New York State Energy Research and Development Authority

Evaluation of the Water Treatment and Recycling System at The Visionaire

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Evaluation of the Water Treatment and Recycling System at The Visionaire

Final Report

Prepared for:

New York State Energy Research and Development Authority
Albany, NY

Robert M. Carver, PE
Senior Project Manager

Prepared by:

Alliance Environmental, LLC
Hillsborough, NJ

Zachary F. Gallagher, PE
Paul R. Knowles, Ph.D.
Lauren M.A. Shuler, B.A., B.S.

and

Albanese Organization Inc.
Garden City, NY

Michael Gubbins, LEED® AP
Project Manager

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Notice

Abstract

This study considered ways to optimize the integration of an in-building water treatment and reuse system (WTRS) to maximize opportunities for potable water conservation while minimizing associated system costs and power consumption. The WTRS in the study was installed at The Visionaire, a U.S. Green Building Council Platinum LEED®-certified residential tower block in Battery Park, New York City. The building has approximately 600 residents. The WTRS was designed to treat 25,000 gallons per day (gpd) and incorporated a membrane biological reactor (MBR) with subsequent disinfection and roof-water capture. Reclaimed water was used for toilet flushing, cooling tower make-up, and irrigation. From May 2010 to October 2011, average water reuse at The Visionaire was 8,200 gpd. The WTRS saved 4.3 million gallons of potable water and reduced water/sewer utility bills by approximately $88,200 over the course of the study by qualifying for the New York City Environmental Protection's Comprehensive Water Reuse Program (CWRP) incentives and exceptions-based sewer billing. Per capita potable consumption and wastewater discharge by The Visionaire was reduced by 35% in comparison to a conventional building. It was possible to achieve 100% use of reuse water in the cooling tower when the WTRS was operated to keep pH at approximately 7.3 and continuous disinfection by hypochlorite was stopped so that conductivity in the cooling tower was kept within limits. The application rate of corrosion/scaling inhibiting polymer in the cooling tower was quadrupled to enable reuse water to be used in the cooling tower up to 10 cycles of concentration. Average power consumption by the WTRS was 343 kWh/day, of which 57% was consumed by the MBR blowers, 15% was consumed by the building booster pumps, and 14% was consumed by combined disinfection provided by ultraviolet (UV) light and ozone. The maintenance requirements and power consumption associated with disinfection were minimized when a combination of ozone generating and ultraviolet disinfection technologies were used. Power consumption by the WTRS was relatively consistent over the course of the day and relatively unaffected by flow-rate. Operating the WTRS in batch-mode, rather than continuous operation, would improve energy efficiency and provide the opportunity to focus treatment during off-peak hours. It was recommended to The Visionaire that the performance of the WTRS be improved through the following measures: maximizing quantity of water reuse by using reuse water for laundry; operating the WTRS in batch-mode to improve WTRS efficiency; using separate blowers for fine and coarse aeration; and utilizing VFDs on the blowers and the booster pumps. It is recommended to NYSERDA that future onsite WTRS be installed to serve entire blocks rather than single buildings. In comparison to centralized water supply and wastewater treatment, onsite WTRS become economically beneficial when servicing a project that is four times larger than The Visionaire (equivalent to approximately 100,000 gpd design capacity for 2,440 people), and become energetically beneficial when servicing a project that is six times larger than The Visionaire (equivalent to approximately 183,000 gpd design capacity for 3,660 people).

Keywords

membrane biological reactor

water reuse

cooling tower

residential building

New York City

NYC

power consumption

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Acronyms and Abbreviations

AE	Alliance Environmental, LLC
Albanese	Albanese Organization Inc.
avg	average
AWM	Applied Water Management Group
BOD	biological oxygen demand
CFU	colony forming units
CWRP	Comprehensive Water Reuse Program
DEP	Department of Environmental Protection
DOB	Department of Buildings
gpcd	gallons per capita per day
gpd	gallons per day
gpf	gallons per flush
gpm	gallons per minute
kWh	kilowatt-hour
kgal	kilogallon
LOI	lost on ignition
MBR	membrane biological reactor
mgd	millions of gallon per day
NaOCl	sodium hypochlorite
NYC	New York City
O_3	ozone addition
TSS	total suspended solids
WTRS	water treatment and reuse system
WWTP	waste water treatment plant

Summary

The study provided insight into the economic, energy, and water performance of an onsite water treatment and reuse system (WTRS) in New York City (NYC). An 18-month monitoring study into the operation of an in-building WTRS was conducted at The Visionaire, a green residential tower in Battery Park, New York City. Recommendations were provided to NYSERDA with regard to how onsite WTRSs should be designed, operated, and integrated into NYC buildings to achieve superior economic and energy consumption performance in comparison to centralized treatment and supply.

S.1 Introduction

Several in-building WTRSs installed in NYC over the past decade have significantly reduced the potable water demand and sewer discharge of those buildings, which helps to reduce the demands on centralized infrastructure. Motivations to reduce potable water consumption and sewer discharge in NYC include: seven droughts in 45 years, projected population increase of 700,000 people in the next 20 years, increasing water and sewer rates, and discharge of raw sewage from combined sewers into New York Harbor during storm events.

In 2009, NYC utilized 1.04 billion gallons of water per day, or approximately 124 gallons per capita per day (gpcd). Approximately 60% of water consumption, or 75 gpcd, was for residential domestic use, which included all potable and non-potable, indoor, and outdoor applications. The NYC Department of Environmental Protection has established incentives to encourage water conservation. The NYC Water Board offers a flat 25% reduction of water and wastewater rates for all buildings that reduce consumption and discharge by 25% or more. In NYC, water reuse for toilet flushing, clothes washing, irrigation, and building cooling is permitted. Therefore, providing reuse water by using an onsite WTRS should reduce potable water demand, as these uses are traditionally supplied by potable water. If reuse water is used for all permitted applications, only 35 gpcd of potable water is actually needed for NYC residents, which is a potential reduction of 53% in comparison to current consumption of 75 gpcd. This reduction equates to saving a total of 550 million gallons of water every day.

One barrier to widespread adoption of onsite WTRSs is that little is known about how the economics and energy efficiency of in-building WTRSs compare with large-scale centralized water and wastewater treatment facilities. To address this knowledge gap, the New York State Energy Research and Development

Authority (NYSERDA) has contracted with Alliance Environmental (AE) to conduct this study in collaboration with the building management company, The Albanese Organization (Albanese); WTRS operator, American Water Works Company, Inc. (American Water); and the manager of the the building heating and cooling system, Chemtreat, Inc. (Chemtreat). Findings regarding the economic, water conservation, and energy consumption performance of The Visionaire WTRS are used to provide guidance to NYSERDA about how future indoor WTRS systems should be designed and operated to maximize potable water conservation while minimizing associated operating costs and energy consumption. The study was comprised of the following tasks:

- Perform a monitoring study at The Visionaire to understand the relationship between reuse water production by the WTRS, reduction on potable consumption and sewer discharge, operating cost expenses for the WTRS associated with energy consumption, chemical consumption and labor, and operating cost savings on water and sewer utility bills.
- Study opportunities to increase reuse water for the building cooling towers. This strategy will include changes to the typical quantity of cooling tower chemicals that are required to accommodate reuse water in place of potable water.
- Monitor the power consumption of the WTRS over time to identify opportunities to reduce power consumption during peak hours and realize cost savings through off-peak power consumption.
- Compare the economic, water, and energy consumption performance of The Visionaire with the WTRS to a building of similar size with water conserving measures but no reuse system, and a baseline building of similar size with no water conserving or reuse measures.
- Propose modifications to the WTRS, on the basis of study results, to improve energy and economic performance, and determine the ideal scale of application (single building, multiple building, or block-level).

S.2 WTRS Design

The Visionaire is a 33-story residential building that contains 248 condominiums. The 473,750-square foot building was designed and engineered to achieve LEED® Platinum designation by the U.S. Green Building Council. The WTRS directly treats a fraction of all domestic wastewater produced by the building. This fraction corresponds to the quantity of water that can be reused in the building for non-potable applications, which are cooling tower make-up, toilet flushing, clothes washing, and external irrigation. The additional water supply and wastewater treatment demands for the building are provided by the centralized NYC municipal water and sewer systems.

The WTRS includes a membrane bioreactor treatment system with disinfection provided by a combination of ultraviolet light (UV), ozone addition (O_3), and chlorination by sodium hypochlorite (NaOCl) addition. This combination of technologies improved the quality of the water to safe standard for indoor non-potable reuse, as regulated by the NYC Department of Buildings (DOB) plumbing code. Chemicals (alum and caustic) were also added to remove phosphate and adjust pH to improve the suitability of the reuse water for use in the cooling tower. A chemical addition program was used in the cooling tower to prevent scaling and corrosion within heat-exchanger elements. The program was adjusted to maximize the number of cycles of concentration that could be achieved with reuse water in the cooling tower before blow-down. In this study, a polymer was added to limit corrosion to the system from chloride, and the polymer dosing rate was increased four-fold.

S.3 Monitoring System Design

The monitoring system was comprised of the following physical components and processes:

- Twelve independent flow meters to monitor the distribution of potable water, reuse water, and wastewater.
- Water quality analyses performed on samples taken from the influent and effluent of the WTRS by a certified third-party laboratory. Analyses include pH, biological oxygen demand, total suspended solids, particle size distribution, fecal coliform count, turbidity, and E. coli count.
- Water quality analyses performed by Chemtreat on the make-up feed and condenser water loops in the cooling tower. Analyses include pH; conductivity; concentrations of total hardness, calcium hardness, and magnesium hardness; phosphates; molybdate; bromine; tolytriazole; iron; copper; total bacteria; zinc; nickel; aluminum; chloride; manganese; potassium; titanium; sulfate; and silica.
- Separate power consumption monitoring of the MBR feed pumps, trash pump, inline grinder, aeration blowers, recirculation pumps, permeate pumps, back-pulse pumps, UV system pump, ozone system pump, ozone system compressor, ozone generator, odor control blower, UV system and booster pump. Stand-alone motors equipped with hour timers are used to monitor the power consumption of the trash pump, ozone pump, uv pump, odor control blower and ozone compressor. The power consumptions of the remaining items are monitored using a data-logging power quality monitor.
- Logs of chemical consumption in the cooling tower and WTRS.
- A deposit monitor to provide an early-detection system for corrosion and scaling in the cooling tower. The deposit monitor uses a test heat exchanger with temperature above the normal skin temperature to provide conditions for preferential deposition.
- 30-day and 90-day corrosion tests performed on the cooling tower condenser water using steel and copper corrosion coupons.
- An annual analysis is performed by Chemtreat on a coupon rack pipe with removable 12 inch nipple.
- The condenser heat exchanger is de-scaled yearly and the removed scale is sent for compositional analysis.
- Chemical costs.
- Electricity expenses.
- Operating expenses for the WTRS are based on the value of the annual service contract charged to The Visionaire by American Water.
- Expenses paid for NYC water and sewer utility are based on monthly water and sewer bills charged to The Visionaire by NYC DEP. The billed rates are based on metered potable water consumption and include adjustments for exceptions based sewer allowances and CWRP incentives, where these adjustments are applied.

S.4 Performance of the WTRS at The Visionaire

Monitoring of WTRS at The Visionaire for this study ran for 529 days, from May 4, 2010, through October 15, 2011. During the study, the building averaged 436 residents, which represented 71% of the maximum population of 610 residents.

Over the study period, The Visionaire reused 4.3 million gallons of water, which would have otherwise been supplied through potable city supply (and subsequently discharged to city sewers). Total reuse comprised approximately 1.9 million gallons of closed loop reuse for toilet flushing and 2.4 million gallons of reuse that was evaporated in the cooling tower. The volume of reuse water utilized over the course of the study was only 52 % of the total volume that could have been reused for three main reasons:

- Use of reuse water in the cooling tower was limited to 5,000 gpd during a trial period which included summer 2010.
- A booster pump malfunction during April and May 2011 suspended reuse.
- The average occupancy of The Visionaire was only 71% of maximum occupancy over the course of the study.

Additionally, during summer 2011, the demand for cooling tower make-up exceeded the quantity of available reuse water, which made it impossible to achieve 100% reduction on potable water for cooling tower make-up.

During the monitoring period, the WTRS consumed 273,300 kWh to provide the total volume of reuse water (4.3 million gallons), which is equivalent to 64 kWh per 1,000 gallons of treated reuse water. Approximately 40% of total power consumption over the study period can be attributed to a booster pump malfunction during the months of April and May 2011, and typical power consumption would be approximately 43 kWh per 1,000 gallons of treated reuse water without the booster pump malfunction.

Chemical consumption by the WTRS over the course of the study is as follows: 671 gallons of sodium hydroxide (caustic), 438 gallons of aluminum sulfate (alum), and 53 gallons of sodium hypochlorite (bleach; continuous use of bleach by the WTRS was discontinued in November 2010). With regard to chemical consumption in the cooling tower, total consumption of corrosion-inhibiting polymer over the course of the study was 120 gallons, which is estimated to be approximately 50 gallons greater than that would have been consumed if potable water had been used in the cooling system.

Total cost of water-related services for The Visionaire over the study period was $232,536, including NYC potable supply and sewer service (32%); energy consumption by the WTRS (8%); chemical consumption by the WTRS and to implement reuse water in the cooling tower (11%); and the operator cost for the WTRS (48%). The total cost was equivalent to $452 per day. From November 2010, The Visionaire began receiving the CWRP incentive and exceptions based sewer allowance, which reduced the water and sewer bills for The Visionaire by approximately 43%.

Results for the monitoring period were used to project the typical annual performance of The Visionaire at full occupancy. At full occupancy, The Visionaire could prevent an estimated 4.9 million gallons per year of potable water consumption and wastewater discharge to sewer, and would consume 128,244 kWh per year to provide this volume of reuse water. Specific power consumption would be 27 kWh per 1,000 gallons treated. Annual costs for water-related services will be $145,127, including NYC potable supply and sewer service (24%), chemical costs (18%), energy costs (6%), and WTRS operator costs (51%).

S.5 Opportunities to Maximize Reuse Water in Cooling Towers

The shell-and-tube heat exchangers used in the cooling system condenser used reuse water as a refrigerant (within the tube side of the heat exchanger) without detrimental consequences for heat transfer performance or component longevity. This switch exchange was achieved by coordinating reuse water quality at the WTRS (target effluent pH of 7.3, ammonia concentration below 1 mg/L, cessation of continuous hypochlorite addition, less than two-log order fecal coliform count, and alum addition to minimize phosphate concentrations) with the chemical control program in the cooling tower (addition of polymer to limit chloride corrosion and enable a higher number of cycles of concentration to be achieved before blow-down is required).

- Through these measures, it was possible to achieve 7-10 cycles of concentration in the cooling tower, which is similar to the number of cycles of concentration achieved using potable water. Results from the deposit monitor, corrosion coupon analyses and heat-exchanger scalant compositional analyses all indicated that scaling/corrosion occurred at a typical rate for standard cooling system performance. According to the chiller deposit analysis, limited scaling was primarily due to calcium-phosphate precipitation (39%) and biological growth (37%). Based on the successful performance over the study period, Chemtreat agreed that future polymer additions could be reduced from 4 times the quantity used with potable water to 2–3 times the typical application for potable water.

S.6 WTRS Power Consumption

Disregarding the booster pump malfunction, process aeration was the largest consumer of energy and accounted for 57% of the total power consumed over the study. When functioning normally, the booster pumps consumed 15% of total power. Based on experience reported in the literature, blower and booster pump power consumption could be reduced by 25% if system modifications were employed such as installation of a Variable Frequency Drive (VFD) controlled via dissolved oxygen set-point in the aerobic tank. The combination of UV and ozone disinfection technologies consumes 14% of total power. Based on the findings of this study, the two disinfection technologies are complementary and it is more beneficial from both a maintenance and power consumption standpoint to maintain technologies than to use only one.

Over the study period, the WTRS consumed approximately 50% of its energy during peak hours (10a.m. to 10p.m.) and 50% during off-peak hours, which indicates that the system operates fairly consistently over the course of the day. Operating the system in batch-mode would provide the opportunity to perform 72% of annual treatment during off-peak hours and reduce demand on the power grid during peak hours. While batch-mode operations would improve energy consumption during peak hours it does not justify switching to a voluntary time-of-use rate structure from an economic perspective. This is due to the 28% of operations occurring during peak hours and the associated higher voluntary time-of-use rate during peak hours.

The power consumption of WTRS when the system produces 3,000 gpd (325 kWh per day) is relatively similar to power consumption at 15,000 gpd (375 kWh per day), thus indicating that power consumption is largely independent of flow. On the basis of Alliance Environmental's knowledge of MBR technology, only fine aeration, disinfection, and odor control must run continuously throughout the day, which is equivalent to a base-load of 176 kWh/day. Coarse aeration, permeate pumps, back-pulse pumps, in-line grinder, feed-pumps, and booster-pumps only need to operate when the membranes are permeating. The load associated with these devices would vary linearly up to 242 kWh/day when the system is producing 25,000 gpd.

S.7 Comparing Performance with a Baseline Building and a Water Conserving Building Without Reuse

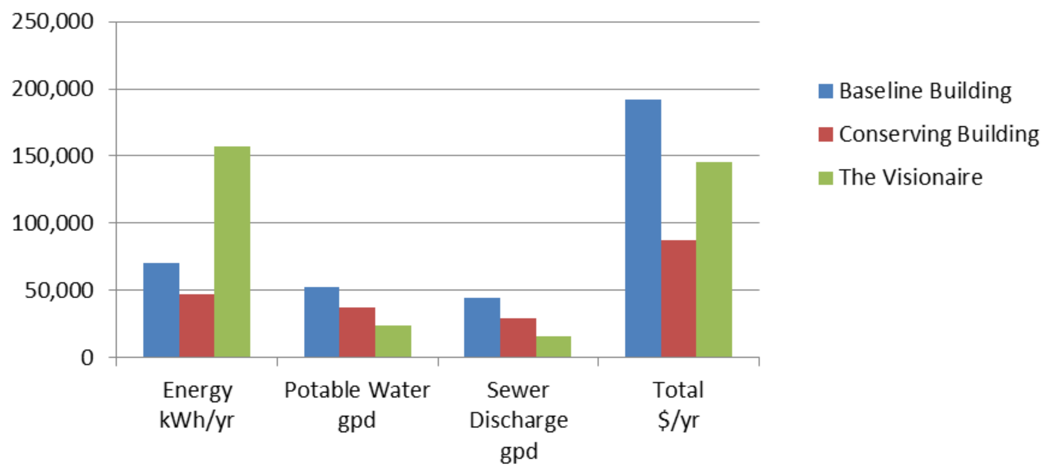
Figure S-1 compares projected annual performance of The Visionaire at full occupancy against the estimated performances of a conserving building (does not reuse water) and a baseline building (does not reuse water or use water conserving fixtures and fittings) of equivalent size (610 residents). Performance is based on the potable water consumed (gpd), wastewater discharged to sewer (gpd), the power consumed (kWh) and the total cost that are required to provide all water related services (potable water, reuse water and wastewater treatment) to the buildings. Figure S-2 illustrates that, in comparison to a baseline building:

- A conserving building would reduce potable water use by 29% and sewer discharge by 33%.
- The Visionaire would reduce potable water use by 55% and sewer discharge by 64%.
- A conserving building would reduce energy consumption for water related services by 33%.
- The Visionaire would increase energy consumption for water related services by 224%.
- A conserving building would reduce total water related service costs by 55%.
- The Visionaire would reduce total water related service costs by 24%.

In summary, at full occupancy, it is anticipated that The Visionaire would be cost-effective in comparison to a baseline building but would cost more to operate than a conserving building. The Visionaire will conserve more potable water and reduce sewer discharge in comparison to the baseline and conserving building. However, The Visionaire would consume more power than both alternatives.

Figure S-1. Comparing Various Water Use Scenarios

Projected annual performance of The Visionaire for all water related services (potable water, reuse water and wastewater treatment), in comparison to a conserving building (no reuse) and a baseline building (no reuse and no conserving fixtures and fittings).



S.8 Recommendations for Improving WTRS

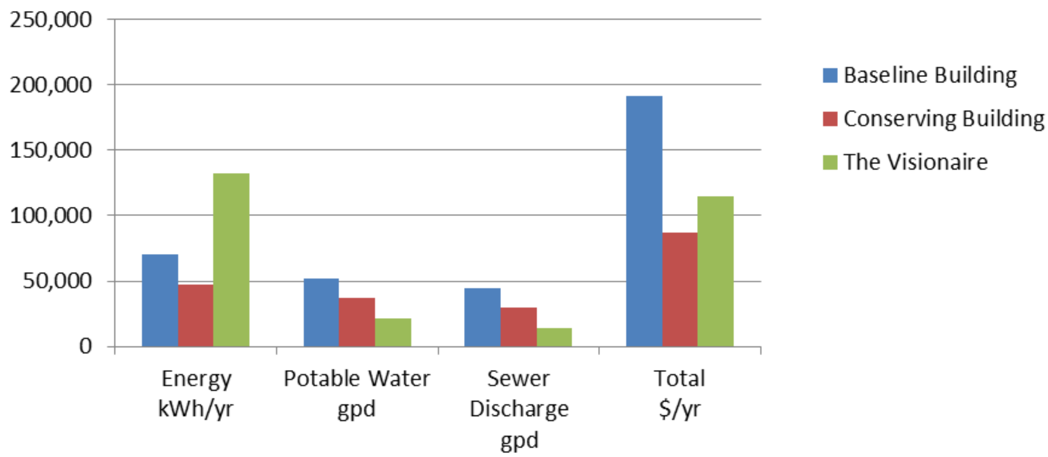
Several modifications were proposed to improve performance of The Visionaire's WTRS in comparison to a conserving building:

- Incorporating reuse water for laundry would save an additional 0.52 million gallons per year and maximize the use of the WTRS.
- Operating the WTRS in batch-mode to improve WTRS efficiency.
- Using separate blowers for fine and coarse aeration.
- Using VFDs on the fine aeration blowers and the booster pumps.
- Reducing the operator contract from $74,472 to $46,800 per year.
- Based on success over the trial-period, scaling back on polymer addition in the cooling tower from 4 times the quantity used with potable water to 2-3 times the amount used with potable water.

Based on these modifications, operating the system in batch-mode would reduce energy consumption of the system from 27 kWh per 1,000 gallons to an estimated 20 kWh per 1,000 gallons treated. Batch mode is when the system is operated at full speed for whatever length of time is required to meet demand for reuse water instead of adjusting the speed to produce less than 25,000 gpd over a 24 hour period. Total costs for water related services would be reduced to $114,172 per year. Figure S-2 compares the projected annual performance of The Visionaire WTRS with proposed modifications against the estimated performances of the baseline and conserving building. Figure S-2 illustrates that The Visionaire with modified WTRS would reduce potable water use by 59% and sewer discharge by 68%, in comparison to a baseline building. Energy consumption for water related services by The Visionaire with modified WTRS would be 189% of energy consumed by a baseline building, and total water related service costs for The Visionaire would be 40% lower than a baseline building.

Figure S-2. Comparing Various Water Use Scenarios with Proposed Modifications

Projected annual performance of The Visionaire WTRS with proposed modifications, for all water related services (potable water, reuse water and wastewater treatment), in comparison to a conserving building (no reuse) and a baseline building (no reuse and no conserving fixtures and fittings)



S.9 Recommendations for On-site WTRS

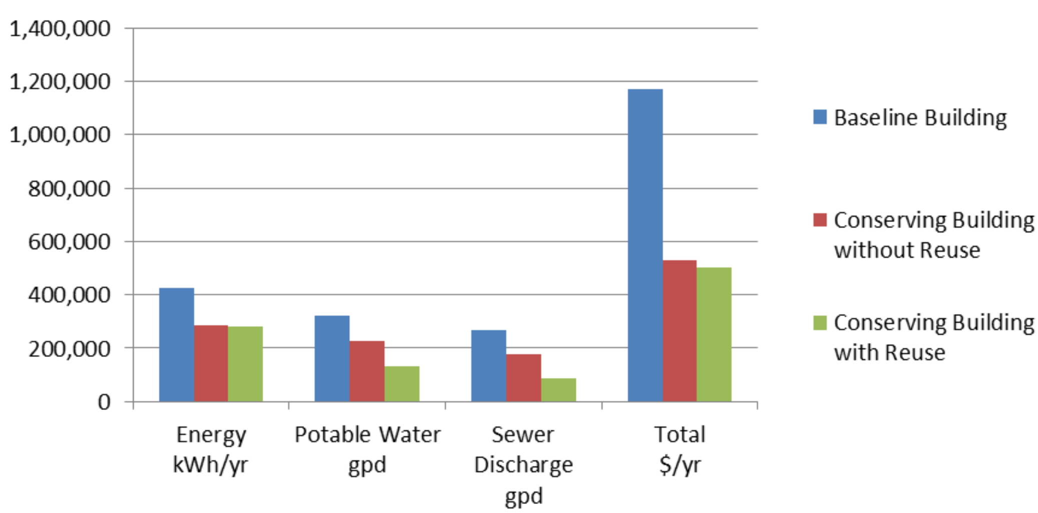
The modeled results regarding the performance of the The Visionaire WTRS at the 25,000-gpd scale were used to investigate the scale at which a conserving building with WTRS becomes economically and energetically beneficial in comparison to a conserving building without a WTRS.

The economic break-even points occur in a system that reduces potable consumption in a conserving building from 148,466 gpd to 85,918 gpd, and therefore conserves 22 million gallons of potable water per year. Given seasonal variations in reuse demand, a WTRS with an estimated design flow of approximately 100,000 gpd would be required, which is four times larger than the system at The Visionaire. In comparison to a conserving building without a WTRS, a conserving building with a 100,000-gpd WTRS would reduce sewer discharge by 51% but would consume 20% more power for all water-related services. At this scale, the conserving building with WTRS would outperform a baseline building on all performance measures.

Figure S-3 illustrates the approximate energy consumption break-even-point for a conserving building without a WTRS and a conserving building with a WTRS. As Figure S-3 illustrates, a system that reduces potable consumption in a conserving building from 227,945 gpd to 130,411 gpd, and therefore conserves 36 million gallons of potable water per year, is required to be energetically beneficial. Given seasonal variations in reuse demand, a WTRS with an estimated design flow of 185,000 gpd would be required, which is approximately six times larger than the system at The Visionaire. At this scale, the system would achieve a specific energy consumption of 3.9 kWh/kgal. A system of this scale would reduce sewer discharge from a conserving building by 51% and reduce total water related costs for a conserving building by $27,000 per year. At this scale, the conserving building with WTRS would outperform a baseline building and a conserving building without WTRS on all performance measures. Therefore, future WTRS installations should be designed to simultaneously serve 4-6 buildings that are similar to The Visionaire (i.e. block-scale), and not an individual building.

Figure S-3. Finding the Break-even Point Scenario

The annual performance of a conserving building with water reuse that is large enough to be energetically and economically beneficial for all water related services (potable water, reuse water and wastewater treatment) in comparison to a conserving building without water reuse. The performance of a baseline building (no reuse and no conserving fixtures and fittings) is also shown. The required service population for this break-even-point in 2012 is approximately 3,660 people.



S.10 Other Notable Findings

- Ozone and UV disinfection technologies are complementary, and maintaining both technologies is more beneficial from maintenance and power consumption standpoints to than to use only one.
- Using hypochlorite as a disinfectant leads to the accumulation of chlorides in the closed-loop reuse system, and limits the ability to supply reuse water to the cooling tower due to corrosion concerns. Hypochlorite should only be used for infrequent pipe-flushing with conventional disinfection provided by UV and ozone.
- Several inexplicable irregularities in the deposit monitor data-log were observed, which created doubt regarding the accuracy/robustness of the instrument. Use of real-time early corrosion/scaling detection systems will be increasingly important if reuse water application in cooling towers becomes more prevalent, however, the technology requires further refinement.

1 Introduction

This report summarizes the findings of an 18-month monitoring study into the operation of an in-building water reuse and treatment system (WTRS) at a green residential tower in New York City. The New York State Energy Research and Development Authority (NYSERDA) contracted Natural Systems Utilities (NSU), to conduct the study in collaboration with The Albanese Organization (Albanese) who manages the building; American Water Works Company, Inc. (American Water) who operates the WTRS operators; and Chemtreat, Inc. (Chemtreat) who manages the building's heating and cooling system.

The WTRS was installed at The Visionaire, an environmentally advanced residential tower completed in 2009 and located at the southern end of Battery Park City in Manhattan. Developed by the Albanese Corporation, the 33-story, 473,750-square-foot building contains 248 condominiums and has been designed and engineered to achieve LEED Platinum designation by the U.S. Green Building Council (USGBC).

The WTRS directly treats a fraction of all domestic wastewater produced in the building. This fraction corresponds to the quantity of water that can be reused in the building for non-potable applications, which are cooling tower make-up, toilet flushing, and external irrigation. The additional water supply and wastewater treatment demands for the building are provided by the centralized NYC municipal water and sewer systems. The concept of on-site wastewater treatment to provide reuse for non-potable demand is referred to as a decentralized or distributed approach.

The monitoring period spanned the first 18 months operation after the newly installed WTRS was permitted by NYC Department of Environmental Protection (DEP) in May 2010. The WTRS comprises a membrane bioreactor treatment system with disinfection provided by some combination of ultraviolet Light (UV), ozone addition (O_3), and chlorination by sodium hypochlorite (NaOCl) addition. This combination of technologies improves the quality of the water to a safe standard for indoor non-potable reuse, as regulated by the NYC Department of Buildings (DOB) plumbing code. Similar in-building WTRSs installed in NYC over the past decade have significantly reduced the potable water demand and sewer discharge of those buildings, which helps to reduce the demands on centralized infrastructure. However, little is known about how the economics and energy efficiency of in-building WTRSs compare with large-scale centralized water and wastewater treatment facilities.

Findings from this study into the economic, water, and energy performance of The Visionaire WTRS are extrapolated to provide general guidance about how future indoor WTRS systems should be designed and operated to maximize potable water conservation while minimizing associated operating costs and energy consumption.

1.1 Background

Background information is provided to put the significance of the study into perspective. The topics covered include the argument for, incentives for, and opportunity for water reuse in NYC, previous experience of providing water reuse in NYC by using decentralized MBR technology, and reports of decentralized MBR energy efficiency in comparison to centralized wastewater treatment in NYC.

1.1.1 The Case for Water Reuse in NYC

In 2009, NYC utilized 1.04 billion gallons of water per day, or approximately 124 gallons per capita per day (gpcd). Approximately 60% of water consumption, or 75 gpcd, was for residential domestic use which included all potable and non-potable, indoor, and outdoor applications. With regards to water efficiency, per capita consumption in NYC compares favorably to national average domestic consumption for single family U.S homes, which remained relatively unchanged between 1995 and 2005 at approximately 100 gpcd (Vickers 2005, USGS 2005). However, typical domestic consumption in NYC is expected be lower than the average U.S. single family home because residents in NYC live in multifamily apartment buildings that will incur less outdoor water uses such as irrigation of individual grounds or supply to individual swimming pools. Regardless, there is room for improvement. Average domestic water consumption in the United Kingdom during 2009, for example, was 40 gpcd (Ofwat 2009).

Numerous motivations exist to improve water efficiency in NYC:

- Seven droughts in 45 years, two of which lasted for more than a year, have exposed the vulnerability of the water supply.
- A projected population increase from 8.4 million in 2009 to 9.1 million by 2030 will create extra demand for existing water supplies.
- Water bills are increasing. The average annual water rate for a single family household in NYC increased from $698 in 2006 to $773 in 2010, an increase of almost 3% per year. Higher water bills can be attributed to rising energy prices and increasing capital replacement costs for existing water infrastructure.
- Combined sewer outfalls (CSOs) result in the overflow of untreated sewage to New York Harbor and are the single largest impairment to the quality of NYC waters. The combined sewer network of NYC becomes overwhelmed during rainfall exceeding 0.1 inches per hour such that a CSO event occurs once a week on average (NYC DEP 2007). There are 494 CSO outfalls discharging 27 billion gallons per year of combined sewage into New York Harbor; more than half occurs from just 15 outfalls. Reducing sewer discharge will help reduce the frequency and impact of CSOs.

1.1.2 Incentives for Water Reuse in NYC

PlaNYC 2030, issued by Mayor Bloomberg in 2007 and updated in April 2011, illustrates a desire to encourage aggressive growth while reducing water demand and discharge of wastes to waterways (The City of New York 2007). To accomplish this goal a combination of creative water and wastewater management strategies will be required. The NYC Department of Environmental Protection has established incentives to encourage more of this type development. The NYC Water Board offers a 25% reduction of water and wastewater rates for buildings that reduce consumption and discharge by 25% or more.

Reductions in potable water consumption can be achieved in several ways, including:

- Implementing water management and conservation practices.
- Utilizing appliances and fixtures which conserve water.
- Safely reusing water.

Modern green buildings, such as The Visionaire, are often designed and engineered to reduce potable water consumption. The USGBC LEED rating system encourages water efficiency by setting targets to achieve points towards LEED certification (Table 1). The Visionaire achieved a maximum number of points for the Water Efficiency section towards LEED Platinum Certification. Safely reusing water via the WTRS contributes toward all of the credits listed in Table1.

Table 1. USGBC LEED® Credit Characteristics for Water Efficiency

Percentage reductions are compared to a standard building without water conservation measures.

Source: LEED New Construction and Major Renovation Reference Guide (V 2.2). (USGBC 2006)

Credit	Description	Number of Points
WEc1.1	Water Efficient Landscaping: Reduce by 50%	1
WEc1.2	Water Efficient Landscaping: No Potable Water Use or No Irrigation	2
WEc2	Innovative Wastewater Technologies	1
WEc3.1	Water Use Reduction: 20%	1
WEc3.2	Water Use Reduction: 30%	2
TOTAL	**Maximum Number of Points from this Category**	**5**

1.1.3 Opportunities for Water Reuse in NYC

Safe reuse of water requires that wastewater is treated sufficiently such that its reuse for various applications does not pose a threat to human health or the environment. Therefore, the 2008 NYC Construction Codes Section PC 101 requires all water recycling systems in NYC to be regulated by the NYC Department of Health and Mental Hygiene. Water reuse in applications with risk of direct human ingestion is not permitted. According to Buildings Bulletin 2010-027 issued by the NYC DOB, water recycling systems in NYC must achieve strict water quality standards for subsequent reuse in non-potable applications, including water closets, urinals, cooling tower make-up, washing of exterior surfaces, laundry, and irrigation systems. Sources of reuse water can include rainwater and wastewater.

Average indoor water consumption in typical residences is 69.3 gpcd, which is used in toilet flushing, dishwashing, clothes washing, bathing, showering, faucets or lost through leaks, according to the data represented in Table 2 (Vickers 2002)**.** In NYC, reuse water supply for toilet flushing and clothes washing is permitted. Based on the numbers in Table 2, typical indoor domestic potable consumption could be reduced by 33.5 gpcd (48%). Other demands, such as irrigation and building cooling, can also be supplied by reuse water. With full utilization of reuse water, only 35 gpcd of potable water is actually needed for NYC resident, which is a potential reduction of 53% in comparison to current consumption of 75 gpcd. This savings equates to a total of 550 million gallons of water every day. Such a reduction would greatly alleviate vulnerability to future water shortages and stress on existing infrastructure.

Table 2. Average daily per capita uses of water in typical single-family U.S. homes

Source: Vickers 2002

End-Use	Reuse Permitted by NYC DOB	Typical Residential Consumption (gpcd)
Toilet Flushing	Yes	18.5
Showering	No	11.6
Faucets	No	10.9
Bathing	No	1.2
Dishwasher	No	1.0
Clothes Washer	Yes	15.0
Leaks	NA	9.5
Other indoor	NA	1.6
Other	Yes	31.7
TOTAL		**101**

The States of California and Florida have successfully implemented centralized reuse water utility, which is distributed in purple pipes to differentiate it from potable supply. However, such systems are not practical for NYC due to the difficulty associated with retrofitting purple-pipe infrastructure throughout existing developed areas. Instead, over the past 20 years, a unique water reuse strategy has evolved in NYC wherein decentralized water reuse systems have been built and operated on stand-alone developments. The Visionaire is an example of one such development. The following are other examples of NYC residential and commercial developments that have successfully implemented onsite water treatment and reuse:

- The Solaire in Battery Park City: The water reuse system at the 293-unit residential high rise apartment building was developed by The Albanese Organization and treats wastewater (black water and gray water) generated from the residential apartment units and recycles that water for flush water, cooling tower water and for landscape irrigation within Teardrop Park. Operation began in 2003 and data collected since that time indicates a 48% reduction in water consumption and a 60% reduction in wastewater discharge by comparison to a base NYC residential building as defined by the NYC Department of Environmental Protection. Some of the treated effluent from The Solaire is transferred to another Albanese building, The Verdesian, located near the Solaire.
- Tribeca Green in Battery Park City: Water reuse system for a 270-unit residential high rise apartment building.
- River House in Battery Park City: Water reuse system for a 264-unit residential high rise condominium that includes storm water and wastewater reuse for toilet, cooling, laundry (not used), and wash-down maintenance purposes.
- The Helena in Manhattan: The Helena is a LEED Gold-certified, 38-story, 597-unit apartment building developed by Durst Fetner. The Helena has an onsite WTRS that supplies treated effluent for toilet flush water and cooling tower make-up.
- The Bank of America Tower at One Bryant Park, Manhattan: The Bank of America Tower was developed by The Durst Organization and is located in the heart of Midtown Manhattan. One Bryant Park performs grey water and storm water reuse for toilet flush water.
- Millennium Tower Residences in Battery Park City: The environmentally advanced residential tower was developed and owned by Millennium Partners. The 234-unit, 35-story structure has earned a LEED Gold designation by the U.S. Green Building Council. Treated wastewater is reused for toilet flushing, building cooling, and irrigation.
- The New School University Center in Manhattan: WTRS to supply recycled water for toilets, cooling tower, and laundry cold water supply for uses in academic, classroom, auditorium, and dormitory.

The buildings listed previously use a combination of water conservation and water reuse to reduce potable consumption. For high urban density situations, on-site water treatment is often provided by membrane package plants, such as MBRs. This technology is installed in The Visionaire, and will be discussed in more detail in Section 2 of this report.

1.1.4 Comparing Energy Efficiency of Wastewater Treatments

Direct water reuse offers many advantages from a water supply and environmental waste load perspective, but the energy aspects are not yet adequately quantified. It is now well recognized that there is a strong connection between energy consumption and water consumption, often referred to as the Energy/Water Nexus, which must be addressed in future planning for both water and energy management. Although not considered by this report, the embodied energy of fabrication, installation and maintenance for potable water distribution lines and sewage collection lines can be a large part of life-cycle energy costs for water infrastructure (Filion et al. 2004).

An estimated 0.7% of U.S. greenhouse gas emissions nationwide are derived from municipal wastewater treatment (Rogalla et al. 2008). Approximately 2% of the energy consumed in New York State is consumed by municipal wastewater treatment facilities (Lampman et al. 2008). The national average of energy consumption for advanced wastewater treatment is approximately 3.0 kWh/kgal. Approximately 4% of the nation's energy is used in water and wastewater treatment (EPRI 2000).

The wastewater of NYC is currently treated by 14 centralized activated sludge wastewater treatment plants. These systems range in capacity from 40 million to 310 million gallons per day (MGD), and are considered large-scale systems. In total, these 14 systems consume 522,300 kWh per day to treat 446 MGD of wastewater, which is equivalent to 1.2 kWh/kgal. According to a study conducted by the City of New York, total power consumption for wastewater treatment including pumping requires approximately 4.0 kWh/kgal (Dickinson et al. 2011).

A nationwide study conducted by the Electric Power Research Institute (EPRI) determined that the treatment and supply of surface water for potable use requires an average 1.41 kWh/kgal. The treatment of surface water uses 15-20% of the total energy, while the remaining 80-85% of energy use is consumed by the distribution system (EPRI 2000).

NYC water is predominantly supplied by surface water reservoir sources from the Catskill/Delaware and Croton Watersheds. These watersheds are protected under the NYC Watershed Protection program, one of the most comprehensive in the nation, to ensure clean drinking water supply for NYC. Approximately 1 billion gallons of water is delivered from these Upstate reservoirs to NYC daily (NYC DEP "Drinking Water" 2012). The treatment and supply of NYC potable water requires approximately 0.3 kWh/kgal (Dickinson et al. 2011). Differences between NYC potable water energy consumption and the nation are a result of predominantly gravity transfer from the Catskills with the addition that NYC is exempt from filtering its water due to the NYC Watershed Protection Program (NYC DEP "Regulatory Background" 2012).

Generally speaking, economies of scale exist whereby the larger the quantity of water and wastewater to be treated, the more energy efficient the process in terms of kilowatt-hours of power consumed per gallon of wastewater treated. However, little is known about how the power consumption of small-scale distributed infrastructure compares to power consumption in large-scale centralized treatment systems. Higher specific power consumption by small-scale treatment systems may be compensated for by negating power consumption associated with pumping to/from centralized facilities. Better understanding regarding energy consumption of onsite WTRS and opportunities to improve energy efficiency will determine the long-term viability of the decentralized infrastructure approach.

Although it will not be considered in this report, the other side of the nexus concerns the amount of water consumed to produce electricity. It is reported that U.S. citizens may indirectly use as much water turning on the lights and running electric appliances as they directly use flushing toilets and feeding water use appliances (Sandia National Laboratories 2005). Electricity production from fossil fuels and nuclear energy requires 190,000 million gallons of water per day, accounting for 39% of all freshwater withdrawals in the nation, with 71% of that going to fossil-fuel electricity generation alone (USGS 2007).

1.2 Aims and Objectives

The major aim of the study was to provide insight into the economic, energy and water performance of an onsite WTRS in NYC. The collected data could then be used to inform other potential projects on how onsite WTRSs should be designed and operated to achieve optimum integration into NYC buildings and achieve superior economic and energy consumption performance in comparison to centralized treatment and supply.

The aim included the following objectives:

- Perform a monitoring study at The Visionaire to understand the relationship between reuse water production by the WTRS, reduction on potable consumption and sewer discharge, operating cost expenses for the WTRS associated with energy consumption, chemical consumption and labor, and operating cost savings on water and sewer utility bills.
- Study opportunities to maximize the use of reuse water for make-up in the building cooling towers. This will include changes to the typical quantity of cooling tower chemicals that are required to accommodate reuse water in place of potable water.
- Monitor the power consumption of the WTRS over time to identify opportunities to reduce power consumption during peak hours and realize cost savings through off-peak power consumption.
- Compare the economic, water, and energy consumption performance of The Visionaire with the WTRS to a building of similar size with water conserving measures but no reuse system, and a baseline building of similar size with no water conserving or reuse measures.
- Based on the findings of The Visionaire study, propose modifications to the WTRS to improve energy and economic performance, and determine at what scale of application (single building, multiple building, block-level) the system would have superior economic and energy consumption performance that a conserving building or baseline building of similar size.

2 Description of The Visionaire WTRS

2.1 Study Site

2.1.1 Description

The Visionaire is a 33-story, 248-unit condominium tower located at 70 Little West Street, Battery Park City, New York, NY 10004. Building construction was completed in 2008 and occupation commenced during 2009. As of November 2011, The Visionaire had 513 residents, which represents 84% of projected population at full capacity (610 residents). In addition there are 16 full time staff and an average of 65 guests per day. The Visionaire was developed by The Albanese Organization (Albanese), and was designed and engineered to achieve USGBC LEED Platinum certification.

2.1.2 The Visionaire Water Balance

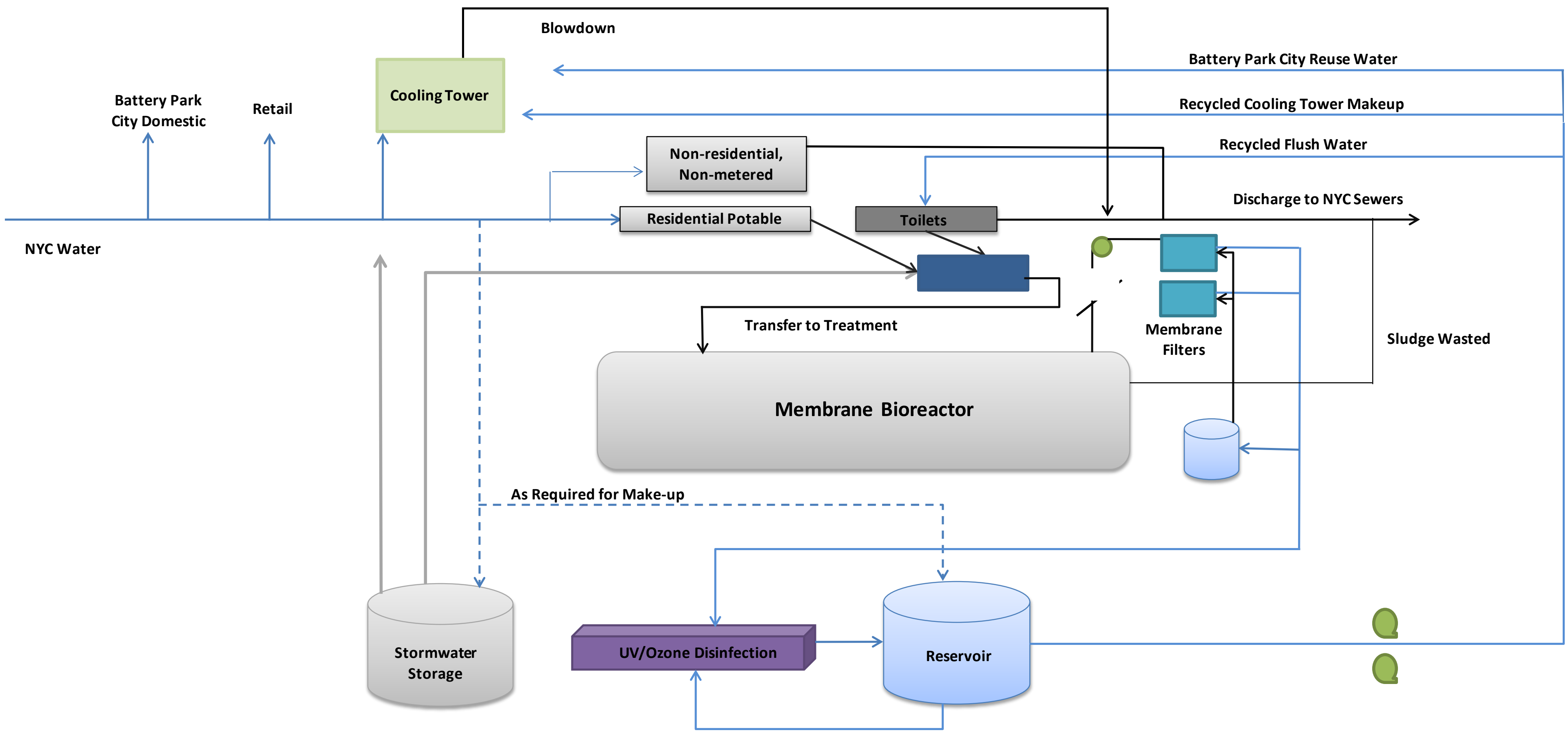
The Visionaire incorporates several systems to reduce the consumption of potable water:

- Water conserving (low-flow) appliances and fixtures.
- Wastewater treatment and recycling for toilet flushing and mechanical cooling.

