Water Management WEQ-1

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: To optimize utilization of site water resources.

Action: Implement a Water Management Plan to evaluate use of stormwater, wastewater and potable water resources, study potentials for onsite reclamation of wastewater and provide a coordinated management plan for full site water resources.

Use Federal Energy Management Program (FEMP) Best Management Practices and EPA recommendations per EO 13123 (Sect 207) (June 1999) to develop the Plan. The Plan must include, at a minimum, information on operation & maintenance, utility information, facility information, emergency response information and planning considerations.

Related Guidelines: SEQ-1, SEQ-2, SEQ-6, WEQ-2, WEQ-3, WEQ-4

Introduction/Context

Water is vital to all life, and is the earth's most precious natural resource. It is also the most at risk. Of all the water in the world, salt and fresh, less than .02% is potable, and much of that is under poor management and/or threatened by global desertification and increasing amounts of pollution. In the United States, water is under enormous pressure in many locations, as the demand to provide increasing amounts of water for industrial purposes, agriculture, commercial and human use often exceeds the ability of the source to replenish itself. Although the annual New York City rainfall exceeds 47 inches, with some 25,000,000 gallons of precipitation in the form of rain and snow falling on the World Trade Center site each year, a rigorous water management plan is increasingly, an essential, sustainable strategy for all new building developments.

The source of New York City's water supply is a vast infrastructure of interconnected reservoirs and lakes in the Catskill/Delaware watershed, which supplies some 90% of the city's needs, along with the original Croton Reservoir System, which supplies 10% or less. A small amount of water – less than 1% of the annual usage -- is generated by a series of groundwater wells in Queens.

Various departments of the New York City Department of Environmental Protection (DEP) are responsible for the management of water in the city, as follows:

- The Bureau of Water Supply is responsible for the collection, treatment and delivery of clean drinking water to the city.
- The Bureau of Water Supply and Sewer Operation operates and maintains the water distribution system, including fire protection and sewage systems for the conveyance of waste water and stormwater to the treatment plants.

- The Bureau of Wastewater Treatment is responsible for the operation of wastewater plants, and has the critical responsibility of making sure that treated water is safe and of an acceptably high standard prior to its release to other bodies of water.

To deal with increasingly frequent hot, dry summers, the New York City DEP has established certain year-round water use restrictions to conserve water and to help ensure that there is an adequate supply for the essential needs of all residents at all times. These include:

- A prohibition on the use of city water for watering sidewalks and lawns from 1 November to 31 March. (This strategy also minimizes the presence of freezing water on sidewalks).
- A prohibition on the use of city water for watering sidewalks and lawns during the hours of 11 AM to 7 PM from 1 April to 31 October.
- It is illegal to open fire-hydrants at anytime.

Water conservation in buildings begins with the development of a Comprehensive Water Management Plan. A principle objective of such a Plan is to match water to its end use in terms of its quality. In this manner, water of varying qualities has a place in commercial building operations where water use is very high, but not a great deal needs to be of potable quality. In this process called 'cascade planning', potable water, or 'first use' water from the municipal utility is ideally reserved solely for human and animal consumption and use. First use water must be available in all buildings at drinking fountains, toilet room and kitchen faucets or taps, and in showers and dish washers. However, water for the conveyance of waste material in urinals and water closets, and water used for irrigation, does not have to meet such a standard of such purity. In these locations, treated and recycled (previously used) water, or rainwater captured from non-porous building and site surfaces may be an option. Such water, known collectively as 'gray water', can also be used as make-up water in cooling towers, and for other maintenance purposes**.**

Relevant Issues

Ecological

Concerns about the quality of drinking water are rising in New York City. The DEP maintains that the potable water supply is of a high standard and meets all health-related state and federal drinking water standards, except for one suspected contaminant in 2003 – the latest year for which data is available. This substance, haloacetic acids (HAAS), is actually a group of acids that forms in surface water as a reaction between natural organic matter, such as leaves and vegetation, and the chlorine disinfectant used to kill bacteria and viruses. The amount of haloacetic acids in the water can fluctuate from day to day, depending on temperature, amount and type of organic matter, etc. According to the DEP, there is some concern that "……..long-term exposure to disinfection by-products (possibly including haloacetic acids) is associated with an increased risk for certain types of cancer." Research into this issue is continuing.

City water is treated with a number of chemicals including the following:

- Chlorine – as a disinfectant
- Fluoride – as a tooth decay preventative (required by NYC Health Code since 1966)
- Orthophosphate – to coat pipes, reducing the potential for metals such as lead to be released.
- Sodium hydroxide – to minimize corrosivity in water with low-pH.

All surface water is vulnerable to pollution and waste from industrial processes, agricultural chemicals (fertilizers, herbicides, etc.), stormwater/sewer overflows, hydrocarbon contamination washing off impervious road and parking surfaces, and biological impacts from animal and bird coliform. To help protect the city's water from waterborne diseases such as Cryptosporidium and Giardia, two serious, potentially harmful, waterborne pathogens, a new ultraviolet plant will be built on the Catskill/Croton system in 2005. In addition, a new filtration system is being designed for the Croton System to further minimize human exposure to microbial organisms and inorganic matter, and to reduce disinfection by-product levels, in an effort to ensure that the city's water supply is in compliance the new, stricter water quality standards.

New York City does not have separate stormwater and wastewater sewer systems. Existing combined systems can quickly become overtaxed during a heavy rain, leading to the discharge of untreated contaminants from sanitary waste and street runoff directly into surrounding water bodies. There are nearly 450 combined sewer outflows annually in all of New York City, each one a threat to the health and quality of the waters surrounding Manhattan. It is therefore of critical importance that the entire, vast World Trade Center site, including buildings, hardscape and landscape, be designed to minimize run-off, capture and retain stormwater at the site to reduce outflow impact, and to conserve this vital resource for essential site requirements.

Economic
The New York Water System is both economical and flexible. Some 95% of the total water supply is delivered to the city by gravity. Only about 5% of the water is regularly pumped to maintain desired pressure, although during periods of drought, additional pumping may be required. The cost of water, at $1.52 per 100,000 cubic feet (748 gallons), based on 2003 statistics, is reasonable by national standards. The minimal need for pumping ensures that operating costs are relatively insensitive to fluctuations in the cost of power, and reduced demand in recent years has helped to maintain stability across the pricing structure. (According to the 2003 New York City Water Supply & Quality Report, the New York City per capita use of water was 136.6 gallons per day for all uses, a significant reduction from 154.5 gallons in 2001.) However, a Comprehensive Water Management Plan addresses more than cost for the resource and its operation. It also considers all potential costs associated with quality maintenance, delivery, use and disposal, or treatment, at municipal facilities. It looks at the impact of new construction and new infrastructure, as well as conveyance and pumping costs (before and after use) and the operation of water-management facilities. Such a plan includes options for water conservation, reuse, more specific metering and potentials for limiting the availability of potable water to

those purposes which require water in its purest form. Studies have indicated that end-use metering of water utilities can reduce usage by up to 20%.

