed to the number of people, not the number of fixtures.

Reducing water usage at a UHE lavatory faucet is a two step design procedure. The first step is to install the UHE fixture. The next step is to reduce the amount of time it takes the hot water to reach the tap, called "time-to-tap." Efficient designs that reduce time-to-tap will reduce water usage and energy usage in a building. It is important to follow the recommendations outlined in the Energy section of this manual, especially the use of energy efficient pumps or heat trace maintenance systems.

Metering faucets shall use .25 gallons per metering cycle. There are also fixtures that use even less water. These fixtures can be used in many different public applications and the design team shall coordinate with the DDC to determine their preference.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist

Required Tasks

Efficient

During the schematic design (SD) phase the DDC PM, architect, building owner, and plumbing engineer should meet to develop a list of acceptable manufacturers to specify for use on the project. The team shall use quality, commercial grade fixtures and inline check valves on metering faucets and on sensor activated faucets. Sensor activated faucets should be used only for sanitary purposes. DDCPM A BO PE

During the SD phase the DDC PM, architect, building owner, and plumbing engineer should meet to determine which type of fixture will be used at each application. Proper faucet controls should also be determined. The team should identify additional locations to install lavatories to encourage hand washing. DDCPM A BO PE

Once the mandatory 20% reduction in water use is achieved, using these low flow faucets on lavatories can be included in the calculation for LEED WE Credit 3, Water Use Reduction. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculation is correct and that the documentation and submittal requirements are complete. PE LS

Commissioning should verify that the specified faucet and inline check valves on sensor operated fixtures are installed correctly and that faucet controls are operating properly. CX

More Efficient **Ultra Efficient** **Innovative**

More efficient buildings or buildings with more aggressive sustainable standards should use UHE fixtures in most applications. During the SD phase, the DDC PM, building owner, architect, and plumbing engineer should meet to verify that UHE fixtures are installed where appropriate. DDCPM A BO PE

During the SD phase, the DDC PM, architect, building owner, and plumbing engineer should meet to determine if a graywater, blackwater or other water reuse system will be specified for use in the facility. The supply water to all lavatories shall be from the building potable water system. The supply water shall not connect to any of the building water reuse systems. The drains from lavatories can feed into a building water reuse system if there are no excessive chemicals used in the building or if food waste will not enter the system. The team shall coordinate with the water reuse filter manufacturer to verify that no adverse materials are entering the waste stream that could compromise the safety of the reuse system. DDCPM A BO PE

If it is determined that a water reuse system is feasible, the plumbing engineer will include the lavatory flows in the water balance. PE

Integration

PS 3a Graywater and Water Reuse

Water from the faucets can supply water to a graywater system. Ultra low flow systems reduce the capacity and equipment size when compared to other systems.

EN 1 Water Heater

Ultra high efficiency systems lower energy usage at the water heater. In applications of multiple systems, water heater sizing can be reduced.

OP 3 Commissioning

Verify ultra high efficiency faucets are installed.

References

US EPA WaterSense
http://www.epa.gov/watersense/pp/bathroom_faucets.htm

PF 3a

Shower

2.5 GPM

Objective
Reduce the amount of supply water used in showers.

Benefits
Reduces supply water and sewer flow compared to fixtures installed before 1992.

Limitations
Specification of low flow shower faucets will not add LEED credits or help meet LEED WE prerequisites.

The wastewater from a shower drain may be reused in another building system that will supply water to a graywater or blackwater system (PF 3a and PF 3b). In these cases, the full 2.5 GPM showers should not be used because they will increase the amount of shower discharge water that flows into the graywater or black-water treatment system when compared to a low flow shower system.

NOTE: WIll not comply with NYC PC requirements after July 2012 when 2.0 GPM will be the maximum allowable flow rate.

Technology
Shower faucets are restricted to a maximum 2.5 GPM under the provisions of the Energy Policy Act of 1992 and are the current industry standard. A wide variety of options is available. Shower systems are available for both residential and institutional applications, and work best in health care, labs, and other areas requiring extensive showering. Faucets are available that can be used in correctional, detention centers, or other building types where vandalism may be a problem. As noted above, the maximum flow rate of 2.0 GPM comes into effect July, 2012.

Integration
USGBC - LEED NC - SS Credit 4.2 Alternative Transportation
Showers are required for the bike rack credit.
High or ultra high efficiency showers are a better selection for this application.

Required Tasks
This fixture is the base standard fixture and requires no added tasks.

High Efficiency Shower

Less than 2.5 to 2.0 GPM

PF 3b

Plumbing Systems PS 3a

Energy EN 3b

Operations OP 3

Objective

Use less supply water, generate less sewer waste, and save energy compared to the standard 2.5 GPM shower fixture.

Benefits

2.5 GPM is the baseline fixture for LEED calculations. Fixtures that use less than 2.5 GPM can be specified to meet the LEED prerequisite or to obtain credits under LEED WE and Energy (EA) categories.

Will meet the NYC PC after July, 2012 when flow will be restricted to a maximum of 2.0 GPM or less. Lower flow fixtures work well in areas with medium or light shower usage.

Limitations

The quality, flow, and user satisfaction differs among manufacturers. The DDC PM and/or BO should notify the design team of their preferences during the schematic design phase of the design schedule.

Lower flow fixtures may not be appropriate for correctional facilities or other building types where vandalism is a concern.

Lower flow fixtures are not recommended in biohazard dressing or decontamination areas where heavy cleaning or wash down is required.

In renovation projects with limited domestic hot water temperature maintenance systems there may be longer wait times for hot water to flow from the showerhead, which will negate any water savings and may cause user dissatisfaction. See EN 5.

Technology

Showerhead certifications list shower systems with little or no reference to the shower mixing valve (automatic compensating valve), which provides assurance that the mixed water will maintain the rated flow and temperature. When considering the whole building, the safety of the users must also be taken into account. Manufacturers have automatic compensating valves (also called thermostatic mixing valves or anti-scald mixing valves) to reduce the risk of scalding and are required by the NYC Plumbing Code. Valves are engineered and manufactured to maintain constant flow at their rated maximums. Installing a showerhead not calibrated for its maximum flow, for example, a 2.5 GPM showerhead with a 2.0 GPM mixing valve can cause the mixing valve to not operate properly, resulting in surges of hot or cold water. The building team should specify, install, and maintain shower systems that include the showerhead and mixing valve together that are rated at the same reduced GPM. It is not recommended to mix and match different showerheads and flow restrictors with valves that are not rated for the reduced flow.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist

High Efficiency Shower

Required Tasks

There are several high quality shower systems available that will provide appropriate pressure and flow while using less than 2.5 GPM, currently and 2.0 GPM after July 2012. The U.S. EPA has established WaterSense performance specifications for showerheads and related devices setting the maximum flow rate at 2.0 GPM (measured at 80 psi). This represents a 20% reduction from the current federally allowable maximum flow rate of 2.5 GPM established by the Energy Policy Act of 1992. The design team needs to follow the development of performance specifications for further changes, but be particularly aware of the July 2012 NYC PC change adopting both the 2.0 GPM maximum and WaterSense label for most fixtures including showerheads and thermostatic mixing valves.

Efficient

Using low flow shower systems that use less than 2.5 GPM can be included in the calculation of the prerequisite and credits under LEED WE Credit 3 Water Use Reduction. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculations are correct and that all submittal requirements and documentation are complete. PE LS

In buildings with multiple shower systems such as housing, dorms, or schools, low flow showerheads will also reduce the amount of energy used. The plumbing engineer, mechanical engineer and LEED specialist should include the savings into the calculations for credits under the LEED EA category. PE ME LS

Low flow showers should be specified and installed as a complete system including mixing valve and showerhead. Thermostatic type valves that are manufactured to maintain a constant temperature at the rated flow are recommended. The plumbing engineer shall specify mixing valves that are rated for the same flow rate as the showerhead. If the DDC has a preference for a type of shower system or fixture types and brands (or types that are not preferred), this information should be given to the design team during the SD phase. DDCPM BO PE

Hot water temperature maintenance systems, such as pumped hot water recirculation systems or heat trace maintenance systems, should be designed to have hot water available in the hot water distribution system branch piping to limit the time it takes hot water to flow to the fixture. The time shall meet code and regulatory requirements (see EN 5). PE

Low flow shower systems are recommended in office buildings, schools, and other light shower applications. Residential facilities are a good application for low flow showers. However, it may be necessary to educate the residents to the benefits, as users may complain about low water flow. DDC PM, building operator, and plumbing engineer should determine if the fixtures are appropriate for each project. DDCPM BO PE

Renovation

It is important to note that adding flow restrictors or low flow showerheads to existing mixing valves can cause poor temperature maintenance at the mixing valve, and in extreme cases, can increase the risk of scalding. Complete shower systems that include showerhead and thermostatic mixing valves shall be installed. PE

When connecting to an existing building hot water system, the hot water temperature maintenance systems, such as pumped hot water recirculation systems, should be checked. Using the low flow shower systems may require reworking the existing system to take into account the reduced hot water at the shower. Showers should be installed close to hot water circulating mains where possible or heat maintenance systems should be specified. PE

More Efficient Ultra Efficient Innovative

In some buildings ultra high efficiency showerheads can be used (see PF 3c).

Drains from the showers can connect to an energy recovery system. In such systems, the heat from the hot water is captured from the drain pipe and redirected to the water feeding the shower mixing valve. The plumbing engineer should verify if the system is applicable for a particular building type. PE

Drains from the shower system can feed the building graywater system. The plumbing engineer should include the shower supply water and wastewater feeding the building graywater system in the building water balance. PE BO

Water feeding showers must be connected to the building potable water system and not a water reuse system. Currently, there are not enough data to support the use of water reuse systems in showers. There is a possibility that contaminants could be introduced into the breathing air at the showerhead, creating potentially harmful breathing environments. PE

Integration

PS 3a Graywater and Water Reuse

Water from the shower drain can supply water to a graywater system. Supply water to showers is always from potable water sources.

EN 1 Water Heater

Low flow showerheads reduce energy usage at the water heater. In applications with multiple shower systems, water heater sizing can be reduced.

EN 3b Heat Recovery (Domestic Hot Water)

OP 3 Commissioning

Verify that low flow showerheads are installed.

USGBC - LEED NC - SS Credit 4.2 Alternative Transportation

Showers are required for the bike rack credit. Low flow showerheads are a good application for most of these facilities.

PF 3c Ultra High Efficiency Shower

Less than 2.0 GPM

Plumbing Systems PS 3a

Energy EN 1

Operations OP 3

Benefits

Obtains additional LEED credits under WE category and helps achieve WE goals for the facility.

Limitations

These fixtures have the same limitations as PF 3b except they will be taken to the next level of efficiency.

Selection may be limited to a few smaller manufacturers; the design team will need to verify that shower systems are available in the configurations required and that accessories are available for each installation.

Users typically notice the lower flow when compared to the 2.0 GPM showers.

Few third party review and approvals are available.

May not be available with temperature mixing valves.

Technology

Some fixtures have special heads that reduce water consumption. The low flow ratings should include the entire system including the thermostatic mixing valve.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent

Required Tasks

Quality Fixture - Few independent ratings are available for these systems. A DDC pilot study could include the installation of such fixtures in existing buildings for a trial installation administered by the building operator. During the trial period, the DDC shall gather information from users and operators to verify that the fixtures meet the DDC preferences. After the trials, the DDC PM and BO will notify the plumbing engineer with a list of fixture types and manufacturers that meet the DDC performance requirements. DDCPM BO PE

Integration

PS 3a Graywater and Water Reuse

Water from the shower drain can supply water to a graywater system. Ultra low flow systems reduce the capacity and equipment size when compared to other shower systems.

EN 1 Water Heater

Ultra high efficiency shower systems reduce energy usage at the water heater. In applications with multiple shower systems water heater sizing can be reduced.

OP 3 Commissioning

Verify that low flow showerheads are installed.

USGBC - LEED NC - SS Credit 4.2 Alternative Transportation

Showers are required for the bike rack credit.
Low flow showerheads are a good application for most of these facilities.

Urinal

1 GPF

PF 4a

Plumbing Systems

PS 2a PS 2b PS 2c

Objective

Urinals using one gallon per flush (GPF) meet the maximum required by the Energy Policy Act of 1992.

Benefits

Uses less water compared to buildings built before 1992.

Limitations

Using these urinals will not help meet the LEED prerequisite or add LEED credits or help reach WE goals for the facility.

Similar to flushometer valve water closets, valves can stick in the open position, which wastes large volumes of water and may flood the toilet room.

Some manufacturers will void their warrantees when the valve is specified for use in some water reuse systems.

These fixtures are not recommended for use in conjunction with blackwater systems due to the relatively large volume of water required. HE fixtures should be specified for blackwater systems.

Note: Will not comply with NYC PC requirements after July, 2012 when .5 GPF will be the maximum flow rate.

Background

Urinals using one GPF are the current industry standard, however this is in process of changing with the issuing of the WaterSense performance specification of .5 GPF which will be required in NYC after July, 2012. A wide variety of options is available. Flushometers should be matched in order to ensure proper performance, although some other parts are interchangeable from one brand to another.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent

Required Tasks

Efficient

In general, these fixtures should not be used in DDC facilities. Lower flow fixtures should be used. However, when the options and accessories that meet the DDC preferences are unavailable, the DDC project manager, building operator, or plumbing engineer shall document why these fixtures were used instead of lower flow fixtures. DDCPM BO PE

If these fixtures are used it should be noted that one GPF urinals are available with both diaphragm and piston type flushometer valves. The piston type valve has a lower risk of flooding compared to the diaphragm type. Sensor operated fixtures are available, but generally use more water than manual activation because they sometimes flush more than one time per use, or are subject to what is commonly known as phantom flushes. DDC PM, plumbing engineer, and building operator shall determine which type of flushometer valve is appropriate for particular building types. DDCPM BO PE

It is important to note that these fixtures and water closets with diaphragm type flushometers specify a minimum water pressure, usually 20 to 30 psi, to operate effectively. When the supply water pressure falls below 20 to 30 psi, flush performance can be affected, the fixture is slow to close, and the potential for sticking in the open position is increased, which can result in flooding the fixture and possibly the toilet room. The building operator should have a program to monitor water pressure and to make quick repairs when a flush valve fails. The plumbing engineer should design the system to maintain proper pressure. BO PE

Maintaining proper operating pressure is of particular concern in assembly type buildings where users will typically stand in line waiting to use a fixture during event intermissions. Urinals can be flushed as many as 2.5 times per minute during such events. If one or two flushometers fail to open, water pressures in the upper levels of the building will likely fall below the critical 20 to 30 psi level. This can result in clusters of fixtures failing, possibly resulting in sewer system overflows and toilet room floods. In extreme cases entire toilet rooms must be closed to the public. DDCPM BO PE

More Efficient Ultra Efficient Innovative

Supply to the fixtures can be from a water reuse system and the waste from the fixture can feed a blackwater system. However, one GPF fixtures are not recommended for water reuse systems because of the excessive use of water. The plumbing engineer should develop a water balance. PE

There are growing concerns that some pharmaceuticals remain in the urine. Once introduced into the large volume of water in the typical U.S. wastewater stream, they are difficult to remove before entering natural water supplies. These pharmaceuticals are not removed out of the water stream through natural processes or at water treatment plants. The end result is that they can harm wildlife and humans if they remain in the water cycle.

To deal with these concerns there are new technologies that may be available in the next few years that can remove these contaminants out of the waste stream. These processes will work best and will be more economical to operate with smaller volumes of wastewater. Although current building practices combine the waste from a urinal with all the other waste streams in a building, an innovative design could provide separate waste piping that only picks up the waste from urinals. This separate piped urine waste system would connect to the building waste system in a lower level. In the future, when the urine treatment technology is available, the urine waste piping can be separated and then connected to the urine process system. DDCPM BO PE

Integration

PS 2c Building Water Reuse Flush Fixtures

The fixtures can receive water from the building reuse system. The ultra low flow fixtures may work best with this application when compared to other water type fixtures because it would reduce the volume of water processed through the system.

PS 3a Graywater and Water Reuse

The fixtures can receive water from the building graywater system. The discharge should not connect to the building graywater system.

PS 3b Blackwater

The fixtures can receive water from the building blackwater system. The discharge from a urinal can feed the building blackwater system. It is best to use ultra high efficiency urinals.

High Efficiency Urinal

.5 GPF

PF 4b

Objective

Use less water, generate less sewer waste, and save energy while performing most of the major functions of a one GPF flushometer type urinal.

Benefits

Using these fixtures can help in obtaining the LEED pre-requisite and credits under the WE category, and meeting building WE goals.

Will meet the NYC PC after July, 2012 when flow will be restricted to a maximum of .5 GPF or less.

Limitations

The fixtures should be used with bowls rated for .5 GPF.

Limited selection particularly for correctional or vandal resistant fixtures.

In some cases, the flush may not clear solids such as gum or cigarettes from the trap.

Technology

The technology is similar to the one GPF fixtures.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
LS LEED Specialist

Required Tasks

Same as one GPF fixtures - PF 4a.

These are the minimum flow fixtures and should be used on DDC projects. Specification of HEUs that use only .5 GPF can be included in the calculation for the LEED prerequisite and the LEED WE 3 Water Use Reduction credits. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculation is correct and that the submittal requirements are complete. PE LS

PF 4c

Ultra High Efficiency Urinal

Less than .5 GPM

Objective

Provide a highly water efficient fixture in cases in which non-water urinals are not approved for use.

Benefits

Using these fixtures can help in obtaining the LEED pre-requisite and credits under the WE category, and meeting building WE goals.

Limitations

The quality, flow, and user satisfaction differs amongst brands. Particular brands should be installed for trial periods in existing facilities. During the trial period, the DDC should survey users and operators to develop a list of preferences for fixture types and brands.

May not be appropriate or option may not be available when vandalism is a concern, such as in correctional facilities.

Fixtures cost more and may require a greater lead time for delivery.

Flushometer valves and bowls are specified as a single combination and cannot be used with different manufac-turers products.

Replacement cost may be higher until fixtures are more readily available.

Some manufacturers only offer sensor operated fixtures.

Technology

The technology of the fixtures is similar to other flushom-eter valves. They are manufactured to operate at lower water flow rates.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- **DDCPM** DDC Project Manager
- **A** Architect of record
- **BO** Building Operator
- **PE** Plumbing Engineer of record
- **PC** Plumbing Contractor
- **CX** Commissioning Agent
- **LS** LEED Specialist

Required Tasks

Same as the other flushometer valve type fixtures.

After the DDC has completed the trial period, the DDC PM will notify the plumbing engineer on installation and brand preferences for these fixtures. **DDCPM** **BO** **PE**

Non-Water Urinal

PF 5

Energy

EN 2

Plumbing Systems

PS 3a PS 3b

Objective

Reduce the amount of water and sewer flow at a fixture compared with conventional flushometer type urinals.

Benefits

- Uses virtually no water.
- Easily recognized by the public as a sustainable effort.
- Reduces flush aeration of bacteria into the air, improving indoor air quality.
- Reduces water use from flushometer valve failure.
- No touch fixture.
- Reduces building materials.
- Reduces vandalism events in which flushometer valves are intentionally held open.
- Limits opportunities for mold growth, which results from flooding, by reducing the risks of flushometer valve failures.

Limitations

- Refer to codes and regulations including the NYC Plumbing Code which require, "Approved waterless urinals may be utilized only as part of an approved building water conservation plan."
- Operators must monitor the usage and change the trap sealant as required preventing sewer gases from escaping into the toilet rooms.
- Operators must clean fixtures as required by code and manufacturer recommendations to ensure proper operation.

Background

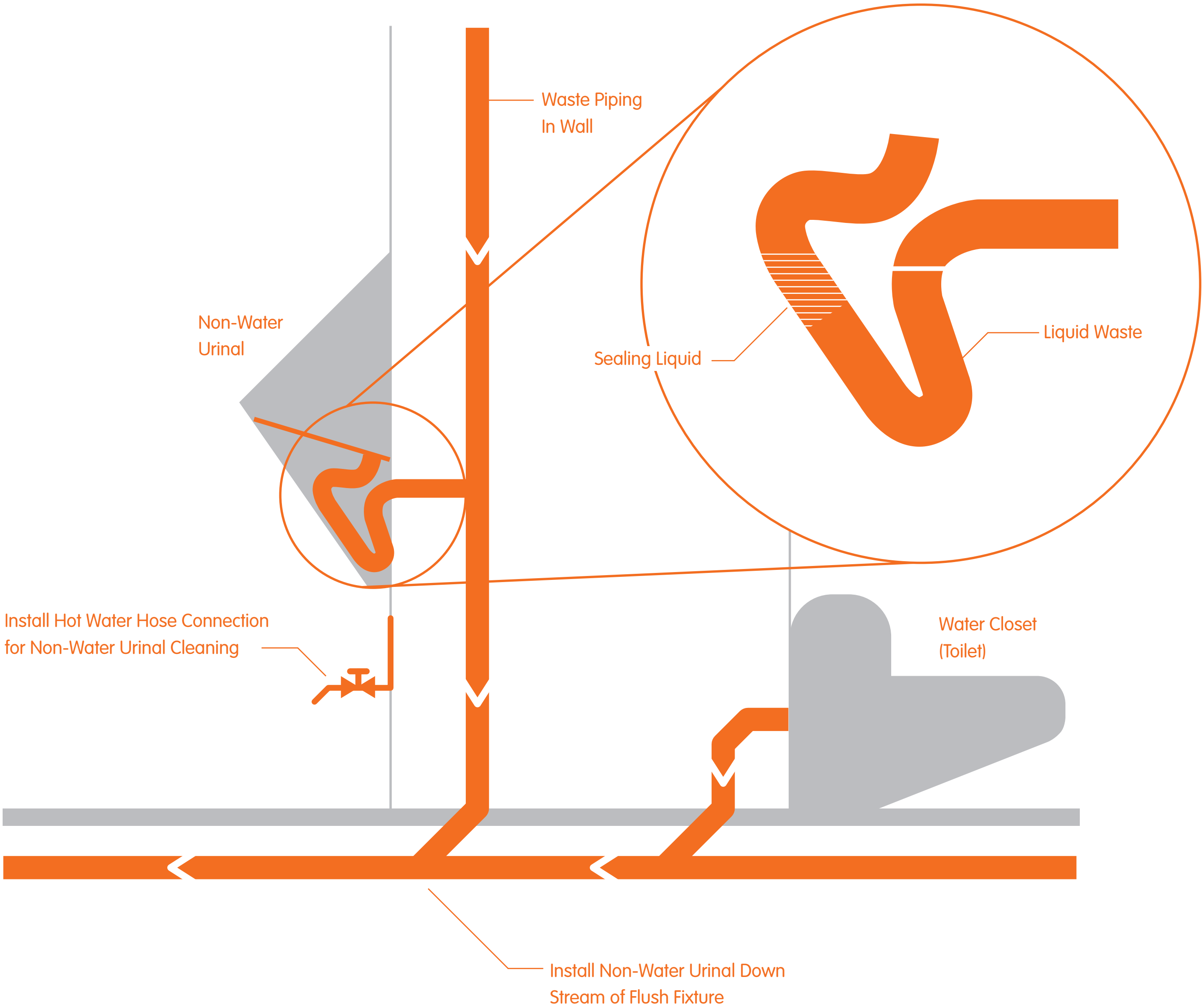
Non-water (sometimes called waterfree or waterless) urinal technology has been in use for decades and is used where water availability is limited. In the last few years, the benefits, as well as the maintenance and cost issues, are being recognized and jurisdictions allowing the installation of these fixtures are becoming more widespread. Non-water urinals will be included in the EPA sponsored WaterSense labeling program for high efficiency urinals.

The non-water urinal does not require flushing after each use; it uses no water during operation. The fixture does not have a flush valve and is not connected to the building's domestic water system. It is connected to the building's waste system in the same manner as a flush-type urinal, but reduces sewage flow because there is no flush water entering the sewer system.

The buildup of solids in the drainlines behind non-water urinals can occur when the fixtures are not installed properly or where drainlines are not code complaint. As such, the building owner may be required to clean out the drainlines of the accumulation of struvite (ammonia magnesium crystals) on a fairly regular basis. Failing to perform such maintenance may result in a full blockage of the drainline.

Non-water urinals have installation and maintenance procedures that must be followed to ensure proper operation. Generally, these requirements are much more rigorous and costly than a flush urinal installation and, in some cases, those life cycle costs may be higher than a flush urinal. These procedures are listed below under the Required Tasks heading. The fixtures are available in fiberglass, acrylic, stainless steel, and vitreous china. Each material requires a different cleaning and maintenance routine.

Non-Water Urinal



Non-Water Urinal

PF 5

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
LS LEED Specialist

Required Tasks

Efficient

Local codes - In general, non-water urinals are acceptable under Local Law 86. Coordination with local building, plumbing, and health authorities is recommended early in the design process. Refer to codes and regulations including the NYC Plumbing Code which require, “Approved waterless urinals may be utilized only as part of an approved building water conservation plan. DDCPM PE

DDC Standard - The trap sealant fluid or cartridge must be changed on a regular basis. The sealants and traps are patented by the manufacturers and are not interchangeable. Some manufacturers recommend changing the sealant every 1,500 uses, while others recommend up to every 7,000 uses or quarterly. However, studies show that the average lifetime of a sealant cartridge is closer to 2,500 uses. Each manufacturer also has a unique seal maintenance routine. Some utilize a cartridge system in which the entire cartridge must be removed and replaced, while others require only the sealant to be changed.

Important Operation Note: Before these fixtures are installed the DDC and the building operator shall install these fixtures under a trial use. During the trial users, housekeeping, and operators should be surveyed and asked about the pros and cons of the fixtures. After the trial period, the DDC shall develop a list of acceptable types, installations, and manufacturers for the plumbing engineer to specify on the construction documents during the schematic document phase of design. DDCPM BO PE

Trap Seal Maintenance - The trap seal material requires maintenance based on the amount of usage. In some cases, cartridge replacement is required. Others require the addition of liquid seal, simply poured into the fixture trap. DDC and building operations should develop a maintenance schedule to ensure proper operation of the fixture. The DDC PM or building operator shall provide the plumbing engineer with documentation showing a maintenance plan is in place before the plumbing engineer specifies the fixtures. DDCPM BO

Trap Wash - To reduce the build up of solids in the urinal and building drainline, manufacturers recommend pouring water in the trap at regular intervals. Building operations are required to develop a maintenance procedure that includes regular cleaning. DDCPM BO

Hose Bibb - A domestic water hose bibb should be located near the non-water urinals for the trap wash procedure. In vandal areas the hose bibb should be located in a secure area or with proper vandal resistant accessories.

Using non-water urinals can be included in the calculation for LEED prerequisites and the LEED WE 3 Water Use Reduction credits. The plumbing engineer shall coordinate with LEED specialist to ensure that the LEED calculation is correct and all submittal requirements and documentation are complete. PE LS

Specification - Specify fixture manufacturers on the DDC acceptable manufacturer list. PE

Renovation

Removing a flush type fixture and replacing with a non-water fixture may result in field coordination issues that include:

Carrier Change - To maintain existing mounting heights, the plumbing contractor may need to rework or replace the fixture carrier in the wall. PE

Finishes - Replacing or reworking the fixture carrier may require removing and patching wall finishes. The architect may have to specify wall repairs. A

Mounting Studs - Upgrading mounting studs in walls may require mounting the fixtures to existing carriers. The contractor shall provide the proper studs for the installation. PC

Gaskets - Installation will require additional gaskets to maintain a sanitary seal between the fixture and carrier. PC

Rough-In Slope - Existing sewer rough-in may slope toward the fixture and not the drain line in the wall. In these cases the rough-in will have to be reworked to maintain code approved slope. The plumbing contractor will rework the rough-in for the new fixture. PC

More Efficient Ultra Efficient Innovative

The drain from the fixtures can connect to a building blackwater system. However, in some cases it may be preferable to isolate the drains from the blackwater system because the waste from these fixtures is concentrated with very little usable water. When the drains are isolated, the piped system should be designed to handle the low flow. Typical pipe slopes could be altered. PE

Currently there is ongoing research to develop systems that can pretreat urine before it enters into the wastewater treatment system. Buildings now in design and construction can make preparations for this new technology by installing separate urinal waste piping from building waste piping. The plumbing engineer and architect can provide space for a future urine treatment system. PE A

Integration

EN 2 Pumps

The fixtures use no water, reducing the amount of energy required to pump water to plumbing fixtures.

PS 3a Graywater and Water Reuse

Graywater systems that supply water to the building can be reduced in size where non-water urinals are specified because the overall demand for water is reduced.

PS 3b Blackwater

Blackwater systems that collect waste from the building flush fixtures and reuse the processed blackwater can be reduced in size where non-water urinals are specified because the overall demand for water is reduced.

Sink Faucet

2.2 GPM

PF 6a

Objective

Sink faucets are used in applications that require more extensive tasks than simple hand washing. See section PF 2. Sinks are typically used to wash utensils or fill water containers. Since different types of sink applications require different water flows, the goal is to match the appropriate sink and faucet with the appropriate application, resulting in the most efficient use of water.

Benefits

Reduces water, energy, and sewer flow when fixtures match application.

The fixtures are available in different configurations and options.

The fixtures work well in service sinks or food service applications.

Limitations

Using these faucets will not help in reaching the LEED WE prerequisite and will not add LEED credits.

The discharge from these sinks is not recommended for use with graywater systems because of the chemicals or food waste that may be introduced into the system.

Not recommended for use in most light kitchen or break-room applications.

Background

Sink faucets are used in three broad categories. The first category is light use in residential and office breakrooms. These fixtures can use lower flow faucets as discussed in section PF 2b and PF 2c.

The second category, which requires heavy use in non-residential applications such as service sinks, laundry sinks, and culinary sinks, is covered here. These faucets are used for filling sinks, buckets, or containers with a predetermined amount of water. As a result, lowering the flow from the fixture will not reduce water consumption, but will increase the amount of time required to fill the container.

Some of these applications may be exempt from the LEED calculations. Close coordination with LEED specialists is required.

It is the task of the building team to identify and install appropriate fixtures, balancing water reduction with appropriate levels of performance.

Lead Content

Lead is used in the faucet manufacturing process. While fixtures do not contain the high levels of lead as in years past, they can contain levels that exceed some health concerns. Several states have passed laws to reduce the amount of lead in fixtures from 8% to less than 1/4 of a percent[1]. In response, manufacturers now typically offer fixtures that meet current requirements.

The DDC design team should specify faucets that meet the lower lead requirement in cases where water could be ingested such as in food preparation areas that have spouts to fill drink containers, or lavatories with drinking water. These fixtures are new to the market and may not be available with all the accessories required for particular applications. Facilities for children or those with compro-mised health should be the first priority to receive these

1 California Assembly Bill 1953 (AB1953) faucets. When fixture models are available, they should be used first in the following types of facilities:

- Schools and universities
- Restaurants and food service facilities
- Hospitals and health facilities
- Assisted living and nursing care facilities.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent

Required Tasks

Efficient

During the schematic design (SD) phase, the DDC PM, architect, building owner, and plumbing engineer should meet to determine which fixtures, if any, must incorporate a higher flow fixture. These fixtures should not be used in applications where lower flow sinks can be used. DDCPM A BO PE

The plumbing engineer should specify faucets with a lead level of less than 1/4 of a percent. Refer to lead section above. PE

Commissioning should verify that the specified faucet is installed and the faucet controls are operating properly. PE

More Efficient / Ultra Efficient / Innovative

More efficient buildings or buildings with more aggressive sustainable standards should only use these fixtures where applicable. During the SD phase, the DDC PM, building owner, architect, and plumbing engineer should only specify these fixtures after consultation with the users. DDCPM A BO PE

High Efficiency Sink Faucet

Less than 2.2 GPM

PF 6b

Plumbing Systems PS 3a

Energy EN 1

Operations OP 3

Objective

Use less water, generate less sewer waste, and save energy while performing most of the major functions of the 2.2 GPM fixtures.

Benefits

These fixtures are very common and are available in many options.

The fixtures work very well in most residential and office applications.

Users usually do not notice the lower flow rate.

Limitations

May not provide enough flow for some washing needs.

Background

These fixtures are typically designed to use between 1.8 to 2.2 GPM and are readily available in many price ranges and options. Some fixtures reduce water usage with a simple flow restrictor in the spout, which can be removed easily. However, better made fixtures, that should be used in DDC facilities, integrate the flow restricting device into the fixture.

Low flow fixtures are appropriate for most residential and office kitchen or breakroom applications. Breakroom or bar sinks may be used for occasional coffee pot or coffee cup cleaning and in most cases, using a fixture that uses 2.2 or even 1.8 GPM is acceptable. Specification of sensor operated valves is not recommended because they do not work well in utensil cleaning applications.

The installation of filtered water fill spouts next to sink faucets in break rooms addresses a problem that had arisen in recent years: the increased use of single use bottled water containers. DDC buildings should encourage the use of reusable containers in staff locations further promoted by the installation of filtered water taps on the sinks. In these applications, staff can fill reusable containers to keep at their workspace to supply drinking water. Refer to PF 8.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist

Required Tasks

Efficient

During the schematic design (SD) phase, the DDC PM, architect, building owner, and plumbing engineer should meet to develop a list of acceptable manufacturers to be used on the project. The team shall use quality commercial grade fixtures. DDCPM A BO PE

During the SD phase, the DDC PM, architect, building owner, and plumbing engineer should meet to determine which type of fixture will be used at each application. DDCPM A BO PE

High Efficiency Sink Faucet

Using low flow faucets on sinks can be included in the calculation for the LEED prerequisite and for LEED WE Credit 3 Water Use Reduction. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculation is correct and that all documents and submittal requirements are complete. PE LS

Commissioning should verify that the specified faucet is installed correctly and that the faucet controls are operating properly. CX

More Efficient Ultra Efficient Innovative

More efficient buildings or buildings with more aggressive sustainable standards should use these fixtures where applicable. During the SD phase, the DDC PM, building owner, architect, and plumbing engineer should specify these fixtures only after consultation with the client. DDCPM A BO PE

During the SD phase, the DDC PM, architect, building owner, and plumbing engineer should meet to determine if a graywater, blackwater, or other water reuse system is feasible for use in the facility. The supply water to all sinks shall be fed from the building potable water system. The supply water shall not connect to any of the building water reuse systems. The drains from sinks can feed into a building water reuse system if there are no excessive chemicals used in the building or if food waste will not enter the system. The team shall coordinate with the water reuse filter manufacturer to verify that no adverse materials are entering the waste stream that could compromise the safety of the reuse system. DDCPM A BO PE

If it is determined that a water reuse system will be specified, the plumbing engineer will include the sink flows in the water balance. PE

Integration

PS 3a Graywater and Water Reuse

Water from the sink drain can supply water to a graywater system. The building drinking water supply water is always connected to sinks.

EN 1 Water Heater

Low flow faucets lower energy usage at the water heater. In applications with multiple systems water heater sizing can be reduced.

OP 3 Commissioning

Verify HE faucets are installed.

Foam Flush Toilet

PF **7a**

Operations

OP OP 3

Objective

Eliminate (or nearly eliminate) toilet waste into the municipal sewer system.

Benefits

Reduces or eliminates water, energy, and sewer flow compared to standard toilets.

Waste product can supply nutrients for local landscaping.

Eliminates, or nearly eliminates, toilet waste from the municipal waste system and saves potable water.

Limitations

Note on foam flush and non-water toilets: The NYC Department of Health and Mental Hygiene, The NYS Department of Health, NYC DEP, U.S. EPA, and other agencies are developing standards. The DDC management team and the design and construction team will have to work closely with these agencies as these standards are issued and developed to ensure that the system meets regulatory standards.

Non-traditional systems will require knowledge by the entire building professional team.

Not acceptable in many building types by some city agencies.

May require special variances and approvals from sewer, health, and other agencies.

There may be cultural concerns regarding sanitation.

Not recommended in health care or correctional facilities.

For optimum operation, plant material and growing areas should be located near the toilet rooms.

Technology

The foam flush toilet looks and functions much like a conventional toilet fixture. It uses a mixture of bio-compatible soap and water to carry toilet waste to the composting system below via a conventional 4" drain line.

Each flush uses only about 3 ounces of water, making it fully compatible with the composting process. Since the foam flush fixture is using water to carry the waste, it is possible to locate the fixtures slightly offset from the compost system.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

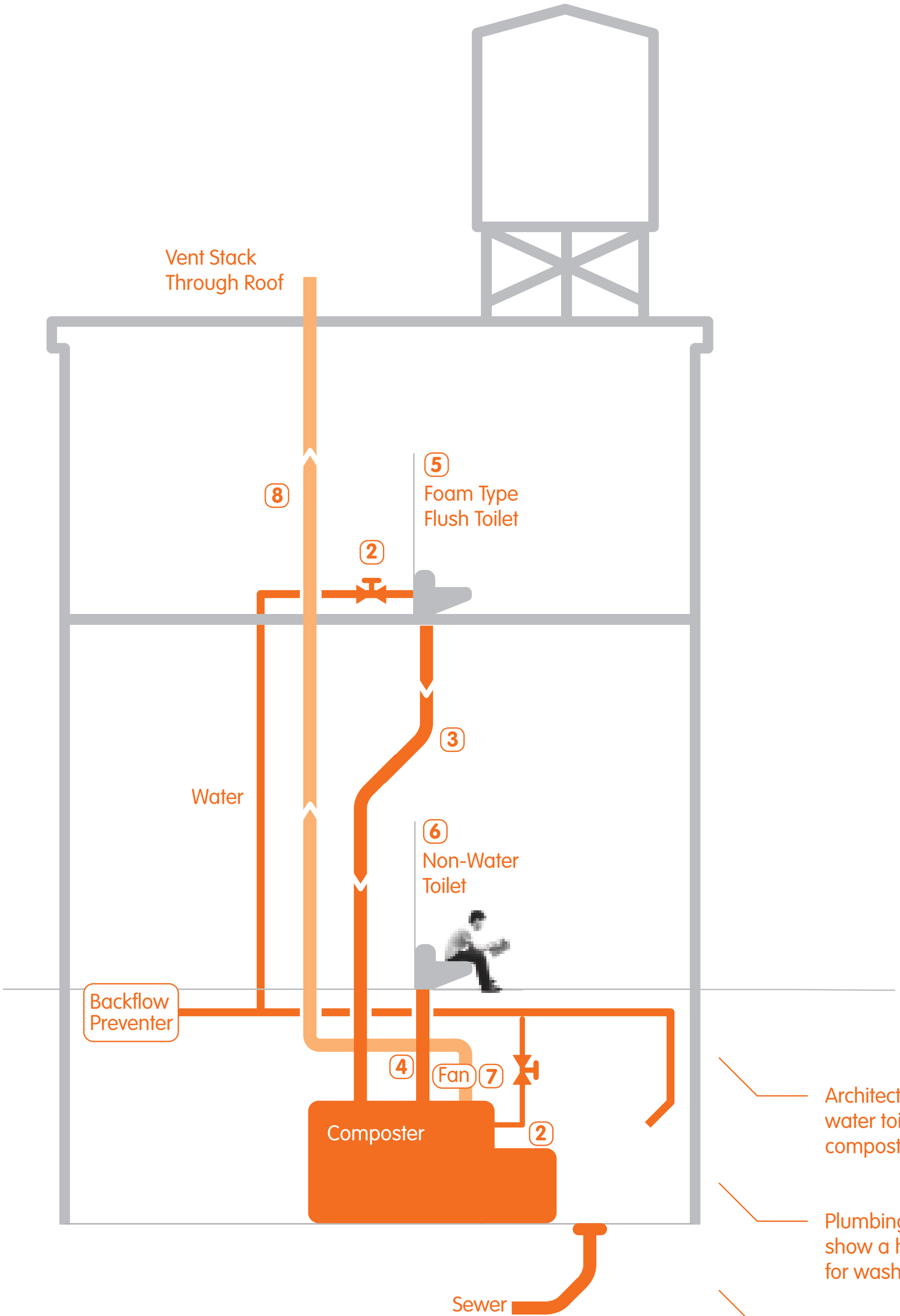
DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
LS LEED Specialist

Required Tasks

Efficient More Efficient

Non-water toilet systems will rarely be specified in either efficient or more efficient buildings.

Foam Flush Toilet



1. DDC should contract with non-water toilet vendor during schematic design (SD) phase.
2. Plumbing engineer shall coordinate piping and water connections to non-water toilet and composter.
3. Plumbing drawings should specify piping from foam type toilet to composter. Route piping as per vendor recommendations.
4. Connection from non-water toilet to composter shall be installed by vendor.
5. Foam flush toilet shall be provided by vendor and installed by plumbing contractor.
6. Non-water toilet shall be provided and installed by vendor.
7. Composter fan shall be provided by vendor and installed by plumbing contractor. Plumbing engineer shall coordinate controls and power requirements to electrical engineer to include in contract documents.
8. Vent piping shall be shown on plumbing documents and installed by plumbing contractor.
9. Coordinate design, installation and start up with vendor and manufacturer requirements.

Architect to coordinate with non-water toilet system vendor for composter access requirements.

Plumbing drawings should show a hose bibb connection for washdown cleaning.

Plumbing drawings should show a floor drain.

Foam Flush Toilet

PF 7a

Ultra Efficient **Innovative**

The DDC PM, building operator, and plumbing engineer should coordinate the approval process with the regulatory agencies when foam flush or non-water toilet systems are considered. DDCPM BO PE

The DDC PM, plumbing engineer, building operator, landscape designer, and landscape operator should develop a proposed system during the schematic design (SD) phase of the schedule. The team shall determine if the system will be included in the design of the building. Alternate SD may be required for the construction manager to review in order to develop the cost estimate. DDCPM BO PE LA LO CM

These fixtures require proper maintenance operations to function safely and efficiently. The DDC shall obtain a maintenance agreement or develop a regulatory agency approved maintenance program during the SD phase. DDC will provide the plumbing engineer documentation that a plan or agreement is in place. DDCPM BO PE

The use of foam flush or non-water toilets can be included in the calculation for the LEED prerequisite and credits under WE 2 Innovative Waste Water Technology and WE 3 Water Use Reduction. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculation is correct and that all submittal requirements and documentation are complete. PE LS

Using this system will typically impact the building layout. The plumbing engineer shall coordinate with the architect on design options. PE LS

The building operator shall develop a procedure to maintain the system. BO

Integration

OP Operations

These systems require a commitment and a dynamic program by building operations personnel. In some cases this can overlap with ongoing landscaping tasks. For example, the landscaping staff can develop a plant nutrition plan to ship, mix, and distribute plant nutrients to the landscaping, which can overlap with the treatment system tasks.

OP 3 Commissioning

The system may require added commissioning efforts to ensure proper operation at building startup.

PF 7b Composting Toilet

Objective

Provide an alternative non-water toilet system.

Benefits

Do not have to be located in close proximity to the growing areas.

Can ship compost to off-site growing areas.

Can operate with little use of mechanical systems compared to the pumping systems required for bio-treatment systems.

Limitations

Similar to the foam flush systems.

Note on foam flush and non-water toilets: The NYC Department of Health and Mental Hygiene, The NYS Department of Health, NYC DEP, U.S. EPA, and other agencies are developing standards. The DDC management team and the design and construction team will have to work closely with these agencies as these standards are issued and developed, to ensure that the system meets regulatory standards.

Technology

Typically, dry composting systems are designed to collect the waste in a bin beneath the fixture. The composting system requires activities from the operations personnel on a regular basis. The bin has to be accessible to building operations personnel from nonpublic portions of the building. These fixtures work well in nature centers or facilities remote from the municipal sewer system. However, they can also be used in larger facilities, such as office buildings.

Integration / Required Tasks

The integration and required tasks are similar to the foam flush type PF 7a.

Drinking Fountain

PF 8

Objective

The increased use of single use bottled water containers and bottled water dispensers has created a number of adverse environmental impacts. Processing, bottling, shipping, and disposing of waste associated with bottled water generates emissions and strains infrastructure and landfills. Providing drinking fountains and spouts to fill reusable containers helps mitigate these impacts.

Benefits

- Reduces landfill waste.
- Reduces carbon emissions from trucks that transport bottles.
- Increased access to drinking water results in both public health and financial advantages for NYC and the general public.

Limitations

- Using these fixtures will not add to LEED credits in the current LEED v3 rating system.
- Some users may prefer to have filtered water available.
- Operations are required to clean fixtures and encourage use.
- Operations are required to maintain filter systems.

Background

The growing popular trend toward single use drinking water bottles and bottled drinking water dispensers has created a cultural norm. As of January, 2011, the NYC PC no longer accepts bottled drinking water dispensers in lieu of required fountains. Furthermore, most fountains must have the addition of a separate faucet for container re-fills. Unfortunately, drinking fountains have been negatively portrayed as unclean and inconvenient. Of course, a more amenable drinking fountain can heighten use.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist

Required Tasks

Efficient

Bottled water dispensers should not be used in place of drinking fountains. In the contract document, the design team should specify 50% more drinking fountains than the code requires. Drinking fountains shall be located where they are accessible to all building occupants. In buildings with workers or offices where containers such as cups or personal water bottles are used, a fill spout shall be included in the fixtures. All fixtures shall be cleaned and maintained according to a strict schedule to encourage use. Refrigeration systems in drinking fountains shall be R-134a (or better). DDCPM BO A PE

More Efficient Ultra Efficient Innovative

Provide filtered water dispensers. When filtered water systems require backwash, specify filters that use a water pressure backwash control to minimize the number of cycles. The building operator shall provide input on the type of filter equipment to be used. Fountains in multi-level facilities should be located so that a single filtered water riser can be installed to supply water to fountains on all floors from a single system. DDCPM BO PE

MS Mechanical Systems

In mechanical systems, water consumption can be reduced in two ways. The first way is to install efficient systems that use less water. Careful planning in the design phase by the design and building operations teams can produce an efficient building, in most cases at very little added cost to the construction budget. For example, designing and installing an efficient water cooling tower system adds little to the construction cost of the facility when compared to the benefits of reduced water and sewer usage. Effective monitoring will then ensure that the system is operating efficiently. An efficient facility requires the operations staff to incorporate a measurement and verification plan along with a commissioning plan to keep the facility operating properly.

The second way water consumption can be reduced is by reusing water that is normally discharged into the sewer. In most urban areas only 30% of the water consumed is required to be drinking water quality. The other 70% is used for irrigation, mechanical cooling systems, water filtration, or laundry equipment. Many of these systems discharge relatively clean water, which can be reused as supply water to other mechanical systems.

Mechanical equipment uses large amounts of water for cooling, ventilating, or heating. Losses are incurred through:

- Evaporation into the atmosphere from inefficient cooling towers
- Dumping into the sewer from unmonitored, dysfunctional, or leaky valves
- Programming that is not set properly at start-up
- Unmonitored and unverified automatic backwashing systems dumping water into the sewer
- Malfunctioning or inefficient cooling tower water treatment systems dumping water into the sewer
- Unnecessary equipment blow downs

The opportunities to reduce water consumption vary from simply specifying different equipment options, using water efficient equipment, or using reuse water to supply the water needs for building processes.

Identifying and selecting strategies to reduce water consumption in mechanical systems usually does not have cultural implications. However, implementing these strategies in a project through design and construction will require leadership from the DDC PM to keep the focus on long term water efficiency goals, as well as short term analysis of upfront cost increases offset by long term cost benefits.

Equipment Cooling (No Potable Water)

MS 1

Mechanical Systems

MS

Operations

OP 3

Owner Furnished Equipment

OFE

Objective

Equipment can be cooled with air flowing through the equipment and not domestic water.

Benefits

Reduces water, sewer, and energy use in a building by eliminating "once through" use in cooling equipment.

Limitations

In some cases it is impractical to install air-cooled equipment.

Background

Some equipment uses potable water for cooling. The supply water flows through the equipment and cools the equipment. The warm water is then dumped into the building waste system. As a result, drinking quality water is wasted down the drain. Most icemaker and drinking fountain cooler equipment is now available with an air-cooled option that does not use potable water. In some cases, the building chilled water or condensing water can be used to cool equipment.

Note: as of January 1, 2011, the NYC PC prohibits the use of potable water for once through cooling.

Building Profession Task Designations

Before the building professional team can use this sytem it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- ME Mechanical Engineer

Required Tasks

Efficient | More Efficient | Ultra Efficient | Innovative

Mechanical and plumbing engineer should not specify "once through" cooling equipment such as remote chillers. PE ME

In the event water cooled equipment is specified, the mechanical engineer should use building condensate water to cool the equipment. When condensate water is not available, domestic water should be metered in order to collect data for the building management system. PE ME

Mechanical engineer shall review owner furnished equipment (OFE) documents to identify equipment requiring water cooling and notify DDC PM if equipment is specified. If equipment is used, condensate water should be used if it is available. DDCPM PE ME

Owner purchasing department should have a standard "not to purchase" list of equipment, such as ice machines, that use domestic water cooling. DDCPM BO

Equipment Cooling (No Potable Water)

Integration

OP 3 Commissioning Verify on-site that “once through” cooling equipment is not installed.

MS Mechanical Systems If air cooled is not available, provide building mechanical water.

OFE Owner Furnished Equipment
Some of this equipment is specified by the owner. Operators will develop a program by which these systems will not be purchased.

Cooling Tower

MS 2

Operations

OP OP 3

Plumbing Systems

PS 1 PS 2b

Objective

Reduce process water supply.

Benefits

A building with efficient mechanical systems will require less energy and water during operations.

Limitations

Up-front equipment and installation cost maybe higher.

Higher engineering costs may be incurred to design more complex systems.

Non-traditional systems may require new operational procedures.

Background

In large energy consumption facilities, up to 70% of water consumption is in process water or nonpotable water applications. Cooling towers will use a large portion of this process water.