Permeable green roof with storm water storage for irrigation. Figure 1 illustrates the water process diagram at The Visionaire. Water proceeds through the property as follows:

- NYC water enters the property and is used at Battery Park City Authority for street cleaning and irrigation, onsite retail, cooling tower top-up, residential potable uses (such as sinks, showers, and faucets), and non-residential uses (such as building maintenance and communal areas).
- Discharge from Battery Park City Authority and retail goes directly to the municipal sewer system. Any water that goes to the cooling tower evaporates or is blown down directly to sewer. Discharges from non-residential uses also go directly to sewer. All wastewater from indoor potable residential use flows to a feed tank in the basement of The Visionaire. Any wastewater not treated through the WTRS is sent to sewer.
- The WTRS via the MBR treats wastewater stored in the wastewater feed tank when there is demand for reuse water. Treated water is stored in a reuse reservoir. Potable water is used to top off the storage reservoir if demand for reuse water exceeds supply capacity. Reuse water is distributed through The Visionaire to provide cooling tower make-up, toilet flush water, and reuse for Battery Park City.
- Storm water is captured and used for irrigation. Excess storm water is sent to sewer. Potable water tops up the storm water tank if demand for irrigation exceeds capacity.

Figure 1. Schematic of the WTRS in place at The Visionaire.



2.1.3 Water Conserving Fixtures

The Visionaire utilizes water conserving (low-flow) fixtures and appliances to directly reduce water demands for residential indoor applications. Table 3 summarizes the water conserving performance and number of fixtures and appliances installed in the building.

Table 3. Plumbing fixture specifications for The Visionaire

Fixture	Description	Water Use	Number Installed
Kitchen faucet	Franke Swing FF 280	2.2 gpm	248
Washing machine	Asko W6022	9.3 gal / use	248
Dishwasher	Asko D3232	3.61 gal / use	248
Lavatory faucet	Waterworks ABLS03	2.2 gpm	501
Showerhead	Waterworks ABSH71	2.5 gpm	655
Toilet	TOTO CST416M dual flush	0.9/1.6 gal / flush	501

Table 4 calculates total water demand for indoor residential applications at The Visionaire, based on the conserving fixtures listed in Table 4, and a population of 610 residents and 65 guests per day. Per population usage statistics for the appliances and fixtures are based on information from "The Handbook of Water Use and Conservation" (Vickers 2002). Table 4 indicates that projected water consumption at The Visionaire for indoor residential uses is equivalent to 26,500 gpd.

Table 4. Projected fixture and appliance-based water demand in The Visionaire

Source: Vickers 2002

Fixture Unit Analysis	The Visionaire (gpd)	Basis of calculation – The Visionaire
Toilet/Urinal Use	4,999	((occupants x 5.1 flushes / day) + (guests x 25%)) x 1.6 gpf)
Showers	8,082	occupants x 1 occ use / day x 5.3 minutes / use x 2.5 gpm†
Faucets	10,870	occupants x 8.1 min/day x 2.2 gpm
Dishwasher	374	occupants x 0.17 uses / day / occupant x 3.61 gallons / use
Clothes Washer	2,211	occupants x 9.3 gallons / use x 0.37 uses / day / person
Total of Indoor Use	**26,536**	

† Showerhead flows are typically 67% of the rating i.e. a rated flow of 3.3 gpm translates to an actual flow of approximately 2.2 gpm

2.1.4 Cooling Tower Demand

Based on previous research performed by Alliance Environmental regarding water consumption in cooling towers, baseline cooling tower consumption is estimated using a coefficient of 0.04 gpd/ft^2 (Alliance Environmental 2010). Cooling tower demand in NYC is highly variable by season, so this number represents an annualized average daily value. Using the total building footprint for The Visionaire (473,750 ft^2), the approximate average demand for a baseline building is 18,950 gpd of potable water.

2.1.5 Green Roof Storm Water Capture and Irrigation Demand

The Visionaire has a total of 19,509 square feet of vegetated green roof (67.4% of total roof area) that is specially constructed with a slow draining support media to reduce roof run-off from the building during storm events. Storm water that percolates through the green roof drains to a 12,000 gallon storm water storage reservoir inside the building. Stored storm water can be directly reused for green roof irrigation, or discharged at a metered rate to the combined sewer, to alleviate pressure on the combined sewer during storm events. Table 5 summarizes all roof areas that drain to the storm water reuse system.

Table 5. Vegetated space at The Visionaire

Location	Area (square feet)
12th Floor	4,856
9th Floor	1,083
Upper Roof	2,840
Floor Terrace	1,059
Outside Entrance	5,500
Apartment 3H	300
Apartment 8K	440
Apartment 8E	377
Apartment PH 2A	979
Apartment PH 2E	2,075
TOTAL	**19,509**

To achieve LEED points for water conservation and reuse in the irrigation category, a baseline calculation is conducted to determine typical irrigation needs of a conventionally designed and operated high-rise building. This value can then be compared to a similar calculation for a water-conserving building. Irrigation demand (annual average 128 gpd) was determined using historical precipitation and evapotranspiration rates for NYC. The Visionaire has an average planting density of mixed plants on drip irrigation system, which reduces water use compared to a sprinkler irrigator. See Appendix A for monthly evapotranspiration profile for The Visionaire's zip code (10004).

2.1.6 Wastewater Treatment and Recycling

The WTRS reduces the total amount of potable water that The Visionaire requires for indoor non-potable applications and building cooling by recycling black water and gray water for toilets, urinals, and cooling tower make-up. Though it is permitted in NYC, The Visionaire does not reuse water in clothes washers. The potential benefit of using reuse water in clothes washers at The Visionaire is analyzed in Section 6.

Table 6 indicates that potable water consumption for indoor residential uses and building cooling at The Visionaire is reduced by 22,000 gpd by providing reuse water for building cooling and toilet flushing. Reuse water supplies 100% of water to the toilets and it is assumed that the WTRS provides 90% of the water demand for the cooling tower on an average daily basis because the WTRS may not be able to supply 100% of cooling tower requirements during the height of the cooling season.

Table 6. Projected reduction in potable water use due to the WTRS

Point of Reuse	Demand (gpd)	% Reduction	Gallons Saved (gpd)
Flush Fixtures (toilets & urinals)	4,999	100%	4,999
Appliances & flow fixtures (shower, faucets, dishwasher, clothes washer)	21,537	0%	0
Cooling tower	18,950	90%	17,055
TOTAL	**45,486**	**52%**	**22,054**

2.1.7 Summary of Water Balance for The Visionaire

summarizes projected water demand in The Visionaire, including water savings due to the WTRS and storm water capture system, is provided in**.** As evident in**,** the projected total water demand at The Visionaire is 45,600 gpd, of which 23,400 gpd would be provided by reuse water. Reuse water would reduce the potable water demand of The Visionaire by 49%.

Table 7. Potable water demand at The Visionaire with water conserving fixtures, storm capture, and WTRS

Point of Demand	Total Demand with Conserving Fixtures (gpd)	% Reduction in Potable use due to WTRS and Storm Capture	Gallons Potable Water Used (gpd)	Non-potable Water Source
Appliance & Fixture (toilets & urinals)	4,999	100%	0	WTRS
Appliance & Fixture (shower, faucets, dishwasher, clothes washer)	21,537	0%	21,537	N/A
Cooling Tower	18,950	90%	1,895	WTRS
Irrigation	128	100%	0	Storm water capture
TOTAL Water Use	**45,614**	**49%**	**23,432**	

2.1.8 Baseline Building Water Balance

Water consumption performance at The Visionaire is compared to a baseline NYC residential high-rise building (non-conserving and no reuse) that is equivalent in size to The Visionaire. Comparison is based on potable water consumption by fixtures and appliances, cooling tower make-up and irrigation demand.

2.1.9 Fixture and Appliance-based Water Use

Table 8 shows the typical quantity of potable water used for fixtures and appliances in a baseline building, based on typical fixture and appliance water consumption data (Vickers 2002). For this analysis, the baseline building was assumed to have a permanent resident population of 610 residents, and an average of 65 guests per day. Table 8 shows the indoor residential water consumption of a baseline building that is equivalent in size to The Visionaire is 41,000 gpd.

Table 8. Projected Fixture-Based Water Use of a Baseline High-Rise In NYC Based on 610 Residents

Source: Vickers 2002

Fixture Unit Analysis	Standard Building (gpd)	Basis of calculation – Standard Building
Toilet/Urinal Use	10,935	[(occupants x 5.1 flushes / day) + (guests x 25%)] x 3.5 gpf)
Showers	10,668	occupants x 1 occ use / day x 5.3 minutes / use x 3.3 gpm†
Faucets	12,352	occupants x 8.1 min/day x 2.5 gpm
Dishwasher	975	occupants x 0.17 uses / day / occupant x 9.4 gallons / use
Clothes Washer	6,093	occupants x 27 gallons / use x 0.37 uses / day / person
Subtotal of Indoor Use	**41,023**	

† Showerhead flows are typically 67% of the rating i.e. a rated flow of 3.3gpm translates to an actual flow of approximately 2.2gpm

2.1.10 Cooling Tower Make-up and Irrigation Demand

Cooling tower demand for a baseline building was assumed to be identical to a conserving building. Irrigation quantities (annual average of 229 gpd) for a baseline building were determined using historical precipitation and evapotranspiration for NYC, an average planting density of primarily turf grass, and a sprinkler irrigation system.

2.1.11 Total Water Consumption for the Baseline Building

Based on the calculations and descriptions of water use provided above, the summary of total water demand in the baseline building is provided in Table 9. Under the baseline scenario all water is provided by potable city water and all wastewater is discharged directly to the municipal sewer system. Table 9 indicates that total water consumption by the baseline equivalent to The Visionaire is 60,200 gpd.

Table 9. Total Water Demand in a Baseline Building Equivalent to The Visionaire

Point of Demand	Total Baseline Use (gpd)
Appliance & Fixture (indoor)	41,023
Cooling Tower	18,950
Irrigation	229
TOTAL	**60,202**

2.1.12 Summary Comparison: Potable Water Consumption at the Baseline Building vs. The Visionaire

Table 10 compares the estimated potable water consumption of The Visionaire and the baseline building. Total potable demand of the baseline building is 60,200 gpd. It is projected that the conservation measures in place at The Visionaire save approximately 14,600 gpd in comparison to the baseline building, which is a 25% reduction of total potable demand. The water demand at The Visionaire is 45,600 gpd, although the WTRS provides 22,200 gpd of this demand using reuse water, such that total potable demand at is 23,432 gpd. Therefore, The Visionaire with WTRS and conserving fixtures is projected to reduce potable water consumption by 63% in comparison to a baseline building.

Table 10. Projected Water Savings in The Visionaire Compared to a Baseline High-Rise in NYC

Point of Demand	Total Demand Baseline Building (gpd)	Total Demand The Visionaire (gpd)	Total Water Saved due to Conserving Fixtures (gpd)	% Reduction in Potable Demand due to conservation measures	Potable Water Saved due to the WTRS and Storm Capture (gpd)
Appliances & Fixtures (toilets & urinals)	10,935	4,999	5,936	54%	4,999
Appliances & Fixtures (other)	30,088	21,537	8,551	28%	0
Cooling Tower	18,950	18,950	0	0%	17,055
Irrigation	229	128	101	44%	128
TOTAL	**60,202**	**45,614**	**14,588**	**25%**	**22,182**

2.2 Study System

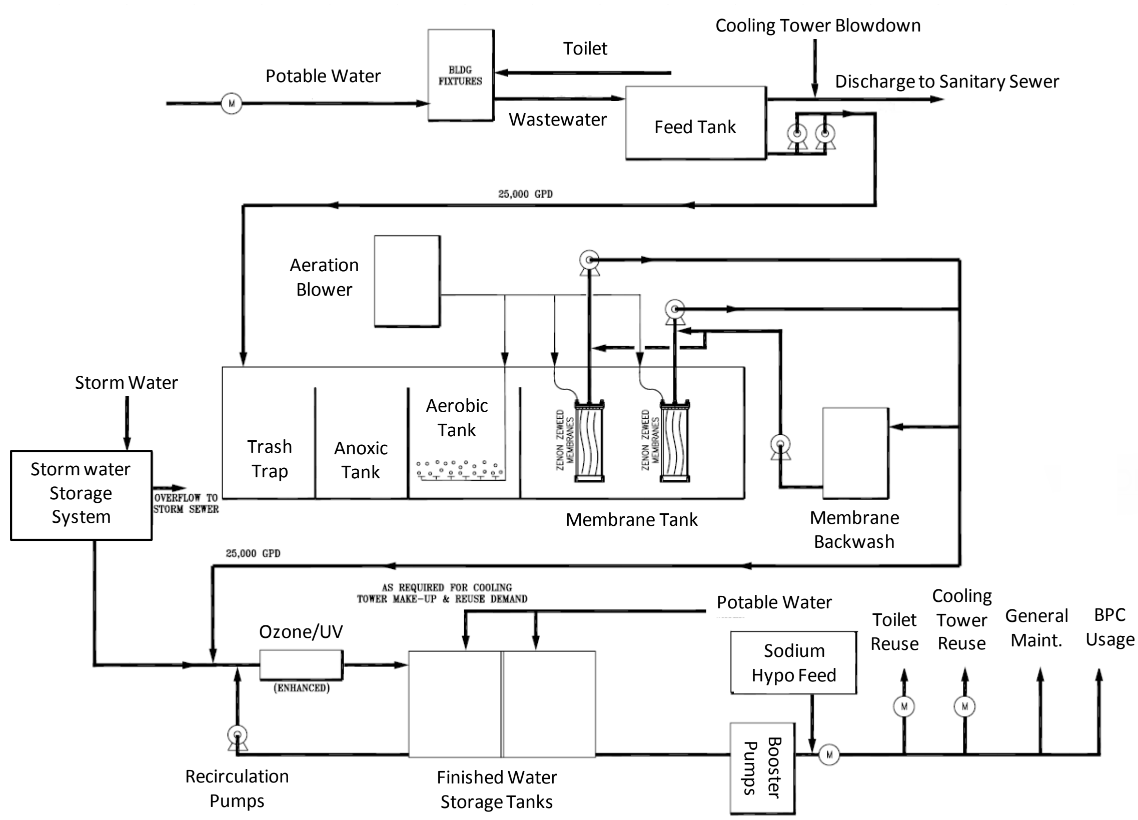
2.2.1 Description

The WTRS is comprised of a 25,000-gpd MBR package plant that treats domestic black and gray wastewater, and storm water when desired. Treated water is stored in a reuse reservoir fitted with a closed-loop disinfection system and is redistributed for toilet flushing, irrigation, and cooling tower make-up. The WTRS only operates when there is demand for reuse water, such that on-site wastewater treatment does not occur beyond that required to meet reuse demand.

The WTRS is entirely contained in a basement level Treatment Room, which has a total footprint of 2,130-square feet and is shown in Figure 2. A schematic layout of the components of the facility is provided in Figure 3.

Figure 2. WTRS at The Visionaire

Figure 3. Schematic of the Components of the WTRS at The Visionaire



The components of the WTRS are:

- **Feed Tank:** All black and gray domestic wastewater produced by the occupants of the building is collected in a 9,000-gal wastewater Feed Tank. A manually cleaned trash basket removes large solids, such as rags, from the incoming flow. There is also the choice to transfer storm water from the storm water storage tank to the Feed Tank. The Feed Tank overflows to the city sewer.
- **Inline Grinder:** An inline grinder (Muffin Monster 20001-A4 with Model PC2200 motor controller, JWC Environmental, Santa Ana, CA) with bypass on the suction side of the pumps is installed to reduce solids to an acceptable size for pumping.
- **Feed Pump:** Duplex solids handling, self-priming, centrifugal feed pumps (T3AS3-B Super T-Series, Gorman-Rupp, Mansfield, OH) transfer wastewater from the feed tank to the Trash Trap Tank. This process occurs when non-potable water is demanded by cooling tower activity, irrigation needs, or toilet flushing.
- **Trash Trap Tank:** Wastewater pumped from the feed-tank is pumped into a 9,000-gal Trash Trap Tank that allows non-biodegradable solids to settle out of the flow. Clarified wastewater flows into the MBR anoxic tank. Solids which accumulate in the Trash Tank are periodically pumped to the sewer using the Trash Pump.

- **Trash Pump:** The trash pump is a motor operated, dedicated solids handling double diaphragm pump (Double Disk Model 3DDSX12 MK1, Penn Valley Pump, Warrington PA). Solids are emptied from the trash trap 4-6 times per year.
- **MBR Anoxic Tank**: This biological treatment step combines the raw-settled wastewater from the Trash Trap with nitrified wastewater recirculated from the MBR Membrane Tank. This stage helps to achieve denitrification.
- **MBR Aerobic Tank**: Water flows from the Anoxic Tank to the Aerobic Tank by gravity. During aerobic treatment, wastewater undergoes carbonaceous oxidation and nitrification via a complete mix tank with fine bubble diffusers. Sodium hydroxide (NaOH) is added to the aerobic tank to control pH. Aluminum chlorohydrate is added in the aerobic tank to achieve advanced phosphorus removal. Fine aeration is provided by two blowers (AERZEN Delta GM 10S DN80) that operate on 15 minute cycles.
- **MBR Membrane Tank**: Water flows from the Aerobic Tank to the Membrane Tank by gravity. The membrane filter modules (Zenon ZeeWeed 500, Zenon Environmental Inc., Burlington, ON) contain thousands of vertically strung hollow-fibers with porous walls. The pores allow water to permeate but filters out particulates greater than 1 micrometer in diameter, such as suspended solids, bacteria, pathogens, and some viruses. Modules are combined into single cassettes that can each permeate 4-6 gpm/square foot of membrane surface. Cassettes are combined to create process trains that can permeate the required quantity of treated wastewater. There are two process trains at The Visionaire, each consisting of 3 cassettes. During operation, the process trains alternate between permeation and back-wash every 15 minutes. Coarse air is used to scour the membranes to prevent fouling. The coarse air is provided by the same blowers that provide the fine air in the aerobic tank.
- **MBR Recirculation Pumps:** The Recirculation Pumps (ABS Submersible Pump Model: AFPK0841.2M22/4, ABS Group, Sweden) transfer wastewater from the Membrane Tank back to the Anoxic Tank to achieve nitrification and improve operational control of the treatment process. The typical recirculation ratio is 11:1 at The Visionaire.
- **MBR Permeate Pumps:** Water is drawn through the membranes fibers using Permeate Pumps. (Jabsco Model: Q30530-4001-209, Water Process Ltd, UK)
- **MBR Back-pulse Pumps:** At regular intervals, the filters are backwashed via back-pulse pumps (G&L Model: GL2ST2C4C4 , ITT-Goulds Pumps, Seneca Falls, NY). The back-pulse pumps are fed using permeated water stored in a side-stream backwash tank. Backwash cycles occur for one minute every 15 minutes and transfer approximately 20 gallons of backwash water through the membrane fibers (depending on the pressure loss across the filter due to fouling). This process removes filtrate from the surface of the fiber so that permeation rates can be maintained.
- **In-line Disinfection**: Once water leaves the MBR, it goes through two in-line disinfection stages before arriving at the treated water storage tank. The disinfection stages include the following processes:
    - **Ultraviolet disinfection**: The filtered water receives its first level of disinfection by passing through a filter that subjects the water to U.V. radiation. The U.V. system consists of a UV circulation pump (Goulds , NPE-F. ITT-Goulds Pumps, Seneca Falls, NY) and a UV disinfection unit (Aqua Azul I-35, Aqua Azul, Hanford, CA) with eight 500 W UV-bulbs with an effective UV dose of 30,000 mW sec/cm^2.
    - **Ozone treatment**: Ozone treatment is used to oxidize residual organic matter, and to improve the aesthetics of the reuse water by removing color and odor, so that the reuse water is socially acceptable for use in toilet flushing. The ozone system consists of an Ozonia OZAT CFS-3A ozone generator (Ozonia North America, Leonia, NJ), a BOGE C3L air compressor (BOGE America Inc., Powder Springs, GA) and an ozone motive pump.

- **Storage Tank:** The newly treated water is stored in a concrete reservoir. As the water level in the tank drops, the computer controller responsible for operating the treatment system extracts water from the wastewater collection pipeline and sends it to the feed tank to undergo disinfection. Stored water is cycled in a closed loop through the UV and ozone treatment steps to maintain quality. Ozone production increases in proportion to the dissolved oxygen (DO) concentration in the storage reservoir. Chlorine residual can also be added to the stored water by dosing sodium hypochlorite. A low-level and high-level switch activates and deactivates flow, respectively. City water make-up to the storage tank is available if the level or reuse water in the tank falls to a minimum level, controlled by a low-level switch.
- **Booster Pumps**: Three booster pumps (Sterling Multistage – MLSA 032 5 Stages), operating on a lead-lag basis, draw water from the storage tank and distribute it throughout the building in pipes labeled as non-potable. These pumps are responsible for maintaining a constant pressure in the pipes for use in toilet flushing and make-up water for the cooling towers located on the roof. When reuse water is consumed, the pressure in the non-potable network drops to a point which activates the booster pumps. The booster pumps work until the system is re-pressurized. The bearings on the booster pumps are water-cooled.
- **Membrane Soak Tank**: The membranes accumulate material within the fiber matrices over the course of operation, which is deleterious to performance. Membranes can be regenerated by immersing them in a soak tank, which consists of sodium hypochlorite. A reserve membrane is stored in the soak tank at all times, and can be switched with an operational membrane when the operational membrane is in need of service or regeneration.

2.2.2 Water Quality Performance Requirements

This section examines the membrane technology and chemicals used in the WTRS at The Visionaire to meet the regulatory water quality requirements stipulated by the NYC DOB. Internal WTRS effluent requirements set by Chemtreat to allow for efficient cooling tower operation and maximum cycles of concentration are also examined.

2.2.3 Requirements for Non-potable Reuse Applications

The WTRS must meet the water quality standards in Table 11 for non-potable reuse as regulated by the NYC. These standards do not include water quality parameters for nutrients such as nitrogen and phosphorous on the basis that reuse water will not be used for potable applications.

Table 11. Potable Water Quality Requirements

NYC Department of Buildings stipulated the following parameters for safe indoor non-potable use in 2010.

Parameter	Limit
BOD (mg/L)	<10
TSS (mg/L)	<10
Fecal Coliform (CFU/100mL)	<100
Turbidity (NTU)	<2
E. Coli Colony Count (#/100mL)	<2.2
pH	6.5-8.0

2.2.4 Membrane Performance

The GE ZeeWeed 500 Ultrafiltration Membrane is designed to produce wastewater effluent to the specifications shown in Table 12**.** Under proper operating conditions, this model of membrane filter should consistently achieve these specifications.

Table 12. GE ZeeWeed 500 Reinforced Membrane Treatment Specifications*

Source: GE http://www.gewater.com/products/equipment/mf_uf_mbr/zeeweed_500.jsp

Wastewater Effluent (As a part of a Membrane Bioreactor process)	
Biological Oxygen Demand (BOD mg/L)	<2
Total Suspended Solids (TSS mg/L)	<2
NH3-N (mg/L)	<0.5
TN (mg/L)	<3**
TP (mg/L)	<0.05**
Turbidity (NTU)	<0.2
Fecal Coliform (CFU/100mL)	<10
Transmissivity	>75%

***with appropriate design and/or chemical addition*

Effluent quality is improved further via the following operational and chemical steps:

- Disinfection – reuse water is disinfected via ozone, UV treatment and addition of Sodium Hypochlorite to eliminate bacteria, viruses, and other biological content. Ozone also serves to reduce odor and color in the reuse water.
- Addition of alum – hydrated aluminum sulfate (alum) is added in the aerobic tank to treat for phosphorous. Alum readily coagulates with phosphate causing it to precipitate.
- Addition of caustic – Sodium hydroxide (caustic) is added to adjust pH.
- Recirculation – The Visionaire utilizes a recirculation rate of 7:1 between the membrane tank and anoxic tank to achieve biological denitrification.

Table 13 lists the most common chemicals used in the WTRS at The Visionaire with the associated cost per gallon.

Table 13. Chemicals Used for WWTP Operation at The Visionaire

Name	Use	Cost ($/gal)
Sodium hydroxide	pH adjustment; caustic	$ 12.14
Sodium hypochlorite	Disinfection - Chlorine	$ 14.00
Aluminum sulfate (hydrated.)	Phosphorous removal	$ 17.01

2.2.5 Additional Requirements for Reuse Water Quality for Cooling Tower Make-up

The cooling system at The Visionaire is a York ParaFlow Absorption Chiller, which achieves heat transfer via an open recirculating cooling system. The cooling tower removes heat from the system by evaporation to the atmosphere. Water is fed to the cooling tower to make-up for evaporative losses. Appendix B provides additional information regarding the cooling tower and HVAC system at The Visionaire.

During the heat transfer process the make-up water comes into contact with three different types of metallurgy: copper and copper-nickel components in the open-loop shell-and-tube heat-exchanger between the adsorption chiller and the cooling tower; and with galvanized steel in the cooling tower. The concentration of dissolved and particulate constituents in the cooling system increases as water evaporates from the cooling tower. Above constituent-specific thresholds, the concentration of constituents can lead to scaling and corrosion of the cooling system metallurgy, which adversely impacts heat transfer performance and component longevity. The threshold concentrations can be increased by the addition of inhibitor chemicals. Once the threshold has been reached, the residual water in the open cooling loop must be discharged, which is a process referred to as cooling-tower blow-down. Make-up water is required to replenish the volume evaporated or blown-down from the cooling tower. Water consumption by open recirculating cooling systems can be reduced by using chemicals to increase threshold blow-down concentrations.

The chemicals listed in Table 14 are used at The Visionaire to prevent scaling in the cooling system and increase the number of possible cycles prior to blow-down. For example, a polymer is used to limit calcium phosphate scaling and allow the number of cycles of concentration achievable using city water to increase from 6 to 10.

Table 14. Chemicals Used for Cooling Tower Operation at The Visionaire

Chemical	Use	Description	Cost
Corrosion inhibitor/dispersant Polymer (Chemtreat CL4816)	Scaling & corrosion inhibitor	Inhibits calcium carbonate and calcium phosphate scale formation and enhances zinc solubility for improved corrosion protection	$21 / gal
Bromine Tablets (Chemtreat CL2188)	Anti-fouling agent	An oxidizing biocide fed at daily intervals by the Brominator, depending on the oxidation-reduction potential of the wastewater	$495 / 50 lb. pail
Non-oxidizing biocide (Chemtreat CL2156)	Anti-fouling agent	Used to prevent fouling in the cooling tower system, fed 2 times per week fed at 120 ppm using timer function on controller	$19 / gal

Table 15 lists constituent concentration limits for in the cooling system at The Visionaire, as based on the chemical addition program used by Chemtreat at The Visionaire. Table 15 also illustrates the typical concentrations of these constituents in potable city water. The ratio of constituent concentration in city water to the limit in the cooling system provides the number of cycles of concentration that can be achieved before the limit is reached. Table 15 shows 10-12 cycles of concentration are typically possible with city water before blow-down is required as governed by pH limits. It would be possible to increase the number of cycles of concentration through further chemical addition; however, cooling tower operators must find the most cost effective balance between chemical consumption and water consumption.

Table 15. City Water Scenarios for The Visionaire Cooling Tower Make-Up

The following parameters describe the maximum concentration of constituents in cooling tower water before blow-down must occur and the number of cycles of concentration achievable before blow-down must occur based on the typical constituent concentrations of city water.

Metric	Concentration unit	Limit	Constituent concentration in city water	Number of potential Cycles of concentration
pH	N/A	8.5	6.9	10-12
Conductivity	umhos	5,000	100	50
Ca hardness ($CaCO_3$)	ppm	500	16	30
Orthophosphates (o-PO_4)	ppm	10	1.7	10(1)
Chlorides	ppm	200(2)	12	16
Iron	ppm	0.2	<0.05	4+
Copper	ppm	0.1	<0.05	2+
Ammonia	ppm	1	-	N/A

(1) Polymer is added to increase the number of cycles achievable before orthophosphates becoming limiting

(2) The chloride limit only applies when stainless steel is present in the system

A different chemical addition program is required to achieve a target number of cycles of concentration using reuse water to supply the cooling tower. Congruent with the aims of this study, a specific WTRS operating program was developed for the WTRS and cooling tower chemical addition to achieve 100% reuse water supply to the cooling tower. The target reuse water quality as requested by Chemtreat, and the achievable number of cycles of concentration are given in Table 16. As no stainless steel exists in the cooling system at The Visionaire, the chloride limit to potential number of cycles of concentration before blow-down does not apply. Chemical is added to control limits to number of cycles that would arise from concentrations of orthophosphates, iron, and copper. As such, the number of cycles of concentration that can be achieved before blow-down must occur using reuse water is 7-10, depending on the conductivity and pH of the reuse water. Appendix B provides additional information regarding cooling tower operation, performance, chemical requirements and dosing.

Table 16. Reuse Water Quality Targets for The Visionaire Cooling Tower Make-Up

The following parameters describe the maximum concentration of constituents in The Visionaire cooling tower water before blow-down must occur and the number of cycles of concentration achievable before blow-down must occur based on the typical constituent concentrations of reuse water.

Metric	Concentration Unit	Limit	Constituent concentration in reuse water)	Number of potential Cycles of concentration
pH	N/A	8.5	7.3	7
Conductivity	umhos	5,000	500-650	7
Ca hardness ($CaCO_3$)	ppm	500	40-60	10
Orthophosphates (o-PO_4)	ppm	10	0.7-1.5	6.5(1)
Chlorides	ppm	200(2)	50-100	2+
Iron	ppm	0.2	<0.05 (minimal)	4+
Copper	ppm	0.1	.05-0.1	2+
Ammonia	ppm	1	<0.10	N/A

(1) Polymer is added to increase the number of cycles achievable before orthophosphates becoming limiting

(2) The chloride limit only applies when stainless steel is present in the system

2.2.6 Power Consumption

Table 17 gives full-load power characteristics for each electrical component in The Visionaire WTRS. Rated efficiency of each component is listed where this information was provided by the manufacturer. Not all components will operate at full-load during typical operation of the WTRS. For example, the power load for the ozone generator is controlled by a dissolved oxygen probe. The various pumps in the system draw power according to the pressure loss across the pump and the specific pump curves for the system. The true power consumption of each component was monitored as part of this study.

Table 17. Full-Load Power Characteristics for The Electrical Components in WTRS Equipment

Equipment	Name (Make, and Model)	HP	Voltage Spec[1]	Name Plate Spec Full LoadAmps	Rated Efficiency (%)	Power Factor.
Feed Pump 1	T3AS3-B Super T-Series, Gorman-Rupp, Mansfield, OH	3	230	8.2 / 4.1	89.5	0.8
Feed Pump 2	T3AS3-B Super T-Series, Gorman-Rupp, Mansfield, OH	3	230	8.2 / 4.1	89.5	0.8
Trash Pump	Double Disk Model 3DDSX12 MK1, Penn Valley Pump, Warrington PA	3	230	8.4 / 4.2		0.8
Inline Grinder	Muffin Monster 20001-A4 with Model PC2200 motor controller, JWC Environmental, Santa Ana, CA	3	208	9.4		0.8
Aeration Blower 1	AERZEN Delta GM 10S DN80	15	230	34	91	0.9
Aeration Blower 2	AERZEN Delta GM 10S DN80	15	230	34	91	0.9
Recirculation Pump	ABS Submersible Pump Model: AFPK0841.2M22/4, ABS Group	3	208	9.2		0.8
Permeate Pump 1	Jabsco Model: Q30530-4001-209, Water Process Ltd, UK	2	230	6.2	87	0.7
Permeate Pump 2	Jabsco Model: Q30530-4001-209, Water Process Ltd, UK	2	230	6.2	87	0.7
Back pulse Pump 1	G&L Model: GL2ST2C4C4 , ITT-Goulds Pumps, Seneca Falls, NY	0.5	115/230	8		0.8
Back pulse Pump 2	G&L Model: GL2ST2C4C4 , ITT-Goulds Pumps, Seneca Falls, NY	0.5	115/230	8		0.8

Table 17 continued

Equipment	Name (Make, and Model)	HP	Voltage Spec[1]	Name Plate Spec Full LoadA mps	Rated Efficiency (%)	Power Factor.
UV system pump	Goulds , NPE-F. ITT-Goulds Pumps, Seneca Falls, NY	0.5		8.2		0.8
Ozone System pump		3	208	8	84	0.9
Ozone System compressor	BOGE C3L BOGE America Inc., Powder Springs, GA	4	208	11.6		0.8
Ozone Generator	Ozonia OZAT CFS-3A Ozonia North America, Leonia, NJ	3	230	9.4		0.8
Odor Control Blower		1.5	208	4.5	86	0.8
UV System	Aqua Azul I-35, Aqua Azul, Hanford, CA	0.5	120	1.2		0.8
Booster Pump System	Sterling Multistage – MLSA 032 5 Stages		200	66.5		0.8

3 Study Design and Implementation

The monitoring program at The Visionaire has been designed to track power consumption, potable water consumption, sewer discharge, reuse water quality, chemical consumption and economics associated with the use of the WTRS. This section will describe the design of the monitoring system, the monitoring program, and the timeline of execution for the monitoring program including changes to the system, monitoring system and monitoring program over the course of the study.

3.1 Monitoring System

The monitoring system consists of a network of water meters to monitor water consumption, a power quality management system to monitor power consumption for the WTRS, reuse water quality testing by external laboratories, manual tracking of chemical consumption, and an early-detection-system at the cooling tower for corrosion and scaling.

3.1.1 Water Consumption

Distribution of potable water, reuse water and wastewater at The Visionaire is monitored using 12 independent flow meters. The location of the flow meters in The Visionaire water cycle is illustrated in Figure 4 The specification for each meter and the flow it monitors is given in Table 18. The meter readings are manually logged two to three times per week by The Visionaire Building Management. The NYC domestic meter (M1) is also logged by DEP for billing purposes. The blow-down meter was installed in April 2011. In addition to the meters identified in Table 18, the WTRS also has three internal process meters: a meter on the feed tank transfer into the MBR, a recirculation meter, and a permeate flow meter after the membrane filters.

Figure 4. WTRS Schematic Provided in Figure 1 with the Location of Flow Meters Identified

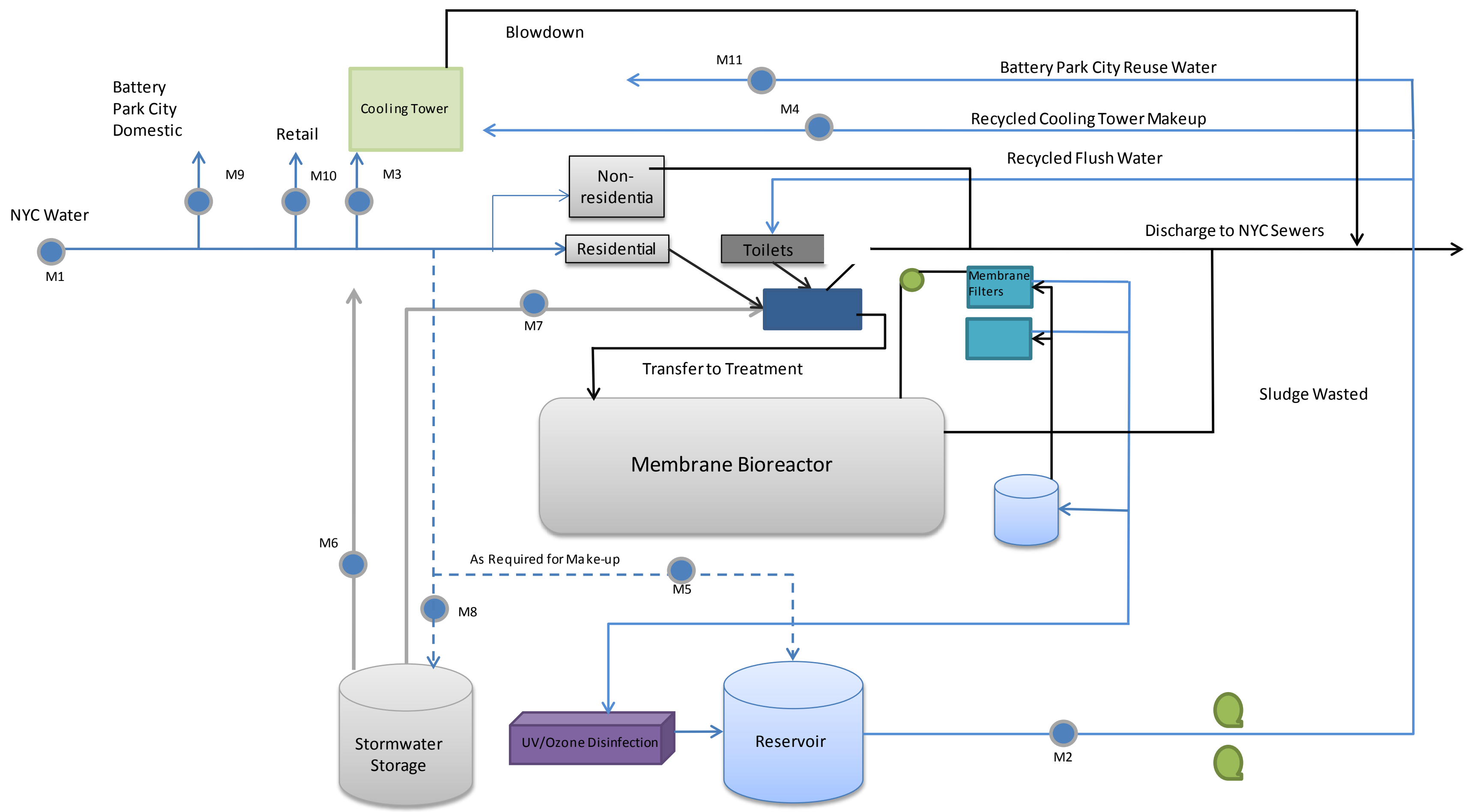


Table 18. Flow Meter Specifications

The flow meter identification number corresponds to the meter labels shown in Figure 4. All meters are manufactured by Neptune Technology Group Inc., Tallahassee, Alabama.

ID Number	Description	Size / Type
M1	NYC Domestic Main Building Meter	4” Compound
M2	Total Reuse Meter	6” Turbine
M3	Cooling Tower Domestic Meter	2” T-10 Displacement
M4	Cooling Tower Reuse Meter	2” T-10 Displacement
M5	NYC Domestic Make-up to WTRS Reservoir	3” Turbine
M6	Storm water Reuse for Green Roof Irrigation	2” T-10 Displacement
M7	Storm water Reuse to WTRS for Cooling / Flush Water	2” T-10 Displacement
M8	NYC Domestic Make-up to Storm water Reservoir	2” T-10 Displacement
M9	Battery park space Domestic	2” T-10 Displacement
M10	Retail Domestic	2” T-10 Displacement
M11	Battery Park space Reuse Water	2” T-10 Displacement
M12	Blow-down meter	2” T-10 Displacement

The combination of meters enables the following water flows to be measured:

- Amount of domestic water provided by NYC.
- Amount of reuse water treated by the WTRS.
- Total amount of NYC domestic water provided to the cooling tower.
- Total amount of reuse water provided to the cooling tower.
- Total amount of reuse water used for flushing toilets (determined by subtracting cooling tower reuse from total reuse).
- Total amount of storm water used for irrigation.
- Total amount of storm water transferred to the WTRS for cooling / flush water purposes.
- Total amount of water sent to the NYC sewer (unused wastewater, storm water, cooling tower blow down, and wasting from the WTRS).
- The amount of flow recirculated in the WTRS.
- The amount of flow back-washed to the WTRS.

3.1.2 Non-Metered Water Quantity

No in-line meter is in place to track specific water consumption by the following systems at The Visionaire:

- Building humidifiers.
- Cooling tower Brominator unit.
- Water supply to the leisure room (showers, swimming pool make-up, steam room make-up and hot-tub make-up).
- Annual emptying of the swimming pool for maintenance (25,000 gpd capacity).
- Annual emptying of the building water supply tower for maintenance (100,000 gpd capacity).

The water consumption for these five uses were monitored through temporary metering or calculated from annualized total uses.

3.1.3 Water Quality

Reuse water quality testing was performed under the permit requirements for The Visionaire WTRS, which require compliance with the NYC DOB regulations for safe indoor non-potable reuse. The pH of the treated reuse water was monitored by an in-line pH meter. Applied Water Management Group (AWM) collected samples from the reuse reservoir and sent them to Garden State Laboratories (Barnegat, NJ) for independent quality testing (Table 24). Garden State Laboratories analyzed concentrations of biological oxygen demand (BOD), total suspended solids (TSS), fecal coliform, turbidity and E. coli.

The quality of water supplied to the cooling tower is independently monitored by Chemtreat to ensure standards for reliable cooling tower operation are maintained and to allow Chemtreat to adjust their chemical addition/blow-down program accordingly. Chemtreat runs two types of analyses: standard and laboratory analyses. Standard analyses, also known as Water Treatment Service Reports, are completed at each visit and analyze for pH, conductivity, and concentrations of total hardness, calcium hardness, magnesium hardness, phosphates, molybdate, bromine, tolytriazole, iron, copper, and total bacteria.

Lab reports were done upon request and are sent out for analysis. Lab reports include all of the analyses conducted in the standard analyses as well as concentrations of zinc, nickel, aluminum, chloride, manganese, potassium, titanium, sulfate, and silica. For each analysis, samples were typically collected from city water, reuse water, cooling tower make-up, condenser water, and, occasionally, chill water and hot water. Biological counts and identifications were performed on condenser water, cooling tower make-up and chiller water. Personnel from The Visionaire completed these analyses on-site by incubating samples for approximately 72 hours in an air-tight container that incorporates an agar plate. Incubated samples are compared against a standard index card that visually qualifies the log order colony population (i.e., to the nearest order of magnitude) based on the number of individual colonies (dots) that can be counted on the agar plate.

Particle size distribution analyses are frequently performed on the reuse water to confirm that the membranes continue to operate to specification and determine filtration efficiencies across particle size ranges. Samples were taken before and after the membranes, and particles were measured down to 0.1 micrometers in size.

3.1.4 Energy

WTRS energy consumption was monitored by a Power Quality Monitor (PQM; GE Model No. PQM II-T20A) supplied by GE Water and Process Technologies in Feasterville-Trevose, PA. Data were collected and stored in a dedicated data logging computer using EnerVista software. The PQM II-T20A data logging polling rate was 64 samples per cycle. Date samples were averaged over 15 minute intervals and stored. The PQM was connected to an Ethernet switch using a GE MultiNet FE RS-485 to Ethernet converter. Both PQM II and PLC used MODBUS-TCP/IP protocol. The PQM separately monitored power consumption by the majority of the treatment and distribution component in the WTRS so that the most energy consuming processes could be identified. A power transducer, installed inside the Booster Pump control panel and connected to the analogue input on the PQM, enabled continuous logging of the Booster Pump's power consumption.

Several components were not monitored by the PQM as they are independent from the WTRS control system. Stand-alone motors equipped with hour timers include the Trash Pump, Ozone Pump, UV Pump, Odor Control Blower, and Ozone Compressor. Run-hour timings are recorded for each meter reading during standard operation and maintenance site visits. Energy consumption of these components is monitored by measuring the run time and calculating the power consumption of the component based on measured current and supply voltage. Full load current of all stand-alone components was measured and recorded during system commissioning and verified periodically.

3.1.5 Chemicals

AWM manually monitored WTRS chemical usage (alum, caustic and sodium hypochlorite) during each operations visit. Chemtreat monitored cooling tower chemical usage (bromide, polymer and biocide) using an order-log and in-building inventory.

3.1.6 Cooling Tower Corrosion and Scaling

The following monitoring strategies were in place to detect any potential scaling or corrosion in the shell-and-tube heat exchangers that results from cooling tower make-up water quality:

- A deposition monitor was used to determine deposition on a test heat exchanger with temperatures above normal skin temperatures so that ortho-phosphate deposition can be predicted before it occurs in the system. The deposition/corrosion monitor, Atlantis A-11817, is provided by Atlantis Technologies, Oakdale, Pennsylvania. The system is set at a temperature above the normal skin temperature to provide conditions for preferential deposition.
- 30-day and 90-day corrosion coupon testing was performed on the tower water. Both steel and copper specimens are analyzed to determine the effectiveness of the treatment program on clean metallurgy.
- An annual coupon rack pipe analysis was completed. Each coupon rack has a 12-inch nipple that was removed and analyzed by the Chemtreat laboratory.
- The chiller was de-scaled yearly and the removed scale was sent for compositional analysis to determine the cause of fouling.

3.1.7 Economics

The following costs are associated with chemical consumption, electrical consumption, service contract for WTRS operation and NYC DEP water and sewer rates:

- Chemical consumption expenses are calculated based on the unit cost for each chemical and the quantity of chemicals used in the WTRS and cooling tower.
- Electricity expenses in the WTRS are calculated based on the standard rates charged for electricity to the Visionaire by ConEd and the power consumption measured by the power monitoring program. The Visionaire does not subscribe to the "Voluntary Time-of-use" program with Con Edison, whereby any power consumed during peak hours would be subject to a higher rate than the standard rate and any power used during off-peak hours would be charged at a lower rate than the standard rate.
- Operating expenses for the WTRS are based on the value of the annual service contract charged to The Visionaire by AWM. Chemtreat reported no change to the annual service contract charged to The Visionaire for cooling tower operation services due to the study, and this expense has been excluded from comparison,
- Expenses paid for NYC water and sewer utility are based on monthly water and sewer bills charged to The Visionaire by NYC DEP. The billed rates are based on metered potable water consumption and include adjustments for exceptions based sewer allowances and CWRP incentives, where these adjustments are applied.

3.2 Monitoring Schedule

Table 19 summarizes monitoring responsibilities by entity as determined at the beginning of the monitoring period. Specific changes in monitoring procedures are discussed in this section.

Table 19. Monitoring Responsibilities by Frequency and Responsible Party

Item	Monitoring Program Responsibility	Frequency	Responsible Entity
1	Organization and coordinate monthly meetings to discuss monitoring schedule and progress	Monthly	AE
2	Receive and process data to ensure consistent system operation and sampling/monitoring regime.	Monthly	AE
3	Collect water samples and read meters	Weekly	AWM
4	Forward operations logs including meter readings, chemical consumption, hour timer readings, etc. to AE	Monthly	AWM
6	Forward meter readings spreadsheet including hour timer readings and cooling tower filter backwash data to AE.	Biweekly	AWM
7	Copy AE on chemical procurement documentation	Monthly	Albanese
8	Forward utility bills to AE	Monthly	Albanese
10	Secure water samples from city water, reuse water, actual tower make-up, tower water, chill water, and hot water. Conduct pH, conductivity, iron and copper levels, and corrosion inhibitor level tests. Perform hardness and phosphate testing on tower make-up and tower water.	Monthly	Chemtreat
11	Perform biological counts and identifications on tower water.	Monthly	Chemtreat
12	Perform biological counts on tower make-up and chill loops.	Monthly	Chemtreat
13	Provide trended results and trend graphs on the Chemtreat ChemTrack program (after the third report)	Monthly	Chemtreat
14	Discuss water treatment related issues with AE and complete a walkthrough of the physical plant.	Monthly	Chemtreat
15	Provide a full report of the findings and recommendations immediately following each analysis and inspection.	Monthly	Chemtreat
16	Perform a particle analysis to determine filter efficiencies and overall particle distribution. Take samples before and after the membranes and measure particles down to 0.1 microns in size.	Monthly	Chemtreat
18	Perform a complete standard analysis on all samples.	Quarterly	Chemtreat
19	Meeting with treatment supplier and site engineer to discuss the previous three months' worth of data and current issues. Publish meeting minutes and provide to AE.	Quarterly	Chemtreat
20	Perform 30-day and 90-day corrosion coupon testing on tower water. Analyze steel and copper specimens to determine the effectiveness of the treatment program on clean metallurgy.	Quarterly	Chemtreat
21	Complete an annual coupon rack pipe analysis, which includes the removal and analysis of the 6-inch nipple on each coupon rack.	Annually	Chemtreat

3.3 Quality Control and Quality Assurance

The following quality control and quality assurance mechanisms were designed into the monitoring program to ensure data quality and integrity:

- **Meter Readings:** Both Albanese and AWM collected independent meter readings in the WTRS and the cooling system. This process provides the opportunity to identify human error associated with misreading meter displays.
- **Data backup:** The PQM backed-up data every 15 minutes and compresses the data into a daily folder at the end of each day to ensure no long term data loss would occur in the event of error. The data-log was accessed and downloaded remotely to create multiple copies on different computers. This process prevented large-scale data-loss should data from one computer be rendered irretrievable.
- **Sampling:** Biological samples were kept in an incubator in the room where sampling occured, which minimized the time to incubation
- **Data Management:** All team partners sent data to a centralized collection and management system used by AE.
- **Project Communication:** AE acted as the central contact point for alarms and communications about the project, so that the team could be notified of any needed changes. In addition, AE ran a monthly data review with all research partners to maintain close communication and provided a key opportunity for discussion of anomalies, operations, maintenance, and any other issues relating to the system.