The collection and reuse of stormwater for non-potable building requirements and landscape irrigation reduces the amount of water that must be purchased from the local utility. Treating and re-using 'used' or gray, and possibly even black water, to flush toilets and for irrigation purposes provides obvious long-term savings, although there may be significant first-costs associated with the design and construction of the necessary on-site treatment facilities and piping systems. Conversely, first-cost financial benefits are realized by reducing the need to build large-scale infrastructure to convey and discharge storm and sewer water that can be usefully retained at the site, as well as avoidance of the typical, on-going utility charges associated with this process, including the costs of energy and chemicals used in municipal water treatment processes. Along with these direct benefits, the construction impacts on greenfields and natural habitat along the rivers and reservoir system are also avoided, as a result of conservation and the recycling or employment of a cascade management system to water reuse.

Neighborhood

Because water is vital to all life, and is today so seriously threatened by overuse and pollution, every step towards conservation may be seen as a protective measure, with the broad intent to share and preserve this critically important resource for the benefit of all users. In New York, water is, by and large, plentiful; however, this fact should not deter every citizen from using it wisely so that it may continue to serve the entire community. In times of drought, the New York State Governor, through the State Emergency Management Office (SEMA), may declare a state of emergency, and restrictive measures will be enforced as an essential part of the DEP's strategy to conserve water. However, conserving water on a voluntary basis not only minimizes this impact on city residents, it may reduce the frequency of occurrence of such restrictions, and it saves building owners money, as well as avoiding the additional costs associated with enforcement.

Unlike most urban areas, the 600 hundred miles of waterways around New York City belong to the population, not the state. The population therefore has a vested interest in maintaining water quality around Manhattan, and especially New York Harbor, which are subject to impacts from combined sewer and stormwater overflows. These water bodies will remain cleaner, with less toxic substances in the water and bottom sediments, and less bioaccumulation of toxins in animal tissue (fish, shrimp, shellfish, etc), when site stormwater flows are retained on-site. PCB's have been found in varying quantities throughout parts of the Hudson River. It only takes only one gram of PCBs to render up to one billion liters of water unsuitable for freshwater aquatic life!.

Methodology

Design Strategies

Water conservation strategies are most efficient when based on the principle of water quality cascade, meaning that the least intervention or treatment required to meet the water quality necessary for the planned end use is by far the most efficient approach...

Increasing perception of risk ↓ / Increasing quality requirement ↑

Source	End Use
Scheme water OR Treated and disinfected rainwater	Drinking Kitchen Showers Basins
Treated and disinfected greywater	Cleaning Cooling tower make up Toilet flushing
Treated and disinfected cooling tower blowdown	Cleaning Toilet flushing
Treated and disinfected blackwater and blackwater blowdown	Roof garden irrigation

Cascade Chart (Chanan 2003)

This reason encourages design strategies which consider an integrated approach to water conservation, incorporating a series of options from the World Trade Center Guidelines. At a minimum, incorporation of low-flow fixtures that exceed the requirements of EPAct to reduce the demand for potable (municipal) water, and strategies for the capture, storage and recycling of storm water from roofs and paved areas can be used to enhance the design approach. After minimal treatment this water is acceptable for both flushing toilets and irrigation. Further reaching efforts would allow for the inclusion of an on-site water treatment plant and building dual piping systems for grey water – all water from sinks and showers – which may be used, after treatment and disinfection, for flushing toilets and cooling tower make-up water. As an even more comprehensive strategy, black water capture, treatment to tertiary standards, and subsequent reuse should be considered.

Green roofs and other planted and pervious areas of the site will contribute to retaining stormwater, lowering the amount of run-off, and acting as an effective water conservation strategy. In addition, vegetation and soil materials help to mitigate heat island effect, and contribute to reducing the impact of the summer sun through evapotranspiration.

Means and Methods

Develop and implement a Comprehensive Water Management Plan to capitalize on the most effective methods for conserving all water resources on the immediate project site and within the building(s). Extend the area for storm water harvesting as far out beyond the project environs as reasonable to capture maximum contributions. Include potable water, stormwater and wastewater strategies in the Plan (WEQ-1), which should be designed according to the recommendations of EPA EO 13123 (June 1999) and FEMP Best Management Practices.

In establishing the water management plan, according to the authors of *Sustainable Water Management in Commercial Office Buildings*, “Support from water utilities is crucial, with a change in mindset from being water suppliers and wastewater managers to complete water service providers”. In developing a Comprehensive Water Management Plan, consult with the DEP. If the plan is for a large scale building or complex, and involves multiple initiatives, it will be important to work with these authorities in order to achieve coordination of strategies and maximum benefits. It is also important to work with city health officials to establish the parameters for waste water systems that may be considered, such as gray and/or black water reuse, and the level of treatment required to render such water useable for irrigation and other building purposes.

Case Studies

United States Environmental Projection Agency – Sample Plans

The US EPA provides various sample water management plans covering different building program types for people to reference. These plans help individual facilities set long- and short-term water conservation goals. The EPA set a goal of incorporating water management plans at 5 percent of its facilities in its Executive Order 13123 and accomplished this by the end of 2002. In conjunction with these plans, the EPA is tracking water use at its facilities than have undergone water management assessments. This will provide feedback regarding the success of different management plans and the strategies they contain. Currently the EPA has water management plans for 11 facilities with additional ones in development. These can be downloaded from the EPA's website at http://www.epa.gov/oaintrnt/water/plans.htm. (EPA 2004)

Reference

Definitions

Potable Water is water that is of sufficient quality that it has been approved for drinking by the authority having jurisdiction.

Water Pollution: The impairment of water quality by agricultural, domestic or industrial wastes to a degree that the natural water quality is changed to hinder any beneficial use of the water or render it offensive to the senses of sight, taste, or smell or when sufficient amounts of wastes create or pose a potential threat to human health or the environment.

Water Contamination: Contamination of the water supply constitutes an actual health hazard, exposing the consumer to potentially lethal water borne disease or illness.

Waterborne diseases: These are diseases or illnesses caused by drinking contaminated water. The contamination can be bacteria (*Salmonella, Campylobacter, Shigella, Myobacterium, Vibrio, Leptospira*, *Escherichia coli*), viruses, or small parasites (*Cryptosporidium*, *Giardia*, *Toxoplasma*). Most outbreaks of waterborne disease are caused by fecal contamination of water by infected animals or people.

Water Treatment:

- Primary treatment involves separation of suspended solids from wastewater by screening and sedimentation.

- Secondary treatment involves additional treatment, usually by biological processes, to remove organic matter and residual suspended material followed by disinfection
- Tertiary treatment produces higher quality effluent through the further removal of contaminants such as nitrogen, phosphorus, heavy metals, residual suspended and dissolved solids, and synthetic organic chemicals. Tertiary treatment can involve processes such as carbon adsorption, reverse osmosis, micro-filtration, and biological nitrogen and phosphorus removal*.*

Water Quality Cascade: Use of water that requires the least intervention or treatment in order to meet the water quality necessary for the planned end use.

Standards

Standards have not been included for this Guideline.

Bibliography

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Steinberg, Nancy, Dennis J. Suzkowski, Lori Clark and Juliette Way. "Health of the Harbor: First Comprehensive Look at the State of the NY/NJ Harbor Estuary". Hudson River Foundation. 2004.