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- ME Mechanical Engineer

Required Tasks

Efficient

Water meters must be placed on the cooling tower make-up connection to the domestic water feed. A second water meter should be connected on the cooling tower blow down. Meter systems shall connect to the building management system or to a system from which the building operator can collect water meter data. Water meters should be specified in the contract documents. PE ME

When cooling towers are employed, the design team should look at options to reduce system domestic water usage. Where condenser water is being lost to the atmosphere, drift eliminators should be used. In other cases, combination sensible and evaporative type cooling towers are applicable. The mechanical engineer should develop options and coordinate with the building operator during the schematic design (SD) phase. The mechanical engineer and building operator will determine the appropriate system. PE ME

The plumbing engineer, with input from the mechanical engineer, should calculate a preliminary water balance on the proposed water demand to the cooling tower and possible water sources from mechanical equipment. The preliminary water balance should be completed during the SD phase. The plumbing engineer and mechanical engineer, with input from the building operator, should develop a plan to include a future water reuse system to provide make up water to the cooling towers. If the amount of air conditioning condensate is high and the layout of the cooling coils in the building allows, a dedicated condensate collection piped system should be installed. In the future a pumped collection system could route the condensate to the cooling towers or another water source need in the building. The building layout will need to provide space and connection points for a future reuse water connection to the cooling tower makeup. The electrical engineer will also provide space for panels and electrical feed to future pumps and equipment. PE ME BO EE DDCPM

Water efficient facilities should monitor and improve the cooling tower's "cycles of concentration," which is calculated as the ratio of the concentration of dissolved solids (or conductivity) in the blowdown water compared to the makeup water. More solids and minerals in the water result in a higher blowdown rate, which will affect efficiency.[1]

The cycles of concentration can be improved with a monitoring program. During the construction document phase, the mechanical engineer should include makeup and blowdown meters (as described above), conductivity controllers and overflow alarms. PE ME

Concentration cycles in cooling towers typically range from three to seven. Because New York City uses surface supply water that is quite low in minerals, cooling towers are often allowed to concentrate at a rate of seven or more. The building operator should monitor the cooling tower makeup water and set a goal of a minimum of seven cycles. BO

The goal for the building operator should be to use no more than 2.3 gallons per ton hour of potable water for cooling tower makeup. Alternatively, calculations should be prepared during operations showing that the cooling tower system uses 10% less water than conventional systems. BO

The commissioning team shall review the contract documents and verify the installation of the equipment during the construction phase. CX

More Efficient

Implement the tasks outlined above for efficient buildings.

The plumbing engineer and mechanical engineer shall coordinate data during the schematic design phase and develop a design to include water reuse for cooling tower makeup. A water balance should be performed to include building condensate or stormwater for a feed system. Alternative designs may be required for construction manager (CM) review. The proposed system will have to be coordinated to meet regulatory requirements. The team must determine the appropriate water reuse system to offset domestic water feed to the cooling towers. The system shall be included on the schematic design (SD) documents. PE ME BO CM DDCPM

The commissioning team shall review the contract documents and verify the installation of the equipment during the construction phase. CX

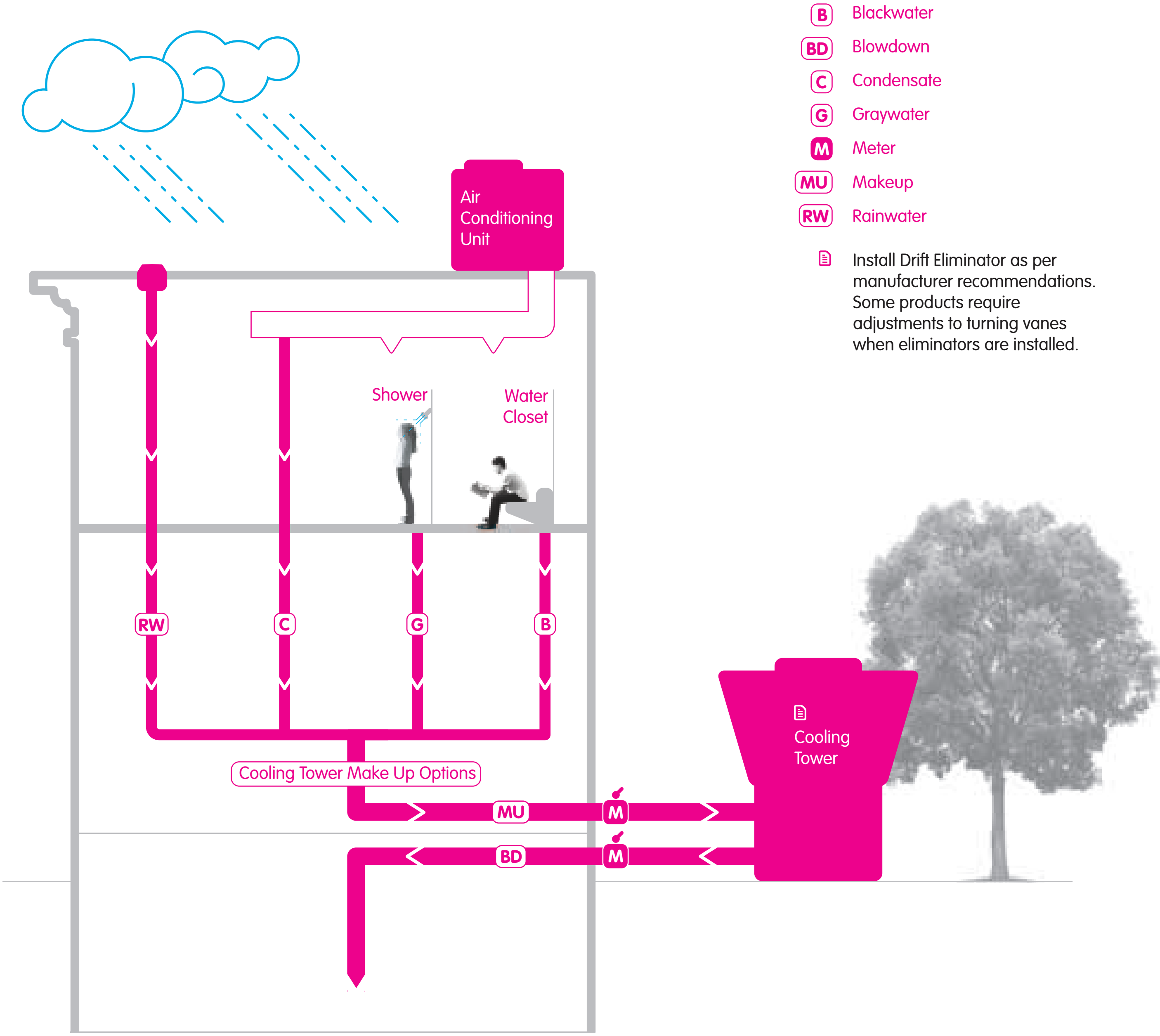
Ultra Efficient / Innovative

Implement all tasks outlined above for efficient buildings.

The plumbing engineer and mechanical engineer shall coordinate data during the schematic design phase in order to develop a design to use 100% water reuse for cooling tower makeup. A water balance should be performed to include building condensate or stormwater

1 U.S. Department of Energy, Energy Efficiency and Renewable Energy, Federal Energy Management Program, *Water Efficiency BMP #10 - Cooling Tower Management*
http://www1.eere.energy.gov/femp/water/printable_versions/water_bmp10.html

Cooling Tower



B Blackwater
BD Blowdown
C Condensate
G Graywater
M Meter
MU Makeup
RW Rainwater

Install Drift Eliminator as per manufacturer recommendations. Some products require adjustments to turning vanes when eliminators are installed.

for a feed system. Alternative designs may be required for construction manager (CM) review. The proposed system will have to be coordinated to meet regulatory requirements. The team will determine an appropriate water reuse system(s) to offset 100 % of the domestic water feed to the cooling towers. The system shall be included on the schematic design (SD) documents.
PE ME BO CM DDCPM

The commissioning team shall review the contract documents and verify the installation of the equipment during the construction phase. CM

Integration

OP Operations
Develop a plan to monitor and improve cooling tower operation including the concentration cycles.

OP 3 Commissioning
Verify on-site that the systems are installed and operating properly.

PS 1 Water Balance
Coordinate water makeup with other water reuse systems.

PS 2b Mechanical Water Reuse
After an efficient cooling tower system is designed, water efficiency is increased when makeup water is provided from a nonpotable water source, such as condensate, stormwater, graywater or blackwater.

Water Softener and Water Filtration

MS 3

Mechanical Systems

MS 2

Operations

OP 3

Plumbing Systems

PS 1

Objective

Reduce the amount of potable water wasted with backwashing of water filtration equipment.

Benefits

Reduces water usage in cooling towers.

Reduces soap usage in large laundries.

Limitations

The city has very soft water and so water hardness is not an issue in most buildings.

Background

Water flowing through the natural environment collects minerals, and the amount of minerals in the water is referred to as hardness. Water flowing into New York City is primarily collected from surface sources and not underground sources that increase water hardness. As a result, the city's water is relatively soft and the drinking water and domestic hot water do not usually need to be softened.

Mechanical systems require softer water than that received through the city distribution system. If the water is not softened, the minerals can damage mechanical systems. Therefore, mechanical chilled water and boiler water systems can have softeners.

Salt is most commonly used as a water softener. When water softeners are used, it is necessary to include a backwash cycle to clean the system. Typically, a timer activates the backwash system at regular times, even if the unit has not been used. As a result, thousands of gallons of water and salt are introduced into the waste stream. Most manufacturers now provide sensors that will activate the backwash only when required by monitoring the hardness of the discharge water. The backwash water is of high quality and can be fed into a graywater or water reuse system.

Some buildings will require a higher quality of water that will filter out chemicals and some biological materials in the water. A common method uses a Reverse Osmosis (RO) system. These systems are used when pure water is required in facilities such as labs and health care. These systems will backwash water through the filter system and dump the water into the building drain. This water is relatively high quality and should not be wasted to drain. Specifying a sensor system on these filters will reduce building water consumption.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- **DDCPM** DDC Project Manager
- **A** Architect of record
- **BO** Building Operator
- **PE** Plumbing Engineer of record
- **PC** Plumbing Contractor
- **CX** Commissioning Agent
- **ME** Mechanical Engineer

Water Softener and Water Filtration

Required Tasks

Efficient

The plumbing engineer or mechanical engineer should specify water softeners, reverse osmosis (RO), or other water filter systems that have sensors that activate backwash only when required. PE ME

Water meters should be connected on the supply and drain piping on all large softening systems. PE

Building operations should develop a process to monitor the amount of water discharged to the drain and to modify the softener controls as required during operations. The water use data should be kept in the building water balance. BO

Water meters should be installed on the inlet and drain connections of other large building water systems, such as reverse osmosis (RO). Provisions should be made for future water reuse of the discharge water from the RO system by providing a pod. During the SD phase, the plumbing engineer should prepare a water balance to size the equipment and connections for the RO pod. PE

The plumbing engineer, mechanical engineer, and building operations should ensure that the system meets all requirements of appropriate regulatory agencies during the SD phase. PE ME BO

Commissioning should verify that the system is installed correctly and operating properly at start up. CX

Building operations should develop a regular building commissioning schedule during operations to verify efficient operation and to make minor changes to the water filter systems as needed. BO CX

More Efficient Ultra Efficient Innovative

Water filter systems that have clean discharge, such as RO, should be part of a water reuse system. The plumbing engineer and mechanical engineer should meet during the SD phase. The plumbing engineer should develop a water balance to determine the size of the equipment and the systems to be fed. PE ME

Integration

MS 1 Cooling Tower

Softened water reduces the amount of makeup water required by a cooling tower system.

OP 3 Commissioning

Verify on-site that the systems are installed and operating properly.

PS 2b Building Water Reuse

Backwash can be used to supply water to other systems.

HVAC Condensate Water Reuse

MS 4

Mechanical Systems

MS 2

Operations

OP 3

Plumbing Systems

PS 1

Objective

Reuse collected condensate to offset domestic water usage.

Benefit

Relatively clean water can be used with little processing.

Limitations

Condensate is available at limited times and the amount will vary at different times of year.

Background

Condensate, which forms on air conditioning cooling coils as humidity level rises, can be collected from air conditioning systems for reuse. Calculations can be performed to determine the anticipated amount of available condensate. Some generalized studies have found that 0.1 gallon can be produced for every ton hour of air conditioning operation at 70% humidity level, increasing to 0.2 gallons at 80% humidity, and 0.3 gallons at 90%.[1]

Systems should provide a dedicated piping system to collect the condensate. This is usually a gravity type system similar to a stormwater piping system. Discharge can feed directly into mechanical systems, such as cooling towers. Excess condensate can also be stored in tanks.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- ME Mechanical Engineer

Required Tasks

Efficient

The plumbing engineer, mechanical engineer, and DDC PM should ensure that the condensate reuse system complies with all the requirements of applicable regulatory agencies. If the reuse system is approved, the team should consider options to use condensate for other building systems. PE ME DDCPM

The mechanical engineer shall provide data to the plumbing engineer to develop a water balance during the SD phase. At this time, a decision should be made if a condensate system will be installed or if a condensate pod will be installed. PE ME BO CM DDCPM

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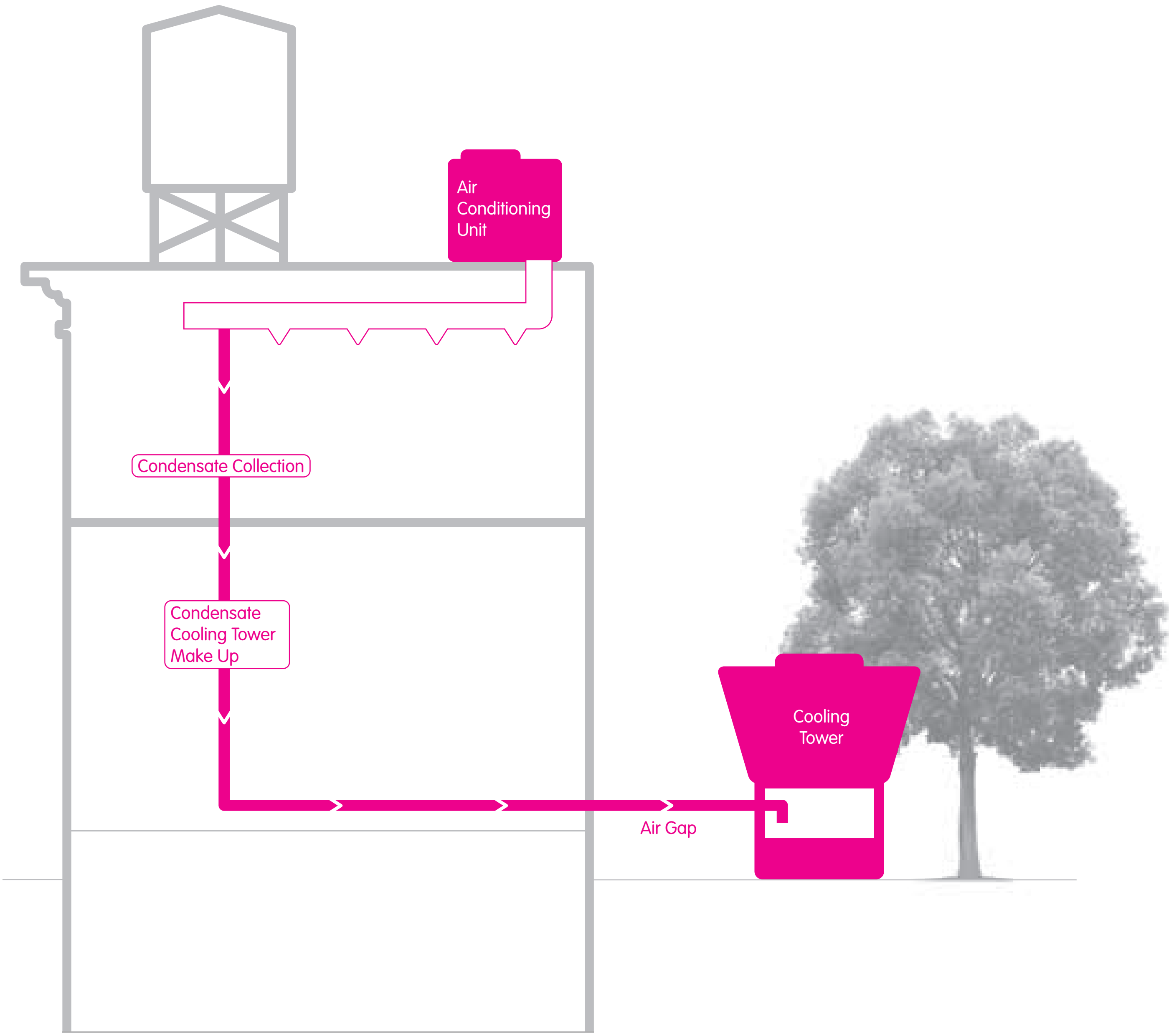
1 http://www.labdesignnews.com/LaboratoryDesign/LD0607FEAT_3.asp

HVAC Condensate Water Reuse



HVAC Condensate Water Reuse

MS 4

More Efficient · Ultra Efficient · Innovative

A condensate reuse system should be incorporated into all more efficient, ultra efficient, and innovative buildings. The mechanical engineer should provide data to the plumbing engineer to develop a water balance and design a water reuse system for the building condensate. PE ME

Building operations should develop a procedure to monitor and modify the system during operations, as required. BO CX

Commissioning should review the design, review the coordination drawings, and verify that the system was installed correctly and is operating properly. CX

Integration

MS 2 Cooling Tower

Condensate can feed cooling tower makeup water.

PS 1 Water Balance

Condensate can feed into a plumbing system water reuse system.

PS 2b Building Water Reuse

Condensate can be used to supply water to other systems.

OP 3 Commissioning

Verify onsite that the systems are installed and operating properly.

MS 5

HVAC Equipment

Mechanical Systems

MS 2

Operations

OP 3

Plumbing Systems

PS 1

Objective

Reduce potable water use in HVAC equipment.

Benefit

Mechanical systems do not require drinking-quality water and may use water from other building systems.

Limitations

Water quality and availability from other systems varies and may not always meet the needs of the mechanical systems.

Background

Building equipment such as air compressors and vacuum pumps can use domestic water for system cooling. Make up water for boilers, chillers, or cooling towers can use water reuse systems.

Water for these systems can be supplied by stormwater, condensate or graywater systems.

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
ME Mechanical Engineer

Required Tasks

Efficient · More Efficient · Ultra Efficient · Innovative

The mechanical engineer and plumbing engineer should not specify equipment requiring water seals or cooling from the building potable water system. PE ME

If water seals are needed, the water shall be used from a building water reuse system. PE ME

If water cooling is required, the system shall receive water from the building condenser water system. ME

If make up water is provided to boilers, the system shall be submetered per the NYC PC as of January 1, 2011.

Integration

MS 2 Cooling Tower
Develop alternative feed sources from other water systems.

PS 2b Water Reuse
Install piping systems to provide makeup water from nonpotable water sources.

OP 3 Commissioning
Verify on site that the systems are installed and operating properly.

CS Civil Systems

Civil Systems include stormwater management practices (SMPs) that primarily deal with the treatment and attenuation of stormwater runoff to reduce the potential downstream impacts to existing conveyance systems and receiving water bodies. They include the following practices: detention and retention practices, infiltration practices, filtering practices, and low impact development practices that can be integrated with enhanced site development. As the amount of impervious surface increases with development, the volume and peak flow of stormwater runoff increases as well. Similarly, the pollutant loading increases due to the change in land use and amount of impervious surfaces. Various pollutants of concern, including but not limited to total suspended solids, phosphorous, nitrogen, metals, hydrocarbons, and fecal coliform, are deposited in stormwater runoff through atmospheric deposition and land use.

The goal of this section is to promote better site design, reduce impervious surfaces, promote infiltration where feasible, decrease potential pollutant loading, and decrease volume and peak flow of stormwater runoff. The practices presented herein are meant to be integrated with other sections of this manual. For example, using permeable pavers and filter strips will not meet the recommended efficiency rating; however, when combined with infiltration practices, an ultra efficient or innovative development can be achieved. Most of the SMPs are designed to treat and attenuate stormwater runoff, however, there are some practices that when coupled with building systems, may reduce the amount of potable water usage. For example, practices such as cisterns and detention or retention, where temporary storage of stormwater runoff is provided, can help reduce water usage through integration with a graywater system as well as the irrigation systems.

Most design engineers will follow the New York City Department of Environmental Protection (NYCDEP) regulations for site connections to sanitary and storm sewers, as well as New York State Department of Environmental Conservation (NYSDEC) requirements for the State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activities.

The NYCDEP has various programs to reduce the number of combined sewer overflows (CSO) and improve the water quality in the surrounding water bodies. Any new connection to a city owned or maintained sewer would require a Site Connection permit for which the applicant is required to demonstrate that the proposed flows will not exceed the allowable design flow to the sewer system for that project. Compliance is often achieved by detaining the stormwater flows on site to the maximum calculated allowable flow as per the NYCDEP regulations. (Note the NYCDEP is planning to update the allowable flow values and will require greater on site detention.)

In accordance with PlaNYC 2030, the city's plan for improved water quality is to pursue proven solutions to prevent stormwater from entering the combined sewer system, capture the benefits of an open space plan, expand, track, and analyze new Best Management Practices (BMPs), require greening of parking lots, provide incentives for green roofs, and protect wetlands.

As required by Local Law 5, the *Sustainable Stormwater Management Plan* was developed to identify source control strategies that reduce the stormwater volume and pollutant loads within the combined sanitary and storm sewer system. In addition to identifying BMPs that could be implemented throughout the city for new and existing developments, the *Sustainable Stormwater Management Plan* will also establish performance, design and construction standards, create incentive to encourage owners to retrofit or construct such BMPs, and amend provisions to the various city and agency codes.

The practices described within this section are to be designed in conformance with the current NYCDEP and NYSDEC requirements to the maximum extent practicable. Most projects within NYC would likely be considered redevelopment projects, under NYSDEC's guidelines and therefore the requirements of Chapter 9, Redevelopment Projects, would typically be followed in the sizing and design of SMPs. There are also other city planning objectives and watershed planning goals that should be considered during the site layout and design of various SMPs described. Based on the Sustainable Stormwater Management Plan 2008, the following design manuals have been released to provide guidelines for public projects: Street Design Manual (NYC DOT), High Performance Landscape Guidelines (NYC Parks Department), and Sustainable Urban Site Design Manual (NYC DDC).

Please note these issues are addressed more in-depth by two other DDC Manuals: *The Sustainable Urban Site Design Manual* and *Cool and Green Roofs*.

For more information go to: http://www.nyc.gov/html/ddc/html/design/reports.shtml

CS 1 Stormwater Detention and Retention Practices

Plumbing Systems

PS 3a 6

Civil Systems

CS 4 5 6

Mechanical Systems

MS

Objective

Detention and retention stormwater management practices (SMPs) capture stormwater runoff from portions of the site and provide treatment and attenuation of the peak runoff rate. An additional objective in NYC areas where combined sewer system exists is to reduce the peak stormwater runoff rate to the receiving combined sewer system, thereby reducing the flows to the Water Pollution Control Plant (WPCP) during wet weather conditions and potentially minimizing the occurrence of combined sewer overflow (CSO) discharges.

Benefit

- Reduces the flow to combined sewers during storm events, thereby reducing potential for combined sewer overflow.
- Decreases peak flow rates and velocities in storm sewer systems and at outlets to water bodies, thereby reducing potential flash flooding and channel bank erosion.
- Are recognized practices in NYC and well known to building professionals.
- Provides treatment of stormwater runoff, thereby reducing pollutant loading to receiving WPCP or water body during a CSO discharge.
- Provides positive visual aesthetic through creation of ponds, if site constraints allow.
- Improves public awareness through easily recognized SMPs.
- Stores and reuses stormwater runoff for irrigation or building graywater systems, thereby reducing potable water use.
- Can install certain systems below pervious or impervious sidewalks, driveways, or parking areas.

Limitations

- Given the dense urban landscape, it may be difficult to place these SMPs and maximize the volume collected.
- A long term inspection and maintenance plan must be implemented onsite.
- Potential safety issues with open water structures.
- Ponds may pose potential issues for public concern with regard to mosquitoes.

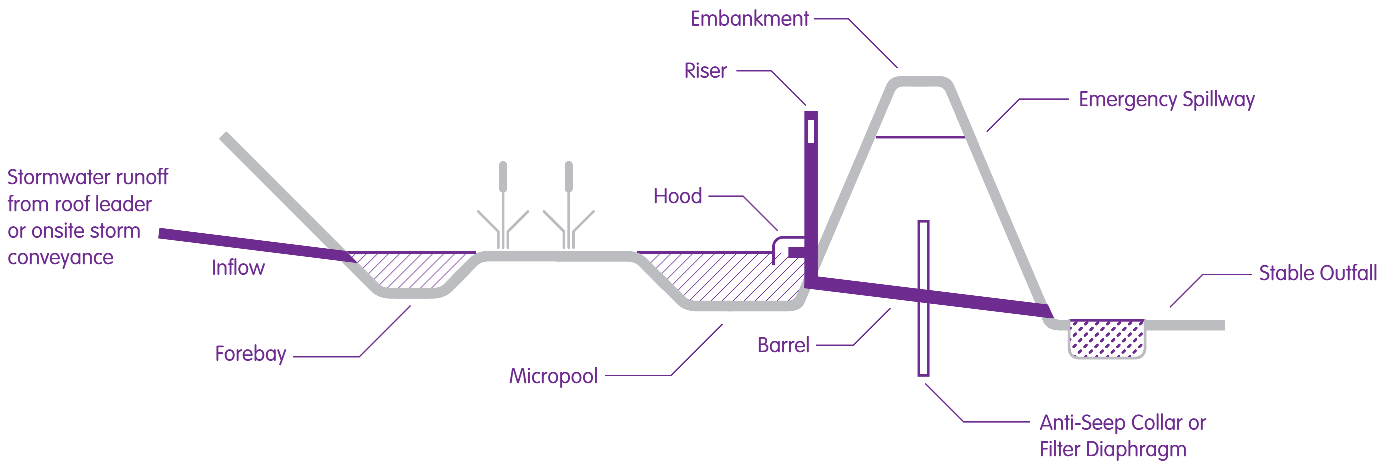
Background

Detention is an SMP used to temporarily store a volume of water and slowly release it over a period of time. Retention is an SMP designed to store a volume of stormwater runoff. It is stored until it is lost through infiltration and evaporation without release. During the larger storm events, the retention pond would be designed to slowly release stormwater runoff over a long period of time.

There are two goals that may be achieved through the use of detention and retention type SMPs: water quality and water quantity. Where possible, detention and retention systems should be designed to achieve both goals; however, given the dense urban landscape of the NYC area both goals may not feasible. Therefore it is anticipated that most of the systems will be below grade or roof detention systems providing some treatment via primary settlement. However, the design is based on attenuating stormwater peak flow rates. Refer to NYC DEP website for updates on addressing this issue.

Stormwater Detention and Retention Practices

CS 1



Roof Detention Systems

Roof detention systems are included in NYCDEP's initiative for onsite stormwater detention. Referred to as "blue roofs," they are typically specified for sites that are primarily building structure and have no room for other alternatives. This SMP may add cost to the roof system, although it is less expensive than a green roof system.

Onsite detention is currently utilized throughout NYC, primarily within the combined sewer system, where there may be limited capacity to convey the storm and sanitary flow during rainfall events. By reducing the storm flow rates, more sanitary flow can be accommodated in the combined sewer system reducing the potential for CSO discharges. The detention SMPs will reduce the peak stormwater runoff flow rate, thereby allowing more sanitary flow to enter the combined sewer system and be conveyed to the treatment plant. The combined sewer overflow (mixing of storm and sanitary flow) discharges to adjacent water bodies in these systems are thereby reduced.

Detention and Retention Ponds

Specific as-built sewer systems located around a specific project site can be located using maps showing where the actual CSO is located, available through the NYCDEP Water and Sewer Records Office.

Detention and retention ponds include:

- Open water ponds
- Below grade pipe network, tanks, or chambers
- Roof detention systems

Typically, site constraints in urban areas limit the potential use of ponds. However, certain sites adjacent to open bodies of water, such as parks, can be constructed with ponds, possibly a retention pond or created wetland system.

Where there are specific limitations to constructing a pond, an underground detention system or roof detention system can be designed. Underground systems can consist of closed pipes, concrete culvert boxes, tanks of various materials, for example. The size of the contributing area combined with land use and maximum allowable depth of the structure will be used to determine the preliminary size of the SMP.

The following design considerations need to be taken into account in sizing and placing a detention or retention system:

- **Size of the Contributing Drainage Area** - will help determine the type of detention or retention system.
- **Available Head** - the amount of available head should be evaluated and will determine the available depth of the detention/retention structure to ensure positive flow through the stormwater management system and prevent backflow or localized flooding.
- **Maintain Setbacks** - separation from onsite septic systems and buildings should be maintained if an open pond system is proposed.
- **Maximize Separation to Utilities** - maximize separation to the stormwater system and avoid crossing utilities where possible.
- **Rock** - depth to rock is crucial to the design of open pond systems as well as the underground systems. Rock removal can add to construction costs.
- **Seasonal High Groundwater Table** - depth to the seasonal high groundwater table is crucial to the design of open pond systems. For underground systems, the buoyancy should be accounted for in the design of the underground system.
- **Soil Characteristics** - absorption and percolation rates.

Stormwater Detention and Retention Practices

Forebays - forebay, located at the inlet, should be incorporated in the design of an open water pond to provide settlement of the larger particulates and reduce the incoming velocity.

Micropools - micropool near the outlet structure of an open water pond will provide for additional settlement of particulates.

Velocity Dissipaters - should be designed at the inlet and outlet of the open water pond to reduce the velocity of outfall and prevent erosion.

Building Profession Task Designations

Before the building professional team can use this practice it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- S Licensed Surveyor
- CE Civil Engineer
- LA Landscape Architect
- SE Structural Engineer
- LS LEED Specialist
- ME Mechanical Engineer

Required Tasks

Efficient

The design team, including the architect, plumbing engineer, and civil engineer, should evaluate the objectives of the proposed project and determine adequate space needed for detention system. At this point the design team should determine whether an open water pond system is of added value or if an underground system or roof detention system will be necessary. For the design of an underground system, the original design team should evaluate the potential locations and depth needed for this system. If an open water pond system is chosen, a landscape architect should be consulted to help evaluate appropriate plantings in and around the proposed pond. If a blue roof system is to be used, the structural engineer should be involved in this phase of the design process to ensure proper structural support of the added weight of the stored water. A PE CE LA SE

In efficient projects, there are two stormwater system design goals: treatment of water quality and control of stormwater quantity. The design parameters are based on the Sustainable Sites (SS) LEED credits available for stormwater design. LS

To achieve water quality, the design team should develop a site plan that reduces the impervious cover and maximizes the total volume captured and treated. The detention or retention pond should be designed to capture and treat the runoff from 90% of the average annual rainfall. The detention or retention pond should be designed in accordance with the requirements of the *New York State Stormwater Management Design Manual* (NYSSMDM).

In NYC there are four ways to achieve stormwater quantity control based upon the existing impervious surface coverage:

- NYCDEP Site Connection Permit;
- NYSDEC uniform sizing criteria;
- LEED requirements for site with greater than 50% impervious coverage; and
- LEED requirements for sites with less than 50% impervious coverage.

The one that produces the largest reductions of volume and flow to the combined sewer should be used for the design of the detention or retention system.

In cases the where a NYCDEP Site Connection Permit is required, the NYCDEP regulations must be followed to determine the detention volume required onsite based on the storm event and associated runoff coefficients for stormwater quantity. Currently systems are designed for the 5 year storm event; however, based on the Sustainable Stormwater Management Plan, the design requirement may change to the 10 year storm event.

A second method of achieving stormwater quantity control is to detain the flows to existing conditions for the 1, 10 and 100 year storm events. This can be achieved by following the NYSDEC methodology for the Channel Protection Volume, Overbank Flood Control and Extreme Flood Control.

The other two sizing alternatives for quantity control are based on the LEED requirements. For sites with an impervious surface coverage greater than 50%, the detention or retention system should result in a 25% decrease in the volume of stormwater runoff from the 2 year, 24 hour storm event. Alternatively, for sites with a total existing impervious surface coverage less than 50%, the detention or retention SMP should capture and detain the postdevelopment peak discharge rate and quantity for the 1 and 2 year, 24 hour storm event to the predevelopment condition.

The overall site layout, taking into account the existing and proposed utilities and available sewers, must be evaluated to develop a stormwater system that captures stormwater runoff from the new impervious surfaces and conveys it to a detention or retention system. The design team, including architect, plumbing engineer, and civil engineer, should work together to find suitable area for the detention and retention system. Given the dense urban landscape, directing the roof runoff towards one or several areas will help in the overall design and best use of the site. The roof leaders should be directed towards this area to minimize the piping system and potential confluences with other below ground utilities.
A PE CE

Hydrologic and hydraulic computations should be performed to demonstrate the reduction of the peak flows. A profile of the system should be provided, showing the invert elevation of each structure and conveyance system as well as other existing and proposed utilities. Most sites are limited by the invert elevation and capacity of the proposed or existing site connection. It is therefore important to determine that there is sufficient elevation and capacity to convey the stormwater runoff through the detention system to the runoff outlet and avoid conflicts with utilities.

A flow splitter or diversion device is often implemented prior to the detention system. The diversion device would be designed to divert the larger flows out of the system to prevent the detention system from short-circuiting.

When a large portion of a parking area will be conveyed to the SMP, a pretreatment device may be used prior to the SMP. For example, a forebay could be used for a pond or an SMP specified in CS 4 **Supplemental/ Pretreatment Practices** could be used to allow the larger particulates to settle prior to treatment in the detention or retention SMP. Pretreatment is typically required to minimize the sediment deposition within the SMP.

Certain construction factors need to be considered relative to the groundwater table. If there is high groundwater, dewatering operations should be considered during construction. Dewatering permits may be required from NYCDEP if discharging into the sewer system. If directly discharging to State waters, a separate permit may be required from NYSDEC. For either of these permits, implementation of filtration and other treatment technologies may be necessary as well as routine sampling and testing for defined water quality parameters.

If rock or groundwater is encountered at a shallow elevation, the construction methods, including rock removal and dewatering, should be considered in the overall cost of the construction of the detention or retention system.

During construction, a licensed surveyor should set the elevations of the outlet control structure. Survey during construction will ensure that the system will perform as designed, maximizing the water detained or retained on site. S

A long term inspection and maintenance plan should be developed during the design and modified based on the final as built conditions. This plan should be turned over to the building operator to implement a schedule for long term inspection and maintenance of the practice. CE BO

Renovation

Renovation projects should match the tasks of new construction, but should be designed to capture only the stormwater runoff from the new impervious surfaces.

Based on the preliminary findings of the *Sustainable Stormwater Management Plan*, building renovations that include roof repairs or replacement will likely be required to detain 1 inch of stormwater, provided the existing structural supports for the roof system can support the loading or can be modified at minimal cost. However, the specific design goals are still being considered at this time and so this should be used as a minimum. DDCPM SE

More Efficient

All of the design parameters for efficient projects should be followed. However, to obtain the goals of a more efficient practice, a larger volume of water should be captured and detained or retained onsite. Generally, the goal should be to reduce the peak flows by 25% to 50% for the 1, 2, 10 and 25 year, 24 hour storm events. Peak flow reduction can be achieved by collecting runoff from additional portions of the site and conveying runoff to the SMP, or by increasing the size of the detention/retention SMP. The outlet control structure can also be modified to increase the detention time and decrease the flow.

The stormwater conveyance system should be sized to handle larger storm events. At a minimum it should convey a 25 year storm event. Calculations should be provided to demonstrate that catch basin grates can convey the runoff from a 25 year storm from the contributing drainage areas.

Ultra Efficient

Ultra efficient buildings require the same tasks as the efficient and more efficient projects and by reducing the peak flows by 50% to 75% for the 1, 2, 10 and 25 year, 24 hour storm events. In addition to these tasks, the ultra efficient building design team may need to determine the feasibility of sizing a detention structure to accommodate these flows.

Ultra efficient design may also be achieved by reusing the water retained for graywater systems, vehicle washing operations, or irrigation systems. Integrating the water reuse system into the building design will require coordination of all system connections and tie-in points and inclusion in the SD documents. PE ME CE LA BO DDCPM

Innovative

Innovative sites require the same tasks as the efficient and more efficient, reducing the peak flows by 75% or greater. If there is insufficient area to achieve this peak flow reduction, then consideration may be given if an ultra efficient design is proposed in conjunction with a minimum of two of the following practices integrated into the stormwater management system:

CS 4 Supplemental / Pretreatment Practices and
CS 5 Irrigation System
CS 6 Green Roof or **PS 6 Green Roof**
PS 3a Graywater and Water Reuse

Integrating the water reuse systems into the building design will require coordination among all the disciplines involved in the reuse system, including all system connections and tie-in points, and inclusion in the SD documents.
PE ME CE LA BO DDCPM

Integration

PS Plumbing Systems
Where possible stored stormwater runoff can be integrated into the nonpotable portion of the system thereby reducing the water use.

CS 4 Supplemental / Pretreatment Practices and
CS 5 Irrigation System
Water reuse for stored stormwater runoff, thereby minimizing the use of potable water.

CS 6 Green Roof or **PS 6 Green Roof**
May be used in combination with the detention system to store water for reuse onsite.

PS 3a Graywater and Water Reuse
Stormwater runoff can be stored onsite and integrated into the graywater system.

MS Mechanical System
Stormwater runoff, or nonpotable water, can be integrated into the mechanical systems.

Infiltration Practices

CS 2

Civil Systems

CS 1 3 6

Objective

The objective of implementing infiltration Stormwater Management Practices (SMPs) is to capture stormwater runoff from the site and exfiltrate a volume of runoff. The infiltration volume of water will be permanently removed from the sewer system and become part of the groundwater recharge. In combined sewer systems the peak stormwater runoff rate is also reduced, thereby reducing the storm flow to the Water Pollution Control Plant during wet weather conditions and minimizing the potential for the occurrence of a combined sewer overflow.

Benefit

Removes a volume of stormwater runoff from the combined sewer system in the areas of combined sewers. Can be installed below impervious or pervious surfaces such as sidewalks, driveways, and parking areas.

Lower peak flow rates and velocities in storm sewer systems, thereby reducing the potential for flash flooding.

Provides channel protection depending on the volume removed from the system.

Provides treatment of stormwater runoff through the exfiltration in the underlying soils.

Increases groundwater recharge and reduce runoff volumes.

Can be combined with other practices cited in CS 3 **Filtering Practices** or CS 4 **Supplemental/ Pretreatment Practices.**

Limitations

Finding suitable soils with sufficient depth to groundwater and an adequate percolation rate.

Should avoid infiltration from hot spot areas (vehicle wash areas, fueling areas, chemical or petroleum storage areas, vehicle maintenance areas, etc.).

Requires pretreatment.

Inspection and maintenance plan must be developed and implemented adding long term maintenance costs.

Background

Infiltration is a common SMP used to treat stormwater runoff and reduce the peak flows during storm events. Infiltration practices are typically basins or underground structures that contains a volume of water and exfiltrates it through the underlying soil. The types of infiltration practices include:

Stormwater Infiltration Basin - an open pond system with a forebay, grassed sideslopes, an outlet control structure, and emergency spillway. The pond will temporarily store stormwater runoff and allow for exfiltration through the subsoil.

Trench - a gravel trench that will capture surface flow and infiltrate through the subsoil.

Perforated Pipes - a system of perforated pipes wrapped in geotextile fabric and gravel allow for stormwater runoff to exfiltrate through the subsoil.

Drywell - typically a precast concrete chamber used to temporarily store stormwater runoff.

Storage Chambers - typically these are manufactured high density polyethylene chambers. The chambers have slots or perforations along the sidewalls, are bottomless, and are surrounded with gravel and geotextile fabric.

Soil testing must be performed to confirm that soil conditions are suitable for infiltration. Soil borings or deep test pits can be performed to determine the soil horizons and evaluate whether the soil is suitable. In redevelopment projects there is a chance that the soils were previously disturbed or filled with construction and demolition debris. In these instances it will be necessary to determine the boundaries of the fill material and evaluate the potential for a cut and fill system.

If suitable soil is present, a percolation test or permeability test should be conducted on site. It is important to confirm that the infiltration rate will still function properly in future. The infiltration rate decreases over time due to changes in the soil structure based on compaction and accumulation of sediments from stormwater runoff. A proper depth to rock and groundwater must also be maintained to maximize the depth of the soil treatment zone.

Certain infiltration practices, such as trenches, perforated pipes, drywells, and storage chambers can be installed below pervious or impervious surfaces. These systems should be designed and installed in accordance with NYSSMDM and manufacturers' recommendations. Practices that will be subject to vehicular traffic loads shall be designed and installed to withstand these loads.

A pretreatment device, possibly combined with a flow diversion structure, should be used prior to the infiltration practice. A sedimentation chamber or SMPs specified in CS 4 **Supplemental/Pretreatment Practices** could be used to allow the larger particulates to settle prior to the infiltration practice. Pretreatment is typically required to minimize the sediment deposition within the infiltration system.

Building Profession Task Designations

Before the building professional team can use this practice it is recommended that a team member is assigned each task. Refer to building profession key below.

- **DDCPM** DDC Project Manager
- **A** Architect of record
- **BO** Building Operator
- **PE** Plumbing Engineer of record
- **PC** Plumbing Contractor
- **CX** Commissioning Agent
- **CE** Civil Engineer

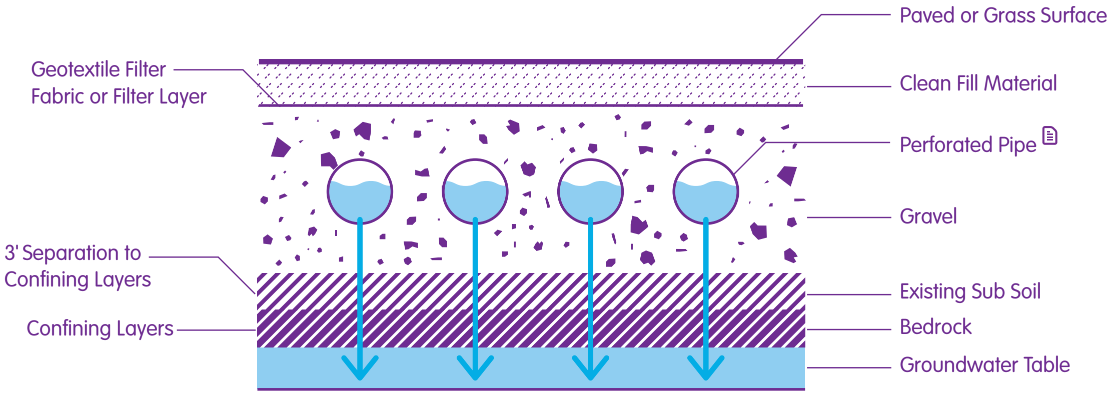
Required Tasks

Efficient

For efficient new construction, there are two stormwater design goals: treatment of water quality; and, control of stormwater quantity. The design parameters are based on the LEED credits available for stormwater design under the Sustainable Sites (SS) category. The architect should consult with the site design engineer early in the conceptual development phase of the project to determine where there is the best potential for infiltration systems. The plumbing engineer shall also be involved in these discussions to evaluate the roof leader system and the potential to connect to the system. **A** **CE** **PE**

To achieve water quality, the design team should develop a site plan that reduces the impervious cover and maximizes the total volume captured and treated. The infiltration practice should be designed to capture and treat the runoff from 90% of the average annual rainfall and meet the requirements of the NYSSMDM.

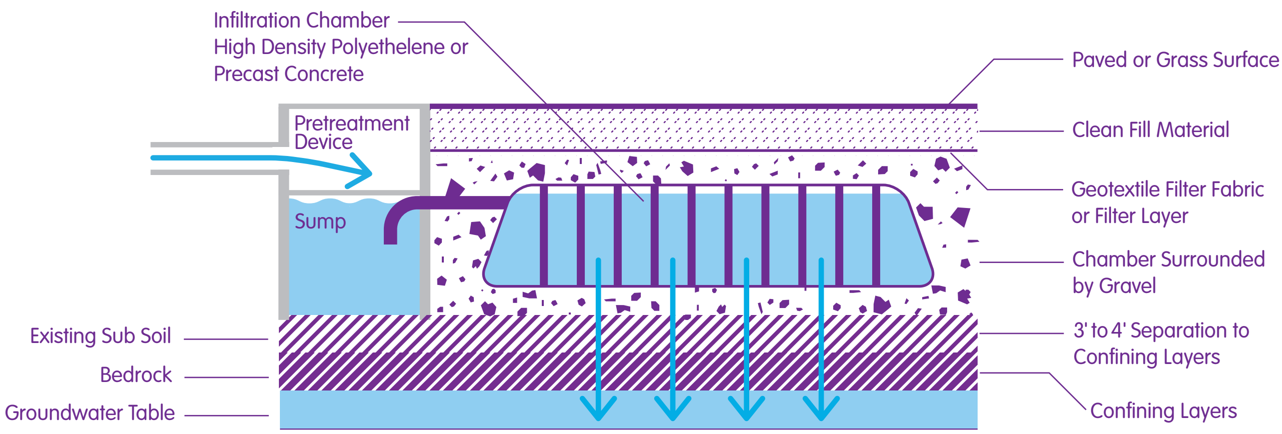
Perforated Pipe System



If the infiltration trenches will be subjected to vehicular traffic then the infiltration pipes or chambers shall be designed to withstand H-20 or HS-25 loading

Section View Not to Scale

Infiltration Chamber System



Profile View Not to Scale

In NYC there are four ways to achieve stormwater quantity control based upon the existing impervious surface coverage:

- NYCDEP Site Connection Permit
- NYSDEC uniform sizing criteria
- LEED requirements for site with greater than 50% impervious coverage
- LEED requirements for sites with less than 50% impervious coverage

The one that produces the largest reductions of volume and flow to the combined sewer should be used for the design of the system.

In cases where a NYCDEP Site Connection Permit is required, the NYCDEP regulations must be used to determine the detention volume required onsite based on the storm event and associated runoff coefficients. Currently systems are designed for the 5 year storm event; however, based on the *Sustainable Stormwater Management Plan* the design requirement may change to the 10 year storm event. If site conditions are acceptable the infiltration system should be designed for the required detention volume.

A second method of achieving stormwater quantity control is to detain the flows to existing conditions for the 1, 10 and 100 year storm events. Reduction of peak flows can be achieved by following the NYSDEC methodology for the Channel Protection Volume, Overbank Flood Control and Extreme Flood Control.

The other two sizing alternatives for quantity control are based on the LEED requirements. For sites with an impervious surface coverage greater than 50%, the infiltration system should result in a 25% decrease in the volume of stormwater runoff from the 2 year, 24 hour storm event. Alternatively, for sites with a total existing impervious surface coverage less than 50%, the infiltration practice should capture and detain the postdevelopment peak discharge rate and quantity for the 1 and 2 year, 24 hour storm event to the predevelopment condition.

A Long Term Inspection and Monitoring Program should be implemented to ensure the proper operation of this system. The plan should be developed during the design and modified based on the final as built conditions. The plan should be turned over to the building operator to implement a schedule for long term inspection and maintenance of the practice. Accumulated sediment shall be cleaned out in conformance with manufacturer and NYSDEC requirements. CE BO

Renovation

Renovation projects should match the tasks of new construction and include capture of stormwater runoff from the new impervious sources.

More Efficient

For infiltration systems in more efficient projects, the infiltration SMP should follow the requirements of Efficient – New Construction and attenuate the post-development flows by 25% to 50% for the 1, 2, 10, and 25 year, 24 hour storm event.

Ultra Efficient

Ultra efficient SMPs require the same tasks of the efficient provisions and attenuate the postdevelopment flows by 50% to 75% for the 1, 2, 10, and 25 year, 24 hour storm event. If there is insufficient area to achieve this peak flow reduction, then consideration will be given if a more efficient design is proposed in conjunction with a minimum of two of the following practices integrated into the stormwater management system:

CS 4 **Supplemental/Pretreatment Practices** and
CS 5 **Irrigation System**
CS 6 **Green Roof** or PS 6 **Green Roof**

In order to implement this approach, the stormwater management system, including roof leaders and catch basin grates, should be designed to convey the runoff from the 25 year storm event.

Innovative

An innovative system may be achieved by eliminating the stormwater runoff from a 25 year, 24 hour storm event. This may be achieved by minimizing the impervious coverage and integrating other aspects of CS including detention and PS 3a **Graywater and Water Reuse**.

Integration

CS 1 CS 3 CS 6 **Civil Systems**

To achieve the innovative level, it may be necessary to integrate these various design practices.

CS 3

Filtering Practices

Civil Systems

CS 1 2 4

Objective

Filtering practices capture stormwater runoff from the site and pass it through media, which filters out the pollutants entrained in the stormwater runoff. These types of practices temporarily store a volume of water thereby reducing the peak runoff rate for smaller storm events. An additional objective, in NYC areas where combined sewer systems exist, is to reduce the peak stormwater runoff rate to the receiving combined sewer system, thereby reducing the flows to the Water Pollution Control Plant (WPCP) during wet weather conditions and potentially minimizing the occurrence of combined sewage overflow (CSO) discharges.

Benefit

Provides treatment of stormwater runoff.

Can be installed below pervious or impervious sidewalks, driveways, and parking areas.

Provides attenuation of stormwater peak runoff during smaller storm events.

Reduces the potential for CSO discharges in combined sewer areas.

Enhances groundwater recharge through infiltration in locations where the underlying soils are suitable.

Provides channel protection, if storage is provided above the media layer.

Provides treatment for stormwater runoff from hotspot areas.

Limitations

These are below grade structures that must be designed to avoid underground utilities.

Depending on the size of the contributing drainage area, a large area will be needed for the filter bed.

Available head is necessary to effectively convey the stormwater through the media.

At some sites the appearance, while below grade, may be perceived as aesthetically displeasing.

Groundwater table and rock ledge can minimize the depth of the system and increase the construction cost.

Long Term Inspection and Maintenance Plan must be implemented onsite.

The underground chambers may pose potential issues for public concern with regard to mosquito breeding.