3.4 Monitoring Period Timeline

Monitoring of The Visionaire for this study occurred between May 4, 2010 and October 15, 2011. This section summarizes the pre-study timeline and changes in monitoring and facility operations that occurred during this time period. Appendix C outlines a journal of system changes (S), operational changes (O), adjustments to the monitoring program (M), and study interruptions (I).

3.4.1 Pre-Study Period Timeline

On November 19, 2009, NYC DOB approved the system to operate in start-up mode, during which time treated water was diverted to sewer pending water quality results that proved compliance. On February 25, 2010, the water treatment and recycling system began temporary operations with approval from the NYC DOB. NYC DOB gave final approval to operate the system in maintenance mode on June 18, 2010, following three months of preliminary testing.

3.4.2 Changes to WTRS and Cooling System

Four major changes were made to the operation of the WTRS and cooling system over the course of the study to optimize system integration: cessation of consistent use of hypochlorite for disinfection; stopping consistent UV disinfection; routing storm water directly to the treated reuse water tank; and changes in cooling tower make-up percentage. More specifically:

- **Stopping hypochlorite:** Prior to November 2010, sodium hypochlorite was added to the system at a rate of approximately 0.25–0.5 gpd as a means of disinfection, pipe cleaning, and pH correction. The addition of hypochlorite led to the accumulation of chlorides in the closed-loop reuse system, and limited the ability to supply reuse water to the cooling tower due to corrosion concerns. In November 2010, the continuous sodium hypochlorite feed was stopped in an attempt to reduce chloride concentrations in the system. From November 2010, hypochlorite is infrequently dosed to the reuse tank to achieve pipe-flushing in the reuse network. By mid-January, little chloride residual was left in the system apart from that derived from city water. The power load on the ozone generator increased from 1% to 3% after the continuous hypochlorite feed was suspended.
- **Stopping UV disinfection:** UV disinfection was removed in early 2011 to assess whether disinfection requirements could be maintained by ozone treatment alone and power consumption associated with UV treatment could be justifiably avoided. It was decided to discontinue UV rather than discontinue ozone treatment because ozone addresses issues of color and odor in water. E. coli and fecal coliform tests were done twice monthly to ensure that the system continued to achieve the required disinfection performance.
- **Routing storm water:** At the beginning of the study, storm water was collected and stored in the 10,000-gallon storm water tank and used only for irrigation. In November 2010, to make storm water available for indoor reuse, storm water was sent to the feed tank to be treated by the MBR. In early March 2011, storm water was diverted around the MBR, as it was deemed wasteful to consumer power to treat storm water in the MBR. The storm water was directly routed to the ozone unit for disinfection and subsequent storage in the reuse reservoir. A large rain event in late March/early April 2011 re-suspended sediment on the floor of the storm water tank and conveyed the sediment to the reuse tank. The high turbidity conditions caused the power load on the ozone generator to increase to 100%. The ozone generator is not designed to operate at full load for prolonged periods and this led to a motor failure. The ozone generator was repaired and the changes to the storm water system were completely reversed by mid-April 2011. From April 2011 storm water is used for irrigation only.
- **Changes to cooling tower make-up:** The fraction of reuse water in the cooling tower make-up blend was gradually increased from 0% to 100% over the course of the study as part of a risk control strategy. The risk control strategy involves increasing the reuse water fraction in the cooling tower make-up blend by 10%, and performing necessary monitoring actions using corrosion coupons and the deposit monitor. The reuse fraction is increased by an additional 10% if all parties agree that the results from the monitoring program do not indicate undesirable corrosion or deposition. The risk control strategy prevents issues in the cooling tower while the interaction between the reuse water and the cooling tower is ascertained. In mid-April 2011, Chemtreat confirmed that the performance of the cooling tower was satisfactory when incorporating reuse water, and the reuse blend could be increased to 100% through an accelerated sequence of operations (See Appendix D for additional information regarding the sequence of operations.)

3.4.3 Changes to Monitoring and Sampling Program

In addition to sampling frequency, three specific monitoring changes occurred over the course of the study: increased reuse water sampling, suspension of regular particle distribution analysis, change of location for the deposit monitor, and corrosion coupon test frequency. Each change is outlined below.

- **Reuse water sampling:** In January 2011, Chemtreat increased the frequency of service reports from monthly to biweekly to enable the quality of reuse water in the cooling tower make-up to be monitored more regularly.
- **Particle distribution analysis:** In mid-March 2011, particle distribution analysis was stopped. Results through March were consistent enough to warrant ceasing regular testing.
- **Deposit Monitor:** In March 2011, the deposit monitor was moved from its location directly before the cooling system condenser, to a location directly after the condenser. The water temperature at the effluent of the condenser is higher than at the influent, and precipitation/corrosion activity is greater at higher temperatures. The change ensured that precipitation or corrosion within the deposit monitor would be likely to occur before precipitation or corrosion within the condenser heat-exchanger, and hence maximize the sensitivity of the corrosion/precipitation early-warning system.
- **Corrosion Coupon Tests:** In May 2011, as the fraction of reuse water in the make-up blend increased from 50% to 100%, lab reports were suspended and 30-day corrosion coupon tests were implemented.

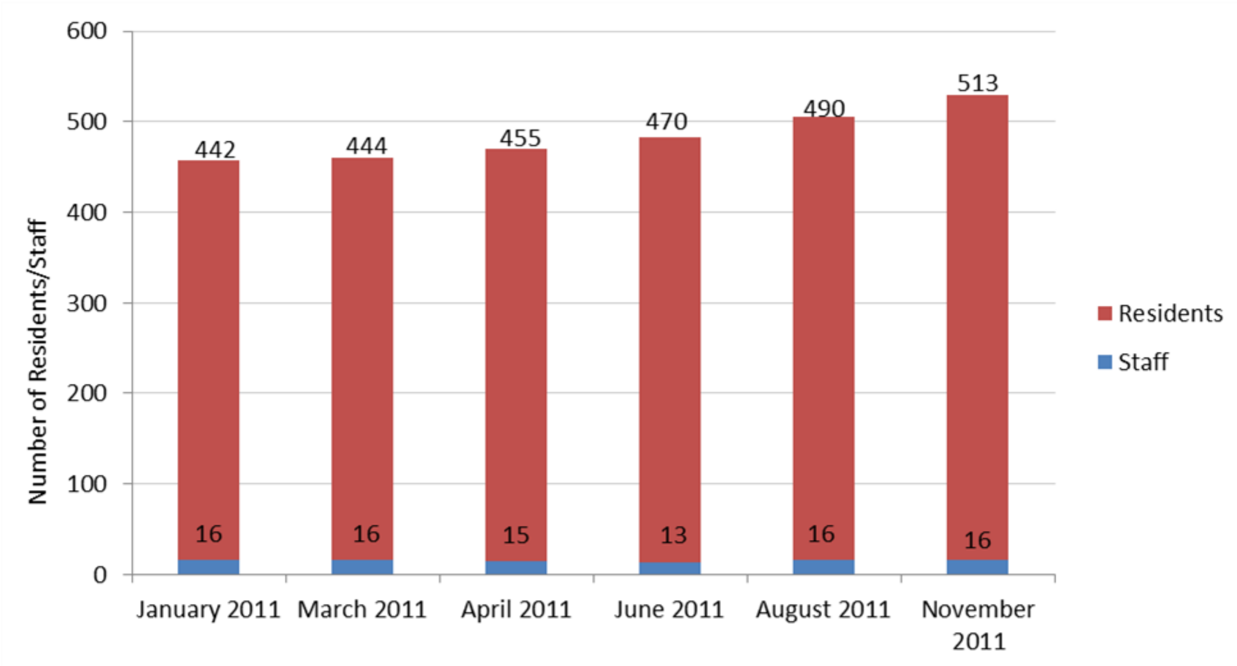
3.4.4 Changes to Non-Controllable Variables

Several non-controllable variables changed over the course of the study that have a direct influence on the results: building population, weather, electricity rates ($/kWh) and water and sewer rates ($/gal).

3.4.5 Building Population

The population of The Visionaire increased from 359 at the start of the study, to 513 by the end of the study. The rate of increase was fairly consistent as shown in Figure 5. Therefore, for the purposes of calculation, the average population for the study is taken to be 436. The number of full-time staff for the building remained at 16 for the duration of the study. The average resident population during the study represents 71% of the maximum population of 610 residents.

Figure 5. Population Changes at The Visionaire Since January 2011



3.4.6 Weather

The weather conditions in NYC, specifically the temperature and precipitation, play an important role in the WTRS at The Visionaire. Higher temperatures indicate increased demand on the cooling system while precipitation indicates additional storm water capture. Figure 6 and Figure 7 provide precipitation and temperature data, respectively, for NYC from January 2010 through May 2011. Data were provided by the National Oceanic and Atmospheric Administration (NOAA) Climate Services and Monitoring Division.

Figure 6. Precipitation Data for NYC in Inches From January 2010 Through September 2011

Source: NOAA (http://www.ncdc.noaa.gov)

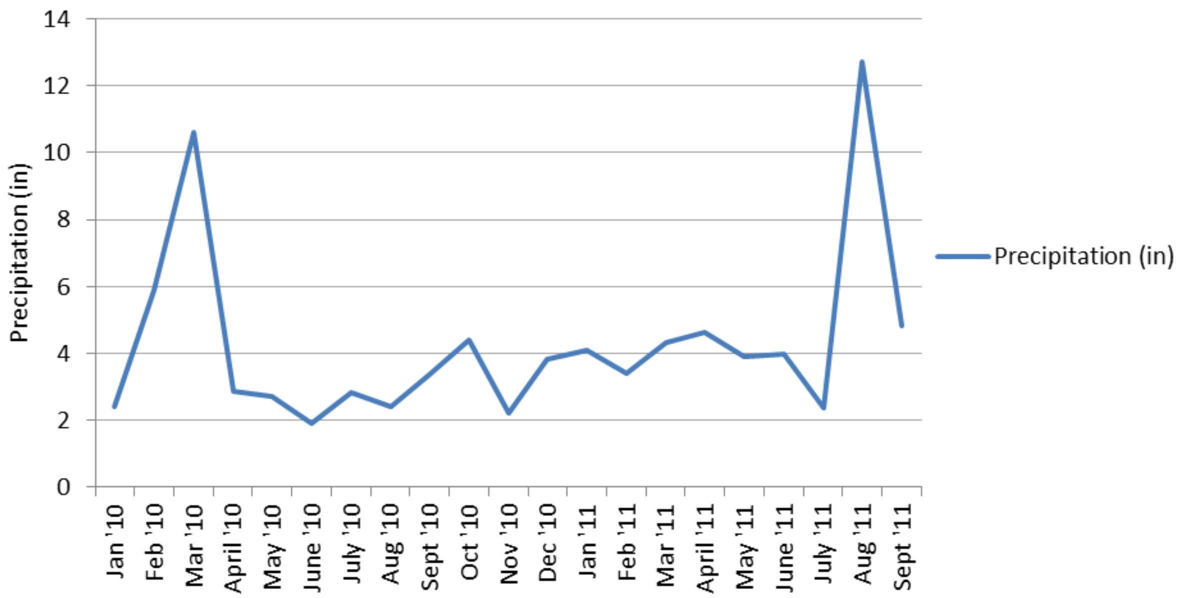
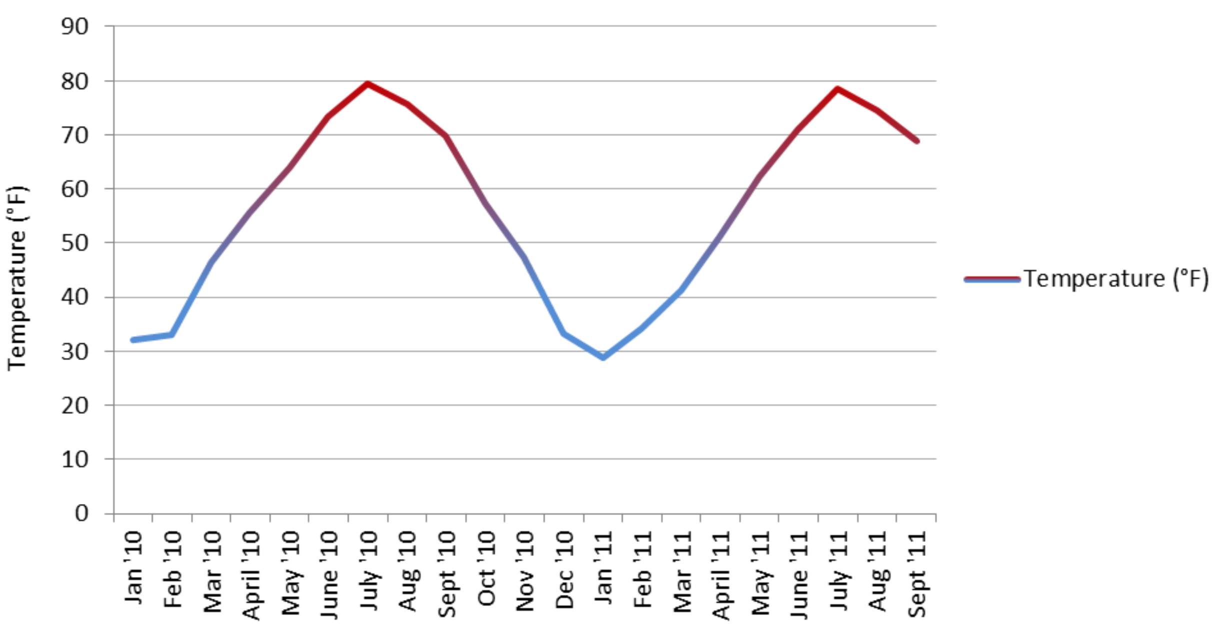


Figure 7. Mean Temperature Data (°F) for NYC from January 2010 Through September 2011

Source: NOAA (http://www.ncdc.noaa.gov)



3.4.7 Electric Rates

Table 20 provides the standard, peak, and off-peak Con Edison rates applicable to The Visionaire over the course of the study.

Table 20. Con Edison Rates for Voluntary Time-Of-Use and Standard-Rate Customers

Month	Voluntary time-of-use*		Standard Rate ($/kWh)
	Peak Rate ($/kWh)	Off-peak Rate ($/kWh)	
Nov-10	0.09	0.08	0.08
Dec-10	0.11	0.08	0.09
Jan-11	0.09	0.07	0.08
Feb-11	0.09	0.07	0.08
Mar-11	0.08	0.07	0.08
Apr-11	0.07	0.06	0.07
May-11	0.08	0.05	0.06
Jun-11	0.09	0.05	0.07
Jul-11	0.11	0.07	0.09
Aug-11	0.05	0.03	0.04
Sep-11	0.07	0.05	0.06
Oct-11	0.05	0.04	0.05

* The Visionaire is subject to standard rates. Voluntary time-of-use rates are provided for reference.

3.4.8 Water and Sewer Rates

Table 21 provides the standard water and sewer rates (without adjustments) charged by NYC DEP to The Visionaire over the course of the study.

Table 21. Water and Sewer Rates Charged to The Visionaire Over the Study Period

	Water Rate ($/gal)	Sewer Rate ($/gal)
May 2010	0.0035	0.0056
June 2010	0.0035	0.0056
July 2010	0.0039	0.0063
August 2010	0.0039	0.0063
September 2010	0.0039	0.0063
October 2010	0.0039	0.0063
November 2010	0.0039	0.0063
December 2010	0.0039	0.0063
January 2011	0.0039	0.0063
February 2011	0.0039	0.0063
March 2011	0.0039	0.0063
April 2011	0.0039	0.0063
May 2011	0.0039	0.0063
June 2011	0.0041	0.0065
July 2011	0.0042	0.0067
August 2011	0.0042	0.0067
September 2011	0.0042	0.0067

4 Study Results

The following section summarizes the data collected from May 4, 2010 to October 15, 2011 for (1) Water Quantity and Conservation, (2) Water Quality & Compliance, (3) Cooling Tower Deposition, (4) Energy Consumption, (5) Chemical Consumption, and (6) Economics.

4.1 Water Quantity and Conservation

Over the course of the study, water demand for The Visionaire was 19.7 MGal. The WTRS prevented 4.3 MGal of potable water from being consumed and hence reduced the potable water footprint of the building by 22%. Figure 8 is a WTRS schematic with meters identified including average flow values for each meter over the study period. Table 22 summarizes the flows at The Visionaire by month for the study period including how each flow was calculated based on meter data. Figure 9, Figure 10, Figure 11, and Figure 12 summarize water supply, use, cooling tower make-up, and discharge respectively, at The Visionaire from May 4, 2010 through October 15, 2011. Appendix E provides schematics water balances for The Visionaire by month, based on metered and estimated unmetered flows for the study. Total unmetered water use in the building is approximately 1,800 gpd. Table 23 reports the approximate values of these unmetered flows.

Figure 8. Schematic of the WTRS at The Visionaire

Includes meter locations and average daily flows in gpd for each meter over the study period.

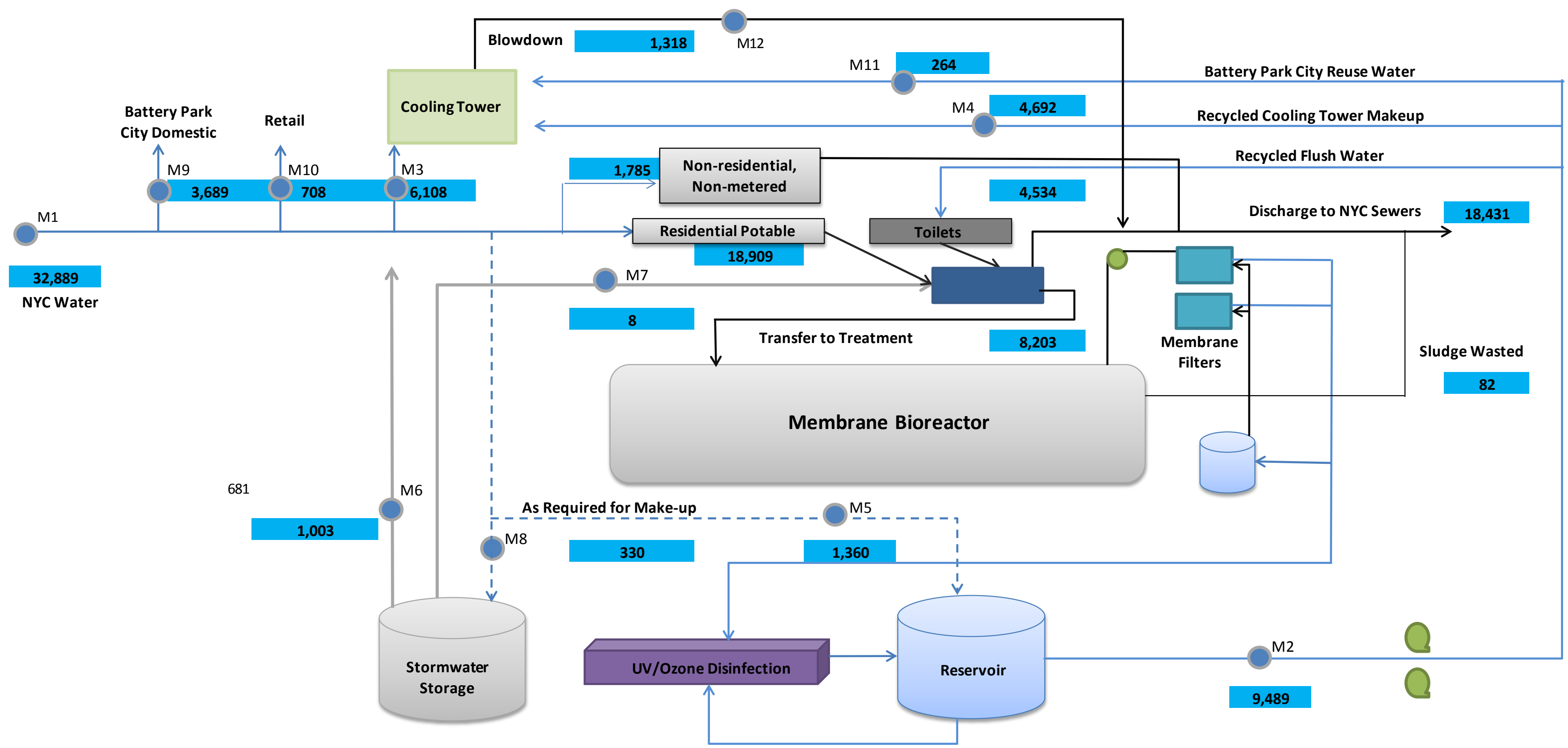


Table 22. Summary of average daily flows (gpd) for each month at The Visionaire for the study period

Month	Storm water Capture[1]	City Water Supply to Visionaire[2]	Total Reuse[3]	Closed loop Reuse (Flush water)[4]	Irrigation[5]	Cooling Load[6]	Discharge to Sewer[7]	Indoor Potable Use[8]	Blowdown[9]
May-10	1,006	28,515	4,492	4,069	1,854	10,600	17,321	15,037	923
Jun-10	1,587	32,620	6,615	2,302	2,007	17,953	14,867	15,545	1,851
Jul-10	2,336	43,108	7,444	2,104	2,801	25,573	17,817	19,055	2,318
Aug-10	1,880	36,757	7,434	2,489	3,291	19,860	14,972	16,333	1,800
Sep-10	1,095	31,654	7,794	5,006	1,354	13,180	17,611	17,865	741
Oct-10	4	26,290	8,619	3,512	4	10,918	20,547	18,206	5,664
Nov-10	0	24,941	4,481	3,455	2	4,123	19,889	18,859	271
Dec-10	0	21,870	3,387	3,329	0	971	20,273	18,300	247
Jan-11	0	22,161	4,214	3,275	0	443	20,560	19,527	186
Feb-11	14	21,405	5,475	4,712	2	948	20,452	19,093	326
Mar-11	118	21,742	7,512	6,641	12	2,050	21,007	19,229	759
Apr-11	23	23,928	6,361	6,511	21	4,428	20,258	17,929	384
May-11	1,227	28,284	4,534	4,758	1,227	7,892	22,546	18,564	1,973
Jun-11	1,485	30,499	11,824	5,115	2,371	14,727	16,639	20,695	869
Jul-11	2,331	42,705	12,873	7,029	2,854	22,732	23,088	25,371	1,776
Aug-11	0	26,521	15,392	5,253	239	16,783	11,363	18,,688	1,031
Sep-11	5	25,628	15,196	5,595	6	13,413	13,423	19,742	1,497
Oct-11	13	24,230	12,537	6,449	13	7,806	19,128	22,327	1,104
AVERAGE	729	28,492	8,121	4,534	1,003	10,800	18,431	18,909	1,318

Table notes are on next page

Table 22 continued

[1] M6-M8+M7 | where M6, M8, and M7 refer to flow meter location in Figure 8 |

[2] M1-M9-M10 |

[3] Transfer to treatment (flow meter on grinder pump) - sludge wasted |

[4] M2-M4-M11 |

[5] M6 |

[6] M3+M4 |

[7] (Indoor Potable Use + Closed Loop Reuse + M7 - Transfer to Treatment) + Sludge Wasted + Blowdown + Non-Metered & Non-Residential |

[8] City Water Supply to Visionaire-M3-M8-M5 - Non-Metered & Non-Residential |

[9] Blow-down meter readings are estimated through March 2011. |

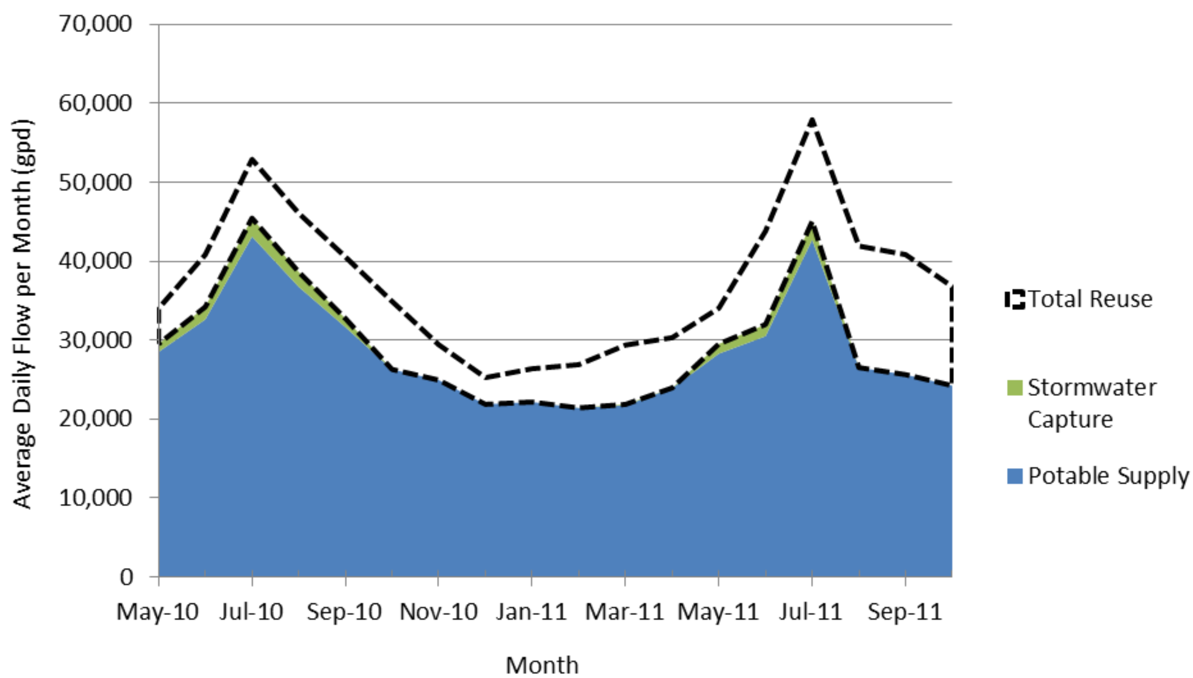
Table 23. Unmetered water uses with approximate daily flows.

Source	Flow (gpd)
Humidifiers	256
Brominator	500
Leisure Room	686
Pool	68.5
Empty Water Tower	274
TOTAL	**1784.5**

4.1.1 Water Demand

During the study period, potable supply to the building was on average 28,492 gpd, ranging between 21,405 gpd (Feb 2011) and 43,108 gpd (July 2010). The Visionaire WTRS treated an average of 8,203 gpd domestic wastewater and accounted for 22% of the total water demand in the building. An additional 729 gpd of storm water was captured and used to provide 73% of total irrigation demand. Figure 9 illustrates water demand by total reuse, storm capture, and potable supply.

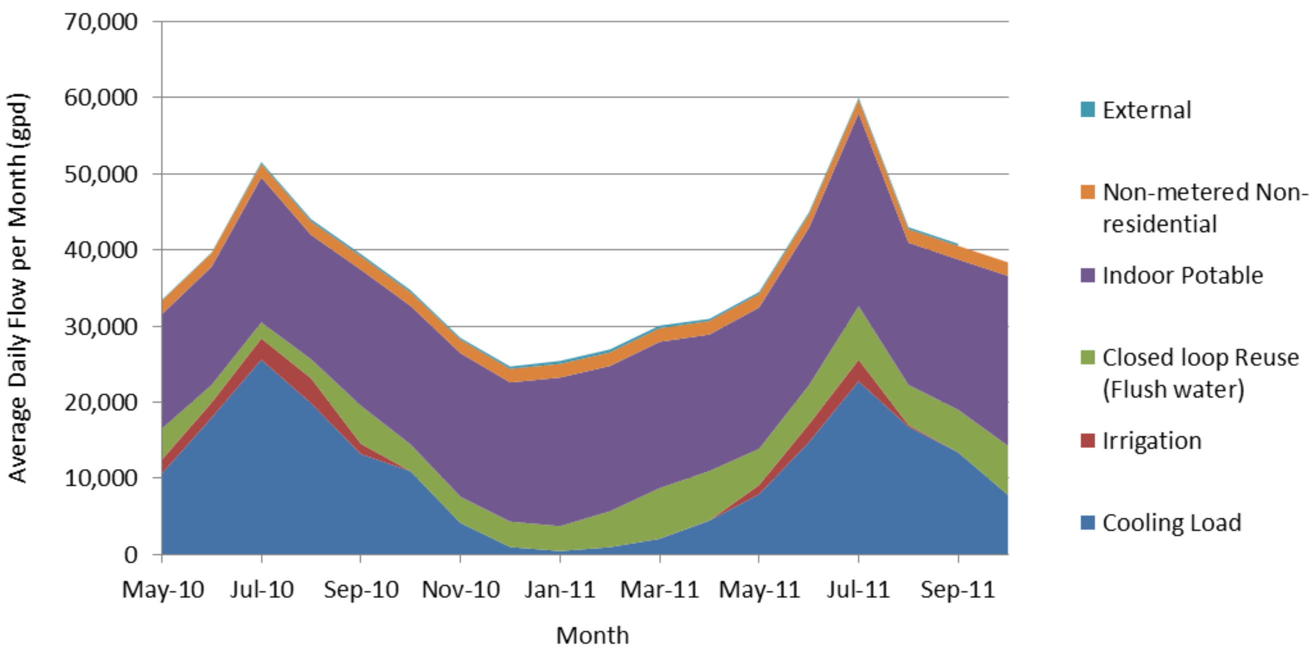
Figure 9. Average Daily Water Demand (gpd) by Supply Source for Each Month of the Study Period



4.1.2 Consumption by End Use

Indoor potable (excluding lavatory) demand accounted for 51% of the total building influent demand and was fairly consistent over the course of the study at approximately 39 gpd per person. Closed loop reuse of approximately 4,534 gpd was present in the flush water loop. Flush water use by the low-flow toilets was equivalent to 10.4 gpd per person on average. Cooling tower demand was 10,800 gpd on average with large seasonal variations. Specific information regarding the quantity of reuse water used for cooling tower operation over the study is provided in the following sections. Irrigation demand was 1,003 gpd on average ranging from a high of 3,291 gpd in August 2010 to a low of 0 gpd during the winter of 2010-2011. Figure 10illustrates the water usage at The Visionaire by end use.

Figure 10. Average Daily Water Consumption (gpd) by End Use for Each Month of the Study Period



4.1.3 Cooling Tower Use

Over the study, the WTRS provided 43% of cooling water demand. Figure 11 illustrates the total potable and reuse water cooling tower demand over the period. Cooling load varied dramatically from 443 gpd in January 2011 to 25,573 gpd in July 2010. Cooling tower evaporation accounted for approximately 50% of total building discharge during the summer. Figure 11 shows the percent of cooling tower reuse as compared to the percent of overall reuse in the building. The percent reuse increased after May 2011 when it was determined that 100% reuse water could be used for cooling tower operation.

4.1.4 Water Discharge

An average of 18,431 gpd of water was discharged to sewer over the study. This amount ranged between 11,361 gpd (August 2011) and 23,088 gpd (July 2011). Discharge includes untreatable water (storm tank flush, pool flush, and cooling tower blow down) and excess flow. Summary of water discharge is shown in Figure 12.

Figure 11. Average Daily Total Potable Water and Reuse Water Consumption (gpd) per Month of the Study Period by the Cooling Tower

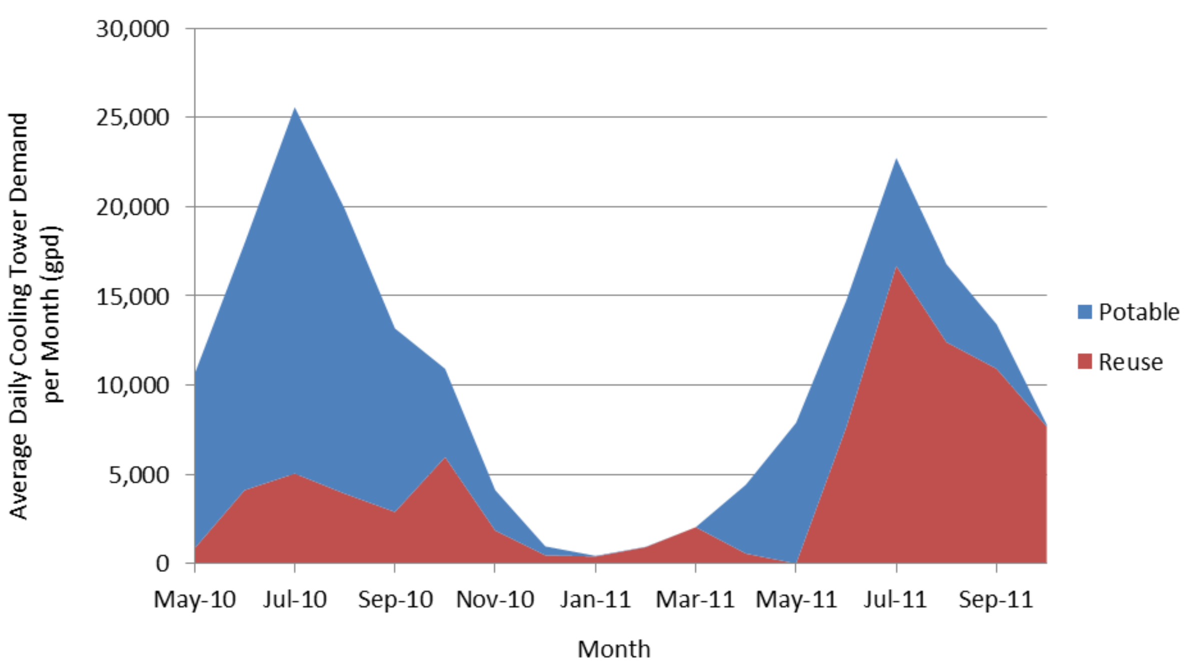
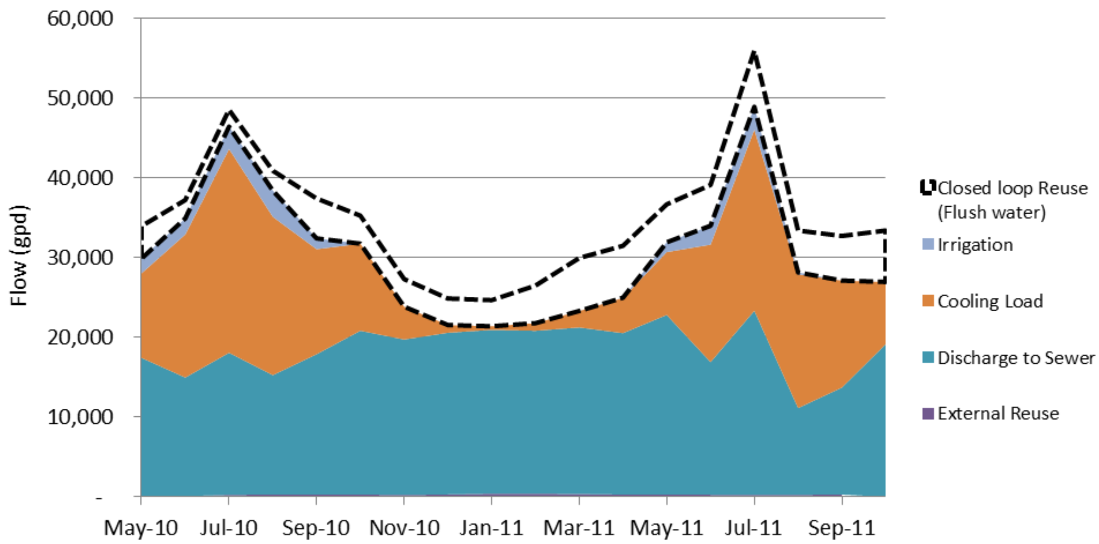


Figure 12. Average Daily Water Discharge by End Sink (gpd) per Month of the Study Period.



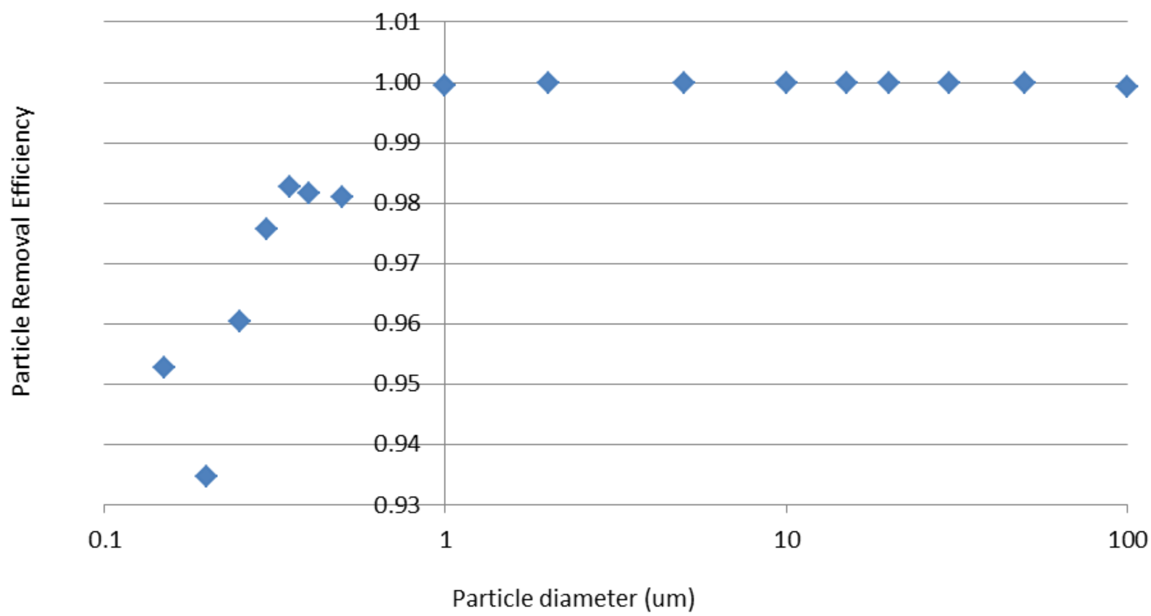
4.2 Water Quality and Compliance

4.2.1 Filter Performance

Figure 13 shows that the MBR proficiently removes all size fractions of 1 micrometer or greater in diameter. Measured particle removal efficiency of particles 0.1 micrometers in diameter was 93%, with removal efficiency increasing with particle diameter up to 100% removal efficiency at the micron scale.

Particle distribution laboratory results are provided in Appendix F.

Figure 13. Particle Removal Efficiency of MBR by Particle Diameter



4.2.2 Water Treatment and Reuse System Performance

Table 24 reports the results of water quality monitoring as required for compliance by the NYC DOB and also indicates the effluent quality limits stipulated by DOB to enable reuse for indoor non-potable applications**.** As shown in Table 24, The Visionaire WTRS consistently met DOB compliance requirements over the duration of the study. Turbidity was consistently below 0.5 NTU and TSS was consistently below 2 mg/L, which concurs with the particle removal performance of the membrane filters. The effluent BOD was consistently below 6 mg/L and E. coli was consistently below 1 colony per 100 mL. See Appendix G for Garden State Laboratory full analysis results.

Table 24. Water Quality Results for the Reuse Water Between May 2010 and September 2011
(Analysis conducted by Garden State Laboratories – see *Appendix G)*

Sample Date	BOD (mg/L)	TSS (mg/L)	Turbidity (NTU)	E Coli (count per 100mL)	Total Coliforms (count per 100 mL)	pH
DOB Limit	<10	<10	<2	<2.2	<100	6.5-8.0
May	<6	<1	0.35	<1	-	7.2
June	<6	<1	0.2	<1	<1	7.0
July	-	-	-	-	-	7.0
August	<6	<1	0.4	<1	<1	6.9
September	<6	<1	0.25	-	<1	6.8
October	<6	<1	0.1	<1	<1	6.8
November	<6	<1	0.35	<1	<1	6.8
December	<6	<1	0.4	<1	<1	6.9
January	<6	2	0.35	<1	<1	
February	<6	<1	0.35	<1	<10	
March	<6	<1	0.55	<1	<1	
April	<6	<1	0.15	<1	<1	
May	<6	<1	0.15	<1	<1	
June	<6	<1	0.15	<1	<1	
July	<6	<1	0.4	1	<1	
August	<6	<1	0.2			
September	<6	<1	0.15			

4.2.3 Cooling Tower Water Quality

Table 25 reports the results of the water quality testing performed by Chemtreat to monitor the suitability of reuse water for cooling tower make-up. Suitability is based on the ability to achieve a target number of cycles of concentration before blow-down. Based on their operational program for the cooling tower at The Visionaire, Chemtreat indicated that make-up water quality is suitable when conductivity is below 800 micro-mhos, pH is below 7.5 and chlorides are below 100 mg/L. Table 25 indicates that in November 2010 the reuse water conductivity had conductivity of 846 umhos and chloride concentration of 165 mg/L. The increase in conductivity was related to the increase in chloride concentration, which was believed to be accumulating in the close-loop toilet flush network as a result of continual hypochlorite addition. These findings led to the suspension of continuous hypochlorite addition to the reuse reservoir. The subsequent reduction of chloride concentrations enabled the quantity of reuse water utilized in the cooling tower to be increased. See Appendix H for full set of Chemtreat standard reports and laboratory reports.

Table 25. Summary of the Water Quality Results that are Pertinent to Cooling Tower Operation

The indicated reuse water quality limits are stipulated by Chemtreat to achieve 7-10 cycles of concentration in the cooling tower with reuse water before blow-down must occur. Polymer is added to increase the numbers of cycles achievable before orthophosphates become limiting. Values of concern are shown in bold italics.

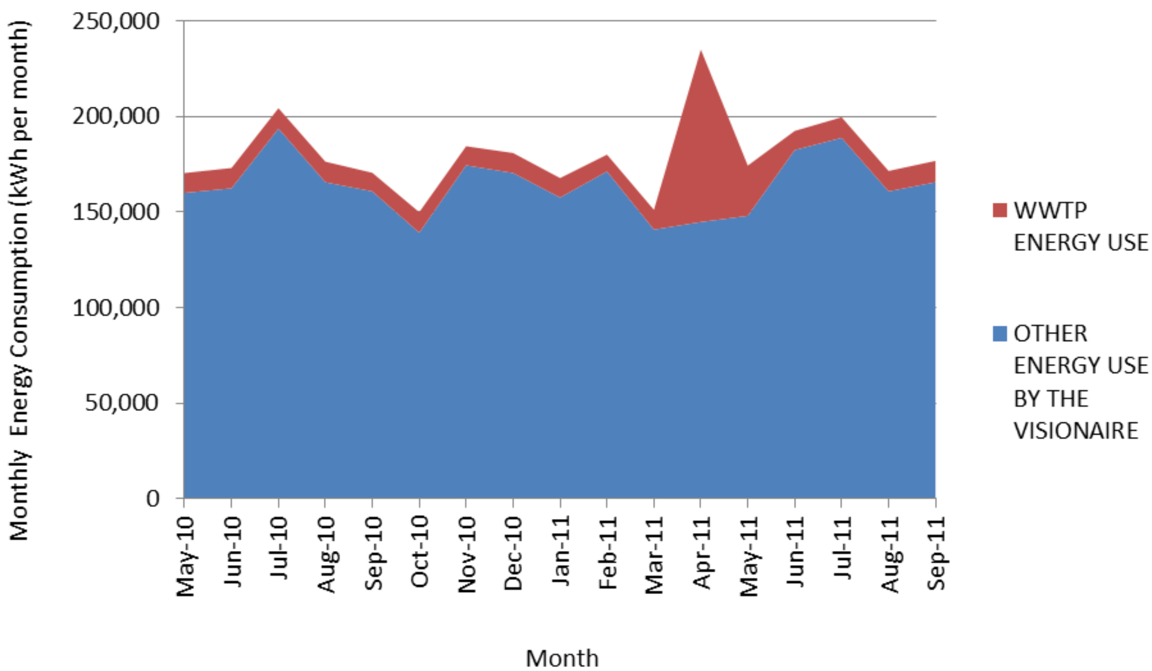
Metric	pH	Conductivity	M−Alkalinity	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Nitrate	Ortho−Phosphate	Silica	Ammonia
Unit	N/A	umhos	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Reuse water quality limits	7.3	500-650		40-60							0.7 – 1.5		<0.10
May	7.58	614	34	50	20	89	13	69	−	131	0.95	5.4	0.11
August	6.94	551	20	52	22	72	7.5	98	−	85	0.7	4.6	<0.10
November	6.79	846	24	58	33	114	10	165	-	154	1	4.5	<0.1
February	6.59	561	19	43	13	72	13	49	-	148	0.76	5.3	0.13
March	6.04	592	23	48	14	88	16	50		141	0.93	5.9	<0.1
May	7.07	499	21	51	16	61	14	66	29	85	1.5	7.3	-
September	7.3	531	20	45	22	63	14	96	25	<0.1	0.77	5.3	<0.1

4.3 Energy Consumption

Between May 4, 2010 and October 15, 2011, The Visionaire WTRS consumed 273,500 kWh across 18 separately monitored components, which equivates to approximately 509 kWh of power per day. Due to a booster pump malfunction in April/May 2011 (detailed in following section), the average daily energy consumption over the study period was much higher than typical consumption. Removing these erroneous months, the typical power consumption of the WTRS over the study period was approximately 343 kWh per day.

As shown in Figure 14, the WTRS constitutes approximately 6% of the total building power usage on a typical average daily basis. The fraction of total building power consumption attributable to the WTRS increases to 38% in April 2011 due to the booster pump malfunction.

Figure 14. Monthly Energy Consumption by The WTRS vs. All Other Consumptions by The Visionaire (kwh/month)



4.3.1 Fractional Energy Usage of the WTRS

Table 26 provides average daily kWh consumption values for each component of the WTRS by month for the study period. Appendix I provides monthly summaries of energy consumption by each component in The Visionaire WTRS.

Table 26. Average Daily Power Consumption of WTRS Components at The Visionaire by Month (May 2010 to October 2011)

All numbers are kWh/day.