United States. Environmental Protection Agency. Water Management Plans. 15 December 2004. US EPA 14 January 2005. *<http://www.epa.gov/oaintrnt/water/plans.htm.>*

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Objective

The Water Management Plan is intended to evaluate storm water, waste water and potable water resources, study potentials for onsite reclamation of wastewater and provide a coordinated management plan for full site water resources

Plan Components

I. Project Description (Plan Summary)

A. Provide a physical description of project. Include description of how water enters the site, is stored on the site and moves off the site.
B. Provide description of site water uses and their corresponding water quality requirements, how the use changes water quality and disposition of water at end of use.
C. Describe site water treatment systems: include onsite and offsite or municipal systems.
D. Outline local codes and city water programs/initiatives.

II. Water Resources Inventory

Provide a detailed list of site water resources. Include stormwater, municipal water, greywater and black water resources.

III. Water Uses Inventory

Provide a detailed list of site water uses. Include landscape requirements, building cleaning and maintenance, HVAC systems, toilets, food processing, showers, lavatories and pantries.

IV. Management Strategies

A. Document increasing Water Collection Potential
   1. Collect rain water from impervious ground-level surfaces and the roofs of buildings, treat water to tertiary standards and redistribute to all those services not requiring potable water.
   2. Consider creating a grey water system to collect, treat water to tertiary standards and redistribute to all those services not requiring potable water.
   3. In association with overall water management planning for the site, and cost considerations, review the potential to treat black water on-site as well.

B. Document means to decrease Water Use
   1. Use low-flow and dry plumbing fixtures.

2. Use automatic controls, such as motion sensors, on plumbing fixtures.
3. Specify no potable water to be used for landscaping, following the first year in which plants, trees and vegetation becomes established.
4. Provide monitoring controls and metering for 100% of the water systems. (*Studies indicate that metering utilities reduces usage by an average of 20%.)*
5. Reduce building cleaning requirements by designing particulate collection systems at entry ways and increasing ventilation air filtration.

V. Targets

Establish and describe project targets for the following

A. Amount of water diverted from the city sewers
B. Decreased demand for potable water due to measures implemented by this plan.
C. 5 year and 10 year plan for project water management.

VI. Evaluation

Upon project completion, compare established targets for IV.A and IV.B with results. If targets have not been met provide explanation and if necessary, revise 5 year and 10 year plans to accommodate revised results.

Water Management
Sustainable Design Guidelines Reference Manual
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Project Name: ______________________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	●	●	●	●	●
		Ⓔ	Ⓔ		

☐ **Required Component:**
A Water Management Plan is attached and includes comprehensive strategies for optimizing storm water, waste water, and potable water resources. This plan reflects the goals of both the Federal Energy Management Program's (FEMP) Best Management Practices and EPA EO 13123 (Sect 207). It also includes details regarding operation and maintenance, utility information, facility information, emergency response information, and planning considerations.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

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Wastewater Reuse WEQ-2

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Purpose: To minimize site wastewater outflows.

Action: Implement wastewater strategies as required by Water Management Plan. Use reclaimed storm water and/or site water for toilet flushing, cooling tower makeup, vehicle maintenance and irrigation needs. Study additional opportunities to reduce the amount of potable water used in the building for conveying sewage.

Related Guidelines: SEQ-1, SEQ-2, SEQ-6, WEQ-1, WEQ-3, WEQ-4

Potential LEED™ 2.1 Credit: 1 possible with WE cr. 2. (see Submittal Template)

Introduction/Context

With concern about water shortages around the world at an all-time high, it makes sense to engage in strategies to conserve this natural, severely threatened resource to the extent possible. To achieve maximum utility from water that has already been drawn from its sources via natural means – the evaporation/rainfall cycle -- and/or by human intervention, it must be recycled and reused in all appropriate situations. In buildings, the process where potable water delivered directly from the utility is reserved only for human consumption and personal use, and all other water applications depend on captured or gray water (recycled water that has been treated to tertiary standards), is known as water 'cascading'. Cascade planning is at the center of sustainable water management planning.

Among heavy water-consuming fixtures in all types of buildings, water closets are consistently the greatest (except for specific water-based industrial uses). Traditional urinals, because of frequency of use, also consume significant amounts of water. These fixtures do not require potable water for the conveyance of waste materials. Additional fixtures and applications that can perform as intended without the need for potable water include make-up water at cooling towers, on-site laundries, water used for irrigation and landscape purposes, and vehicle maintenance. These applications, along with toilets and urinals, may be supplied by non-potable, secondary use water from sources as described below.

At every building and building site, there are several sources of non-potable water that may be used to contribute to an overall Water Management Plan. First among these is storm water, precipitation that falls as rain or snow on the site. All water that falls on impervious surfaces may be harvested, cleaned and stored for application in any of the secondary uses described. Water from the roofs of buildings is significantly cleaner than water which has fallen on the streets, which tends to be compromised by hydrocarbons, dirt and particulate matter from fuel emissions and salts, and in plaza areas, from fertilizers and herbicides that wash out from planting beds. Gray water is the name given to this water, and to water that is recaptured from sinks and showers --'light-soil' uses. Both sources provide water that can be used, after treatment and disinfection, for all applications described. Black water is water that has been used for the conveyance of sewage, and while it may be recycled back into the system for cleaning and further application, often in the form of sewage conveyance again, must be treated to tertiary standards and disinfected in order to eliminate pathogens.

Relevant Issues

Ecological

There are many ecological benefits associated with recycled water captured from sources other than the water utility, and used for non-potable purposes. The most important of these is the protection of the watershed region and the water supply by minimizing draw-down of freshwater resources.

The harvesting of precipitation involves the simple capture of a free, natural resource at the site, followed by the retention of that asset at the site for future use. Treatment and filtering of these volumes of water is essential prior to reuse, but stormwater has a wide application and may be used at all non-potable fixtures and equipment. Harvested rainwater is an effective measure in stormwater control, limiting the amount of run-off from the site, which is particularly important in New York City, where the stormwater and sewer lines are combined. Restricting run-off from the World Trade Center site will help to avoid some of the mearly 450 outflows which occur each year in the city, dumping raw sewage into surrounding water bodies, as a result of storm surge overtaxing capacity and flooding of the combined storm/sewer systems.

Gray water systems are designed to draw off and reuse water from lavatories, showers, kitchen sinks, dish and clothes washing machines and laundries. The water, which is lightly soiled, is filtered, treated and disinfected before its reuse. Because of the large volumes generated, utilizing gray water is an important conservation strategy for a sustainable building or complex. In planning, the design of a treatment facility that is able to service several buildings might be considered, to off-set first costs. In addition to the on-site treatment plant, a secondary set of piping is required at each building, to ensure separation of gray water from potable water supply lines.

Currently, wastewater from Lower Manhattan and the World Trade Center site is piped to the Newtown Creek waste facility in Queens, New York. Cutting down on volumes of contaminated waste water that are delivered to the treatment facility will reduce the amount of energy expended and chemicals needed in the treatment process prior to its release to the East River. The amount of chlorination currently in use at the plant is in excess of limits set by the Federal Clean Water Act, so any diminishment of waste and waste water helps to reduce the water pollution resulting from this process at its point of greatest impact.

Economic

The actual need for '*potable*' water use in commercial buildings is measured at 15% to 20% maximum of all water supplied to the building. This is the only direct fresh water supply from municipal sources that is actually *needed* for commercial building use. Assuming there is a sufficient supply, all other water could come from gray water sources. However, because black water systems are still fairly rare, not all water used even in sustainably designed buildings is able to be recaptured. An efficient water system can still be expected, reasonably, to use municipal water for as much as 50% of total consumption. Clearly, even at a 50% reduction in municipal water use, there is an enormous economic benefit in avoided water utility fees, which can accrue to any building designed to take advantage of these economies. However, to participate in the benefits, non-traditional strategies, which contribute recycled water for some 50% to 80% of the building's supply must first be designed and put in place.