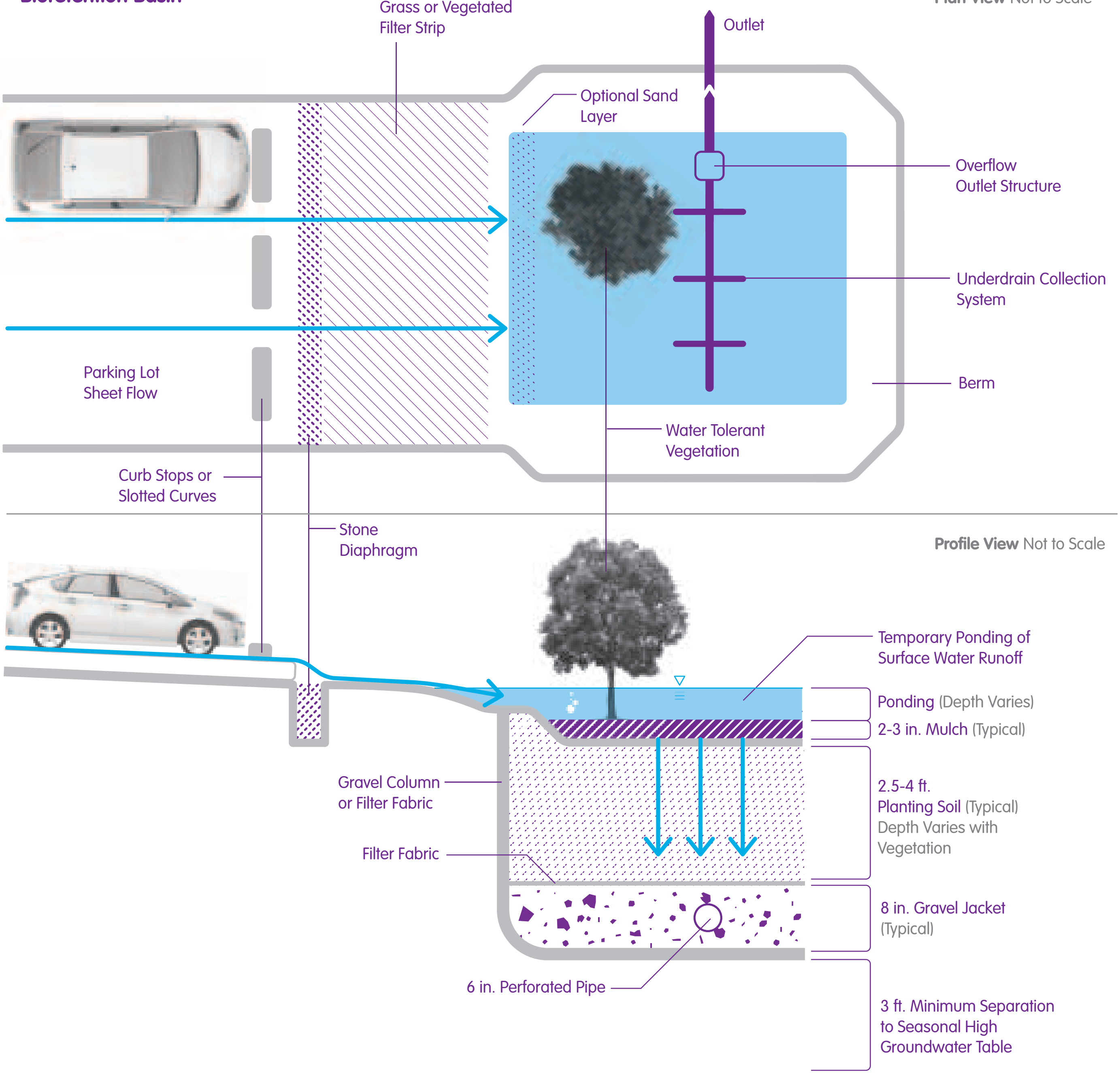
Background

Various forms of filtering practices are commonly used to capture stormwater runoff from paved surfaces. Soil testing should be performed to determine suitability for potential infiltration. However, if groundwater or rock is present, the filtering practice can be constructed with an impervious liner or within a concrete structure.

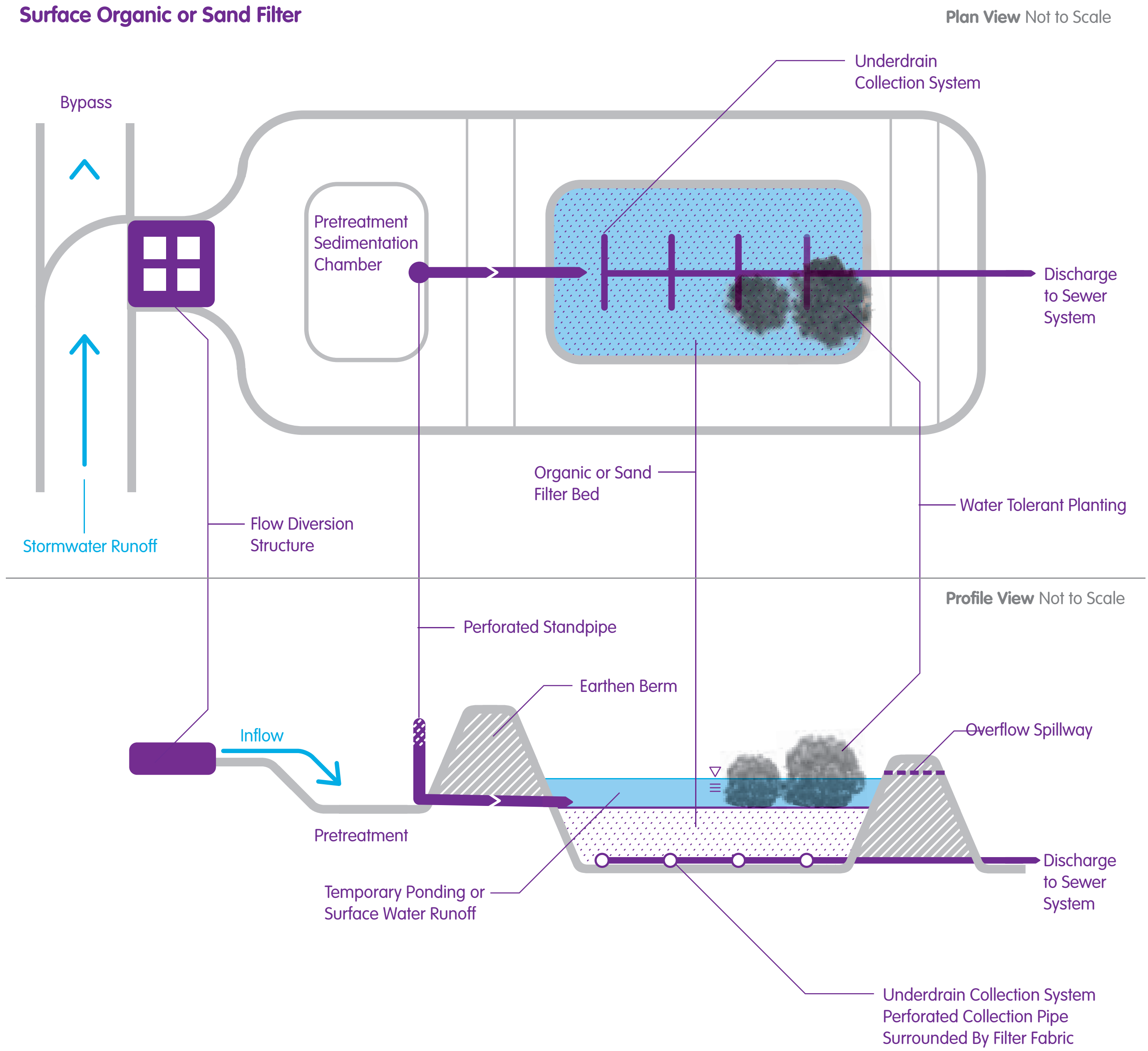
Any of the following types of filtering practices can be implemented for the site:

Bioretention - stormwater runoff is conveyed via sheet flow to a landscaped area where the stormwater runoff infiltrates through a 2.5 to 4 feet planting soil layer and is conveyed offsite via an underdrain. In areas with suitable soil and separation to seasonal high groundwater table, the stormwater can be completely infiltrated.

Bioretention Basin



Surface Organic or Sand Filter



Filtering Practices

CS 3

Surface Sand Filter - consists of a sediment chamber followed by a filter bed comprised of approximately 18 inches of sand media, all located at grade.

Organic Filter - similar to surface sand filter, with an organic filter medium in lieu of sand.

Underground Sand Filter - stormwater is piped to a below grade concrete chamber, which consists of a sedimentation chamber and filter bed.

Perimeter Sand Filter - similar to the underground sand filter, however, stormwater runoff is conveyed via overland flow through the inlet grates.

Building Profession Task Designations

Before the building professional team can use this practice it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- CE Civil Engineer
- S Licensed Surveyor
- LA Landscape Architect

Required Tasks

Efficient

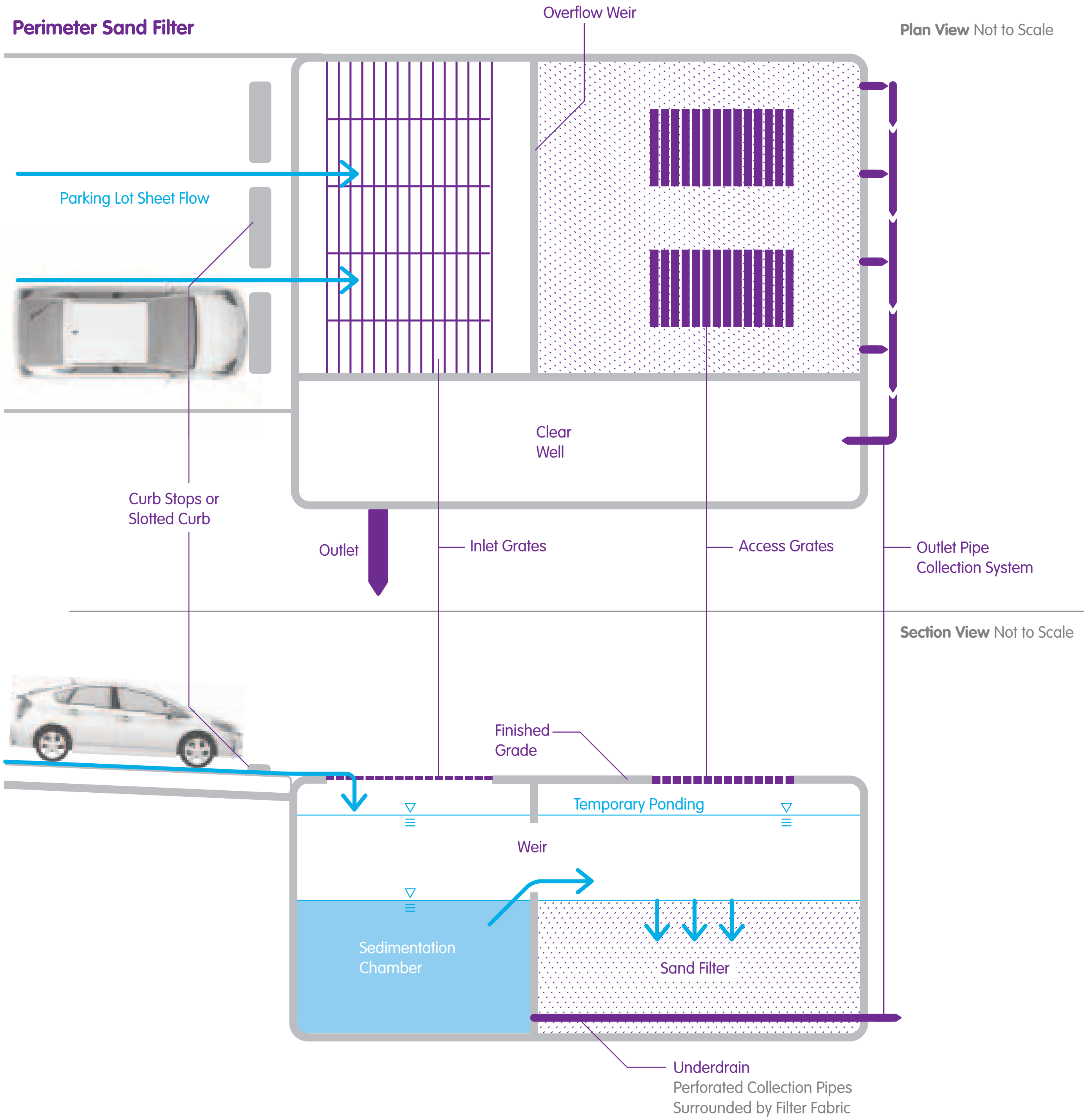
In the initial phases of developing the conceptual site plan, the design team, including architect, civil engineer, and plumbing engineer, should evaluate the potential for locating the filtering systems. If an open water system is selected a landscape architect should help develop the planting plans.
A CE PE LA

In efficient projects, there are two stormwater system design goals: treatment of water quality; and, control of stormwater quantity. The design parameters are based on the LEED credits available under the Sustainable Sites (SS) category for stormwater design. Filtering practices are used primarily to treat stormwater runoff and are not typically used for attenuation of stormwater quantity. Therefore the goals for control of stormwater quantity should be achieved in combination with CS 1 **Detention/Retention Practices** or CS 2 **Infiltration Practices**.

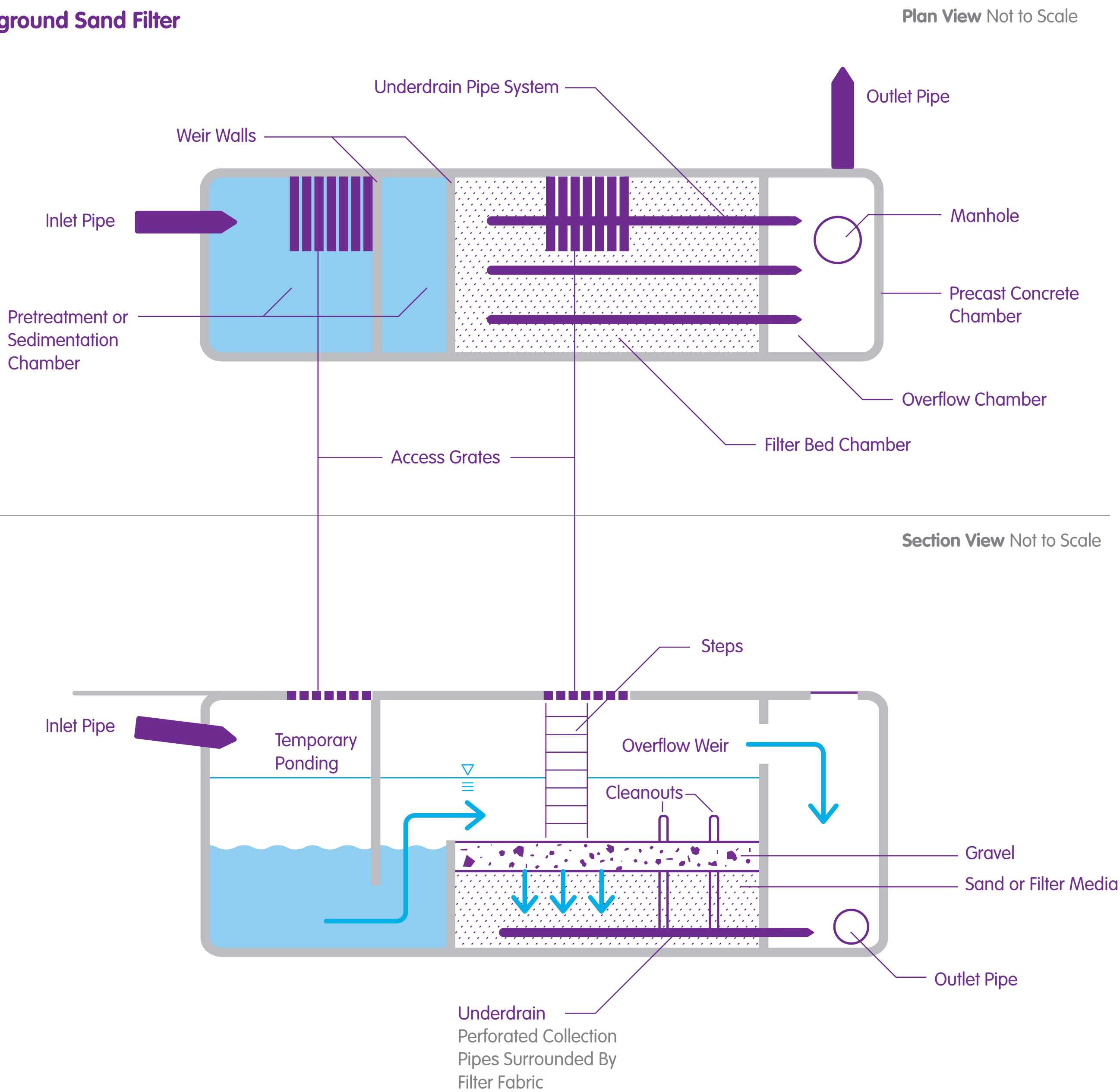
To achieve water quality, the design team should develop a site plan that reduces the impervious cover and maximizes the total volume captured and treated. The filtering practice should be designed to capture and treat the runoff from 90% of the average annual rainfall and in accordance with the requirements of the *New York State Stormwater Management Design Manual* (NYSSMDM).

A flow splitter or diversion device is often designed for installation prior to the filtering practice which allows the smaller flows to be conveyed to the filtering practice and larger flows to be diverted away from the filtering practice. Use of a flow-splitter or diversion device will prevent short-circuiting.

Pretreatment is necessary to trap coarse sediments prior to being conveyed through the filter media and can be achieved with any of the practices in CS 4 **Supplemental/Pretreatment Practices**. A sedimentation chamber can also serve as pretreatment for filtering practices.


Perimeter Sand Filter
Overflow Weir
Plan View Not to Scale
Parking Lot Sheet Flow
Clear
Well
Curb Stops or
Slotted Curb
Outlet
Inlet Grates
Access Grates
Outlet Pipe
Collection System
Section View Not to Scale
Finished
Grade
Temporary Ponding
Weir
Sedimentation
Chamber
Sand Filter
Underdrain
Perforated Collection Pipes
Surrounded by Filter Fabric

Underground Sand Filter



Certain construction factors need to be considered relative to the groundwater table. If there is high groundwater, dewatering operations should be considered during construction. Dewatering permits may be required from NYCDEP if discharging into the sewer system. If directly discharging to State waters, a separate permit may be required from NYSDEC. For either of these permits, documentation of filtration and other treatment technologies may be necessary.

If rock or groundwater is encountered at a shallow elevation, the construction methods, including rock removal and dewatering, should be considered in the overall cost of the construction of the filtering practice.

During construction, a licensed surveyor should set the elevations of the inlet and outlet structure. This will ensure that the system will perform as designed, maximizing the water detained or retained on site. S

A Long Term Inspection and Maintenance Plan must be developed during the design and modified based on the final as built conditions. This plan should be turned over to the building operator to implement a schedule for long term inspection and maintenance of the practice. BO

Renovation

Renovation projects should match the tasks of new construction, capturing the runoff from the new impervious surfaces.

More Efficient

Following the design requirements of Efficient - New Construction and exceed the target water quality volume by more than 25%.

Ultra Efficient

Ultra efficient buildings require the same tasks of the Efficient - New Construction design requirements and exceed the target water quality volume by more than 50%.

Integration

CS 1 Detention/Retention Practices

CS 2 Infiltration Practices

CS 4 Supplemental/Pretreatment Practices

Supplemental/ Pretreatment Practices

CS 4

Plumbing Systems

PS 2a 2b 2c

Civil Systems

CS

Objective

Various supplemental practices or pretreatment practices may be used to treat or reduce stormwater runoff to the sewer system or water body.

Benefit

- Provides treatment of stormwater runoff.
- Reduces impervious coverage to decrease overall stormwater runoff.
- Can be combined with other practices such as detention, retention, or infiltration to enhance pollutant removal and further reduce the peak flow rates of stormwater runoff.
- Reduces stormwater runoff and minimize potential flash flooding.
- In combined sewer areas, reduces potential for combined sewer overflow (CSO) discharges.

Limitations

- The land use type will guide the type and design of the practice.
- Suitable soil is required for some of these practices.
- Depending on the contributing area, some of these practices may be cost prohibitive.

Background

Supplemental/pretreatment practices are included in the overall category of Stormwater Management Practices (SMP). There are various low impact development practices that can be implemented on site to reduce the volume of runoff leaving the site. Practices such as porous pavement, pervious pavers, rain gardens, stormwater planters, cisterns, swales, or grassed or landscaped filter strips can be implemented throughout the site to reduce the impervious coverage. Typically any one of these practices cannot treat the entire site, but portions of the site may be directed to each of the practices. These practices should be used as a way to disconnect the impervious surface thereby increasing the travel time of the peak runoff and potentially reduce the stormwater runoff volume. Some of these practices rely on the infiltrative capacity of the underlying soils. Additionally, pretreatment devices such as oil grit separators, hydrodynamic devices, and other proprietary products remove a large portion of the floatables and larger particulates. Refer to NYC DEP website for updates on possible mandatory measures in the interest of city-wide run-off reduction requirements.

Porous Pavement

Porous pavement is an asphalt or concrete surface that is more permeable than typical surfaces. Typically a stone reservoir is located below the porous pavement. This surface will allow for infiltration therefore the subsoil should be suitable for this practice. This SMP should not be used in areas where salting and sanding are required for winter traction.

Pervious Pavers

Pervious pavers are a modular block porous pavement where grass, sand, or gravel is used in the pore space. Issues relating to accessibility and potential tripping hazard should be taken into consideration before specifying the use of pervious pavers, which should only be used where appropriate. Certain pervious pavers can be installed to meet American Disabilities Act (ADA) criteria.

Supplemental/Pretreatment Practices

Rain Gardens

Typically stormwater runoff is conveyed via overland flow to a landscaped, conditioned planting soil bed. This SMP relies on a decent percolation rate and a vertical separation to the seasonal high groundwater table. Rain gardens should not be used in hotspot areas.

Stormwater Planters

Typically the roof leader is directed to these small landscaped SMPs that are placed near the building. They can be in structured planters or below grade.

Cisterns

Stormwater runoff is captured and stored to be used for irrigation or possible graywater use within the building system.

Swales

Low gradient grassed swales can capture stormwater runoff and infiltrate a portion of the volume. If soils are not suitable, a filter media can be placed in the swale and an underdrain can collect the filtered stormwater.

Grassed or Landscaped Filter Strips

Gently sloping grassed or landscaped areas that can slow the stormwater runoff allowing for some additional infiltration. This area will also trap some of the larger particulates and provide nutrient uptake.

Building Profession Task Designations

Before the building professional team can use this practice it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
CE Civil Engineer
LA Landscape Architect
ME Mechanical Engineer

Required Tasks

The design team should evaluate the project objectives and determine the most viable use of each of these practices. The architect, civil engineer, plumbing engineer, and landscape architect should review the potential location for these practices and evaluate how they may be integrated with other systems. A CE PE LA

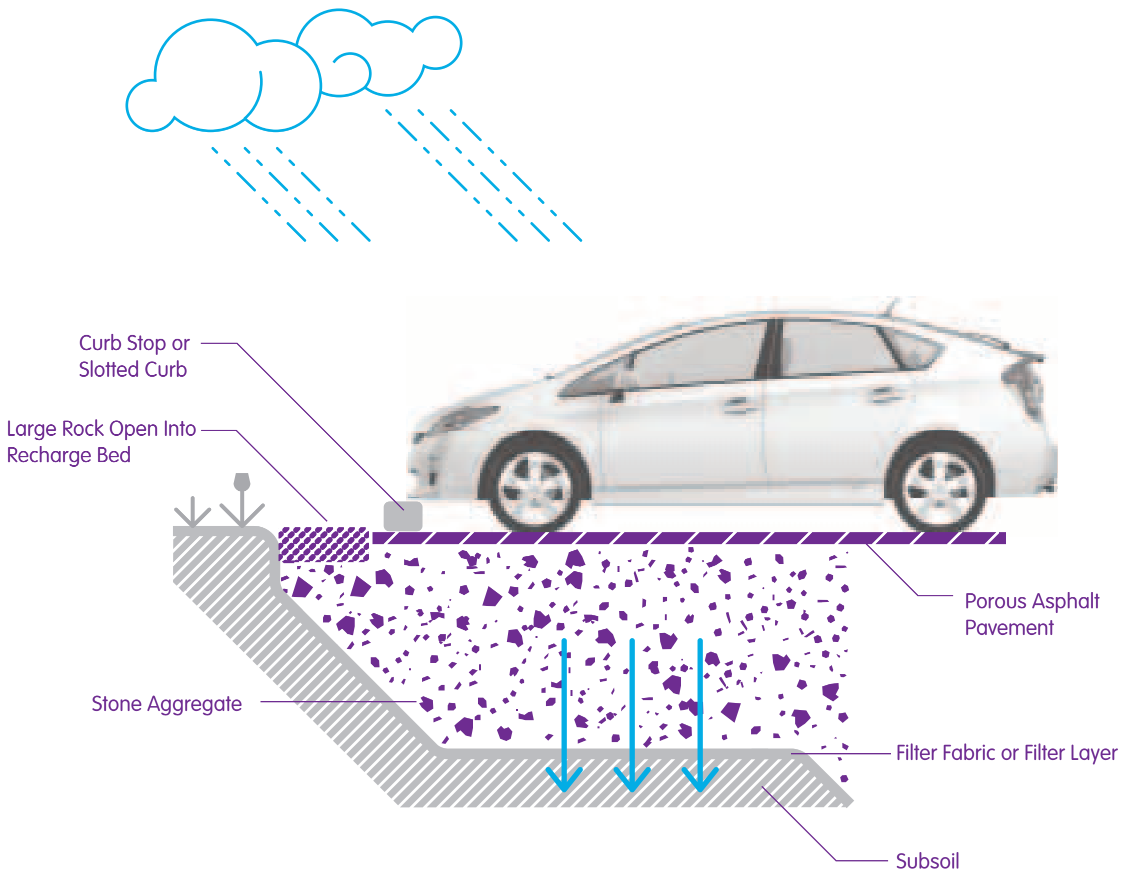
Most of these practices are not conventional stormwater management practices. However, they are often proposed to improve the land use and reduce the impervious surface coverage. When implemented in conjunction with detention, retention, and infiltration practices, they can maximize the pollutant removal efficiency and reduce the peak runoff rates. The requirements outlined in the NYSSDM should be followed for the design of each of these SMPs.

A Long Term Inspection and Maintenance Plan should be developed for each of the proposed practices. A Long Term Maintenance Plan will contribute to the effectiveness of the practice over its lifetime. BO

Integrating the water reuse systems into the stormwater management system design will require coordination amongst all the disciplines involved in the reuse system, including all system connections and tie-in points, and inclusion in the SD design documents. PE ME CE LA BO DDCPM

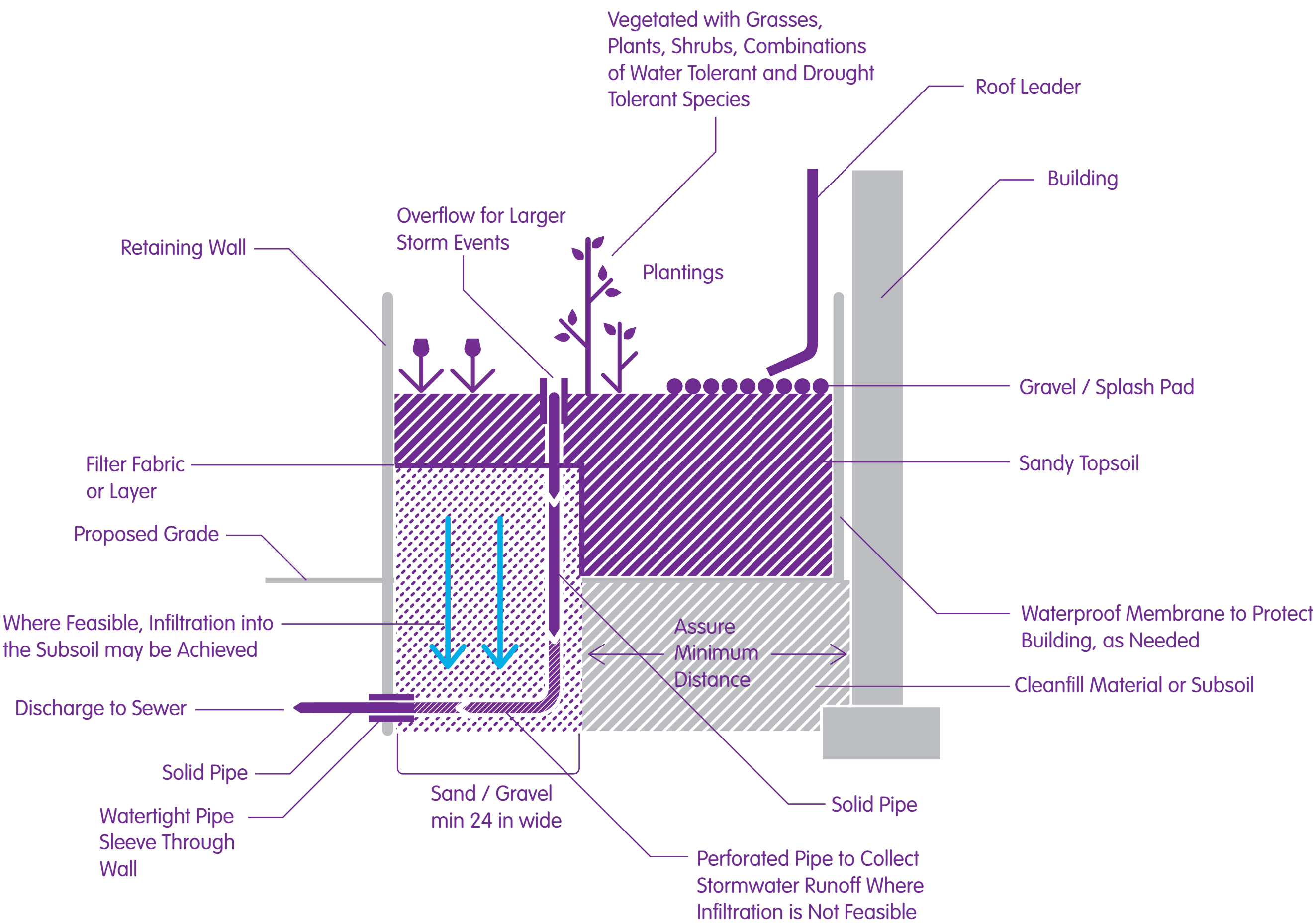
Porous Pavement

Section View Not to Scale



Stormwater Planters

Section View Not to Scale



Supplemental/Pretreatment Practices

Integration

PS 2a 2b 2c Water Reuse
The cistern can be used to supplement the water reuse system.

CS Civil Systems
These practices should be integrated to improve the pollutant removal efficiency and further reduce the stormwater runoff peak flows.

CS 5

Irrigation Systems

Operations	Civil Systems	Plumbing Systems
OP 2	CS 2	PS 3a 3a

Objective

Irrigation systems should be designed to provide water for onsite plant materials with a minimum of potable water use. By designing an efficient landscape and irrigation system, there is the potential to reduce or eliminate the potable water usage. If the source for irrigation is integrated with detention systems or graywater reuse, flows to the sewer system will be reduced as well.

Benefit

Establishes and maintains vegetation which, in addition to aesthetic and air quality value, provides soil erosion and sediment control.

Properly designed passively irrigated areas, with plant materials that require no irrigation once established, do not require permanent irrigation.

Indigenous plants are naturally attuned to the local climate and soil conditions.

Limitations

Irrigation systems require periodic maintenance and testing, and need occasional tuning to minimize runoff and water application to paved surfaces.

Irrigation system water demands can be many times higher than other uses within the building and tend to have a higher percentage of water loss due to leakage than other piping systems.

Irrigation systems, permanent, temporary, or ad hoc, may be necessary on a site for various design and O&M reasons.

Temporary and container plantings usually require regular watering, and are not usually serviced by irrigation systems.

The variety of plant materials that fit the design criteria is limited.

Given the demands of an urban environment, the use of nonpotable water for irrigation may not be recommended.

Background

Selection of landscaping materials should be based not solely on aesthetic design, but also soil, site, and climatic factors. Although the range of species that are indigenous to the climatic zone, drought tolerant, and resistant to the stresses of the urban environment is narrower than the full line made available by commercial nurseries, selection within this narrower class is key to water conservation.

Building Profession Task Designations

Before the building professional team can use this practice it is recommended that a team member is assigned each task. Refer to building profession key below.

- **DDCPM** DDC Project Manager
- **A** Architect of record
- **BO** Building Operator
- **PE** Plumbing Engineer of record
- **PC** Plumbing Contractor
- **CX** Commissioning Agent
- **LA** Landscape Architect
- **CE** Civil Engineer

Irrigation Systems

CS 5

Required Tasks

Efficient

For an efficient building, potable water use for irrigation should be reduced to 50% of the calculated mid-summer baseline case. The design team should develop a site design and building system that will minimize the potable water used. This design parameter is based on the LEED credit available under the water efficiency (WE) category. CE LA PE

In order to achieve this goal, the following techniques may be considered:

- Grade the site to minimize runoff and provide passive irrigation.
- Where appropriate, consider directing runoff from site walkways, pedestrian plazas, and roofs into planting areas.
- Select and install species appropriate to the soil and climate of the site.
- Selection of drought tolerant plantings is encouraged.
- Provide a rain gauge and timer to prevent irrigation during rainfall.

A long term Inspection and Monitoring Program should be implemented to ensure the proper operation of this system. Proper care of the landscape area should occur on a routine basis to ensure plant survival and maintain the water balance to minimize the potable water use. BO

Renovation

Renovation projects should match the tasks of new construction, except that vegetation preserved due to significant stature and historic significance may be excluded from the efficiency calculation.

More Efficient

The design parameters within the efficient building tasks should be followed, while using only captured rainwater, recycled treated wastewater, recycled graywater, or condensate from the air conditioning system for irrigation. Please note that surface disposal of recycled wastewater and graywater is generally not allowed, but has been accepted by DOB and DOH on a case by case basis. The stored stormwater from **CS 1 Detention/Retention Practices** or **CS 4 Supplemental/Pretreatment Practices** can be used as nonpotable sources for irrigation. Groundwater intercepted in a footing or surface drain may also be used for irrigation so long as it does not interfere with the stormwater management system.

Ultra Efficient Innovative

Ultra efficient and innovative sites will feature landscaping and grading that does not require a permanent irrigation system. A temporary irrigation system may be used during the first year to establish vegetation.

Integration

OP 2 Water Audit

Consider metering outdoor water uses separately.

CS 2 Infiltration Practices

Follow as necessary for runoff.

PS 3 Plumbing Systems

Graywater and Blackwater Systems.

CS 6

Green Roof

Civil Systems

CS 5

Plumbing Systems

PS 2a PS 3 PS 6

Mechanical Systems

MS

Energy

EN 1d

Objective

As a civil system, the plant and soil material of a green roof provides attenuation of stormwater runoff from an otherwise impervious surface and can provide urban greenspace. The green roof system will reduce the stormwater runoff flows to the sewer system through evapotranspiration and infiltration through the soil, thus helping to reduce combined sewer overflow (CSO) discharges. A green roof incorporates plant and soil material into a building's roofing system to minimize the solar load on the building's HVAC system. The reduction in the solar loading reduces HVAC system size and power requirements. By absorbing sunlight, green roofs help to reduce the heat island effect.

Benefit

- Provides attenuation and treatment of stormwater runoff.
- Provides improved air quality through the additional vegetation.
- Provides a reduction of the heat island effect due to the capacity of vegetation and soil to absorb solar heat and insulate.
- Can potentially create an urban green space for recreational use.

Limitations

- Can potentially add significant structural loading to a building.
- Can require significant and regular maintenance.
- Requires care in plant species selection.
- Tree species are difficult to accommodate due to deep root systems.
- May require irrigation.
- Potentially elevated runoff temperatures require consideration if discharging directly to open waters or sensitive habitats.
- Building insurance policy and product warranties should be reviewed for comparability with the green roof system proposed.

Background

Green roofs are a modern application of the timeless building systems known as earth sheltered and passive solar design. In the modern, urban iteration of this building technique, the solar shading and water absorbing properties of soil and plant materials are used to lessen solar loading on roofing systems, as well as provide the opportunity for enhancing rooftops as special urban spaces.

The importance of the green roof system in reducing stormwater runoff as well as reducing energy costs is discussed in both the DDC *Cool & Green Roofing Manual* and the PlaNYC *Sustainable Stormwater Management Plan 2008*.

The green roof systems within this section apply to earth-based structures, such as parking garages. Typical building green roof systems are addressed in PS 6. The structural Engineer needs to evaluate and design the roof structure to support the weight of the green roof system. Other green roof components include watertight or waterproof membrane, a drainage layer or gravel layer, geosynthethic layer, soil media and vegetation. Extensive systems typically consist of shallow soil media and vegetation with a shallow root system and generally do not allow for pedestrian or public access. Whereas intensive systems have a deeper soil media which allows for vegetation with deeper root systems, allowing for a more complex ecosystem. Typically pedestrian or public access is provided within the intensive systems, allowing for park like settings.

Building Profession Task Designations

Before the building professional team can use this feature it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
CE Civil Engineer
SE Structural Engineer
LA Landscape Architect

Required Tasks

Efficient

Early in the design process the design team including the architect, plumbing engineer, structural engineer, landscape architect, and civil engineer should discuss the type of green roof system, intensive or extensive.
A PE SE LA CE

For a green roof on an efficient building, provide a vegetated green roof system on 50% of the roof surface. Consider locating these spaces in visible areas to provide a visual amenity.

For parking garages, provide a sunshade or high albedo decking material (minimum Solar Reflectance Index (SRI) 29) on the roof level.

The design parameter for Efficient - New Construction is based on the LEED credit available for reduction in the heat island effect under the Sustainable Sites (SS) category.

An inspection and maintenance plan should be developed for the green roof system by the design team and submitted to the building owner for implementation. BO

Renovation

Follow efficient building tasks with consideration to structural limitations. Renovation projects should consider adding green roof tray systems as allowable based on the building's structure.

For renovation of parking structures, consider installing a sunshade over the roof level, if used for parking, with an SRI of 29 or more.

Building component warranty and insurance policies should be reviewed early in the planning process. The warranty of any existing roof components should be checked for prohibitions against the use of the green roof system proposed. Where the warranty will be voided, plan to replace existing with compatible components. Some insurance policies may limit or prohibit the installation of green roofs, and should be reviewed for necessary policy coverage modifications.

More Efficient

More efficient sites require the same tasks as efficient. For a more efficient building green roof, in addition to a minimum of 50% vegetated surface, provide an additional 10% of roof area as useable with vertical access from within the building, paver walkways, furniture, and mowed grass.

For parking structures, consider tall perimeter and strip plantings to introduce shadows, with a high albedo roof deck material. Also consider providing a sunshade or raised solar panels.

Ultra efficient sites require the same tasks as more efficient buildings. Install a green roof system throughout the maximum roof area, with 20% useable, where solar is not planned or practical. If possible, fence or wall off HVAC systems to minimize heat, noise, and vibration intrusion into useable roof area. Consider planning circulation and HVAC roof locations to maximize the free open space on the roof, provide convenient access, and keep vents clear.

Innovative

Innovative sites require the same tasks as ultra efficient. In addition to maximizing the planted area of the roof, provide a captured rainwater irrigation system for the roof. Use the roof space as a garden or agricultural space for community or managed use. Consider providing glazed greenhouse structure(s) with a deep planting bed and temperature controller for community or managed use.

Ideally, agricultural products will be produced for use by building tenants and neighborhood.

Integration

CS 5 Irrigation Systems

PS 2a Building Water Reuse

Potential coordination with rooftop water storage tanks.

PS 3 Graywater and Blackwater Systems

PS 6 Green Roof

MS Mechanical System

Locations of rooftop HVAC systems should be coordinated with green roof design.

EN 1d Solar Water Heater

Coordination with design of Solar Water Heater systems.

References

New York State Stormwater Design Manual
Chapter 9, April, 2008, http://www.dec.ny.gov/docs/water_pdf/swdmredevelop.pdf

DDC Cool & Green Roofing Manual
June 2007, http://www.nyc.gov/html/ddc/downloads/pdf/cool_green_roof_man.pdf

PlaNYC Sustainable Stormwater Management Plan 2008
http://www.nyc.gov/html/planyc2030/downloads/pdf/sustainable_stormwater_plan.pdf

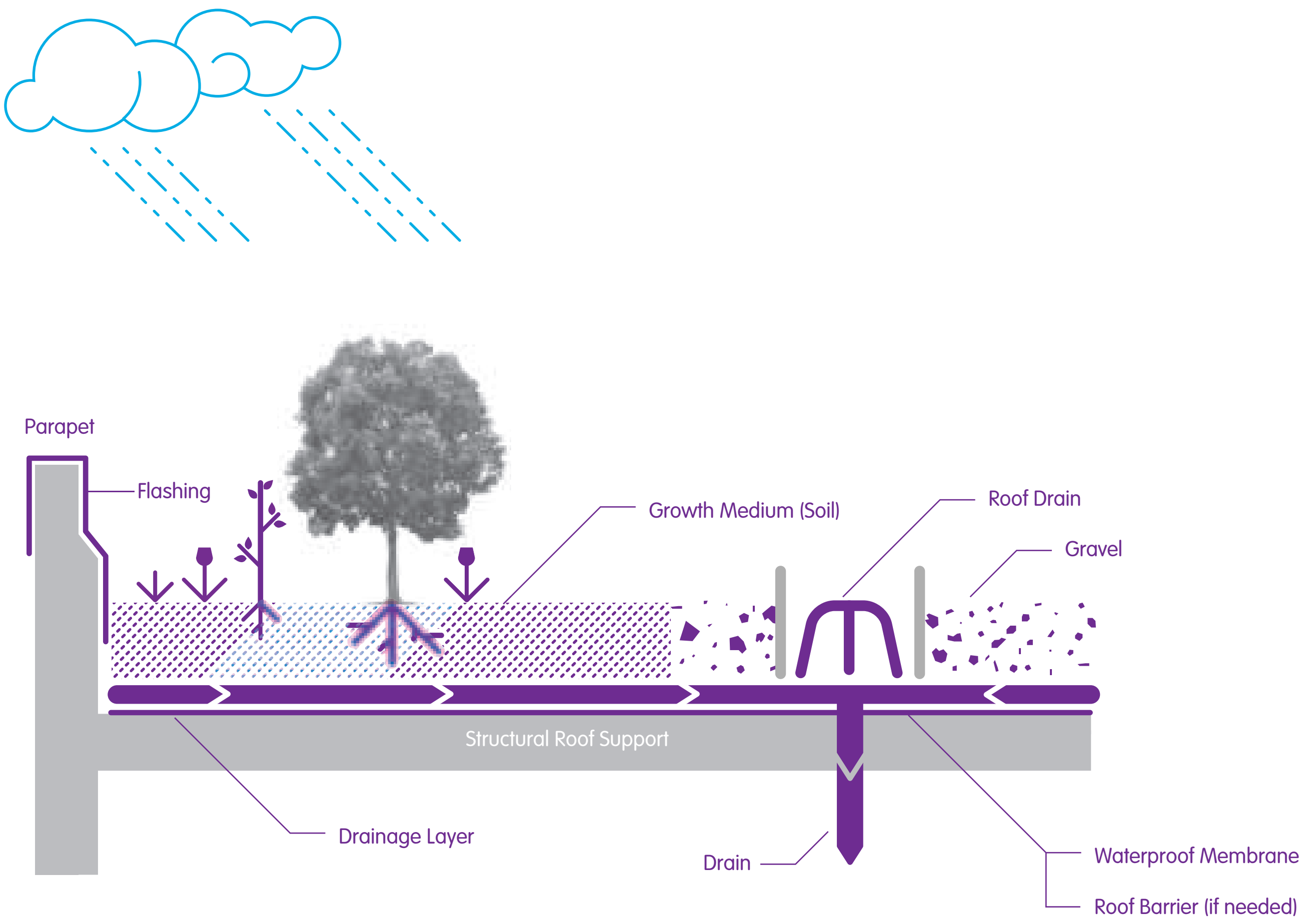
Chicago Green Roofs
Guide for Building Green Roofs in Chicago, 2008
http://www.artic.edu/webspaces/greeninitiatives/greenroofs/main.htm

PlaNYC Water, 2007
http://www.nyc.gov/html/planyc2030/html/plan/water.shtml

NYC Building Code
http://www.nyc.gov/html/dob/html/model/construction_code.shtml

Green Roof

Section View Not to Scale



PS

Plumbing Systems

There are many strategies and technologies applied to the plumbing system that can reduce the amount of water used by a facility, both in supply and waste streams. However, because a typical plumbing system can be quite complex, care must be taken to identify and implement any water efficiency strategies with regard to all the plumbing systems in the building.

This concept can be illustrated by looking at a typical building stormwater system. The traditional strategy is to design a system to collect water on the roof and move it to the municipal stormwater system as quickly as possible without regard to the source or the destination of the water downstream. However, rainwater falling on the building can be used on a green roof that retains some of the water, preserves the roof material, reduces energy use, and cleans the water before it enters the building stormwater system. In this case, the rainwater is of relatively high quality and can also be reused inside the building for the mechanical system, plumbing flush fixtures, or irrigation, which in turn reduces the amount of municipal potable water needed by the facility.

Plumbing systems can improve the quality of the waste stream exiting the facility by isolating, treating, monitoring, or pretreating on site. The end result is that the volume and toxicity level of the waste stream entering the waste-water treatment plant is reduced and the quality of the effluent water is higher. Still, the current costs of these treatment and pretreatment systems are high and may be prohibitive. By contrast, installing separate plumbing systems in the building adds little construction cost to the project and as treatment systems become more affordable in future and can be brought online, the separate systems will be ready.

Irrigation is another big water user. Typically, large amounts of potable water are used. There are many ways to reduce the amount of water used for irrigation, including plant selection, water efficient systems, and using reclaimed water.

A recent NASA study reported that up to 163,800 km2 of land (slightly smaller than the State of Washington) is cultivated with turf grasses in the continental United States, which is an area three times larger than that of any irrigated crop.[1]

1 Milesa, Cristina and Steven W. Running, "Mapping and Modeling the Biogeochemical Cycling of Turf Grasses in the United States," Environmental Management, Vol. 38, No. 3, 2005, pp. 426-438.

Water Balance

PS 1

Plumbing Systems

PS 2a 2b 2c

Mechanical Systems

MS

Operations

OP 1 2 3

Objective

A water balance tracks the water sources and usage on a site.

Benefit

Monitoring water sources and uses is a key task to aid the building user to develop and monitor water saving activities.

Developing a balanced system will ensure water re-use systems have source water available when there is demand.

Peak loads can be reduced by moving demand times.

Limitations

Building operations will need to develop a data reading process, measurement, and verification program.

Water systems in buildings are dynamic. Data used in the design phase to size equipment may need to be fine-tuned based on actual building operation.

Water filtration systems add front end costs and maintenance costs.

Background

In buildings with water reuse systems, the water balance calculates and models the proposed rate of water flow from a building source and balances this with the proposed flow to a water use. In the design phase, the data are used to size the reuse water filtration, storage, pumping, and piping system. During operation, the real data are used to monitor and adjust system storage and pumping needs. For example, a simple water balance will calculate the amount of air conditioning condensate that is generated during the summer months. The calculation will balance this source with a building demand such as the air conditioning cooling tower water. A simple system could route the condensate to the cooling tower. This system would require minimal water storage and filtration.

A building water system — water flows and uses — will change throughout the life of a building. Equipping the building operator with the tools to monitor the water system enables the operator to change the water flow when demand changes.

Data acquisition begins in the design phase with the calculation of projected flows and continues into operations when real flow data are collected. As a result, the building design team must incorporate tracking points in the building.

Building Profession Task Designations

Before the building professional team can use this technique it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist
- CE Civil Engineer
- LA Landscape Architect
- ME Mechanical Engineer

Required Tasks

Efficient

On a basic building the design team integrates a system that monitors the building water source and the major water systems in the building. Installation of water meters connected to the building management system is required. On small, simple buildings monitoring points may be limited to water entry and the building domestic hot water system. In larger buildings, monitoring may include boiler, chilled water, cooling tower, irrigation, domestic water heater and plumbing fixtures. Refer to OP 1. PE

During construction, the commissioning team ensures the monitoring systems are installed and are recording data into the building management system. CX

During building operation, data are collected and monitored. A measurement and verification plan is developed to record and monitor water usage and trends. An action plan is developed to respond to situations in which water usage exceeds the normal trends. The action plan will include tasks such as checking for water leaks. The building operator will develop a schedule to review data and make necessary water balance adjustments during operations. This can be accomplished with a regular building water audit. BO

Renovation

Renovation projects should match the tasks of new construction and include the renovated water systems of a building.

More Efficient

More efficient buildings should match the tasks of the efficient building water balance with some additional tasks. More efficient buildings will usually incorporate at least one water reuse system. The water balance is important to first identify the possible systems that can be reused, and second to design the piping, pumps, tanks and equipment for the system.

Early in the schematic design phase (SD), a proposed water balance calculation needs to be developed by the plumbing engineer on the potential building water sources and water uses. This will include stormwater, condensate, graywater, blackwater, and other water sources and uses. On simple, small to medium sized buildings, stormwater and/or building air conditioning condensate reuse systems can be used.

Performing the calculation will require that the plumbing engineer obtain water source and use data from the different design team disciplines such as the mechanical engineer, civil engineer, landscape architect, operator, and others involved with potential water systems using or discharging water.

Upon completion of the water balance calculation, the design team must determine if incorporating a water reuse system is feasible at building construction or at a future point during building operation. If feasible at construction, the water reuse system will be designed into the building. If feasible at a later date, a water, waste, and/or energy pod must be incorporated into the design to allow for future water reuse systems. A multiple piped system must be installed in the building for the future water reuse system.

Water Balance

PS 1

Integrating the water reuse system into the building design will require coordination of all system connections and tie-in points and inclusion in the SD documents. PE ME CE LA BO DDCPM

The plumbing engineer will coordinate the water balance with the LEED specialist to ensure that the data and documentation needed for LEED credits are provided. PE LS

During construction the commissioning team must ensure that the monitoring systems are installed correctly and are accurately recording data into the building management system. CX

During building operation data are collected and monitored. A monitoring plan must be developed to ensure that water usage and trends are recorded and monitored. An action plan must be developed to respond to situations when water usage exceeds the normal trends. The building operator is responsible for developing a schedule to review data and make necessary balance adjustments to the building water reuse system during operations. Such adjustments may involve modifying water storage and distribution systems flows. BO

Ultra Efficient Innovative

Ultra efficient buildings require the same tasks of the efficient and more efficient building water balance provisions. Ultra efficient and innovative buildings will have multiple water reuse systems. The first step will be to identify the possible water reuse systems and their interconnections. The next step will be to ensure early in the design phase that the necessary data are obtained from the different design and building professionals. The third step will be to design the systems.

Similar to the tasks for a more efficient building as described above, early in the design phase a proposed water balance calculation must be developed on the potential building water sources and water uses by the plumbing engineer. This needs to be completed before the Schematic Design (SD). The water balance calculation will incorporate multiple reuse systems. PE

Proper completion of the water balance task will require water source and use data from the other design team disciplines. Upon completion of the water balance, the design team must determine if incorporating multiple water reuse systems is feasible at building construction or at a future point during the building's operation. If feasible at construction, the water reuse systems will be designed into the building. If some of the systems are feasible at a later date, water, waste and/or energy pods will need to be incorporated into the design to allow for future water reuse systems. A multiple piped system must be installed in the building for the future water reuse system(s).