	Feed Pump 1	Feed Pump 2	Blower 1	Blower 2	Recirc. Pump	B/P Pump 1	B/P Pump 2	Perm. Pump 1	Perm. Pump 2	UV Pump	Trash Pump	Odor Cntrl	Ozone Pump	Ozone Gen.	Ozone Compr.	Inline Grinder	UV Syst.	Boost Pump
May	0.77	0.81	99.37	99.37	16.35	0.15	0.11	3.60	3.74	14.77	0.00	16.87	3.09	5.42	20.41	0.80	6.59	43.01
June	0.83	0.79	99.65	99.37	16.43	0.16	0.16	3.87	4.03	14.77	0.00	21.97	3.97	7.05	26.50	0.83	6.65	47.76
July	0.68	0.68	99.10	99.37	16.50	0.18	0.15	3.90	4.06	14.77	0.00	18.76	3.39	6.03	22.73	0.69	6.19	46.84
Aug	0.68	0.68	99.64	99.10	16.35	0.13	0.13	3.33	3.47	14.77	1.13	18.72	4.32	6.02	22.69	0.69	6.81	48.03
Sep	0.83	0.75	99.65	99.09	16.51	0.18	0.16	4.03	4.19	14.79	0.00	18.72	3.38	6.02	22.67	0.81	6.82	25.90
Oct	0.85	0.85	96.43	98.57	16.50	0.18	0.15	4.32	4.49	14.77	0.00	18.75	3.39	6.03	22.72	0.87	6.38	51.04
Nov	0.48	0.44	99.65	99.09	16.51	0.09	0.11	2.31	2.40	14.79	0.00	18.71	2.26	4.03	21.91	0.47	6.42	44.38
Dec	0.34	0.38	99.91	98.57	16.50	0.07	0.07	1.74	1.81	14.77	0.00	19.40	3.35	5.97	23.47	0.37	5.98	43.97
Jan	0.43	0.38	97.23	96.17	10.62	0.09	0.07	1.93	2.01	14.77	0.00	19.38	3.50	6.24	23.48	0.41	0.41	44.84
Feb	0.54	0.63	99.37	99.06	7.96	0.10	0.08	2.39	2.49	14.77	1.25	17.92	3.21	5.72	21.50	0.60	1.94	47.30
Mar	0.94	0.81	99.10	99.10	7.99	0.15	0.13	3.60	3.74	14.75	0.00	18.72	3.38	6.02	22.68	0.89	0.00	52.32
Apr	0.61	0.57	106.27	86.40	8.02	0.02	0.05	2.86	3.91	14.77	0.00	18.78	1.32	2.35	9.45	0.60	0.00	2748.27
May	0.51	0.43	97.50	97.23	9.80	0.09	0.09	2.31	2.48	14.64	1.05	19.34	2.97	5.38	20.26	0.48	0.00	389.97
Jun	1.54	1.36	99.65	99.09	4.05	0.23	0.23	5.91	6.19	14.77	0.00	18.09	3.27	5.82	21.91	1.48	1.48	49.20
Jul	1.84	1.93	99.37	99.37	5.37	0.23	0.23	5.99	6.11	14.77	1.17	18.86	3.41	6.07	22.81	1.92	0.00	69.34
Aug	2.28	1.98	99.37	99.37	22.50	0.30	0.30	7.63	7.94	14.77	0.00	15.49	2.80	4.99	18.76	2.17	0.00	54.93
Sep	2.00	1.73	98.51	99.94	22.47	0.33	0.31	7.69	7.92	14.77	0.00	19.40	3.50	6.24	23.50	1.90	0.00	74.07
Oct	1.41	1.32	98.27	101.03	22.42	0.27	0.27	5.95	6.27	14.77	0.00	18.08	3.27	5.82	21.91	1.39	0.00	43.15
Avg.	0.98	0.92	99.34	98.30	14.05	0.16	0.16	4.08	4.29	14.77	0.26	18.67	3.21	5.62	21.63	0.96	3.09	218.02

From Figure 15, it can be seen that the fractional energy consumption of all components is relatively uniform over the study period May 2010 to October 2011, apart from the months of April and May 2011. The booster pumps had an atypically high percentage of power consumption over this period due to a malfunction which caused them to run continuously at full power load for a period of approximately two weeks. The booster pump typically consumes approximately 13% of the total energy required by the WTRS. During the period of malfunction, the power consumed by the booster pump represented 84% of the total power used by the WTRS.

Figure 15. Fractional Power Consumption (%) of Each Component in the WTRS

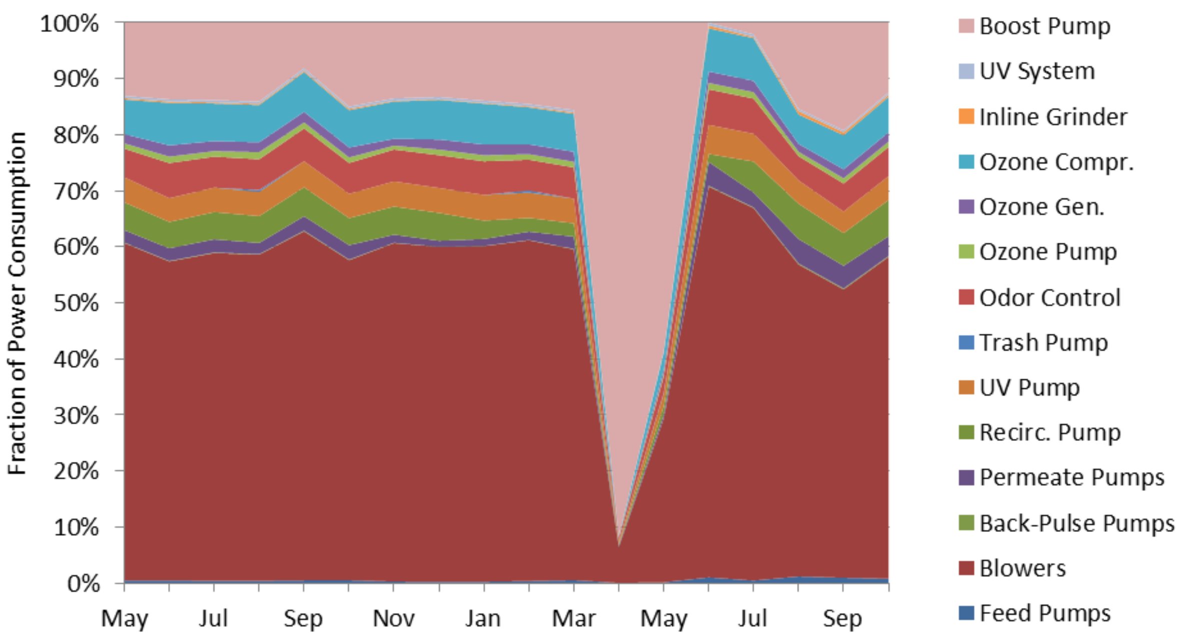
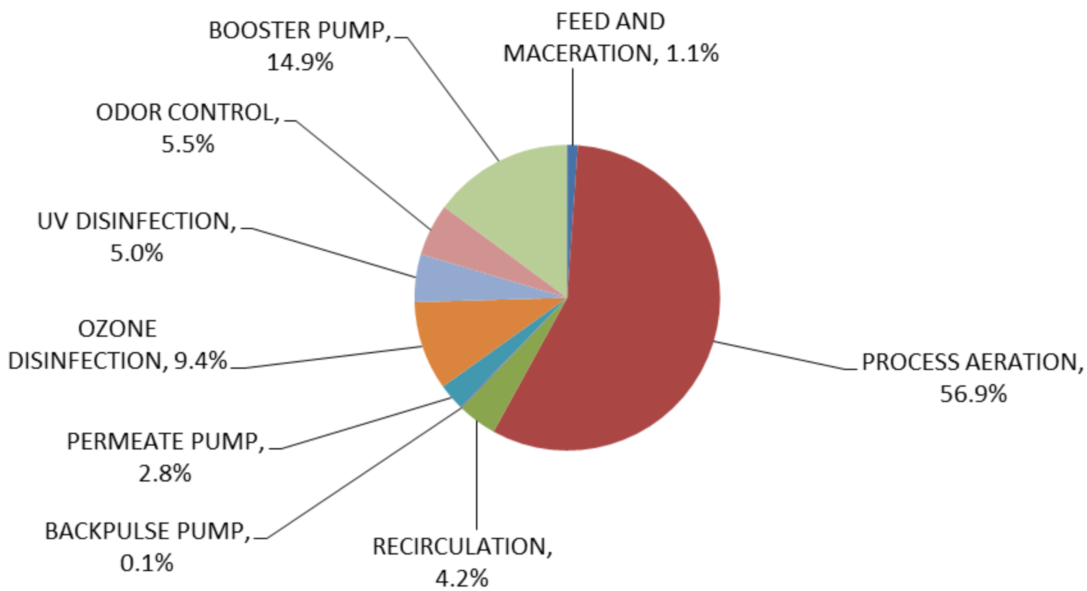


Figure 16 demonstrates the average power consumption by each component as a percentage of total consumption by the WTRS over the duration over the study, excluding the erroneous months of April and May. Excluding April and May, the MBR consumed approximately 65% of the total power required to run the WTRS, of which 87% can be attributed to the blowers. The tertiary disinfection stage (UV, ozone, and odor control) consumed approximately 20% of total power, of which 50% is attributed to the ozone unit.

Figure 16. Power Consumption (%) of Each Component as a Percentage of Total Power Consumption in the WTRS Excluding April and May of 2011



4.3.2 Water-Energy Nexus

Figure 17 demonstrates the relationship between average daily power consumption and average daily treated flow for each component in the WTRS. Each component consumes a relatively consistent amount of power per gallon of wastewater treated. Based on the collected flow and energy data, the specific energy consumption of the treatment system per gallon of water treated was calculated. Figure 17 illustrates that the system is more efficient when more water is treated, varying between 98 kWh/kgal for 3,421 gpd and 23 kWh/kgal for 15,548 gpd with an average of 48.9 kWh/kgal treated over the study period. Figure 18 indicates that energy consumption per gallon of water treated would be approximately 14.7 kWh/kgal if the WTRS treated at the design flow-rate of 25,000 gpd.

Figure 17. Energy Consumption (kwh/Day) of Each Component Based on Flow Treated (gpd)

Additional power consumptions by the trash pump and back-pulse pump are negligible and are not shown.

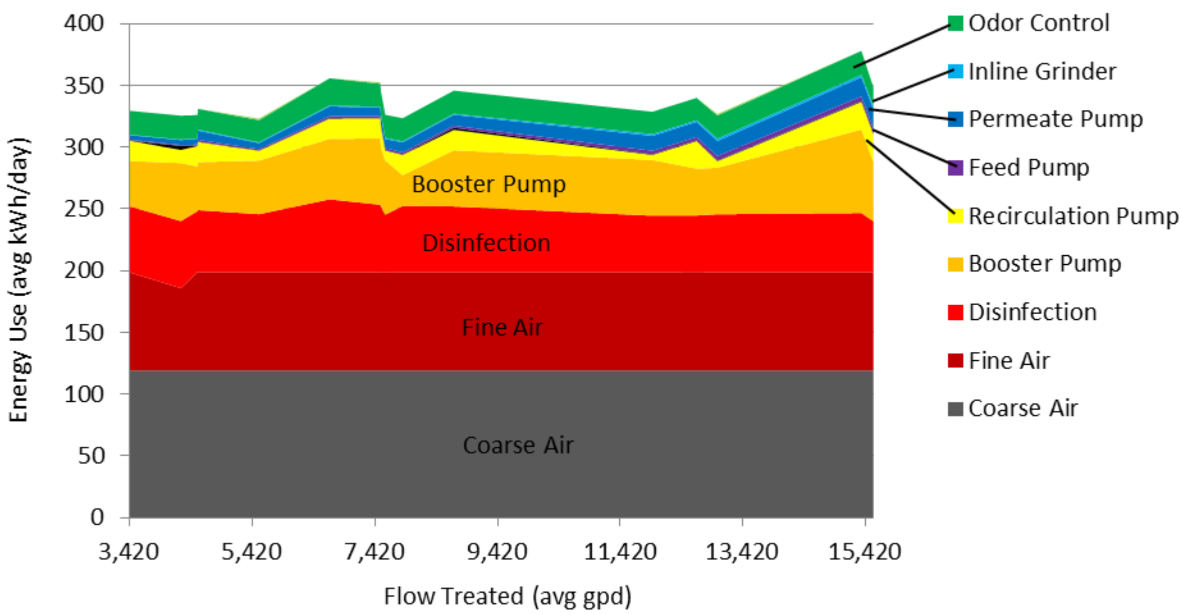
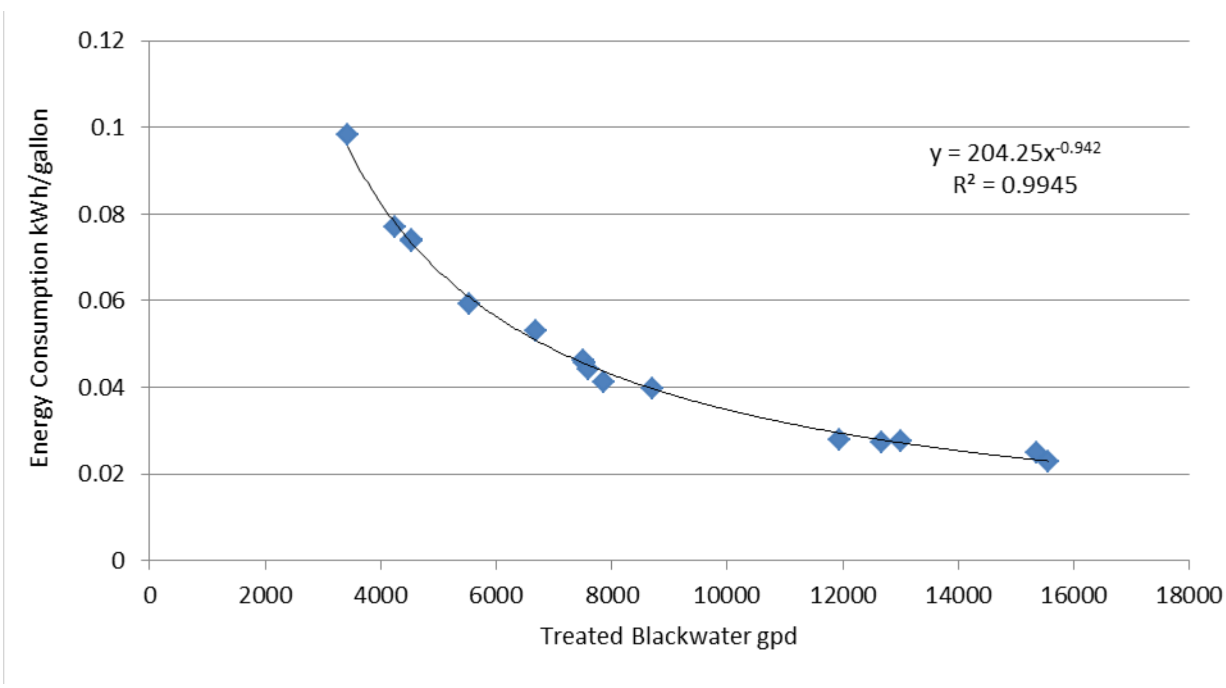


Figure 18. Specific Energy Consumption (kwh/gallon) of The Visionaire WTRS



4.3.3 Peak/Off-Peak Power Consumption Analysis

An analysis was performed to assess the typical profile of power consumption by the WTRS over the course of the day. Consumption by each component was divided into consumption during peak and off-peak times, as summarized in Table 27. Con Edison defines peak energy hours to be 10 a.m. to 10 p.m. on weekdays. Tertiary treatment and odor control components were not included in the analysis as they run continuously. As evident from Table 27, most components exhibit a relatively even split between peak and off-peak power use. Total peak energy use was approximately 117,900 kWh while off-peak use was 116,650 kWh.

Table 27. Total kWh Usage for Each Component Broken Out by Peak and Off-Peak Use

	Feed Pump 1	Feed Pump 2	Blower 1	Blower 2	Recirc. Pump	B/P Pump 1	B/P Pump 2	Perm. Pump 1	Perm. Pump 2	Boost. Pumps	UV Pump	TOTAL
Peak (kWh)	303	266	26,466	25,091	3,679	50	44	1,265	1,316	59,417	-	**117,898**
Off-Peak (kWh)	207	212	26,449	26,110	3,658	34	30	857	922	58,167	0.66	**116,646**

Figure 19 provides insight into the demand for reuse water over the course of the day, based on how power is consumed by the booster pump over the course of the day. Figure 19 shows that there is demand for reuse water throughout the day and the daily profile of demand is relatively similar between months. A diurnal fluctuation is evident with use dipping in the early morning hours, peaking between 8 and 9 a.m., and steadily declining through the remainder of the day. The majority of reuse water demand is between the hours of 7 a.m. and 6 p.m.

Figure 20 provides insight into how the WTRS processes wastewater for reuse over the course of the day, based on how power is consumed by the feed pump over the course of the day. It is evident from Figure 20 that the daily treatment schedule for the WTRS is random and does not necessarily correspond to when there is demand for reuse water, as illustrated in Figure 19. Power consumption by the feed pump appears relatively even over the course of the day, which supports the findings presented in Table 27 regarding the even division of peak versus off-peak power consumption by the WTRS.

Given the predictable nature of demand for water reuse illustrated in Figure 19, an opportunity exists to modify the operation schedule of the WTRS to make maximum use of off-peak power.

Figure 19. Hourly Power Consumption By The Booster Pump as a Fraction of Total Daily Power Consumption by The Booster Pump, for Each Monthly Average Day

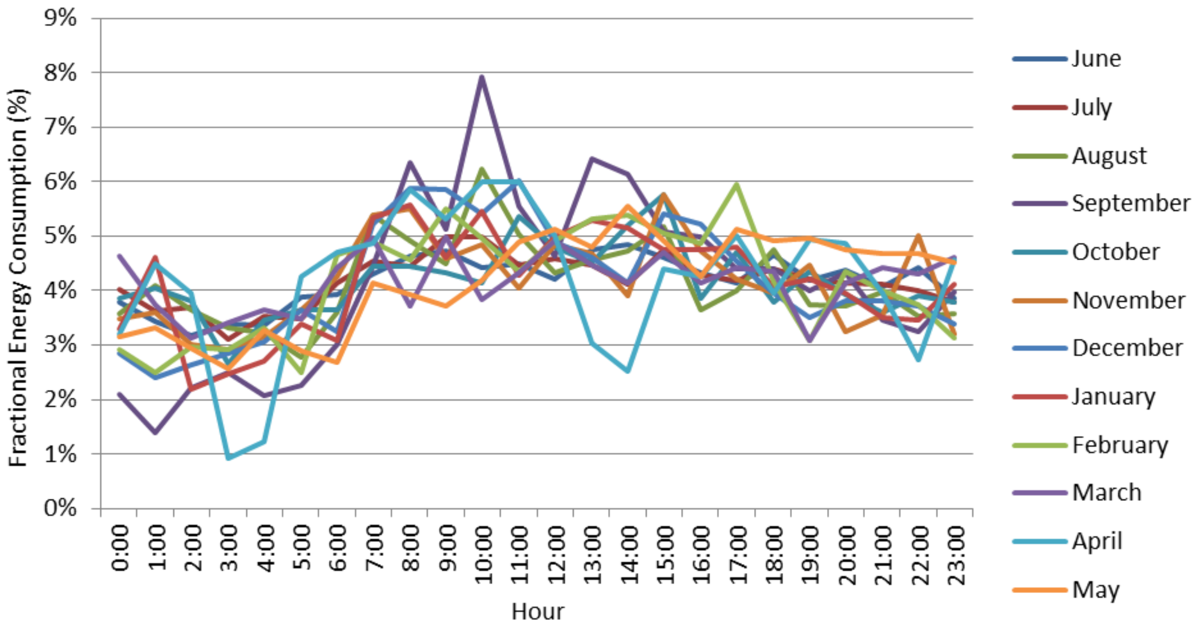
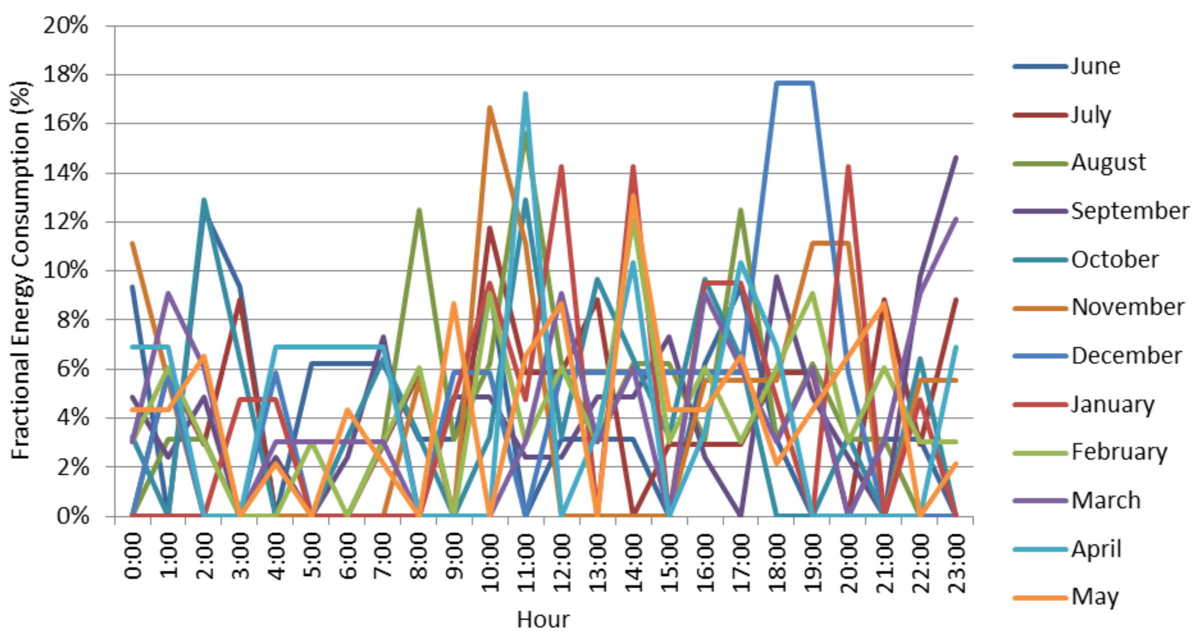


Figure 20. Hourly Power Consumption by The Feed Pump as a Fraction of Total Daily Power Consumption by the Feed Pump, for Each Monthly Average Day



4.4 Chemical Consumption

Table 28 details the chemical consumption for the WTRS at The Visionaire over the study time period. Average caustic (NaOH) and aluminum chlorohydrate ($AlCl_3$) use over the period timeline was approximately 1.12 gpd and 1.01 gpd, respectively. Prior to November 2010, AWM estimated that approximately 0.25 gpd of sodium hypochlorite (NaOCl) was used.

Cooling tower chemical use varied over the study as Chemtreat determined what level of reuse water was possible in the cooling tower. From May 2011 through the end of the study the average polymer and biocide use was approximately 0.57 gpd and 0.52 gpd, respectively. Three 50-lb buckets of bromide tablets were used over the entire study period. See Appendix J for cooling tower chemical inventory data.

Table 28. WTRS Chemicals Consumed at The Visionaire During The Study Period

Sodium hypochlorite feed ceased in November 2010 due to chloride buildup in the system.

Month	days/month	NaOH (avg gpd)	$AlCl_3$ (avg gpd)	NaOCl (avg gpd)
5/4/2010	28	1.42	0.75	0.25
6/1/2010	30	2.10	1.33	0.25
7/1/2010	31	1.81	0.54	0.25
8/1/2010	31	0.92	0.73	0.25
9/1/2010	30	1.36	0.75	0.25
10/1/2010	31	2.04	0.72	0.25
11/1/2010	30	1.30	0.67	0.25
12/1/2010	31	0.83	0.70	0
1/1/2011	31	0.92	0.58	0
2/1/2011	28	1.04	0.46	0
3/1/2011	31	1.13	0.42	0
4/1/2011	30	0.39	0.43	0
5/1/2011	31	0.50	0.75	0
6/1/2011	30	2.12	0.70	0
7/1/2011	31	2.08	1.54	0
8/1/2011	31	1.10	1.60	0
9/1/2011	30	0.74	1.00	0
10/1/2011	15	0.71	1.54	0

4.5 Impacts of Reuse Water on Cooling Tower Maintenance

The impact of reuse water on the maintenance of the cooling tower in terms of corrosion and deposition are discussed.

4.5.1 Cooling Tower Corrosion Coupon Analysis

Table 29 provides corrosion coupon analyses conducted by Chemtreat. The corrosion coupon materials represent the metals present in the cooling tower. The results indicate the extent of corrosion for each corrosion coupon that results from the conditions in the cooling tower over the test period. Copper corrosion rates were consistently below 0.1 mils per year (mpy; 1 mill is 1/1000th of an inch). Mild steel corrosion rate varied between 2.4 mpy and 9.1 mpy. Chemtreat confirmed that these results are typical of cooling tower corrosion rates and do not suggest any accelerated corrosion as a result of using reuse water in the cooling tower. Due to a clog in the coupon rack in early July, sufficient flow (8 gpm) was not achieved through the coupon rack. This issue was identified and resolved by the end of the month. See Appendix K for the Chemtreat corrosion coupon reports.

Table 29. Corrosion coupon analysis results for The Visionaire cooling tower

Section numbers for Appendix K are listed by each respective parameter.

Specimen Type	Date Installed	Date Removed	Corrosion Rate (mpy)[1]	Location
Copper	3/30/2011	5/20/2011	<0.1	Cooling Tower
Mild Steel	3/30/2011	5/20/2011	9.1	Cooling Tower
Copper	5/20/11	6/15/11	0.2	Cooling Tower
Mild Steel	5/20/11	6/15/11	5.5	Cooling Tower
Stainless Steel 316	6/2/2011	7/5/2011	<0.1	Cooling Tower
Copper	6/9/2011	7/12/2011	<0.1	Condenser Water
Mild Steel	6/9/2011	7/12/2011	2.4	Condenser Water
Copper	6/15/11	7/26/2011	<0.1	Cooling Tower
Mild Steel	6/15/11	7/26/2011	7.9	Cooling Tower
Copper	7/26/2011	9/1/2011	<0.1	Cooling Tower
Mild Steel	7/26/2011	9/1/2011	2.7	Cooling Tower

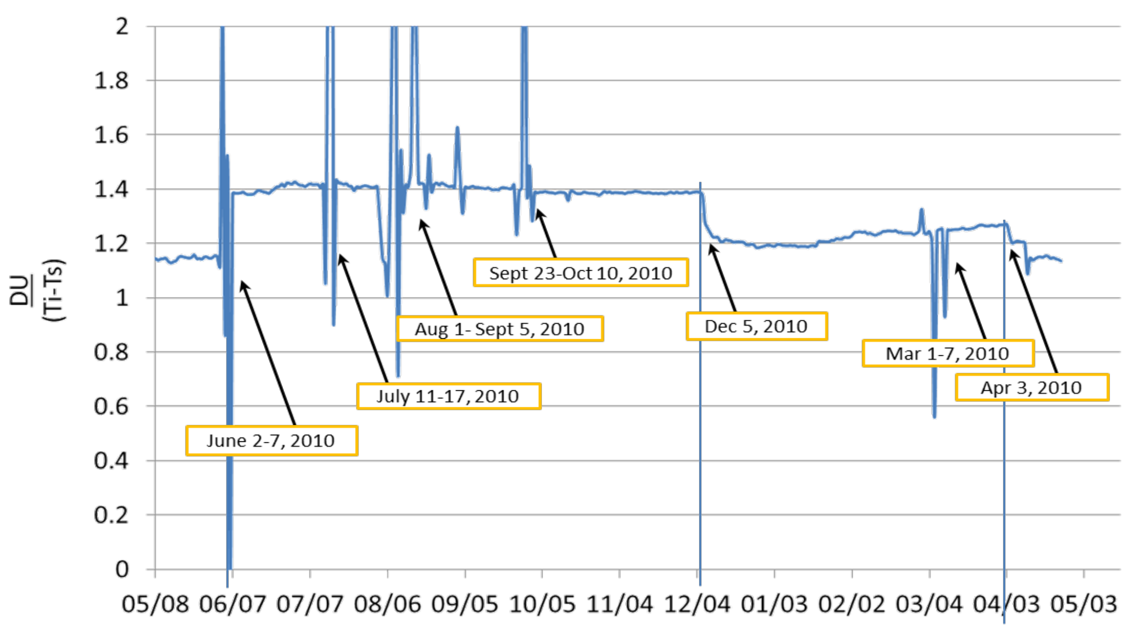
1 mpy = mils per year where a mil is 1/1000th of an inch.

4.5.2 Deposit Monitor

The deposit monitor log was analyzed, and the interpreted data are presented in Figure 21. The temporal trend which indicates deposition is the gradient of Deposit Units (DU) versus temperature difference between shell and inlet (ts-ti). The data log appears to indicate several unstable periods, dated June 2-7, July 11-17, August 1- September 5 and September 23 - October 10. The oscillations occur randomly and for random durations and were believed to be caused by a data logger software problem. An engineer from Atlantis Engineering visited The Visionaire and serviced the deposit monitor on October 23, 2010, and purported to find a problem that may have been causing the instabilities. However, the monitor reading dropped from 1.4 to 1.2 in December 2010 and did not recover. The cause of this drop is unknown. Additional large fluctuations occurred March 4 and April 3 followed by a slow downward trend in April 2011. Despite these random perturbations, the major trend is a flat-line, which indicates negligible deposition over time. Reuse blend was increased to 50% (September 22, 2010 and onward), and there is negligible discernible change in the temporal trend. The overall usefulness of the deposit monitor for determining the effect of reuse water will be discussed in Section 7.

Figure 21. Results from the Deposit Monitor

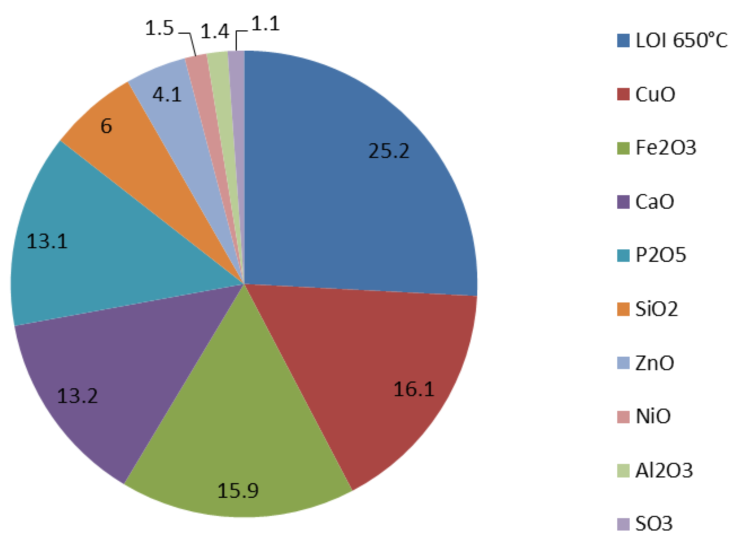
The vertical axis represents the gradient of deposit unit versus temperature difference between the inlet and shell. A flat line indicates negligible deposition.



4.5.3 Chiller Deposit

Figure 22 shows the compositional analysis by mass of the scale cleaned from the chiller during annual maintenance. It was found that calcium phosphate formed 26% (comprised of 13.2% CaO and 13.2 % P_2O_5) of the deposit, most probably derived from the reuse water. Calcium phosphate is typically controlled by limiting the pH. Other large fractions comprising the scale include 25% biological material, which was Lost On Ignition (LOI 650 °C in Figure 22), and copper and iron (both 16%) associated with chiller cleaning. Advisors from ChemTreat explained that the total amount of scale removed was typical of chillers that operate without reuse water. The fraction of calcium oxide present in the scale is a result of blending reuse water and city water to cooling tower makeup, whereby residual levels of phosphate in city water reacting with low concentrations of calcium in reuse water. ChemTreat identified that the degree of calcium phosphate precipitation is controllable using polymers; however, using single source cooling tower-make up water, either 100% city water or 100% reuse water, would be the easiest way to minimize calcium phosphate precipitation.

Figure 22. Chemical Analysis of the Chiller Deposit



4.6 Economics

The cost of energy, water & sewer, chemicals (both WTRS and cooling tower), and operations for the WTRS are presented and summarized for the study period.

4.6.1 Energy

Figure 23 illustrates the price paid for energy to run the WTRS by month for the entire course of the study. The spike in the energy bill in April and May 2011 is associated with booster pump malfunction. As shown in Table 30, the total cost of energy during the study was approximately $19,642. If the cost of the booster pump malfunction were replaced with typical monthly values, the cost of energy would have been closer to $14,525 for the study.

Figure 23. Energy Cost to Run the WTRS at The Visionaire by Month

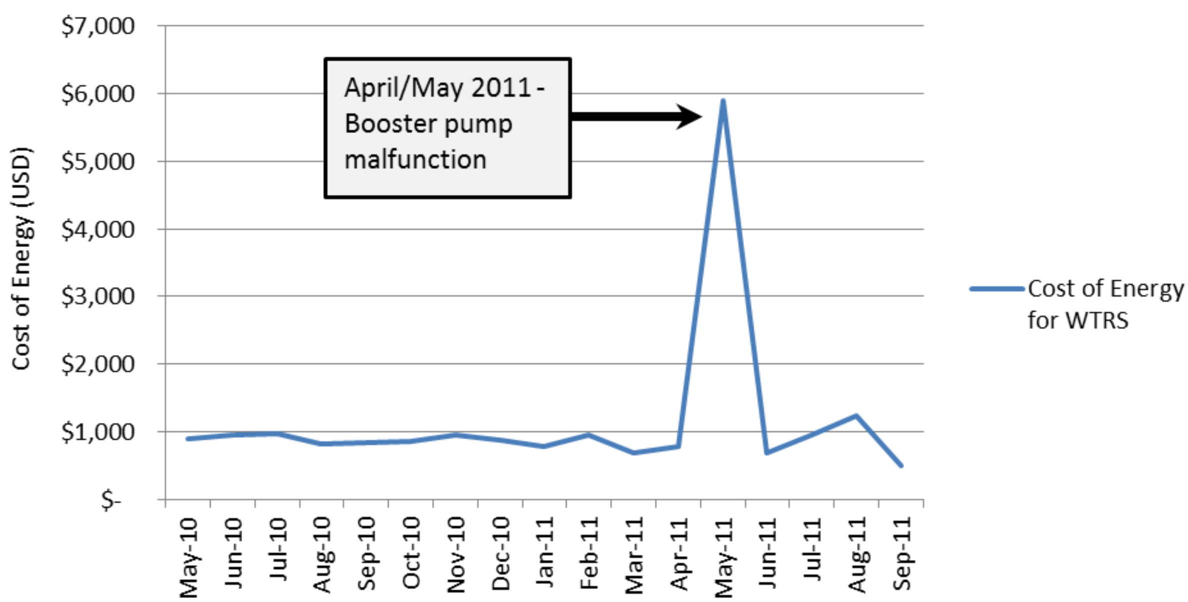


Table 30. Operating Cost Breakout for The Visionaire WTRS Over the Study Timeline

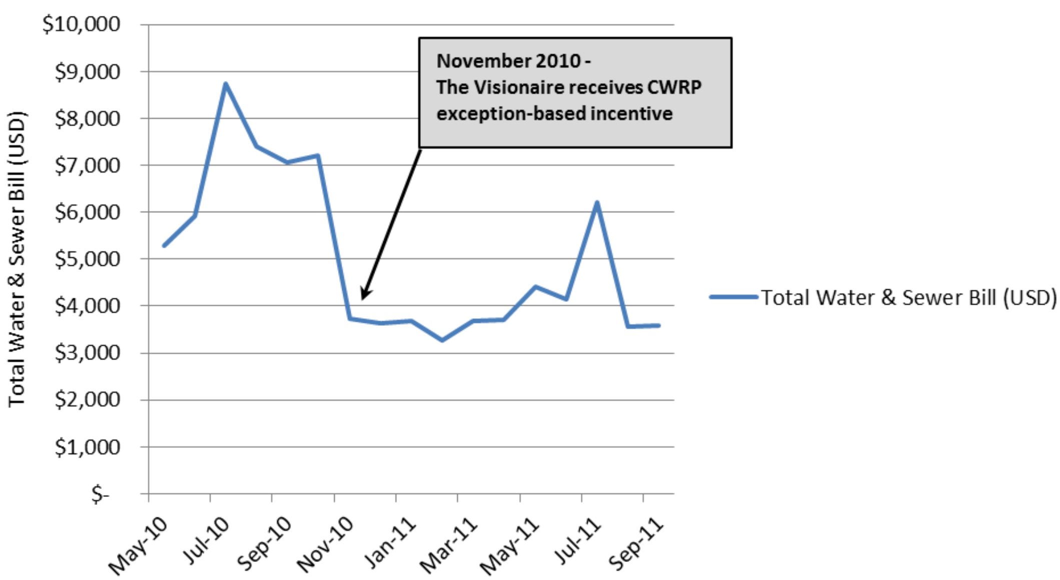
Note that water and sewer and energy costs do not include the 15 study days in October. All other costs do include these days.

BILL	COST
Energy	$ 19,642
NYC Potable Water & Sewer Discharge*	$ 80,486
Cooling Tower Chemicals	$ 11,569
WTRS Chemicals	$ 16,332
AWM Contract	$ 105,498
TOTAL	**$ 233,527**

4.6.2 Water and Sewer

As shown in Figure 24, The Visionaire was able to reduce the monthly water and sewer bills by qualifying for an exceptions-based sewer allowance in November 2011. The Visionaire currently receives a 25% reduction on monthly water and sewer bills under the CWRP and a further 40% off each sewer bill due to the exception-based incentive. Prior to receiving the exception incentive, the average monthly bill for municipal water and sewer services was approximately $5,502. Post incentives, the average bill dropped to $3,960 / month. The total water and sewer bill for The Visionaire during the study was $85,223 with $41,613 spent on the first six months of the study without the exception incentive, and $43,610 spent on the remaining 11 months of the study when both the CWRP incentive and exception-based sewering was applied. Note that this number does not include the bill from the 15 study days in October 2011.

Figure 24. Water and Sewer Bills for The Visionaire by Month



4.6.3 WTRS and Cooling Tower Chemicals

The cost of chemicals used for the study for the WTRS and cooling tower is provided in Table 31. Total chemical cost for the WTRS over the study was approximately $16,332. The total approximate cost for cooling tower chemicals during the study is estimated to be $11,568. Although there are additional chemicals used in each system, they are used in negligible quantities. In total, the chemicals for the WTRS and cooling tower cost $27,901.

Table 31. Chemical Cost Information for the Cooling Tower and WTRS Over The Study

Note that bromide tablets are ordered in 50 lb. pails

Chemical	$/gal (delivered)	Total Cost for Study
WTRS		
Caustic	$ 12.14	$ 8,142
Aluminum Chloride	$ 17.01	$ 7,452
NaOCl	$ 14.00	$ 739
COOLING TOWER		
Polymer/anti-corrosive	$ 21.00	$ 5,903
Biocide	$ 19.00	$ 4,180
Bromide Tablets ($/pail)*	$ 495.00	$ 1,485

4.6.4 AWM Contract

The AWM WTRS operator contract has a fixed annual value of $74,472, and includes all labor hours for operations and maintenance visits. It does not include the cost of chemicals for the WTRS or capital replacement costs. The total cost to contract AWM as the WTRS operator was $105,498 for the study period. This is based on approximately 2–3 visits per week at 2–3 hours per visit.

4.6.5 Total Costs Related to Water and Wastewater Utilities at The Visionaire

Over the course of the study The Visionaire spent approximately $233,527 on energy, water & sewer, cooling tower chemicals, WTRS chemicals, and the WTRS operator contract. This equates to a daily cost of $444 per day to provide all water related services to The Visionaire over the 526 day study period. Table 31 summarizes these costs. More specific information for each of these costs is provided in Appendix L.

5 Performance Analysis of WTRS

Two analyses were performed to qualify the benefits of the WTRS at The Visionaire. In each analysis, the practical performance at The Visionaire in terms of potable water consumption, sewer discharge, energy consumption and operating costs were compared to the theoretical performances of two alternatives:

- Conserving Building: A building that is equivalent to The Visionaire over the study period, but without the WTRS (no reuse).
- Baseline Building: A building that is equivalent to The Visionaire over the study period but without the WTRS (no reuse) and no water conserving fixtures (higher water consumption for indoor residential uses).

The first analysis used the performance of The Visionaire over the study period as the basis for comparison. The second analysis used the projected performance of The Visionaire with WTRS at full occupancy (610 persons) as the basis for comparison. In both analyses, water demand for cooling tower consumption and non-metered uses (non-residential) was assumed to be equal to that consumed by The Visionaire over the study period.

5.1 Performance Over the Study Period

The first comparison is based on the performance of The Visionaire over the study period: May 4, 2011 to September 30, 2011.

5.1.1 Potable Water and Sewer Discharge Savings

Meter data history over the study period is used to determine potable water consumption and sewer discharge for both The Visionaire and the Conserving Building scenarios. The population history of The Visionaire over the study period is used to calculate the theoretical water consumption and sewer discharge for residential uses in the Baseline Building. Fixture consumption information for the Baseline Building is based on “The Handbook of Water Use and Conservation” (Vickers 2002). Irrigation data for the Baseline case is based on LEED v2.2 Guidelines. The assumptions behind estimated water consumption for the Baseline Case are summarized in Table 32.

Table 32. Estimated Baseline Water Consumption for a Non-Conserving Building

Fixture Unit Analysis	Basis of calculation – Standard Building
Toilet/Urinal Use	(number of occupants x 5.1 flushes / day) + (65 guests x 25%)) x 3.5 gpf)
Showers	(number of occupants x 1 use/day x 5.3 minutes / use x 3.3 gpm
Faucets	(number of occupants x 8.1 min/day x 2.5 gpm
Dishwasher	(number of occupants x 0.17 uses / day / occupant x 9.4 gallons / use
Clothes Washer	(number of occupants x 27 gallons / use x 0.37 uses / day / person
Irrigation	LEED points for irrigation are achieved for baseline reduction of at least 50%. Meter readings from The Visionaire were therefore doubled to approximate baseline use.
Cooling Load	From average M3+M4* meter data from May 2010 - September 2011
Other	Based on estimated non-metered consumption

* M3 and M4 refer to flow meters in Figure 8

Table 33 and Table 34, respectively, summarize potable water demand and sewer discharge for the three scenarios. The monthly breakdowns for each scenario that were used to calculate the totals shown in Table 33 and Table 34 are in Appendix L.

Table 33. Potable Water for Three Building Scenarios

Potable water demand over the study period for The Visionaire was compared to estimated potable water demand for the Baseline Building, and Conserving Building scenarios.

Building Type	Potable Demand
Baseline (avg gpd)	44,428
Total over study period (gal)	22,881,649
Conserving (avg gpd)	37,376
% Reduction from Baseline	16%
Total over study period (gal)	19,254,484
The Visionaire (avg gpd)	28,743
% Reduction from Baseline	35%
Total over study period (gal)	14,799,923

Table 34. Sewer Discharge for Three Building Scenarios

Sewer discharge over the study period for The Visionaire was compared to estimated sewer discharge for the Baseline Building and Conserving Building scenarios**.**

Building Type	Discharge to Sewer
Baseline (avg gpd)	33,131
Total over study period (gal)	17,048,924
Conserving (avg gpd)	26,659
% Reduction from Baseline	20%
Total over study period (gal)	13,717,682
The Visionaire (avg gpd)	18,431
% Reduction from Baseline	45%
Total over study period (gal)	9,427,427

Over the study period, The Visionaire consumed 14.8 million gallons of potable water. Based on the assumptions for each scenario regarding water consumption over the study period, Table 31 indicates that a Baseline Building would require approximately 22.8 million gallons of potable water to operate. The Conserving Building consumes 19.2 million gallons, a 16% reduction over the baseline. The Visionaire reduces potable water consumption by 35% in comparison to a Baseline Building, indicating that the WTRS is responsible for an additional 19% reduction on potable water demand from baseline conditions. The WTRS enables The Visionaire to achieve the threshold 25% reduction on potable water consumption from baseline conditions to quality for the CWRP incentives.

Based on the study period The Visionaire discharged approximately 9.4 million gallons of wastewater to sewer. Based on the assumptions for each scenario regarding sewer discharge over the study period, Table 33 indicates that a Baseline building would send 17 million gallons of wastewater to sewer. The Conserving Building would send 13.7 million gallons to sewer, which represents a 20% reduction in sewer discharge compared to a Baseline Building. The Visionaire reduced sewer discharge by 45% in comparison to a Baseline Building, indicating that the WTRS is responsible for an additional 25% reduction on sewer discharge from baseline conditions.

5.1.2 Energy

The WTRS consumed approximately 176,420 kWh (342 kWh per day) over the study period (excluding October 2011 and the erroneous months of April 2011 and May 2011) to provide 4,049 kgal (7,941 gpd) of reuse water, resulting in a specific power consumption of about 43 kWh/kgal. As reported by Dickinson et al. (2011), the power consumption associated with municipal water supply and wastewater treatment is 4.3 kWh/kgal. The WTRS at The Visionaire was, therefore, approximately 10 times more energy-intensive than the NYC-centralized WWTPs.

5.1.3 Economics

Table 35 summarizes the costs associated with potable water consumption and sewer discharge over the study period. All costs were based on the estimated quantities of potable water consumption and sewer discharge shown in Table 33 and Table 34 and the NYC DEP billing rates for water and sewer service over the study period. It is assumed that the Conserving Building does not qualify for the CWRP incentive, based on the analysis shown in Table 35 and does not receive the exceptions-based sewer allowance.

Based on the assumptions for each scenario regarding water consumption over the study period, the cost of water and sewer service for the Baseline Building would be $198,300. The cost of water and sewer service for the Conserving Building would be $163,000. The actual cost of water and sewer service for The Visionaire, which includes CWRP incentives and exception-based sewer allowance from November 2010 onwards, was $85,223. With regard to the cost of municipal water and sewer service over this period, The WTRS with CWRP incentives and exceptions-based sewer billing saved The Visionaire approximately $66,730 over a Conserving Building and $77,777 over a Baseline Building. The cost for water and sewer service for The Visionaire over the study period would have been $74,775 had CWRP incentives and exceptions-based sewer billing been available from the beginning of the study (May 2010).

Table 35. Economic Summary of Potable Water and Sewer Costs With and Without The CWRP Incentive for the Study Period

Water/Sewer	CWRP Allowance	Exception-Based Sewer	Baseline	Conserving	Visionaire
Water	No CWRP	N/A	$ 90,775	$ 76,415	$ 58,557
Water Actual	*Yes CWRP	N/A	N/A	N/A	$ 49,675
Sewer	No CWRP	No Exception	$ 107,517	$ 86,524	$ 59,232
Sewer	*Yes CWRP	No exception	N/A	N/A	$ 49,116
Sewer	No CWRP	*Yes Exception	N/A	N/A	$ 41,142
Sewer Actual	*Yes CWRP	*Yes exception	N/A	N/A	$ 35,548

* CWRP and Sewer Exception allowances were applied from November 2010, where these items are indicated.