There is a significant 'first cost' (initial capital investment) associated with the design and construction of an on-site waste water recovery, filtration, treatment and disinfection system, and the more extensive piping necessary for gray water will increase the cost of regular plumbing. There are also costs associated with the purchase or construction of large-scale cisterns and their associated piping to hold and distribute harvested rainwater, and additional costs associated with maintaining these storage facilities. Water efficient cooling towers can use gray water and are typically designed to minimize evaporation through the use of delimiters; however, it is important to consider any energy penalty that may result from the application of this technology. All of these strategies must be reviewed in terms of a life-cycle analysis (LCA) including an assessment of the relevant systems and their impacts and benefits. Once the capital expenditure has been amortized, water conservation through maximum utility can 'pay back' handsomely, in terms of reduced fees and operating costs. (This will be dramatically more significant in the years to come, as New York's water costs are projected to rise sharply in the near future). Even more importantly, it is a far-reaching conservation strategy with long term advantages for the entire community being served by New York's huge, complex water system.

With an efficient Water Management Plan in place, addressing fresh water supply and conservation, as well as waste water reuse strategies, both the supply lines and the sewer mains are asked to handle significantly lower volumes of water. As a result, there is less wear on existing systems and fewer repairs required, reducing regional infrastructure costs. The strategy may also defer or even eliminate the need for new processing, filtration and treatment plants. Eliminating the necessity to continually expand by building new water management infrastructure not only reduces the economic burden on the city, it preserves open land and habitat. This is a win win situation – a prime example of sustainability, where thoughtful planning maximizes the use of a free resource (stormwater) and optimizes a resource that is already drawn down (gray water). In this manner a critical need is supplied, while deferring, and perhaps permanently avoiding, significant infrastructure costs as well as reducing the day-to-day costs of an increasingly vulnerable and scarce commodity.

Neighborhood

Conservation of water resources is a goal of universal significance. It is an approach to sustainability intended to enhance protection of the water supply for the greater benefit of all who share its life-giving force. Beneficiaries include those who consume it and depend upon it, from the people in the watershed region to those downstream in the city. It is essential for agriculture, fishing and recreational activities. Wildlife too, must have a plentiful supply of fresh water to remain strong and vital. With careful management and less draw-down through conservation strategies, the many lakes, rivers and reservoirs that constitute the great watershed areas of the Catskill/Delaware Reservoir and Croton Reservoir systems, will remain capable of supplying the entire community they serve with essential fresh water every day, including times of emergency, during the inevitable and seemingly increasingly common, summer droughts.

Rainfall harvesting at the site addresses two critically important issues that enhance community quality of life, as well as contributing to conservation: it provides a large portion of the 'raw material' for gray water systems, so that potable water does not have to be used for non-essential functions, and it reduces the potential for stormwater surge, where the sewers are overwhelmed by run-off, resulting in raw sewage and bio-hazardous outflows. For the health and well-being of the community, it is important to minimize these outflows, which contaminate the waters around Manhattan, contributing to hazardous (unsafe) or poor water quality for fishing, recreation and sport.

A reduction in the amount of water required to convey sewage through the municipal system actually increases the net efficiency of the plants, thereby avoiding the need for new and larger treatment facilities. These facilities are costly and typically have a negative impact on their neighborhoods, producing odors and air pollution. In addition they need energy to operate and a heavy use of chemicals to neutralize contaminants. Use of less potable water on the supply side, may also have the effect of stabilizing utility rates and reducing taxes.

Methodology

Design Strategies

The simplest approach to waste water reuse is through rainwater harvesting. A system which captures water from the building roof may use conventional methods such as slight slopes to direct flow, gutters and downspouts or pipes to capture and deliver the water to storage tanks, or cisterns, located either at the side of the building or in the basement. The cisterns require an overflow valve to handle excess water beyond their capacity. With limited treatment, in accordance with the city requirements, this water can be filtered and reused in toilets, urinals and for irrigation purposes. Stormwater collection from impervious surfaces at street level is strongly encouraged; however this water typically requires additional treatment before reuse.

The selection and specification of low-flow, or ultra-low-flow fixtures at rest rooms, laundries and kitchens, will not only reduce the demand for potable water; it will reduce the amount of waste water generated by the building. This is a second methodology which can be used to contribute to meeting the goals of this credit.

Many fixtures are available today, which are more efficient than the baseline established more than twelve years ago by the Energy Policy Act (1992), and are further described in WEQ-3 Water Use Efficiency.

Because most of the buildings will be new, gray water systems are an important consideration for the World Trade Center site. These systems are essential to the conservation of water in the long run, and can be used here as practical and effective exemplars for all future construction where water recovery is central to the sustainable goals of the project. It is simpler and more cost effective to design and construct gray and/or black water systems for new structures, rather than retrofitting existing buildings, because space for the additional plumbing required can be designed-in intentionally and provided for in planning and in the construction documents. The selection of the type of treatment system is important, with a choice of several available, such as aerobic biological reactors or mechanical sand filtering systems.

Means and Methods
Architectural/engineering teams engaged in sustainable projects need to undertake a water audit early in the design process, in order to determine the amount of waste water that will be generated in the building and available from all sources in the project. Consider all possibilities where the replacement of potable water with recycled or gray water would be appropriate, safe and contribute to water conservation and a reduction in sewage conveyance needs. Among the possibilities, include water closets and urinals, as well as maintenance areas, outside hose bibs used for irrigation and vehicle maintenance. Sub-surface and drip irrigation systems can also take advantage of gray water. Cooling tower make-up water can use gray water as well.

Based on the scale of the project, the anticipated water use, municipal rates and operational expenses, determine if a gray water system is an economically viable alternative to the use of municipal water at all appropriate locations. Although water rates in New York City are extraordinarily low at the time, they cannot be expected to remain so, as the water supply is increasingly under pressure, with greater demand across the globe than the available supply. Design teams are encouraged to consider several pricing structures to determine a reasonable break-even point between first costs and future water costs, in their examination of the viability of waste water recovery systems.

The generation of waste water can be greatly reduced by the specification and installation of low-flow toilets and appliances, and dry fixtures. A review of strategies designed to reduce the use of all water resources needs to be undertaken in the waste water analysis, and must be coordinated with WEQ-1 and WEQ-3 to correctly develop the water inventory. Less waste water means that there will be a smaller resource for a gray water system. The system should be designed to permit ‘topping up’ as necessary with harvested rainwater or municipal water - by running all piping from this single source, the duplication of piping is minimized.

Because gray water systems can be costly to install, a good methodology for reducing this capital expense is to consider a single gray water treatment plant to service several buildings. Diversity of water sources will reduce the potential need for added municipal water and help to reduce costs. Maintaining as much water at the site for reuse as described, will not only conserve potable water, it will greatly reduce the costs associated with sewage conveyance.