Integrating the water reuse systems into the building design will require coordination amongst all the disciplines involved in the reuse system of all system connections and tie-in points and inclusion in the SD documents. PE ME CE LA BO DDCPM

The plumbing engineer will coordinate the water balance with the LEED specialist to ensure that the data needed for LEED credits are provided. PE LS

During construction, the commissioning team must ensure that the monitoring systems are installed correctly and are accurately recording data into the building management system. CX

PS 1 Water Balance

During building operation data are collected and monitored. A monitoring plan must be developed to ensure that water usage and trends are recorded and monitored. An action plan must be developed to respond to situations when water usage exceeds the normal trends. The building operator is responsible for developing a schedule to review data and make necessary balance adjustments to the building water reuse system during operations. Such adjustments may involve modifying water storage and distribution systems flows. BO

Integration

PS 1a PS 1b PS 1c Water Reuse

Water balance is a key tool for proper application of water reuse systems.

MS Mechanical System

Water demands from mechanical systems should be included in the water balance.

OP 1 Water Meter

The water meter data are included in the water balance.

OP 2 Water Audit

A water audit is a key tool to audit existing buildings.

OP 3 Commissioning

Verify that the systems are installed and operating properly.

Building Water Reuse (Irrigation)

PS 2a

Plumbing Systems

PS 1

Mechanical Systems

MS

Operations

OP 1 2 3

Objective

Reduce potable water used for irrigation and design a system that more closely matches the natural water usage at the site prior to development.

Benefit

Water supply for irrigation systems is not required to meet drinking water standards. Therefore, other systems can meet irrigation water demands. The overall demand from the domestic water system can then be reduced.

Limitations

Irrigation water demands may differ from reuse water availability and storage tanks and pumps may be needed.

Water filtration systems add front end costs and maintenance costs.

Background

Reducing water usage for irrigation includes planting drought tolerant vegetation, installing water efficient irrigation systems, and/or incorporating water reuse supply systems. The LEED reference guide and EPA WaterSense material show alternative designs for irrigation systems.

Using indigenous plants reduces and in some cases eliminates the need for irrigation and using strong chemical fertilizers that can drain off into local water supplies. These plants celebrate, enhance, and highlight the city's geographical location.

If irrigation is required there are new irrigation technologies that include smart controllers that measure real time weather conditions and soil conditions for each type of plant. WE valves, spray misters and drip irrigation systems are effective in reducing water use.

A third way to reduce water is to combine a water reuse system with one of the new water efficient irrigation systems. This system will collect water that would usually discharge to the sewer or stormwater system and reuses the water for the facility irrigation system.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist
- LA Landscape Architect
- CE Civil Engineer
- ME Mechanical Engineer

Building Water Reuse (Irrigation)

Required Tasks

Efficient **Renovation**

During the schematic design (SD) phase, the landscape architect must develop a landscaping plan that meets the requirements of LEED WE Credit for reducing potable water used for building irrigation by 50%. It will be necessary for the LA to coordinate with the civil engineer, plumbing engineer, building operator, LEED specialist, and users. DDCPM LA BO PE CE LS

The irrigation designer, installer, and auditor should be certified under the EPA WaterSense professional certification program.

The plumbing engineer will use data included in the landscaping plan in the water balance calculation. PE

The landscape architect and plumbing engineer will coordinate with the LEED specialist to ensure that the data and documentation needed to obtain the LEED credit are provided. PE LA LS

The EPA WaterSense irrigation certification process is not complete. Final specifications are not yet published. However, the system should be designed as per the recommendations of the WaterSense guidelines, as outlined by the certified irrigation designer. LA

The commissioning team must ensure that the systems are installed and operational during the design and construction phases. CX

The operations team must maintain the vegetative and water systems. All systems must be monitored, and a plan must be developed and implemented to modify the system, as needed, in response to actual demand. This plan can be included in the regular water audit. BO

The irrigation system should be audited a minimum of once a year by an EPA WaterSense Certified Auditor. A repair program should be developed by building operations to make quick repairs to system leaks and make modifications to the system as recommended by the audit. BO

More Efficient **Ultra Efficient** **Innovative**

During the schematic design phase, the landscape architect must develop a landscaping plan that meets the requirements of LEED WE Credit for no potable water used for building irrigation. The plan should be coordinated with the civil engineer, plumbing engineer, building operator, LEED specialist and building users. LA LS BO CE PE

During the schematic design (SD) phase, the landscape architect must calculate and submit the irrigation water demand to the plumbing engineer so that a water balance can be prepared. The water balance process should match the best water reuse system possible to the irrigation system demand. In some cases it may be necessary for the design team to develop alternate schematic designs for two or more water reuse systems.

Determination must also be made as to whether the complete system is to be installed during construction or if multiple piped systems with water pods are to be installed for future water reuse systems.

The DDC project manager shall meet with the design team, users, regulators, and construction management team to determine the best approach to proceed. The design team must then prepare the construction documents incorporating the appropriate system(s) developed in the schematic design. DDCPM LA BO PE ME CE

Building Water Reuse (Irrigation)

PS 2a

The landscape architect and plumbing engineer must coordinate system data with the LEED specialist so the system can be properly documented to ensure that the LEED credit can be obtained. PE LA LS

The commissioning team must ensure, during the design and construction phases, that the systems are installed properly and are fully operational. CX

It is the responsibility of the operations team to maintain the vegetative and water systems after building delivery. The systems must be monitored and a plan must be developed and implemented to modify the system, as necessary, to respond to actual demands. This plan is to be included in the regular water audit. BO

Integration

PS 1 Water Balance

Water balance is a key tool for water reuse systems.

MS Mechanical System

Water demands from mechanical systems should be included in the water balance.

OP 1 Water Meter

The water meter data is included in the water balance.

OP 2 Water Audit

A water audit is a key tool to audit the building after construction.

OP 3 Commissioning

Verify on site that the systems are installed and operating properly.

PS 2b Building Water Reuse (Mechanical Use)

Plumbing Systems

PS 1

Mechanical Systems

MS

Operations

OP 1 2 3

Objective

Reduce potable water use to mechanical systems and reuse water from mechanical system discharge.

Benefit

Although mechanical systems use large amounts of water, it is not necessary that the water be drinking quality. The overall demand from the domestic water system can therefore be reduced.

Reduces wastewater flow into the city sewer system.

Limitations

Water demands may differ from supply water availability resulting in a need for storage tanks and pumps.

Water filtration systems add front-end and maintenance costs.

Some reuse systems may not be accepted or approved by regulatory agencies.

Background

Mechanical systems that use water include cooling towers, boilers, blowdown systems, building heating and cooling systems. Makeup water traditionally comes from the potable water supply, however, these systems can use water reused from another source.

Some of the mechanical systems that discharge water include the air conditioning condensate, blowdown, and water softener backwash. The discharge from these systems traditionally goes into the city waste system. Water from these systems can be diverted and used to supply other building water needs.

It is important to coordinate these systems early in the schematic design phase with regulatory agencies, including the health department, to verify the systems are acceptable and meet regulatory standards.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- ME Mechanical Engineer

Required Tasks

Efficient Renovation

Future Reuse System

During the schematic design (SD) phase, the DDC PM, plumbing engineer, and mechanical engineer should develop a water balance showing all potential water sources and demands. In some cases, alternative SD documents may be produced for the construction manager and DDC to determine the feasibility of the reuse systems.

Building Water Reuse (Mechanical Use)

PS 2b

When appropriate reuse systems are defined, the construction documents (CD) should include provisions to add the reuse systems in a future building project. This can include installing multiple piped systems and water, waste, and energy pods. DDCPM ME BO PE

SD Alternate Designs

Example: The DDC authorizes the design team to conduct a water balance in order to develop two alternative designs. After reviewing the water balance, the design team develops one set of SD documents for water reuse from air conditioning condensate and mechanical water filtration backwash for irrigation, and another that collects stormwater for reuse in the irrigation system. After review of the documents, it is discovered that the stormwater system costs more than the mechanical reuse system based on the size of the proposed water storage. There was no difference in the construction schedule on the two systems. The DDC PM, mechanical engineer, plumbing engineer, building operator, civil engineer, and construction manager determined that by reducing the amount of stormwater sent into the combined city system, a storage retention system would be required. The storage retention system could also serve as the irrigation water reuse storage system. At the end of the process, the team decided to use the stormwater reuse system because it ultimately produced the greatest water efficiency results with the least amount of effort.

The plumbing engineer will use reuse data in the water balance. PE

The commissioning team will ensure that the systems are installed correctly and are fully operational during the design and construction phase. CX

The operations team will begin gathering real world water use data during building operations to help in the design, construction, and operations of the future water reuse system. BO

More Efficient

Single Reuse System

The DDC PM, plumbing engineer, and mechanical engineer should develop a water balance showing the possible water sources and demands during the schematic design (SD) phase. In some cases alternative SD documents may be produced for the construction manager and DDC to determine the feasibility of the reuse systems.

The construction documents (CD) should include the design for the system. DDCPM ME BO PE

The plumbing engineer will use the reuse system data in the water balance. PE

The commissioning team will ensure that the systems are installed correctly and are fully operational during the design and construction phase. CX

The operations team will begin gathering water use data to develop a plan to modify the system to match the real world demands of the system during building operations. BO

Ultra Efficient Innovative

Multiple Reuse Systems

The DDC PM, plumbing engineer, and mechanical engineer should develop a water balance showing the possible water sources and demands during the schematic design (SD) phase. In some cases alternative SD documents may be produced for the construction manager and DDC to decide the feasibility of the reuse systems.

The construction documents (CD) should include the design for the systems. DDCPM ME BO PE CM

The plumbing engineer will use the reuse system data in the water balance. PE

The commissioning team will ensure that the systems are installed correctly and are fully operational during the design and construction phase. CX

The operations team will begin gathering water use data to develop a plan to modify the system to match the real world demands of the system during building operations. BO

Integration

PS 1 Water Balance

Water balance is a key tool for water reuse systems.

MS Mechanical System

Water demands from mechanical systems should be included in the water balance.

OP 1 Water Meter

The water meter data is included in the water balance.

OP 2 Water Audit

A water audit is a key tool to audit existing buildings.

OP 3 Commissioning

Verify on site that the systems are installed and operating properly.

Building Water Reuse (Flush Fixtures)

PS 2c

Plumbing Systems

PS 1a 1b

Mechanical Systems

MS

Operations

OP 1 2 3

Objective

Reduce potable water use to plumbing flush fixtures.

Benefit

Plumbing flush fixtures do not require potable water to operate. Reusing water from other building systems will reduce building water, sewer, and energy usage.

Limitations

May not be approved by regulatory agencies.

Water demands may differ from supply water availability, resulting in the need for storage tanks and pumps.

Water filtration systems add front end and maintenance costs.

Extra vigilance is required when two water systems are installed in a building to ensure that a future user does not connect a potable water fixture to the water reuse piping.

Background

Stormwater, condensate, mechanical, graywater and blackwater systems can provide water to the building flush fixtures, such as water closets and urinals.

Important Note on Graywater Systems

The Department of Health and Mental Hygiene, The State Department of Health, Federal EPA, and other agencies are developing discharge water quality standards.
The design and construction team along with the DDC management team will have to work closely with these agencies to ensure the system meets regulatory standards as they are issued and developed.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- **DDCPM** DDC Project Manager
- **A** Architect of record
- **BO** Building Operator
- **PE** Plumbing Engineer of record
- **PC** Plumbing Contractor
- **CX** Commissioning Agent
- **LS** LEED Specialist
- **ME** Mechanical Engineer
- **CE** Civil Engineer

Required Tasks

Efficient Renovation

Future Reuse System

These systems are new and approved technology may not be available or the equipment may be too expensive for the project budget. In the future, technologies will be approved and the cost will reduce. Designers should keep this in mind. Providing space for equipment and installing dual piped systems will allow for such systems to be installed in the future.

The DDC PM and plumbing engineer should coordinate efforts with DEP, city sewer, city health and other regulatory agencies in order to determine if the reuse system can be installed during construction or if future installation is appropriate, before the schematic design (SD) phase.

If the system is approved, the plumbing engineer will develop a water balance showing the possible water sources and demands. In some cases alternative SD documents may be produced for the construction manager and DDC to decide the feasibility of the reuse systems.

The construction documents (CD) should include provisions in the building to add the reuse systems in a future building project when appropriate future reuse systems are defined. This can include installing multiple piped systems and water, waste, and energy pods. DDCPM PE

The plumbing engineer will use reuse system data in the water balance. PE

The commissioning team will ensure that the systems are installed correctly and are fully operational during the design and construction phase. CX

The operations team will begin gathering real world water use data to help in the design, construction, and operations of the future water reuse system during building operations. BO

More Efficient

Single Reuse System

The DDC PM and plumbing engineer should coordinate efforts with city sewer, city health and other regulatory agencies to determine if a system can be installed before the schematic design (SD) phase.

If a reuse system is approved, the DDC PM, plumbing engineer, mechanical engineer, and civil engineer should develop a water balance showing the possible water sources and demands during the (SD) phase of the design process. In some cases, alternative SD documents may be produced for the construction manager and DDC to determine the feasibility of the reuse systems.

The construction documents (CD) should include the design for the system. DDCPM ME CE BO PE

The plumbing engineer will use the reuse system data in the water balance. PE

The plumbing engineer will coordinate with the LEED specialist to ensure that the documentation of the water balance is accurate and complete for submission for LEED credit under the WE category. PE LS

The commissioning team will ensure that the systems are installed correctly and are fully operational during the design and construction phase. CX

The operations team will begin gathering water use data to develop a plan to modify the system to match the real world demands of the system during building operations. BO

Ultra Efficient **Innovative**

Multiple Reuse Systems

In some cases, a single reuse system will not supply enough water to the building flush fixtures. In these cases multiple systems may be required.

Similar to the efficient and more efficient designs, before the schematic design (SD) phase, the DDC PM and plumbing engineer should meet with city sewer, city health and other regulatory agencies to decide if a system can be installed.

If a reuse system is approved, the DDC PM, plumbing engineer, mechanical engineer and civil engineer should develop a water balance showing the possible water sources and demands during the (SD) phase. In some cases alternative SD documents may be produced for the construction manager and DDC to determine the feasibility of the reuse systems.

Building Water Reuse (Flush Fixtures)

PS 2c

The construction documents (CD) should include the design for the system. DDCPM ME CE BO PE

The plumbing engineer will use the reuse system data in the water balance. PE

The plumbing engineer will coordinate with the LEED specialist to ensure that the documentation of the water balance is accurate and complete for submission for LEED credit under the WE category. PE LS

The commissioning team will ensure that the systems are installed correctly and are fully operational during the design and construction phase. CX

The operations team will begin gathering water use data to develop a plan to modify the system to match the real world demands of the system during building operations. BO

Integration

PS 1 Water Balance

Water balance is a key tool for water reuse systems.

MS Mechanical System

Water demands from mechanical systems should be included in the water balance.

OP 1 Water Meter

The water meter data is included in the water balance.

OP 2 Water Audit

A water audit is a key tool to audit existing buildings.

OP 3 Commissioning

Verify on site that the systems are installed and operating properly.

PS 3a Graywater and Water Reuse (Building System)

Plumbing Systems

PS 1b 1c

Mechanical Systems

MS

Operations

OP 1 3

Objective

Reduce potable water use with the installation of a graywater system that will reuse rainwater or wastewater from domestic processes such as washing dishes, laundry, and bathing.

Benefit

Water supply for flush fixtures, irrigation, and mechanical systems is not required to meet drinking water standards. The discharge from fixtures such as showers or building air conditioning condensate can be filtered and reused for other nonpotable water applications. The overall demand from the domestic water system can then be reduced.

Limitations

Installation cost is high.

Requires regular maintenance.

May not meet regulatory standards in some applications. Regulatory approving agencies include (but are not limited to) Department of Health and Mental Hygiene, and Office of Technical Certification and Research (OTCR). Regulations are included in (but are not limited to) New York City Plumbing Code, and New York State Environmental Conservation Law Title 6.

Background

Civil and Plumbing Engineer Designed Systems

Graywater and blackwater systems designed by the civil engineering and landscaping team working on exterior building sites and landscaping plans are usually plant and earth based systems. In these applications, the plumbing engineer designs the waste collection system inside the building, which connects to the site graywater system outside the building. At this point the civil engineer or landscape architect is responsible from the building to the site graywater or blackwater system. Water from the site graywater or blackwater system is used for site water purposes and does not re-enter the building.

Graywater and blackwater systems can also be designed by the building team consisting of the building owner, architect, and plumbing engineer. Typically these are packaged, chemical based systems that are manufactured to meet regulatory standards. The building design team specifies the packaged system for a particular building, while the plumbing engineer designs the supply water piping system to the graywater and blackwater systems. The discharge from this type of graywater system, as designed by the plumbing engineer, can feed systems inside the building. Alternatively, the discharge can be used for civil systems such as irrigation, in which case the plumbing engineer should coordinate with the civil engineer, landscape architect or irrigation designer.

Graywater (or gray water) refers to recycled water from non-industrial wastewater generated from domestic processes such as lavatories, laundry, and bathing. It must be noted that water systems listed as sources for graywater systems and systems listed as uses for graywater in this manual may not be currently acceptable with the regulatory agencies. These are relatively new systems, which along with annual changes to the codes, makes for a great deal of volatility. However, it is the intent of this section to provide guidelines for important concepts and elements that should be included in DDC facilities.

Although graywater is a relative new term, recycled water systems have been in use for decades. Some of the possible water sources for recycled water systems (as per NYC Plumbing Code) are lavatories (the NY Plumbing Code classifies water from office building lavatories as recycled water) and rainwater harvesting. The NYC Plumbing Code may also allow treated effluent from approved blackwater systems.

Other sources under consideration by the NYC Plumbing Code and other agencies that may be acceptable for use in future regulation changes include:

- Steam condensate
- Cooling tower blowdown
- Foundation drain water
- Air conditioner condensate MS 4
- Pass-through cooling water
- Recycled, treated wastewater (municipally reclaimed water)
- Swimming pool filter backwash water
- Filtered water backwash MS 3
- Fire protection fire pump flow test discharge FP 1
- Fuel cell discharge NT 1

Sources of graywater that require added treatment include:

- Bathtubs
- Showers
- Lavatories (the NY Plumbing Code may classify lavatories in public office buildings differently than other lavatories)
- Clothes washers
- Laundry trays

Graywater (recycled water) as per the NYC Plumbing Code can be used to supply the water requirements for:

- Flush water closets (toilets)
- Urinals
- Cooling tower makeup
- Irrigation

Other uses that may be included in future plumbing codes revisions include:

- Boiler feed makeup
- Vehicle wash
- Building washdown

The graywater collection and reuse systems being fed shall be located on the same lot.

Note on NYC Steam Condensate

Larger residential and nonresidential buildings located below 72nd Street in Manhattan typically have access to steam from the district system. There is no district system to collect the condensate and reuse it in the system boilers. Currently there is no requirement that utility steam condensate be reused in any way, only that steam condensate cannot be drained to the sewer if its temperature exceeds 150 degrees (Plumbing Code Section PC 803, 803.1). Between six and ten million gallons of this water is dumped into the sewersheds draining to the Newtown Creek, Wards Island, and North River wastewater plants every day, increasing flow and diluting sewage strength. Likewise its energy content is lost.

New buildings in the district that use utility steam for space heating and/or cooling should reuse at least 50% of the steam condensate using one or more of the following means:

- Preheating/heating incoming cold water for domestic hot water. EN 1b EN 3
- Toilet/urinal flushing with some portion, but not necessarily all of the toilet/urinal risers piped to use either steam condensate or another source.
- An outdoor hose bibb with a sign reading "Non Potable Water" or "Steam Condensate for Sidewalk Washing" as a source of water for washing the sidewalk.
- Cooling tower makeup water
- Other uses proposed by the owner (e.g., laundry or other process use).

When graywater is used inside the building to supply the plumbing flush fixtures, systems comprised of the components outlined below are required. Note that the NYC Department of Health and Mental Hygiene, the NY State Department of Health, US EPA, and other agencies are developing discharge water quality standards. The design and construction team, along with the DDC management team, will have to work closely with these agencies to ensure the system meets regulatory standards as they are developed and implemented.

Reservoir - The system will have an airtight reservoir vented to the atmosphere with access openings. The holding capacity shall be a minimum of twice the volume of water required to meet the daily flushing requirements and not less than 50 gallons capacity. The plumbing engineer, along with the graywater system vendor will size the reservoir based on the water balance calculation.

First Flush Diverter - When collecting rainwater, roof surfaces can collect leaves, pollen, bird droppings, and air pollution particulates that should not go into the collection system. First flush diverters are devices that divert the first inch of water into the stormwater system that exits the building. After the first flush of water is discharged, the device will then divert the clean water into the collection system.

Filter - The system will have an approved filter medium and there shall be a full open valve that connects the discharge from the system to the filter system. The plumbing engineer should specify this if it is not included on the vendor equipment.

Disinfection - An approved disinfection system is required that can use ultraviolet, chlorine, iodine or ozone.

Makeup Water - The system shall be supplied with a potable water source for makeup water. The system shall have an approved backflow prevention device with a full open device. The plumbing engineer shall coordinate with the LEED specialist and backflow makeup requirements. Usually a flow switch connected to the building management system is acceptable for both groups as a means to monitor when the facility is using makeup water.

Overflow - There shall be an overflow pipe with an indirect connection (at least 1" air gap) to the sewer system that is the same size as the inlet pipe. The drain shall be the lowest point of the system and a minimum of 4" diameter. This connection should be in a mechanical or nonfinished ventilated room. The overflow device should have an approved method to prevent rodents and vermin from entering the storage system.

Graywater and Water Reuse (Building System) PS 3a

Vent - The reservoir shall have a piped plumbing vent to the exterior of the building.

Coloring - The recycled water shall be dyed blue or green before it is supplied to the fixtures. This requirement could change and be replaced with the standards as outlined in EPA 2004 Guidelines for Water Reuse, the National Standard Plumbing Code, and the Uniform Plumbing Code Appendix J.

Identification - All piping shall be marked as nonpotable water. For educational purposes, some facilities will route the piping exposed in the toilet rooms with clear markings to show the building occupants that the building is recycled water.

Meter - A water meter shall be installed on the supply piping main. The data will be collected and used for the building measurement and verification system OP 1.

Area Washdown - The space next to the graywater system should have at least one floor drain and a hot and cold water washdown hose station to clean the floor in the event of a spill.

When the graywater systems are connected to an underground exterior irrigation system, the following is a partial list of the requirements:

There shall be check valves on both the inlet and outlet side of the system.

Makeup water from the building potable water system is not required. In DDC facilities the controls on the irrigation system can set the graywater irrigation system as the primary irrigation system. When there is no water for the primary system in the reservoir tank, the secondary potable water system will feed water to the irrigation system. The connection shall meet backflow requirements. To obtain LEED credits a manual makeup water valve may be required.

These irrigation systems do not require disinfection or coloring if they are not used in the building flush fixtures.

Always check the other tasks to be conducted by the civil or geotechnical services diverting the clean water into the collection system.

It is important to note that these recommendations are based on requirements at the time of publication. Particularly with graywater systems, regulations are changing and each project may require a different design approach.

Waste Pods

Graywater technology is relatively new and standards are under development. The cost of installing and operating the systems can be prohibitive. However, a waste pod can be installed where feasible and designed to include double piping with floor space reserved for future graywater equipment.Some DDC facilities, such as correctional, police, or firehouses can use backup water systems during times of extreme drought. This would reduce the demand for water and sewer services on the city system.

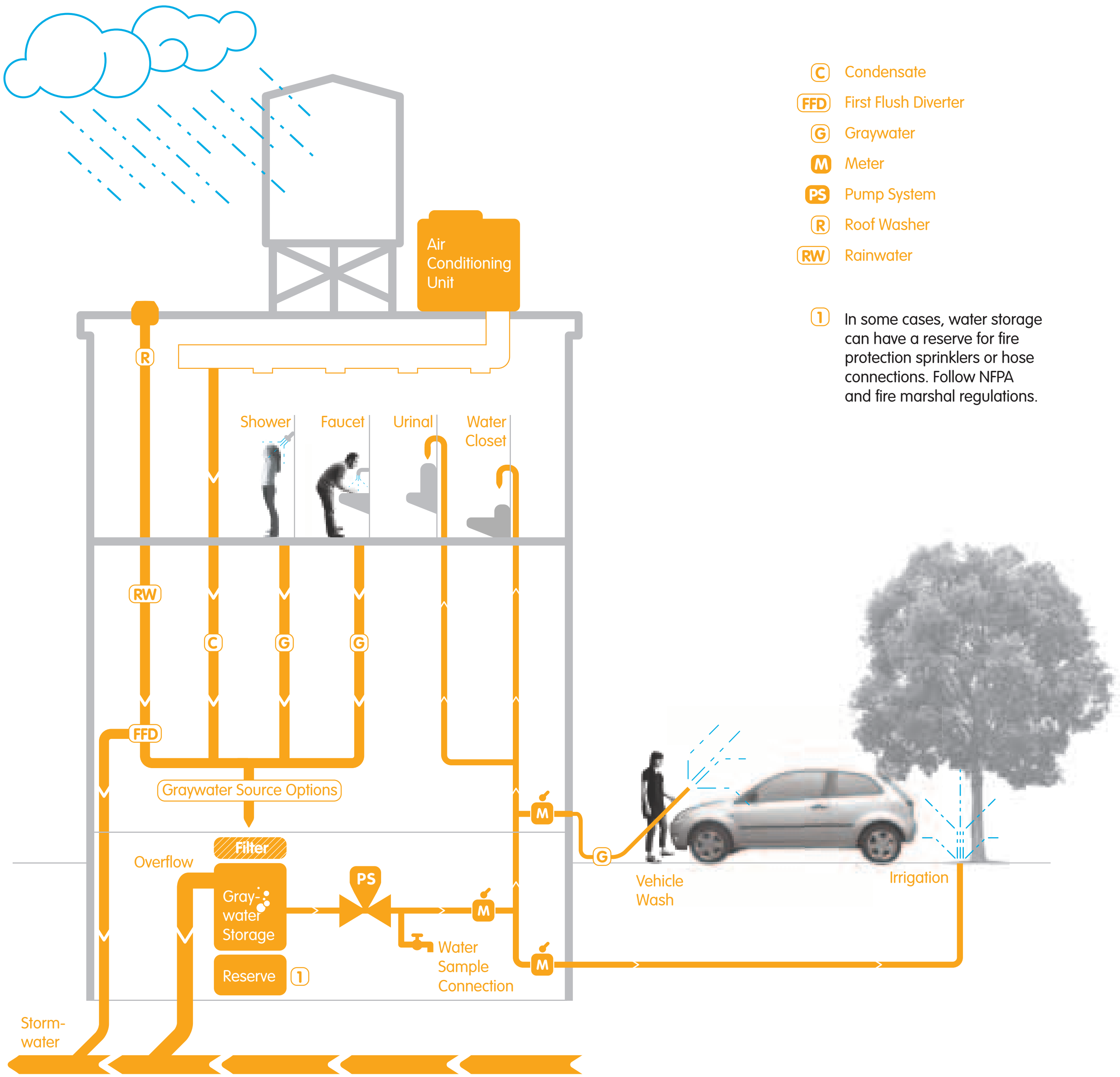
Packaged Systems

Graywater systems can be complicated and the individual pump, valves, filters, controls, and interconnecting piping could be provided as a packaged system. This would reduce the effort of the plumbing engineer or design team. It is recommended that the systems should be complete and purchased from a city-approved manufacturer. The manufacturer can assist the plumbing engineer and building team to design the system feeding the graywater and discharge systems. The manufacturer shall be responsible for warrantees, startup and training of maintenance staff.

Maintenance

A city-approved maintenance procedure must be developed and agreed upon before a graywater system can be designed or installed.

Graywater and Water Reuse (Building System)



- (C) Condensate
- (FFD) First Flush Diverter
- (G) Graywater
- (M) Meter
- (PS) Pump System
- (R) Roof Washer
- (RW) Rainwater

(1) In some cases, water storage can have a reserve for fire protection sprinklers or hose connections. Follow NFPA and fire marshal regulations.

Graywater and Water Reuse (Building System)

PS 3a

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
LA Landscape Architect
LS LEED Specialist
CE Civil Engineer
SE Structural Engineer
ME Mechanical Engineer

Required Tasks

Efficient More Efficient

New Construction/Renovation

The DDC PM, building operator, architect, and plumbing engineer shall meet during the schematic design (SD) phase to determine if a future graywater system is appropriate for the facility. On facilities with landscaping, the landscape architect shall be included to determine the amount of water that will be needed for landscape irrigation. If it is not feasible to include the graywater equipment in the building design, the plumbing engineer and architect will include a graywater waste pod in the design. DDCPM A LA BO PE

Buildings receiving steam from the district system shall reuse at least 50% of the steam condensate or provide a doubled piped system with water pod for a future 100% reuse system. DDCPM A LA BO

Ultra Efficient

The DDC PM and building operater will notify the design team that the DDC is interested in specifying a graywater system on the project. DDCPM BO A PE

The DDC PM, architect, building operator, landscape architect and plumbing engineer shall confirm with regulatory agencies that graywater systems are acceptable. If so, the team shall obtain the requirements for design, installation, and operation from the regulatory agencies. DDCPM BO A LA PE

The DDC shall provide the architect and plumbing engineer documentation that the city has approved the DDC graywater maintenance plan. DDCPM BO A PE

If the design team decides to use a vendor to supply the graywater system, before the SD phase, the DDC should develop a contract or agreement with a graywater manufacturer that will provide design services during the design process. DDCPM

The plumbing engineer will gather data, coordinate activities with the graywater vendor, and develop a water balance to size the equipment during the schematic design (SD) phase. The architect, landscape architect, DDC PM, and building operator may request alternate designs so the construction manager can develop a constructability, schedule, and budget review. By the end of the design, the team will decide on a proposed graywater system. DDCPM BO A LA PE

Large systems can require large water storage tanks. These tanks can be cast-in-place using the building structure common walls. The structural engineer, DDC PM, building operator, architect, and plumbing engineer will meet during the SD phase to develop a building design to include the tanks. DDCPM BO A PE SE

PS 3a Graywater and Reuse Water (Building System)

Graywater systems can be included in the calculation of credits under LEED WE 3, Water Use Reduction category and SS credits for irrigation. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculations and makeup connection to the potable water system are correct and that all submittal requirements and documentation are complete. PE LS

If the graywater will be used for irrigation, the DDC PM, building owner, architect, civil engineer, and plumbing engineer shall coordinate the system requirements with the landscape architect and irrigation designer. DDCPM BO A LA PE CE

Commissioning will verify the system is installed correctly and operating. CX

Buildings receiving steam from the district system shall reuse at least 100% of the steam condensate. PE ME

Innovative

Research and development (R+D) professionals are developing new technologies that will be on the market in the next few years. The innovative facility could include these new technologies in the building design. The DDC PM, building operator, architect, and plumbing engineer shall meet with the research and development (R+D) group during the SD phase. The R+D group shall provide the team with documentation from the city regulatory agencies that the system is approved for use in the city, along with the city design and maintenance requirements. DDC shall provide the design team documentation that the maintenance plans meet city requirements. DDCPM BO A LA PE

Integration

PS 1 Water Balance

Water balance is a key tool for water reuse systems.

MS Mechanical System

Water demands from mechanical systems should be included in the water balance.

OP 1 Water Meter

The water meter data is included in the water balance.

OP 3 Commissioning

Verify on site that the systems are installed and operating properly.

Blackwater (Building System)

PS 3b

Plumbing Systems

PS 1a 1b

Mechanical Systems

MS

Operations

OP 1 2 3

Objective

Reduce facility potable water use with a blackwater system that will reuse the waste from fixtures to other water uses in a building.

Benefit

Water supply for flush fixtures, irrigation, and mechanical systems is not required to meet drinking water standards. The discharge from fixtures, including flush fixtures, can be filtered and reused for other nonpotable water applications. The overall demand from the domestic water system can then be reduced.

Limitations

Installation cost is high.

Requires regular maintenance.

May not meet regulatory standards in some applications. Regulatory approving agencies include (but are not limited to) Department of Health and Mental Hygiene, and Office of Technical Certification and Research (OTCR). Regulations are included in (but are not limited to) New York City Plumbing Code, and New York State Environmental Conservation Law Title 6.

Background

Blackwater systems are similar to graywater systems except they can receive waste from the building flush fixtures. There are currently some blackwater systems in operation inside and outside the city, in commercial, retail, and educational facilities. Over the last few years there have been advancements in membrane filtration technology, which now have commercial applications. In the future, these decentralized systems will be used in multiple building applications, and the amount of wastewater flowing to the large centralized wastewater treatment facilities can be reduced.

In parts of the city where access to water and sewer has limited capacity for a new facility, the installation of blackwater systems may be advantageous. Blackwater systems require close coordination with the city regulatory agencies and a commitment on the part of the building operators to maintain the system after it is in operation.

The blackwater system shall first meet all of the building regulatory requirements. After these requirements are met, the design team may consider incorporating a blackwater system.

Systems listed as sources for blackwater and systems listed as uses for blackwater effluent in this manual may not be currently acceptable with the regulatory agencies. The intent of this section of the manual is to provide guidelines to the design team and to highlight the important elements of a blackwater system that should be included in DDC facilities when they are acceptable.

Source water for a blackwater system can include:

- Water closets (toilets)
- Urinals
- Kitchen or food service fixtures discharging animal or vegetable matter in suspension or solution.

Blackwater (Building System)

Blackwater effluent can be used to supply the water requirements for systems such as:

- Flush water closets (toilets)
- Urinals
- Cooling tower makeup
- Boiler water makeup
- Irrigation
- Vehicle wash
- Building washdown

Note that the NYC Department of Health and Mental Hygiene, the NY State Department of Health, US EPA, and other agencies are developing discharge water quality standards. The design and construction team, along with the DDC management team, will have to work closely with these agencies to ensure the system meets regulatory standards as they are developed and implemented. When a blackwater system is installed in a building the following should be considered:

Reservoir - The system will have an airtight reservoir vented to the atmosphere with access openings. The design team will have to initiate coordination between the equipment vendor and the regulatory agencies to develop appropriate reservoir sizing that can account for the building peak and normal effluent discharge flow rates.

Filter - The area around the filtration system will require access for maintenance and the replacement of equipment in the future.

Makeup Water - When the system is used to supply water to the building flush fixtures, the system shall be supplied with a potable water source for makeup water. The system shall have an approved backflow prevention device with full open device. The plumbing engineer shall coordinate with the LEED specialist and backflow makeup requirements. Usually a flow switch on the potable water supply that is connected to the building management system is acceptable for both as a means to notify the staff when the facility is using potable makeup water.

The makeup piping shall be installed so the building can operate for short periods of time on potable water when the blackwater system is down. If potable water is limited the facility may have to install potable water storage tanks that will supply the building with potable water until the blackwater system is back in operation.

Overflow - There shall be an overflow system with an indirect connection to the city wastewater system that is the same size as the inlet pipe. The drain shall be the lowest point of the system. This connection should be in a mechanical or nonfinished ventilated room. The overflow device should have an approved method to prevent rodents, vermin, and backflow from the city system from entering the blackwater storage system.

When buildings are located in areas with limited city wastewater system capacity, the building may have to provide a retention tank to collect the building wastewater until the blackwater system is back in operation.

Vent - The reservoir shall have a piped plumbing vent to the exterior of the building.

Coloring - The recycled water shall be dyed blue or green before it is supplied to the flush fixtures. This requirement could change and be replaced with the standards as outlined in EPA 2004 Guidelines for Water Reuse, the National Standard Plumbing Code, and the Uniform Plumbing Code Appendix J.

Blackwater (Building System)

PS 3b

Identification - All piping shall be marked as nonpotable water or reuse water. Some facilities will route the piping exposed in the toilet rooms with clear markings to show the building occupants that the building is recycling water.

Meter - A water meter shall be installed on the supply piping main. The data will be collected and used for the building measurement and verification system OP 1

Waste pods

Similar to graywater, there are some DDC facilities such as correctional, police, or firehouses that could use backup water systems during times of extreme drought. The buildings with a waste pod would have the space and the connections required to connect the building to a temporary blackwater system or to a future permanent system. This would reduce the demand for city water and sewer services.

Packaged systems

Blackwater systems are complicated and the individual pump, valves, filters, controls, and interconnecting piping should not be designed by the plumbing engineer or design team. Instead, the systems should be complete and provided by a city-approved manufacturer. The manufacturer can assist the plumbing engineer and building team in the design of the blackwater feed and discharge systems. The manufacturer shall be responsible for warrantees, start up and training of maintenance staff.

Maintenance

A city approved maintenance procedure must be developed and agreed upon before a blackwater system can be installed. The DDC design team should not proceed with the design of the system until the operations agreements are approved and finalized by the DDC.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LA Landscape Architect
- SE Structural Engineer
- LS LEED Specialist

Required Tasks

Efficient / More Efficient

New Construction/Renovation

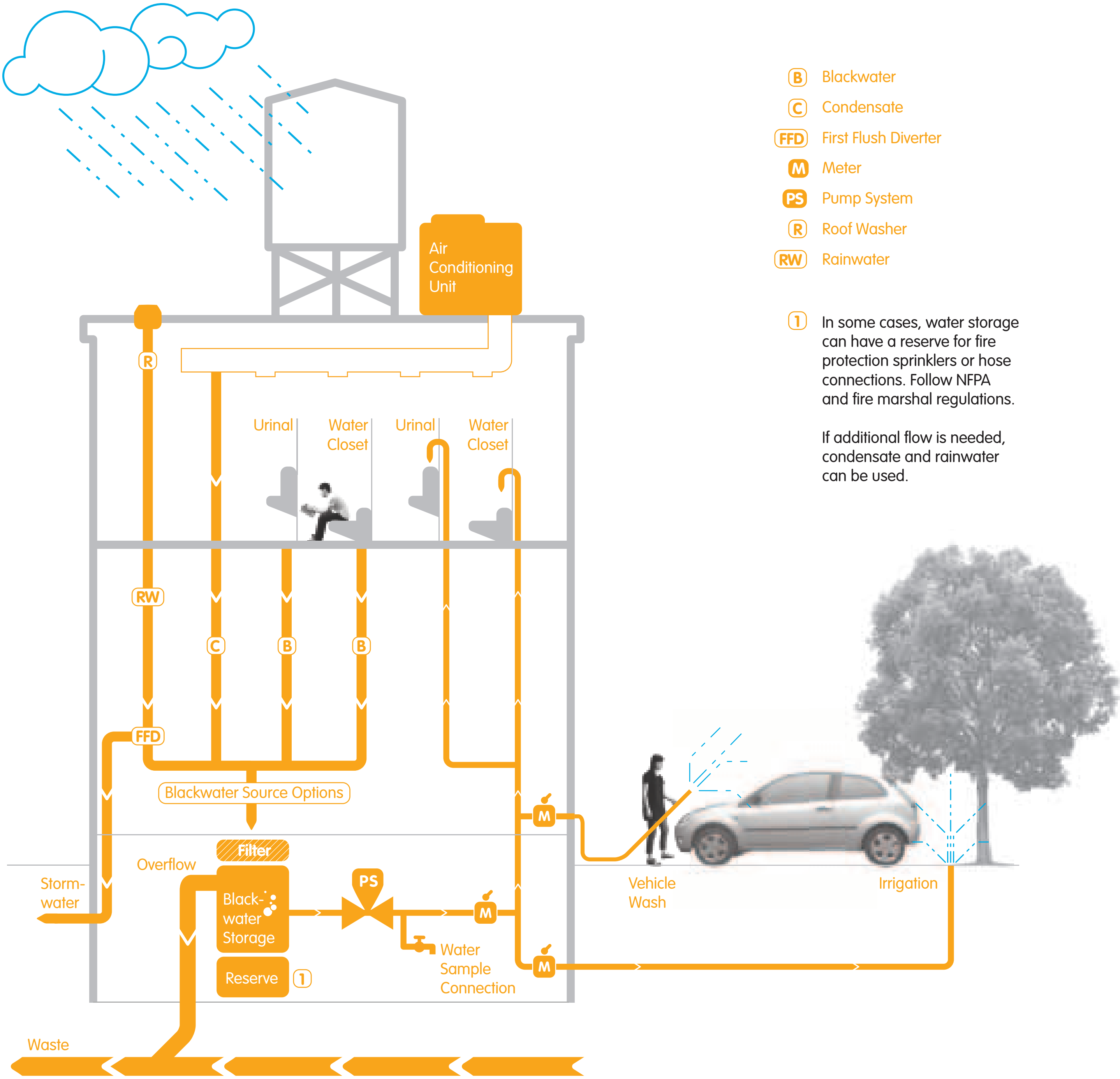
The DDC PM, building operator, architect, and plumbing engineer shall meet during the schematic design (SD) phase to determine if a future blackwater system is appropriate for the facility. On facilities with landscaping, the landscape architect shall be included to determine the amount of water required for landscape irrigation. If a future system is feasible, the plumbing engineer and architect will include a blackwater waste pod in the design. DDCPM A BO LS

Ultra Efficient

The DDC PM and BO will notify the design team that the DDC is interested in specifying a blackwater system on the project. DDCPM A BO PE

PS 3b

Blackwater (Building System)



B Blackwater
C Condensate
FFD First Flush Diverter
M Meter
PS Pump System
R Roof Washer
RW Rainwater

1 In some cases, water storage can have a reserve for fire protection sprinklers or hose connections. Follow NFPA and fire marshal regulations.

If additional flow is needed, condensate and rainwater can be used.

Blackwater (Building System)

PS 3b

The DDC PM, architect, landscape architect, building operator, and plumbing engineer shall confirm with regulatory agencies that blackwater systems are acceptable. If so, the team shall obtain the requirements for design, installation, and operation from the regulatory agencies. DDCPM A LA BO PE

The DDC shall provide the architect and plumbing engineer the city-approved blackwater maintenance plan. DDCPM A BO PE LS

The plumbing engineer will gather data and coordinate with the blackwater system vendor to develop a water balance to size the equipment during the SD phase. The architect, landscape architect, DDC PM, and building operator may request alternate designs so that the construction manager can develop a constructability, schedule, and budget review. By the end of the design phase, the team will decide on a proposed blackwater system. DDCPM A BO PE LS

Large systems can require large water storage tanks. These tanks can be cast-in-place using the building structure common walls. The structural engineer, DDC PM, building operator, architect, and plumbing engineer should meet during the SD phase to develop a building design to include the tanks. DDCPM A BO PE SE

Blackwater systems can be included in the calculation of credits under LEED WE 3, Water Use Reduction category and SS credits for irrigation. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculations are correct and that all submittal requirements and documentation are complete. PE LS

If the blackwater will be used for irrigation, the DDC PM, building owner, architect, civil engineer, landscape architect, and plumbing engineer shall coordinate the system requirements with the irrigation designer. DDCPM A BO PE CE LA

Commissioning will verify the system is installed and operating correctly. CX

Innovative

The DDC PM, building operator, architect, and plumbing engineer shall meet with the research and development (R+D) group during the SD phase. The R+D group shall provide the team with documentation from the city regulatory agencies that the system is approved for use, along with the city design and maintenance requirements. DDC shall provide the design team with documentation that the maintenance plans meets city requirements. DDCPM A BO PE

Integration

PS 1 Water Balance

Water balance is a key tool for water reuse systems.

MS Mechanical System

Water demands from mechanical systems should be included in the water balance.

OP 1 Water Meter

The water meter data is included in the water balance.

OP 3 Commissioning

Verify on site that the systems are installed and operating properly.

PS 4

Waste Sample Pits

Plumbing Systems

PS 3a 3b

Mechanical Systems

MS

Operations

OP 3 4

Objective

Provide for future waste stream sampling.

Benefit

Sampling pits allow operations to isolate sources of harmful waste streams.

Limitations

Access to gravity systems can be limited.

Criteria

Sampling pits should be installed in waste systems before discharge from the building. These systems would include stormwater, sanitary waste, blackwater, graywater, and mechanical systems.

Building Profession Task Designations

Before the building professional team can use this feature it is recommended that a team member is assigned each task. Refer to building professionkey below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent

Required Tasks

The plumbing engineer should coordinate with building operations as well as DEP, and other regulatory agencies for design, detail, and locations of the proposed sampling pits. DDCPM PE

Sampling pits should be installed at the final building discharge on the stormwater, sewer, mechanical, graywater, and blackwater systems. PE PC

Building operations should develop a procedure to monitor waste streams on a regular basis. BO

Integration

PS 3a PS 3b Graywater and Blackwater

Install in system main.

MS Mechanical System

Install in system main.

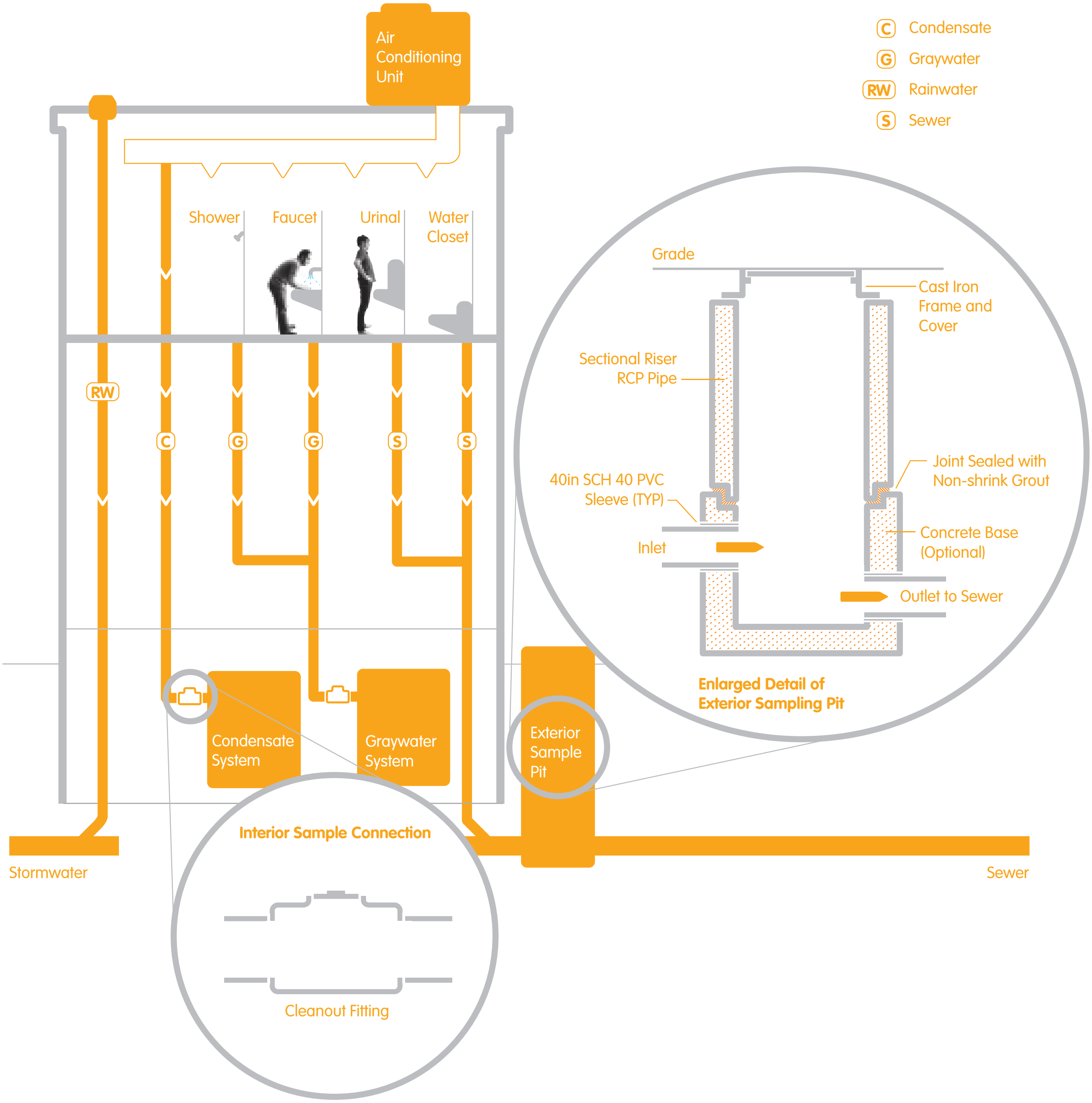
OP 3 Commissioning

Check that access is maintained during construction.

OP 4 Retro-Commissioning

Develop procedures for ongoing testing during building operations.

Waste Sample Pits



PS 5 Graywater and Water Reuse (Vehicle Wash)

Plumbing Systems

PS 1

Mechanical Systems

MS

Operations

OP 1 2 3

Objective

Reduce potable water, sewer, and stormwater flow from a facility by reusing stormwater as supply water to the vehicle wash equipment.

Benefit

Systems that capture, store, filter, and reuse stormwater for vehicle washing reduce potable water use and stormwater overflow.

Limitations

Water demand may differ from reuse water availability. As a result, storage tanks and pumps may be needed.

Water filtration systems add front-end and maintenance costs.

Background

Studies have shown the benefits of using reclaimed water in reducing fresh water supply in commercial car washes. NYC Transit's Storm Water Management Program minimizes the use of potable water by harvesting rainwater, and then recycling the graywater (non-industrial wastewater generated from domestic processes such as washing dishes, laundry, and bathing). A rainwater collection system on the roof of the new Corona Car Washer and Maintenance Facility in Queens drains into a 40,000-gallon underground storage tank that supplies water to a subway car washer.

In addition to using stormwater, further water reduction can result by using the proper cleaning equipment, settings, and orientation. For example, spray nozzles with a fan shaped spray installed parallel to the spray bar will reduce water usage.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- CE Civil Engineer
- ME Mechanical Engineer
- EE Electrical Engineer

Required Tasks

Efficient More Efficient Ultra Efficient Innovative New Construction/Renovation

Follow the recommendations outlined in *The Interim Report of the Blue Ribbon Commission on Sustainability and the MTA*. The following list of tasks is keyed to the Water Management Working Group Interim Recommendations (WM):

For more information go to: http://www.mta.info/environment/pdf/draft_final3.pdf

Graywater and Water Reuse (Vehicle Wash)

PS 5

Recommendation WM 1

The MTA should reduce its use of potable water and increase the use of harvested rainwater and recycled "gray water" for regular operations.

Reclaimed water should be used in gun-type, undercarriage nozzles, presoak cycles, mat cleaning and floor cleaning. When reverse osmosis (RO) or other filtered water is used for the final rinse, the backwash water from the filter system can be collected and used in the reuse system. Low flow, high pressure nozzles should be used on hoses and water brooms. To reduce floor washing, drains should be located next to liquid discharge areas.