Table 36 summarizes the expenses incurred over the study period for water and sewer service, power consumption by the WTRS, chemical consumption by the WTRS, chemical consumption required to control corrosion in the cooling system, and the service contract to operate the WTRS. The expenses for The Visionaire are based on actual costs over the study period. It is assumed that the Conserving Building and Baseline Building do not incur expenses for power consumption by the WTRS, chemical consumption by the WTRS and service fees to operate the WTRS. The cost of chemical consumption by the cooling tower for the Baseline Building and Conserving Building is based on total water demand by the cooling tower over the study period and estimates provided by Chemtreat regarding chemical consumption in typical cooling systems that do not employ reuse water. Appendix L provides additional information in support of the summary shown in Table 36.

Table 36 indicates that complete costs for potable water, reuse water and sewer service over the study period for The Visionaire were $233,147. Based on the assumptions for each scenario, the estimated cost of water and sewer service over the study period for the Baseline Building was $209,861. The complete cost of water and sewer service for the Conserving Building was $174,508.

Table 36. Economic Summary of Energy, Water and Sewer, Chemicals, and Operation Contracts for Three Building Scenarios

Parameters were compared for a baseline building, conserving building with no WTRS, and The Visionaire over the study period (excludes 15 days of October). Energy costs for the anomalous months of April and May have been replaced with typical energy figures for those months. This accounts for the cost difference between the figures displayed below and those presented in Table 31.

	Baseline	**Conserving**	**The Visionaire**	**Notes**
ENERGY COSTS*	$ -	$ -	$ 14,525	No energy costs for the WTRS in the baseline case. Energy costs for the WTRS based on Con-Ed standard monthly rates. Energy costs for the cooling tower are considered equivalent in both cases.*
WATER & SEWER COSTS	$ 198,292	$162,939	$ 85,223	Water and sewer costs for the baseline based on total amount of reuse and NYC DEP average water and sewer rates without CWRP adjustment. Rates with and without the WTRS shows the savings made with reuse and CWRP + exceptions based allowances after November 2010.
CHEMICAL COSTS	$ 11,569	$ 11,569	$ 27,901	No WTRS chemicals under baseline scenario. Chemtreat indicate that the cost for cooling tower corrosion inhibitor is four times higher with the WTRS system than with the baseline case.
AWM CONTRACT	$ -	$ -	$ 105,498	The baseline case does not incur WWTP operator costs. The operating contract for the WTRS is a fixed annual cost for all operating and maintenance work but does not include capital replacement costs.
TOTAL	$ 209,861	$ 174,508	$ 233,147	

* Assuming average energy consumption for the months of April and May, which were not typical months from an energy consumption stand point.

5.1.4 Performance Over the Study Period

Table 37 provides a summary of the performance comparison over the study period between a Baseline Building, a Conserving Building, and The Visionaire. Energy use values for the Baseline and Conserving scenario are based on total potable demand and discharge to sewer, and NYC average energy use for wastewater treatment (4.0 kWh/kgal) and potable water treatment and conveyance (0.3 kWh/kgal). The energy use by The Visionaire also includes the energy consumed by the WTRS over the time period, corrected for the booster pump malfunction (176,420 kWh).

Table 37. Summary of Energy, Water, and Sewer Use and Cost for the Study Period (Excluding October) Based on Actual Data for The Visionaire

	Baseline Building	Conserving Building	The Visionaire
Energy (kWh/study) *	75,060	60,647	218,569
Potable Water (Mgal/study)	22.88	19.25	14.80
Sewer Discharge (Mgal/study)	17.05	13.72	9.43
Total $/study	**$ 209,861**	**$ 174,508**	**$ 233,147**

* Energy consumption includes NYC potable water supply (Mgal/study * 3.0 kWh/kgal), wastewater treatment (Mgal/study * 4.0 kWh/kgal) and WTRS consumption where applicable (176,420 kWh/study).

In Table 38, it can be seen that The Visionaire consumes more than three times the amount of energy of a conserving building. For complete water services over the study period (reuse water, potable water and wastewater treatment), The Visionaire with the WTRS cost $12,838 more than a Baseline Building and $48,191 more than a Conserving Building. However, it must be emphasized that The Visionaire WTRS was operating in trial mode for the first several months of the study, with a 5,000 gpd limit on reuse water supply to the cooling tower. Reuse was limited during the months of April and May, 2011 because of the booster pump malfunction. Resultantly, the average quantity of treated wastewater over the course of the study (8,203 gpd) was below the design capacity of the WTRS (25,000 gpd). compares the total monthly water demand that could have been supplied by reuse water versus the total monthly production of reuse water. The potential demand for reuse water is based on total cooling tower and toilet flush consumption, up to a maximum equivalent of 25,000 gpd. As evident from Table 38, the WTRS provided 4.4 million gallons (MGal) over the course of the study, which is 51% of potential utilization. Maximum potential demand for reuse water was 8.2 MGal which is equivalent to an average of 15,474 gpd. Values are based on actual data from the study period.

Table 38. Potential Versus Actual Reuse Water Consumption at The Visionaire

For period between May 2010 and October 2011, and based on water use for toilet flushing and cooling tower make-up.

	Potential Reuse (gal)	Actual Reuse (gal)	Utilization		Potential Reuse (gal)	Actual Reuse (gal)	Utilization
May-10	454,737	136,044	30%	Feb-11	158,476	142,520	90%
Jun-10	607,659	195,829	32%	Mar-11	269,425	222,239	82%
Jul-10	775,000*	223,332	29%	Apr-11	328,166	182,577	56%
Aug-10	692,827	221,617	32%	May-11	392,123	132,431	34%
Sep-10	545,586	225,600	41%	Jun-11	595,247	347,007	58%
Oct-10	447,321	258,492	58%	Jul-11	775,000*	391,558	51%
Nov-10	227,325	127,820	56%	Aug-11	683,086	469,390	69%
Dec-10	133,306	95,809	72%	Sep-11	570,239	447,548	78%
Jan-11	115,279	118,699	103%	Oct-11	477,304	379,823	80%
				TOTAL	**8,248,106**	**4,318,334**	**52%**

* Potential reuse is capped at the maximum design flow of 25,000 gpd

Additionally, the average population of The Visionaire over the study period was 436, which represents 61% of maximum occupancy (610 people). A fairer comparison between The Visionaire, a Conserving Building and a Baseline Building would be based on performance at maximum occupancy, as maximum occupancy is used as the basis of design for the WTRS.

5.2 Projected Annual Performance at Full Occupancy

The second comparison is based on the projected annual performance of The Visionaire when the building is fully occupied (610 residents). Several modeling assumptions use actual data obtained during the study, based on the year period between October 1, 2010 and September 30, 2011. These assumptions include NYC DEP billing rates for potable supply and sewer service, ConEdison electric rates, water demand data for cooling tower (assuming this does not depend on population), and chemical consumption in the cooling tower.

5.2.1 Potable Water and Sewer Discharge Savings

Table 32 summarizes the assumptions that were used to calculate the projected water demand for indoor residential uses by the Baseline Building at full occupancy. Table 39 summarizes the alternative assumptions that were used to calculate projected water demand for indoor residential uses by the Conserving Building and The Visionaire. Irrigation demand for The Visionaire and the Conserving Building are based on actual irrigation demand by The Visionaire over the period October 1, 2010 through September 30, 2011. Irrigation demand for the Baseline Building is assumed to be 50% higher than for The Visionaire, based on the LEED 2010 Guidelines discussed in Table 36**.** Table 40 and Table 41 summarize water consumption and sewer discharge, respectively, for each scenario. Average daily flow under this scenario is 13,061 gpd. A monthly breakdown of each scenario can be found in Appendix M.

Table 39. Estimated Baseline Water Consumption for the Conserving Building and The Visionaire.

Source: Vickers 2002

Fixture Unit Analysis	Basis of calculation – Conserving
Toilet/Urinal Use	((610 x 5.1 flushes / day) + (guests x 25%)) x 1.6 gpf)
Showers	610 x 1 occ use / day x 5.3 minutes / use x 2.5 gpm
Faucets	610 x 8.1 min/day x 2.2 gpm
Dishwasher	610 x 0.17 uses / day / occupant x 3.6 gallons / use
Clothes Washer	610 x 9.3 gallons / use x 0.37 uses / day / person

Table 40. Comparison of Potable Water Demand in Three Scenarios

Comparison includes a baseline building to a conserving building with no WTRS and a conserving building with a WTRS.Water balance based on full resident population at The Visionaire of 610 residents.

Building Type	Potable Demand
Baseline (avg gpd)	52,228
Annualized (gal)	19,084,911
Conserving, no WTRS (avg gpd)	37,061
% Reduction from baseline	29%
Annualized (gal)	13,547,350
Conserving, WTRS (avg gpd)	23,576
% Reduction from baseline	55%
Annualized (gal)	8,606,934

Table 41. Comparison of Sewer Discharge in Three Building Scenarios

Comparison includes a baseline building to a conserving building with no WTRS and a conserving building with a WTRS. Sewer discharge based on full resident population at The Visionaire of 610 residents.

Building Type	Discharge to Sewer
Baseline (avg gpd)	44,078
Annualized (gal)	16,091,559
Conserving, no WTRS (avg gpd)	29,472
% Reduction from baseline	33%
Annualized (gal)	10,760,446
Conserving, WTRS (avg gpd)	15,966
% Reduction from baseline	64%
Annualized (gal)	5,812,536

Based on the projections for each scenario regarding water consumption at full occupancy, Table 40 indicates that a Baseline Building would consume approximately 19.1 million gallons of potable water. The Conserving Building would consume 13.5 million gallons of potable water, which represents a 29% reduction of potable water consumption in comparison to the Baseline Building. The Visionaire would consume 8.6 million gallons of potable water. This amount represents a 55% reduction of potable water consumption in comparison to a Baseline Building, indicating that the WTRS is responsible for an additional 26% reduction on potable water demand from baseline conditions. In contrast, The Visionaire as operated over the study period only reduced potable water consumption by 35% in comparison to a Baseline Building.

Based on the projections for each scenario regarding sewer discharge at full occupancy, Table 41 indicates that a Baseline Building would discharge 16.1 million gallons of wastewater to sewer. The Conserving Building would discharge 10.7 million gallons of wastewater to sewer, which represents a 33% reduction of sewer discharge in comparison to a Baseline Building. The Visionaire would discharge 5.8 million gallons of wastewater to sewer. This amount represents a 64% reduction over baseline discharge, indicating that the WTRS is responsible for an additional 31% reduction on sewer discharge from baseline conditions. In contrast, The Visionaire as operated over the study period only reduced sewer discharge by 45% in comparison to a Baseline Building.

5.2.2 Energy

The total energy requirements are determined using projected water reuse demand at full occupancy and the specific energy consumption per gallon treated (Figure 18 in Section 4). Based on this analysis, the WTRS would require 128,211 kWh (351 kWh/ day) over the study period to provide 4,784 kgal (13,061 gpd) of reuse water, resulting in a specific power consumption of 26.8 kWh/kgal. This amount is a 38% reduction on specific power consumption in comparison to the performance of the WTRS over the course of the study and is approximately 6.2 times more energy intensive that the typical energy consumed to supply water and treat wastewater in NYC (4.3 kWh/kgal). This reduction in specific energy consumption illustrates the economy of scale and the importance of treating at or near design capacity.

5.2.3 Economics

Table 42 summarizes the projected annual costs associated with potable water consumption and sewer discharge at full occupancy. Costs for all scenarios are based on the estimated quantities of potable water consumption and sewer discharge shown in Table 40 and Table 41, and the NYC DEP billing rates for water and sewer service over the study period. Based on the resulting percentage decrease in potable water use and sewer discharge over a Baseline Building, it is assumed that the Conserving Building and The Visionaire would qualify for CWRP incentives and exceptions-based sewer billing.

Based on the assumptions for each scenario regarding water consumption over the study period, Table 42 indicates that the cost of water and sewer service for the Baseline Building would be $177,153. The cost of water and sewer service for a Conserving Building with CWRP incentive and exceptions-based sewer billing would be $74,778. The cost of water and sewer service for The Visionaire would be $34,452, indicating that the WTRS would save The Visionaire $40,000 in comparison to a Conserving Building and save $143,000 in comparison to a Baseline Building.

Table 42. Summary of Annual Potable Water and Sewer Cost Based on Theoretical Consumption

Parameters included a full building population (610 residents) and actual irrigation and cooling tower demand based on the results of the study period between October 1, 2010 and September 30, 2011.

Water/Sewer	CWRP Allowance	Exception-Based Sewer	Baseline	Conserving	Visionaire
Water	No CWRP	N/A	$ 75,263	$ 53,425	$ 33,942
Water	Yes CWRP	N/A	N/A	$ 40,069	$ 25,457
Sewer	No CWRP	No Exception	$ 101,890	$ 68,887	$ 37,805
Sewer	Yes CWRP	No exception	N/A	$ 51,665	$ 28,354
Sewer	No CWRP	Yes Exception	N/A	$ 46,278	$ 24,160
Sewer	Yes CWRP	Yes exception	N/A	$ 34,709	$ 8,995

Table 43 summarizes the projected expenses incurred at full occupancy for water and sewer service, power consumption by the WTRS, chemical consumption by the WTRS, chemical consumption required to control corrosion in the cooling system, and the service contract to operate the WTRS. All expenses are based on projected potable water consumption, water reuse and sewer discharge, and actual utility rates over the period October 1, 2010 and September 1, 2011. It is assumed that the Conserving Building and Baseline Building do not incur expenses for power consumption by the WTRS, chemical consumption by the WTRS, and service fees to operate the WTRS. The cost of chemical consumption by the cooling tower for the Baseline Building and Conserving Building is based on total water demand by the cooling tower over the study period and estimates provided by Chemtreat regarding chemical consumption in typical cooling systems that do not employ reuse water. Appendix M provides additional information in support of the summary shown in Table 43.

Table 43 indicates that complete costs for potable water, reuse water, and sewer service over the study period for The Visionaire are $145,700. The estimated cost of water and sewer service over the study period for the Baseline Building would be $189,200. The complete cost of water and sewer service for the Conserving Building would be $86,800. When operated at full occupancy, The Visionaire with the WTRS would save an estimated $43,500 in comparison to a Baseline Building but cost $58,900 more than a Conserving Building.

Table 43. Economic Summary of Energy, Water, and Sewer, Chemicals, and Operation Contracts for Three Building Scenarios

Scenarios were a baseline building, conserving building with no WTRS, and The Visionaire at a full build-out population of 610 residents between October 1, 2010 and September 30, 2011. Average flow was 13,061 gpd.

	Baseline	No WTRS	WTRS (The Visionaire)	Notes
Energy Costs*			$ 9,389	No energy costs for the baseline & conserving cases. Energy costs for the WTRS based on ConEdison standard monthly rates. Energy costs for the cooling tower are considered equivalent in all cases.*
Water & Sewer Costs	$ 177,153	$ 74,778	$ 34,452	Water and sewer costs for the baseline based on total amount of reuse and NYC DEP average water and sewer rates without CWRP adjustment. Rates with and without the WTRS shows the savings made with reuse and CWRP and exceptions based allowances after November 2010.
Chemical Costs	$ 10,429**	$ 10,429**	$ 25,784	No WTRS chemicals under baseline scenario. Chemtreat indicate that the cost for cooling tower corrosion inhibitor is four times higher with the WTRS system than with the baseline case.
AWM Contract	$ -	$ -	$ 74,469	The baseline case does not incur WTRS operator costs. The operating contract for the WTRS is a fixed annual cost for all operating and maintenance work but does not include capital replacement costs.
TOTAL	**$ 187,582**	**$ 85,207**	**$ 144,094**	

* assuming average energy consumption for the months of April and May, which were not typical months from an energy consumption stand point.

** cost of chemicals for this scenario (12 months) is only marginally less than the actual cost of chemicals over the full study due to increased average daily flow.

5.2.4 Projected Performance at Full Occupancy

Table 44 provides a summary of the projected performance comparisons at full building occupancy for a Baseline Building, a Conserving Building, and The Visionaire. Energy values are calculated based on NYC average energy consumption values for water and wastewater treatment and theoretical water use and sewer discharge at full occupancy. At full occupancy, the energy consumption of water services at The Visionaire (including all reuse water supply, municipal potable water, and sewer service) is 157,096 kWh/yr, which is 2.2 times more energy intensive than a Baseline Building. During the study The Visionaire was 4.3 times more energy intensive than a Baseline Building, which indicated the improved energy efficiency that can be achieved by operating the WTRS at closer to design flow.

Table 44. Summary of Energy, Water and Sewer Use, and Cost for a Theoretical Year

Theoretical period was October 1, 2010 through September 30, 2011 and based on actual data and theoretical full build-out of The Visionaire.

	Baseline Building	Conserving Building	The Visionaire
Energy (kWh/yr)	70,091	47,106	157,096
Potable Water (Mgal/yr)	19.08	13.55	8.61
Sewer Discharge (Mgal/yr)	16.10	10.76	5.81
Total $/yr	**$ 191,712**	**$ 87,181**	**$ 145,712**

Further improvements in performance for the WTRS would require a change to the design and functioning of the WTRS at The Visionaire. Section 6 provides an additional analysis that identifies opportunities to improve performance and quantify the potential benefit regarding energy, water, and cost savings.

6 Optimization Analysis of WTRS

This section considers ways to optimize the performance of The Visionaire in comparison to a Baseline Building or Conserving Building, particularly with regard to energy consumption and economic performance. Opportunities to improve performance included: ways to increase water reuse and reduce potable water consumption and sewer discharge; reducing energy costs by treating at the design flow, treating off-peak and improving the energy efficiency of system components; and reducing costs associated with operator contract and chemical consumption. Although the feasibility analysis will use The Visionaire as a case study, it is intended that suggested improvements would be incorporated into the design of future onsite WTRSs. The assumptions suggest what scale, such as block or multi-building scale, onsite WTRS would be the advantageous choice in terms of economics and energy, when compared to Baseline Buildings and Conserving Buildings.

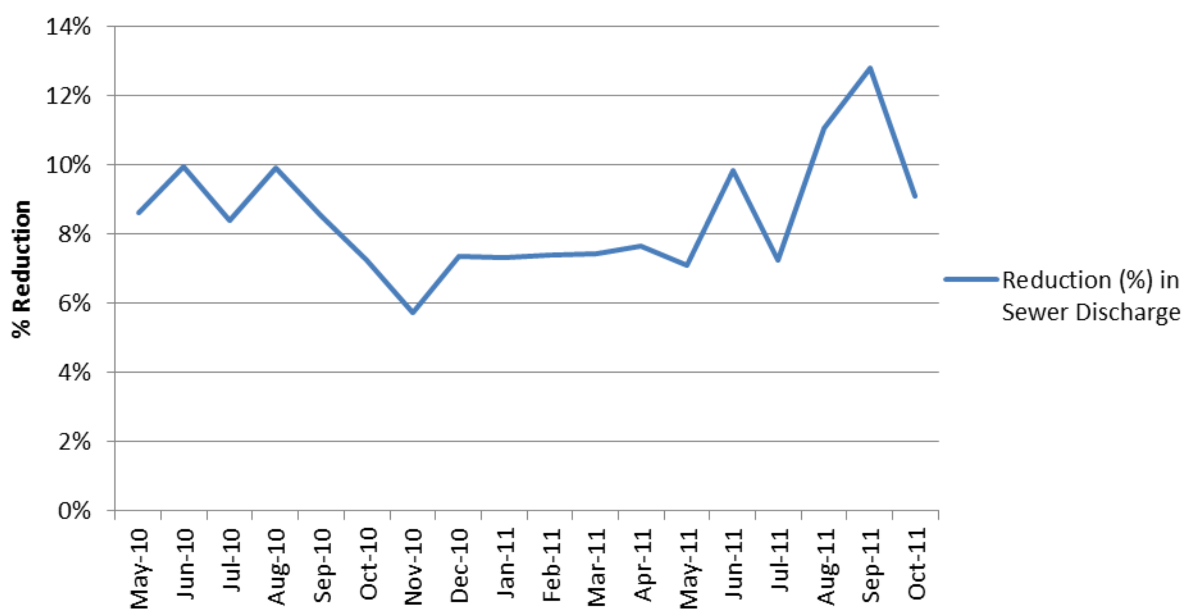
6.1 Opportunities to Reduce Potable Consumption and Sewer Discharge By Reusing Water For Laundry

As discussed in Section 1, The Visionaire does not use reuse water for clothes washing to avoid any potential concerns from residents. However, studies have proven that reuse water is of high enough quality for safe use in clothes washing machines. A study conducted by the Department of Epidemiology and Preventive Medicine at Monash University in Australia examined the transfer rate of microorganisms such as E. coli and bacteriophages, C. parvum oocysts, and other indicator organisms to laundered material, hands, and the surrounding environment. The researchers concluded that "highly treated recycled water [concentrations <100 CFU/100 mL] designated for non-potable use in dual reticulation schemes, when used for machine washing, will not lead to the transmission of numbers of microorganisms likely to cause enteric diseases" (O'Toole et al. 2008). The Visionaire provides reuse water with an average E. coli concentration of <1 CFU/100 mL, well below the recommended limits, indicating that MBR technology is capable of providing safe reuse water for clothes washing.

In the United States, clothes washer use is on average 10 gpcd for a non-conserving building and 3.44 gpcd for a conserving building (Vickers 2002). At full capacity (610 residents), using reuse water for clothes washing would save 766,000 gallons per year of potable water at The Visionaire, which is equivalent to about $3,025 per year, based on an average rate of $3.95 per 1,000 gallons for potable water. It should be stated that this number assumes that the reuse water temperature (approximately 70 °F) is suitable for all laundry cycles, and no differentiation is given between hot and cold loads. In reality, laundry cycles requiring water that is warmer than the reuse water temperature would be provided by the potable hot water supply, and therefore it is unlikely that reuse water could provide 100% of laundry demand. This process would avoid the need for an additional water heating system for the reuse water loop.

Figure 25 illustrates the average reduction in sewer discharge by month that would be achieved with laundry reuse. Assuming the use of clothes washers reduces sewer discharge by 8%, The Visionaire would reduce sewer discharge (at full occupancy) by approximately 465,000 gallons per year, which is equivalent to $3,000 in annual savings.

Figure 25. Average (%) Reduction in Sewer Discharge at The Visionaire Over the Study Period If Reuse Water Were Utilized in Clothes Washers



6.2 Opportunities to Reduce Energy Costs in the WTRS

Opportunities to reduce expenses associated with energy consumption by the WTRS can be segregated into operational changes and technological improvements. Operating the WTRS in batch mode would take advantage of the improved energy efficiency of the system at design flow. Operating in batch-mode would make it possible to maximize the amount of treatment during off-peak hours and to minimize the amount of treatment during peak hours. Upgrading to technologies with superior energy performance is another opportunity to reduce power consumption by individual processes. The general feasibility of achieving these strategies will be explored in this section.

6.2.1 Operating the WTRS in Batch Mode and at the Design Flow Rate

The WTRS at The Visionaire currently provides treatment when there is demand for reuse water, and attempts to maintain a constant reserve of reuse water in the building. Under an alternative strategy, the WTRS would operate in batch mode at the design flow rate (25,000 gpd) to produce all of the reuse water demand that is anticipated for the next day. Cost savings would be achieved by operating the WTRS at design flow to achieve maximum energy efficiency. Sufficient storage would be required to contain the reuse water produced during each treatment cycle.

The various components of the WTRS have varying ability to operate under a batch mode treatment strategy. Processes can be segregated into the three following groups..

6.2.1.1 Continuous Technologies

The technologies that must run continuously are:

- **Fine aeration:** Fine aeration must run continuously to maintain aerobic conditions in the aerobic tank. Currently, fine aeration consumes an average of 79 kWh/day.
- **Disinfection**: All disinfection technologies must run continuously to ensure that reuse water remains compliant. Disinfection includes the ozone generator, ozone compressor, ozone pumps, UV system and UV pump. Energy use for disinfection requires an average of 50 kWh/day.
- **Trash pump**: The trash pump does not run continuously, but cannot definitely be operated as part of an off-peak operating strategy. The trash pump is independent of flow and consumes 0.22 kWh/day on average.
- **Odor control:** Odor control must run continuously to avoid any potential odor nuisance. The odor control system consumes approximately 19 kWh/day.

6.2.1.2 Technology With Different Operating Strategies

The recirculation pump has different operating strategies when permeating and not permeating. The recirculation pump will run at a recirculation rate of 11:1 (recirculated volume: permeated volume) during permeation hours. At all other times it will run at a recirculation rate of 4:1. At a flow rate of 0 gpd and 25,000 gpd , the recirculation pump would consume an average of 8.18 kWh/day and 22.5 kWh/day respectively. This operation scheme would have reduced recirculation pump power consumption by 42% if used over the course of the study.

6.2.1.3 Technologies that Operate with Permeation

Technologies that only have to operate when permeating are:

- **Coarse aeration**: It is possible to only supply coarse air during permeation, to ensure that permeation rates through the membrane are maintained. At the moment, coarse and fine air at The Visionaire are supplied by the same set of blowers. Only providing coarse air when the system is permeating would require that different blowers are used to provide coarse air and fine air. At a flow rate of 0 gpd and 25,000 gpd, coarse air would consume an average of 0 kWh/day and 119.25 kWh/day respectively. This altered scheme would have provided approximately 43% in energy savings on aeration or approximately $2,400 in energy bills over the course of the study timeline at a standard rate.
- **Permeate pump:** Permeation can be altered to occur off-peak in segments of time equivalent to relative demand as opposed to in consistently spaced time intervals continuously throughout the day. At a flow of 0 gpd and 25,000 gpd, the permeate pump would require an average of 0 kWh/day and 28.8 kWh/day, respectively.
- **Back pulse pump:** Back pulsing would only occur during hours of permeation similar to the scheme developed for coarse aeration. Back pulsing may also be required at less frequent intervals, though further analysis would need to be done to determine potential consequences. At all other times the back pulse pump would be shut off. At a flow of 0 gpd and 25,000 gpd, the back pulse pump would require an average of 0 kWh/day and 16.8 kWh/day, respectively.
- **Inline grinder:** The inline grinder will run during permeation hours. At all other times, it will be off. The inline grinder consumes a marginal amount of energy. At a flow of 0 gpd and 25,000 gpd, the inline grinder would require an average of 0 kWh/day and 0.04 kWh/day, respectively.
- **Feed pump:** The feed pump is currently strongly correlated to permeation. Although there would not be significant energy savings, the feed pump will primarily consume energy during off-peak hours, resulting in lower energy bills. The feed pump uses 0 kWh/day at a 0 gpd flow and 31.2 kWh/day at a full flow of 25,000 gpd.
- **Booster pump:** Being able to run the booster pumps during off-peak hours would require a storage tank on the roof to allow all the demand that will be required the next day to be transferred during the night before. Demand for reuse water would be supplied by gravitational flow from the storage tank. Under this operation scheme, the booster pump would utilize no energy for flows of 0gpd and up to 46.6 kWh/day for a flow of 25,000 gpd.

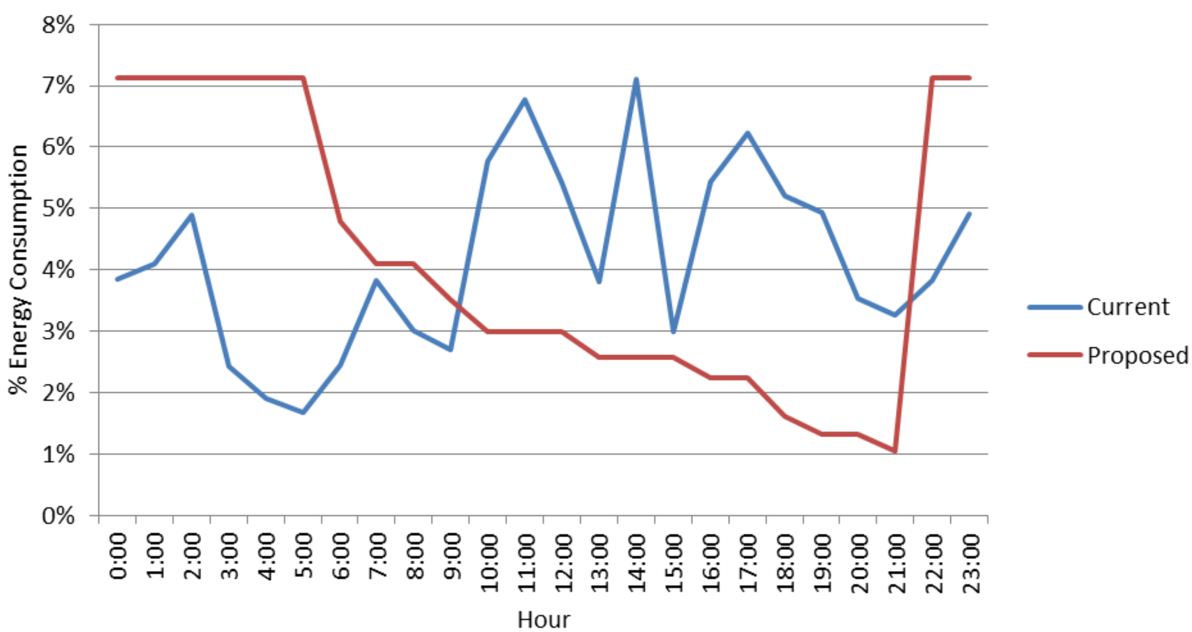
6.2.2 Operating the System During Off-Peak Hours

Operating the system in batch mode creates the opportunity to minimize the amount of treatment performed during the peak hours, and instead attempt to produce all of the reuse water demand anticipated for the next day during off-peak hours. Cost savings will be achieved by avoiding peak energy rates.

Figure 26 illustrates the average daily energy consumption profile of the feed pump to indicate the current schedule of operation for the WTRS, and the proposed schedule of operation to maximize treatment during off-peak hours. As evident from Figure 26, 50% of annual treatment is performed during on-peak hours. Under the off-peak treatment strategy, approximately 72% of annual treatment could be performed during off-peak hours. During months when reuse water demand is low (winter months with no cooling tower demand), it is possible to produce all required reuse water during off-peak hours. Appendix N provides additional information about the potential savings associated with providing off-peak treatment.

Figure 26. Average daily energy consumption profile of the feed pump

The current schedule of operation for the WTRS and and the proposed schedule of operation to maximize treatment during off-peak hours are shown.



6.2.3 Potential Technology Improvements to Reduce Energy Consumption

The energy monitoring results indicated that the most energy consuming processes are fine aeration, coarse aeration, booster pump operation, and disinfection. Energy consumption associated with these processes could be reduced by modifying or replacing the existing technology at The Visionaire. The capital costs to make these upgrades at The Visionaire WTRS were not considered in this study. However, incorporating these design modifications for a new WTRS at the time of installation would not markedly increase the capital cost in comparison to the WTRS as designed and installed at The Visionaire. This section outlines how these four processes could be modified to reduce energy consumption.

Fine aeration: Energy demand for fine aeration could be reduced in three ways: using a novel biological process referred to as XPV; using variable frequency drives (VFD) to optimize aeration efficiency; replacing the existing blowers with a more energy efficient alternative.

The XPV process promotes the growth of a microorganism called acrea that achieves similar treatment standards with approximately half the oxygen requirements of the heterotrophic bacteria commonly used for wastewater treatment (Giraldo et al. 2011).

Variable frequency drives (VFDs) attached to the fine air blowers would allow blower operation to be controlled by dissolved oxygen (DO) levels in the aerobic tank. Aeration would only be provided when required to maintain necessary aerobic conditions in the tank, and would improve the efficacy of aeration. The energy savings associated with implementation of VFDs has been shown to be as high as 50%, though average reduction of 10-25% compared to conventional aeration processes is typical (EPA 2006).

Energy consumption by the blowers could be reduced by using a blower technology that is more energy efficient than the rotary lobe blowers used at The Visionaire. In an independent technical study, Van Leuven et al. determined that screw blowers are up to 50% more efficient than lobe blowers under identical operational circumstances.

It is considered conservative and realistic to suggest that, via a combination of the above technology modifications, the power consumption for fine aeration could be reduced from 79 kWh/day to 60 kWh/day.

Coarse aeration: Ceramic membranes have been shown to require less scour air than the hollow fiber membranes currently used in The Visionaire. Particulate matter is less adherent to the surface of the ceramic plates and therefore less scour air is needed for cleaning. Ceramic membranes are also able to withstand higher pressure back pulsing, further aiding in cleaning efficiency. This relatively new ultrafiltration membrane technology has a larger footprint than the extremely compact hollow fiber systems, but may be able to compensate for this through higher flux ratings (CFM-Systems®). For this analysis, it is assumed that ceramic membranes are not used and that the current membrane technology remained in place.

Booster Pump: Alternate booster pump technology could provide sizeable energy savings by reducing the total time the pumps run on a daily basis. The booster pumps currently have a mandatory run time of approximately 5 minutes each time they turn on. If the desired water load is reached in less time, the pump spins without pumping for the remainder of the time allotment. Adding VFDs to the multi-stage centrifugal pumps currently in place would remove the wasteful energy draw created by the set run time. A booster pump optimization in the Parkview Towers (West New York, NJ) reduced energy consumption 92% over the identical tower next door that had not been retrofitted with alternate booster pump technology. The optimization included the use of six vertical multistage pumps on VFDs and an automatic controller that turns on an additional booster pump as demand requires. This option eliminated the need for two larger booster pumps, which had previously run almost continuously to maintain pressure in the system (Prangsgaard 2012). For this energy analysis, it is assumed that the booster pump is optimized with VFDs to eliminate the mandatory run time. It is also assumed that the booster pump provides the full quantity of reuse water demand at one time by pumping continuously to roof storage during off-peak hours.

Disinfection: During the study continuous UV treatment was disengaged and continuous disinfection was provided solely by the ozone system. The results of the study indicated that it is advantageous to operate the UV system in conjunction with the ozone system, from an operation and maintenance (O&M) perspective. For this reason, it is proposed that the installed continuous flow dual disinfection system would continue to be used as designed. Hypochlorite disinfection would continue to incur intermittently due to O&M benefits.

6.2.4 Revised Energy Profile for The Visionaire

Figure 27 presents a revised energy-flow profile for the WTRS at The Visionaire that is based on the previously discussed modifications. Figure 27 illustrates that, if the proposed modifications were adopted, energy consumption of the booster pumps and coarse aeration would have a positive linear correlation with average daily flow treated. This figure contrasts energy consumption that is independent of flow treated, as illustrated by the energy consumption profile for the existing system (Figure 17**).** Note that in the original energy profile, at a flow rate of 5,000 gpd, the system would require approximately 325 kWh/day to operate, versus 216 kWh/day in the optimized system. At 15,000 gpd, the original system required approximately 375 kWh/day while the optimized system could run on 315 kWh/day.

Figure 28 compares the current specific energy use of the WTRS (kWh per gallons treated) at different flow rates, with the specific energy at different flow rates that could be achieved through the proposed modifications. As evident from Figure 28, the specific energy consumptions of the WTRS as currently operated and the WTRS with proposed modifications converge as flow tends towards the design flow rate. The proposed modifications would have the greatest impact on energy efficiency improvements when demand for reuse water is low.

Figure 27. Theoretical Energy Profile of the WTRS at The Visionaire.

This profile assumed implementation of energy efficiency measures and batch production. Inline grinder and trash pump are less than 1 kWh/day for all flow rates and are not visible on the figure.

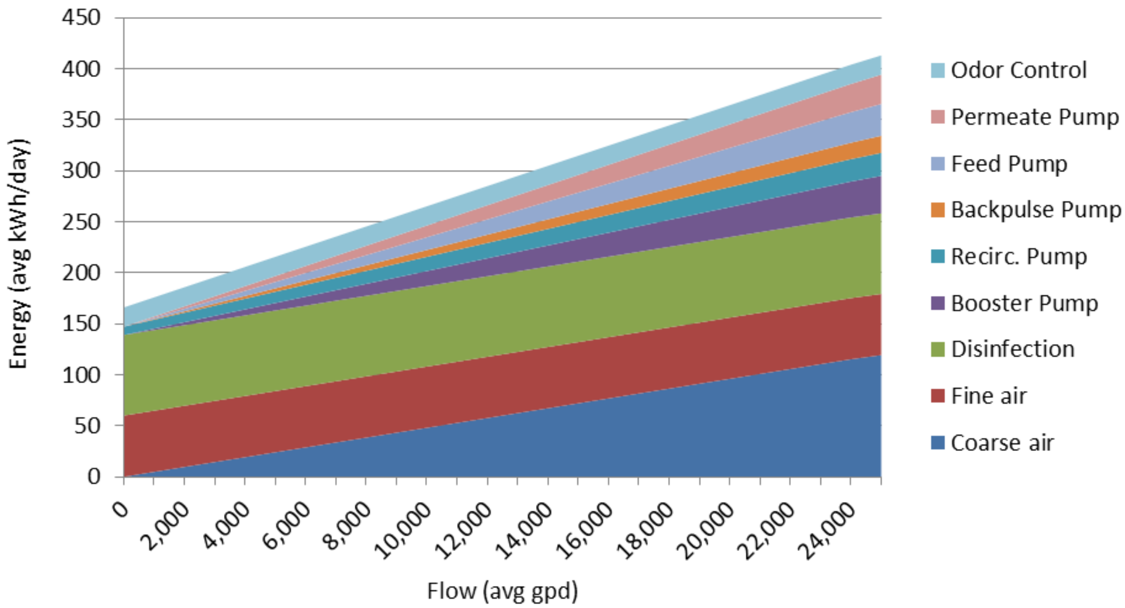
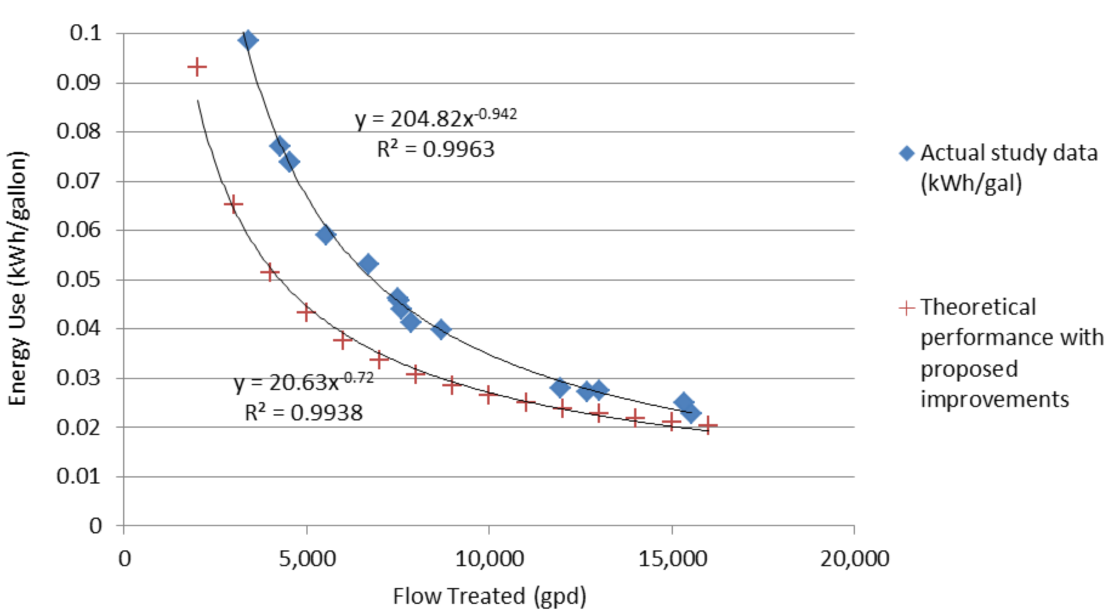


Figure 28. Comparison of the Specific Energy Consumption of the WTRS

Consumption was measured during the study (kWh/gal) and the theoretical performance is based on the proposed technology modifications (kWh/gal). Lines of best-fit are shown for each series with corresponding equations and correlation coefficients (R^2).



6.3 Other Opportunities to Improve Affordability

Potential reductions in operator contract and chemical consumption are explored as additional opportunities to reduce the cost of the WTRS.

6.3.1 Operator Service Contract for WTRS

Based on AWM's operational knowledge and experience, the annual O&M contract for a 25,000-gpd WTRS in NYC can be provided for approximately $46,800. This cost is based on an average labor rate of $100/hr with a typical labor requirement of 9 hours per week.

6.3.2 Reduction of Chemical Consumption

The quantity of chemicals used by the WTRS is assumed to be directly correlated to the quantity of wastewater treated. Based on the amount of chemicals ordered for the study and an average daily flow of 8,203 gallons, the cost for chemicals when treating 25,000 gpd was calculated.

Similarly, it is assumed that the quantity of chemicals used in the cooling tower when implementing reuse water is directly proportional to the reuse water demand for cooling tower make-up. The level of polymer currently used in the cooling system is about four times the typical levels that would be required if the cooling system used potable water as the refrigerant. However, this feed is gradually being reduced to approximately 75% of its current quantity as the effect of reuse water on cooling tower operation is better understood.

The chemical addition program is required to control corrosion and scaling inside the open-loop shell-and-tube heat exchanger of the condenser unit. Chemtreat suggested that shell-and-tube heat exchangers are more prone to corrosion/scaling problems than plate-and-frame heat exchangers, and less chemical control would be required to implement reuse water inside a plate-and-frame heat exchanger. Alternatively, using a closed-loop heat-exchanger in the condenser would obviate scaling and corrosion concerns for the condenser. This option would require a low-cost secondary heat-exchanger to transfer heat between the condenser closed-loop and the cooling tower open-loop. The secondary heat-exchanger would not be chemically protected to the same extent as the condenser and corrosion/scaling would be tolerated. The reduction in chemical costs and the reduced maintenance costs for the condenser would be considered against the reduction in the coefficient of performance due to the additional heat-transfer stage and the cost to regenerate the secondary heat-exchanger. Finally, the cooling system could be designed to match the anticipated tower water quality. For example, corrosion resistant materials such as PVC and titanium could be used in place of standard cooling tower and exchange materials if it anticipated that reuse water would be corrosive. Alternative cooling tower technologies are not considered further by this analysis.

6.4 Projected Performance Through Proposed Improvements

An economic analysis is conducted to estimate the potential cost, energy, and water performance at The Visionaire if the proposed modifications are adopted. The improved performance is compared against the Conserving Building and Baseline Building scenarios described in Section 5, which are based on average annual performance at full occupancy (610 residents). The analysis is based on the following assumptions for the modified performance of The Visionaire:

- Energy:
  - Average energy use by the WTRS based on the relationship illustrated in Figure 28.
  - Electricity rate based on the standard rate charged each month to The Visionaire over the course of the study.
- Water and sewer:
  - Billing incorporates the exception based incentive and the CWRP (both the conserving building and the WTRS building qualify).
  - Actual water and sewer rates for the period September 30, 2010 to October 1, 2011 are used.
  - Reuse water is utilized for clothes washing instead of potable water. At full occupancy and with water reuse for laundry, The Visionaire would treat an average of 14,491 gpd.
  - Water demands for internal residential use, cooling tower make-up and irrigation are based on the analysis performed in Section 5.2.
- Chemicals:
  - Chemical requirements for all cooling tower chemicals, alum and bromide in the WTRS scale directly with the quantity of wastewater treated in the WTRS.
  - Consumption rate of polymer in the cooling tower is 75% of that utilized during the study (gallons of polymer per gallon of reuse water used for cooling tower make-up).
  - Based on aggregate performance, caustic requirements decrease with increased WTRS flow from approximately 0.089 gal/kgal treated at the 8,203-gpd scale to approximately 0.031 gal/kgal treated at the 15,000-gpd scale.
- Operator Contract:
  - Adjusted to $46,800/year.

Total annual power consumption by the WTRS based on the above assumptions is 109,209 kWh, which is equivalent to 20.6 kWh per 1,000 gallons treated**.**

Table 45 summarizes the total costs for The Visionaire under these assumptions as compared to the Baseline Building and Conserving Building. Appendix O provides the cost breakout by month. Based on this analysis, The Visionaire saves approximately $78,500 per year over a baseline building and is $26,000 per year more expensive than a Conserving Building. The majority of these savings are achieved through the proposed modification to the operator contract. Without the modifications to the design of the system (energy efficiency and clothes washing reuse), The Visionaire saves $43,500 per year over a baseline building (see Section 5), and therefore the proposed modifications would be worth $35,000 per year in potential savings. Retrofitting VFDs on blowers and pumps for The Visionaire MBR would be relatively straightforward to implement. In comparison, modifying building plumbing at The Visionaire to allow reuse water to be utilized by laundry facilities would be less straightforward and more costly. It is recommended that the combination of proposed modifications be incorporated into the basis of design for new MBR WTRSs.

Table 45. Cost Analysis Summary for a 25,000-gpd Treatment System

The average treatment would be 14,491 gpd, and is compared to a baseline building and a conserving building. Projected annual costs are based on full occupancy of 610 persons over the period October 1, 2010 through September 30, 2011.

	Baseline Building	Conserving Building	The Visionaire
Energy Costs	$ -	$ -	$ 7,950
Water & Sewer Costs	$ 180,250	$ 75,719	$ 31,608
Chemical Costs	$ 10,429**	$ 10,429**	$ 26,817
AWM Contract	$ -	$ -	$ 46,800
TOTAL	**$ 190,679**	**$ 86,148**	**$ 113,175**

* Includes energy conservation measures, clothes washing provided by reuse water, and off-peak treatment schedule

** cost of chemicals for this scenario (12 months) is only marginally less than the actual cost of chemicals over the full study due to increased average daily flow.

Table 46 compares the projected annual performance of The Visionaire with proposed modifications at full occupancy, to a Baseline Building and a Conserving Building. The performance comparisons consider energy consumption, potable water demand, sewer discharge and operating cost. With the optimized energy profile, The Visionaire would consume 1.9 times the energy that is consumed by the Baseline Building. Table 44 indicates that The Visionaire at full occupancy and without the proposed modifications would consume 2.2 times more energy than a Baseline Building.

Table 46. Summary of projected annual energy, water and sewer use, and cost of 25,000 gpd WTRS

Costs were estimated for full occupancy during the period October 1, 2010 through September 30, 2011, and with the proposed modifications implemented by the WTRS.

	Baseline Building	Conserving Building	The Visionaire
Energy (kWh/yr)	70,091	47,106	132,449
Potable Water (Mgal/yr)	19.08	13.55	7.84
Sewer Discharge (Mgal/yr)	16.10	10.76	5.17
Total $/yr	**$ 191,712**	**$ 87,181**	**$ 113,175**

As previously stated, the suggested performance improvements are discussed for The Visionaire, but are intended to be incorporated into the design of future on-site WTRSs. If incorporated at the time of construction, only a small increase in capital cost would be required to provide reuse water to laundry machines and VFDs on pumps and blowers. As a retrofit, the cost and ease of implementation of each improvement depends on the scale and type of project and the environmental and economic priorities of the project. With regard to The Visionaire, the reduction of operations contract costs would be the easiest measure to implement and would provide the greatest cost saving. From experience with WTRSs similar in size to The Visionaire, retrofitting VFDs on blowers and pumps is easy to implement with a typical cost in the range of $5,000–15,000 and a payback-time of less than 5 years. Retrofitting reuse water supply to laundry machines at The Visionaire is unlikely due to the cost and disruption required for implementation.