Case Studies

Audubon Center at Debs Park, Los Angeles, CA

The Audubon Society commissioned this project to provide a regional center with environmental education programs for 50,000 schoolchildren in the city of Los Angeles. Built on land leased from the City, the Center occupies 17 acres of a 282-acre urban wilderness park in downtown L.A. As part of its environmental agenda, this LEED 2.1 Platinum building was designed with a heavy focus on water conservation.. The building uses only 30% of the water consumed by a typical building of the same size and program. Even more significant, however is the degree to which this project reduces wastewater outflows. In fact the building is not even connected to the municipal sewer system, as 100% of its wastewater is treated on-site. The Audubon Center uses an anaerobic/aerobic hybrid treatment and filtration process. Wastewater is further cleansed by a peracetic acid and ultraviolet light advanced oxidation disinfection method. After being treated, a portion of this recycled water is used to flush toilets. 30% of the water is returned to the soil in an anaerobic sub-surface dispersion field. The architect specified dual-flush, low-flow toilets to lessen the initial amount of wastewater generated and reduce the required capacity and resource consumption of the treatment systems. (USGBC 2003)

20 River Terrace – The Solaire, Manhattan, New York

This LEED Gold residential tower operates an on-site blackwater system that processes 100% of the building's wastewater for reuse. The water recycled by this system supplies the HVAC system's cooling tower and toilets. Enough surplus is available to send 5,000 gallons a day to an adjacent public park. This building uses 50% less potable water than a conventional structure of this type. The structure recycles sufficient wastewater so that there is no potable water needed for exterior irrigation on the site. Waterless urinals and low-flow toilets further reduce the volume of wastewater generated by the tower. (USGBC 2003 [2])

CK Choi Building, University of British Columbia, Vancouver, B.C.

The CK Choi Building is home to the Institute of Asian Research at the University of British Columbia. The Building is a 29,000 ft², $4.5 million graduate research center comprised of offices, student workstations and seminar rooms. It's design incorporates many strategies to reduce wastewater generation and therefore does not require connection to a sanitary sewer system. In fact CK Choi uses 50% less water use than a typical new building of the same. (The building's water consumption is roughly 53 gallons per day.) Water efficient fixtures were used throughout the building. Bathrooms on all three levels of the building house composting toilets that, combined, save nearly 100,000 gallons of water per year. The composting "tea" that these toilets produce is automatically extracted from the compost tanks in the basement and combined with graywater from sinks and then filtered through a subsurface constructed wetland. The vegetation and microbial life in this wetland filter and clean the graywater through natural processes. In order to verify the safety and effectiveness of this system, the Vancouver Health Department has tested levels of fecal coliform in post-treated water and found that they are as low as 10 parts per

100 milliliters (mL). This is quite low considering that water with levels up to 200 parts per 100 mL is considered safe for people to swim in.

Reference

Definitions

Potable Water is water that is of a sufficiently high quality that it has been approved for drinking by the authority having jurisdiction.

Water Quality Cascade: Use of water that requires the least intervention or treatment in order to meet the water quality necessary for the planned end use.

Water Treatment:

- Primary treatment involves separation of suspended solids from wastewater by screening and sedimentation.
- Secondary treatment involves additional treatment, usually by biological processes, to remove organic matter and residual suspended material followed by disinfection
- Tertiary treatment produces higher quality effluent through the further removal of contaminants such as nitrogen, phosphorus, heavy metals, residual suspended and dissolved solids, and synthetic organic chemicals. Tertiary treatment can involve processes such as carbon adsorption, reverse osmosis, micro-filtration, and biological nitrogen and phosphorus removal.
  Source: Thomas et al. (1997).

Health Hazard or Non-Health Hazard: in water is a determination of whether the substance in the water is toxic (health hazard) or non-toxic (non-health hazard).

Standards

Standards have not been included for this Guideline.

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Wastewater Reuse

WEQ-2-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ______________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	○	○	○	○	○

☐ **Required Component:**
An outline is attached, describing strategies used to reduce wastewater production as part of the Water Management Plan.

☐ **Required Component:**
An outline is attached, explaining strategies used to capture and use stormwater as part of the Water Management Plan.

☐ **Required Component:**
Calculations are attached, as part of the Water Management Plan: Part V. – Targets. These serve to demonstrate the target reduction of building potable water use that is expected to result from the strategies outlined above. Further, a calculation matrix is attached to show the difference between 'best practice' and adopted sustainable strategies.

☐ **Optional Component:** (To satisfy the requirements of LEED™ 2.1 Water Efficiency Credit 2: Innovative Wastewater Technologies)
This certifies that the use of potable water for sewage conveyance will be reduced by at least 50% from baseline conditions. Supporting calculations and a narrative description of the measures used to achieve this reduction are attached.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

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Purpose: To maximize water efficiency within buildings and reduce the burden on municipal water systems.

Action: Reduce consumption of potable water as required by Water Management Plan. Use 30% less potable water than a baseline building (utilize 1992 Energy Policy Act fixture requirements to determine baseline) would by utilizing efficient water fixtures, automatic controls and/or waterless urinals.

Related Guidelines: SEQ-1, WEQ-1, WEQ-2

Potential LEED™ 2.1 Credits: 2 possible with WE cr. 3.1, and WE cr. 3.2 (see Submittal Template)

Introduction/Context

Until the early 1990's, traditional toilet room fixtures and kitchen faucets were designed solely on the basis of aesthetics and functionality, indicating an alarming lack of awareness of the shrinking fresh water supply and worldwide water crisis. Until recently, these types of fixtures, which consume enormous quantities of water (a typical old-style water closet will use 5 gallons per flush), were the only choices available. However, today while they are still in wide use, they cannot be specified for new design projects. In 1992, new water efficiency standards were introduced through the Energy Policy Act (EPAct), and were designed to reduce significantly the amount of water consumed by typical fixtures – water closets, lavatory faucets, kitchen faucets, shower heads and others. Shortly thereafter, a series of incentive programs were made available in a number of cities across the country to replace heavy-usage fixtures with more efficient fixtures compliant with EPAct. These programs were universally successful: in 1994, the New York City residential rebate program, for instance, replaced 1,635,400 old-style water closets with units using 1.6 gallons of water per flush.

The sustainable water conservation strategies of this Guideline strive to exceed the EPAct requirements. The ability to surpass these minimum standards is increasingly possible with the continuing introduction of new technologies. These include low-flow fixtures, the design of which has improved greatly in recent years. In addition many fixtures may also incorporate flow-controls and sensors to further conserve water. The use of dry fixtures for non-potable functions is also being encouraged by the green movement. Dry fixtures include such technologies as composting toilets and waterless urinals. The use of recycled, or treated 'gray' water, in fixtures and equipment, where appropriate is another conservation strategy gaining popularity.

Relevant Issues

Ecological

Water is the common denominator for all life as we know it. Preserving supplies provides for a long-lasting and more equitable distribution of this vital resource, which in turn supports both human activities and greater biodiversity. Minimizing draw-down of the huge watershed system of lakes, rivers and reservoirs to the North and West of the city, helps to maintain a healthy supply for all dependents – agriculture, recreation, wildlife – as well as the city's needs, especially in times of drought.

Reduced demand for potable water directly from the utility preserves the integrity of the infrastructure, saves on energy used to pump supplies, and avoids the release of pollution associated with the burning of fossil fuels to generate electricity. It also lessens use of chemical treatments, such as chlorine, fluoride and sodium hydroxide, required to ensure that the water is safe to drink and meets the standards established by the New York City Health Code.