On site towel washing should use high efficiency machines with a Tier 3 CEE rating with a water factor of 4.5 gallons per cubic foot of washer capacity. Install automatic shut off valves on hoses and water using equipment.

In some cases, deionization equipment can be used in place of water softeners or RO filters. When water softeners or other filters are required, specify filters that backwash on a pressure sensor (not a timer).

In tunnel systems, friction type brush systems should be used instead of touchless systems.

The DDC PM, building operator, plumbing engineer, civil engineer, architect, equipment supplier, and mechanical engineer should meet before the schematic design (SD) phase to compare the water demands of the building to available water sources. On facilities with large water demands, such as vehicle washing, the team shall develop conceptual designs of systems to reduce potable water usage. The team shall base the design on the existing facilities with stormwater reuse. When possible, the same systems should be used to simplify maintenance and repair procedures.

If an alternate design is identified as a more efficient installation, the DDC PM will instruct the plumbing engineer to develop a water balance and the design team to develop alternatives for the construction manager to review. After construction manager review, the team will determine the most efficient design for the project. DDCPM BO PE CE A ME

Commissioning will verify that the system is installed correctly and operating properly. CX

Building operations will develop a monitoring and verification (MV) program and conduct a water audit a minimum of every 5 years. The MV program will include modifications to the system to increase water and energy efficiency. BO

Recommendation WM 2

The MTA should map sources of groundwater and stormwater in its tunnels and infrastructure and identify their viability for thermal and other beneficial uses.

During the SD phase, the DDC PM should conduct a study to incorporate a geothermal system on the facility. Follow the recommendations from the DDC Geothermal Manual. DDCPM

When the study is complete, the DDC PM, building operator, architect, civil engineer, plumbing engineer, and mechanical engineer shall meet to determine if geothermal will be used on the facility. The team will also assess if other energy saving systems can be used. DDCPM BO PE CE A ME

Recommendation WM 3

The MTA should submeter all large scale water usage in its operations, such as the water used for washing vehicles.

Submeters shall be installed and connected to the building management system as outlined in the metering section of this manual OP 1. PE

Monitoring of the meters will be included in the building M+V procedure. BO

Recommendation WM 4

The MTA should encourage the use of local drinking water by its employees to minimize bottled water consumption.

Architect, building operator, and plumbing engineer will meet to identify locations for drinking fountains that are easily accessible to employees. The team should identify the types of fountains, which may include water filters PF 8. DDCPM A BO PE

The following list of tasks is keyed to the MTA Agency Water Management Projects (WM):

Project WM 1

The MTA will evaluate current water usage and available best practices to reduce the amount of potable water used to wash vehicles.

The M+V plan will help the building operator to monitor and adjust water systems during operation.

Project WM 2

NYC Transit will evaluate ways to utilize water harvested from the subway system (groundwater ingress) for various beneficial uses, such as cooling of some transformers.

The DDC will conduct a geotechnical report to determine the amount of underground water entering into a facility within the project scope of work. DDCPM

The DDC PM, civil engineer, and plumbing engineer should meet to determine the design options to include harvested water. The team should gather water source data and develop a water balance. During the SD phase, the team will decide on the water reuse systems that should be incorporated in the facility design. DDCPM CE PE

Other tasks

During the SD phase, the PE should coordinate with the electrical engineer to determine if fuel cell electrical generation will be used, and if this system will help generate hot water for the vehicle wash. EE PE

The plumbing engineer will coordinate with the geothermal designer to verify that the system can be used to preheat domestic hot water. PE

The plumbing engineer will coordinate with the solar design team to see if solar water heating panels can be used to heat domestic hot water. PE

The commissioning team will monitor during the design and construction phase to ensure that the systems are installed correctly and operational. CX

Graywater and Water Reuse (Vehicle Wash)

PS 5

Integration

PS 1 Water Balance
Water balance is a key tool for water reuse systems.

MS Mechanical System
Water demands from mechanical systems should be included in the water balance.

OP 1 Water Meter
The water meter data is included in the water balance.

OP 2 Water Audit
A water audit is a key tool to audit the building after construction.

OP 3 Commissioning
Verify on site that the systems are installed and operating properly.

Examples
MTA NYC Transit Corona Subway Car Maintenance Shop and Car Washer

Grand Avenue Bus Depot and Maintenance Facility in Maspeth, Brooklyn

References
"New York City Transit and the Environment" http://www.lirr.org/nyct/facts/ffenvironment.htm#swmp

Abdallah, Thomas, P.E., "MTA NYC Transit New Corona Subway Car Maintenance Shop and Car Washer: 1st NYCT LEED Certified Facility and ISO 14001 EMS Conformance Example," MTA New York City Transit, New York City, NY.

NYC MTA, "The Interim Report of the Blue Ribbon Commission on Sustainability and the MTA". 2008.

International Car Wash Association, www.carwash.org

Koeller, J., Brown, C., and Bamezai, A. January 2007. *A Report on Potential Best Management Practices, Annual Report—Year Three*. Prepared for The California Urban Water Conservation Council.

East Bay Municipal Utility District, *The WaterSmart Guidebook: A Water Use Efficiency Plan Review Guide for New Businesses*. Oakland, CA. 2008.

PS 6

Green Roof (Building System)

Plumbing Systems

PS 2a

Operations

OP 4

Objective

Reduce and improve the quality of stormwater discharge while reducing building energy loads and heat island effect.

Benefit

Reduces the amount of "first flush" stormwater to the city system.

Stormwater quality is improved.

Vegetation and growing media provide mass to insulate the roof and protect roof membrane from UV exposure.

Improves the quality of life for those with visual access to the green roof.

Limitations

Adds upfront cost to the construction of the facility.

Adds operation cost for maintenance.

Background

Green roofs can be designed by the civil engineer or landscape architect working on building sites and landscaping. These systems are earth based systems and are addressed in the **Civil Systems** section CS 6. Green roofs are also designed by the building architect and structural engineer team working on building design and structure. In the latter case, the green roof is considered part of the building envelope and is specified as a roof system. These systems are included in this section.

Green roofs can be used for recreation, gardening, or ecological cover. The roof's function determines its design. The type of green roof specified is limited by capacity, slope, and budget.

There are the two main types of green roofs: **Extensive** and **Intensive**.

Extensive

Extensive green roofs are thin and have few layers. As a result, they are lighter, less expensive, and easier to maintain. The depth of the growing media can be as thin as one inch when vegetative mats are used. However, the media is usually two and one-half to six inches deep.

Extensive green roofs are intended for use as an ecological cover for the building with little access for building occupants. They are not designed for pedestrian traffic. However, designers can add pavers or aggregates for maintenance equipment access. Extensive green roofs use low growing, horizontally spreading ground covers with a typical maximum plant height of 16 inches to 24 inches. Fully saturated, extensive green roofs can weigh from 10 pounds to 50 pounds per square foot (psf), whereas ballasted singleply roofs are normally between 10 pounds and 15 pounds psf. Extensive green roofs can be installed up to a 45 degree slope. Steeper slopes require raised grids or lath. Because extensive roofs are relatively light, easy to maintain, and inexpensive, they are increasing in popularity across the country.

Intensive

Intensive (or high profile) green roofs can include a wide variety of plant material due to their deep media, which is typically between eight inches and 12 inches, but can range to more than 15 inches. These roofs are designed to be pedestrian friendly with architectural accents such as waterfalls, ponds, gazebos, and walkways. A fully saturated intensive green roof weighs between 80 and 120 psf. These roofs are relatively flat, and their maintenance requirements, including irrigation systems, are greater than extensive green roofs.

It is best to use plant systems that require little or no irrigation. However, when irrigation systems are required, EPA WaterSense labeled systems should be used. A roof drain system is required for green roofs. The quality of the stormwater can be high and it is a good source for other building water reuse systems. If the water is reused, the construction and operations team will have to ensure that only fertilizers and chemicals that can be broken down during the filtration process be used.

First Flush - Refer to PS 2a Irrigation
Green roofs will retain the first inch or two of rainwater in the growth media, which will be used by the plants after the rain event. It is assumed that this rainwater will not enter the building stormwater system, and will retain contaminants that may be in the first flush.

For more information refer to the DDC *Cool & Green Roofing Manual.* Additional building load, including green roofs in saturated condition, requires filing with the Department of Buildings (DoB). The property tax abatement rule for green roofs, 1 RCNY 105.01, provides code guidance. Requirements are subject to change, as new regulations are developed. Also, green roof structures must comply with BC Section 1507.16 "Roof Assemblies and Rooftop Structures."

Building Profession Task Designations
Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LA Landscape Architect
- CE Civil Engineer
- SE Structural Engineer

Required Tasks

Efficient

DDC PM and architect will meet during the programming stage to determine if a green roof can be incorporated into the design. It will be decided if the design will be based on a civil engineered and landscape architect type system or a manufactured green roof system. DDCPM A

If a civil engineer and landscape designed system is specified, refer to the **Civil Systems** section CS 6 of this manual. CE PE

DDC PM, architect, structural engineer, plumbing engineer, building operator, civil engineer, and green roof designer will meet during the schematic design (SD) phase to determine the type of green roof that will be specified. This process may require issuing alternative SD documents to be reviewed and to develop cost, schedule, and constructability reports. During the SD phase, the team will develop the scope of the green roof. The design will be included in the contract documents. DDCPM A PE BO CE SE

The green roof designer, architect, irrigation designer, plumbing engineer, and DDC PM will meet during the SD phase to determine the irrigation needs for the green roof. The team should develop a vegetation system requiring little or no irrigation. Some green roofs will require a temporary irrigation system until plants are established. If permanent irrigation is required, the plumbing engineer will work with the green roof designer during SD to determine the amount of water required for irrigation. The data will be included in the water balance. A water reuse system should provide at least 50% of the green roof irrigation and an EPA WaterSense certified irrigation contractor should be specified. A LA PE

More Efficient Ultra Efficient Innovative

If irrigation is required, the plumbing engineer will work with the green roof designer during SD to determine the amount of water required for irrigation. The data will be included in the water balance. A water reuse system should be used to provide 100% of the green roof irrigation. PE

Integration

PS 2a Irrigation

Some green roofs will require irrigation.

OP 4 Retro-Commissioning

Procedures should be in place to eliminate or minimize the use of chemicals applied to the vegetation.

Waste Pod (Multiple Piped Waste System)

PS 7a

Plumbing Systems

PS 2 3

Mechanical Systems

MS

Operations

OP 1 2 3 4

Objective

Provide for the future installation of water reuse systems.

Benefit

Installing the water reuse piping without the equipment can reduce construction budgets, while providing the option to include WE technologies in the future.

Reuse technologies are relatively new, expensive, and may not have regulatory approval for installation. As the technology develops, is improved, and becomes acceptable, these buildings can be more easily retrofitted with water reuse systems.

Limitations

Multiple piped systems may be too expensive.

Cross connecting piping systems can occur without proper labeling.

Background

Space allocated in buildings for future collection systems are referred to as pods. The pods indicate the areas reserved for future tanks, filters, and pumps. In some cases, piping can be capped for future connection. Empty power conduit and panels can be provided for future electrical feeds to the equipment. Floor drains need to be installed for future overflow.

The pods can also be used for research. For example, portable prototype equipment can be installed, which runs for limited periods of time to collect data. Equipment can be removed when the research is complete.

Pods can be located outside the building, especially with underground storage tanks and pumping systems. This is a preferred option with stormwater systems that may supply future irrigation systems.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent

Required Tasks

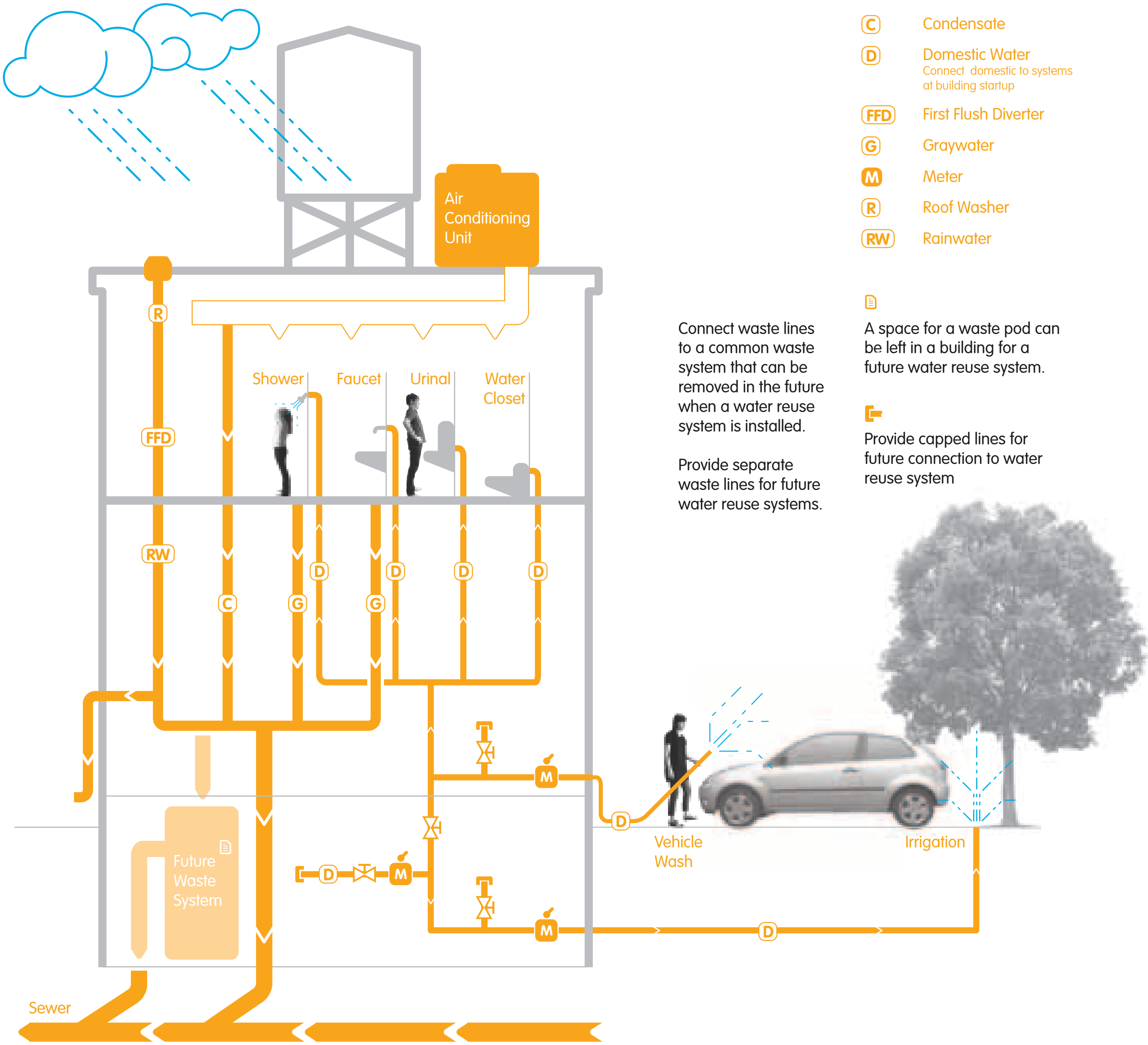
Efficient

Stormwater - In the past buildings were built with one stormwater and waste pipe system. However, it is now preferable for the building stormwater piping and waste piping to be piped in two separate systems out of the building. PE

Condensate - Air conditioning condensate can be contained in a separate piped system. This works well when the AC units are located in a common core area of the building and a single riser can collect the condensate. In efficient buildings, the plumbing engineer should

PS 7a

Waste Pod (Multiple Piped Waste Systems)



Waste Pod (Multiple Piped Waste Systems)

develop a water balance and size the piping and equipment for a pod dedicated for future building condensate collection. The system shall terminate at a pod where the future condensate system can be installed. PE PC

Graywater - A gravity system that collects wastewater from showers, bathtubs, and laundry can connect to a common piped system and routed to a graywater collection and filtration system. During the schematic design (SD) phase, the building operator, DDC PM and PE should meet to determine if it is feasible for a graywater system to be installed in the future. Similar to the other systems, a waste pod can be installed for a future system.

Piping - To ensure safety, piping systems need to be clearly marked, either by painting the piping a different color or marking the piping. During design, the third party commissioning team should review the plumbing drawings to verify piping is not cross connected. A second review is necessary when the contractor prepares the coordination drawings. Additional reviews should be scheduled during construction and at the end of construction, and prior to occupancy. PE PC BO CX

If possible, drains and inlets that connect to a graywater, condensate, or blackwater system should be marked in the interior spaces. Building operations will need to develop procedures to reduce the risk of cross connections during building operation. Warning posters and signs can be installed in staff areas illustrating the piped systems and markings. Close coordination with regulatory agencies is required from the design phase through construction into operations. PE PC BO CX

In the future when a reuse system is connected, cross connection testing should be performed to ensure that the domestic water system is not compromised with a cross connection. BO CX

More Efficient

In a more efficient building a condensate, stormwater reuse or graywater reuse system should be included during the SD phase. DDCPM PE

Blackwater - The building operator, plumbing engineer and DDCPM will meet during the SD phase to determine the feasibility of installing a gravity system that collects waste from flush fixtures and sinks, connects to a common piped system, and is routed to a blackwater collection system. A waste pod can be installed for a future system. The plumbing engineer should develop a water balance and size the piping and equipment for the pod. DDCPM PE BO

Mechanical - The building operator, plumbing engineer and DDCPM will meet during the SD phase to determine the feasibility of installing a gravity system that collects wastewater from the mechanical systems and connects to a common piped mechanical collection system. A waste pod can be installed for a future system. The plumbing engineer should develop a water balance and size the piping and equipment for the pod. DDCPM PE BO

Ultra Efficient

Ultra efficient buildings should install two water reuse systems and provide pods as described for more efficient buildings for the other future systems.

PS 7a

Waste Pod (Multiple Piped Waste Systems)

Innovative

During the SD phase, the DDC PM, building operator, architect, and plumbing engineer should meet to discuss the technology and feasibility of future waste treatment systems. Provisions for future equipment should be incorporated in the contract documents.

DDCPM BO A PE

Integration

PS 2a 2b 2c Water Reuse

Coordinate requirements for these systems.

PS 3a 3b Graywater and Blackwater

Coordinate requirements for these systems.

MS Mechanical System

Coordinate requirements for these systems

OP 3 Commissioning

Check for cross connections.

OP 4 Retro-Commissioning

Check for cross connections during building operation.

Water Pod (Two-Pipe System)

PS **7b**

Plumbing Systems

PS 2a 2b 2c 3a 3b

Mechanical Systems

MS

Operations

OP 3 4

Objective

Install piping system and space for future water reuse systems.

Benefit

Installing the water reuse piping without the equipment can reduce construction budgets, while providing the option to include WE technologies in the future.

Reuse technologies are relatively new, expensive, and may not have regulatory approval for installation. As the technology develops, is improved, and becomes acceptable, these buildings can be more easily retrofitted with water reuse systems.

Limitations

Multiple piped systems may be too expensive.

Cross connecting piping systems can be a problem.

Background

Space allocated in buildings for future distribution systems are referred to as pods. In most cases, these can share space with the waste pods PS 7a. Distribution system pods indicate the areas reserved for future tanks, filters, and pumps. In some cases piping can be capped for future connection. Empty power conduit and panels can be provided for future electrical feeds to the equipment. Floor drains need to be installed for future overflow.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- SC Sustainability Coordinator
- CE Civil Engineer
- LA Landscape Architect
- ME Mechanical Engineer

Required Tasks

On large projects or LEED Gold/Platinum projects, assign a sustainability coordinator within the building professional team. DDCPM or PE

The building team must have experience in water reuse. DDCPM SC

Facilitate, schedule, and coordinate data to develop water balance. DDCPM SC PE ME CE LA

Coordination with other nonpotable water supplies. SC PE ME CE LA

Coordination with regulatory requirements. SC PE DDCPM

Efficient

The plumbing engineer, DDC PM and building operator shall meet during SD to discuss reuse water options. During this phase, the feasibility of incorporating water reuse systems in the building will be determined. DDCPM PE BO

If water reuse systems are considered, the plumbing engineer shall prepare a water balance and meet with the building operator and DDC PM to determine if a pod and piped system will be installed during the construction phase. DDCPM PE BO

Potable Water - The primary potable water system will feed drinking fountains, ice machines, showers lavatories and sinks. PE

Mechanical - In some cases, a separate mechanical distribution system can be designed, which is not part of the building plumbing systems. During the SD phase the mechanical engineer must provide data to the plumbing engineer in order to prepare a water balance that includes mechanical systems. At this time the feasibility of installing a mechanical reuse or pod will be determined. DDCPM ME PE BO

Stormwater- Stormwater can be used for mechanical systems, flush fixtures, or irrigation. During the SD phase, the plumbing engineer will prepare a water balance that includes stormwater. At this time the feasibility of installing either a stormwater reuse system or pod will be determined. DDCPM ME PE BO

If installed, the reuse piping must be clearly marked to ensure safety, either by painting or marking the piping. PE PC

Third party commissioning should review the plumbing drawings during design to verify that piping is not cross connected. Additional reviews should be scheduled with the contractor during the preparation of the coordination drawings, during construction, and at the end of construction. Another review should be performed prior to occupancy. At system start up, the different systems could be tested for cross connection using air pressure tests or dye injected into the water. PC CX

Outlets should be marked in the interior spaces indicating connections to the building graywater, mechanical or blackwater system. PE PC CX

Building operations will need to develop procedures to reduce the risk of cross connections during building operation. Warning posters and signs can be installed in staff areas illustrating the piped systems and markings. PE PC CX BO

Close coordination with regulatory agencies is required from the design phase through construction into operations. DDCPM PE PC BO

More Efficient

More efficient buildings should install one complete water reuse system. At least one water reuse pod should be installed.

Graywater - A pressure piped graywater distribution system can feed nonpotable water fixtures. As discussed with other technologies, this system can provide water for flush fixtures, landscape irrigation, and mechanical systems. During the SD, the plumbing engineer will develop a water balance and size the potential graywater system. The DDCPM, building operator, and plumbing engineer will meet to decide if provisions should be

made for a graywater system and pod. If the pod concept is accepted, the plumbing engineer should size the graywater piping and the pod size for the future graywater system. Piping should be designed and installed with proper spacing for valves, fittings, and backflow preventers.
DDCPM PE BO

Ultra Efficient Innovative
Ultra efficient and innovative buildings should have two water reuse systems, and at least one pod. PE

Blackwater - Similar to the graywater system, a pressure piped distribution system from the blackwater system can supply nonpotable water fixtures. This system can feed other technologies including flush fixtures, landscape irrigation, and mechanical systems. During the SD phase, the plumbing engineer shall prepare a water balance and size the piping and pod for the future equipment.
DDCPM PE BO A

Integration

PS 2a 2b 2c Water Reuse
Coordinate requirements for these systems.

PS 3a 3b Graywater and Blackwater
Coordinate requirements for these systems.

MS Mechanical System
Coordinate requirements for these systems

OP 3 Commissioning
Check for cross connections.

OP 4 Retro-Commissioning
Check for cross connections during building operation.

EN Energy

On an average day, over one billion[1] gallons of water moves into New York City. On the same day 1.2 billion gallons[2] move through the city's wastewater treatment facilities. Once in the city, energy is used to pump, heat, cool, and filter the water in buildings. When water leaves the building as wastewater, it is joined by stormwater in some parts of the city and is treated in wastewater treatment plants.

According to the PlaNYC report "*Inventory of New York City Greenhouse Gas*," New York City's greenhouse gas (GHG) emissions in 2007 were 61.5 million metric tons of carbon dioxide equivalent (CO2e). Operation of municipal facilities and related activities accounted for 4.3 MMT, with approximately 63 percent of these emissions resulting from the operation of city government buildings.[3]

Although energy use in buildings is the largest contributing sector to the greenhouse gas emissions inventory, other sources include sewer and water (approximately 7%) as well as methane from water pollution treatment plants (approximately 7%).

The facilities that make up the wastewater and water treatment systems are buildings that use a large amount of energy, but were not counted in the buildings sector in the PlaNYC study. The DEP-operated water pollution control plants, water supply, and wastewater transport system plus methane generated by the wastewater treatment process combined to produce this 14 percent. Most of the water supply to the city is gravity fed, therefore the majority of GHG emissions is from the energy used for wastewater transport and treatment, and the methane generated by the wastewater treatment process.

Reducing the amount of water used by the building systems will reduce energy used in the city and the city's GHG emissions in these ways:

- Reduces the amount of energy used to move and filter water.
- Reduces pump energy inside buildings.
- Reduces water heating energy inside buildings.

Note: Domestic hot water systems are included in the energy audit and retro-commissioning required by Local Law 87 for buildings 50,000 square feet and above.

Reducing the wastewater from the building benefits the city in these ways:

- Reduces city wastewater transport and treatment costs.
- Reduces the city's GHG emissions from waste treatment system and methane generation.

Water reuse, graywater, and blackwater systems that also include stormwater benefits the city in these ways:

- Reduces the amount of energy used to transport and filter water.
- Reduces wastewater transport and treatment costs.
- Reduces GHG emissions from wastewater treatment systems.

1 New York City Department of Environmental Protection, History of Drought and Water Consumption http://www.nyc.gov/html/dep/html/drinking_water/droughthist.shtml

2 New York City Department of Environmental Protection, New York City's Wastewater Treatment System Cleaning the Water We Use: Protecting the Environment We Live In http://www.nyc.gov/html/dep/pdf/wwsystem.pdf

3 PlaNYC, Inventory Of New York City Greenhouse Gas Emissions, February 24, 2009 http://www.nyc.gov/html/planyc2030/downloads/pdf/inventory_nyc_ghg_emissions_2008_-_feb09update_web.pdf

Water Heater (Small Storage)

Less than 100 gallons and 10 KWh

EN 1a

Objective

Reduce building energy load.

Benefit

- Provides moderate energy savings at a competitive cost.
- Readily available and easy to install and maintain.

Limitations

- Other water heaters are available that provide greater energy savings.
- Not applicable in large buildings.
- May create a minor safety risk when compared to non-storage type.
- Takes up floor space.
- Provides little energy savings toward LEED energy credits.

Background

Storage type water heaters are popular in residential and small commercial installations because of the low front end cost. However, with higher energy costs, the high operations cost may render the units impractical. Typically, some of the heat energy from the storage unit transfers out into adjacent space, so that energy to maintain the temperature of the water is needed constantly. These systems may not be practical in office buildings where hot water is only required during the workweek with no demand on weekends.

Standard natural gas water heaters are less than 80% efficient. At efficiencies over 80%, condensate in the flue will change from a gas to a liquid. This condensate contains acids that can decay the inside of a heater, causing it to leak. Gas water heaters that are less than 80% efficient are referred to as non-condensing. They are less expensive to manufacture than the condensing type, but less efficient. On small systems non-condensing heaters are the only option.

If electric heaters are used, an energy efficiency (EF) rating of .62 or higher should be specified.

Building Profession Task Designations

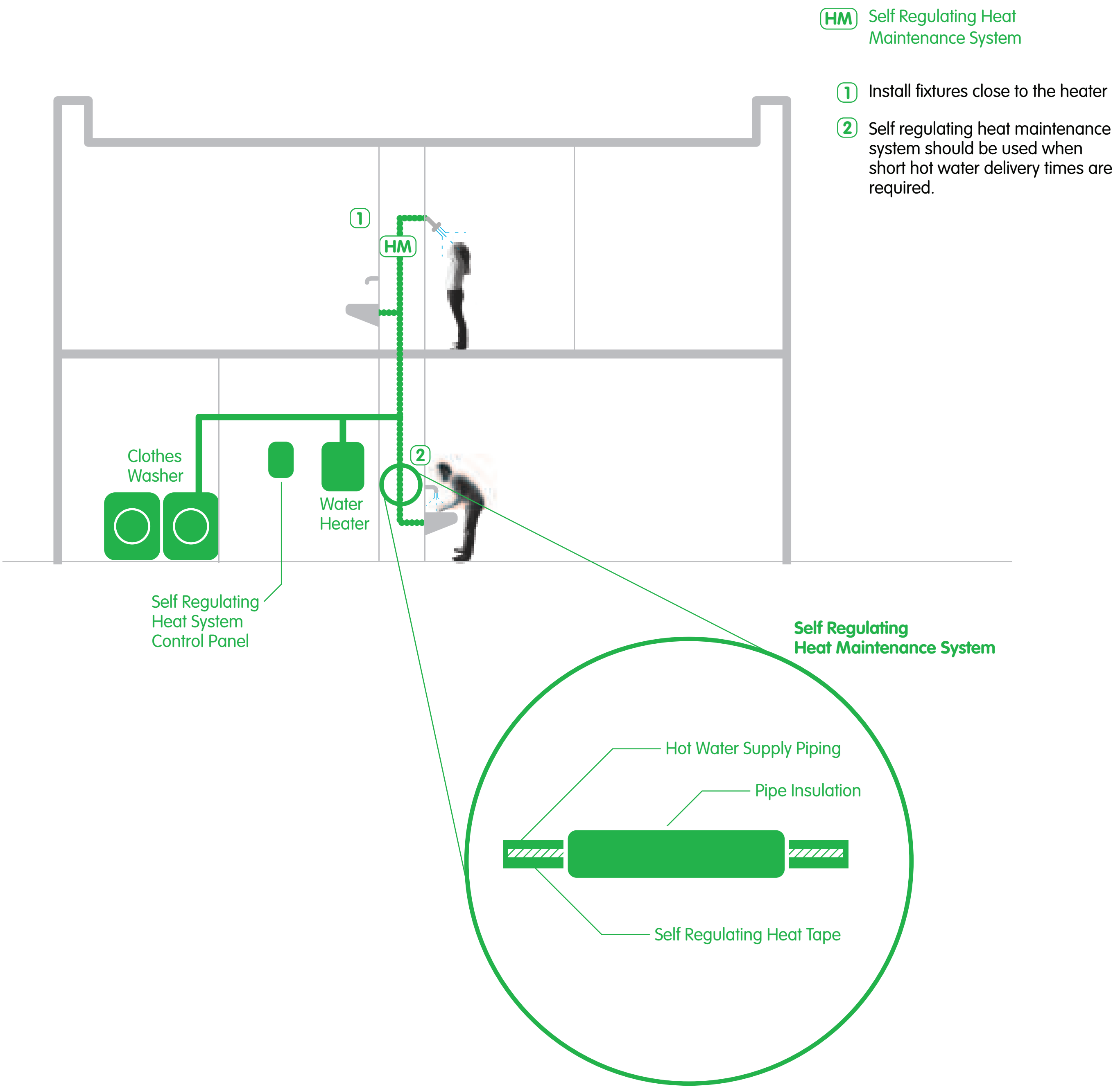
Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

- **DDCPM** DDC Project Manager
- **A** Architect of record
- **BO** Building Operator
- **PE** Plumbing Engineer of record
- **PC** Plumbing Contractor
- **CX** Commissioning Agent

Required Tasks

All water heater systems must comply with codes and regulatory requirements. Energy sources feeding water heaters such as steam, gas, electric, or other alternative fuels shall meet all regulatory, insurance, and testing requirements. Equipment shall be used as per the manufacturer's intent. System water temperatures shall be maintained to reduce the risks of temperature spikes that can cause bodily harm. Piping systems shall be installed to reduce the risk of legionella or other contaminants. Cross contamination requirements shall be maintained to ensure the sanitation of the domestic water system. Cross connection protection from the facility to the city water system shall be maintained as per regulatory standards. System pressure ratings for piping, valves, fittings, and equipment shall not be exceeded. These precautions are the responsibility of the entire building professional team.

Water Heater (Small Storage)



Water Heater (Small Storage)

EN 1a

Efficient

Storage type water heaters are acceptable as a code minimum. However, they will not help obtain LEED water efficiency (WE) or energy (EA) category credits. Tankless water heaters with heat maintenance heat trace systems should be used when small heaters are required. The plumbing engineer should specify a more energy efficient system. PE

Storage type water heaters can be used on small projects employing hot water recirculation pumps and piping, or in projects requiring high amounts of hot water over short periods of time. If specified, the pumped recirculation system should have controls that turn the system off at night, weekends, and/or when not in use. In small buildings or residential applications, hot water maintenance pumped systems can operate with motion sensors in the toilet or shower room to signal when people are present and the recirculation pump is activated. The plumbing engineer and building operator shall coordinate the best application for each system. PE BO

Renovation

Some renovation projects require replacement of small water heater systems. In these facilities, access to gas or electric power may be limited. As a result, replacing a storage system with a newer energy efficient system may be the only option. In these situations use an EF rating of .62 or higher. The heat maintenance system should be controlled as described above.

More Efficient Ultra Efficient Innovative

Storage type water heaters should not be used. These buildings should use a higher efficiency system. See EN 1b and EN 1c.

EN 1b Water Heater (Small Tankless)

Less than 10 GPM

Objective

Reduce building energy load by eliminating losses associated with hot water storage.

Benefit

- Achieves greater energy savings at a minor cost increase.
- Readily available and easy to install and maintain.
- Uses less floor space than storage type water heaters.
- Works well in residential or small buildings.
- Less pollution with low nitrogen oxide discharge.
- No tank disposal issues.
- No time limit for hot water supply at low flow fixtures.
- Tighter temperature control.

Limitations

- Higher installation cost.
- Not applicable in some large buildings.
- Limited ability to provide hot water for simultaneous multiple uses.
- Replacing storage type water heaters with tankless heaters may require larger gas piping, larger flues, and/or larger electric feeds.
- Reworking electrical and gas feeds to the water heaters may not be practical in renovation projects.

Background

Tankless water heaters (also known as point of use or on demand), operate only when there is a demand for hot water. There is no associated hot water storage, and so standby losses are eliminated. Tankless water heaters are also referred to as instantaneous water heaters.

Tankless heaters employ a heating element to heat the water as it flows in. Unlike tank heaters, they do not use energy to maintain the temperature of the water in the tank and, as a result, use less energy. A second advantage is that these water heaters take up less space and weigh less.

Storage type water heaters can generate hot water while there is flow through the heater, but they need recovery time, and are not sized to provide hot water flows for long periods. Thus, the supply of hot water over time is limited. In contrast, a tankless heater can provide hot water over long periods of time because it maintains the same amount of hot water as long as water is flowing through the heater. Tankless water heaters do not operate well in applications where multiple simultaneous use is required. Small gas tankless heaters are not usually condensing type heaters and at best are 80% efficient.

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

- **DDCPM** DDC Project Manager
- **A** Architect of record
- **BO** Building Operator
- **PE** Plumbing Engineer of record
- **PC** Plumbing Contractor
- **CX** Commissioning Agent

Water Heater (Small Tankless)

EN 1b

Required Tasks

Efficient More Efficient
Ultra Efficient Innovative

Tankless water heaters should be used in installations where a single heater will meet the hot water demand. Using multiple heaters piped in parallel requires multiple valves, which will complicate the system and will be difficult to install and operate. If the demand exceeds the capacity of a single tankless heater, consider specifying a larger condensing unit with a 95% efficiency rating. PE

To increase the effectiveness of a tankless heater, the architect should layout the spaces so the water heater is located close to the plumbing fixtures. This will reduce the length of piping runs between the heater and the fixtures EN 5. A

Renovation

On small renovation projects requiring water heater replacement, tankless water heaters should be specified. Tankless water heaters may require a larger gas line and flue compared to storage type water heaters. Electric tankless water heaters will require increased electrical service. The plumbing engineer must verify that the gas piping, flue, and electrical service are sized properly. PE

EN 1c

Water Heater (Large Condensing)

Energy

EN 1d 3a 5

Objective

Reduce building energy load without the heat loss associated with hot water storage.

Benefit

- Achieves greater energy savings at minor cost increase.
- Readily available and easy to install and maintain.
- Uses less floor space than storage type.
- Works well in large buildings with high hot water demand.
- Emits low nitrogen oxide discharge.
- No tank disposal issues.
- No time limit for hot water supply at low flow fixtures.
- Allows for tight temperature control.

Limitations

- Higher installation cost.
- Larger gas or electric feed.

Background

Condensate Note

The term “condensate” is used in different ways in this manual. Condensate from a fuel burning appliance is different from condensate from a cooling coil used in air conditioning systems or steam condensate collected from cooled steam used in heating systems. Condensate from a fuel burning appliance is corrosive and should never be reused in any water reuse system. Refer to the NYC Mechanical Code 307.1 Fuel-burning appliances. Liquid combustion byproducts of condensing appliances shall be collected and discharged to a plumbing fixture or disposal area in accordance with the manufacturer’s installation instructions.

Condensing water heaters are over 92 percent efficient. These heaters can be provided as a complete system with the interconnecting piping, equipment, controls, and valves installed at the factory, which can reduce installation labor and simplify repairs.

Condensing instantaneous heaters can exceed 92% efficiency and do not require storage tanks, while meeting hot water demand. Technically these are tankless heaters. However, industry typically refers to small units as tankless and large units as instantaneous. The condensing tank and instantaneous heaters have single point connections that can reduce installation cost while providing a single point of contact if problems arise. These heaters can be provided as a complete system with the interconnecting piping, equipment, controls, and valves installed at the factory, which can reduce installation labor and simplify repairs.

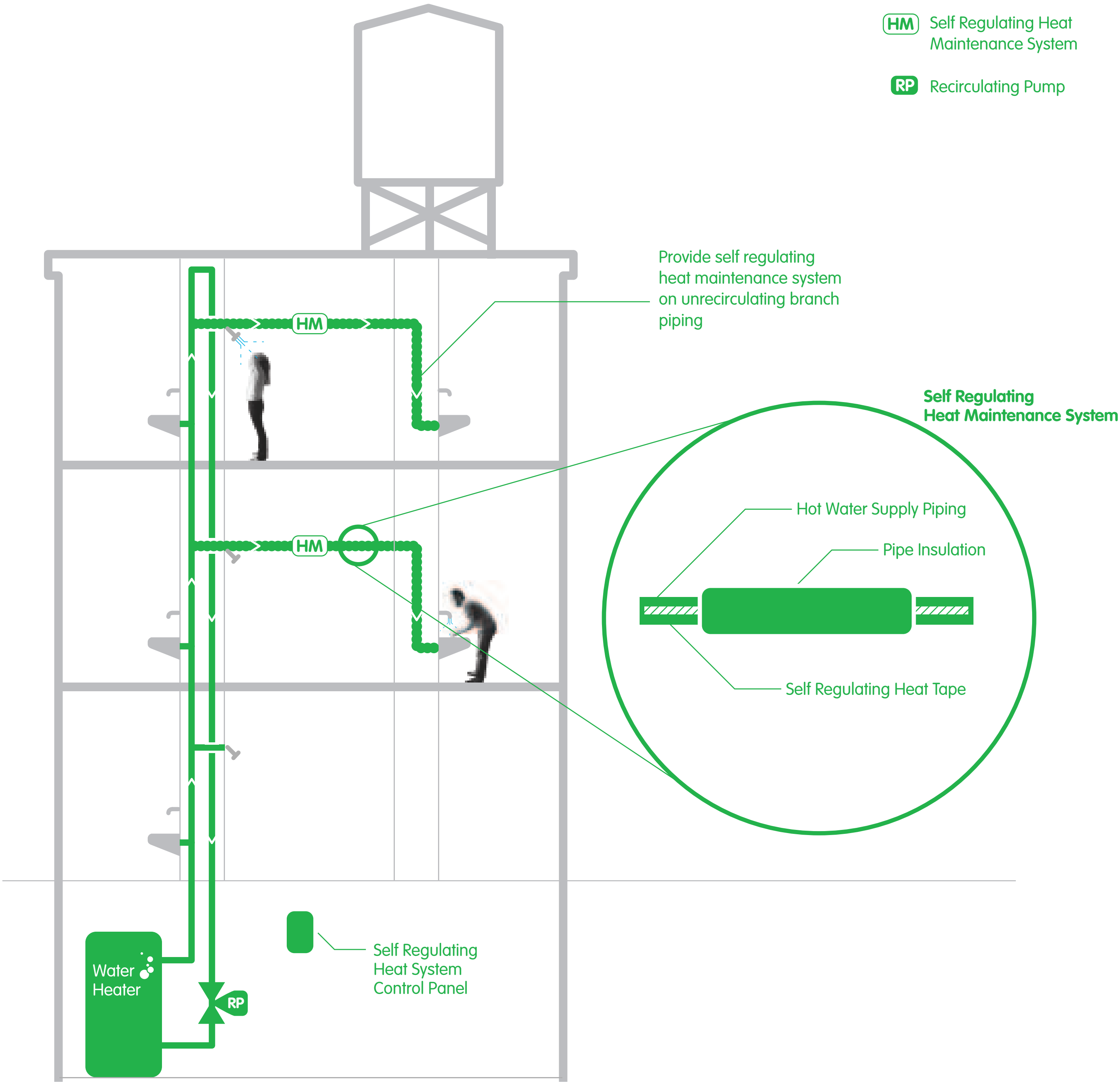
Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

- **DDCPM** DDC Project Manager
- **A** Architect of record
- **BO** Building Operator
- **PE** Plumbing Engineer of record
- **PC** Plumbing Contractor
- **CX** Commissioning Agent
- **LS** LEED Specialist
- **ME** Mechanical Engineer

Water Heater (Large Condensing)

EN 1c



Water Heater (Large Condensing)

Required Tasks

Efficient

In facilities where hot water demand exceeds the capability of small tankless water heaters, condensing type heaters should be used. Instantaneous steam heaters should be used where steam is available. PE

Using efficient water heaters can be included in the calculation for LEED Energy and Atmosphere (EA) credits. The plumbing engineer shall coordinate with the mechanical engineer and LEED specialist to ensure that the LEED calculation is correct and that all requirements and documentation are complete. PE ME LS

Renovation

Condensing storage type heaters may be appropriate in renovation projects requiring the replacement of the water heater system. Existing utilities may not provide capacity for the installation of instantaneous water heater systems. PE

More Efficient / Ultra Efficient / Innovative

Preheat or economizer systems can be used in more efficient, ultra efficient and innovative projects. The plumbing engineer and mechanical engineer should determine appropriate domestic hot water preheat systems during the schematic design (SD) phase. These systems and interconnections should be included in the contract documents. Alternative SD documents may be issued to the construction manager to provide proposed budgets, schedules, and constructability information to the design team. The mechanical engineer or plumbing engineer may provide cost payback analyses for the different systems. DDCPM PE ME BO

Integration

EN 1d Water Heater (Solar)

Solar preheater

EN 3a Energy Recovery

Coordinate domestic water preheat with mechanical and plumbing systems.

EN 5 Piping Layout

Reduce piping runs to fixtures.

Water Heater (Solar)

EN 1d

Energy

EN 3a 5

Objective

Reduce building energy load using renewable power.

Benefit

- Reduces the amount of energy purchased.
- Uses renewable power.
- Reduces pollution.

Limitations

- Higher installation cost.
- Requires a backup heating source.
- Requires solar access.
- Requires unfamiliar maintenance activities.

Background

Solar water heaters can be an important part of reducing electrical power generation for a particular building. Widespread use in DDC buildings will result in reduced peak electrical load for the city.

According to the Solar Rating and Certification Corporation,[1] a small, residential size, 64 square foot solar water heater panel delivers the equivalent of 4 kilowatts of electrical thermal power. One would need 400 square feet of photovoltaic panels to generate the same amount of power.

This same small heater can defer .5 kilowatts of peak demand load or about 2,400 kilowatt-hours per year.

If the DDC installed 1,000 solar heaters in place of electric heaters, this could reduce the electrical load of the city by 2,400,000 kilowatts a year.

There are several types of solar water heating systems available. The simplest direct systems route water through panels, typically located on the roof. The water is heated by the sun and is then routed to a storage tank for later use. While this system is simple, it has limitations, such as having to be drained in the winter season to keep from freezing. Alternatively, the system can be designed so that a glycol mixture flows through the solar panel, is heated, and is then routed to a heat exchanger. At the heat exchanger, the energy is transferred to the potable domestic water, which is then stored in a tank. Some systems employ vacuum tube technology in which energy efficiency is increased because energy loss from the piping is reduced due to the use of a double walled glass piping system. Solar water heaters usually employ pumps that require electrical power. However, photovoltaics can provide power for the pump system.

To obtain the greatest benefit from solar water heaters, systems should be installed in projects in which the hot water demand aligns with maximum availability of hot water from the solar system, for example, a food service with high lunch traffic. In such an application, food preparation activities, with little hot water usage, take place in the mornings when the solar water heater has the least amount of hot water. After lunch, dishwashing with the highest demand for hot water begins. This coincides with the peak hot water production of the solar water heater. Solar heaters also work well with locker rooms where staff typically shower before leaving for home in late afternoons.

1 http://www.solar-rating.org/solarfacts/solarfacts.htm

Water Heater (Solar)

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
LS LEED Specialist
SC Solar Consultant
EE Electrical Engineer
SE Structural Engineer
CM Construction Manager
ME Mechanical Engineer

Required Tasks

Efficient

Solar water heaters are not typically specified, often based on financial concerns. However, it is suggested that the DDC PM, architect, solar consultant, electrical engineer, and plumbing engineer should develop alternative designs to use solar power during the schematic design (SD) phase. The intent is to provide space for both solar water heater panels and electrical power generation systems. These designs may be reviewed by the construction manager to determine construction feasibility. The electrical, mechanical, or plumbing engineer may develop a payback analysis for the system. The team shall decide if solar panels are to be used in the project, or if provisions can be made for future panels, or if solar panels are not possible with this project. DDCPM A SC EE PE

Space inside the building can be designated for a future solar water heater system. The domestic hot water system can provide connection points to future solar water heater piping. A PE

Solar systems will require a conventional water heater system backup for use when solar generation is not available. High efficiency water heating systems should be used. PE

Using efficient water heaters can be included in the calculation for LEED Energy and Atmosphere (EA) credits and EA credits for onsite renewable power. The plumbing engineer shall coordinate with the mechanical engineer and LEED specialist to ensure that the LEED calculation is correct and that all requirements and documentation are complete. PE ME LS

Building operations should develop a procedure to maintain the solar water heating system, the glycol system, as appropriate, and to ensure that the panels are cleaned regularly. BO

NYC Regulations - During the schematic design phase of a project, the DDC PM, mechanical engineer, plumbing engineer, architect, and structural engineer shall review current codes and regulations. It is noted that these codes are changing, and requirements must be verified for each project. Issues cited in the NYC Mechanical Code chapter 14 include, but are not limited to:

Access - Access shall be provided to solar energy equipment and appliances for maintenance, firefighting, doors, windows and fire escapes, etc.

Roof-Mounted Collectors - Roof-mounted solar collectors that also serve as a roof covering shall conform to the requirements for roof coverings in accordance with the New York City Building Code.

Protection from Freezing - System components shall be protected from damage by freezing.

Expansion Tanks - Liquid single-phase solar energy systems shall be equipped with expansion tanks.

Any additional load on a building, including solar thermal and its associated equipment, requires filing with Department of Buildings (DOB). The property tax abatement rule for PVs, 1 RCNY 105.02, provides guidance on what the Codes address and what will be required in another rule in development. Other requirements may apply to each individual project. DDCPM BO ME PE A SE

Renovation

The DDC PM, architect, solar consultant, electrical engineer, and plumbing engineer should develop alternative designs that use solar power during the schematic design (SD) phase. In renovation projects, access to the exterior building and existing conditions will have to be analyzed. Space will need to be provided for both solar water heater panels and electrical power generation systems. These designs may be reviewed by the construction manager to determine construction feasibility. The electrical, mechanical, or plumbing engineer may develop a payback analysis for the system. The team shall decide if solar panels are to be used in the project, if provisions can be made for future panels, or if solar panels are not appropriate for the project. DDCPM A SC EE PE

A backup water heater system should be provided. LEED credits can be obtained (see above) and building operations procedures must be developed. PE ME LS BO

Comply with the NYC Regulations section above.

More Efficient

The same tasks should take place as outlined for efficient buildings above. However, more efficient buildings should at least have dedicated space on the exterior of the building for future panels, and dedicated space inside the building for future equipment. DDCPM A PE

Ultra Efficient

The DDC PM, plumbing engineer, solar consultant, architect, structural engineer, and building operator should meet during the schematic design (SD) phase to establish a decision-making procedure, such as the *ASHRAE Solar Design Manual*, to determine if a solar water heater system is appropriate for the particular site. DDCPM A PE BO

If the DDC does not have a list of acceptable solar water heater manufacturers the DDC PM, building operator and PE should develop a list for the project. DDCPM BO PE

The water heaters should be Solar Rating Certification Corporation (SRCC) certified. It is best to use solar water heaters with an electric water heater backup. The storage tank should be a minimum of 80 gallons. PE

The plumbing engineer should size and design the solar and backup water heating systems. PE

Innovative

Innovative buildings should provide space and install systems that employ technologies that are new or may be in the research and development stages. In addition to energy savings, their use will help institutions evaluate the effectiveness of the technologies. The DDC PM, building operator, plumbing engineer, architect, solar consultant, construction manager, and technology

team shall meet during the SD phase. The team will discuss the requirements for the system and how to include these items in the construction documents.
DDCPM BO PE A CM SC

Refer to the New Technology NT section for additional information.

Tasks outlined for efficient buildings above should be included in innovative buildings.

Integration

EN 3a Energy Recovery
Coordinate domestic water preheat with mechanical and plumbing systems.

EN 5 Piping Layout
Reduce piping runs to fixtures.

Example

NYC Firehouses are using solar water heaters.
Refer to Section 4.

Pumps (High Efficiency)

EN 2a

Mechanical Systems

MS

Plumbing Systems

PS 2

Operations

OP

Objective

Reduce building energy load.

Benefit

Reduces energy load and radiates less heat.

Reduces electrical feed sizes.

Limitations

High efficiency motors may not be available in packaged equipment.

Higher upfront cost.

Background

Moving large volumes of water inside a building consumes large amounts of energy. A water efficient building will need to move smaller amounts of water, which in turn reduces energy and maintenance costs of the building.

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- CE Civil Engineer
- ME Mechanical Engineer
- EE Electrical Engineer

Required Tasks

Efficient

Conventional water seals, through which water is run prior to being piped to drain, waste water. Mechanical seals can be used that do not waste water. The mechanical engineer and plumbing engineer should specify mechanical seals instead of water seals to reduce the amount of water wasted to drain. ME PE

The plumbing engineer should specify variable frequency pumps on systems such as the domestic water booster system. If variable frequency pumps are not applicable, staged systems that use a low horsepower jockey pump should be used. PE

Mechanical pumped systems should use variable frequency drive pumps when available. ME

Part of the energy loss with pumps is attributed to the electric motor efficiency. Typically, motors operating in the 75% range are not uncommon. There is a move to require high efficiency motors that operate with motor efficiencies in the 85% to 95% range (Table 12-10 of NEMA MG-1, Rev. 1). The mechanical engineer and plumbing engineer should specify high efficiency motors. ME PE

Pumps (High Efficiency)

All pumps, including plumbing and mechanical pumps, should be analyzed to reduce power demands on a building. For example, pressure-reducing valves add to the energy load on the system; wastewater pumps that move solids and liquids are less efficient. The civil engineer, mechanical engineer, and plumbing engineer should size pumping systems to minimize building power usage. CE ME PE

Some high rise buildings in the city employ water tanks at the roof and draw from the city water system over long periods of time. Other buildings use pressure tanks at a lower floor. When possible, it is best to use city water pressure to minimize the amount of energy used to pump water.