6.5 Optimum Scale for On-site WTRS

An analysis was performed to assess the scale at which a WTRS would be advantageous in comparison to a Conserving Building, with regard to energy consumption and economic performance. Again, the analysis was based on projected performance at full occupancy and uses population data from The Visionaire to calculate indoor residential water consumption, and data from the study period October 1, 2010 through September 30, 2011 to estimate non-residential water consumption. It is assumed the WTRS incorporates the previously discussed modifications.

6.5.1 Break-Even Point for Cost

An analysis determined that a 100,000 gpd treatment system treating an average of 59,941 gpd is the scale of WTRS that would be cost competitive with a Conserving Building. This size WTRS is four times the size of the WTRS at The Visionaire, and therefore would be applicable at a city-block scale. provides the breakdown of costs for water services at a building with a 100,000-gpd WTRS, a Baseline Building and a Conserving Building. The assumptions used for this analysis were:

- Energy:
  - Average energy use by the WTRS based on the relationship illustrated in Figure 28**.**
- Water and sewer:
  - Water demand was determined using four times the full build-out population of The Visionaire and four times the current number of guests. [610 × 4 = 2,440 residents; 65 × 4 = 260 guests/day].
  - Metered cooling tower demand and associated blow-down, irrigation demand, and storm water capture for the period from October 1, 2010 to September 30, 2011 were also multiplied by four.
  - The average flow for the system under these conditions is about 59,941 gpd due to seasonal variations in demand.
- Operator Contract:
  - Adjusted to $91,250.

Table 47. Cost Analysis Summary for a 100,000-gpd (59,941 avg gpd) WTRS

Projections were compared to a baseline building and a conserving building assuming reuse water was utilized for clothes washing in the building. Costs were totalized for one year (October 1, 2010 to September 30, 2011).

	4 times Baseline Building	4 times Conserving Building	4 times The Visionaire	$/kgal for The Visionaire
Energy Costs	$ 0	$ 0	$ 10,283	$ 0.47
Water & Sewer Costs	$ 717,862	$ 300,795	$ 126,670	$ 5.79
Chemical Costs	$ 44,308	$ 44,308	$ 92,418	$ 4.22
Operator Contract	$ 0	$ 0	$ 91,250	$ 4.17
TOTAL	**$ 762,170**	**$ 345,103**	**$ 320,621**	

Based on the data provided in Table 48, there is potential for significant energy, chemical, and operations (operator contract) savings in scaling up an in-building system to a design capacity of 100,000 gpd. The cost of energy drops from $1.40 / kgal to $0.47 / 1,000 gal, a 66% reduction. Operation cost per 1,000 gallons drops from $8.84/kgal to $4.17/kgal, a 53% reduction in cost. Due to the reduced caustic requirements at higher flow rates, specific chemical cost drops 17% between the 25,000-gpd system and the 100,000-gpd system. As water and sewer costs were assumed to have a linear relationship, there is no apparent specific cost savings associated with increased scale. At an average flow of 59,941 gpd, the WTRS saves $441,549 and $24,482 over Baseline and Conserving Buildings, respectively, making the WTRS economically viable. See Appendix O for detail by month.

As shown in Table 48**,** The Visionaire is still more energy-intensive than a Conserving Building of equal population by a factor of 1.2. Under the full-occupancy scenario, (25,000 gpd system treating an average of 14,491 gpd) The Visionaire was 2.8 times as energy-intensive. This comparison demonstrates the economy of scale from a specific energy consumption standpoint. As previously described, the break-even point for cost was at a scale of just below an average treatment of 60,000 gpd for a system designed for 100,000 gpd.

Table 48. Summary of Annual Projected Energy, Water and Sewer Use, and Cost for a 100,000-gpd (59,941 avg gpd) WTRS.

Projections were based on data from the period October 1, 2010 through September 30, 2011, an optimized energy profile, full occupancy, reuse water used for clothes washing and a system designed at 100,000-gpd treating an average of 59,941 gpd.

	4 times Baseline Building	4 times Conserving Building	4 times The Visionaire
Energy (kWh/yr)	278,448	186,506	223,504
Potable Water (Mgal/yr)	76.34	54.19	31.36
Sewer Discharge (Mgal/yr)	64.52	43.19	21.34
Total $/yr	**$ 762,170**	**$ 345,103**	**$ 320,621**

6.5.2 Break-Even Point for Energy Consumption

Table 49 gives the energy break-even point for energy consumption. The same assumptions were made as in the previous two analyses with the following exceptions.

- Energy:
  - Average energy use by the WTRS based on the relationship illustrated in Figure 28.
- Water and sewer:
  - Water demand was determined by altering the population by a factor of 6.14 so that energy consumption of the Conserving Building for water treatment at a municipal treatment plant would be equal to the total energy consumption for water treatment at The Visionaire including the WTRS and municipal treatment plant. This factor was calculated by altering the building population until the annual energy consumptions for water treatment at the Conserving Building and The Visionaire were equal..
  - Metered cooling tower demand and associated blow-down, irrigation demand, and storm water capture for the period from October 1, 2010 to September 30, 2011 were also multiplied by the same population factor.
- Chemicals:
  - Though caustic requirements decrease with the quantity of wastewater, the same specific caustic requirement per gallon treated as used in the 59,941 gpd scenario was used for this analysis as a conservative estimate.

Table 49. Cost Analysis Summary for a 183,000-gpd (94,460 avg gpd) WTRS

Projections were compared to a Baseline Building and a Conserving Building. Model for 183,000gpd system assumed reuse water is utilized for clothes washing in the building. Costs were totalized for one year (October 1, 2010 through September 30, 2011).

	6.2 times Baseline Building	6.2 times Conserving Building	6.2 times The Visionaire	$ /kgal
Energy Costs	$ 0	$ 0	$ 10,583	$ 0.31
Water & Sewer Costs	$ 1,101,079	$ 461,223	$ 203,358	$ 5.79
Chemical Costs	$ 69,256	$ 69,256	$ 145,073	$ 4.21
Operator Contract	$ 0	$ 0	$ 144,540	$ 4.17
TOTAL	**$ 1,170,335**	**$ 530,479**	**$ 503,554**	

Based on the figures provided in Table 49, there is significant energy savings potential in scaling up an in-building system to a design capacity of 183,000 gpd and average treatment flow of 94,460 gpd. The cost of energy drops from $0.47/kgal to $0.31/1,000 gal, a 34% reduction. At an average flow of 94,460 gpd, the WTRS saved $666,781 and $26,925 over Baseline and Conserving Buildings, respectively. See Appendix O for detail by month.

As shown in Table 50, at a scale approximately equal to 6.14 times The Visionaire, the WTRS is more energy efficient than a conserving building or baseline building of equal population. This demonstrates that at a treatment scale of approximately 95,000 gpd, the WTRS becomes both economically and energetically favorable.

Table 50. Summary of Annual Projected Energy, Water and Sewer Use and Cost for 183,000- gdp (95,000 avg gpd) WTRS

Projections are based on data from the period October 1, 2010 through September 30, 2011, an optimized energy profile, full occupancy, and a system designed at 183,000 gpd treating an average of 95,000gpd (approximately 6.2 times The Visionaire).

	6.2 times Baseline Building	6.2 times Conserving Building	6.2 times The Visionaire
Energy (kWh/yr)	426,968	285,872	278,953
Potable Water (Mgal/yr)	117.2	83.2	47.6
Sewer Discharge (Mgal/yr)	98.0	65.2	31.8
Total $/yr	$ 1,170,335	$ 530,479	$ 503,554

7 Conclusions and Recommendations

The major aim of this study was to provide insight into the economic, energy, and water performance of an on-site WTRS in NYC. This section includes conclusions and recommendations regarding how to design and operate on-site WTRSs for optimum integration into NYC buildings as well as superior economic and energy consumption performance in comparison to centralized treatment and supply.

7.1.1 Performance of the WTRS at The Visionaire

An 18-month study was conducted between May 2010 and October 2011 to measure the performance of the WTRS at The Visionaire with regard to potable water conservation, sewage discharge, power consumption and operating cost. Over the course of the study, The Visionaire reused 4.3 million gallons of water, and prevented this volume from being supplied through potable city supply and from being discharged to city sewers. Total reuse comprised approximately 1.9 million gallons of closed loop reuse for toilet flushing and 2.4 million gallons of reuse that was evaporated in the cooling tower.

The WTRS consumed 273,300 kWh of power to provide the total volume of reuse water, which is equivalent to 64 kWh per 1,000 gallons of treated reuse water. Approximately 40% of total power consumption over the study period can be attributed to a booster pump malfunction during the months of April and May 2011, and typical power consumption would be lower than 64 kWh per 1,000 gallons of treated reuse water.

The WTRS consumed the following quantities of chemicals during the course of the study: 671 gallons of sodium hydroxide (caustic), 438 gallons of aluminum sulfate (alum), 53 gallons of sodium hypochlorite (bleach; continuous use of sodium hypochlorite by the WTRS was discontinued in November 2010). With regard to chemical consumption in the cooling tower, total consumption of corrosion-inhibiting polymer over the course of the study was 120 gallons, which is estimated to be approximately 50 gallons greater than that would have been consumed if potable water had been used in the cooling system.

Total cost of water-related services for The Visionaire over the study period was $232,536, including: NYC potable supply and sewer service (32%); energy consumption by the WTRS (8%); chemical consumption by the WTRS and to implement reuse water in the cooling tower (11%); and the operator cost for the WTRS (48%). The total cost was equivalent to $452 per day. Beginning in November 2010, The Visionaire began receiving the CWRP incentive and exceptions based sewer allowance, which reduced the water and sewer bills for The Visionaire by approximately 43%.

The volume of reuse water utilized over the course of the study was limited to 52% of potential reuse for three main reasons: use of reuse water in the cooling tower was limited to 5,000 gpd during a trial period which included summer 2010; a booster pump malfunction during April and May 2011 that suspended reuse; and the average occupancy of The Visionaire was 71% of maximum occupancy.

Results for the monitoring period were used to project the performance of The Visionaire at full occupancy. At full occupancy, The Visionaire could prevent an estimated 4.9 million gallons per year of potable water consumption and wastewater discharge to sewer, and consume an estimated 128,200 kWh per year to provide this volume of reuse water. Specific power consumption was estimated to be 26 kWh per 1,000 gallons treated. Annual costs for water-related services would be approximately $145,000, including: NYC potable supply and sewer service (24%), chemical costs (18%), energy costs (6%), and WTRS operator costs (51%).

7.1.2 Opportunities for Using Reuse Water in Cooling Towers

The shell-and-tube heat exchangers used in the cooling system condenser were able to employ reuse water as a refrigerant without detrimental consequences for heat transfer performance or component longevity. Reuse water quality at the WTRS (target effluent pH of 7.3, ammonia concentration below 1 mg/L, cessation of continuous hypochlorite addition, less than two-log order fecal coliform count, alum addition to minimize phosphate concentrations) was coordinated with the chemical control program in the cooling tower (addition of polymer to limit chloride corrosion and enable a higher number of cycles of concentration to be achieved before blow-down is required). Through these measures it was possible to achieve 7–10 cycles of concentration in the cooling tower, which is similar to the number of cycles of concentration achieved using potable water.

Three independent methods were used to evaluate corrosion/scaling in the condenser heat-exchanger: corrosion coupon analysis; chiller deposit removal and analysis; and the in-line deposit monitor log. According to the chiller deposit analysis, scaling was primarily due to calcium-phosphate precipitation (39 %) and biological growth (37 %). The deposit monitor generally indicated negligible scaling/corrosion over the course of the study, which concurred with visual inspection of the corrosion coupon used in the deposit monitor. However, several inexplicable irregularities in the deposit monitor data-log were observed, which created doubt regarding the accuracy/robustness of the instrument. Use of real-time early corrosion/scaling detection systems will be increasingly important if reuse water application in cooling towers becomes more prevalent, however, the technology requires further refinement.

None of the methods detected scaling/corrosion at a rate that is atypical of standard cooling system performance. During the study period, polymer was applied in the cooling tower at four times typical rates for city water to prevent corrosion/scaling. Chemtreat agree that future polymer addition can be reduced to 2–3 times typical application, based on the successful performance over the study period.

The study illustrated that it is possible to employ 100% reuse water in the cooling tower with the correct WTRS operation and cooling system chemical control program. At The Visionaire, the demand for cooling tower make-up during the summer months exceeded the quantity of wastewater produced by the building, which limited the quantity of reuse water used for cooling tower make-up to less than 100%.

7.1.3 Profile of WTRS Power Consumption

Disregarding the booster pump malfunction, process aeration is the largest consumer of energy and accounted for 57% of the total power consumed over the study. The booster pumps consume 15% of total power. Based on experience reported in the literature, it is considered conservative to suggest that power consumption by the blowers and the booster pumps could be reduced by 25 % by employing modifications such as a variable frequency drive (VFD). On the blowers, the VFDs would be controlled via a dissolved oxygen set-point in the aerobic tank. The combination of UV and ozone disinfection technologies consumes 14% of total power. Based on the findings of this study, the two disinfection technologies are complementary and it is more beneficial from both a maintenance and power consumption standpoint to maintain both technologies than to use only one.

Over the study period, the WTRS consumed approximately 50% of energy during peak hours (10 a.m. to 10 p.m.) and 50% during off-peak hours, which indicated that the system operates fairly consistently over the course of the day. Operating the system in batch-mode would provide the opportunity to perform 72% of annual treatment during off-peak hours. It should be emphasized that operating the system off-peak should not require the voluntary time-of-use rate structure to be used because it is not economically beneficial in comparison to subscribing to a standard rate structure.

The power consumption of the WTRS when the system produces 3,000 gpd (325 kWh per day) is relatively similar to power consumption at 15,000 gpd (375 kWh per day), thus indicating that power consumption is largely independent of flow. Based on AE’s knowledge of the MBR technology, only fine aeration and disinfection and odor control must run continuously throughout the day, which is equivalent to a base load of 176 kWh/day. Coarse aeration, permeate pumps, back-pulse pumps, in-line grinder, feed pumps, and booster pumps only need to operate when permeating. The additional load associated with these devices would vary from 0 kWh/day when the system is idol, to 242 kWh/day when the system is producing 25,000 gpd.

7.1.4 Comparing a Baseline Building to a Conserving Building Without Reuse

Figure 29 compares the performance of The Visionaire over the study period (May 4, 2010 to September 30, 2011) against the estimated performances of a Conserving Building (does not reuse water) and a baseline building (does not reuse water or use conserving fixtures and fittings) of equivalent size (436 residents). Performance is rated based on the potable water consumed (gpd), wastewater discharge to sewer (gpd), power consumed (kWh) and total cost ($) that are required to provide all water related services (potable water, reuse water and wastewater treatment) to the buildings. Figure 29 illustrates that a Conserving Building would have reduced potable water consumption by 16% and sewer discharge by 20%, in comparison to a baseline building. The Visionaire reduced potable consumption by 35% and sewer discharge by 45%, in comparison to a Baseline Building. Based on energy required for municipal water supply and wastewater treatment (4.3 kWh per 1,000 gallons supplied and treated and specific to NYC), energy use for water-related services in a Conserving Building would have been 19% below that of a Baseline Building. In contrast, The Visionaire required 421% the amount of energy of a Baseline Building. Total water-related service costs for the Conserving building (based on water, sewer, and power utility rates for The Visionaire) would have been 17% below that of a baseline building, whereas costs for The Visionaire were 106% the total costs for a Baseline Building. Over the course of the study period, The Visionaire had lower potable water consumption and sewer discharge than a Baseline Building and Conserving Building, however, The Visionaire consumed more energy and cost more than the alternatives.

Figure 29. Comparison of Water-Related Services for Three Buildings During Study Period

Performance of The Visionaire over the study period (May 4, 2010 to September 30, 2011) for all water-related services (potable water, reuse water, and wastewater treatment) was plotted against a Conserving Building (no reuse) and a Baseline Building (no reuse and no conserving fixtures and fittings). Energy consumption for The Visionaire is corrected to remove the effects of the booster pump malfunction.

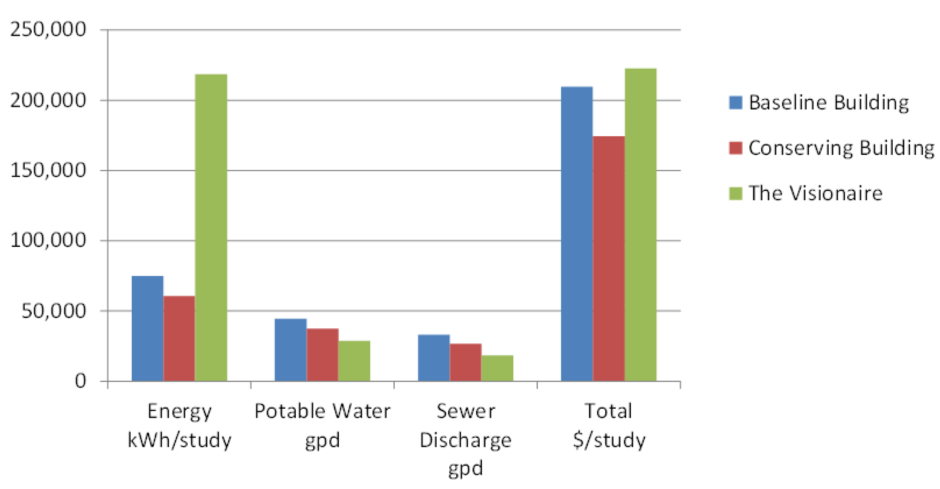
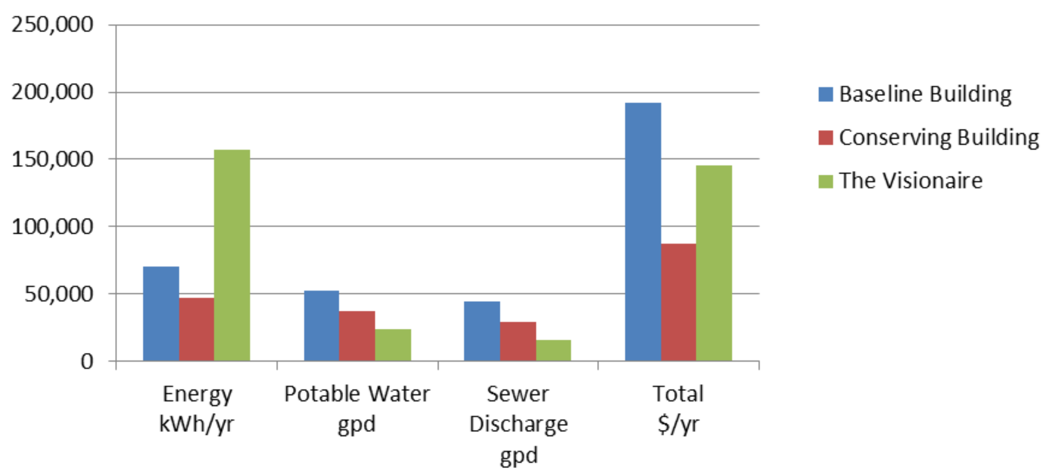


Figure 30 compares the projected annual performance of The Visionaire at full occupancy against the estimated performances of a Conserving Building (does not reuse water) and a Baseline Building (does not reuse water or use conserving fixtures and fittings) of equivalent size (610 residents). Figure 30 illustrates that a Conserving Building would reduce potable water use by 29% and sewer discharge by 33%, in comparison to a Baseline Building. The Visionaire would reduce potable water use by 55% and sewer discharge by 64%, in comparison to a Baseline Building. Energy use in a Conserving Building for water related services would be 33% below a Baseline Building whereas The Visionaire would require 224% times the amount of energy of a Baseline Building. It is projected that total water related service costs for the conserving building would be 55% less expensive than a baseline building and costs for The Visionaire would be 24% lower than a baseline building. At full occupancy, it is anticipated that The Visionaire would be cost-effective in comparison to a Baseline Building, but would cost more to operate than a Conserving Building. The Visionaire will conserve more potable water and reduce sewer discharge in comparison to the Baseline and Conserving Buildings, however, The Visionaire will consume more power than both alternatives.

Figure 30. Projected Annual Performance of Water-Related Services for Three Buildings

Projected annual performance of The Visionaire for all water related services (potable water, reuse water and wastewater treatment) is plotted in comparison to a conserving building (no reuse) and a baseline building (no reuse and no conserving fixtures and fittings).



7.1.5 Recommendations for Improving the WTRS at The Visionaire

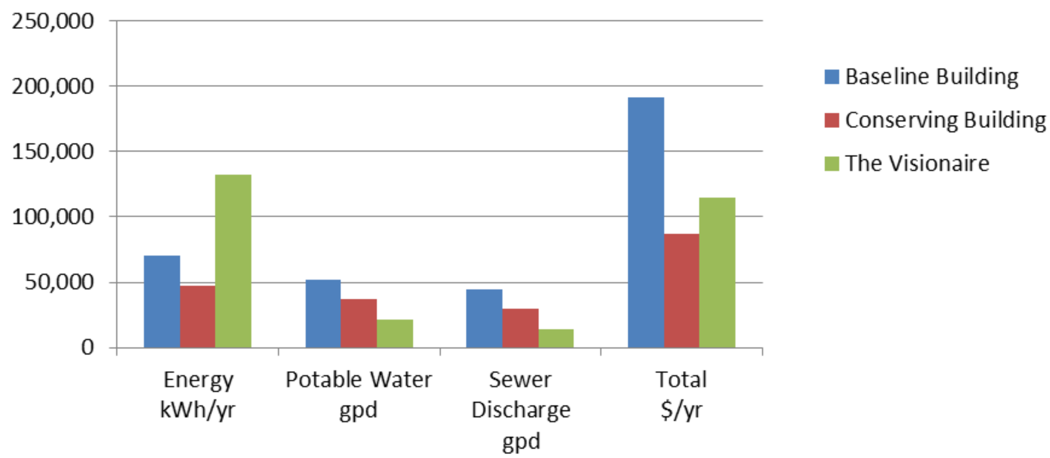
Figure 29 and Figure 30 shows that The Visionaire with WTRS as installed and operated is not economically advantageous in comparison to a Conserving Building without reuse. Several proposed modifications could improve performance in comparison to a conserving building:

- Incorporating reuse water for laundry would save an additional 0.52 million gallons per year and maximize the use of the WTRS.
- Operating the WTRS in batch-mode to improve WTRS efficiency.
- Using separate blowers for fine and coarse aeration.
- Utilizing VFDs on the fine aeration blowers and the booster pumps.
- Reducing the operator contract to $46,800 per year.
- Based on success over the trial-period, scaling back on polymer addition in the cooling tower to 2–3 times typical rates.

Based on these modifications, it is projected that operating the system in batch-mode (equivalent to 25,000 gpd for whatever length of time is required to meet demand for reuse water) would reduce energy consumption of the system from 27 kWh per 1,000 gallons to 20 kWh per 1,000 gallons treated. Total costs for water-related services would be reduced to $114,172 per year. Figure 31 compares the projected annual performance of The Visionaire WTRS with proposed modifications against the estimated performances of the baseline and conserving building. Figure 31 illustrates The Visionaire with modified WTRS would reduce potable water use by 59% and sewer discharge by 68%, in comparison to a Baseline Building. Energy consumption for water-related services by The Visionaire with modified WTRS would be 189% of energy consumed by a baseline building, and total water related service costs for The Visionaire would be 40% lower than a Baseline Building.

Figure 31. Projected Annual Performance of The Visionaire WTRS with Proposed Modifications for All Water-Related Services

The Visionaire services (potable water, reuse water and wastewater treatment) were compared to a Conserving Building (no reuse) and a Baseline Building (no reuse and no conserving fixtures and fittings).



7.1.6 Recommendations for Future Use of On-site WTRS

The modifications to the WTRS would improve economic and energy performance, however, Figure 32 shows the modifications would still not enable The Visionaire with WTRS to compete with a Conserving Building without reuse, in terms of energy consumption and total costs. The Visionaire is a beacon amongst residential green buildings with regard to water management and was willing to adopt a WTRS to enable the long-term economic and environmental viability of the technology to be better understood. As such, The Visionaire is willing to tolerate higher operational expenses for water-related services to conserve more potable water and demonstrate its commitment to sustainable water management.

The lessons learned from The Visionaire regarding the limits of the WTRS at the 25,000-gpd scale were used to investigate the scale at which a conserving building with WTRS becomes economically and energetically beneficial in comparison to a conserving building that does not reuse. The analysis considered the economy of scale for operating costs and power consumption that would be achieved for multiples of The Visionaire.

Figure 32 illustrates the approximate economic break-even-point for conserving buildings without reuse and conserving buildings with a WTRS. Figure 32 shows a system that reduces potable consumption in a conserving building from 148,466 gpd to 85,918 gpd, and therefore conserves 22 MGD of potable water per year, which is what is required to be economically beneficial. Given seasonal variations in reuse demand, it is estimated that a WTRS with design flow of approximately 100,000 gpd would be required, which is four times larger than the system at The Visionaire. At this scale, the WTRS would reduce sewer discharge from a Conserving Building by 51% but would consume 20% more power than the Conserving Building for all water-related services. At this scale, the Conserving Building with WTRS would outperform a baseline building on all performance measures.

Figure 32. Comparing WTRSs of Economically Beneficial Size

The annual performance of a Conserving Building with water reuse that is large enough to be economically beneficial for all water-related services (potable water, reuse water, and wastewater treatment) in comparison to a Conserving Building without water reuse. The performance of a Baseline Building (no reuse and no conserving fixtures and fittings) is also shown. The required service population for economic break-even-point in 2012 was approximately 2,440 people.

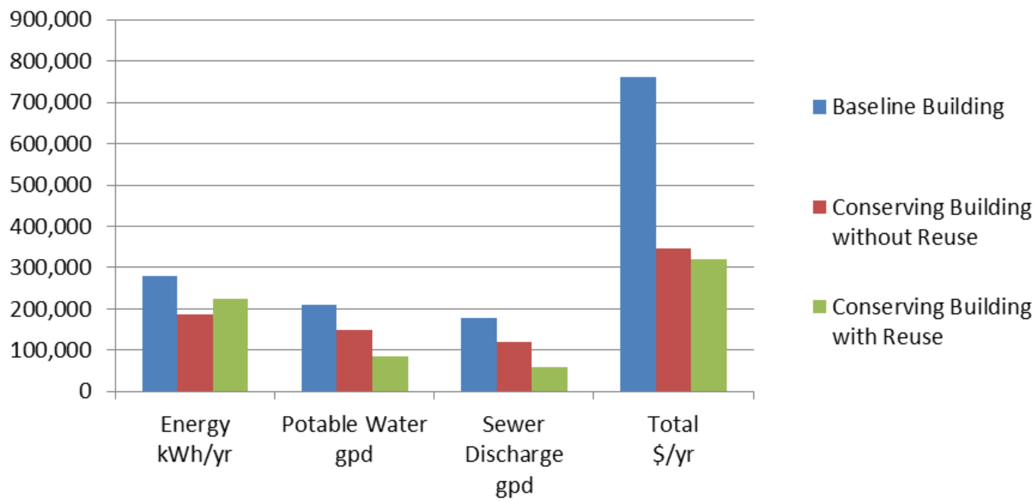
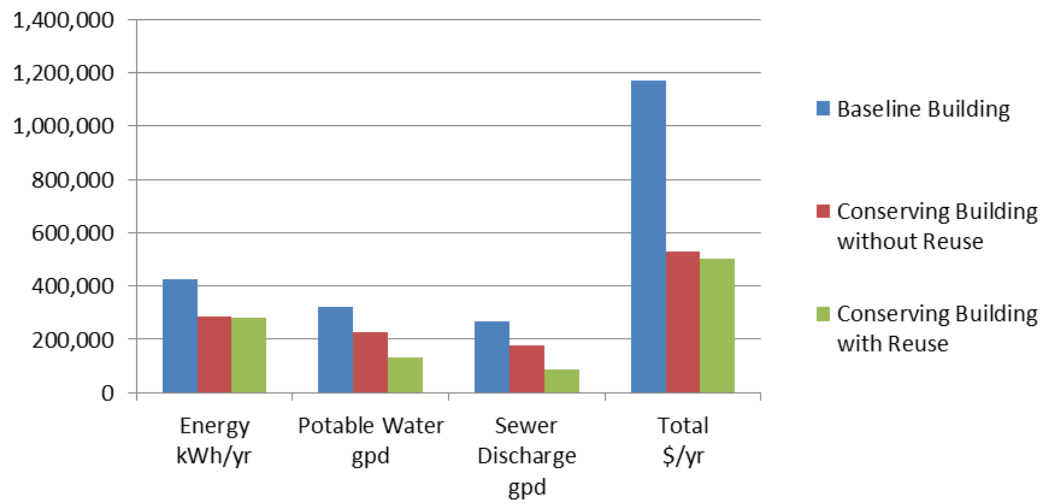


Figure 33 illustrates the approximate energy consumption break-even-point for conserving buildings without reuse and conserving buildings with a WTRS. Figure 33 shows a system that reduces potable consumption in a conserving building from 227,945 gpd to 130,411 gpd, and therefore conserves 36 MGD of potable water per year, which is what is required to be energetically beneficial. Given seasonal variations in reuse demand, it is estimated that a WTRS with design flow of 185,000 gpd would be required, which is approximately six times larger than the system at The Visionaire. At this scale, the system would achieve a specific energy consumption of 3.9 kWh/kgal. A system of this scale would reduce sewer discharge from a conserving building by 51% and reduce total water related costs for a conserving building by $27,000 per year. At this scale, the conserving building with WTRS would outperform a baseline building and a conserving building without reuse on all performance measures.

Figure 33. Comparing WTRSs of Energetically Beneficial Size

The annual performance of a conserving building with water reuse that is large enough to be energetically beneficial for all water-related services (potable water, reuse water, and wastewater treatment) in comparison to a Conserving Building without water reuse. The performance of a Baseline Building (no reuse and no conserving fixtures and fittings) is also shown. The required service population for energy consumption break-even-point in 2012 is approximately 3,660 people.



In conclusion, on-site water treatment and reuse provided by an optimized MBR WTRS is projected to become economically beneficial when servicing a project that is four times larger than The Visionaire (equivalent to approximately 100,000 gpd design capacity for 2,440 people), and becomes energetically beneficial when servicing a project that is six times larger than The Visionaire (equivalent to approximately 183,000 gpd design capacity for 3,660 people). Therefore, future WTRS installations would best be made at a block-scale and not an individual building scale. It should be noted that the capital cost of an MBR-type WTRS benefits from economy of scale. For example, the 25,000-gpd system at The Visionaire cost approximately $35 per gallon capacity to design and construct in 2008 without the proposed modifications. A 100,000-gpd system would cost approximately $23 per gallon capacity and a 183,000-gpd system would cost approximately $19 per gallon capacity. Economy of scale on capital costs will improve the pay-back-times associated with the project.

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List of Appendices

Appendix A: Historical evapotranspiration data for The Visionaire zip code (10004)

Historic ET Data for 10004											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0	0.07	0.1	0.14	0.16	0.17	0.18	0.16	0.14	0.1	0.07	0.05

Source: http://www.rainmaster.com/historicET.asp zip code 10004

Appendix B: Cooling tower operational information

Incorporating reuse water into cooling tower operation:

Air cooling in large buildings, such as the Visionaire, is often achieved using an open recirculating cooling system. Heat is removed from the air supplied to the building by using water to cool the air to the wet bulb temperature. The cooling tower is used for heat rejection by evaporating some of the heated water to the atmosphere. The latent heat of evaporation cools the water so that it can be reused for additional cycles of cooling. Makeup water is added to account for evaporative losses. During summer months makeup water to the cooling tower can constitute a large fraction of building water use and there is scope to supplement water demand to the cooling tower using reuse water. The amount of reuse water which can be utilized by the cooling tower depends on the climatic conditions, the design and operation of the cooling tower and the reuse water quality.

Considerations for using reuse water at The Visionaire

The cooling system at the Visionaire is a York ParaFlow Absorption Chiller, which consists of the following stages:

- A closed recirculating cooling loop containing pure water (chill water) that runs between the air handling unit (AHU) and the evaporator.
- An evaporator which consists of a multi-pass shell and tube heat exchanger. The chill water flows through the tube coils and another stream of water (refrigerant) is sprayed over the coils. The evaporator is separated from the absorbed by a phase separator (eliminator), which enables the transfer of vapor between the components but prevents the transfer of liquid.
- An absorber which consists of a multi-pass shell and tube heat exchanger. The tower water flows through the tube coils and a solution of Lithium Bromide (absorbent) is sprayed over the coils.
- A condenser, which consists of a multi-pass shell and tube heat exchanger. The tower water flows through the tube coils in the condenser. Refrigerant condenses at this stage.
- An open recirculating cooling loop containing reuse water (tower water) that passes through the absorber and the condenser before going to the cooling tower.

A schematic flow-diagram for the York ParaFlow Absorption Chiller is shown in Figure 1.

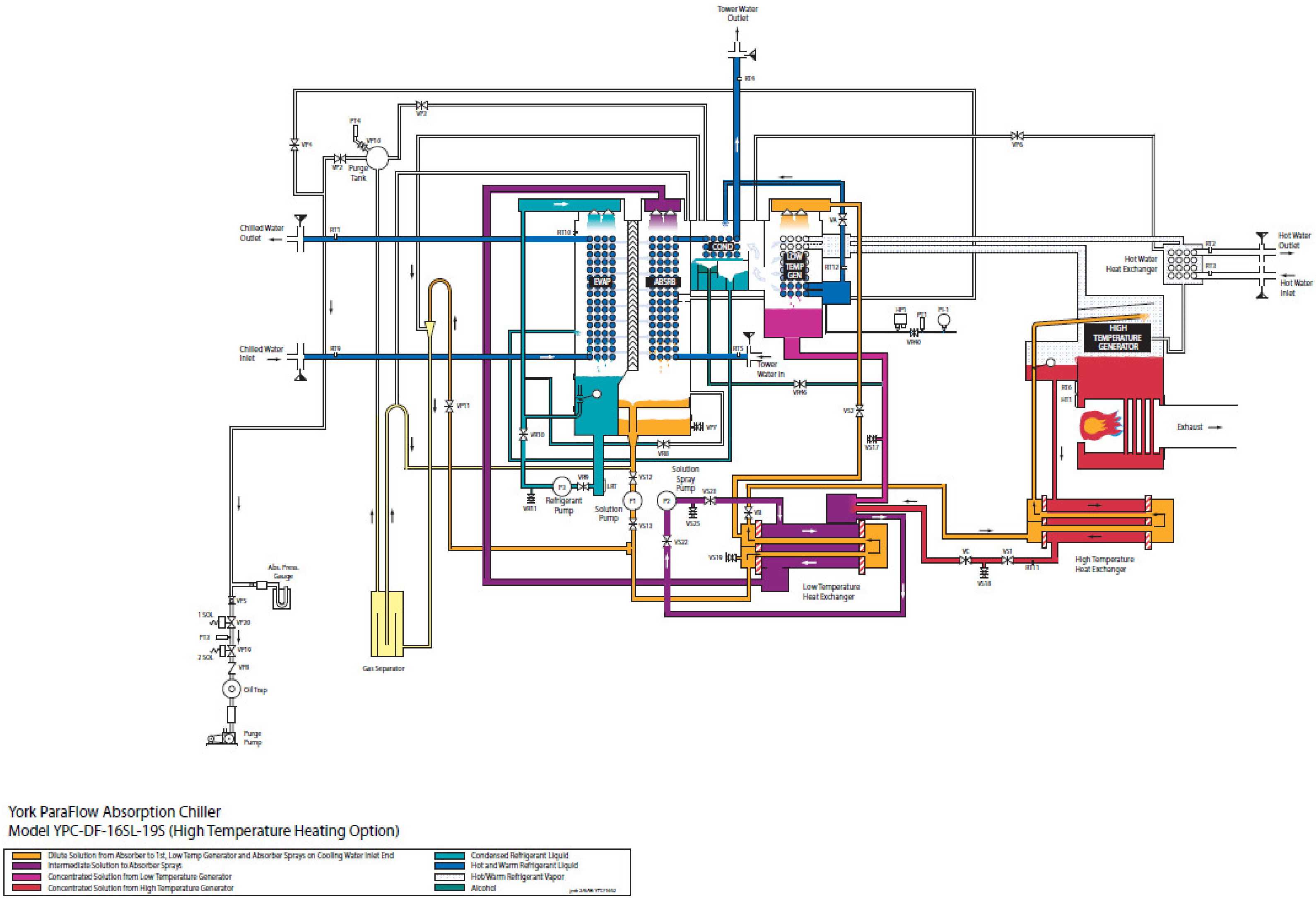


Figure 1: Schematic flow diagram of the York ParaFlow Absorption Chiller

Heat transfer from the indoor air to outdoor air is achieved through several stages of heat and mass transfer. Chill water in the air handling unit removes heat from indoor air and flows through the coils in the evaporator. The refrigerant evaporates from the surface of the coils in the evaporator and removes the latent heat of vaporization from the chill water which is then sent back to the air handling unit to provide air conditioning. The refrigerant evaporates because of the difference in vapor pressure between the evaporator and the absorber. The absorber operates at low vapor pressure because Li-Br (68% by weight) absorbs water vapor. This results in the movement of water vapor from the evaporator to the absorber, through the phase separator. The absorption of water vapor into the Li-Br solution at the coil surface results in transfer of latent heat of condensation to the tower water inside the coils.

The warmed tower water is sent through the condenser. Recycled refrigerant condenses on the surface of the coils and transfers the latent heat of condensation to the tower water. The heated tower water is passed to the cooling tower where it is sprayed over a media in the cooling tower which is open to outside air. The air evaporates some of the tower water and the latent heat of evaporation cools the residual tower water typically by 15 to 25 degrees Fahrenheit. The cooled tower water is collected in a sump at the base of the cooling tower for recirculation through the absorber. The heat rejection from the cooling tower is what achieves the overall heat transfer from indoor air to outdoor air. Work is done on the system to evaporate the refrigerant from the absorbent so that these streams can be recirculated.

Impact of water quality on cooling tower performance

Make-up water is required to replace the tower water evaporated from the cooling tower. At the Visionaire, reuse water is used as make-up water and is introduced to the system at the cooling tower sump. The concentration of dissolved and particulate constituents in the make-up water will increase as pure water is evaporated from the cooling tower and is replaced with additional reuse water. At high concentrations, certain constituents in the tower water react chemically with the inside surfaces of heat-exchanger tube bundles. This can have an adverse impact on heat transfer performance and component longevity. Cooling systems are generally operated with specified cycles of concentration and the corresponding chemical water treatment technology to prevent these conditions from evolving.

At The Visionaire, all the tubes in the absorber are made of copper except for the row closest to the eliminator, which are made of cooper nickel to provide corrosion protection in the event non-vapor water passes through the eliminator. All of the tubes in the condenser are made of copper. Copper has a long life when exposed to typical waters because it has good thermodynamic stability, biostatic properties, high resistance to reacting with the environment, and forms an insoluble corrosion product of copper oxide that insulates the metal from the environment. Adverse chemical reactions between the tower water and the copper tubes would cause the inside of the copper tubes to scale or corrode.

Scaling

Scaling occurs when the concentration of dissolved solids reaches supersaturation and the precipitant forms as a scale on the inside of the copper tubes. The precipitate of major concern at the Visionaire is calcium phosphate. The concentration at which Calcium phosphate reaches supersaturation is a function of water temperature and pH. Calcium phosphate becomes less soluble as pH increases. The solubility of dissolved Calcium phosphate is also inversely proportional to temperature (retrograde solubility). In the Visionaire cooling system, precipitation is most likely to occur inside the condenser tubing, as this is hottest stage of the open recirculating loop where tower water is in contact with copper. Corrective maintenance involves scouring the inside of the tubes with brushes to remove the scale; however, this also reduces the longevity of the tube.

Corrosion

At pH below 6.5, the copper oxide corrosion product that protects the metal from further corrosion becomes less stable and more likely to dissociate. The unstable layer can be removed easily by the erosive action of moving water, permitting further corrosion to take place. This erosion-corrosion mechanism will continue to remove the inner surface of the tube and can cause extensive damage of tube walls leading to potential tube rupture.

Chemical Control vs. Blow-Down Control

When constituents of concern reach the limit of concentration for reliable cooling system operation the tower water must be partially discharged (a process known as blow-down) and replenished with a new volume of feed water. The blow-down water contains a high concentration of dissolved solids, which cannot be effectively removed by an MBR. Blow-down water at The Visionaire is therefore not reused and is instead discharged to sewer. As such, the frequency of blow-down determines the net rate of water consumption by the cooling system.

It is possible to control corrosion and scaling through chemical addition if it is desired to increase the number of cycles before blow-down and consume less water. However, the amount of chemical required is proportional to the increasing concentrations of corrosive and scaling constituents. A compromise exists between reducing cycles which results in more water use and less chemical use, or increasing cycles which results in less water use and more chemical use.

At the Visionaire the following chemicals are added to provide protection from corrosion and scaling:

- Zinc, a mild steel corrosion inhibitor to prevent galvanic corrosion (pitting)
- Polymer, to inhibit calcium carbonate and calcium phosphate scale formation and to enhance zinc solubility for improved corrosion protection
- Tolytriazole, a yellow metal corrosion inhibitor that promotes the formation of a protective copper-TTA oxide layer on all yellow metal surfaces Low level Molybdate, is used solely as a chemical tracer for ease in monitoring and controlling chemical dosage
- BromoChloroDiMethylHydantoin (BCDMH), is a solid halogen donor used for disinfection (biological control) of the cooling water

Figure 1 illustrates the recommended dosage of polymer that is required to prevent scaling, for different combinations of tower water pH and orthophosphate concentration. The higher the pH or orthophosphate concentration of the reuse water coming into the tower, the more chemical that must be added to achieve a target number of cycles before blow-down.

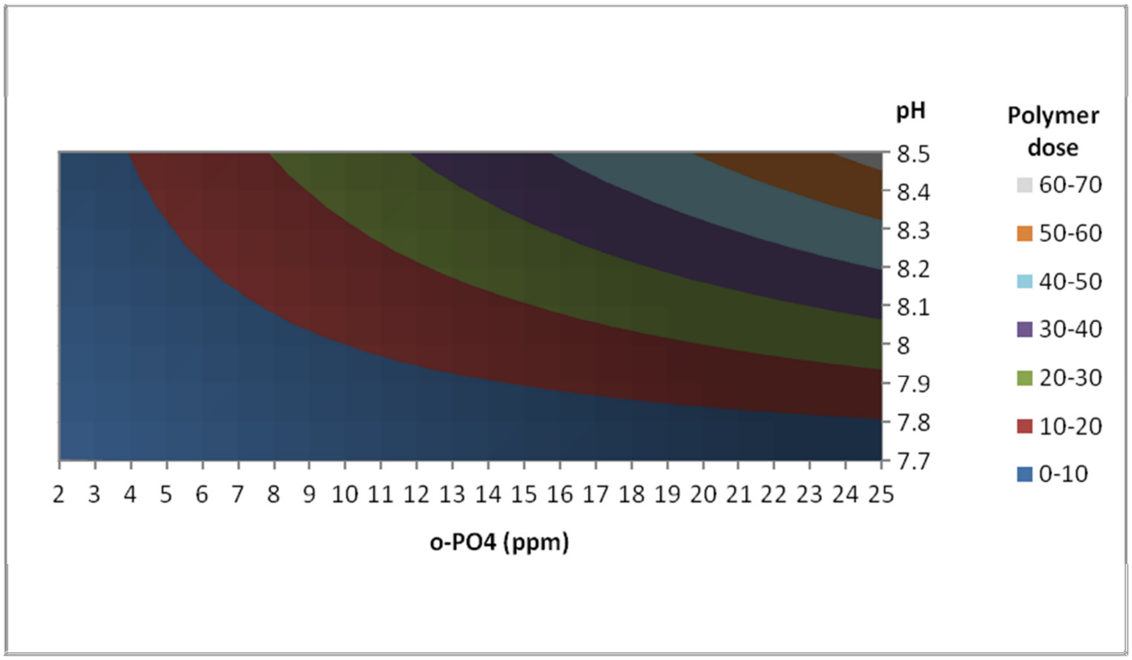


Figure 1: Chart demonstrating the relationship between orthophosphate concentration, pH, and the required polymer dose to prevent $CaCO_3$ and $CaPO_4$ scaling in an open recirculating cooling tower system.

Planning to integrate reuse water into cooling system operation

The cooling system operator must understand the chemical composition of the reuse water being supplied to the cooling tower so that decisions can be made about chemical addition and blow-down programs. The wastewater system operator must operate the system so that it consistently produces an effluent with the chemical composition that the cooling system operator is anticipating. Avoiding variability in the quality of the reuse water will minimize the risk associated with feeding reuse water to the cooling tower.

Table 1 lists constituent limits for tower water beyond which blow-down must occur, as specified by ChemTreat based on the cooling technology at The Visionaire. Table 1 also shows the typical concentrations of these constituents in the reuse water typically produced at The Visionaire and the number of cycles of concentration which would be achievable with reuse water before these limits are reached.

Table 1: Hard limits for effective cooling tower operation

METRIC	LIMIT	TYPICAL LEVEL	# POTENTIAL CYCLES	UNIT
pH	8.5	7.3	10	
Conductivity	5,000	500-650	7-10	umhos
Ca hardness ($CaCO_3$)	500	40-60	8-10	ppm
Orthophosphates (o-PO_4)	10(1)	0.7-1.5	7-14	ppm
Chlorides	200(2)	50-100	N/A	ppm
Iron	0.2	<0.5 (minimal)	N/A	ppm
Copper	0.1	.05-0.1	N/A	ppm
Ammonia	1	<0.10	N/A	ppm

(1) Could go higher, but not cost justified due to higher polymer requirements
(2) If any stainless steel is present in the system – not present in the Visionaire

This program would be based on 100% reuse water supplied to the cooling tower. A blend of potable NYC water with reuse water would enable fewer chemicals to be used to reach a target number of cycles of concentration. The higher the quality of the reuse water the less chemical needs to be added in the cooling tower to achieve a target number of cycles. However, higher effluent quality requires an increase in chemicals of operating energy in the wastewater system. As such, different relationships exist between potable water consumption, reuse water quality, and chemical consumption that will provide the greatest water savings, the most cost-effective solution, or the lowest operating carbon footprint. This relationship will be explored by this study.

Incorporating reuse water into different cooling systems

In general, reuse water has applicability in almost all cooling water applications. The unique aspects to consider include the high biological nutrient loading (phosphorus and nitrogen), ammonia, and the elevated chloride content. Due to the high phosphorus and nitrogen, biological control is a significant consideration and would be difficult to manage in a closed cooling system. Hence, reuse water would not be recommended for use in a closed loop. However, in open, recirculating cooling systems, biological control is routine and easily monitored for effectiveness. Likewise, the elevated phosphorus provides corrosion inhibition for mild steel and is readily controlled relative to scaling tendencies with polymeric dispersants. The water reclaim process at the Visionaire effectively removes the ammonia, hence it is not problematic. However, considering it is such an aggressive corrodent to copper, close monitoring of ammonia levels is recommended. Finally, the chloride content of the reuse water is such that at the recommended cycles of concentration, it would be problematic for stainless steel heat exchangers (stress corrosion cracking). In cooling systems with stainless steel, the reuse water treatment operation would need to include provisions for chloride reduction prior to use.

To ensure asset protection of the water systems as well as health and safety, the water treatment program is always designed based on the quality and chemical composition of the make-up water. Relative to reuse water, there are no aspects that cannot be managed cost effectively with proper treatment. Typically, a good biological control program along with a polymeric dispersant and copper corrosion inhibitors are the basis of the program. Optimum results can then be achieved by operating at elevated cycles of concentration to achieve alkaline pH conditions. Excellent performance for both system cleanliness and corrosion protection is readily achievable using 100% reuse water. In fact, reuse water is now the standard design for most of the new construction projects (Power Plants) in the US.