Economic

Much of the water delivered to commercial and industrial buildings does not need to be of potable quality (see WEQ-1, Comprehensive Water Management Plan and WEQ-2 Waste Water Reuse). However, of the portion that must be potable – drinking water, water at fountains and faucets, showers and dish washers -- conservation strategies that depend on low-flow fixtures and enhancement devices such as automatic controls -- can save considerably on both municipal water fees and operational costs. These controls also subtly reduce the amount of water available for each function, reducing the energy demand for pumping and for water heating, while providing associated savings. A major benefit accrues to the city from the minimized burden on the utility infrastructure, which delivers potable water to the building, allowing major expansions to be deferred, and repairs minimized.

Based on the New York City census figures, the per capita use of water in 2003 was 136.6 gallons per day for all uses, down from 141.8 gallons in 2002 and154.5 gallons in 2001. This declining curve indicates a new awareness of the need to conserve water, reflected in a more careful selection of high-efficiency plumbing fixtures and other conservation strategies. The new, low-flow fixtures as mandated by EPAct do not have a cost premium, while those that conserve even more water may still be slightly more expensive due to their novelty. However, with greater demand, these costs are coming down, while the long-term benefits and reduced amounts of water needed increasingly off-set any initial up-charge.

Neighborhood

Drought, as experienced in recent years in the New York area – 1989 for instance, when the available supplies of water dropped to 55% of capacity (a Stage III emergency), as well as the shortages of 1991, 1995 and 2002 -- puts a strain on the whole watershed. All activities which depend on a plentiful supply of water suffer under such conditions, including upstate agriculture, fishing and recreation, as well as the quality of wildlife habitat and fisheries. Every individual in the city feels, at a minimum, discomfort. In April 2002, when reservoirs were at a Stage I level (57.5% full), there was a proposal to divert water from the Hudson River for municipal use.

Only the concern that the new, invasive species of zebra mussel would gain access to the city's water supply, multiply quickly and block sinks, toilets and drains prevented this initiative from going forward. The use of Hudson River water has been shelved temporarily, but may have to be reintroduced – with disastrous results according to the New York City DEP -- if extreme drought conditions recur and conservation strategies have not been sufficient to protect and sustain the water supply.

Methodology

Design Strategies

The design of a sustainable building's plumbing system must consider all issues of sanitation, flow and pressure, as well as environmental issues, which seek to reduce the use of all water, but especially potable water. The challenge presented by this credit is to achieve a water conservation goal in the aggregate of 30% over a 'best practice' base-case design, which relies on EPAct 1992 to determine its permissible water use. In the marketplace, there are many choices that will assist a design team in succeeding in this endeavor. Below are listed a number of options and strategies that can be considered and/or specified:

Fixture	Code/EPAct Fixture	Sustainable/Low-Flow Fixture
• Water Closet:	1.6 GPF	0.8 – 1.1 GPF
• Urinal	1.0 GPF	0.0 (Waterless)
• Lavatory (Bathroom Sink):	2.5 GPM	1.8 GPM
• Shower Head:	2.5 GPM*	1.8 GPM
• Kitchen Sink:	2.5 GPM	1.8 GPM
• Hand Wash Fountain:		0.5 GPM

*At flowing water of 80 psi

The performance of the water efficient fixtures noted above can be enhanced further by the specification and/or addition of a number of devices, among which are vacuum toilet systems, dual-flush toilet systems, electronic sensors that turn faucets on and off automatically when they 'sense' the presence of a person, and devices that are self-closing after releasing a pre-determined amount of water. These are particularly appropriate for use in public places. Aerators, which maintain water pressure but restrict the flow, may be inserted in shower heads and lavatory faucets. This strategy is mandated by the city during times of drought so that water is conserved while the impression of a plentiful supply remains. New technologies have made waterless urinals a real option for the 21st century – they are now sanitary, odorless, efficient and cost effective. These units depend on hydraulic action, and use a buoyant, often blue, gel in place of water. They require little more maintenance and represent an excellent water conservation strategy. Waterless urinals are one of the multiple water conservation strategies that are beginning to be specified widely throughout public and private sector buildings in New York City.

In applications other than drinking fountains, typical washroom fixtures, and kitchen sinks, potable water use can be restricted or eliminated in accordance with the overall Water Management Plan. Options include use of recycled or gray water at non-essential potable water locations, including cooling towers, on-site laundry locations and for irrigation purposes. Laundries or any commercial washing machine operation (on-site restaurant use, for example) can limit demand through use of a water-efficient ozone laundry system. Dry fixtures, such as composting toilets are an option, but are still fairly expensive and require special construction and maintenance methodologies, as well as an educated public.

Means and Methods
Develop an inventory in which all fixtures, equipment and services in the building that consume potable water are listed, but not those fixtures indicated in WEQ-2, Waste Water Reuse, which may be scheduled to operate with treated recycled storm or gray water. The fixture water use maximum allowance listed should reference EPAct as a starting point. This will provide a means to establish a base-case water use scenario. Following this, provide an inventory of low-flow and alternative water conserving fixtures specified for the project. The delta between standard 'good practice' (EPAct) and the more sustainable level achievable by the selection of water-conserving fixtures and equipment, will serve to indicate the amount of water saved.

Case Studies
<u>National Resources Defense Council Robert Redford Building, Santa Monica, CA</u>
The downtown Santa Monica Offices of the NRDC espouse ecologically benign water management strategies befitting a group dedicated to protecting public health and the environment. The systems in the building only use potable water for applications where it is essential: drinking and bathing. Graywater collected from sinks and showers is treated and then used for toilet flushing and landscape irrigation. A rainwater catchment and filtering system also provides non-potable water for these uses. The building's bathrooms are equipped with dual flush toilets that provide the user a choice of either a 0.8 or 1.2 gallon flush depending on how much water is needed. Waterless urinals contribute to maintaining water-use efficiency. The building operates water-conserving appliances such as a high-efficiency dishwasher. These strategies ultimately produce 60% less use of potable water as compared to a standard building.

<u>New York City Toilet Rebate Program (New York, NY)</u>
The New York City Department of Environmental Protection (DEP) launched one of the nation's most ambitious low-flow (LFT) toilet rebate programs in March of 1994. The City's goal was to encourage the replacement of one-third of the toilets in New York City with water-saving, 1.6 gallons-per-flush ULFTs.

"The Toilet Rebate Program (TRP) is a consumer-orientated water conservation initiative designed to save landlords and tenants money while helping the City stretch its capital construction budget. Since the program began in 1994, the TRP has installed more than one million toilet fixtures, cutting water use in the City by about 60 million gallons a day (MGD). These savings allowed the City to avoid the high costs of building new water supply and wastewater treatment facility, which helps keeps all water bills low and provides particular support to the City's affordable housing sector." (BuildingGreen.com 2004)

"The residential conservation programs have, in conjunction with other programs, reduced the City's use by almost 150 million gallons a day, with total savings to be expected from the TRP approaching 90 MGD by program end (end of calendar year). City wide 1,135,400 old-style toilets have been replaced by water-saving models and applications for an additional 500,000 toilets have been approved. Conservation has helped to preserve the City's affordable housing stock, helped protect water quality and allowed the City to avoid potentially billions of dollars in costly system expansions and modifications." (Mega-Cities 2001)

Reference

Definitions

Potable Water: is water that is of sufficient quality that it has been approved for drinking by the authority having jurisdiction.