In some buildings the time it takes hot water to reach a faucet is an issue, particularly where codes and users demand shorter wait times. Since WE faucets and showers use less hot water a result can be an increase in the hot water to tap time. In small hot water systems, the plumbing engineer should use a heat maintenance trace system on hot water lines instead of pumps. The control system should turn off at times when the building is not in use. PE

A typical hot water recirculation pump can lose energy in three areas. First, the pump motor uses energy. Pumps with efficiencies in the 85% to 95% range should be used. Second, the pump uses energy if it is in operation 24 hours a day. As appropriate, timers should be installed to turn off pumps at night and/or on weekends. Third, constant use recirculating pumps cause water heater losses while maintaining temperature as the heat dissipates throughout the hot water system. Operating a circulation pump based on thermal dropoff of the return water is a more efficient choice. In larger systems where circulation pumps and heat maintenance trace systems are required, pumps with thermal or timed controls should be specified. PE

On some small systems a recirculating hot water delivery system with a user-activated pump can be specified. The pump circulates cool water in the hot water supply line back to the water heater through a return line. The cool water is replaced by hot water until a controller turns the pump off. This occurs when the water at the fixture the greatest distance from the water heater reaches the desired temperature. Or, the pumping cycle can be activated by the push of a button or motion sensor at the point of use, such as a bathroom shower. PE

More Efficient / Ultra Efficient

When installing water reuse systems, the architect and plumbing engineer should install gravity flow, thus reducing or eliminating energy and maintenance costs for pumps. For example, locate stormwater collection systems close to the roof. PE A

Innovative

Pumped systems to do not always have to connect to the city power grid system. Using solar or wind energy to power pumps will reduce the energy load. A backup pump should be provided to operate when renewable power is not available. PE EE

Pumps (High Efficiency)

EN 2a

Integration

MS Mechanical Systems

Specify and install energy efficient motors on pumps.

PS 2 Water Reuse

Install water reuse systems in locations that take advantage of gravity.

OP Operations

Develop procedures to modify pump controls to save energy.

EN 2b

Pumps (Variable Frequency Drive-VFD)

Mechanical Systems MS

Plumbing Systems PS 2

Objective

Reduce building energy with pumped systems to match building load.

Benefit

- Reduces energy by specifying pumps to match building load, not building peak load.
- Reduces electrical load to the building.
- Reduces potential for water hammer on piped systems due to hard starts and stops.
- Lowers cost of VFD pumps as technology increases.
- Available in small horse power pumps.

Limitations

- Higher installation cost.
- Requires different maintenance procedures.

Background

Non-VFD pumps are sized for a constant water flow and pressure. However, the actual flows in a building vary due to factors such as time of day and season. In order to match varying flow, conventional pumps, some of which operate as full-on or full-off, cycle on and off, wasting energy and stressing piping and equipment.

Variable frequency drive pump systems modulate at different flows and can be designed and sized to meet building demands. When more flow is needed, the pumps ramp up and provide the flow. When the flow is not needed or stops, the pumps power down or stop.

Ultimately these pumps consume less energy in a building. High efficiency motors should be specified for use with VFD pump systems.

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- CE Civil Engineer
- EE Electrical Engineer

Required Tasks

Efficient | More Efficient | Ultra Efficient

Follow recommendations for pump specification and sizing as described in section EN 2a.

The plumbing engineer, civil engineer, and mechanical engineer should specify VFD pump systems whenever applicable. CE ME EE

Building operators shall develop procedures to monitor VFD performance and controls. The system should be reviewed with operations data and modified to reduce energy use in a building, as needed. BO

Pumps (Variable Frequency Drive -VFD)

EN 2b

Innovative

Alternative power sources such as site generated power should be used to power pumped systems. PE

Integration

MS Mechanical Systems

Specify and install energy efficient motors on VFD pumps.

PS 2 Water Reuse

Specify and install energy efficient motors on VFD pumps.

EN 3a Energy Recovery (Mechanical Systems Preheat)

Mechanical Systems

MS

Plumbing Systems

PS 2a 2b 2c

Operations

OP 3

Objective

Reduce energy use by recovering energy losses from the building.

Benefit

Reuses energy that would have been lost.

Limitations

Higher upfront cost.

Adds maintenance and operation procedures.

Takes up space.

Background

Mechanical systems exhaust excess heat out of a building. However, there are systems that can capture this heat for reuse within the building. For example, recovery systems for steam or boiler stacks capture heat, which is then reused to preheat water supply to the boiler.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
ME Mechanical Engineer

Required Tasks

Efficient

Coordinate with regulatory agencies to provide proper protection to domestic water. DDCPM PE

Mechanical and plumbing engineers should specify equipment to which heat recovery systems can be added in the future. Piped systems shall be valved and capped for future tie in. Space shall be allocated for future equipment. ME PE A

More Efficient

Heat recovery systems should be installed to preheat water entering the boiler where steam or hot water boilers are specified. The system shall be sized for the particular hot water demands of the building and water heating equipment. Some boiler or water heating manufacturers offer heat recovery equipment as an option to their equipment. These systems are engineered and manufactured by the heater manufacturer. It is preferred for the building team to use this equipment because it is engineered and constructed to match the water heating or boiler system and it minimizes design and installation costs. ME PE

Building operations shall develop procedures for operation and for modifications of the system, as necessary. BO

The building operations staff must know how to maintain the system, and to order parts when needed. If the system is not seen as essential by operations staff, it can fall into disrepair and/or be abandoned. Building commissioning will verify that the system is installed correctly and is operational at start up, and will verify the system remains in operation at regular intervals of at least every 5 years. BO CX

Ultra Efficient
Additional preheat or economizer systems should be used in the building. Systems that capture heat from mechanical building exhaust systems can be used to capture and reuse the heat in other applications. ME PE

Innovative
DDC PM, mechanical engineer, building operator, and plumbing engineer should coordinate incorporation of new technologies into building systems during the schematic design (SD) phase.
DDCPM ME PE BO

Integration

MS Mechanical Systems
Coordinate with the other mechanical systems for the feed water.

PS 2a PS 2b PS 2c Water Reuse
Coordinate with these systems if they are providing makeup water to mechanical heating systems.

OP 3 Commissioning
Commissioning will need to check system to ensure it is operating properly at building start up and at regular times during building operations.

EN 3b

Heat Recovery (Domestic Hot Water)

Mechanical Systems

MS

Plumbing Systems

PS 2a 2b 2c

Operations

OP 3

Objective

Reduce energy cost to heat water by recovering energy from hot water discharge.

Benefit

Reuses energy that would have been lost.

Limitations

Higher upfront cost.

Adds maintenance and operation procedures.

Takes up space.

Background

The heat energy from high temperature discharge water can be transferred to preheat water supply to other building systems.

NYC Steam Condensate Note

Larger residential and nonresidential buildings located below 72nd Street in Manhattan typically receive steam from the district system. There is no district condensate system to collect the condensate and reuse it in the system boilers. Currently there is no requirement that utility steam condensate be reused in any way, only that steam condensate cannot be drained to the sewer if its temperature exceeds 150 degrees (Plumbing Code Section PC 803, 803.1). Between six and ten million gallons of this water is dumped into the sewersheds draining to the Newtown Creek, Wards Island, and North River wastewater plants every day, increasing flow and diluting sewage strength. Likewise its energy content is lost.

New buildings in the district that use utility steam for space heating and/or cooling should reuse at least 50% of their steam condensate using one or more of the following means:

- Preheating/heating incoming cold water for domestic hot water EN 3 1b.
- Toilet/urinal flushing with some portion, but not necessarily all of the toilet/urinal risers piped to use either steam condensate or another source PS 3a 3b
- An outdoor hose bibb with a sign reading "Non Potable Water" or "Steam Condensate for Sidewalk Washing" as a source of water for washing the sidewalk PS 3a 3b.
- Cooling tower makeup water PS 3a 3b.
- Other uses proposed by the owner (e.g., laundry or other process use) PS 3a 3b.

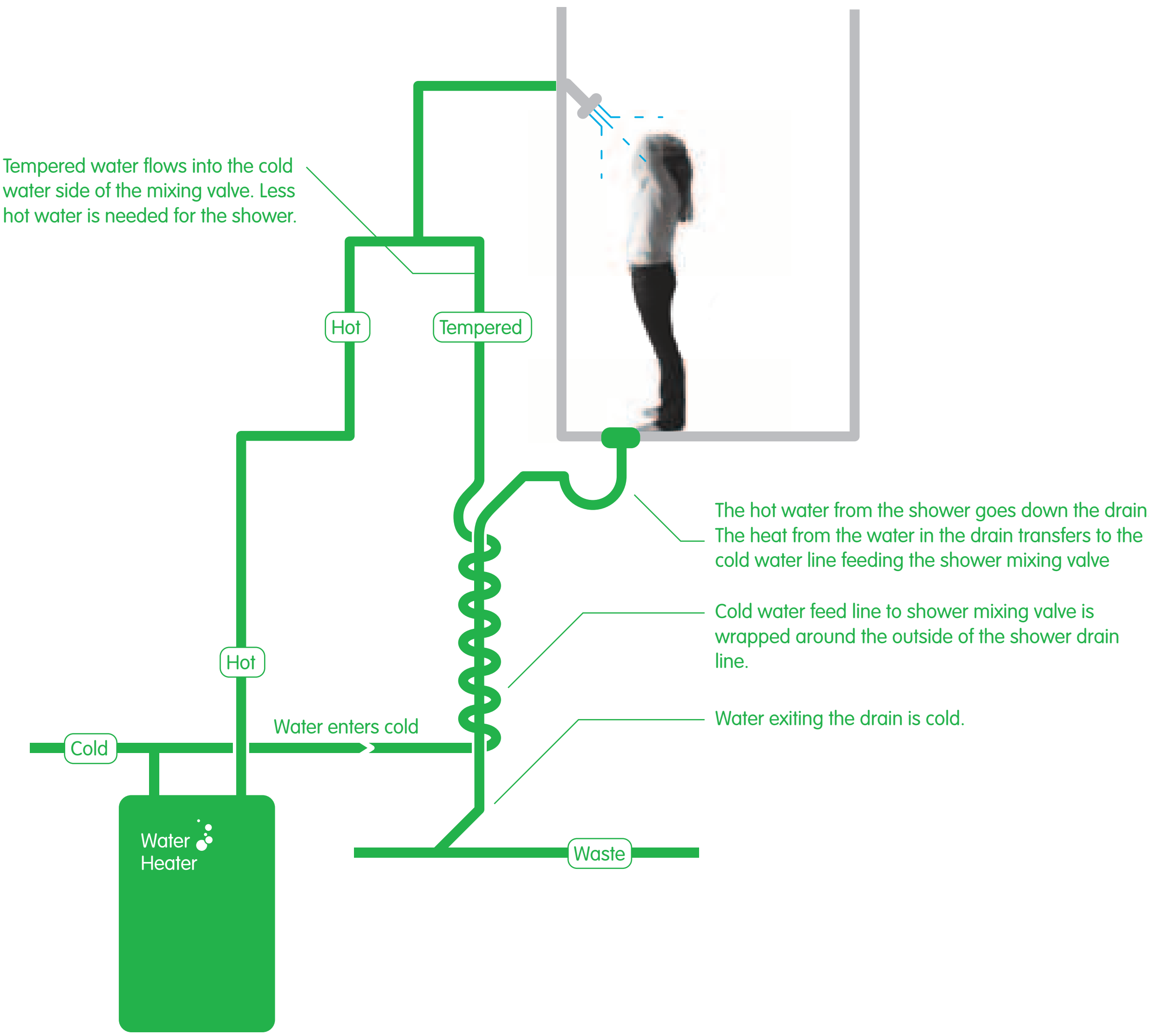
Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent

Heat Recovery (Domestic Hot Water)

EN 3b



Heat Recovery (Domestic Hot Water)

EN 3b

Required Tasks

Efficient

Typically, wastewater heat recovery systems are not specified. However, they should be installed and should be evaluated for feasibility. The plumbing engineer should provide valved and capped lines for future systems. PE

Buildings within the district steam system should have domestic hot water preheat systems that use the steam condensate. DDCPM

More Efficient / Ultra Efficient

Coordinate with regulatory agencies to provide proper protection to domestic water. PE DDCM

Preheat systems should be used in systems with large hot water discharge flows. For example, the discharge water from a laundry system is at a high temperature. In large systems, the washers will discharge into pits where the water will slowly flow into the building waste system. A heat transfer system can be installed in the pit to capture the heat energy which is then used to preheat the supply water into the building. PE BO

Premanufactured systems are available that wrap around hot water discharge drain piping. These systems are effective on shower drain pipes, for example. The cold water supply valve is connected to the reheat system wrapped around the drain piping and the heat is transferred. The supply water is heated by the time it enters the shower valve. The result is that the mixing valve will not require as much water from the building hot water system. The plumbing engineer should specify these systems in buildings with high shower use, if space allows. PE BO

It is very important for the operations staff to know how to maintain the system. Building commissioning will verify that the system is installed correctly and is operational at start up and will verify that the system remains in operation at regular intervals, at least every 5 years. BO CX

Integration

MS Mechanical Systems

Coordinate with the other mechanical systems for the feed-water.

PS 2a PS 2b PS 2c Water Reuse

Coordinate with these systems if they are providing makeup water to mechanical heating systems.

OP 3 Commissioning

Commissioning will need to check the system to ensure it is operating properly at building start up and at regular times during building operations.

Piping Insulation (Domestic Hot Water)

EN 4

Mechanical Systems

MS

Plumbing Systems

PS 2a 2b 2c

Operations

OP 3

Objective

Reduce energy use by reducing heat loss through piping.

Benefit

Reuses energy losses.

Reduces water heater cycling.

Limitations

Adds front end cost.

Background

In domestic water systems, hot water is distributed to fixtures through piping. The water temperature will lower as heat energy dissipates out through the piping into the adjacent space. To slow this process, insulation should be installed on the hot water piping.

Building Profession Task Designations

Before the building professional team can use this practice it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
ME Mechanical Engineer

Required Tasks

Plumbing and mechanical engineer shall specify insulation. PE ME

Commissioning will verify insulation installation. CX

Efficient More Efficient Ultra Efficient

In larger systems with remote hot water outlets, hot water is typically circulated to reduce the time for hot water to reach remote fixtures. As the water circulates through the piping, the heat energy dissipates causing the water heater to cycle on and off. This results in additional energy use to maintain water temperature. Installing insulation on the piping reduces heat loss. All domestic hot water piping and heat recovery piping should have minimum R4 insulation. Insulation shall be properly installed on all piping elbows to adequately insulate 90º bends. In places where hot and cold water piping are routed close together hot and cold water piping should be insulated. (Cold water should maintain a temperature of less than 80 degrees F.) PE

On systems with self-regulating heat maintenance systems, the R-value of the insulation shall be coordinated with the manufacturer's recommendations. Some systems require that the insulation thickness matches the pipe diameter. The plumbing engineer and plumbing contractor shall coordinate to ensure proper specification and installation. PE PC

Innovative

Some innovative designs will require using higher R-value insulation. The plumbing engineer and plumbing contractor shall coordinate with the insulation manufacturer to ensure that materials are specified that will not change the UL, FM, or other listing and certifications. PE PC

Insulation ratings, vapor barrier ratings, and fire and smoke ratings shall be reviewed to ensure proper specification. Close coordination with regulatory and insuring agencies, such as the fire marshal, are required by the design team. DDCPM ME PE PC A

Pipe penetrations through rated walls shall meet building codes. Materials in contact with new insulation materials, such as fire stops, shall be reviewed to ensure materials are compatible and will meet regulatory standards. DDCPM ME PE PC A

Integration

MS Mechanical Systems

Coordinate with mechanical piping layout.

PS 2a PS 2b PS 2c Water Reuse

Coordinate with piping layout.

OP 3 Commissioning

Commissioning will need to check system to ensure piping is insulated.

Piping Layout (Domestic Hot Water)

EN 5

Mechanical Systems

MS

Plumbing Systems

PS 2a 2b 2c

Objective

Reduce energy use by reducing heat loss through piping and materials.

Benefit

Reuses energy radiating through pipe.

Reduces water heater cycling.

Reduces building materials.

Limitations

Not always applicable to building function and layout.

Background

The NYC Plumbing Code requires hot water supply temperature maintenance where the developed length of hot water piping from the source of the hot water supply to the farthest fixture exceeds 20 feet (6096 mm). In such cases, the hot water supply system shall be provided with a method of maintaining the temperature in accordance with the New York City Energy Conservation Code.

In small facilities locating hot water fixtures within 20 feet of the water heater can eliminate the need for a complex pumped hot water circulating system. Plumbing fixtures that require hot water close together and close to the water heater reduces materials and reduces energy used to maintain hot water temperature. Locating fixtures in a central core of the building in close proximity to the water heater or chase is one solution. Another solution is to install fixtures back to back against a common wall, or installing fixtures close together.

Refer to section EN 2a for pumped hot water circulating systems.

Some facilities, such as health facilities, will have different requirements based on the time it takes hot water to reach the fixture instead of the length of piping. In these cases, the plumbing engineer will calculate the amount of time required using the flow rate of the fixture in relationship to the size and length of pipe.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent

Required Tasks

Efficient

The architect should work with the building users to develop a layout in which the plumbing fixtures are located close together or back to back. Mechanical spaces with water heating equipment should be located near hot water outlets. In multiple floor buildings, water use fixtures should be located near a common chase. DDCPM A PE

Piping Layout (Domestic Hot Water)

More Efficient | Ultra Efficient | Innovative

Water reuse systems, when specified, should be located in close proximity to supply systems. For example, multiple showers and flush fixtures should be located near the graywater system to reduce piping materials. Or, flush fixtures using reuse water should be located near a common chase so one pipe riser can feed the reuse water to all fixtures. This layout also minimizes cross connection risks. Coordination should take place with the architect and users during or before the schematic design (SD) phase. DDCPM | A | PE

Gravity systems, which reduce the building energy usage, should be used to move water from one part of the building to another, when practicable. For example, rainwater collection systems should be located in mechanical spaces near the roof. Coordination should take place with the architect and users during or before the SD phase. DDCPM | A | PE

Integration

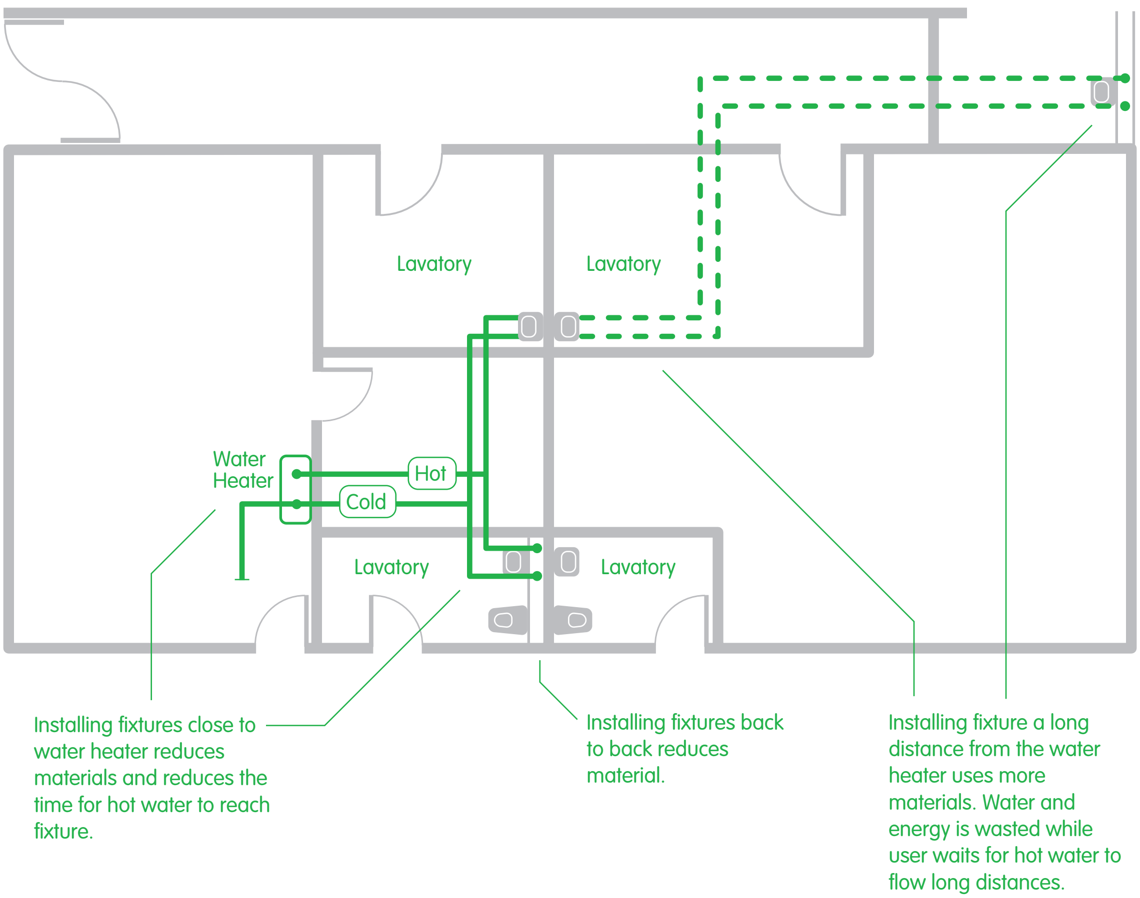
MS Mechanical Systems

Coordinate with mechanical piping layout.

PS 2a PS 2b PS 2c Water Reuse

Coordinate with piping layout.

Piping Layout (Domestic Hot Water)



EN 6

Energy Pod

Energy

EN 1 2

Objective

Provide space for future onsite energy production.

Benefit

Provides for future sustainable energy source without the current expense of installing the system at construction.

Potential to provide safety backup energy in the event of blackouts.

Limitations

Space may not be available.

Background

There are many technologies that provide power to a building water system, which include electric, gas, steam, and geothermal. There are new onsite sustainable power generation systems now on the market. These systems may not be feasible for most buildings because of the high installation cost. However, as costs come down, these systems can become good alternative onsite generation systems. An energy pod refers to a future location for an onsite power system with electrical connections so the system can provide all or partial power to a building in the future with minimal retrofit costs and little down time.

The energy pod can also be used for emergency generators, which connect power to a building during power outages. This may be important in some DDC buildings that provide essential services.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
EE Electrical Engineer
ME Mechanical Engineer

Required Tasks

Efficient

The plumbing engineer, mechanical engineer, electrical engineer, building operator, and DDCPM should meet during the SD phase to determine which systems are feasible candidates for an energy pod. Systems could include water connections for an alternative power water heater, alternative electrical connections for power to electric water heaters or pumps to make provisions for future power sources. Potential exists for these systems to offset power usage from the electrical grid.

Future alternative systems also have the potential to provide a backup power feed in the event of a prolonged power outage, which is a benefit for government services.

DDCPM PE ME EE BO

More Efficient / Ultra Efficient

The pod can also include alternative steam generation equipment. In this case steam connections could be provided on the building steam water heater system.

DDCPM PE ME EE BO

Energy Pod

EN 6

Innovative

The plumbing engineer, mechanical engineer, electrical engineer, building operator, and DDC PM shall meet with providers of new technology and develop locations and tie-in requirements for new energy technologies during the SD phase. The contract documents will show the tie-in locations and energy pod. DDCPM PE ME EE BO

Integration

EN 1 Water Heater

Coordinate requirements with building water heater system.

EN 2 Pumps

Coordinate requirements with building pumps.

EN 7 Geothermal

Energy

EN 1 2

Objective

Provide domestic hot water supply from geothermal system.

Benefit

Reduces energy load for domestic hot water.

Reduces the payback time for the geothermal system.

Limitations

Space may not be available.

Adds upfront cost.

Requires water heater backup system.

Background

In buildings in which geothermal systems are specified, it is possible to use the excess heat from the system to heat the domestic hot water. Mean earth temperatures are approximately 55 degrees Fahrenheit in New York City, which will provide adequate performance. See the NYC DDC Geothermal Manual for further information

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
ME Mechanical Engineer

Required Tasks

Efficient

The geothermal designer, plumbing engineer, mechanical engineer, building operator, and DDC PM will coordinate efforts during the schematic design (SD) phase to determine if geothermal systems will be specified. Alternative designs may be required for construction manager input on costs, schedule, and constructability. The mechanical engineer or plumbing engineer may prepare a cost payback analysis. DDCPM PE ME BO CM

More Efficient Ultra Efficient Innovative

The design team should meet during the SD phase as described above. When it is determined that a geothermal system will be included, the plumbing engineer, mechanical engineer, geothermal designer, architect, building operator, and DDC PM should meet to determine the scope and to what extent the system can supply domestic hot water to the building. The PE shall coordinate the specifications of the hot water system. DDCPM PE ME BO A

For more information go to: http://www.nyc.gov/html/ddc/html/ddcgreen/documents/geotherm.pdf

Geothermal

Commissioning should review the documents during design and verify that the system is installed correctly and is operating properly during building start up. The building operator shall develop a plan for enhanced building commissioning after the building is in operation for no more than 5 years. BO CX

The building operator shall develop procedures to monitor the geothermal system and make modifications to improve its effectiveness during operations. BO

High efficiency pump motors or VFD pumps should be used in the geothermal system. ME PE

Integration

EN 1 Water Heater

Coordinate requirements with building water heater system.

EN 2 Pumps

Coordinate requirements with building pumps.

OP Operations

In order to be effective in the long run, water efficiency and energy systems depend on efficient operations to maintain peak potential. After a building is built and/or renovated and the systems are started, it is important to go through the commissioning process to verify that all the systems are installed correctly and operating as designed.

In buildings that are designed and constructed with little input from operations, it will be difficult to reach full efficiency potential. Without early involvement in the decision-making process, and continued involvement during construction, operations staff will know little about the building or its operation. The end result is that the staff knows little about the efficient systems in a building. And, they may know even less about how to maintain system operations.

The importance of commissioning cannot be understated and is not restricted to new buildings. Requiring a program that commissions existing facilities or conducting regular water audits, and acting on the resulting recommendations, can keep a facility running efficiently in the future.

Water monitoring and verification (MV) by professional staff can detect leaks and inefficiencies in systems. Operations should develop procedures to respond to leaks identified through MV. A side benefit of monitoring can be achieved through the use of visible monitoring systems. These systems, which are seen by the building occupants, or better yet, by the general public, promote better understanding of water conservation goals and enthusiasm for reaching goals. This education and outreach component should not be overlooked. Where possible, visible monitoring systems should be installed in central, public spaces. Plaques or signage with brief explanations should also be posted at the public water meter and at the location of the water efficient feature. For example, plaques can be installed at non-water urinals that explain how the fixtures help to reduce water and waste flows from the building.

Building operations should also monitor harmful waste flow into sewage waste streams, and implement waste stream and operations policies.

Water Meter (Measurement and Verification)

OP 1a

Mechanical Systems

MS

Plumbing Systems

PS 1 2

Operations

OP 3

Objective

Provide for the ongoing accountability and optimization of building water consumption performance over time.

Benefit

Helps maintain water balance.

Monitors leaks.

Monitors water use trends.

Limitations

Added front end cost.

Added responsibility for building operations.

Background

There are three major types of meters. The first meter is the site meter or utility meter, the second is a submeter, which, as defined in ASHRAE 189, is installed subordinate to a site meter. A submeter is typically used to measure water intended for one purpose, such as irrigation, and is also known as a dedicated meter. The third type is a public monitoring meter, discussed in OP 1b.

Water meters are a key element in developing a water balance for the facility. Water meters also aid the building operations staff in measuring and verifying (MV) where water is used in a facility. When meters and an MV procedure are in place, leaks can be detected, water saved, WE activities modified, and WE practices can be replicated at other facilities.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
LS LEED Specialist

Required Tasks

Efficient

The building operator, civil engineer, and plumbing engineer shall coordinate site meter details with the DEP citywide automatic meter reading (AMR) program, since it will provide significant tools for MV purposes:

The DEP are installing AMR transmitters on all water meters in the city which is expected to be completed by 2011. In new construction, a DEP inspector will install the AMR Meter Transmitter Unit (MTU) as part of the new meter inspection process.

The MTUs will either read the meter four times a day or hourly, depending on the size of the building and the owner's needs.

Readings will be available to the building owner/operator through DEP's website beginning in mid-2009.

Cooling tower makeup and blowdown

The building operator shall coordinate a method to obtain readings from the site meter to include in the building MV program. PE BO PE

Water Meter (Measurement and Verification)

Water submetering locations and types of systems should be determined by the DDC PM, building operator, and plumbing engineer during the schematic design (SD) phase. Water meters should be installed on water lines feeding the various systems, such as:

- Potable water system
- Sections of a facility, such as wings or floors
- Domestic hot water
- Kitchen
- Large toilet rooms
- Laundry
- Purified water system (reverse osmosis and/or deionized)
- Outdoor irrigation systems
- Cooling tower makeup and blowdown
- Filter backwash water
- Steam boiler system makeup water
- Closed loop hydronic system makeup water
- Blackwater
- Graywater
- Preheat system

Note: As of January 1, 2011, submeters will be required on several of the above systems per the NYC PC.

Furthermore, Local Law 84 (Benchmarking) requires buildings with automatic meter reading equipment installed by NYCDEP to record and report their water usage through EPA's Benchmarking tool on an annual basis. Private buildings 50,000 square feet or more and City buildings 10,000 square feet or more must comply.

Submeters shall be installed with an AMR system that sends data back to a building automation system (BAS). In some cases the DEP site meter may not be compatible with the BAS. Meters approved for utility use in New York City must have absolute encoder registers. They do not generate pulses or other signals.

For submeters, the design team can specify versions of approved meters that have digital or pulse based registers with meter attachments that generate a separate 4-20 ma, 12-24 VDC or pulse output. Or, install attachments or converters that provide appropriate output, which could cost more.

The meter data management system shall be capable of electronically storing water meter and submeter data and creating user reports showing calculated hourly, daily, monthly, and annual water consumption for each meter and submeter and provide alarm notification capabilities as needed to support the requirements of the water efficiency MV plan.

The BAS controls installer, building operator, and plumbing engineer shall develop the SD documents that will include specifying submeters that are compatible with the BAS.

The submeters shall be shown on the contract documents. Contractor shall be responsible for calibrating meters at start up. DDCPM BO PC PE

Meters installed to verify savings should comply with appropriate American Water Works Association (AWWA) accuracy standards and the DEP standards. Regular calibration should be part of any measurement and verification plan that relies on the use of either whole facility or submeters for the calculation of savings. PE BO

The commissioning agent will verify that all meters are installed and calibrated correctly during design and construction. CX

Water Meter (Measurement and Verification) OP 1a

More Efficient

In addition to the installation of submeters, building operations should develop a measurement and verification plan as outlined under LEED EA Credit Measurement and Verification. LEED for Existing Buildings Operation and Maintenance (EBOM) requires permanently installed water metering that measures the total potable water use for the entire building and associated grounds. Meter data must be recorded on a regular basis and compiled into monthly and annual summaries. Coordinate this credit with the LEED specialist during the design and construction phases. DDCPM BO LS PE

Commissioning shall verify submeters are installed, calibrated, and connected to data collection system. CX

Ultra Efficient Innovative

Water reuse systems should be submetered and connected to a monitoring data collection system.
DDCPM BO PE

Building operator should develop a monitoring program to monitor and continually optimize the water systems. Meters should be calibrated on a regular basis. BO

Integration

PS 1 Water Balance

Coordinate with water balance.

PS 2 Water Reuse

Coordinate with water reuse systems.

MS Mechanical Systems

Coordinate with mechanical systems using water.

OP 3 Commissioning

Coordinate installation.

OP 1b Water Meter (Public Monitoring)

Operations

OP 1a 3

Objective

Provide ongoing accountability and optimization of building water consumption performance for building occupants and the general public.

Benefit

Monitors leaks.

Maintains openness and educates and inspires the public to implement water conservation techniques.

Limitations

Adds front end cost.

Added responsibility for building operations.

Background

Water meter readouts can be monitored at public areas, such as the entrance to the building. Water meter displays increase public awareness of water usage and serve as a means to compare building water usage. In buildings with efficient water systems, there is typically a high level of enthusiasm on the part of the building occupants and curiosity of the general public. Although water efficient buildings look much like any other building, visible water meters can highlight the efforts of the building designers, operators, and staff. It is helpful to include brief explanations alongside visible public monitoring systems so that the maximum effect can be achieved. Signage can highlight the interaction of water systems that reduce water and waste demand in the building. For example, a condensate collection system that supplies water to a cooling tower could be highlighted.

Public meters could encourage informal staff water efficiency competition between other city facilities.

Water meter displays often compare water usage to that of similar buildings. This can be done by comparing a typical building base month by month water usage with the real time water usage of a WE building. This helps operators, users, and the public become more aware of the water used. Water meter displays in schools also serve as a powerful educational tool and can be incorporated into the water and energy conservation curriculum. Visibility also sends a message to the public that the city is monitoring both water usage and public funds.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- **DDCPM** DDC Project Manager
- **A** Architect of record
- **BO** Building Operator
- **PE** Plumbing Engineer of record
- **PC** Plumbing Contractor
- **CX** Commissioning Agent

Required Tasks

Efficient

In order to coordinate activities necessary to provide public displays, DDC PM, plumbing engineer, plumbing engineer, architect, BAS controls contractor, and DEP representative should meet during the schematic design

(SD) phase. An effort should be made to develop a standard display method, especially if the display is in the public entrance. DDCPM PE BO A

The DEP representative should provide data on the projected monthly water usage for the building based on similar buildings in the city.

The water representative should coordinate with the water department to provide a meter with a remote readout.

The BAS designer should develop a display that shows current water usage in real time, and water usage for each month compared to water usage of similar buildings, and current monthly water usage compared with water usage during the same time period in the previous year.

BAS designer will specify and provide hardware and connections to the building water meter.

Building operations will develop a procedure to monitor the system to ensure that it is operating and collecting data correctly.

The architect will design and locate the display, ensuring vandal resistance and accessibility.

Display will be able to be accessed by building operations maintenance.

The city should display a phone number for the public to call if water usage is above projected demands. A website address can be provided to educate the public on water efficiency.

The public display should list WE technologies installed in the building.

More Efficient / Ultra Efficient

Install monitoring display as described under Efficient.

In more efficient and ultra efficient buildings, the water display should provide data from the submeters installed on the water reuse systems. The data should show reductions in water use from the city water main and into the sewer system. DDCPM

Innovative

In buildings with experimental or new technologies, the display should include submeter detail showing the amount of water saved by the new technology system. DDCPM

Integration

OP 1a Water Meter

Connect water monitoring to a readout at the main entrance or other public space.

OP 3 Commissioning

Coordinate installation.

Reference

International Performance Measurement + Verification Protocol: Concepts and Options for Determining Energy and Water Savings
Volume I, Revised March 2002
http://www.evo-world.org/index.php?option=com_philaform&form_id=37&Itemid=1

OP 2 Water Audit

Plumbing Systems PS 1 2

Mechanical Systems MS

Objective

Provide water use data to the building operator and design team to inform water usage reduction activities.

Benefit

Provides real time data on actual water usage and sewer flows.

Monitors WE activities to verify effectiveness.

Verifies accurate operation of water meters.

Limitations

The amount of accurate data is limited by the number of water meter data collection points.

Building operations has to develop a method and budget to react to the audit report and implement changes.

Background

Users are motivated to develop and implement effective WE procedures when there is a method to measure change. Moreover, water usage typically decreases when the results of implementation can be seen, often through the use of water meters, which are sometimes referred to as the building's cash registers.

The audit gathers water use data from the building water meters and water use equipment providing the building owner with a report on the systems using water and generating sewer waste. Procedures to monitor building systems can then be developed.

The audit can also show the accuracy of the water meter systems. The audit report clearly identifies ways to further reduce water use and sewer waste.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- CE Civil Engineer
- ME Mechanical Engineer

Required Tasks

Efficient

The building operator should conduct a water audit on the building during the first year of operation to develop a baseline for comparison of future audits. The audit will also identify water systems that are not operating properly resulting in waste. If problems are found the system contractors can be brought to the site to correct the problems before the warrante period ends. BO

The building operator should develop and implement a procedure to conduct a water audit on the building every five years and develop a budget to repair or implement operational changes based on the audit. BO

Renovation

The DDC PM and building owner should contract with a firm to conduct a water audit on the existing facility before the design of a renovation project begins. The water audit report will be provided to the civil engineer, plumbing engineer, mechanical engineer, and architect. These data will be used to determine which, if any, of the building systems should be replaced, upgraded, or repaired during the renovation process. DDCPM A BO ME CE PE

More Efficient / Ultra Efficient

The building operator should conduct a water audit on water reuse systems during the first year of operation to develop a baseline and to verify proper operation. System start up settings are based on design and modeling of proposed operating conditions. However, real operating conditions may vary from the design models. The audit will identify such variations and the operations team should adjust the water reuse systems to match actual use. BO

On complex or new technology water reuse systems, the building operator may want to conduct a second water audit after the second year. This follow up audit will provide additional information on the systems as they run through the different seasons and will help determine whether additional adjustments are needed to ensure that the systems operate close to peak efficiency. BO

Innovative

A water audit should be conducted prior to full operation of systems that are under development. This audit will provide baseline operational data to the research team so that the effectiveness of the new system under development can be analyzed. A second water audit should take place during the first year of full operation of the system. BO

Integration

PS 1 Water Balance
Coordinate with water balance.

PS 2 Water Reuse
Coordinate with water reuse systems.

MS Mechanical Systems
Coordinate with mechanical systems using water.

OP 3 Commissioning

Plumbing Systems

PS 1 2

Mechanical Systems

MS

Energy

EN

Objective

Verify that the project's water related systems are installed, calibrated, and performing according to the owner's project requirements, basis of design, and construction documents.

Benefit

- Reduces water and energy use.
- Lowers operating costs.
- Reduces contractor callbacks.
- Improves building documentation.
- Verifies that the systems are performing in accordance with the owner's project requirements.
- Lowers O & M cost due to efficient systems operation.
- Life-cycle analysis shows the Return on Investment has a fast payback.
- Provides documentation that additional construction cost is recovered through lower operation and maintenance costs.

Limitations

- Building operator and DDC PM will require a procedure to follow up on commissioning reports.
- Added construction cost.

Background

The commissioning (CX) process provides quality assurance in building construction. The process is systematic and incorporates the operators' basis of design and includes: uniform total quality management; collaborative, planned review of drawings; and, equipment testing. The three-stage process begins before the schematic design (SD) phase. The second phase is conducted through construction, while the third stage is ongoing commissioning during building occupancy. One of the real benefits of the commissioning process is improved scheduling during construction. The CX agent can identify issues early on, instead of during the crucial last few weeks of construction.

The CX process is applied to new buildings, major renovation, and system replacement, whereas re-commissioning refers to an ongoing, scheduled process to ensure that previously commissioned buildings are operating properly over time. Retro-Commissioning OP 4 refers to the process as applied to existing buildings not previously commissioned.

The CX agent with the overall responsibility for commissioning should follow the ASHRAE CX process. The agent should be employed by the DDC and not by the design team in order to serve as a third party review. Refer to the DDC commissioning training material for more information.

Commissioning is required under LEED Energy and Atmosphere (EA Prerequisite 1). Credits can be obtained for Enhanced Commissioning under LEED EA Credit 3.

http://www.nyc.gov/html/ddc/html/design/training.shtml

Commissioning

OP 3

There are nine major tasks that should take place on all DDC projects, which seek LEED certification:

- Designate the commissioning authority.
- Define the scope of the commissioning task.
- Develop and implement a commissioning plan.
- Document the Owner's Project Requirements (OPR).
- Ensure that the Basis of Design (BOD) includes all of the owner's requirements.
- Develop and incorporate commissioning requirements into the construction documents.
- Verify the installation and performance of the systems.
- Complete a summary commissioning report.
- Prepare operating and maintenance instructions/ manuals for building O&M staff.

Incorporation of new water efficient technologies should be part of the CX team's scope. The technology sections in this manual list special tasks for the CX team. During the design phase, the CX team will review the project documents to ensure that the owner's project requirements are included. During the construction phase, time must be provided in the construction schedule for the CX team to verify that systems are being installed per the contract documents and the OPR. The CX team should visit the building during occupancy to verify that the systems are operating as per the design and OPR.

Building Profession Task Designations

Before the building professional team can use this process it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
LS LEED Specialist
CM Construction Manager

Required Tasks

Efficient

Before the SD phase, the DDC PM and building operator should add a CX team to the project. All water efficiency systems should be included as part of the CX scope of work. CX services should check and coordinate MEP systems within the Wicks Law requirements. DDCPM BO

The DDC PM, building operator, and CX team shall meet and determine the CX schedule based on the LEED EA Prerequisite 1 and LEED EA Credit 3, Enhanced Commissioning requirements. DDCPM CX BO

Commissioning must be included for LEED EA Prerequisite 1. Additional credit can be obtained under LEED EA Credit for Enhanced Commissioning. The CX shall coordinate with the LEED specialist to ensure that the LEED calculation is correct and that all submittal requirements and documentation are complete. CX LS

Renovation

Refer to Retro-Commissioning OP 4

More Efficient / Ultra Efficient

The DDC PM and BO should include special water efficiency technologies in the CX scope of work prior to the SD phase. DDCPM BO

The CX and plumbing engineer shall meet during the SD phase to determine the WE technologies that will require CX reviews. Because some of the technologies are new and have no precedent to follow, the CX and plumbing engineer may decide to have a meeting with the construction manager and/or the contracting team early in the construction schedule to verify that system requirements are clearly understood. CX CM PE

The DDC PM and building operator should determine the schedule for re-commissioning on a regular basis, at least every 5 years. The team will coordinate with the requirements for LEED EBOM. DDCPM BO CX

Innovative

For buildings using systems under development, the DDC PM, building operator, and CX team should meet prior to the SD phase to introduce the innovative systems. The CX team shall coordinate with the system designer and installer to ensure that verification activities are in order. The CX team shall advocate for the DDC to ensure that its objectives are met. All CX reports should be submitted to the DDC and are owned by the DDC. Data requests by the system developers should be coordinated through the DDC PM. The system developers will be responsible for data collection required for in-house reports and publication. DDCPM BO CX

Integration

PS 1 Water Balance
Coordinate with water balance.

PS 2 Water Reuse
Coordinate with water reuse systems.

MS Mechanical Systems
Coordinate with mechanical systems using water.

EN Energy Systems
Water heaters or other energy systems.

Retro-Commissioning

OP 4

Plumbing Systems

PS 1 2

Mechanical Systems

MS

Energy

EN

Objective

Verify that water related systems in existing buildings are installed, calibrated, and performing according to the owner's project requirements, basis of design, and construction documents. The retro-commissioning process helps the operator set goals for repairs and upgrades on existing buildings. The process can be used to develop the scope of work for a renovation project.

Benefit

- Helps to allocate renovation resources to deficient systems.
- Develops a baseline of existing conditions before renovation begins.
- Properly operating systems reduce water and energy use.
- Lowers operating costs.
- Provides better building documentation.
- Provides verification that the systems perform in accordance with the OPR.

Limitations

- Some existing facilities have systems located behind equipment or walls with limited or no access to valves, test ports, or equipment. In these cases, the CX team will not be able to verify if systems are operating properly. As a result, detailed information in the report may be limited.
- Building operator and DDC will have to develop a procedure to follow up on commissioning reports.

Background

Retro-commissioning can help identify the quality of an existing facility before renovation projects are undertaken. The process will help identify systems that are not operating properly, as well as those that can be reworked to operate as per the original design intentions, and those systems that should be replaced.

The retro-commissioning report has two general purposes. The first is to assist the building operations team in developing methods and procedures to ensure that a facility is operating efficiently and economically. Retro-commissioning should be scheduled on a regular basis, at least every 5 years.

The second purpose is to assist the renovation design team in assessing the condition of the existing systems before a renovation project begins. Faulty systems can be identified and added to the project scope. On extensive renovation projects, after the initial retro-commissioning, a new construction CX team may be engaged for the new construction portion of the project. Refer to the DDC commissioning training material for more information.

http://www.nyc.gov/html/ddc/html/design/training.shtml

Building Profession Task Designations

Before the building professional team can use this process it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent

Required Tasks

Efficient

The DDC PM, building operator, and CX team shall meet and set the criteria for ongoing CX after construction. The CX construction data shall be maintained by the building operations team for future CX review. The CX report shall be formatted for use in an ongoing CX process. CX services should report on MEP systems within the Wicks Law requirements. DDCPM BO CX

Renovation

The DDC PM and building owner should contract for retro-commissioning, including the water systems. The commissioning report shall be made available to the design, construction, and operations teams. The teams will use the report to develop a scope for the renovation project. DDCPM BO CX

On projects where inefficiencies in existing systems are identified by the retro-commissioning, the design team shall determine the scope of work for the renovation project. For example, the report may indicate that existing water heater and distribution systems are operating efficiently and meet LEED energy prerequisites, but the report documents long wait times for hot water to reach the taps. The DDC PM, building operator, plumbing engineer, and CX would then meet and address shortening tap wait times in the renovation project but keeping the existing water heating system. DDCPM BO CX PE

More Efficient Ultra Efficient

The retro-commissioning report shall be used to develop a scope of work in projects where new technologies are added to existing systems. The report shall inform the team as to whether or not the systems are operating properly and if replacement is needed. For example, a preliminary renovation budget included funds to replace the hot water heater and distribution system. The retro-commissioning report determines that an existing building has an efficient gas water heater system in place, which is operating properly and does not need replacing. With the information from the report, the design team can then redirect the funds to other parts of the project. Or, the team may decide to add sustainable elements that could give the project added LEED credits, such as a solar water heater or a fuel cell could be added to the project, which would reduce the amount of energy used by the facility and garner a LEED energy credit. The DDC PM, building operator, plumbing engineer, CX, and architect shall meet during the SD phase to determine if WE technologies can be added to the existing building. DDCPM BO CX PE A

Innovative

The DDC PM, building operator, and CX should meet before the SD phase to introduce systems under development. During this time, the retro-CX report will be analyzed to verify that the new system can be used in the facility. The team will help develop a CX plan for the new construction process. DDCPM BO CX

Integration

PS 1 Water Balance
Coordinate with water balance.

PS 2 Water Reuse
Coordinate with water reuse systems.

MS Mechanical Systems
Coordinate with mechanical systems using water.

EN Energy Systems
Water heaters or other energy systems.

OP 5a Harmful Material Waste Stream Prevention

Plumbing Systems

PS 4

Operations

OP 3

Objective

Protect natural habitat, waterways, and water supply from pollutants carried by building discharge water.

Benefit

Helps maintain natural water streams.

Improves waste treatment plant effectiveness.

Limitations

Substances are difficult to monitor.

Background

The composition of wastewater can include varying concentrations of specific chemicals that may represent exposure risks to aquatic ecosystems and public health. Some chemicals and substances have regulatory material handling requirements. Harmful materials are categorized as those that may or may not have regulatory handling requirements, but which can pose health risks to workers. Harmful materials include those that are difficult for wastewater treatment plants to remove from the sewer waste stream. Wastewater from laboratory buildings, for example, may contain ionic mercury and organomercuric compounds, other heavy metals, organic chemicals, formaldehyde, blood products and body fluids, and particulate matter. The DEP can work with the building operator to develop a list of potential harmful materials that should be kept out of the waste stream.

Operations should prepare a chemical waste minimization plan to minimize or eliminate chemical waste drainage to the sanitary sewer system. The plan should include a listing of chemical products and systems for the evaluation and implementation of least toxic alternatives. Some of the facilities affected include: dialysis, environmental services, laboratory, pathology, histology, nutrition services, pharmacy, radiology, and laundries. The list should include a description of chemical storage areas, and a description and implementation plan for secondary containment.

Operations should establish procedures to eliminate chemical waste from cooling tower blowdown and/or boiler blowdown. An action plan should be developed to eliminate, minimize, substitute, recycle, and dispose of harmful chemicals safely, improving distribution, and limiting quantities of harmful materials.

There are growing concerns that traces of some commonly prescribed drugs and pharmaceuticals remain in urine. Once introduced into the large volume of water in the typical U.S. wastewater stream, these contaminants are difficult to remove and can enter natural water supplies. These pharmaceuticals are not being removed from the water stream through natural processes or at water treatment plants. The end result is that the contaminants can harm wildlife and humans if they remain in the water cycle.

To deal with these concerns, there are new technologies currently being developed that are meant to remove these contaminants out of the waste stream. These processes work best and can be more economical to operate with smaller volumes of wastewater. Current building practices combine the waste from a urinal with all the other waste streams in a building.

An innovative design could provide separate waste piping that only picks up the waste from urinals. This separate piped urine waste system would connect to the building waste system in a lower level. In the future, when the urine treatment technology is available, the urine waste piping can be separated and then connected to the urine process system. Refer to PF 4 for more information. DDCPM BO PE

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
ME Mechanical Engineer

Required Tasks

Efficient

The DDC PM, building operator, architect, mechanical engineer, DEP representative, and plumbing engineer should meet during the schematic design (SD) phase and should prepare a list of harmful materials that will be used and/or stored in the building. The building operator shall develop a handling procedure. During this meeting the team will determine if special rooms or modifications to the building design are necessary to safely handle the materials and how these materials will be moved through the building. For example, some materials should be stored in rooms with building exhaust and without floor drains to keep materials from leaking into the sewer systems. DDCPM BO A ME PE

More Efficient Ultra Efficient

The building operator will coordinate with the various tenant departments to eliminate the use of these materials when possible. BO

The building operator will set up a schedule to review all possible harmful materials that could be used in the building. The schedule for this review could be every five years, or less for labs or medical buildings, to keep up with rapid technological developments. BO

Innovative

The building operator will meet with organizations installing elements into the building for research and development purposes to verify that harmful materials are handled properly. BO

Integration

PS 4 Waste Sample Pits

Locate sampling pits to aid program.

OP 3 Commissioning

Develop a plan.