Given the type of system in place at the Visionaire, water reuse is being maximized. The critical component is that cycled up tower water is introduced to the hottest point of the absorber tubes. If the system could be changed, it would be ideal to have the condenser water to go to a plate and frame exchanger creating a closed secondary condenser system loop such that the absorber would be completely protected from the possibility of scaling. This would require a small open system between the plate and frame and the cooling tower. The plate and frame requires a smaller volume of open source condenser water – the only fouling potential would be at the plate and frame exchanger, which would be located on the roof or in the engine room. In addition to the reduction in scaling, this setup would reduce the amount of times the system tubing would need to be punched from approximately once a year for open loop to once every 2-3 years for a closed loop.

Appendix C: Journal of system, operation, interruption, and maintenance changes over study timeline

Date	Type	Event	Impact/Remedy
2/2010	S	Trial phase begins	Testing shows water is meeting DOB standards
5/3/2010	S	Non-trial phase begins	Baseline for cooling tower demand and deposit monitor data are found
6/2010	S	Final certification received from DOB	
6/2010	O	Reuse blend @ 25%	
7/2010	M	Change in particle distribution sampling	particles will be measured down to 0.1 micron as opposed to 1 micron. Lab services provider changed.
9/6/2010	O	Schedule for reuse water ramp-up executed	Reuse fraction to be increased from 25% on 9/06/2010 to 90% by 10/18/2010
9/2010	I	Conductivity meter needs replaced	Incorrect readings are leading to a high cooling tower blow down rate. Meter to be replaced asap.
10/2010	O	Schedule for reuse water ramp-up modified	Reuse fraction to be increased from 25% on 9/06/2010 to 60% by 10/18/2010
10/2010	I	sodium hypochlorite leak detected	
10/19/2010	M	Start take bacteria samples prior to disinfection system	Understand the direct impact of the disinfection system
11/2010	S	Chlorides found to building up in the system	Sodium hypochlorite will no loger be used as the main form of disinfection. Levels have been adjusted and will be monitored closely over the next period.
10/23/2010	I	Inconsistent trend on deposit monitor	The problem causing the problems was fixed after routine servicing of the monitor.
1/2011	O	Reuse blend to be set @ 100% for the winter	Achievable given low loading rates and no discernable fouling in the cooling tower at 50% reuse blend
1/2011	M	Change in bacteria/Cl-/NO3 sampling to biweekly	
2/2011	M	New current clamp meter	Energy use on the ozone unit can now be determined on a consistent and accurate basis
2/2011	O	ChemTreat recommends that reuse blend not go above 50% in the cooling tower	AE would like to see more information prior to making any final decisions.
2/2011	S	Stormwater routed through ozone unit via gravity feed	During a major storm event, excess suspended soilds entered the ozone unit. A filter to remove these solids should be installed to remedy this issue.
2/2011	M	An additional meter added to monitor stormwater transfer to the reuse reservoir.	Helps the team to better understand the impact of stormwater flow on total reuse flow.
2/2011	O	Deposit monitor may not be reflecting conditions in the cooling tower	Set points are changed to better reflect the conditions present in the tower.
3/1/2011	O	Chlorides will be ciruclated twice per week	This helps to disinfect pipes while preventing the buildup of chlorides in the system.
3/1/2011	M	High nitrate levels	recirculation ratio reduced to help identify ways to improve de-nitrification
3/2011	S	Stormwater ceased to be routed through the ozone unit and instead travels straight to the reuse tank.	After solids entered ozone unit over a few separate storm events, the ozone unit was pushed into overdrive requiring it to be shut down for a short period.
3/2011	M	Blow down meter installed on the cooling tower	Meter will provide valuable information on the quantity of cooling tower blow down.
3/2011	S	Plumbing finished to allow ozone unit to be cooled by reuse water	Saves about 1,252 gpd of potable water.

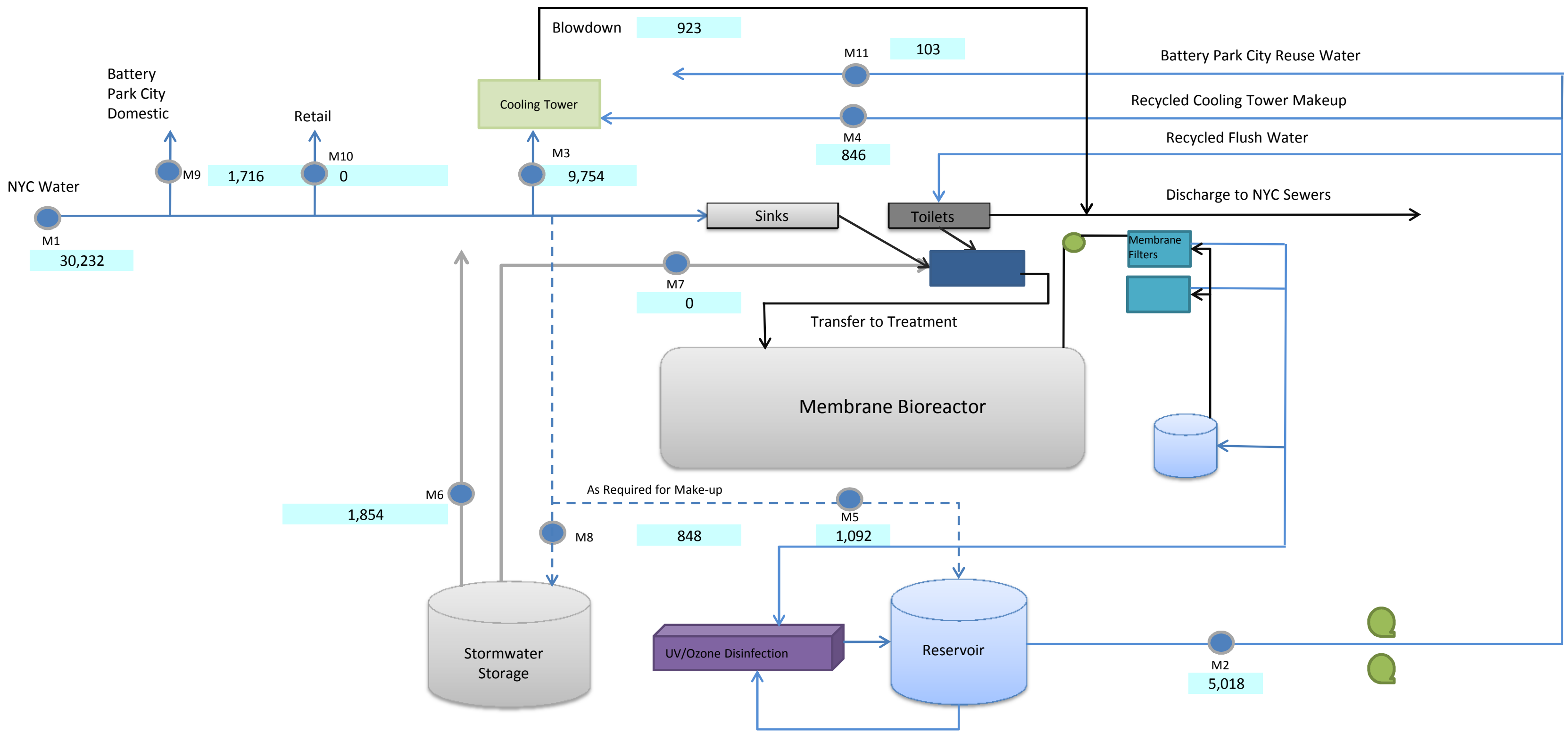
4/2011	I	Booster pumps on overdrive	Due to a malfunction, the booster pumps ran on overdrive for approximately 2 weeks before they could be fixed. This resulted in extremely high energy consumption.
5/2011	O	Reuse blend @ 60% set to increase incrementally on a biweekly basis	It was determined that a reuse blend of 100% is possible given proper operation. Cycles will also be ramped up from the current level of 2-5 to 5-10. ChemTreat advises treated water pH be raised to approximately 7.3 in addition to increased polymer and inhibitor levels.
5/2011	I	Booster pumps down	Booster pumps down for approximately 2 weeks after running on overdrive for about two weeks in late april. During this time no reuse flow was sent to the cooling tower.
6/7/2011	M	Toilet inspection installed on office toilet	When removed, the coupon should demonstrate weather fouling is ocurring in pipes after removing hypochlorite as a consistent form of disinfection.
6/7/2011	O	New schedule of operations to increase cycles is put in place. Phase 1	Increase inhibitor dosage and monitor phosphate levels. Adjust molybdate dosage. Monitor corrosion coupon.
6/24/2011	O	Phase 2	Increase pH control range to 8-8.5 and keep cycles around 3 (the same). Monitor phosphate levels and corrosion coupon.
7/5/2011	M	Deposit monitor temperature lowered to 30°/35° difference	No significant deposits present, lower temperature should fix discrepancy between monitor and coupon data.
7/18/2011	I	Booster pumps fail for 18-36 hours due to stripped motor mounts	Visionaire were briefly forced to push water into the cooling tower via garden hoses. AWM replaced motor mounts and put a 2-hour automatic reset on the pumps to avoid the same issue in the future.
7/23/2011	O	Phase 3 (reuse blend @ 70-80%)	Increase cycles from 3 to 5 keeping same pH control range. Monitor conductivity, corrosion coupon, and phosphate levels. Proceed to 7 cycles and eventually 10 depending on monitoring results.
7/23/2011	O	Reuse blend reuduced to 60%	Excessive cooling load required that the reuse blend be lowered to recover.
7/2011	M	Flow meter on coupon rack broken	The necessary flow (8gpm) through the coupon rack is not being achieved leading to inconsistent data. Flow meter was replaced asap.
8/4/2011	O	Ahead of schedule on raising cycles	ChemTreat has not seen any adverse effects on the deposit monitor at the current 5 cycles. Corrosion inhibitor has been increased until further notice.
8/2011	M	Conductivity probe not reading consistently	Improper conductivity readings. Probe issues were promptly remedied.
9/1/2011	M	M2 meter replaced	Reuse meter data began after a several month absence
9/2011	O	Reuse blend reported @ 100%	After further analysis, it was determined the blend was closer to 80%. Cooling tower operating normally at 5-7 cycles.
10/4/2011	M	Toilet inspection removed from office toilet	No visible signs of corrosion or deposition present
10/4/2011	M	Pool study - plan of action created	Due to the inability to get a clamp on meter, losses from the pool will be determined through standard temperature/evaporative loss tables
10/2011	O	Reuse blend @ 100%	Cooling tower operating normally at 7 cycles.

I = Interuption/Issue; **M** = Monitoring; **O** = Operation; **S** = System

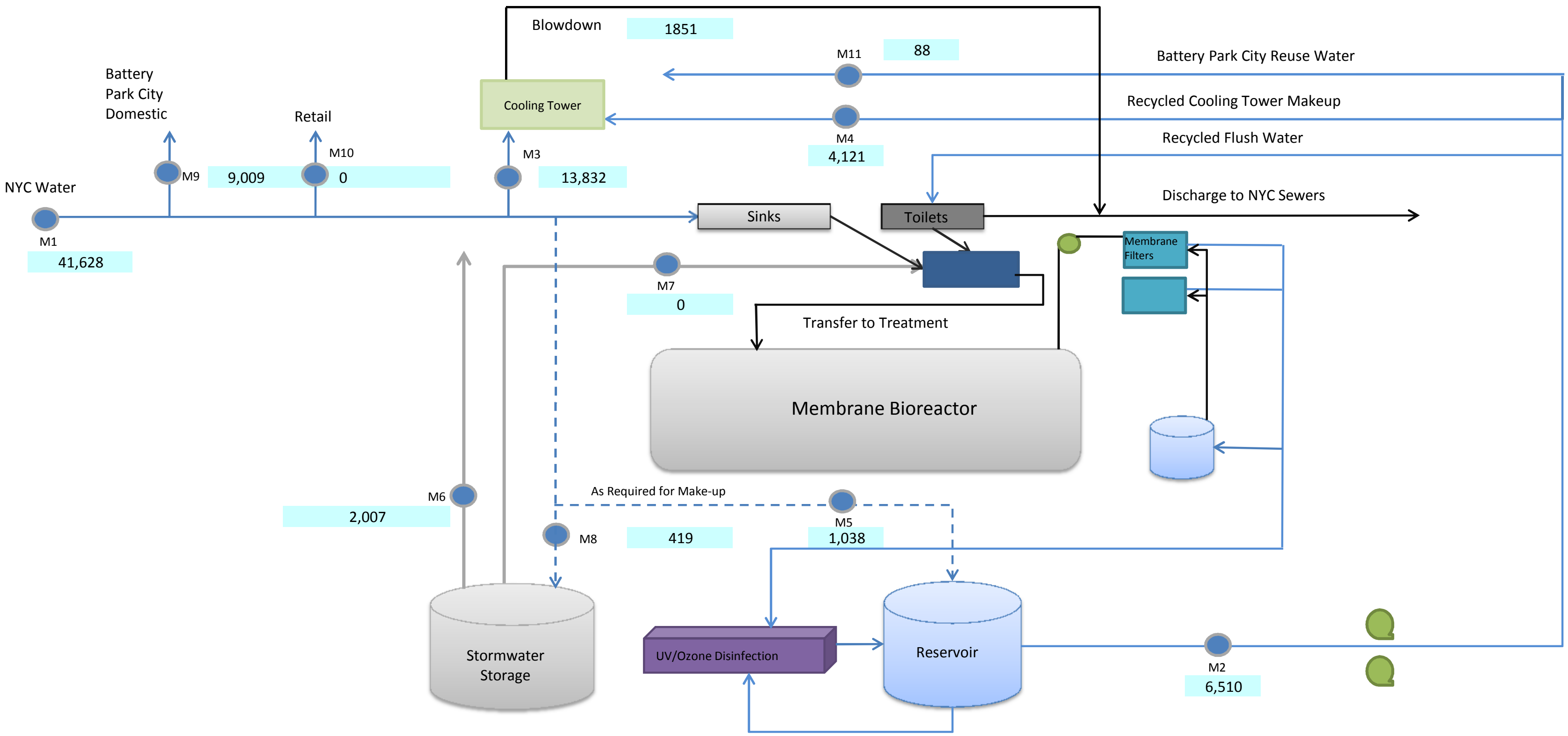
Appendix D: Sequence of operations

Stage	Name	Duration	ChemTreat	AWM	AE	Albanese
1	Increase inhibitor	7th June - 24th June	1. Set molybdate at 1.3 ppm 2. Take 30 day coupon by 24th June. Send results to AE	-	1. Confirm with York whether there is stainless steel in the tower 2. Interpret all data and advise on increase to 70% by 24th June	1. Confirm cooling tower blend is back at 60% as soon as booster pumps are turned back on 3. Send Deposit monitor data and biological assays to AE per sched. 4. Increase blend to 70% upon recommendation from AE
2	Increase pH	24th June – 22nd July	1. Adjust chemical dosage as necessary 2. Take 30 day coupon by 22nd July. Send results to AE	Increase reuse water pH to 7.3, keep all other parameters below previously specified limits	1. Interpret data and advise on increase to 80% at next meeting. 2. Advise on increase to 90% by 22nd July	1. Send Deposit monitor data and biological assays to AE per sched. 2. Increase blend to 80% and 90% upon recommendation from AE
3	Increase cycles	23rd July – 19th August	1. Increase cycles to 5 if stainless, and 7 if no stainless 2. Take 30 day coupon by 19th Aug. Send results to AE	-	1. Interpret data and advise on increase to 100% at August meeting	1. Send Deposit monitor data and biological assays to AE per sched. 2. Increase blend to 100% upon recommendation from AE
4	Optional step	20th August onwards	Increase cycles to 10 if not stainless and this is deemed possible. Advise AWM regarding required reuse pH	Prepare to adjust pH as advised by Chemtreat		

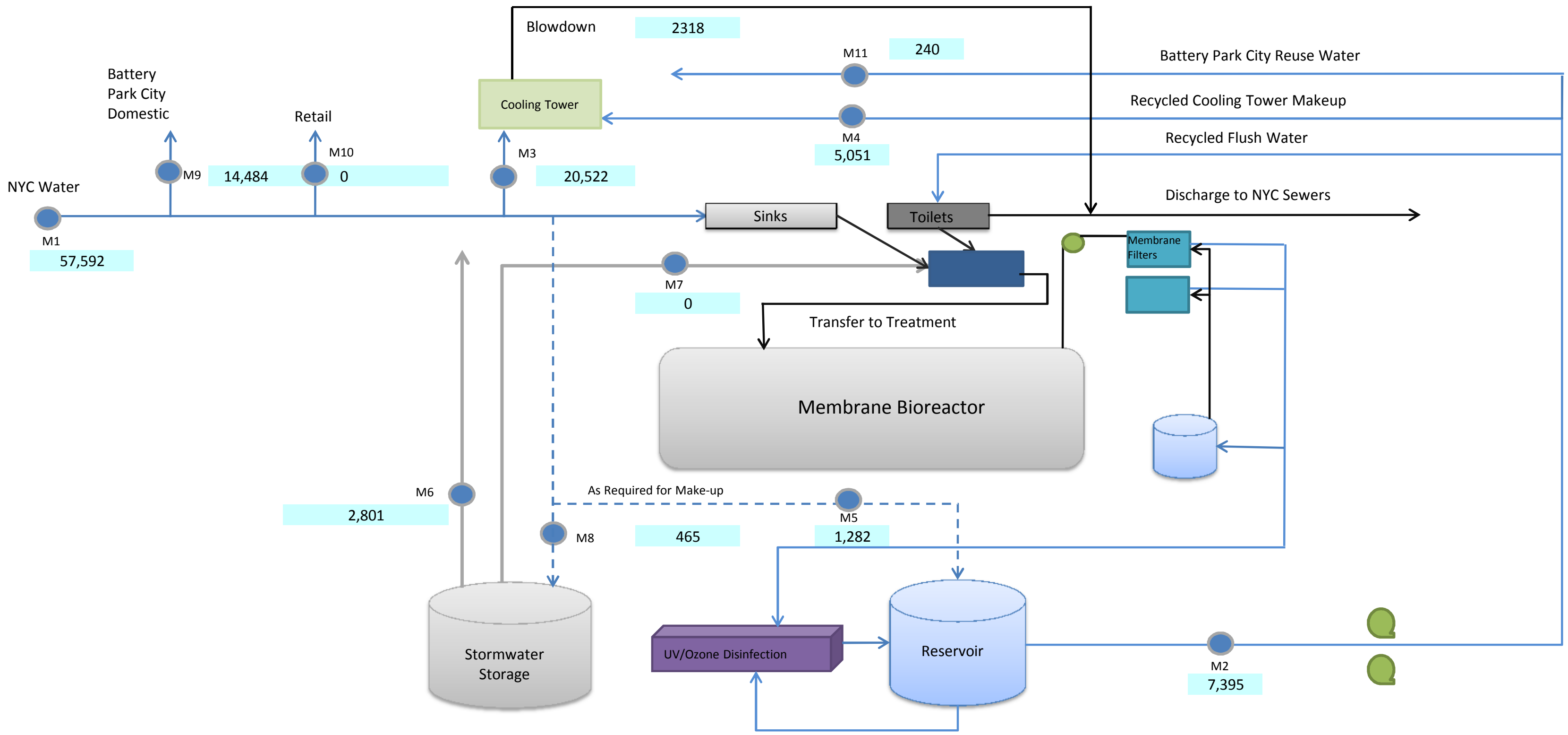
Appendix E: WTRS flow diagrams by month including average monthly flows for each meter



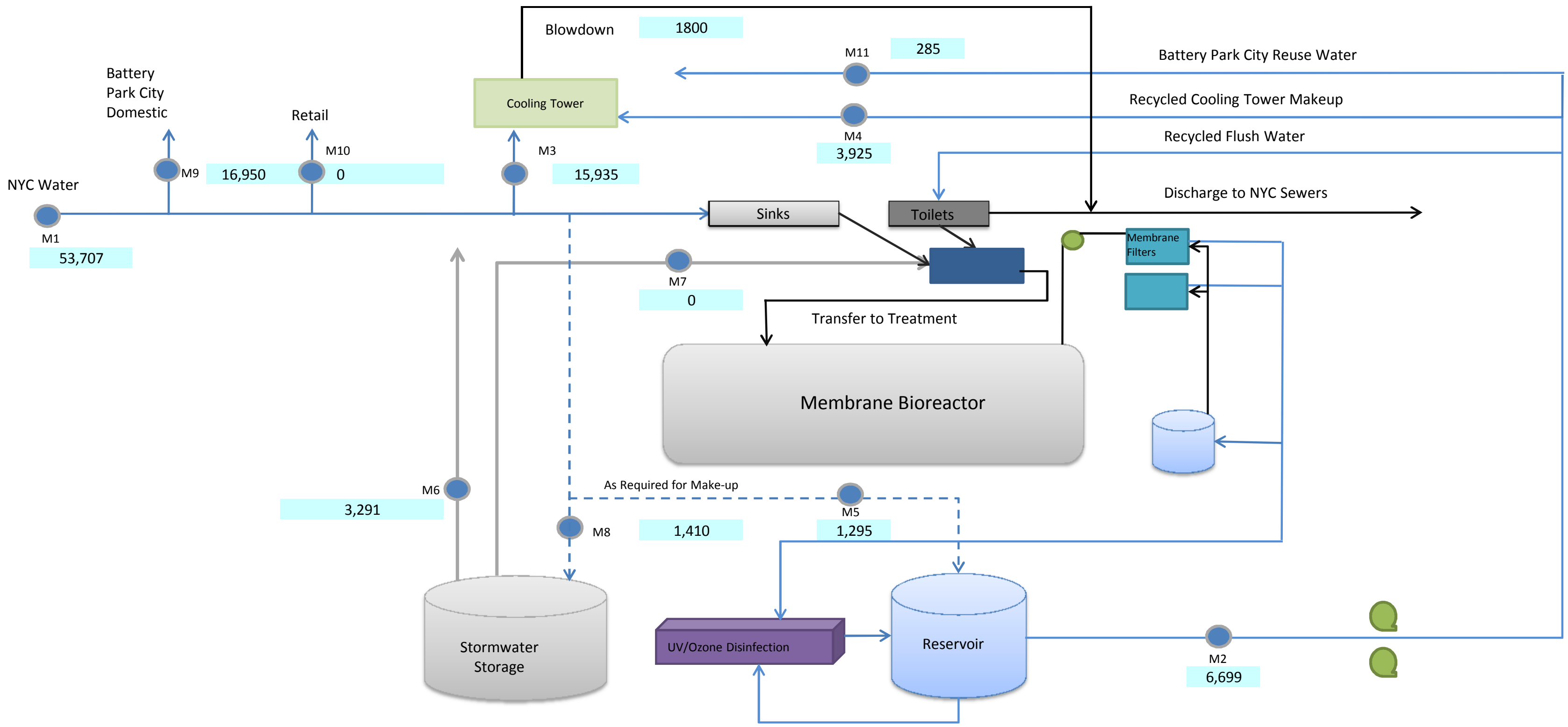
Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	m2
Reading Date	5/4/2010												
Reading (cf)	2340141	571315	7878	1471	1343	40702	33534	643041	45917	260283	3474960	27	88660
Reading Date	5/27/2010												
Reading (cf)	2426187	578228	13156	1789	1343	43309	39234	673034	48518	263641	3579318	27	104090
Usage (gal)	643,624	51,709	39,479	2,379	0	19,500	42,636	224,348	19,455	25,118	104,358	0	15,430
Avg Daily Usage (gpd)	27,984	2,248	1,716	103	0	848	1,854	9,754	846	1,092	4,537	0	5,018



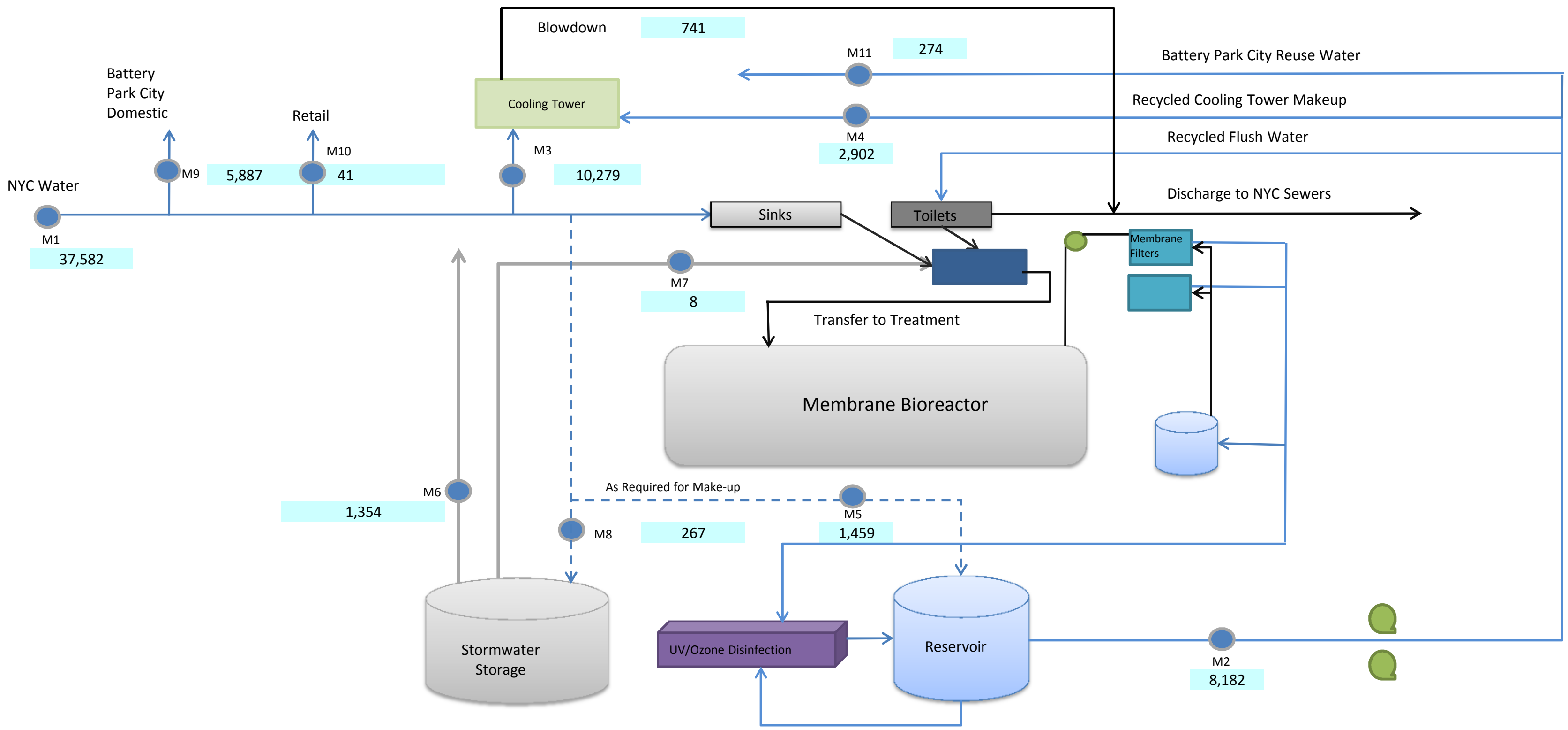
Meter Reading Data												
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2 (gal)
Reading Date	6/3/2010												
Reading (cf)	2446884	579983.1	13201	1827	1343	43452	39070	675037	63811	268708	3679271	27	122150
Reading Date	6/30/2010												
Reading (cf)	2581219	595910.3	45719	2143	1343	44966	46313	724967	78686	272456	3859685	27	145650
Usage (gal)	1,004,826	119,135	243,235	2,364	0	11,325	54,178	373,476	111,265	28,035	180,414	0	23,500
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2 (gal)
Avg Daily Usage (gpd)	37,216	4,412	9,009	88	0	419	2,007	13,832	4,121	1,038	6,682	0	6,510



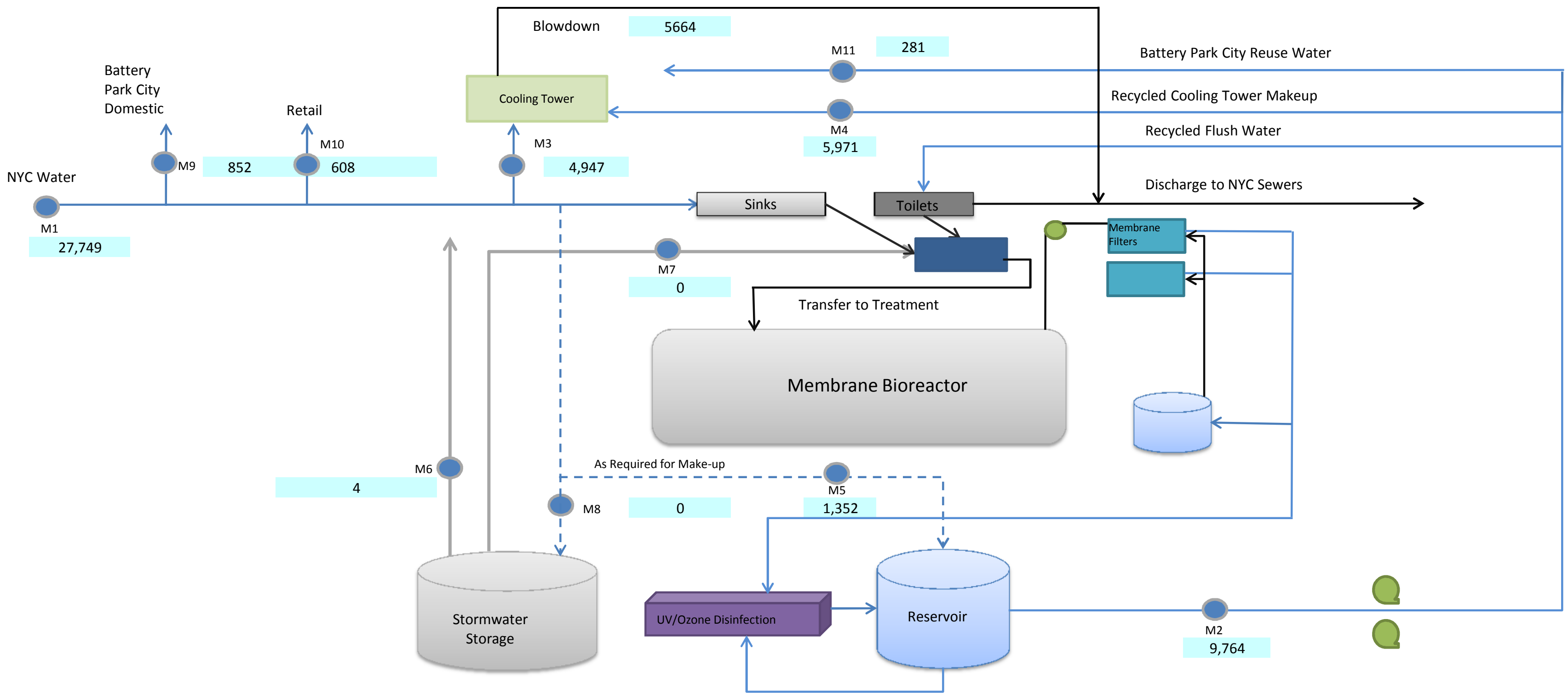
Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Reading Date	7/1/2010												
Reading (cf)	2586987	596749	57983	2203	1343	44964	46411	727153	79418	272627	3868845	27	146770
Reading Date	7/31/2010												
Reading (cf)	2791930	622791	116074	3166	1343	46827	57644	809462	99675	277767	4094432	27	176430
Usage (gal)	1,532,974	194,798	434,521	7,203	0	13,935	84,023	615,671	151,522	38,447	225,587	0	29,660
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Avg Daily Usage (gpd)	51,099	6,493	14,484	240	0	465	2,801	20,522	5,051	1,282	7,520	0	7,395



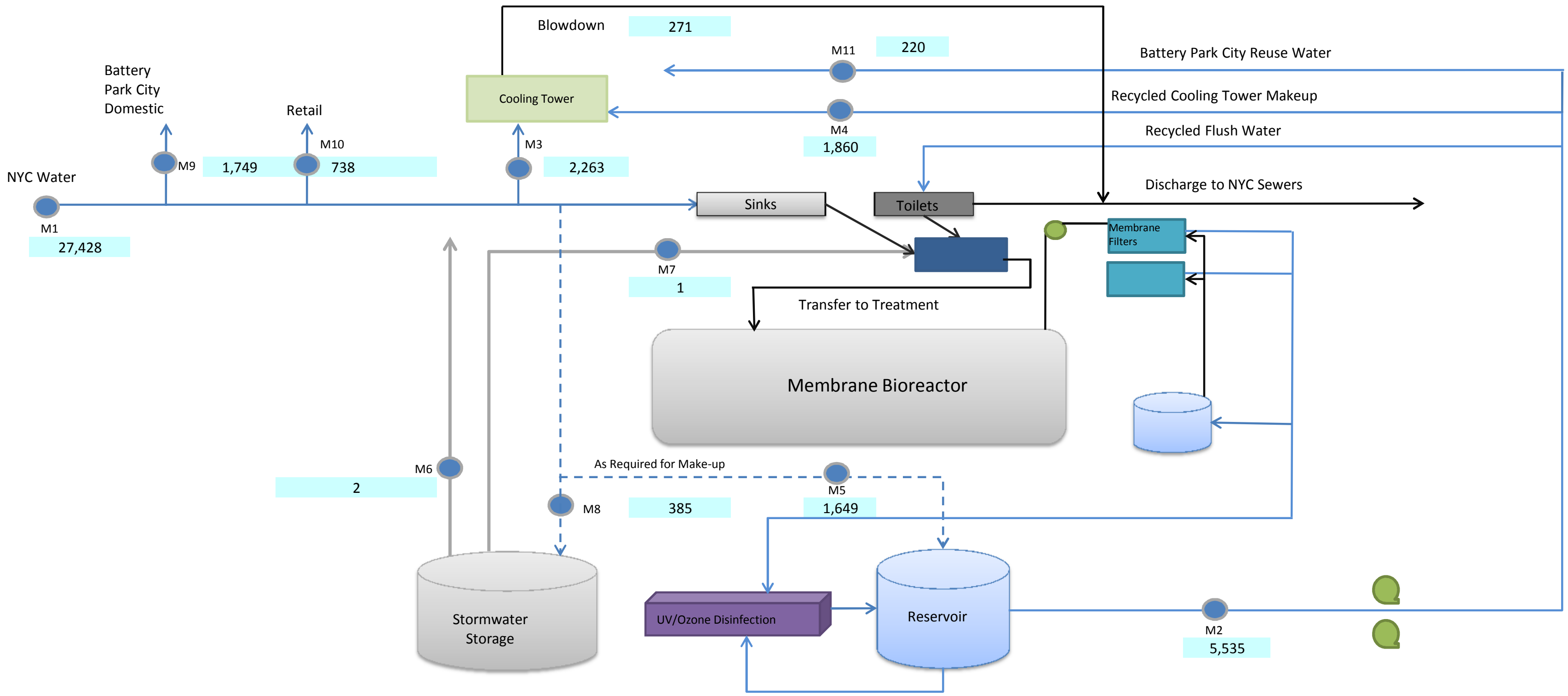
Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Reading Date	8/1/2010										8/2/2010		
Reading (cf)	2796950	623606	118287	3178	1343	46827	57829	811316	103270	277944	4115151	27	179290
Reading Date	8/27/2010										8/31/2010		
Reading (cf)	2961560	645678	177203	4169	1343	51729	69267	866706	116913	282444	4310388	27	201680
Usage (gal)	1,231,283	165,099	440,692	7,413	0	36,667	85,556	414,317	102,050	33,660	195,237	0	22,390
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Avg Daily Usage (gpd)	47,357	6,350	16,950	285	0	1,410	3,291	15,935	3,925	1,295	7,509	0	6,699



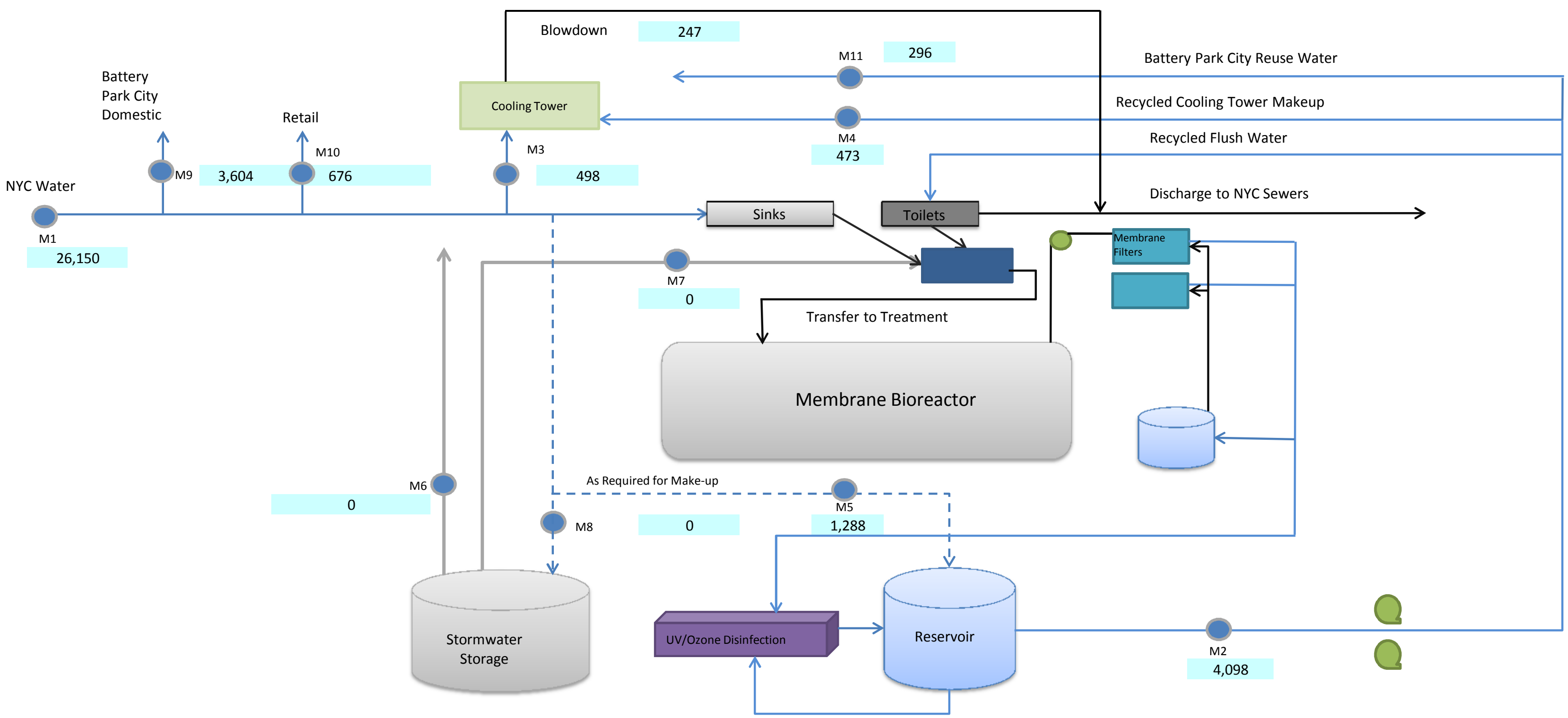
Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Reading Date	9/1/2010												
Reading (cf)	2993800	650200	188289	4311	1343	52403	72337	880553	117112	283313	4315072	27	204110
Reading Date	9/30/2010												
Reading (cf)	3124050	665654	211112	5373	1501	53439	77586	920403	128362	288968	4543379	59	235830
Usage (gal)	974,270	115,596	170,716	7,944	1,182	7,749	39,263	298,078	84,150	42,299	228,307	239	31,720
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Avg Daily Usage (gpd)	33,596	3,986	5,887	274	41	267	1,354	10,279	2,902	1,459	7,873	8	8,182



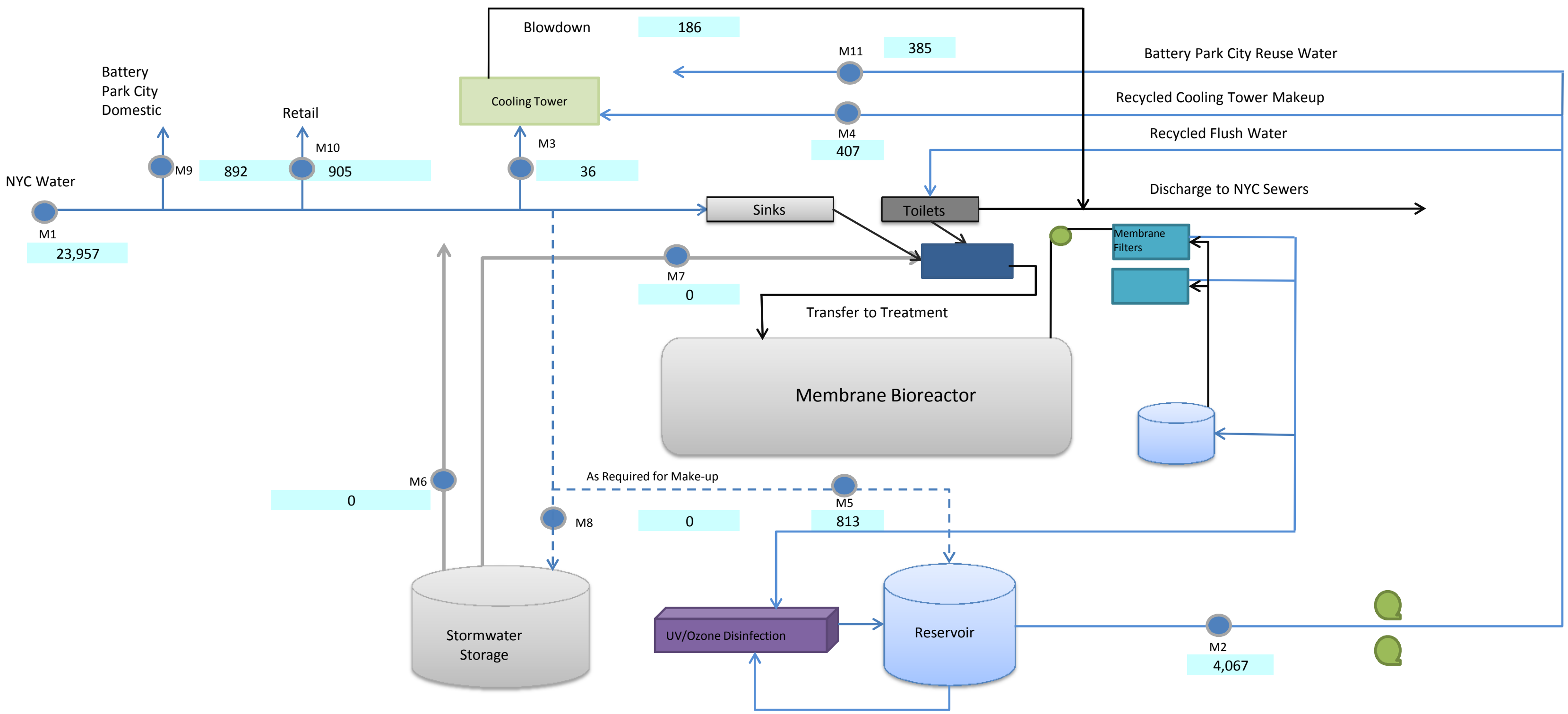
Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Reading Date	10/2/2010												
Reading (cf)	3133900	666542	211713	5484	1567	53439	77587	922259	131461	289328	4578423	59	240730
Reading Date	10/30/2010												
Reading (cf)	3225950	678367	214901	6536	3844	53439	77602	940776	153813	294389	4822206	59	277280
Usage (gal)	688,534	88,451	23,846	7,869	17,032	0	112	138,507	167,193	37,856	243,783	0	36,550
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Avg Daily Usage (gpd)	24,591	3,159	852	281	608	0	4	4,947	5,971	1,352	8,707	0	9,764



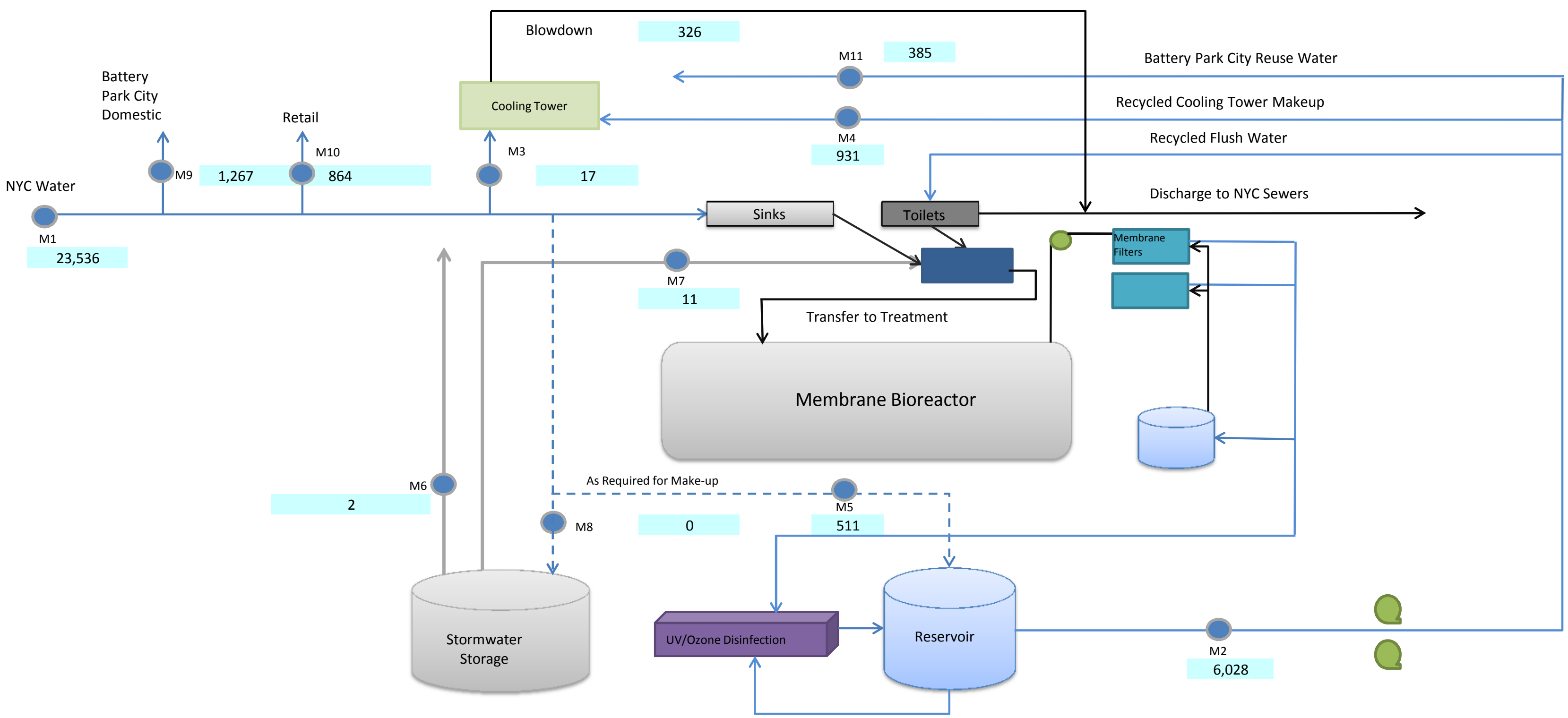
Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Reading Date	11/1/2010												
Reading (cf)	3232460	679148	215177	6553	4031	53439	77602	941075	153813	294686	4831646	59	278660
Reading Date	11/30/2010												
Reading (cf)	3324610	693336	221957	7407	6894	54933	77609	949847	161024	301079	4962906	62	300120
Usage (gal)	689,282	106,126	50,714	6,388	21,415	11,175	52	65,615	53,938	47,820	131,260	22	21,460
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2
Avg Daily Usage (gpd)	23,768	3,660	1,749	220	738	385	2	2,263	1,860	1,649	4,526	1	5,535