Dry Fixtures: This term refers specifically to waterless urinals and toilets, such as composting and vacuum toilets that do not require water for the conveyance of sewage. These fixtures may have a water supply for maintenance purposes only.

Standards

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Water Use Efficiency

WEQ-3-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ____

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	◉	◉	◉	◉	◉
		Ⓔ	Ⓔ		

☐ **Required Component*:*** *(This will satisfy both LEED™ 2.1 Water Efficiency Credit 3.1: Water Use Reduction – 20% and Credit 3.2: Water Use Reduction – 30%)*
The attached documentation illustrates that the design achieves a minimum of 30% greater water efficiency than a baseline building defined according to The Energy Policy Act of 1992.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

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Purpose: To maximize utilization of site water for landscape requirements.

Action: Use storm water for landscape irrigation requirements in conjunction with Water Management Plan. Specify plantings requiring low amounts of watering. Use indigenous or acclimatized plants suitable for the current nature of the site. Employ high-efficiency irrigation systems with slow-drip, sub-soil irrigation and computer operation with linkages to meteorological data to optimize water resources.

Related Guidelines: SEQ-1, SEQ-2, WEQ-1, WEQ-2

Potential LEED™ 2.1 Credits: 2 possible with WE cr. 1.1, and WE cr. 1.2 (see Submittal Template)

Introduction/Context

As part of the Comprehensive Water Management Plan, water must be used to maximum levels of efficiency in order to preserve resources and to ensure the availability of potable water at all times for human and animal consumption. One of the most successful ways of contributing to this goal is to eliminate the use of potable, or municipal, water for irrigation purposes and landscape maintenance. All water used for landscaping functions can appropriately be derived from two, non-potable sources: First, through the natural cycle of precipitation, and second, through the use of recycled or gray water, gathered via rainwater harvesting from impervious surfaces at the site, and/or the collection of lightly soiled water from the buildings' waste systems. All water in this latter category must be treated to appropriate standards in accordance with the New York City Department of Health prior to use for irrigation.

In the United States, a growing number of cities have instigated conservation programs with municipal landscaping ordinances, rate structures and requirements for the installation of wastewater reuse systems, indicating a growing awareness of the need to preserve water resources. In recent years, public acceptance, as well as technological advances, in the collection and treatment of gray water and stormwater harvesting and storage have made the maintenance of healthy, efficient landscaping more cost effective and straightforward. Other significant strategies include the use of efficient water distribution systems, the specification of an indigenous or acclimatized tree, plant and ground-cover program, and application of an appropriate support and maintenance program of fertilizers, pesticides and herbicides to sustain the quality and health of the landscape planting materials with minimal toxic chemical impacts.

Relevant Issues

Ecological

Planted areas and trees are essential elements in the planning of the site. These pervious areas absorb stormwater naturally through their surfaces, contributing to the overall plan objective to capture and retain this vital element at the site (See WEQ-2). Ground cover such as grass offers opportunities for recreation and relaxation. Trees provide contrasting light and shade (chiaroscuro), enlivening the visual quality of open areas, plazas and streetscapes. Site plantings mark the changing of the seasons, adding variety, color and interest to the cityscape, a factor known to enhance human well-being. However, green spaces are important for more than their visual quality and psychological impact: these spaces contribute a major cooling effect at street level, which is a key environmental and human-centered/well-being issue. They reduce heat island effect at both ground level and planted roof areas, and they help to clean the air, absorbing carbon dioxide from vehicle exhaust, while throwing off oxygen.

Potable water is not needed for the maintenance of this huge asset-base. Carefully selected trees and landscaping plants thrive on recycled water, and in fact, contribute to the natural bioremediation cycle of such water by absorbing any remaining nutrients. The selection of indigenous and/or acclimatized trees, plants and especially ground-cover materials reduces the need for watering, as plants which have evolved in any given habitat are generally capable of surviving in tandem with the weather and precipitation patterns that characterize it. Indigenous planting materials also offer natural resistance to the typical pests with which they have evolved, and therefore require less use of fertilizer and pesticides to remain healthy, which in turn diminishes the amount of toxic chemicals needed for their maintenance. They provide food and habitat for indigenous species, such as the local song birds and insects -- bees and butterflies, for instance, which are essential to the continuum of biodiversity.

Economic

The use of trees and plants that require less water, and the use of irrigation systems that deliver that water efficiently, reduces municipal water fees and operating costs. The use of captured or recycled water further mitigates these costs. Native, drought resistant plants require minimal physical maintenance as well as the use of less maintenance chemicals, which also benefits the bottom line.

Purchasing plants from regional nurseries and tree farms not only guarantees planting materials that are acclimatized to the New York weather patterns and are therefore suited to the site locale, it saves on the costs of trucking, and cuts down on the use of gasoline, with its associated pollution. A further advantage is that this strategy supports local nurseries and market gardens, and helps to maintain the economy of the region by supporting small businesses.

Fertilizers, pesticides and herbicides are among the most toxic chemicals handled regularly by the general population. Many have ingredients that are in the process of being phased out and/or totally banned in the United States because of their extreme levels of toxicity. Minimizing toxins such as these, which pollute the air, exposing site occupants both at times of spray applications and during windy conditions, lessens the often severe health risks that are associated with exposure to pesticides and other such plant maintenance treatments. These spray and surface-applied chemicals also ‘wash out’ in stormwater, so any reduction in their use, together with decreased volumes of stormwater, minimize the amount and number of treatments needed to handle the waste from the site at the Newtown Creek Waste Facility, protecting the East River and New York Harbor ecology and reducing water conveyance fees.

Neighborhood

The original World Trade Center site was comprised of approximately 16 acres of land and the redevelopment zone now continues to grow. With an annual New York City rainfall of more than 47 inches, that means that some 25,000,000 gallons of precipitation in the form of rain and snow falls on the site each year. Capturing and retaining a large amount of this water will contribute to enhanced site hydrology and reduce the potential for stormwater/sewage outflows in times of heavy rain.

Using water wisely ensures that there will be sufficient available for community needs in times of scarcity. Potable water is best conserved for human use, and captured or recycled water, which has multiple applications, can be stretched by the sustainable strategies discussed in this chapter. Native or indigenous vegetation thrives on recycled waste water, which may deliver additional nutritional value (depending on the system), and will provide enriched green spaces and natural habitat for wildlife, enhancing community enjoyment of the site.

Minimized use of pesticides, fertilizers, herbicides and other chemical treatments contributes to a safer environment for human beings and wildlife, and to enhanced health of workers and community members. Fewer spray-type chemical applications reduce human exposure to airborne pollution. Fewer chemical toxins washing into the New York Harbor and nearby bodies of water enhance overall water quality and contribute to an increase in fish and marine animal populations, along with cleaner conditions for recreation, such as boating and fishing. Wildlife, including song birds, frequent locations with an abundance of native vegetation offering food and shelter that are not treated with excessive chemicals.

Methodology

Design Strategies

Specify trees, shrubs, flowering plants and ground cover that are indigenous, or that have become acclimatized to the conditions and weather patterns of the North East region of the United States. Once established, these plant materials will require minimal manual watering beyond regular rainfall. Ensure that planting beds are of a sufficient depth to support the tree or plants’ root systems, with good drainage at the lower levels, and soil capable of retaining and storing rainfall water. Test and amend soil if necessary, so that the alkalinity and/or acidity is appropriate for intended plantings, and add organic matter such as compost, manure or mulch to help retain moisture in the planting beds. Avoid laying out planting beds under building overhangs, where possible, or where they will not receive the full effect of available rainfall.