OP 5b

Harmful Material Stormwater Prevention

Plumbing Systems

PS 4

Operations

OP 3

Objective

Incorporate grounds/site/building exterior management practices that preserve ecological integrity, enhance biodiversity, and protect wildlife.

Benefit

Protects the offsite ecosystem.

Reduces staff and building occupant exposure to harmful landscaping chemicals.

Limitations

Vegetation used in landscaping may not survive.

Chemical snow or ice removal may be prohibited, increasing risk of accident.

Background

The health of building occupants and the surrounding ecosystem can be directly impacted by the use of chemicals, including those used for landscaping (pesticides, herbicides, insecticides, fungicides, and termiticides), and those used for snow and ice removal. Chemicals applied outdoors can also impact indoor air quality when applied proximate to air intakes and when tracked inside on shoes and equipment. These chemicals may then run off the facility site impacting natural water ways. Many chemicals commonly used on facility grounds have not been tested for their low level, long term health impacts. Some widely used chemicals are included on Persistent Bioaccumulative and Toxic Chemical (PBT) lists for avoidance.[1]

Operations should have in place a low impact site and green building exterior management plan that addresses these topics:

- Maintenance equipment
- Plantings
- Animal and vegetation pest control
- Landscape waste
- Fertilizer use
- Snow removal
- Cleaning of building exterior
- Paints and sealants used on building exterior
- Other maintenance of the building exterior

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LA Landscape Architect

1 Green Guide for Healthcare Version 2.0 Pilot November 2004, Copyright © 2003-2004. www.gghc.org.
A best practices guide for healthy and sustainable building design, construction and operations.

Harmful Material Stormwater Prevention

OP 5b

Required Tasks

Efficient

The DDC PM, building operator, landscape architect, and landscape maintenance representative should meet during the SD phase and develop an organizational management plan for establishing/maintaining a low impact site and building exterior plan that addresses and specifically highlights required actions and how they are being implemented. DDCPM BO LA

The building operator shall compile regular reports documenting that the management plan is being implemented on an ongoing basis. The report should encourage staff input on how the operations could be improved. BO

Integration

PS 4 Waste Sample Pits

Coordinate locations of sampling pits that connect to the stormwater system.

OP 3 Commissioning

Coordinate plan implementation.

Reference

International Performance Measurement + Verification Protocol: Concepts and Options for Determining Energy and Water Savings
Volume I, Revised March 2002
http://www.evo-world.org/index.php?option=com_philaform&form_id=37&Itemid=1

OFE Owner Furnished Equipment

The design, installation, oversight, and operations of building equipment overlap with many different agencies, designers, contractors, and operators. Particular care must be taken to ensure that decision making is coordinated so that overall water conservation goals can be met. The plumbing engineer, plumbing contractor, and the building plumber are not the only people responsible for a water efficient building. Different departments purchase, use, and order equipment that uses water and generates waste flows to the sewer.

For example, the money saved specifying an inexpensive ice machine that uses domestic water for once through cooling will be offset by the water wasted. In this case, large amounts of drinking quality water are literally wasted down the drain. Higher operations costs to pay for the water and sewer far surpass the front end cost savings of the equipment.

Food service equipment can use large amounts of water in the dishwashing and food preparation processes. There are important strategies to employ to reduce the amount of energy, supply water, and wastewater generated from these systems. The first step is to install equipment that uses less water. The next step, which is equally important, is to train the people using the equipment to ensure efficient operation. It is also important to remember to look at procedures that could be streamlined to reduce water usage.

Washing machines (both for clothes and dishes) typically use large amounts of water, but newer technology machines use less water and energy to operate while washing effectively. Those involved in the ordering and purchasing of this equipment should look at more than just first cost. The costs associated with operation, energy usage, and water consumption are equal parts of the equation.

All owner furnished equipment should be required to be certified and labeled under the U.S. EPA's Energy Star and/or WaterSense programs, which apply to both energy and water efficient products. Other third party certification and labeling programs should be consulted for equipment and products not included under Energy Star or WaterSense. In addition, monitoring all equipment installed in a building should be required.

Before equipment is purchased, it is important to include the design team, contracting team, and operators into the discussion and evaluation of equipment. This should be accomplished early in the design process. A little extra time in preparation can result in cost reductions during construction and operations.

Ice Maker

OFE 1

Mechanical Systems

MS

Objective

Eliminate use of potable water to cool equipment.

Benefit

Reduces upfront costs.

Reduces operational costs.

Limitations

Heats up space around ice machine.

May not work in areas with limited space for air circulation.

Large system may require connections to the building condenser water system.

Background

Ice machines use compressors that require cooling. Some ice machines accomplish this by using clean domestic water, which runs through the compressor cooling coil. The water is then dumped into the sanitary sewer drain. This type of cooling is not recommended for water efficient buildings. **Note:** As of January 1, 2011, the NYC PC prohibits the use of potable water for once through cooling.

Another type of ice machine uses air to cool the compressor. On some machines the compressor is located on the ice machine. However, this results in warm air being blown into the space. Another option is to locate the compressor or condensing unit outside of the building, where outside air is used to cool the compressor. This type of system may be preferable in that hot air is not introduced into the conditioned space.

Energy Star[1] qualified ice machines should be used in DDC projects. The Energy Star restaurant guide[2] covers installation of ice machines. The following general guidelines should be adhered to when ice machines are specified:

Demand Time - Ice machines blow hot air into the surrounding spaces. During peak food preparation time, kitchen cooking equipment can produce heat into spaces. To save space conditioning energy and the energy used to make the ice, a timer can be added to the ice machine control so that it will produce ice during off hours of operation. In some areas off peak electrical power is available at a reduced rate.

Compressor location - On larger systems the compressor can be located outside the kitchen. In these cases the heat from the compressor is not introduced into the conditioned space.

Buy efficient machines - The Air Conditioning and Refrigeration Institute[3] lists ice machine manufacturers and machine efficiency ratings.[4] USGBC LEED reference documents also list these ratings. In general ice ma-

1 http://www.energystar.gov/index.cfm?c=comm_ice_machines.pr_comm_ice_machines
2 http://www.energystar.gov/ia/business/small_business/restaurants_guide.pdf
3 http://www.ahrinet.org/Content/AutomaticCommercialIceMakersandIceStorageBins_82.aspx
4 http://www.ahridirectory.org/ahriDirectory/pages/acim/ACIMdir-20May2008.pdf

chines with the compressor located on the ice machine should use less than 35 gallons of water for every 100 pounds of ice. Ice machines with remote compressors should use less than 25 gallons of water for every 100 pounds of ice.

Capacity - Match the ice capacity with the efficiency of the machine. In some cases, it is more efficient to install a larger capacity machine that uses less energy. For example, a 520 pound per day machine uses almost half the energy per pound as a 200 pound per day machine, but the cost of the machine is not double the purchase price. The larger machine can operate at night reducing peak electrical loads.

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
ME Mechanical Engineer

Required Tasks

Efficient Renovation

The DDC PM, building operator, food service vendor, architect, mechanical engineer, and plumbing engineer should meet during the schematic design (SD) phase and establish the amount of ice required in the facility and the locations of the ice machines. The mechanical engineer may have to conduct an energy study to verify the added cooling load if the compressor is located in the conditioned space. Operations will develop a procedure to run the ice machine during off peak hours. The food service vendor will specify an efficient machine with the appropriate capacity. DDCPM BO A ME PE

More Efficient Ultra Efficient Innovative

The DDC PM, building operator, food service vendor, architect, mechanical engineer, and plumbing engineer should meet during the SD phase to determine if a water cooled ice maker that uses less water and energy than the air cooled type is feasible. This will require the mechanical engineer to conduct an energy model and cooling tower water use model to determine the most efficient system for the building. DDCPM BO A ME PE

Integration

MS Mechanical Systems

Eliminate once through cooling systems using domestic water.

Energy Star

OFE 2

Mechanical Systems

MS

Owner Furnished Equipment

OFE 3

Energy

EN 1

Objective

Energy Star equipment saves energy and water.

Benefit

Installing labeled products eliminates the need for owner testing on water and energy usage.

Limitations

Energy Star is not available for all equipment.

Background

Energy Star is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy. The voluntary labeling program, designed to identify and promote energy efficient products to reduce greenhouse gas emissions, was initiated in 1992. The Energy Star label is now on major appliances, office equipment, lighting, home electronics, and more. It is an evolving certification system. This manual generally highlights larger water using equipment and services although there is other smaller labeled equipment. The Energy Star website should be consulted from time to time to check for additional equipment included after the publication of this manual.

WaterSense, a partnership program that is sponsored by the U.S. Environmental Protection Agency, labels water efficient products that have been third party tested and certified as compliant with the WaterSense specification.

In general the DDC should require that all owner furnished dishwashers, washers, and dryers purchased have the Energy Star rating (when they are available).

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent

Required Tasks

DDC PM and building operator should set up procedures to purchase Energy Star equipment. DDCPM BO

Integration

MS Mechanical Systems

Eliminate once through cooling systems using domestic water.

OFE 3 Food Service

Use Energy Star dishwashers and ice makers.

EN 1 Water Heater

Use Energy Star water heaters.

OFE 3a

Food Service (Dishwasher Pre-Rinse)

Energy

EN 1

Objective

Pre-rinse will reduce water and energy consumption in commercial applications by increasing pressure and reducing flow.

Benefit

Water usage is reduced through the use of a high pressure spray.

Limitations

In some applications users may complain that there is not enough flow to sufficiently clear solids from the dishes.

Background

A pre-rinse spray valve is typically a handheld device that uses a spray of water to remove food waste from dishes prior to cleaning in a commercial dishwasher. Pre-rinse spray valves (PRSV) consist of a spray nozzle, a squeeze lever that controls the water flow, and a dish guard bumper. Models may include a spray handle clip, allowing the user to lock the lever in the full spray position for continual use. For LEED WE credit a maximum 1.6 GPM spray should be specified, although there are PRSVs rated at 1.3 GPM (at 60 PSI).

There are new PRSVs that use less than 1.3 GPM. The design team shall coordinate with facility buildings and operations before specifying these PRSVs to see if they have any experience with some in-house trials of the PRSV and have developed any recommendations.

Building Profession Task Designations

Before the building professional team can use this fixture it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent

Required Tasks

More Efficient · Ultra Efficient · Innovative

DDC should require all contracted food service vendors to specify and install pre-rinse sprays with Energy Star low flow pre-rinse valves. DDCPM BO

Plumbing engineer will coordinate kitchen equipment to size water heating system. PE

Integration

EN 1 Water Heater

Fixture uses less hot water and could reduce the size of the water heater equipment.

Food Service (Dishwasher)

OFE 3b

Energy

EN 1

Objective

Reduce dishwasher water usage while maintaining function and safety.

Benefit

Saves water and reduces energy usage.

Limitations

In some applications users have concerns about wash time and the cleanliness of the dishes.

Background

Commercial dishwashers with the Energy Star label are on average 25 percent more energy efficient and 25 percent more water efficient than nonlabeled models. All commercial dishwashers (under counter, stationary single tank door, single tank conveyor, and multiple tank conveyor) must meet high temperature and low temperature efficiency performance criteria set forth for by U.S. EPA for both energy and water consumption.

EPA does not currently test water consumption in residential dishwashers but covers energy use only. Qualified dishwashers use at least 41 percent less energy than the federal minimum standard for energy consumption.[1] In 2006, the California Urban Water Conservation Council (CUWCC) compiled a list of dishwashers that meet the Energy Star specification. CUWCC has also verified that the criteria for Canada's Energy Star program are the same as that for the U.S. Further, CUWCC has confirmed that hot water use refers to total water consumed. Residential dishwasher models vary from 2.5 gallons per full cycle to 8.7 gallons.

The Consortium for Energy Efficiency[2] (CEE) maintains a list of qualifying dishwasher products. DDC projects should use dishwashers that are CEE Tier 2 at minimum.

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent

Required Tasks

Efficient

DDC PM should coordinate with the kitchen vendor on large projects to specify and install Energy Star qualified dishwashers. DDCPM BO

In small commercial projects using residential type dishwashers and in residential projects, the architect or DDC PM should use CEE Tier 2 dishwashers DDCPM BO A

1 http://www.energystar.gov/index.cfm?c=dishwash.pr_dishwashers
2 www.cee1.org

More Efficient

In small commercial projects using residential type dishwashers and in residential projects, the architect or DDC PM should specify and install Energy Star dishwashers with an energy factor (EF) of 0.68 or more. DDCPM BO A

DDC should coordinate with the kitchen vendor on large projects to specify and install Energy Star qualified dishwashers. Rack type dishwashers should use less than 1 gallon per rack (GPR). DDCPM BO

Ultra Efficient

DDC PM should coordinate with the kitchen vendor on large projects to specify and install Energy Star qualified dishwashers. Rack type dishwashers should use less than 0.70 gallon per rack (GPR). Manufacturers are now offering water saving options below 0.70 gallons of water per rack. There are other options that preheat cold water to dishwasher water heater by capturing heat from the hot air exhausted from the dishwasher. Other manufacturers use sensors to limit the amount of rinse water used in the machine. DDCPM BO

Innovative

DDC PM, building operator, health officials, and regulatory agencies should coordinate the design of water reuse systems employing washer rinse (free from chemicals). Other food service graywater from steam tables and ice machines can also be tied into a water reuse system. This water can be used for irrigation or other nonpotable water uses. Kitchen designer and plumbing engineer shall coordinate available water amounts and include the water in the building water balance during the schematic design (SD) phase. DDCPM BO PE

Integration

EN 1 Water Heater

Equipment may use less hot water and could reduce the size of the water heater equipment.

For more information refer to ENERGY STAR qualified dishwashers:
(http://www.energystar.gov/index.cfm?fuseaction=dishwash.display_products_html

Laundry (Washer)

OFE 4

Energy

EN 1

Objective

Reduce water usage for washing machines while maintaining function.

Benefit

Fixtures can save water and reduce energy usage. Increased upfront costs will be offset by lower operation cost.

Limitations

May add to front end construction cost.

Background

Energy Star qualified washers will use approximately 20% less water and are available in both commercial and residential models. Washing machines use energy and water. It is important to specify appliances with high water efficiency ratings and high energy efficiency ratings.

For residential washers, in addition to the Energy Star rating, the Consortium for Energy Efficiency (CEE)[1] rates washing machines[2] under the CEE Super-Efficient Home Appliances Initiative Clothes Washer Qualifying Product List. DDC projects using residential type washing machines should be certain that washing machines are on the Tier 3 list.

There are family-sized commercial washing machines that are usually associated with coin operated machines and that are often used in nonresidential applications. In City buildings, these machines may be used in Firehouses or other locations where residential models are not appropriate. The applicable CEE rating system is the CEE Commercial, Family-Sized Washer Initiative Commercial, Family-Sized Clothes Washer Qualifying Product List, which is based on CEE's 2007 Commercial, Family-Sized Clothes Washer Specification.[3] DDC projects should specify equipment listed on the Tier 2 list.

Washing machine hoses can leak or break causing wash rooms to flood. Water can flow into walls and floors, which may lead to mold growth, impacting indoor air quality. Braided type hoses should be specified for all washing machine connections. Quarter turn shutoff supply valves should be specified to allow the user to turn off the water supply when the washer is not in use. When possible, drain pans should be used under washers and the drain lines should be connected to the building sewer system. Floor drains with trap primers should be installed in laundry rooms.

1 http://www.cee1.org/

2 http://www.cee1.org/resid/seha/rwsh/rwsh-prod.pdf

3 http://www.cee1.org/com/cwsh/cwshspec.pdf

Building Profession Task Designations

Before the building professional team can use this equipment it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent

Required Tasks

DDC PM, building operator, architect, and plumbing engineer should meet during the schematic design (SD) phase to determine if a residential or family sized commercial washer is appropriate for the facility. Efficient washers should be specified. DDCPM BO A PE

The plumbing engineer should design the valves and drains listed above. PE

Integration

EN 1 **Water Heater**Equipment uses less hot water and could reduce the size of the water heater equipment.

FP Fire Protection

Fire protection systems that supply water to fire suppression sprinkler systems are essential for the life safety of building occupants and the city. However, even critical systems can be designed in ways that conserve water. Large amounts of water are used for regularly scheduled testing and start up, literally dumping hundreds of gallons of drinking quality water per minute into the sewer system. And, leaky systems result in more wasted water.

Because fire protection is a life safety system, there are many regulatory organizations involved in the design, construction, and operations of a facility, including:

- Fire Department New York (FDNY)
- Department of Buildings (DOB)
- Insurance Agency
- Building Codes
- Building Inspectors
- Fire Marshal Inspector
- Fire Protection Engineer
- Fire Protection Contractor

It is important to work with all agencies in order to assure that water efficiency remains part of the solution and goals are met. During the design phase, these groups must be brought into the design process and water efficiency concerns discussed at the coordination meetings.

It is also important to include the water efficiency elements in each phase of a building. There are design elements discussed in this section that should be included in the building design that reduce water used in testing. There are practices described, such as charging the system with reuse water during start up, which affect the construction process. Later, when the building is in operation, tests can be conducted without discharging large amounts of water to the sewer.

There are alternative systems that can reduce the amount of water wasted in tests. There are also methods to capture water during tests and reuse the water for other nondrinking water applications.

Fire Pump Testing

FP 1

Objective

Reduce the amount of water consumed during yearly fire pump tests.

Benefit

- Reduces water flow during testing
- Reduces effort during testing.

Limitations

- May not be allowed by the Department of Buildings (DOB) in some areas of the city.
- Cannot be installed on all fire pump systems

Background

The fire suppression sprinkler system in some multiple floor buildings includes fire pumps. The pumps provide water pressure for the building sprinkler system and fire department hose connections. These pumps have the capacity to pump hundreds of gallons of water per minute (GPM). Codes, standards, and insuring agencies typically require annual flow testing of the fire pump.

Typically these are 500 GPM pumps in existing buildings and new facilities are now required to have 750 GPM pumps. Larger facilities can have larger pumps.

One method of testing requires connecting hoses to connections at the roof of the building. Currently the DOB requires an annual test where one hose connection will flow for a particular amount of time; then the second hose valve is opened, which will flow water for an additional amount of time. In 750 GPM and larger fire pumps, a third hose will also flow water. In the real world test, these hoses can flow water a minimum of 500 GPM or 750 GPM on the larger systems for 5 minutes or longer.

In many cases, these large amounts of water flow from the hoses onto the roof and into the stormwater systems. It is sometimes the case that the water can damage the roof and cause roof leaks in the building. In any case, thousands of gallons of potable water are wasted down the stormwater system. Currently this is the required testing method by the DOB.

There are ways to reduce the amount of test water that meet National Fire Protection Association (NFPA) standards but do not meet DOB standards. One method is to install a bypass line with a flow meter at the fire pump. Special attention must be paid to the strict requirements on how this type of system is to be installed and tested, including the NFPA, specifically NFPA 20 Chapter 14, and insuring agencies. As per NFPA standards the flow meter testing method must be used for the initial testing of a new system and then it does not have to be tested with a flow test for two years. While this method is not currently acceptable in New York City, the flow meter system can be installed in new buildings so it can be used if city requirements change in the future. Buildings with the flow meter bypass installations can be tested with the flow test method until the bypass method is acceptable.

During the test, the water from the flow test can be collected. The first flush of the system will have dirty, oily water that should be discharged to the waste system. The remainder of the water is relatively clean and can be reused. In buildings with graywater or reuse water storage tanks, the fire flow test discharge can be collected and used in other systems, such as irrigation or mechanical uses. In buildings without water reuse systems, the water can be collected in a tank truck and can be used off site for park irrigation, street cleaning, or other nonpotable uses.

Pressure relief and pressure reducing valves are sometimes used to protect the sprinkler piping in a building from excessive water pressures. In some buildings, these valves can release large amounts of water, usually during testing. Water storage type systems can be installed to collect and recycle this water for other nonpotable uses.

In new construction and major fire protection system renovations a submeter can be installed on the fire lines to monitor system leaks. It is imperative for life safety that the hydraulic flow conditions of these meters are included in the hydraulic flow design of the system. This meter is different than the fire pump flow meter and is usually installed at the fire protection water supply connection (typically at the municipal water connection). It can be monitored in the same way as the other building meters and submeters.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent

Required Tasks

Efficient

During the schematic design phase of the project, the DDC PM, fire protection designer (or plumbing engineer), and building owner shall meet with the facility insuring agency, FDNY, DOB, and authority having jurisdiction to determine if installing a fire pump test flow meter, bypass, and submeter at the fire pump is acceptable, even if it is not used for annual testing to meet current DOB requirements. DDCPM BO PE

When pressure relief or pressure reducing valves are installed in new construction projects or existing buildings they shall be located so that building staff can visually see when water is flowing from the valve into the building waste system. PE

Building operations shall monitor DOB testing requirements. When or if it is acceptable by the DOB to conduct flow meter tests, procedures will be set up to conduct the annual test using the flow meter method. BO

During flow tests the owner should contract with a sprinkler testing company to capture and reuse the water from annual flow tests. BO

The Commissioning team shall review the plans and the construction to verify that the system was installed correctly and is operating per specifications. CX

Fire Pump Testing

FP 1

More Efficient Ultra Efficient Innovative

Follow the tasks listed under Efficient with the following additions. If over 5,000 gallons of water is expected to be discharged during the annual fire pump test, or from a pressure relief or pressure reducing valve, the DDC PM, fire protection designer (or plumbing engineer), and building owner shall meet with the facility insuring agency, FDNY, DOB, and authority having jurisdiction to determine if installing a fire water collection tank system is acceptable for the facility. The water in the tank will be used in one of the building water reuse or graywater systems. If a permanent tank is not feasible in new construction or in an existing building, the DDC should obtain the services of a water collection contractor that can collect the discharge water and recycle it for other purposes. DDCPM BO PE

NT New Technologies

The building industry is constantly evolving and developing new technologies to meet the demands of the day. New York City has historically provided an environment that creates a need for new building solutions. As a result building practices developed in the city are adopted elsewhere.

Currently the City is focusing on promoting water efficient building systems that reduce water usage and waste. Conservation of resources is one motivating force. However, reduction of harmful materials that find their way into the waste and stormwater streams is equally important, as these materials are hard to treat at the wastewater treatment facilities. Installation of new systems that monitor the building processes to reduce or eliminate these materials is becoming essential.

One strategy is to embrace and install new technologies. These technologies can have special design, installation and operational requirements and may require added support from the manufacturer.

Some technologies, such as the vacuum plumbing system, are not new technologies, but have great potential to reduce water usage in building applications not previously used. So, new technologies can refer to new and creative applications of existing technologies.

Other technologies such as solar water heaters may require a redundant nonsolar water heater system to provide hot water during nonsolar days. This will add front end construction cost to the facility. However, the energy savings can offset the added cost in a relatively short time. Further, knowledge that is gained from using the system can be invaluable for future installations.

The new technology section covers a few of the new technologies on the market. It is important to note that any new technologies, either those under development today or those yet to be developed can and should undergo a trial installation in a facility before widespread use is recommended.The building team should review the approach to the technologies listed herein and use them as a means to incorporate other new technologies into a building.

Installation of new technologies can impact the construction and operations of a facility, and the plusses (advancing technologies) must be carefully weighed against the minuses (added time and cost). Ultimately, the building team is responsible for balancing the benefits of using new technologies with the cost of adding these technologies to the budget and schedule. It is critical that all new technologies or, existing technologies used in non-traditional methods, shall first be coordinated with the various departments and agencies that are responsible for protecting health and safety early in the building process before budgets and schedules are finalized. This will include identifying the appropriate agencies, incorporating necessary reviews, and obtaining approvals from regulatory agencies. Some practices may require special variances, added cost, and time to a construction project and should be taken into account in the project budget and schedule.

Building teams should review the 2008 NYC Building Code Chapter 1 Administration Section 28-113.2 as well as the Office of Technical Certification and Research (OTCR).

Fuel Cell

NT 1

Energy

EN 1 6

Operations

OP 1

Objective

Provide alternative onsite power generation with hot water byproduct.

Benefit

- Reduces peak grid power demand.
- Provides domestic hot water with little additional power generation.
- Produces power during power outages.
- Helps obtain LEED Energy and Atmosphere Credits.
- Reduces CO_2 emissions when power offsets grid power generated from coal fired electrical generation plants.

Limitations

- Installation costs are high.
- Natural gas connection required.
- Can require installation of a second domestic water heater system.
- Fuel cells used in nontraditional applications will require regulatory and/or special approvals.

Background

Fuel cells use natural gas, waste gas, and other fuels to generate power through a chemical reaction without combustion. Hot water and carbon dioxide are the only by-products. The hot water can be used to help heat the building during winter and to help heat domestic hot water.

Fuel cells can be installed in buildings to provide back-up power during power outages, or they can operate to offset electrical grid power.

The New York Power Authority (NYPA) has funded and installed fuel cells starting in the late 1990s. Some of the installations are powered by waste gas at four wastewater treatment plants operated by the New York City Department of Environmental Protection in the Bronx, Brooklyn and Staten Island.[1]

The New York Power Authority has also installed natural gas-powered fuel cells at the Central Park police precinct in Manhattan, the North Central Bronx Hospital, the MTA Corona Maintenance Yard in Queens, the Bronx Zoo, the New York Aquarium in Coney Island (Brooklyn), and the State University of New York (SUNY) College of Environmental Science and Forestry in Syracuse.

Building Profession Task Designations

Before the building professional team can use this technology it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- ME Mechanical Engineer
- SE Structural Engineer
- EE Electrical Engineer

1 https://www.nypa.gov/services/fuel cells.htm

NT 1 Fuel Cell

Required Tasks

Efficient Renovation

The DDC PM and building operator should coordinate with the New York Power Authority and other agencies during the schematic design (SD) phase, to determine if the facility qualifies for the NYPA New Technology Program or other programs. DDCPM BO

If the building qualifies for a fuel cell, the DDC PM, building operator, architect, mechanical engineer, electrical engineer, and plumbing engineer should meet during the SD phase to coordinate the installation of the equipment. The mechanical engineer and plumbing engineer shall conduct an energy cost analysis to determine if it is more cost effective to use the resultant hot water for building space heating or for domestic hot water or for both. DDCPM BO A ME EE PE

Fuel cells can offset and backup the primary domestic hot water heater. The plumbing engineer should design a primary domestic hot water system to provide hot water to the facility when the fuel cell is not in operation. Each fuel cell manufacturer has different recommendations offsetting domestic hot water heating. In most cases a thermostatic mixing valve is needed to minimize temperature fluctuations in hot water system. PE

The Commissioning team shall review the design plans and the construction to verify that the system was installed correctly and is operating per specifications. The system should be recommissioned regularly after the building is in service, at least every 5 years. CX

The system shall be included in the building measurement and verification plan. BO

More Efficient Ultra Efficient

Even if the building does not qualify for a fuel cell program, the DDC PM, architect, mechanical engineer, plumbing engineer, electrical engineer, and building operator should meet during the schematic deseign (SD) to evaluate if a fuel cell should be used in the facility. This process generally involves performing an energy analysis along with a cost analysis. An alternative SD design should be developed for the construction manager to review and prepare constructability, schedule, and cost information. If a fuel cell is specified, the building team should follow the tasks listed above. DDCPM BO A ME EE PE

Innovative

When new fuel cell technologies under development are used in the facility, the DDC PM, building operator, mechanical engineer, plumbing engineer, architect, and structural engineer should meet with the fuel cell research team during the SD phase. The team should develop a procedure to incorporate the system into the building design. DDCPM BO ME EE PE A SE

Integration

EN 1 Water Heater

Coordinate primary water heater size.

EN 6 Energy Pod

Install an energy pod for future fuel cell.

OP 1 Water Meter

Include fuel cell in building MV plan.

Vacuum Plumbing System NT 2

Plumbing Fixtures

PF

Operations

OP 1 3

Objective

Reduce water usage in a building using a plumbing system without either a biological or composting system.

Benefit

- Reduces the amount of water used by the facility.
- Helps qualify for LEED WE credits.
- Provides water efficient, reliable plumbing system.
- Does not require underfloor piping.
- Reduces piping sizing.
- Reduces pipe routing problems sometimes encountered in gravity waste systems.
- Integrates with building water reuse systems.

Limitations

- Installation costs are high.
- Requires specialized maintenance.

Background

The typical gravity waste piping system requires water to flush and clean wastes from the toilet bowl and to flow into the gravity piping from the fixture to the sewer main outside the building. Although water saving fixtures are available, there is a limit to the amount of water that can be saved since too much water flow reduction from the water closet causes problems in the waste line and blockages.

A vacuum system does not use gravity to clean the fixture or move solids in the pipe. Rather it relies on the use of a mechanical vacuum system. The vacuum pulls the waste from the fixture to a gravity waste system, similar to vacuum systems typically used in ships and aircraft. Piping can be placed overhead and piping size can be reduced. Water closets operate on as little as 0.5 GPF, roughly 2/3 less water than the conventional 1.6 GPF. The piping systems can be isolated to collect graywater and blackwater. The vacuum piping system can also be used to collect condensate. In grocery stores, for example, it is common to collect cooling coil condensate from freezer, refrigeration, and display systems. Both the graywater and condensate can then be used in a water reuse system.

Vacuum system can be used in correctional facilities, grease waste, grocery store, and food service applications.

Building Profession Task Designations

Before the building professional team can use this technology it is recommended that a team member is assigned each task. Refer to building profession key below.

- DDCPM DDC Project Manager
- A Architect of record
- BO Building Operator
- PE Plumbing Engineer of record
- PC Plumbing Contractor
- CX Commissioning Agent
- LS LEED Specialist
- EE Electrical Engineer
- ME Mechanical Engineer

Required Tasks

Efficient

In correctional, remote, food service, or grease applications, the DDC PM, building operator, plumbing engineer, and architect should meet at the schematic design (SD) phase to determine if a vacuum system should be used in the facility. This could require the development of alternate designs for the construction manager to determine constructability, schedule, and budget. DDCPM BO A ME EE PE

Specifying a vacuum system for the plumbing fixtures can be included in the calculation for LEED WE 3 Water Use Reduction credits. The plumbing engineer shall coordinate with LEED specialist to ensure that the LEED calculation is correct and all submittal requirements and documentation are complete. PE LS

If one or more vacuum systems are used, the DDC PM and plumbing engineer should coordinate and determine who will specify the system. Plumbing systems are usually specified by the plumbing engineer. However, the system may be specified by the food service vendor in food storage systems. DDCPM BO

The Commissioning team shall review the plans and the construction to verify the system was installed correctly and is operating as per specifications. The system should be recommissioned regularly after the building is in service, at least every 5 years. CX

The water supplying the vacuum system shall have a water meter connected to a data collection system. The system shall be included in the building measurement and verification plan. BO

Renovation

Vacuum systems may be a viable option for some renovation projects where there is limited access below the floor or in ceilings. The DDC PM, building owner, architect, and plumbing engineer should meet during the SD phase to determine if a vacuum system is appropriate for the facility. DDCPM BO A PE

Specifying a vacuum system for the plumbing fixtures can be included in the calculation for LEED EB – Additional Indoor Plumbing Fixture and Fitting Efficiency credits. The plumbing engineer shall coordinate with the LEED specialist to ensure that the LEED calculation is correct and all submittal requirements and documentation are complete. PE LS

Follow other tasks as listed for an efficient building.

More Efficient Ultra Efficient Innovative

Buildings with refrigeration units can use the vacuum piping system to collect condensate, which can be used in the building water reuse system. A vacuum system can also collect graywater, which can be similarly incorporated into a water reuse system. The DDC PM, architect, mechanical engineer, plumbing engineer, and building operator should meet during the SD phase to evaluate if a vacuum system will be used in the facility. DDCPM A ME PE BO

If the systems are specified, the mechanical engineer or refrigeration supplier shall perform a calculation and provide condensate water volumes to the plumbing engineer in order to prepare a water balance. During the SD phase, the system should be designed from the water balance. ME PE

Integration

PF Plumbing Fixtures

Coordinate where vacuum fixtures and standard fixtures are used.

OP 1 Water Meter

Include in building MV plan.

OP 3 Commissioning

Building commission to verify system is installed and operational.

Water System Start Up

NT 3

Objective

Reduce the amount of water used during chilled water and sprinkler system start up.

Benefit

Reduces water demand from city supply.

Limitations

May add cost to start up.

Connections may not be accessible.

Water start up systems will require regulatory and/or special approvals.

Background

When a new building is placed into service, the chilled water and sprinkler systems can use hundreds of gallons of water to flush and start up the system. There may be limitations on using domestic water to charge or flush the systems, particularly during times of drought.

Reuse water may be available from some wastewater treatment facilities, which is not cleaned to potable water quality levels, but can be used for nonpotable applications. Typically, this water is shipped to the site by tanker truck and can be used to flush large chilled water systems, fire sprinkler, or irrigation systems. Some of these systems, for example, chilled water systems, may be treated before being put into service.

Building Profession Task Designations

Before the building professional team can use this system it is recommended that a team member is assigned each task. Refer to building profession key below.

DDCPM DDC Project Manager
A Architect of record
BO Building Operator
PE Plumbing Engineer of record
PC Plumbing Contractor
CX Commissioning Agent
LS LEED Specialist
LA Landscape Architect
ME Mechanical Engineer

Required Tasks

More Efficient | Ultra Efficient | Innovative

The DDC PM, plumbing engineer, mechanical engineer, and building owner shall meet during the schematic design (SD) phase to determine if the use of treated graywater is feasible at start up. DDCPM BO ME PE

If graywater or reuse water can be used for the chilled water system, the mechanical engineer shall add this procedure to the system start up specifications. If graywater or reuse water is used in the sprinkler system, the fire protection designer should add this procedure to the start up specifications. If graywater or reuse water is used in the landscaping irrigation system, the irrigation designer shall add this procedure to the irrigation specifications. ME PE LA

The Commissioning team shall review the plans and the construction to verify the system was installed correctly and is operating as per specifications. CX

Integration Application Examples

4

4.0 Overview/Building Types

Introduction

The importance of establishing an engaged and effective design team when selecting technologies and developing strategies to reduce water supply and waste cannot be overstated. Equally important is viewing the building as a whole, not just individual systems. This whole building approach recognizes that decisions made on one system or technology have an effect on the other building systems, which in turn may vary depending upon the type of building project.

In this section, a brief description of each of the building types referenced in the manual is presented, along with guidance on technologies that would typically be incorporated into the water conservation goals for that building type. Several case studies have also been provided, which show the successful incorporation of water conservation strategies into actual buildings. Both the building type descriptions and case studies are meant as guides. Each project you work on will require analysis and technology selection based on the actual building parameters and agreed upon sustainability goals.

Building Types

Office

Office buildings typically have relatively stable, high populations per square foot, which benefit from the installation of water efficient plumbing fixtures. In renovated spaces in existing buildings, when possible, older inefficient plumbing fixtures should be replaced with new efficient fixtures. Water meters should be installed, and the DDC should encourage lease agreements where water and energy costs will be paid by the tenant. Water monitoring devices should be installed in places visible to both building occupants and the general public. In addition to these strategies, the following list can provide some guidance for the office design team:

PF Plumbing Fixtures

- Specify non-water urinals PF 5.
- If non-water urinals are not feasible, or if they are not acceptable due to codes or regulations, select ultra low flow urinals PF 4c.
- In staff toilet rooms with little use by the public, select dual flush water closets PF 1c.
- Specify ultra low flow lavatories PF 2c
- Specify metering lavatories in public areas.
- High efficiency shower systems PF 3b, where provided. These showers typically do not have a high demand, and so the high efficiency systems are appropriate.
- In renovation and lease spaces install new efficient fixtures in place of existing fixtures.

MS Mechanical Systems

- In larger office buildings, specify chilled water systems and water efficient mechanical systems.

CS Civil Systems

- When there is landscaping, reduce potable water by at least 50% in efficient and more efficient buildings.
- Ultra Efficient and Innovative buildings should use no potable water for irrigation.

EN Energy

- Where emergency power back up is not required, install an energy pod which allows for temporary power to be connected in cases of extended power outages.

Specify water heater systems that can be shut down at night and/or on weekends.

Locate plumbing fixtures to reduce long piping runs.

OP Operations

Public metering is important in office buildings where staff (and the public) can take part in water efficiency and sustainable solutions. Meters should be installed in renovation projects.

Library

Libraries are characterized by moderate traffic flow over long periods of time with occasional large traffic flow (visits by school groups and other assembly events). Technologies such as low flow plumbing fixtures can have a significant impact on water use reduction. Due to the presence of the general public, and specifically children, public metering is an effective educational tool and should be included as part of the overall water conservation strategy.

PF Plumbing Fixtures

Low flow water closets and public lavatory faucets using 0.5 GPM flow or metering faucets and non-water urinals.

MS Mechanical Systems

In larger libraries specify a chilled water cooling system with cooling towers.

Reduce water in cooling tower operations by reusing condensate.

PS Plumbing Systems

Water balance should include rainwater harvesting.

Air conditioning condensate can be reused for irrigation.

Reuse rainwater in flush fixtures (with regulatory agency approval) in Ultra Efficient and Innovative facilities.

Reduce water in cooling tower operations and reuse condensate.

EN Energy

Tankless water heaters in public lavatories. Specify solar water heaters to offset energy costs and to provide an educational tool.

OP Operations

Water meters serve as an educational tool and should be placed in an area for public viewing; regular water audits can be used for educational purposes.

OFE Owner Furnished Equipment

Where food service is provided, install Energy Star and WaterSense plumbing fixtures and dishwashers.

Public Assembly

Assembly facilities have unique water usage demands based on high usage for short periods of time. Choice of plumbing fixtures can have significant impact. For example, traditional flushometer water closets and urinals can impose high pressure and flow demands on a plumbing system. Plumbing systems designed for peak audiences often result in oversizing of pumps and piping.

PF Plumbing Fixtures

Non-water urinals PF 5 and high efficiency PF 1b water closets.

Overview/Building Types

MS Mechanical Systems

In large assembly buildings, specify a chilled water cooling system.

Install simple condensate recovery systems MS 4 that pump condensate to the cooling towers.

CS Civil Systems

When there is landscaping, reduce potable water use by 50% to 100%.

EN Energy

Properly sized energy pods can offer a method to provide sustainable or renewable power for a particular event EN 6.

Temporary power generating systems, such as fuel cells and biofuel generators NT 1, can provide power without being connected to the city power grid.

OP Operations

Water meters OP 1b placed in public areas provide educational information on how water efficient plumbing fixtures save water.

Community Facility

Community facilities include senior citizen facilities, daycare centers, classrooms, and cultural facilities. Similar to libraries and public assembly facilities, they are characterized by moderate traffic flow over long periods of time with occasional large traffic flow for special activities, and so water usage for these types of facilities are similar. In these facilities, low flow plumbing fixtures have a significant impact on water use reduction.

PF Plumbing Fixtures

Low flow water closets and public lavatory faucets using 0.5 GPM flow or metering faucets and non-water urinals.

MS Mechanical Systems

In larger facilities specify a chilled water cooling system with cooling towers.

Reduce water in cooling tower operations by reusing condensate.

PS Plumbing Systems

Water balance should include rainwater harvesting.

Air conditioning condensate can be reused for irrigation.

Reuse rainwater in flush fixtures (with regulatory agency approval) in Ultra Efficient and Innovative facilities.

EN Energy

Tankless water heaters in public lavatories. Specify solar water heaters to offset energy costs and to provide an educational tool.

OP Operations

Water meters serve as an educational tool and should be placed in an area for public viewing; regular water audits can be used for educational purposes.

OFE Owner Furnished Equipment

Where food service is provided, install Energy Star and WaterSense plumbing fixtures and dishwashers.

Health Facility

Health facilities may have multiple functions. The portions of the facility that resemble office space can follow the recommendations in the office section. However, clinical areas will have different demands.

PF Plumbing Fixtures

High efficiency faucets or water closets may not be appropriate in clinical areas where there are infection control issues. Fixtures for clinical use can be exempt from the LEED calculation.

Specify dual flush water closets in exam rooms and patient rooms.

MS Mechanical Systems

In larger facilities specify a chilled water cooling system with cooling towers.

Reduce water in cooling tower operations by reusing condensate.

PS Plumbing Systems

Water balance should include rainwater harvesting.

Reuse air conditioning condensate and harvest rainwater for irrigation.

In Ultra Efficient and Innovative facilities facilities, reuse rainwater in mechanical systems.

EN Energy

In some facilities with high hot water usage, specify condensing type water heaters.

OP Operations

Water meters serve as an educational tool and should be installed in public areas.

In renovation and leased spaces, monitor water usage to lower costs in lease contract negotiations.

OFE Owner Furnished Equipment

In larger facilities, food service may be made available. Install Energy Star and WaterSense plumbing fixtures and dishwashers.

Park & Recreation Facility

Parks typically have a high usage rate by the public, and are often in locations with limited access to city water supply and sewer systems. The challenge is providing safe toilet facilities without harming the natural setting of the park. Since parks attract large numbers of people, there is an opportunity to educate the public about water efficiency solutions.

PF Plumbing Fixtures

Specify non-water urinals PF 5.

Specify non-water toilets PF 7 that can provide compost for the park.

CS Civil Systems

If irrigation is planned, reduce potable water by 50% to 100%.

EN Energy

Install solar water heaters EN 1d to meet the need for light hand washing while educating the public on the importance of renewable power.

OP Operations

In parks where water is supplied, water meters OP 5 can be used as an educational tool on how water is being consumed and how efficient plumbing fixtures conserve water.

Police Precinct

Police precincts have moderate occupant load. Some facilities will have holding cells that should follow the recommendations for correctional facilities.

PF Plumbing Fixtures

Specify non-water urinals and low flow water closets.

In public washrooms, specify 0.5 GPM flow or metering lavatory faucets.

In staff washrooms used for washing and showering, specify high efficiency faucets and high efficiency showers. In these areas, the lavatories can be exempt from LEED calculations.

MS Mechanical Systems

In larger precinct buildings, specify a chilled water cooling system with cooling towers.

Reduce water in cooling tower operations by reusing condensate.

PS Plumbing Systems

Water balance should include rainwater harvesting.

Air conditioning condensate can be reused for irrigation.

In Ultra Efficient and Innovative facilities reuse rainwater in flush fixtures (with regulatory agency approval).

Install water and waste pods.

EN Energy

Fuel cells may be installed to offset energy costs to preheat hot water.

Install energy pods for future energy generation systems.

Specify tankless water heaters in public washrooms.

OP Operations

Water meters serve as an educational tool and should be placed in an area for public viewing; regular water audits can be used for educational purposes.

OFE Owner Furnished Equipment

Where food service is provided, install Energy Star and WaterSense plumbing fixtures and dishwashers.

Firehouse and other Fire Department Facilities

Firehouses require staff shower facilities and, in some cases, fire equipment vehicle wash. Both use large amounts of water and create large sewage flows into city wastewater systems. Water efficiency strategies can reduce water flow in both systems. The firehouse design team should meet the LEED WE prerequisite of 20% water reduction, however, achieving greater water reductions for additional WE credits may be difficult without specifying low flow shower systems. Emergency Medical Service (EMS) facilities require less intensive water use than firehouses. Washdown areas for equipment and EMS personnel clothing should be sized adequately and require special attention for infection prevention.

PF Plumbing Fixtures

Specify non-water urinals PF 5 along with dual flush water closets PF 1c.

Low flow shower systems PF 3 may not be appropriate because of the heavy washing required after returning from a fire call.

CS Civil Systems

Where there is landscaping, reduce use of potable water for irrigation by 50% to 100%.

PS Plumbing Systems

Some firehouses require washing equipment PS 5 for the drive and sidewalks outside the building; rainwater harvesting PS 3a can offset or provide 100% of the water used for these tasks.

EN Energy

Install solar water heating systems EN 1d in More Efficient and Ultra Efficient firehouses.

Geothermal systems EN 7 are appropriate for firehouses and can also provide alternative domestic water heating. In some cases, excess heat in summertime can provide hot water for the vehicle wash.

OP Operations

Visual access to water meters OP 1b will provide the firehouse staff an important mechanism with which to compare water usage.

OFE Owner Furnished Equipment

Some firehouses have kitchens OFE 3. Energy Star dishwashers with an energy factor (EF) of 0.68 or more should be specified in small projects where residential-type dishwashers are used.

In larger commercial type kitchens, specify pre-rinse spray OFE 3a less than 2.5 GPM.

Rack type dishwashers OFE 3b if required, use less than 0.70 GPR.

NT New Technologies

Fuel cells NT 1 may be appropriate to provide alternative space heating and/or domestic hot water heating systems during power outages.

Courthouse

Courthouse facilities are characterized by moderate traffic flow over long periods of time with occasional periods of heavy traffic and are therefore somewhat similar to other public assembly type buildings. In areas reserved for holding cells, follow guidance for Corrections (below).

PF Plumbing Fixtures

Low flow water closets and public lavatory faucets using 0.5 GPM flow or metering faucets and non-water urinals.

MS Mechanical Systems

In larger libraries specify a chilled water cooling system with cooling towers.

Reduce water in cooling tower operations by reusing condensate.

PS Plumbing Systems

Water balance should include rainwater harvesting.

Air conditioning condensate can be reused for irrigation.

In Ultra Efficient and Innovative facilities reuse rainwater in flush fixtures (with regulatory agency approval).

EN Energy

Tankless water heaters in public lavatories. Specify solar water heaters to offset energy costs and to provide an educational tool.

OP Operations

Water meters serve as an educational tool and should be placed in an area for public viewing; regular water audits can be used for educational purposes.

Overview/Building Types

OFE Owner Furnished Equipment

Where food service is provided, install Energy Star and WaterSense plumbing fixtures and dishwashers.

Correction/Juvenile Detention

Correction facilities include jails and juvenile detention and typically use large amounts of water for the inmate showering fixtures, food service and laundries. Facilities typically operate 24/7 and, as a result, moderate water reduction strategies can reap large benefits. The design team should bear in mind that inmates in such facilities are generally not motivated to reduce water usage. On the contrary, inmates may use large amounts of water, which places unusual stress and demands on the plumbing systems. At the same time, security factors will require installation of special tamper-resistant fixtures that cannot be flushed repeatedly and where the drain cannot be jammed with bedding, clothing or other material resulting in overflow and flooding.

Opportunities for water and energy use reduction in correction facilities can be found in plumbing fixtures, landscaping, food service, laundries, water heating, and graywater reuse. By taking advantage of water conservation strategies, average water rate per person per day can be reduced.

PF Plumbing Fixtures

Specify low flow water closets PF 1.

Specify correctional type stainless steel fixtures instead of vitreous china fixtures, which can be broken and used as weapons.

Flushometer valves should be concealed to ensure that fixtures cannot be removed from walls or be used for hiding contraband.

Install toilet controls to prevent excessive flushing.

In high security facilities, specify controls to limit the number of flushes. Some manufacturers can provide systems to shut down the water to fixtures.

Vacuum systems NT 2 are appropriate and stop large pieces of material such as bedding and clothing at the fixture.

A screen system can be installed in the drainage system to prevent materials such as bedding or clothing from entering the municipal system. In some cases a grinder system will be required.

Specify high efficiency systems PF 3b or ultra high efficiency PF 1c shower systems.

Shower systems should be time controlled and include remote water shut off.

Specify vandal proof institutional showerheads in medium to high security areas.

Specify .5 GPM or metering type lavatory faucets with time controls PF 3c.

CS Civil Systems

In facilities with green areas open to inmates, specify grasses and other plantings that do not require irrigation.

If irrigation sprinklerheads are required, they should not be accessible to inmates.

If irrigation is required, specify a rainwater harvesting graywater system CS 7.

PS Plumbing Systems

Correctional facilities can use graywater systems PS 3a. Rainwater, condensate, and wastewater from laundries can be reused for irrigation, cooling tower makeup, boiler makeup, and flush fixtures. Medium to large facilities should incorporate at least one of these systems.

EN Energy

Specify condensing type water heaters EN 1c.

In Efficient facilities, specify preheat systems from solar water heaters EN 1d, geothermal EN 7, or mechanical system preheat EN 3a.

In Ultra Efficient facilities consider Fuel Cells NT 1.

When vacuum systems NT 2 are used, the excess heat from the vacuum pumps can be used to preheat water.

OFE Owner Furnished Equipment

In medium to large facilities with food service kitchens OFE 3, supply to food service water heaters can be preheated from dishwasher discharge heat exchangers.

In medium to low security facilities, washing machines and dryers may be accessible to inmates for clothes washing. Higher security facilities may have large laundries. Specify efficient equipment OFE 4 in medium to small laundries.

In large laundries, specify washing machines that reuse and recycle a portion, or all, of the water for reuse. A simple recycle system recovers the discharge from the final rinse in a multi-cycle operation for use in the first flush or first rinse of the next cycle. More complex systems can recover more than 85% of the water for reuse. Simple systems rarely incorporate any type of treatment, since the final rinse water tends to be very clean.

In some systems water is filtered to remove lint and dirt, then reheated and sent for reuse. More complex larger systems process wash water is cleaned to the point that it can be recycled for use in all cycles of the washing process.

When heated water is discharged to the waste system a heat exchanger can be used to preheat water feeding the laundry water heaters.

Warehouse/Maintenance Shop

A Warehouse/Maintenance Shop is usually a large volume facility with a low occupancy rate. As a result, low flow plumbing fixtures will not have a significant impact on reducing water usage in the facility. However, this may not be true for high occupancy facilities with concentrated water demand at shift changes. Look for opportunities for roof rainwater and process water reuse. The building design team should work to meet the LEED WE Prerequisite for 20% water reduction. Additional WE credits may be harder to achieve.

PF Plumbing Fixtures

Specify low flow water closets and 0.5 GPM flow or metering lavatory faucets.

Specify non-water urinals.

Low flow faucets may not be appropriate for heavy hand washing usage or showers where workers must clean off at the end of a shift. Higher flow fixtures should be specified in such cases and can be exempt from the LEED calculation.

MS Mechanical Systems

In larger facilities, specify a chilled water cooling system with cooling towers.

Reduce water in cooling tower operations by reusing condensate.

PS Plumbing Systems

Water balance should include rainwater harvesting.

Air conditioning condensate can be reused for irrigation.

In Ultra Efficient and Innovative facilities reuse rainwater in flush fixtures (with regulatory agency approval).

In large facilities with large shower usage after each shift, specify a graywater system that reuses the shower water (with regulatory agencies approvals).

EN Energy

Tankless water heaters in public lavatories.

Specify solar water heaters to offset energy costs.

Vehicle Wash

Vehicle Wash facilities typically have low occupancy rates. They are also characterized by the very high water use and waste required for washing vehicles.

PF Plumbing Fixtures

Specify low flow water closets and 0.5 GPM flow or metering lavatory faucets.

Specify non-water urinals.