Consider using Xeriscape landscaping to totally eliminate irrigation needs for part of, or the entire, site. After the first year in which they become established, Xeriscape systems can reduce total water demand by as much as 50%. Where irrigation is necessary, employ efficient irrigation technologies to disseminate irrigation water economically and effectively, so that there is little or no loss or waste, and water is widely distributed, reaching the maximum amount of site vegetation.

While strategically placed lawns are an important community asset, and need to be included in the overall planning for green spaces at the site, they also have a high water demand and require the heavy use of herbicides to manage weeds. Regular mowing throughout the growing season is necessary, which contributes significantly to air pollution at the site. In small areas which are not conducive to public recreation or relaxation, but which will contribute to the overall 'greenspace' and landscaping plan, plant alternative, indigenous ground covers, which require little water and maintenance.

Design a stormwater harvesting system with cistern storage tanks, and/or a gray water system, with a piped or flexible hose delivery system to provide a large percentage of water for irrigation.

Means and Methods
Stormwater collection systems provide the means to use rainfall from the impervious surfaces at the site for irrigation purposes. If cisterns or holding tanks associated with such a system are located at basement level or below ground, they can be protected from frost damage, which is a serious consideration in New York City. However, a pump system, which uses energy, will be necessary to deliver the stored water to plaza or street level. If the tanks are located at ground level, they will be more vulnerable to the freeze/thaw cycle, however a gravity feed may be used to deliver water on an 'as needs' basis to irrigation systems and for other purposes. In either case, the cisterns must be equipped with an overflow valve and a means to remove excess water in case of flooding at times of heavy precipitation. Treated gray water may be a part of an overall collection system, or handled and stored separately for use within the site's buildings or for landscaping purposes.

In addition to using 'salvaged' or recycled water, employment of permanent, high-efficiency irrigation systems for all watering functions will extend the spread and delivery of water more effectively. These may be sub-soil hoses or pipes, or they may be near the surface of the planting beds. The following strategies may be considered:

- Use of slow-drip emitters and other low-volume irrigation devices
- Include moisture/rain sensors, timers, and shut-off devices, or tensiometers, which may be used to automatically limit distribution of irrigation water after a heavy rainfall.
- Systems that coordinate water demand with real-time meteorological data.
- Use of electronic controllers with timing devices
- Plan for multiple irrigation zones, with multiple cycles in accordance with the anticipated needs of each plant type or green area
- Zone lawn or turf irrigation areas separately from planting beds and trees

By setting all mechanical watering devices, including slow-drip system timers, to operate before sunrise or in the evening, water absorption is maximized and the potential for evaporation is minimized. This simple strategy can save as much as 30% of irrigation demand. Another option is to establish a water use pattern through careful plant material selection that minimizes or eliminates the need for watering in early spring, late fall and winter. This requires the setting of timers to operate accurately with seasonal changes. Automatic timers must be adjustable to allow for appropriate modification of irrigation sequences in times of drought and city water emergency restrictions. Use high quality mulch to help retain moisture in the planting beds in summer, and as a cover to protect plants from frost damage in winter. In New York City, most irrigation systems need to be drained and shut down during the winter months to avoid the freeze/thaw cycle and damage to pipes and valves.

A centralized irrigation control system for large areas of the site will save costs and labor and will increase water efficiency. These systems are generally computerized. There are several programs available such as Hyper-SPACE™, and SPACE Irrigation Survey, both developed by the Center for Irrigation Technology at California State University. Since water use will be part of the commissioning plan for the building, install water meters dedicated to track landscape irrigation water use.

Case Studies

<u>EPA Research Triangle Park Facility, Triangle Park, North Carolina</u>

This building was erected on the heavily eroded land of an abandoned farm. The land was covered with second growth vegetation that was only about 50 years old. During site analysis, a grouping of 100-year-old trees was discovered and marked for preservation. In fact, the EPA and their design team preserved as many old-growth trees as they could find on the site. They enacted strict forest protection laws and limited clearing to those areas absolutely essential for the buildings' construction. To reduce the need for major landscape maintenance, site vegetation was selected for its low-maintenance characteristics. Native landscaping and wildflowers were employed to reduce the long-term needs for water, fertilizer, and fossil-fuel burning maintenance equipment. Volunteers spent four weekends salvaging existing native plants to be reincorporated into the site design. The EPA now manages this site as a wildlife habitat. (BuildingGreen.com 2003)

Reference

Definitions

<u>Potable Water</u> is water that is of sufficient quality that it has been approved for drinking by the authority having jurisdiction.

<u>Xeriscape:</u> A landscaping approach designed to respond to natural climactic conditions. It is primarily concerned with water conservation. A xeriscape landscape is considered 'dry' because it uses plant species that survive on typical rainfall that is available via the normal climatological cycle at the site.

<u>Water Treatment:</u>

- Primary treatment involves separation of suspended solids from wastewater by screening and sedimentation.

- Secondary treatment involves additional treatment, usually by biological processes, to remove organic matter and residual suspended material followed by disinfection
- Tertiary treatment produces higher quality effluent through the further removal of contaminants such as nitrogen, phosphorus, heavy metals, residual suspended and dissolved solids, and synthetic organic chemicals. Tertiary treatment can involve processes such as carbon adsorption, reverse osmosis, micro-filtration, and biological nitrogen and phosphorus removal.
  Source: Thomas et al. (1997).

Standards

Standards have not been included for this Guideline.

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Landscape Hydrology

WEQ-4-T

Sustainable Design Guidelines Reference Manual
WTC Redevelopment Projects

Project Name: ______________________________

Phase:

SD	DD	CD	FINAL
☐	☐	☐	☐

Legend:

- ● Action Required
- ◉ LEED™ Equivalency Option allowed
- ○ Action Recommended
- Ⓔ Exemplar model

Project Type:

Transportation Hub	Site/Parcel	Commercial Office	Commercial Retail	Memorial	Cultural
☐	☐	☐	☐	☐	☐
●	◉	◉ Ⓔ	◉ Ⓔ	◉	◉

☐ **Required Component*:***
A site planting plan, schedule, and anticipated water requirements are attached. Calculations estimating the percentage of irrigation requirements to be achieved through water harvesting are indicated. A narrative description is attached outlining the high-efficiency irrigation technologies that have been specified.

☐ **Optional Component** *(To satisfy the requirements of LEED™ 2.1 Water Efficiency Credit 1.1: Water Efficient Landscaping – 50% Reduction.)*
This certifies that potable water consumption for site irrigation has been reduced by at least 50% over conventional means. A brief narrative of the methods used to achieve this is attached.

☐ **Optional Component** *(To satisfy the requirements of LEED™ 2.1 Water Efficiency Credit 1.2: Water Efficient Landscaping – No Potable Use.)*
This certifies that the project site will not use any potable water for irrigation. A complete description of systems used to capture and recycle rain/site water is attached. A list of all plant species used and calculations demonstrating how their irrigation needs can be met by the water capture systems described above is also attached.

Name ______________________ Signature ______________________

Company ______________________ Role in Project ______________________

Date ______________________

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