Low flow faucets may not be appropriate for heavy hand washing usage or showers where workers must clean off at the end of a shift. Higher flow fixtures should be specified in such cases and can be exempt from the LEED calculation.

MS Mechanical Systems

In larger facilities, specify a chilled water cooling system with cooling towers.

Reduce water in cooling tower operations by reusing condensate.

PS Plumbing Systems

Water balance should include rainwater harvesting.

Specify vehicle wash equipment that reuses water.

EN Energy

Tankless water heaters in public lavatories.

Specify solar water heaters to offset energy costs building.

4.1a
Integration Application Examples

The following application examples are buildings that evolved through an integrated design process. Each example illustrates how water conservation measures have been combined with other design objectives in a design approach that emphasizes involved active participation by all stakeholders early in the project: the A-E design team, building occupants, owners and operators, and members of surrounding communities.

In all cases the project's impact on total environmental quality was considered, resulting in building designs that are sensitive to their local surroundings, aesthetically pleasing, satisfy the environmental and programmatic needs of their users, and provide for durable and economic operation over the life cycle of the facility.

4.1b
Featured Case Studies

The Integration Application Examples described on the following pages are:

Marine Park Community Center
Brooklyn, NY

Queens Botanical Garden
Flushing, NY

Lehman College Science Facility
Bronx, NY

MTA New York City Transit Maintenance Shop + Car Wash
Corona, NY

Western Virginia Regional Jail
Salem, VA

Fire Department Facility Solar Hot Water Project
Bronx, NY

Community Center
Marine Park Community Center

Process: This is the first environmentally friendly, sustainable green building designed by Parks & Recreation staff, and the first Parks & Recreation building registered for LEED certification.
Team: *Architectural*, NYC Parks & Recreation; *MEP*, Dewberry; *Structural*, Dewberry; *Environmental*, Viridian Energy & Environmental, LLC
Site Analysis: The building is sited within the large outdoor active recreation area of Marine Park, which is also an important natural link to the Jamaica Bay ecosystem. Bay waters, marshes, and mud flats are home to a complex food chain of regional significance.
Building: One-story, circular shaped with a windowed raised clerestory over the main multi-purpose meeting space. Various community service spaces, sanitary and food facilities, and maintenance facilities are arranged around the circular periphery below the lower vegetated green roof. The building with broad overhangs, sits on a plaza.

Design Objectives

To provide a long-awaited community meeting and gathering space.

To house the local park district maintenance headquarters.

To design an environmentally friendly green building that will serve as a prototype for subsequent Parks & Recreation facilities.

Occupancy and Functions

Maintenance headquarters for all parks in the local park district, housing maintenance staff, repair facilities, and materials storage in the basement.

Community center for local group gatherings, both large and small, in a flexible multi-purpose space. Will serve 180 senior citizens breakfast and lunch daily. A training classroom is provided with computer stations.

Adjacent outdoor plaza for meals, local group events, and informal social gatherings in suitable weather.

Water Conservation Strategies

Stormwater: A vegetated green roof will filter rainwater runoff and discharge into the ground. Hardscape plaza areas are designed to allow runoff infiltration into the ground. One hundred percent onsite infiltration of stormwater runoff, and no discharge to sewer system.

Landscape Design: Native and meadow grasses are to be planted around the facility. No permanent irrigation is being provided. Hoses will be used to irrigate planting until established for one year. New shade trees will protect the building from harsh sunlight, shade outside sitting areas, and absorb infiltrated water runoff.

Estimated domestic water use reduction of 35.3% assuming approval of use of waterless urinals by the NYC Building Department.

Geothermal system pumps water from the aquifer for building heating or cooling systems.

Vegetated roof insulates the interior space, reduces heat island effect, filters and reduces rainwater runoff, and humidifies the atmosphere.

Low flow faucets, showerheads, and kitchen sink, and waterless urinals to be used.

Results

Tracking LEEDSilver rating in compliance with Local Law 86.

Owner: City of New York Parks & Recreation **Location:** Brooklyn, NY
Size: 9,800 Gross SF **Construction Cost:** $9,000,000
Construction Timeline: 2009-2010

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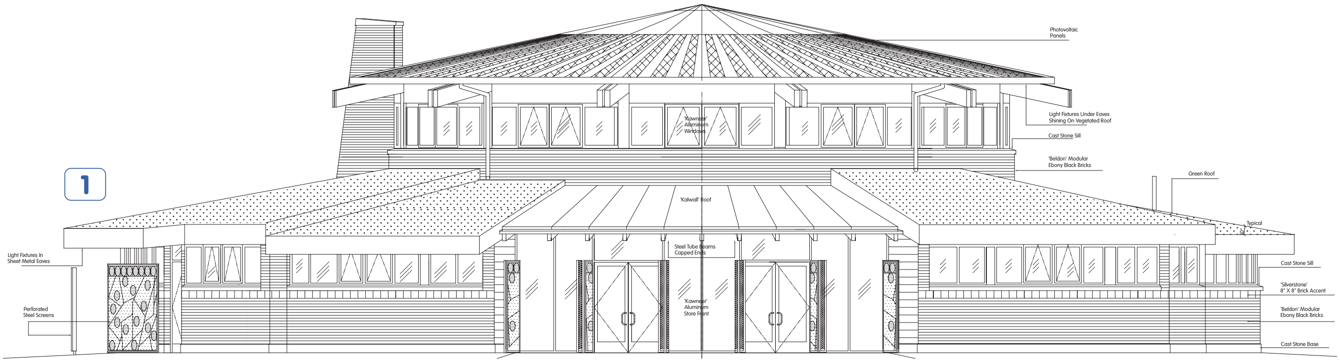

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1 South Building Elevation.

2 Overall view of building model showing the Vegetated Green Roof.

Park
The Queens Botanical Garden (QBG)

Process: The Queens Botanical Garden was committed to a green initiative from the start. Early participation of community members of different cultures supported environmental stewardship. For project team members, water quickly became an overarching design principle. The design firms' strategy views water as a resource.
Team: *Architecture and Interior*, BKSK Architects; *Landscape*, Atelier Dreiseitl and Conservation Design Forum; *Structural and Civil*, Weidlinger Associates; *MEP*, P.A. Collins; *Commissioning Agent*, STV; *Environmental*, Viridian Energy & Environmental, LLC; *Lighting*, Kugler Associates; *General Contractor*, Stonewall Contracting.
Site Analysis: The garden is used extensively by neighborhood residents who voiced an early interest in weaving water features into the design. The 39 acre site had been previously developed and a natural environment was reestablished by introduction of appropriate soils, native trees, and vegetation.
Building: The two-story, steel-framed structure houses administrative offices, gallery space, a store, and meeting rooms. The auditorium is in a partially underground reinforced concrete structure covered with a green roof.

Design Objectives

To reduce carbon footprint and overall environmental impact of project, with a special emphasis on efficient water use.

To fully engage the local community in the planning and design process, and to create a facility that serves the greater city and local population.

Occupancy

QBG is typically occupied by 15 full time staff, and is visited by 5,400 people per week, estimated at 2 hours per visitor per week.

Water Conservation Strategies

The role of water as the building's organizing theme is most evident when it rains. Water falls from the zinc-clad roof down into the channel below, eventually flowing into a "cleansing biotope," a manmade catchment area, consisting of gravel and aquatic plants. Sediments and nutrients are removed from the water before it is pumped underground to a fountain near the garden's main gate. From there, water travels again through the channel and the cleansing biotope. The process imitates the natural hydrology of the site, which originally contained low-lying streambeds that were tributaries of the Flushing River.

Stormwater: All rainwater is collected and utilized onsite to irrigate landscaped areas and the constructed wetland, which keeps runoff out of the overloaded NYC combined sewer system.

Landscape Design: The cleansing biotope mentioned above cleans all rainwater before it is returned to the site planting areas. Near the base of the green roof, a constructed wetland planted with marsh grasses and other species cleans the graywater from sinks and showers.

Plumbing Fixtures: Waterless urinals and, in staff restrooms, composting toilets.

Wastewater + Water Reuse: Graywater from sinks and showers is piped to the constructed wetland for cleansing. The water is then pumped back into the building to flush toilets in public restrooms.

Owner: The Queens Botanical Garden **Location:** Flushing, NY (Flushing Meadows)
Size: 15,831 SF **Cost:** $12,000,000 (buildings and adjacent landscaping only)
Completed: September 2007

Results

Reuse of graywater estimated to save 55% on potable water consumption.

Indoor potable water use is 36,700 gallons per year.

A grant-funded monitoring system will track and display air temperature, plant surface temperature, relative humidity, soil moisture, and soil temperature on the green roof.

Future data collection will involve water sampling and video monitoring.

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1 Rainwater cascades off of the sheltering canopy and into the cleansing biotope pools below.

2 Water course and sloping green roof beyond.

3 Cleansed rainwater from the green roof supplies a site water feature.

College/Classroom
Lehman College Science Facility (LCSF)

Process: High level of involvement by the campus academic community in setting sustainability and educational objectives and programmatic needs. A fifteen year effort is envisioned to fully develop the LCSF through completion of Phase II, eventually to 210,000 SF.
Team: *Client*, Lehman College, The City University of New York; *Architect*, Perkins+Will; *MEP*, Syska & Hennessy; *Site/Civil*, Leonard J. Strandberg Associates; *Landscape*, Mathews Neilsen; *Structural*, Leslie E. Robertson Associates; *Lighting*, Cline Bettridge Bernstein; *CM*, Gilbane
Site Analysis: Lehman College is a well developed urban campus. The new LCSF complex is planned around a central courtyard with a constructed wetland that will be integrated with the campus as an amenity and research/educational tool, to be continuously monitored and studied by all scientific disciplines.
Building: Designed to connect and fit into the existing fabric of campus Gothic Revival structures, but also be expressive of a modern program of advanced interdisciplinary scientific research.

Design Objectives

To be a sustainable design and provide lifetime durability and ease of maintenance of materials and systems.

To connect and integrate into the existing campus fabric and surrounding community.

To integrate sustainable design elements into the educational program and to ensure that the design elements are visible and scientifically observable.

Occupancy and Functions

Daylit research and laboratory space is provided on the building perimeter. Lab offices have operable windows. Interior lab spaces are provided for light-sensitive experiments. Common lab core elements maximize efficiency of lab usage and encourage cross-disciplinary scientific inquiry.

Water Conservation Strategies

Stormwater: Roof rainwater will be harvested and cleaned through a system of underground filtration and holding tanks, and through the wetland planting beds of native grasses.

Landscape Design: Native grasses are to be planted in the central courtyard. No potable water is used for irrigation.The filtered nonpotable water will be reused in the toilets and janitor sinks of the building and the landscape irrigation system. A parallel mechanical filtration system is provided in case of a natural filtration system failure, and enabling students to run comparative analyses.

Wastewater + Water Reuse: Provision is being made for a system of graywater collection and cleaning to be implemented in Phase II. This system will draw wastewater from the showers in an existing gymnasium building next door, and will treat LCSF toilet blackwater before release into the municipal sewer system.

This building will serve as an urban biotecture model and educational tool for aggressive water management, monitoring, and research. The LCSF will be integrated into the campus building management system. Campus O&M personnel will be trained in the new systems being used. Students and faculty will be able to continuously monitor and research wetland water quality and condition of the plant life.

Owner: Lehman College, The City University of New York **Location:** Bronx, NY **Size:** 69,000 gross SF (Phase I) **Estimated Construction Cost:** $54,000,000 (Phase I) **Construction Timeline:** 2008-2012

Results

Ratings: Tracking LEED Gold rating

Lessons Learned: Identify sustainable strategies meaningful to building users and operators.

Importance of integrating all stakeholders

Create a mutually supportive atmosphere to solve difficult problems.

Fees should support critical green research and analysis.

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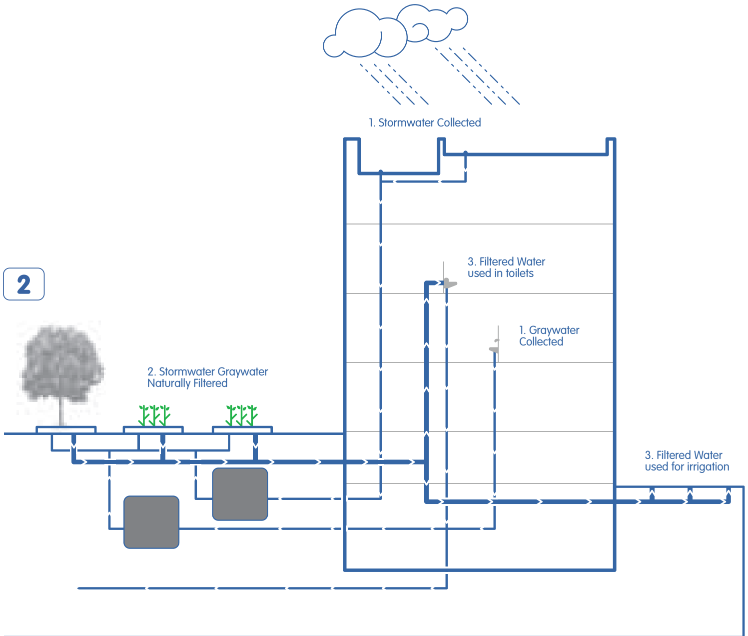

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1 View of the constructed wetland in the LCSF courtyard.

2 Cross section of building and constructed wetland showing natural and mechanical filtration systems, and reuse of cleansed water back to toilets and janitor sinks and irrigation.

3 Detail of wetland in the LCSF courtyard.

Maintenance Shop / Vehicle Wash
MTA NYCT Corona Maintenance / Car Wash

Process: MTA NYCT operates under an agency wide Environmental Management System (EMS), a long-range plan that is certified to ISO 14001 Standards.

MTA NYCT created a Storm Water Management Program (SWMP) in accordance with USEPA regulations under the Federal Clean Water Act.

The building design process was highly integrated using a whole building design concept to set objectives in compliance with NY state and agency environmental objectives and to achieve project design objectives.

This is the first transit railcar maintenance facility to receive a Certified rating under the Leadership in Energy and Environmental Design (LEED) program of the U.S. Green Building Council (USGBC), and the first MTA NYCT facility to be LEED certified.

Team: *Design-Build Contractor*, Skanska USA Civil Northeast; *Architect*, El Taller Colaborativo, PC; *Engineer*, PB Americas; *LEED Consultant*, Scott Chrisner

Design Objectives

The NYCT CPM seeks to reduce energy consumption, save natural resources, and prevent pollution while designing and constructing world class transit facilities for NYCT.

To create a safe, environmentally beneficial, and productive workplace for the transit employees.

To create a facility with positive environmental benefits to the surrounding community. The facility is visible from subway trains and the station that serves the NY Mets stadium.

To minimize energy consumption through the integration of mechanical and electrical systems with passive architectural design elements.

Occupancy

Contains subway car maintenance areas, parts storage spaces, some office space, and employee facilities for over 310 employees.

Water Conservation Strategies

Maintenance shop roof rainwater is harvested and directed to a filtering process and 40,000 gallon underground storage tank that supplies nonpotable water to the 3,000 SF car wash facility. A system of pumps and filter tanks reclaims 80% of the used wash water.

Results

Reused rainwater for the car wash facility is estimated to save 2.455 million gallons of potable water per year.

80% reclaim of used car wash water

36% more energy efficient than required by code

5% of facility's electricity is provided by a 100KW photovoltaic solar array.

10% of facility's electricity is provided by 200KW fuel cells.

Awards: Honorable Mention, 2004 Green Building Competition sponsored by NYC and U.S. EPA; Honorable Mention, 2004 Green Apple Award from NYC and U.S. EPA

Ratings Achieved: LEED Certified

Lessons Learned: More education about maintenance of new building systems is needed than had been estimated.

More water conservation strategies will be utilized in future transit facilities.

Owner: MTA NYC Transit (NYCT) Dept. of Capital Program Management
Location: Corona, New York **Size:** 135,000 SF **Cost:** $165 Million
Completed: June 2006

Collected roof rainwater is filtered and reused to wash subway cars.

Correctional Facility
Western Virginia Regional Jail (WVRJ)

Process: The WVRJ consolidates inmates, staff, and costs from four separate localities into one new facility. The owner directed the A/E to develop a state of the art facility to include green features and to obtain a LEED Certified rating, the first LEED Certified jail in the U.S.
Site Analysis: The 43 acre site is bordered on three sides by the Roanoke River, and stormwater runoff was a great concern during design. The developed site, with 13.5 acres of new impervious surfaces, will actually produce less runoff to the river than when it was undeveloped pasture land.
Team: *Site and Building Engineering*, AECOM Design; *Architecture*, Thompson & Litton, Architects

Design Objectives

To create a facility with positive public opinion and environmental benefits for the surrounding community.

To reduce water consumption by using high performing vacuum plumbing systems for sanitary waste transport.

To minimize environmental impact by collecting stormwater from the roof via siphonic roof drains, filtering it, and storing it in a 120,000 gallon underground tank for exclusive use for washing of inmates' laundry.

Water Conservation Strategies

Vacuum plumbing (first of its kind on the east coast of the U.S.).

Electronic flush valve control system.

Rainwater harvesting used for the inmate laundry facility.

Plumbing Fixtures and Controls: Vacuum toilets and urinals use only 0.50 gallons per flush compared to conventional toilet flush rate of 1.6 gallons per flush and urinal flush rate of 1.0 gallons per flush. The electronic flush valve control system allows maintenance staff the ability to remotely control the quantity of flushes per hour per inmate in the facility, providing additional significant water savings.

Results

A 62.4% domestic water reduction was achieved over the facility baseline which equates to 6,611,000 gallons per year (GPY) savings, also achieving a LEED ID credit. The rainwater harvesting system calculated water savings equal to 4,276,000 GPY, also achieving a LEED ID credit. The total water savings equates to nearly 11 million GPY.

Ratings: Tracking for LEED Certified

Publications: Corrections News, March/April 2007 and July 2009; PM Engineer, The Next Frontier - Vacuum Plumbing Systems, February 2008.

Owner: Western Virginia Regional Jail Authority (a partnership between Roanoke, Franklin, and Montgomery Counties and the City of Salem, Virginia)
Location: Salem, Virginia **Size:** 264,000 SF

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1 Vacuum Waste Collection System showing Overhead Sanitary Piping

2 Typical Cell featuring Vacuum Water Closet

3 Vacuum Pumps

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EMS Battalion
New York City Fire Department Facility

Process: FDNY is committed to make a substantial contribution to PlaNYC 2030 energy and water reduction objectives and to a sustainable future for New York City.
Team: *PE Design/Consultant*, Alexander Weiss; *Project Engineer*, PMS Construction Management Corp; Kew Forest Plumbing & Heating Inc
Building: An existing 40-year old neighborhood FDNY building that is used as an EMS facility.

Design Objectives

To reduce energy and water consumption in new and existing FDNY buildings.

To accomplish energy and water reductions by integrating renewable energy technologies in a cost effective manner that would not require extensive modifications to the existing building fabric, much of which is historic.

To extend the use of clean renewable energy to all FDNY facilities, such as EMS battalions and firehouses, particularly at more remotely located facilities that have challenging access to utilities.

Solar Hot Water System: EN 1D

The solar hot water system installed at EMS Battalion 19 is an active solar thermal system, so-called because a circulator pump is used to move fluid through the solar collector and transport heat to hot water storage tanks. The solar system has the capacity to provide for the full EMS 19 demand although there is a gas backup system.

It should be noted that returning fire fighting crews are required to take showers, so demand at firehouses will be much higher than at an EMS facility. Actual loads and hot water storage capacity must be engineered for each building situation.

Collectors: Two heat transfer tube collectors are installed on the roof, which is open to the sun on all sides and excellent for harvesting solar energy. High efficiency twin glass evacuated tubes absorb solar energy and convert it into heat used for domestic hot water heating. Freeze-protected heat pipes transfer heat from within the evacuated tubes up to an insulated copper header pipe through which a heat transfer liquid is circulated.

Hot Water Storage: A two-tank hot water storage system is used consisting of the existing EMS 19 gas fired hot water heater and a new solar hot water storage tank. In summertime the solar system is expected to meet the facility hot water demand. However, during less favorable solar weather conditions the water may only be able to be preheated to 85 F. Upon demand, this preheated water will flow to the inlet port of the existing gas fired water heater which will raise the water to the desired setting. The hot water distribution system is equipped with a mixing valve to ensure the proper hot water temperature range of 120 F to 124 F. The combination of solar and gas fired hot water storage tanks provides capacity for night shifts or use when solar gain is diminished.

Certification

Installations are certified by Solar Rating Certification Corporation (SRCC) for compliance with *Standard OG-100, Operating Guidelines for Certifying Solar Collectors*; and, *Standard OG-300, Operating Guidelines and Minimum Standard for Certifying Solar Water Heating Systems*.

Results: Water and gas submeters are installed to provide measurable data to verify the operating efficiency of the system as compared to previous utility bills. FDNY anticipates a substantial reduction in the use of energy supplied by fossil fuel, resulting in less CO_2 emission.

Project: Solar Hot Water System for Emergency Medical Service (EMS) Battalion 19
Location: Bronx, NY **Owner:** New York City Fire Department (FDNY)

1 Active Closed Loop Water Heater

2 Solar Heat Exchanger and Backup Gas-fired Water Heater

3 Rooftop Solar Heat Transfer Tube Collector

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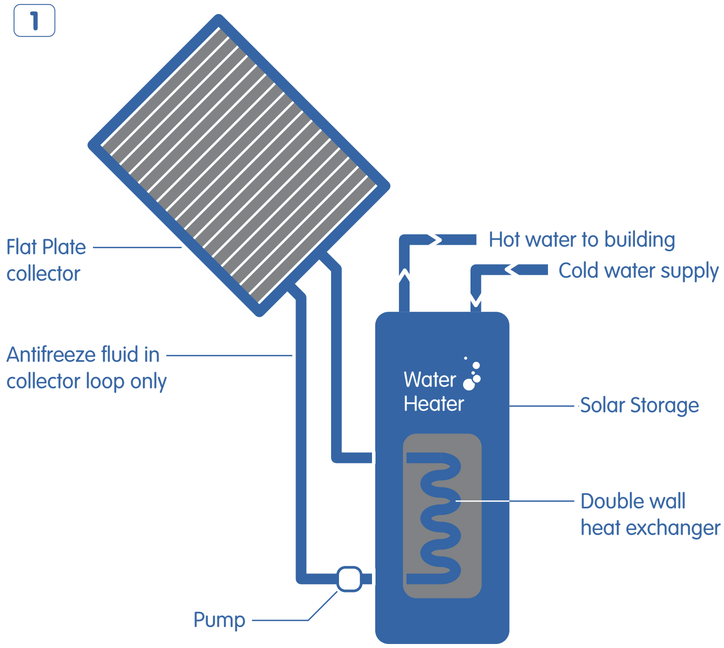

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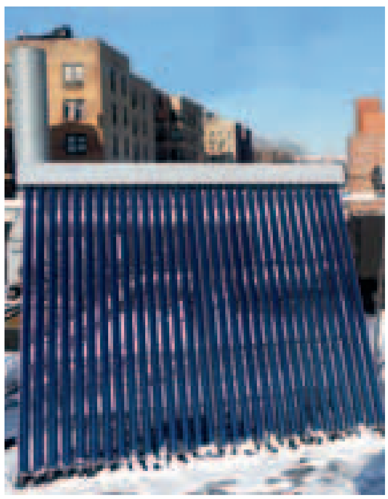

Glossary, References, Credits, and Acknowledgements

5

5.0a Glossary/Abbreviations

A Architect

AMR Automated Meter Reading

ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.

AWWA American Water Works Association

BAS Building Automation System

BMP Best Management Practice

BO Building Operator

CEE Consortium for Energy Efficiency

CM Construction Manager

CO2 Carbon Dioxide

CSO Combined Sewer Overflow

CS Civil Systems

CX Commissioning, Commissioning Agent

DD Design Development

DDC (NYC) Department of Design & Construction

DDC PM DDC Project Manager

DEP (NYC) Department of Environmental Protection

DOB (NYC) Department of Buildings

EN Energy

EPAct Energy Policy Act of 2005

FDNY (NYC) Fire Department

FP Fire Protection

GPD Gallons Per Day

GPF Gallons Per Flush

GPM Gallons Per Minute

HE High Efficiency

HET High Efficiency Toilet

HEU High Efficiency Urinal

LEED® Leadership in Energy and Environmental Design, a green building rating system developed by U.S. Green Building Council (USGBC). LEED references in this manual refer to LEED v3.0 2009. Applicable LEED rating systems for DDC projects:
EB, EBOM Existing Building: Operations & Maintenance
CI Commercial Interiors
CS Core & Shell
NC New Construction & Major Renovation
Credit categories in order of appearance in the LEED 2009 checklist:
SS Sustainable Sites
WE Water Efficiency
EA Energy & Atmosphere
MR Materials & Resources
IEQ Indoor Environmental Quality
ID Innovation in Design
RP Regional Priority

LL86 NYC Local Law 86, 2005.

LS LEED Specialist

ME Mechanical Engineer

MV Measurement and Verification

NFPA National Fire Protection Association

NT New Technologies

NYC New York City

NYPA New York Power Authority

NYC PC New York City Plumbing Code

NYSDEC New York State Department of Environmental Conservation

OFE Owner Furnished Equipment

O&M Operation and Maintenance

PC Plumbing Contractor

PE Plumbing Engineer

PF Plumbing Fixtures

PS Plumbing Systems

SD Schematic Design

SE Structural Engineer

SMP Stormwater Management Practice

UHE Ultra High Efficiency

USGBC U.S. Green Building Council

USEPA U.S. Environmental Protection Agency

VFD Variable Frequency Drive

WE Water Efficient, Water Efficiency

5.0b Glossary/Terms

B

Best Management Practices (BMPs)

Management practices, schedules of activities, prohibitions of practices, and maintenance procedures implemented to prevent or reduce the discharge of pollutants to waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, waste disposal, or drainage from raw material storage. BMPs include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters.

Bioinfiltration

An effective management practice combining vegetation and appropriate soil compositions to both filter pollutants from stormwater and aid in retention strategies.

Bioretention

Use of plant systems to capture, store, and cleanse stormwater, including rain gardens, vegetated buffers, swales, and medians.

Blackwater

Wastewater discharged from water closets, urinals, and any other fixtures discharging animal or vegetable matter in suspension or solution.

Blueroof

A rooftop detention system that uses a controlled flow device to temporarily retain a certain amount of rainwater on a building's rooftop, allowing the stored rainwater to gradually drain over time.

Building Drain

That part of the lowest piping of a drainage system that receives the discharge from soil, waste, and other drainage pipes inside the building that extends 5 feet (1524 mm) in developed length of pipe beyond the exterior walls of the building, and conveys the drainage to the building sewer.

C

Catch Basin

A box-like underground concrete structure with openings in curbs and gutters designed to collect runoff from streets and pavement and carry the runoff into the sewer.

Cistern

A covered tank for storing rainwater to be utilized for purposes other than in the potable water supply.

City

The City of New York

City Environmental Quality Review (CEQR)

The process used to identify and assess the potential environmental impacts of certain actions that are proposed in New York City by public or private applicants and funded or approved by a city agency.

Clean Water Act (CWA)

The CWA is the primary federal law controlling water pollution. Specific sections of the CWA seek to eliminate the release of pollutants to waterways. Formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972 Pub.L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. 6-483, and Pub. L. 97-117, 33 U.S.C. 1251 et seq.

Combined Sewer Overflow (CSO)

Untreated wastewater from a combined sewer system at a point prior to the headworks of a publicly owned treatment works. CSOs generally occur during wet weather (rainfall or snowmelt) when these systems become overloaded, bypass treatment works, and discharge directly to waterways.

Combined Sewer System (CSS)

Pipes that convey both sanitary sewage and stormwater.

Commissioning

A quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.

Commissioning Agent, or Commissioning Authority

An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the Commissioning Process.

Composting Toilet

A toilet system that converts human waste into organic compost, typically using micro and macro organisms.

Constructed Wetland

Manmade water treatment systems that filter pollutants from stormwater that flows through the system ultimately discharging to receiving bodies of water. The function of the created wetland is to replicate the functions of natural wetlands. Constructed wetlands are treatment systems that use natural processes involving wetland vegetation, soils, and their associated microbial assemblages to improve water quality.

Cycles of Concentration

A number representing the quality of water circulating in a cooling tower, typically the ratio of the conductivity of cooling tower discharge (blowdown or bleedoff) divided by the conductivity of the makeup water. Systems operating at a higher concentration will generate less blowdown water and require less makeup water. Also called Concentration Ratio.

D

Demand Initiated Recirculating Hot Water Delivery System

A recirculating hot water delivery system with a user-activated pump which circulates cool water in the hot water supply line back to the water heater so that the cool water is replaced by hot water. A controller turns the pump off when the water at the fixture reaches a desired temperature. The pumping cycle can be activated by the push of a button or a motion sensor. Some retrofit systems may send the cool water down the cold water line. When the water reaches a desired temperature a control closes the zone valve and turns off the pump. Also called an On-Demand Hot Water System.

Design Flood Elevation

The elevation of the "design flood," including wave height, relative to the datum specified on the city's legally designated flood hazard map.

Detention

The capture and subsequent release of stormwater runoff from the site at a slower rate than it is collected, the difference being held in temporary storage.

Direct Discharge

Release of stormwater into a water body without first passing through a municipal sewer system or receiving treatment.

Discharge Pipe

A pipe that conveys the discharge from plumbing fixtures or appliances

Dual Flush Water Closet

A toilet that enables the user to select a high flush for solid waste or a reduced volume, low flush for liquid waste.

E

Energy Pod

A future location for an onsite power system with electrical connections that can provide all or partial power to a building or the water pumping and heating systems in order to provide for future flexibility and minimal down time. The energy pod can also be used for emergency generators, which connect power to a building during power outages.

Energy Recovery

Energy recovery transfers energy from

one system to another. This is similar to the process of Heat Recovery.

Energy Star®

A joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy that is designed to identify and promote energy efficient products to reduce greenhouse gas emissions. Computers and monitors were the first labeled products. Through 1995, EPA expanded the label to additional office equipment products and residential heating and cooling equipment. In 1996, EPA partnered with the U.S. Department of Energy for particular product categories. The Energy Star label is now on major appliances, office equipment, lighting, home electronics, and more. EPA has also extended the label to cover new homes and commercial and industrial buildings. (www.enerystar.gov)

Exfiltration

The downward movement of runoff through the bottom of a stormwater facility into the soil.

F

Faucet

The valve end of a water pipe through which water is drawn from or held within the pipe.

Flush Tank

The tank portion of the water closet designed with a ball cock and valve to flush the contents of the bowl.

Flushometer Tank

A device integrated within an air accumulator vessel that is designed to discharge a predetermined quantity of water to fixtures for flushing purposes.

Flushometer Valve

A valve attached to a pressurized water supply pipe designed to open when activated to allow direct flow into the fixture at a rate and quantity to operate the fixture properly, and then to close gradually, resealing fixture traps and minimizing water hammer.

G

Geothermal

A system that uses the earth as a heat source or sink by means of a circulating water loop. Mean earth temperatures are approximately 55 degrees Fahrenheit in New York City, resulting in excellent coefficients of performance for heating or cooling. (Refer to the DDC Geothermal Heat Pump Manual.)

Graywater

Wastewater discharged from lavatories, bathtubs, showers, clothes washers, and laundry sinks.

Graywater (Reuse)

Capture and reuse of wastewater for purposes such as irrigation.

H

Heat Recovery

A system using an air or water heat exchanger to transfer heat from one water or air stream to another water or air stream. For example, a boiler exhaust flue heat recovery system can transfer the heat from the boiler exhaust to boiler feed water through a heat exchanger.

High Efficiency Toilet (HET)

See WaterSense.

Hot Water

Water at a temperature greater than 110°F (43°C).

I

Impervious Surface

A surface that prevents the infiltration of water into the ground.

Infiltration

The percolation of water into the ground. Infiltration is often expressed as a rate (inches per hour), which is determined through percolation testing.

Leader

A drainage pipe used to convey stormwater from roof or gutter drains to an approved means of disposal.

Leadership in Energy and Environmental Design (LEED®)

The LEED certification process, developed by USGBC, is a nationallyaccepted standard for the design, construction, and operation of high performance green buildings. LEED certification criteria target five areas: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. Regional Priority is a sixth area recently added.

L

Low Impact Design (LID)

A comprehensive stormwater management and site design technique. Within the LID framework, the goal is to design a hydrologically functional site that mimics predevelopment conditions, achieved through infiltration, filtration, evaporation, and storing runoff close to its source instead of relying on costly large scale conveyance and treatment systems. LID addresses stormwater through a variety of small, cost effective landscape features located onsite. LID is a versatile approach that can be applied to new development, urban retrofits, and revitalization projects. This design approach incorporates strategic planning with micro management techniques to achieve environmental protection goals while still allowing for development or infrastructure rehabilitation to occur.

M

Makeup Water

Replacement water, in most cases potable water from a municipal system, is a secondary backup supply to another system using water. Systems requiring make up water include but are not limited to: irrigation, mechanical cooling systems and boiler makeup.

Manifold System

Water distribution system having a manifold connected to the cold water supply and water heater from which dedicated hot and cold water pipes are connected to each water fixture. Also called a parallel pipe or home run system.

Metering Faucet

A faucet which automatically shuts off after delivering a predetermined volume of water.

Micro-Irrigation System

The application of small quantities of water directly on or below the soil surface, usually as discrete drops, tiny streams, or miniature sprays through emitters placed along the water delivery pipes (laterals). Micro-irrigation encompasses a number of low flow, low volume irrigation systems with any type of emission device, including surface drip irrigation systems, subsurface drip irrigation systems, and popup surface micro-irrigation systems. These systems have flow rates no more than 25 gallons per hour.

N

National Pollutant Discharge Elimination System (NPDES)

As authorized by the Clean Water Act, the NPDES permit program controls water pollution by regulating point sources that discharge pollutants into U.S. waterways. Industrial, municipal, and commercial facilities must obtain permits if their discharges go directly to surface waters.

Nonpotable Water

Water not safe for drinking, personal use, or food preparation.

Non-Water Urinal

A non-flushing urinal which typically uses a trap insert containing a sealant liquid (instead of water) that prevents odors.

O

Occupancy

The purpose for which a building or portion thereof is utilized or occupied.

Once Through Cooling

The practice of using potable water to cool a condenser or building equipment and then discarding the water to a sanitation drain, including the use of potable water to temper hot water or steam before sending it to a sanitation drain.

Outfall

The point where combined sewer discharges excess volume into a waterway or where separate stormwater sewer discharges to a waterway.

P

Permeable Pavement

An area paved with materials that permit water penetration into a suitably designed discharge bed. Permeable pavement may consist of any porous surface materials that are installed, laid, or poured.

Plumbing Appliance

Any one of a class of plumbing fixtures intended to perform a special function dependent on one or more energized components, such as motors, controls, heating elements, or pressure- or temperature-sensing elements. Plumbing appliances are manually adjusted or controlled by the owner or operator, or are operated automatically through one or more of the following actions: a time cycle, a temperature range, a pressure range, a measured volume or weight.

Plumbing Fixture

A receptacle or device that is either permanently or temporarily connected to the water distribution system of the building requiring a supply of water; discharging wastewater, liquid-borne waste materials or sewage either directly or indirectly to the drainage system of the premises; or requiring both a water supply connection and a discharge to the drainage system

Plumbing System

The water supply and distribution pipes, plumbing fixtures and traps, water-treating or water-using equipment, soil, waste and vent pipes, and sanitary and storm sewers and building drains, within a building.

Pod

See Energy Pod, Waste Pod, and Water Pod.

Pollution Loading

An amount of pollutants that is introduced into a receiving waterbody.

Potable Water

Water free from impurities conforming to the bacteriological and chemical quality requirements of the Public Health Service Drinking Water Standards or the regulations of the public health authority having jurisdiction.

Private

In the classification of plumbing fixtures, private applies to fixtures in nonpublic toilet rooms in buildings where the plumbing fixtures are intended for use by an individual or specific group of individuals.

Public or Public Utilization

In the classification of plumbing fixtures, public applies to fixtures in general toilet rooms of schools, gymnasiums, hotels, airports, bus and railroad stations, public buildings, bars, public comfort stations, office buildings, stadiums, stores, restaurants, and other installations where a number of fixtures are installed so that their use is similarly unrestricted.

Public Sewer

A common sewer directly controlled by public authority.

Public Water Main

A water supply pipe for public utilization controlled by public authority.

R

Rain Barrels

Typically small scale, onsite storage containers for the catchment of stormwater in order to manage stormwater and minimize the use of potable water for activities that do not require potable water.

Rain Garden

Also sometimes referred to as a vegetated infiltration basin, a rain garden is a vegetated facility that temporarily holds and infiltrates stormwater into the ground.

Glossary/Terms

Rain Harvesting

The practice of collecting and using stormwater in place of potable water for purposes such as irrigation and toilet flushing. Rain harvesting is both a stormwater management strategy and a water conservation strategy.

Recycled Water

Water treated to remove waste matter attaining a quality that is suitable for the water to be used again.

Retention

The permanent onsite storage or use of stormwater to prevent it from leaving the development site. A practice designed to store stormwater runoff by collection as a permanent pool of water without release except by means of evaporation, infiltration, or attenu-ated release when runoff volume exceeds the permanent storage capacity of the permanent pool.

Retro-Commissioning

The Commissioning Process applied to an existing facility that was not previously commissioned.

Roof Drain

A drain installed to receive water collecting on the surface of a roof and to discharge the water into a leader or a conductor.

S

Sampling Pit

A structure installed in the waste or stormwater discharge piping to allow access for the retrieval of samples for testing. Collecting samples helps the building operator or the municipal system operator track materials in the waste stream before they enter the main piping.

Sanitary Drain

A building drain that carries sewage only.

Sanitary Sewer

A sewer that carries sewage and excludes storm, surface, and ground water.

Separate Sewer System (SSS)

Systems that convey stormwater directly into nearby bodies of water without treatment.

Sewershed

All the land area that is drained by a particular sewer network.

Sewage

Any liquid waste containing animal or vegetable matter in suspension or solution, including liquids containing chemicals in solution.

Source Controls

Stormwater management practices that capture and control rainfall at its source, before it can pool as runoff or combine with sewage in the combined sewer system.

State Pollutant Discharge Elimination System (SPDES)

New York State program, approved by the U.S.EPA for the control of wastewater and stormwater discharges in accordance with the Clean Water Act. SPDES permits can be broader in scope than those required by the Clean Water Act in that they can control point source discharges to groundwater as well as to surface waters.

Storm Drain

A building drain that conveys stormwater or other drainage, but not sewage.

Storm Sewer

A sewer that conveys rainwater, surface water, subsurface water, and similar liquid wastes.

Stormwater

Surface flow resulting from precipitation that accumulates in and flows through natural and/or manmade storage and conveyance systems during and immediately following a storm event.

Submeter

A site meter typically used to measure water intended for one purpose, such as irrigation. Also known as a Dedicated Meter.

T

Tankless Water Heater

Operates only when there is a demand for hot water and does not incorporate any hot water storage. Tankless water heaters eliminate most standby losses associated with tank type water heaters that must constantly maintain a tank of water at a high temperature. Also called Instantaneous Water Heater.

Tempered Water

Water heated to a temperature between 85°F (29°C) and 110°F (43°C).

V

Vacuum

Any pressure less than that exerted by the atmosphere.

Vegetated Swale

A long and narrow, trapezoidal or parabolic channel, planted with a variety of trees, shrubs, and grasses. Stormwater runoff is directed through the swale, where it is slowed and in some cases infiltrated, allowing pollutants to settle out.

Vegetative Source Control Measure

A source control measure that relies on living vegetative systems to reduce and/or slow the flow of stormwater into a combined sanitary and stormwater sewer or a separate stormwater sewer.

W

Waste

The discharge from any fixture, appliance, area, or appurtenance excluding fecal matter.

Waste Pod

Space allocated in buildings for future waste collection and treatment systems. The pods indicate the areas reserved for future tanks, filters and pumps. In some cases, piping can be capped for future connection.

Waste Sample Pit

See Sampling Pit.

Water Balance

The calculation made to balance water demand from various sources and can be determined by calculating the input, output, and storage changes of water during facility operations.

Water Efficiency

The planned management of water to prevent waste, overuse, and exploitation of the resource.

Water Pod

Space allocated in buildings for future water distribution systems. The pods indicate the areas reserved for future tanks, filters and pumps. In some cases, piping can be capped for future connection. Empty power conduit and panels can be provided for future electrical feeds to the equipment (see Energy Pod).

Water Pollution Control Plant (WPCP)

Plants that process sewage from sanitary sewers and sewage and stormwater in combined sewer systems.

Water Softener

Water is referred to as 'hard' when it contains an excess of minerals, especially calcium and magnesium. Rainwater is naturally soft, but as it percolates through the soil it dissolves and collects minerals. A water softener is a pressurized water treatment device in which hard water is passed through a bed of exchange media for the purpose of exchanging calcium and magnesium ions for sodium or potassium ions, thus producing "softened" water which is more desirable for laundering, bathing, and dishwashing.

Waterbody or Waterway

Any river, tidal estuary, bay, creek, canal, or other body of surface water.

Water Factor

Clothes Washer Water Factor

The quantity of water, in gallons, used to wash each cubic foot of machine capacity.

Dishwasher Water Factor

The quantity of water use, in gallons, per full machine wash and rinse cycle.

Water Heater

Any heating appliance or equipment that heats potable water and supplies such water to the potable hot water distribution system.

Waterless Urinal

See Non-Water Urinal.

Water Main

A water supply pipe or system of pipes installed and maintained by a city, township, county, public utility company or other public entity, on public property, in the street or in an approved dedicated easement of public or community use.

WaterSense

A partnership program sponsored by U.S. EPA to promote water efficiency while enhancing the market for water efficient products, programs, and practices. Products carrying the WaterSense label have been independently tested and certified to meet WaterSense criteria for efficiency and performance. Plumbing fixtures currently labeled under the WaterSense program include showerheads, toilets, lavatory faucets, and urinals.

WaterSense Bathroom (Lavatory) Faucets

Faucets that have a flow rate not to exceed 1.5 gallons per minute (gpm) (5.7 liters per minute) at a pressure of 60 psi (4.2 kg/cm^2) at the inlet, when water is flowing; and is not less than 0.8 gpm (3.0 liters per minute) at a pressure of 20 psi (1.4 kg/cm^2) at the inlet, when water is flowing. The specification can be found at http://www.epa.gov/watersense/specs/faucet_final.htm.

WaterSense HET

Toilets that have a flush volume not to exceed 1.28 gallons (4.8 liters), a solid waste removal of 350 grams or greater, and that conform to the adjustability and other supplementary requirements included in the specification. The specification can be found at http://www.epa.gov/watersense/specs/het.htm and a list of labeled toilet models can be found at http://www.epa.gov/watersense/pp/find_het.htm.

Wetlands Areas

Subject to Clean Water Act Section 404 are defined as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Wicks Law

Section 135 of the New York State Finance Law or otherwise commonly known as the "Wick's Law" requires specific separate Multiple Prime Contracts for certain public work projects where the total project cost of the public work (excluding site utilities outside the building and building demolitions) exceeds:

a. $3 million in Bronx, Kings, New York, Queens and Richmond counties, for work in NYC,

b. $1.5 million in Nassau, Suffolk and Westchester counties, and

c. $0.5 million in all other counties

Wick's Law requires that the contract documents be subdivided into the following major Prime Contracts with separate drawings and specifications packages to permit separate and independent bidding and award: Construction, Heating Ventilation and Air Conditioning (HVAC), Plumbing, and Electrical.

5.1 References

American Institute of Architects, AIA 50 to 50, Water Conservation, AIA website: http://wiki.aia.org/Wiki%20Pages/Water%20Conservation.aspx, 2007

City of Chicago, Department of Transportation, The Chicago Green Alley Handbook.

City of New York, Department of Environmental Protection, Harbor Water Wastewater Treatment System, NYC DEP website: http://www.nyc.gov/html/dep/html/harbor_water/index.shtml

City of New York, Department of Environmental Protection, History of Drought and Water Consumption, NYC DEP website: http://www.nyc.gov/html/dep/html/drinking_water/droughthist.shtml.

City of New York, Department of Environmental Protection, History of New York City's Water Supply System, NYC DEP website: http://www.nyc.gov/html/dep/html/drinking_water/history.shtml

City of New York, Department of Environmental Protection, New York City's Wastewater Treatment System, NYC DEP website: http://www.nyc.gov/html/dep/pdf/wwsystem.pdf, 2007

City of New York, Department of Environmental Protection, New York City's Wastewater Treatment System, Process Layout of a Typical New York City Water Pollution Control Plant, NYC DEP website: http://www.nyc.gov/html/dep/html/harbor_water/wwsystem-processdiagram_wide.shtml

City of New York, Department of Environmental Protection, New York City's Wastewater Treatment System, Wastewater Treatment Process, NYC DEP website: http://nyc.gov/html/dep/html/harbor_water/wwsystem-process.shtml

City of New York, Department of Environmental Protection, New York City's Water Supply System Map, NYC DEP website: http://nyc.gov/html/dep/html/drinking_water/wsmaps_wide.shtml

City of New York, Office of the Mayor, PlaNYC 2030, Water, PlaNYC website: http://www.nyc.gov/html/planyc2030/html/plan/water.shtml, 2008

City of New York, Office of the Mayor, PlaNYC 2030 Sustainable Stormwater Management Plan, PlaNYC website: http://www.nyc.gov/html/planyc2030/html/stormwater/stormwater.shtml, 2008

The Water Cycle, a summary and diagram by John M. Evans, U.S. Geological Survey, USGS website: http://ga.water.usgs.gov/edu/watercyclesummary.html.

Amy Vickers, Handbook of Water Use and Conservation: Homes-Landscapes-Businesses-Industries-Farms, WaterPlow Press, Amherst MA, 2001.

WaterSense, a partnership program sponsored by the U.S. Environmental Protection Agency, USEPA website: http://www.epa.gov/watersense

Watersmart Guidebook, A Water-Use Efficiency Plan-Review Guide, for New Businesses, East Bay Municipal Utility District, 2008, East Bay Municipal Utility District, 375 11th Street, Oakland CA 94607

Whole Building Design Guide, Achieving Sustainable Site Design through Low Impact Development Practices, Anne Guillette, LEED AP, WBDG website: http://www.wbdg.org/resources/lidsitedesign.php, last updated 2008

Whole Building Design Guide, Low Impact Development Technologies, Anne Guillette, LEED AP, WBDG website: http://www.wbdg.org/resources/lidtech.php, last updated 2008

Whole Building Design Guide, Water Conservation, Joseph Bourg, WBDG website: http://www.wbdg.org/resources/water_conservation.php, last updated 2008

5.2 Credits

Note: Most diagrams and illustrations used in this manual have been created using various source materials (credited in the following list). Those indicated by an * are original and exclusive to this publication.

1 Introduction

p.008 Overview of NYC Water Use System; NYC DEP website: http://nyc.gov/html/dep/html/watershed_protection/history.shtml

http://nyc.gov/html/dep/html/drinking_water/history.shtml

p.010 NYC Water Supply System; NYC DEP website, http://nyc.gov/html/dep/html/drinking_water/wsmaps_wide.shtml

p.011 Detail of NYC Water Supply Tunnels and Wastewater Treatment Plant Locations; NYC DEP website, http://nyc.gov/html/dep/html/harbor_water/wwsystem-plantlocations_wide.shtml

p.014 Water Conservation and Energy; NYC Energy Conservation Steering Committee, Introductory Memorandum of PlaNYC Long Term Plan to Reduce Energy Consumption and Greenhouse Gas Emissions of Municipal Buildings and Operations, NYC, July 2008.

2 How to use this Manual

p.022 Efficient Strategy System Diagram *

p.024 More Efficient Strategy System Diagram *

p.025 Ultra Efficient Strategy System Diagram *

p.028 Innovative Strategy System Diagram *

p.029 Renovation Strategy System Diagram *

p.032-045 Strategy Matrix *

3 Methods and Technologies

p.078 PF 5 Non-Water Urinal, Kohler, http://www.us.kohler.com/onlinecatalog/waterlessurinal.jsp

p.086 PF 7a Foam Flush Toilets, Clivus Multrum, www.clivusmultrum.com

p.095 MS 2 Cooling Tower *

p.100 MS 4 HVAC Condensate Water Reuse *

p.107 CS 1 Stormwater Detention and Retention Practices, New York State Stormwater Management Design Manual, Center for Watershed Protection, 2003.

p.115 CS 2 Infiltration Practices, New York State Stormwater Management Design Manual, Center for Watershed Protection, 2003, (figure is adapted from the Minnesota Stormwater Manual, http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html).

p.119 CS 3 Filtering Practices, New York State Stormwater Management Design Manual, Center for Watershed Protection, 2003.

p.120 CS 3 Filtering Practices, New York State Stormwater Management Design Manual, Center for Watershed Protection, 2003.

p.122 CS 3 Filtering Practices, New York State Stormwater Management Design Manual, Center for Watershed Protection, 2003.

p.123 CS 3 Filtering Practices, New York State Stormwater Management Design Manual, Center for Watershed Protection, 2003.

p.127 CS 4 Supplemental/Pretreatment Practices, New York State Stormwater Management Design Manual, Center for Watershed Protection, 2003.

p.128 CS 4 Supplemental/Pretreatment Practices, New York State Stormwater Management Design Manual, Center for Watershed Protection, 2003.

p.135 CS 6 Green Roof, Ecoroof Handbook, Environmental Services City of Portland Oregon, 2009.

Credits

p.154 PS 3a Graywater and Water Reuse (Building System) *

p.160 PS 3b Blackwater (Building System) *

p.163 PS 4 Waste Sample Pits, Smith Seckman Reid Engineers, www.ssr-inc.com

p.172 PS 7a Waste Pod (Multiple Piped Waste System) *

p.180 EN 1a Water Heater (Small Storage) *

p.185 EN 1c Water Heater (Large Condensing), Tyco Thermal, www.tycothermal.com

p.199 EN 3b Heat Recovery (Domestic Hot Water), GFX http://gfxtechnology.com

p.205 EN 5 Piping Layout (Domestic Hot Water) *

4 Integration Application Examples

p.261 1, 2 NYC Department of Parks & Recreation

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p.265 1, 2, 3 Lehman College Science Facility, Perkins+Will, New York, NY

p.267 1, 2 MTA NYC Transit Corona Maintenance/Car Wash, MTA NYCT Department of Capital Program Management

p.269 1, 2 Western Virginia Regional Jail, AECOM Design, Roanoke, VA

p.271 1, 2 NYC Fire Department (photos)

p.271 3 Solar Water Heat Loop Diagram

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