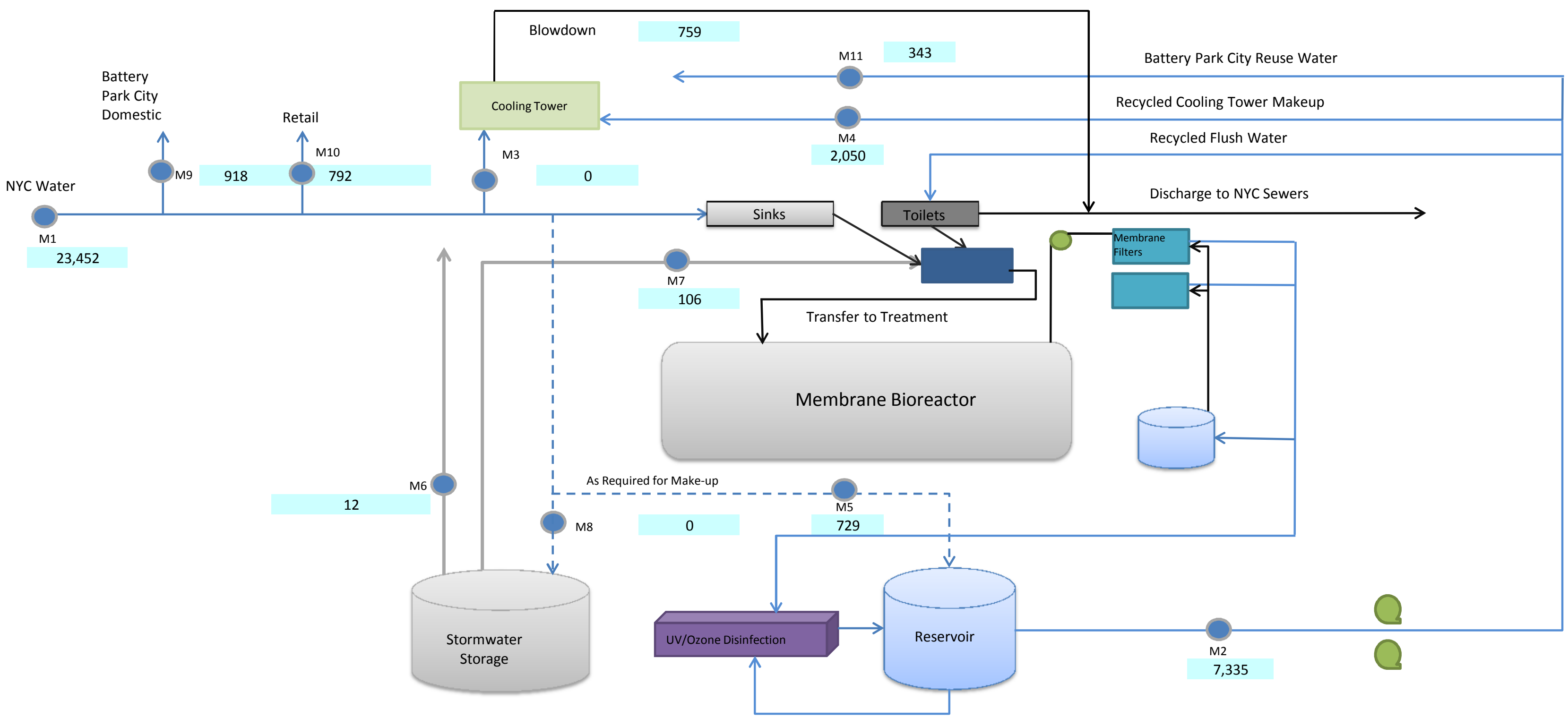
Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	m2
Reading Date	12/3/2010												
Reading (cf)	3333810	695176	222722	7553	7407	54933	77609	950306	161078	301801	4977802	62	301790
Reading Date	12/31/2010												
Reading (cf)	3417720	709154	236214	8661	9937	54933	77608	952171	162848	306621	5073585	62	317130
Usage (gal)	627,647	104,555	100,920	8,288	18,924	0	-7	13,950	13,240	36,054	95,783	0	15,340
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	m2
Avg Daily Usage (gpd)	22,416	3,734	3,604	296	676	0	0	498	473	1,288	3,421	0	4,098



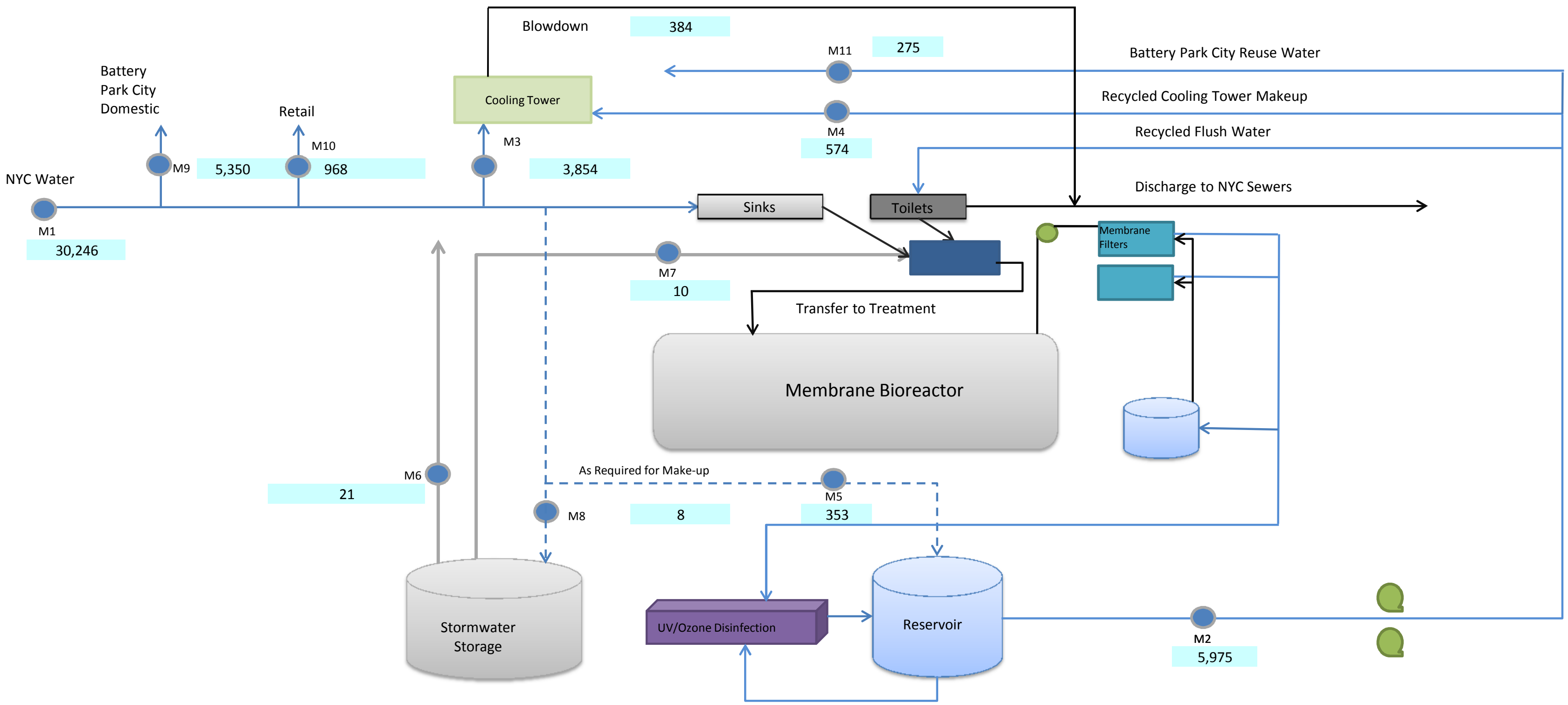
Meter Reading Data													
Meter No	**m1a**	**m1b**	**m9**	**m11**	**m10**	**m8**	**m6**	**m3**	**m4**	**m5**	**inf (gal)**	**m7**	**m2**
Reading Date	1/4/2011												
Reading (cf)	3428670	710403	236531	8751	10074	54933	77608	952543	163087	307166	5089924	62	319320
Reading Date	1/31/2011												
Reading (cf)	3504110	721439	239749	10139	13339	54933	77608	952674	164556	310101	5204838	62	334000
Usage (gal)	564,291	82,549	24,071	10,382	24,422	0	0	980	10,988	21,954	114,914	0	14,680
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	m2
Avg Daily Usage (gpd)	20,900	3,057	892	385	905	0	0	36	407	813	4,256	0	4,067



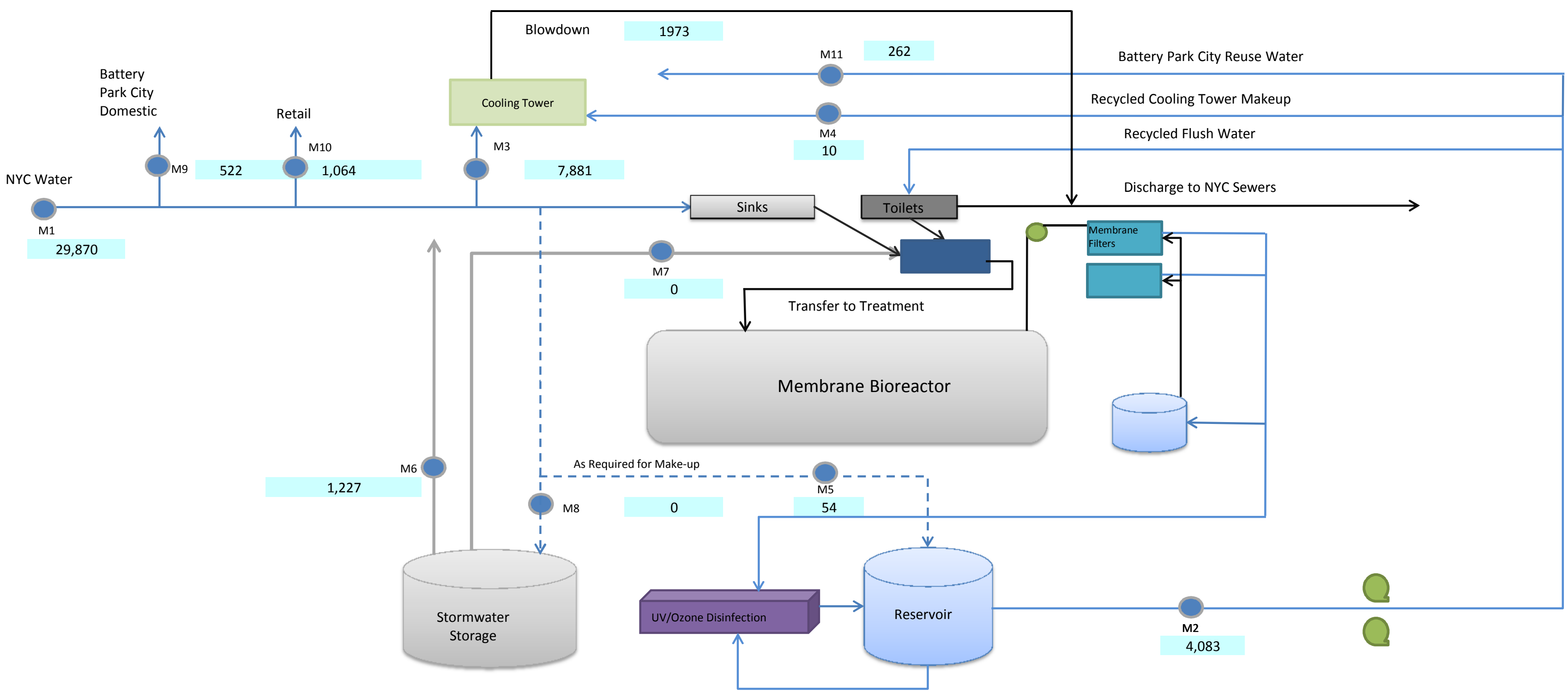
Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	m2
Reading Date	2/1/2011												
Reading (cf)	3507520	721787	239885	10226	13409	54933	77608	952614	164611	310171	5209755	62	334590
Reading Date	2/28/2011												
Reading (cf)	3581740	732524	244457	11616	16528	54933	77617	952674	167973	312015	5359075	102	356350
Usage (gal)	555,166	80,309	34,199	10,397	23,330	0	67	449	25,148	13,793	149,320	299	21,760
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	m2
Avg Daily Usage (gpd)	20,562	2,974	1,267	385	864	0	2	17	931	511	5,530	11	6,028



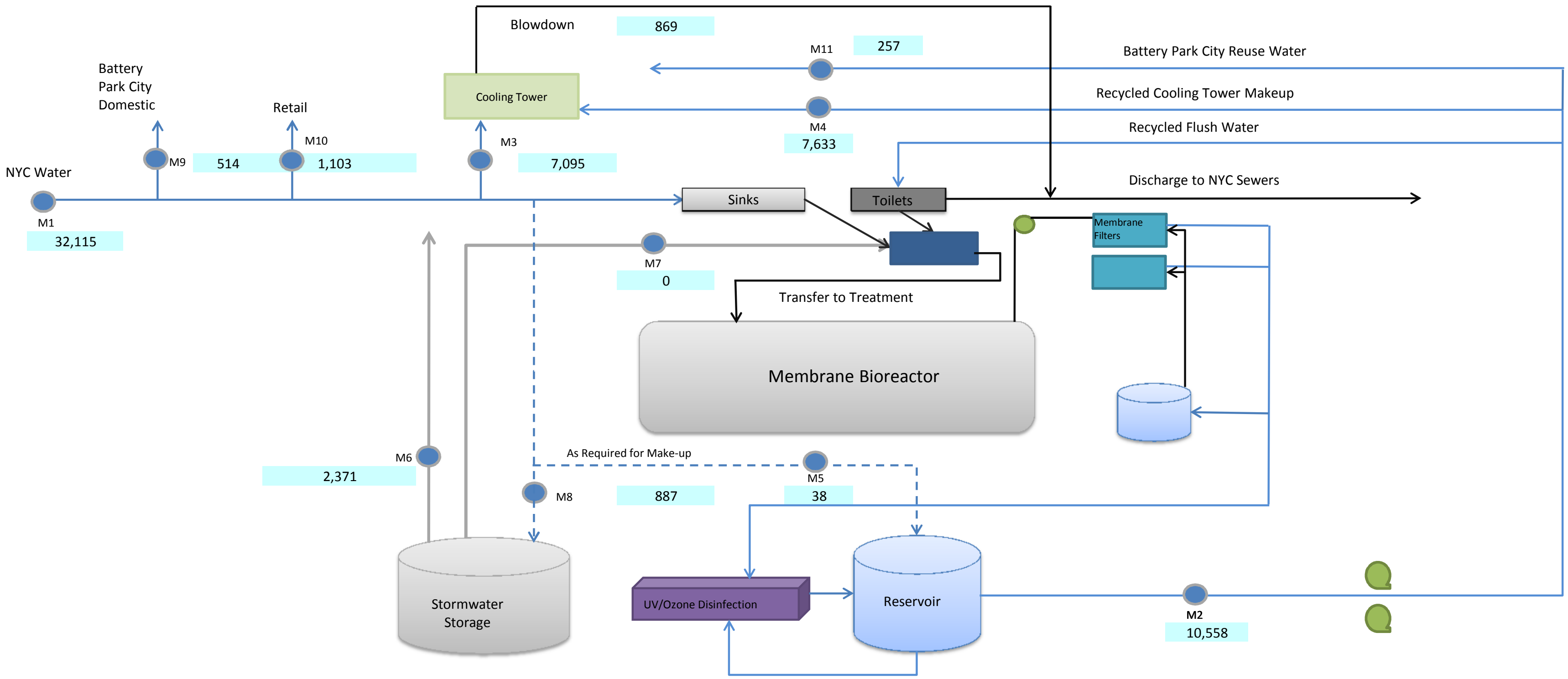
Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	m2
Reading Date	3/1/2011												
Reading (cf)	3583680	732820	244609	11674	16629	54933	77617	952674	168124	312014	5368302	102	358350
Reading Date	3/31/2011												
Reading (cf)	3668640	741920	248289	13051	19807	54933	77665	952674	176346	314937	5595948	527	408730
Usage (gal)	635,501	68,067	27,526	10,300	23,771	0	359	0	61,501	21,864	227,646	3,179	50,380
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	m2
Avg Daily Usage (gpd)	21,183	2,269	918	343	792	0	12	0	2,050	729	7,588	106	12,561



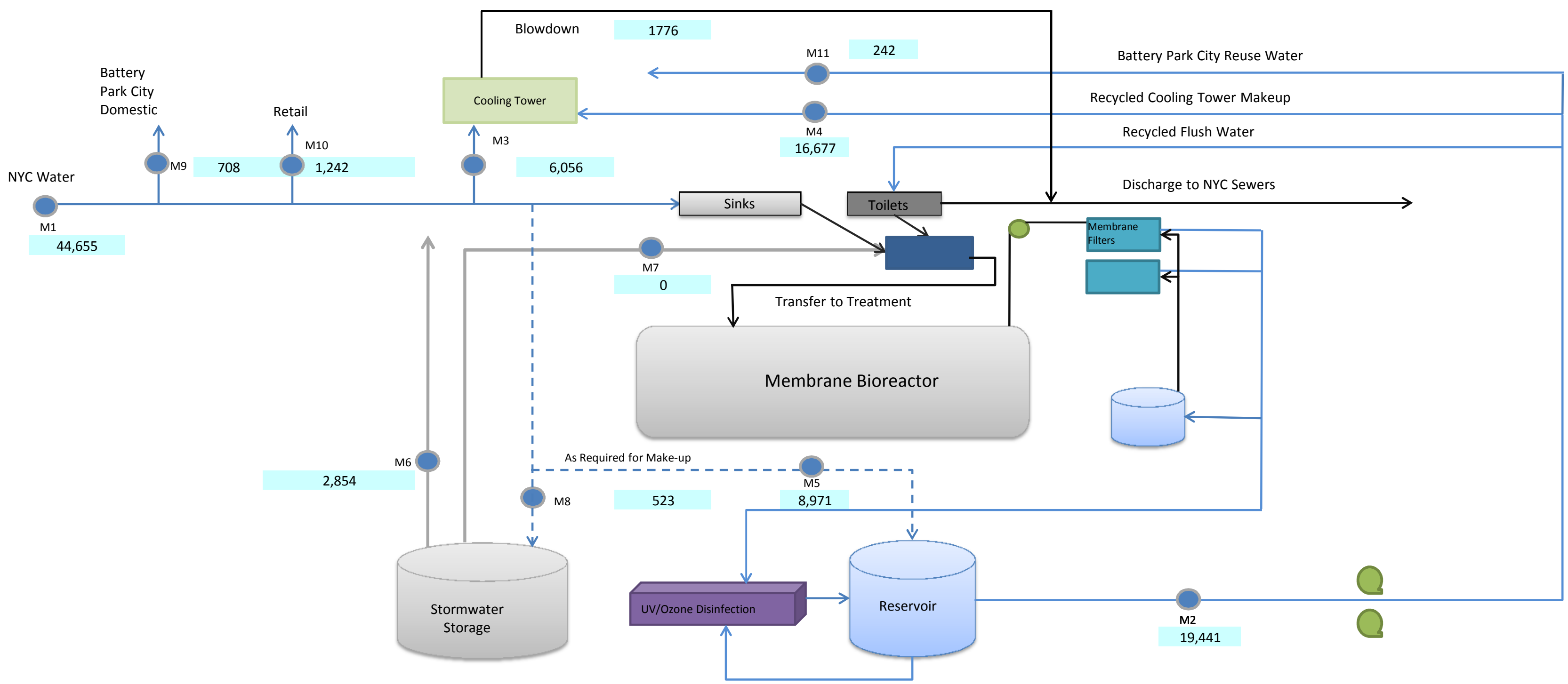
Meter Reading Data												
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7
Reading Date	4/1/2011											
Reading (cf)	3671600	742171	248344	13108	19923	54933	77665	952675	176576	314936	5600919	527
Reading Date	4/29/2011											
Reading (cf)	3776160	750831	268370	14137	23546	54964	77743	967102	178724	316256	5780820	566
Usage (gal)	782,109	64,775	149,794	7,697	27,100	232	583	107,914	16,067	9,874	179,901	292
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7
Avg Daily Usage (gpd)	27,932	2,313	5,350	275	968	8	21	3,854	574	353	6,425	10



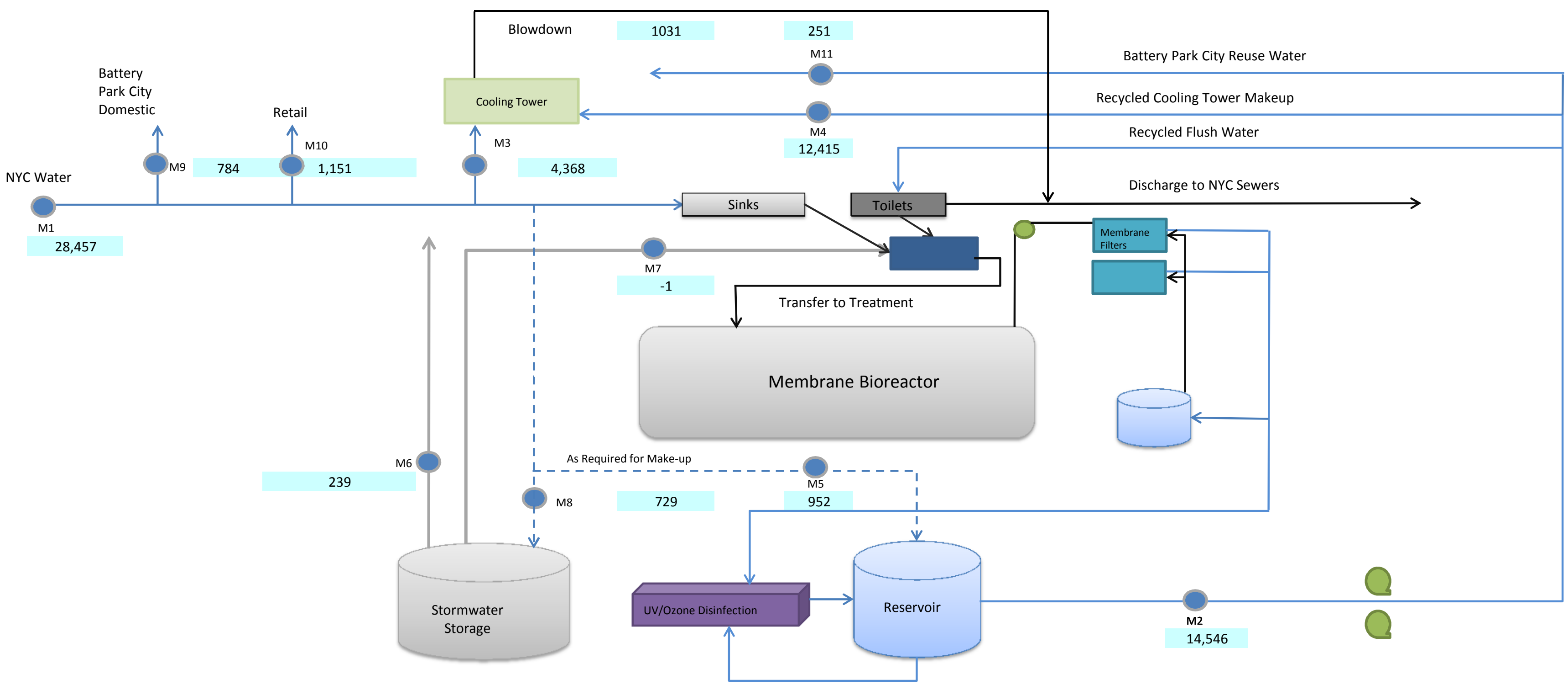
Meter Reading Data												
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	Blowdown
Reading Date	5/2/2011												5/4/2011
Reading (cf)	37837730	751323	250023	14150	24078	54964	77746	968645	178726	316254	5797720	566	15672
Reading Date	5/31/2011												
Reading (cf)	38904420	760461	252048	15164	28203	54964	82502	999201	178766	316464	5930520	567	15673
Usage (gal)	797,884	68,349	15,147	7,585	30,855	0	35,575	228,559	299	1,571	132,800	6	7
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	Blowdown
Avg Daily Usage (gpd)	27,513	2,357	522	262	1,064	0	1,227	7,881	10	54	4,579	0	0



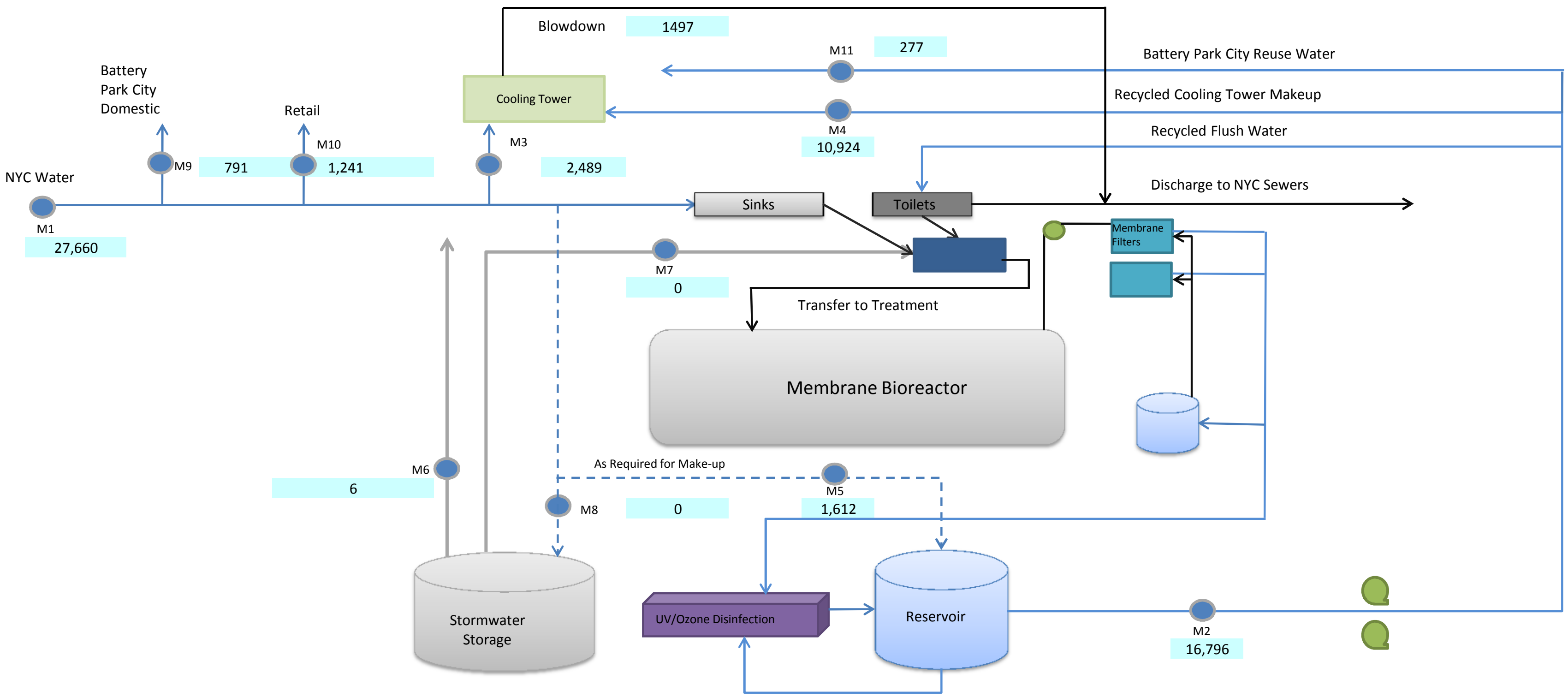
Meter Reading Data												
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	Blowdown
Reading Date	6/1/2011												
Reading (cf)	38970270	760855	252143	15205	28346	54964	83165	1003289	178772	316464	5936231	567	15673
Reading Date	6/29/2011												
Reading (cf)	40080630	770035	254066	16168	32474	58283	92042	1029846	207344	316607	6270652	567	40011
Usage (gal)	830,549	68,672	14,384	7,203	30,877	24,826	66,400	198,646	213,719	1,070	334,421	1	24,338
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	Blowdown
Avg Daily Usage (gpd)	29,662	2,453	514	257	1,103	887	2,371	7,095	7,633	38	11,944	0	869



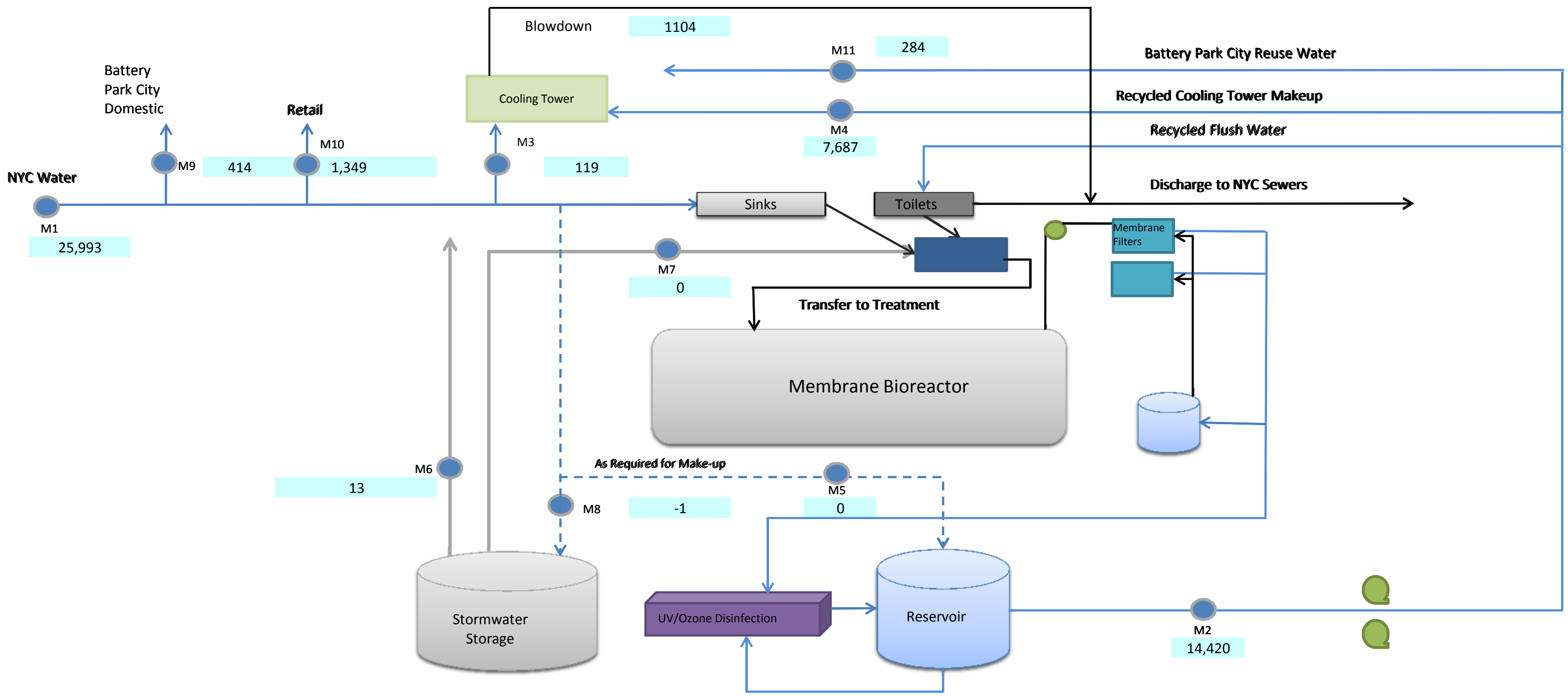
Meter Reading Data												
Meter No	**m1a**	**m1b**	**m9**	**m11**	**m10**	**m8**	**m6**	**m3**	**m4**	**m5**	**inf (gal)**	**m7**	**Blowdown**
Reading Date	7/1/2011												
Reading (cf)	40181170	770786	254224	16247	32813	58284	92709	1031143	210251	316607	6304226	567	40011
Reading Date	7/30/2011												
Reading (cf)	41789890	783042	256968	17184	37629	60311	103773	1054621	274906	351388	6681302	567	91514
Usage (gal)	1,203,323	91,678	20,525	7,009	36,024	15,162	82,759	175,615	483,619	260,162	377,076	-1	51,503
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	Blowdown
Avg Daily Usage (gpd)	41,494	3,161	708	242	1,242	523	2,854	6,056	16,677	8,971	13,003	0	1,776



Meter Reading Data													
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	Blowdown
Reading Date	8/1/2011												
Reading (cf)	41888180	783770	257007	17203	37842	60311	103782	1056162	278866	355966	6681302	567	91514
Reading Date	8/31/2011												
Reading (cf)	42926760	794043	260153	18209	42458	63235	104739	1073682	328657	359783	7147740	564	122452
Usage (gal)	776,858	76,841	23,532	7,525	34,528	21,872	7,158	131,050	372,437	28,551	466,438	-19	30,938
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	inf (gal)	m7	Blowdown
Avg Daily Usage (gpd)	25,895	2,561	784	251	1,151	729	239	4,368	12,415	952	15,548	-1	1,031



Meter Reading Data														
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2	Blowdown
Reading Date	9/1/2011													
Reading (cf)	4296559	794461	260877	18238	42594	63235	104739	1074112	330172	359783	7162941	5642	467760	122452
Reading Date	9/30/2011													
Reading (cf)	4393967	804290	263943	19313	47407	63236	104761	1083761	372526	366033	7608063	5642	532880	165874
Usage (gal)	728,612	73,522	22,934	8,041	36,001	7	165	72,175	316,808	46,750	445,122	0	65,120	43,422
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2	Blowdown
Avg Daily Usage (gpd)	25,125	2,535	791	277	1,241	0	6	2,489	10,924	1,612	15,349	0	16,796	1,497



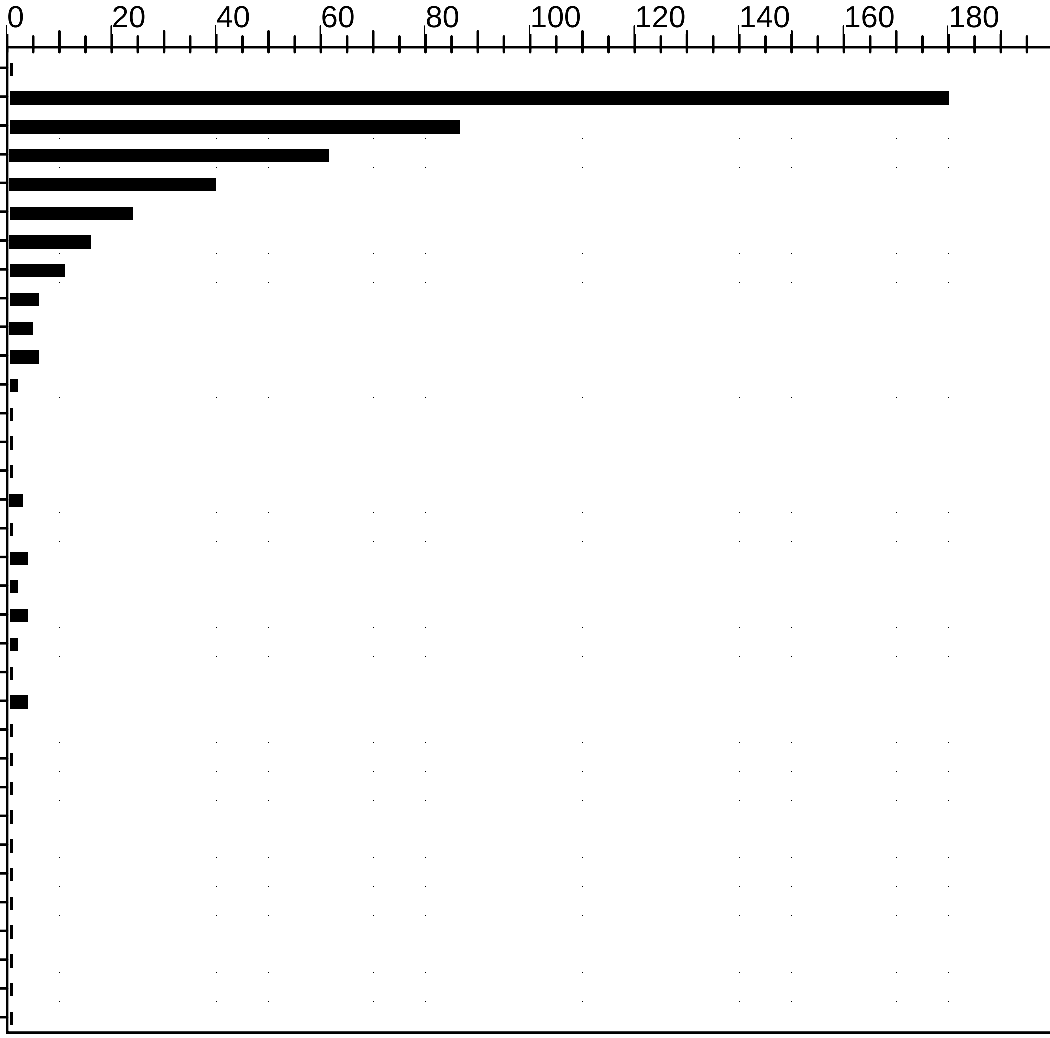
Meter Reading Data														
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2	Blowdown
Reading Date	10/1/2011													
Reading (cf)	4396677	804563	264008	19342	47543	63236	104761	1084147	373289	360633	7618062	5642	539770	165873
Reading Date	10/15/2011													
Reading (cf)	4440734	809157	264783	19874	50068	63235	104785	1084369	387677	360633	7795347	5642	566760	181322
Usage (gal)	329,546	34,359	5,797	3,979	18,887	-7	180	1,661	107,622	0	177,285	0	26,990	15,449
Meter No	m1a	m1b	m9	m11	m10	m8	m6	m3	m4	m5	Inf (gal)	m7	m2	Blowdown
Avg Daily Usage (gpd)	23,539	2,454	414	284	1,349	-1	13	119	7,687	0	12,663	0	14,420	1,104

Appendix F: Chemtreat particle distribution analysis

CHEMTREAT
ATTN: MARK CORDREY
SAMPLE: 10-05-24-41.1
DATE: NONE TIME: NONE
SPECTREX CODE: 5958

Spectrex Laser Particle Counter 800-822-3940 v8.13g

#	um	%	Interim Count
	<	0.00	0
1	1	39.60	180
2	2	19.00	86
3	3	13.52	61
4	4	8.76	39
5	5	5.15	23
6	6	3.41	15
7	7	2.25	10
8	8	1.09	5
9	9	1.03	4
10	10	1.22	5
11	11	0.39	1
12	12	0.19	0
13	13	0.19	0
14	14	0.06	0
15	15	0.52	2
16	16	0.19	0
17	17	0.81	3
18	22	0.33	1
19	27	0.65	3
20	32	0.33	1
21	37	0.00	0
22	42	0.65	3
23	47	0.16	0
24	52	0.00	0
25	57	0.00	0
26	62	0.00	0
27	67	0.16	0
28	72	0.00	0
29	77	0.00	0
30	82	0.00	0
31	87	0.16	0
32	92	0.00	0
	>	0.16	0



Filter 0%
A-T 0 s
S-T 48 s
Dilut'n 11.0:1
Offset 0.00V
Gain 5.55x
Counts 5001
NSF Groups

NSF Class	Size	Total counts /cc	Counts percent	Surface area percent	Volume percent	Mass/bin ppm
#1	< 1	0.00	0.00%	0.00%	0.00%	0.0000
#2	1-5	4,044.59	80.88%	6.33%	0.87%	0.0220
#3	5-15	750.31	15.00%	12.70%	3.72%	0.0945
#4	15-30	124.82	2.50%	17.29%	10.79%	0.2738
#5	30-50	56.89	1.14%	30.82%	30.80%	0.7814
#6	50-100	16.25	0.33%	32.85%	53.81%	1.3649

Total counts: 5,001.00/cc
Total suspended solids: 2.54ppm (mg/liter)
Dilution factor: 11.00:1
Spec. gravity: 1.00
Mean size: 3.76um
Standard dev: 6.75um

Sample taken on May 27, 2010 at 15:31

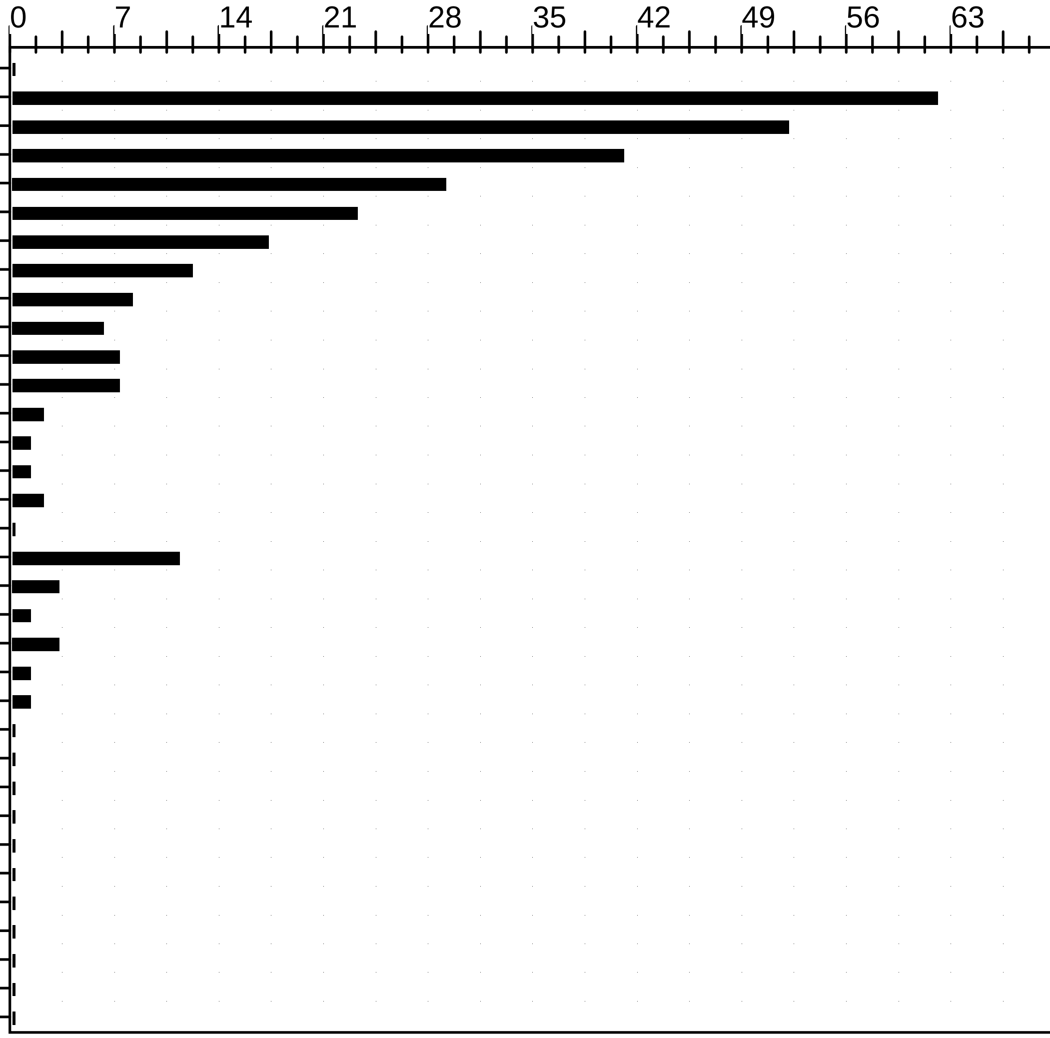
CHEMTREAT
ATTN: MARK CORDREY
SAMPLE: 10-05-24-41.1
DATE: NONE TIME: NONE
SPECTREX CODE: 5958

NSF Bin	Size	Total counts /cc	Counts percent	Surface area percent	Volume percent	Mass/bin ppm
---	--------	---------	----------	----------	---------	-----------
	<	0.00	0.00%	0.00%	0.00%	0.0000
1	1um	1,980.43	39.60%	0.66%	0.04%	0.0010
2	2um	949.96	19.00%	1.27%	0.13%	0.0033
3	3um	676.25	13.52%	2.04%	0.29%	0.0073
4	4um	437.95	8.76%	2.35%	0.41%	0.0104
5	5um	257.62	5.15%	2.16%	0.44%	0.0113
6	6um	170.67	3.41%	2.06%	0.49%	0.0123
7	7um	112.71	2.25%	1.85%	0.49%	0.0124
8	8um	54.74	1.09%	1.17%	0.34%	0.0087
9	9um	51.52	1.03%	1.40%	0.45%	0.0114
10	10um	61.18	1.22%	2.05%	0.71%	0.0180
11	11um	19.32	0.39%	0.78%	0.29%	0.0074
12	12um	9.66	0.19%	0.47%	0.19%	0.0047
13	13um	9.66	0.19%	0.55%	0.23%	0.0059
14	14um	3.22	0.06%	0.21%	0.09%	0.0024
15	15um	25.76	0.52%	1.94%	0.91%	0.0231
16	16um	9.66	0.19%	0.83%	0.41%	0.0104
17	17um	40.64	0.81%	3.94%	2.03%	0.0515
18	22um	16.25	0.33%	2.64%	1.65%	0.0418
19	27um	32.51	0.65%	7.94%	5.79%	0.1470
20	32um	16.25	0.33%	5.58%	4.62%	0.1173
21	37um	0.00	0.00%	0.00%	0.00%	0.0000
22	42um	32.51	0.65%	19.22%	19.53%	0.4954
23	47um	8.13	0.16%	6.02%	6.65%	0.1687
24	52um	0.00	0.00%	0.00%	0.00%	0.0000
25	57um	0.00	0.00%	0.00%	0.00%	0.0000
26	62um	0.00	0.00%	0.00%	0.00%	0.0000
27	67um	8.13	0.16%	12.23%	17.64%	0.4473
28	72um	0.00	0.00%	0.00%	0.00%	0.0000
29	77um	0.00	0.00%	0.00%	0.00%	0.0000
30	82um	0.00	0.00%	0.00%	0.00%	0.0000
31	87um	8.13	0.16%	20.62%	36.17%	0.9175
32	92um	0.00	0.00%	0.00%	0.00%	0.0000
	>	8.13	0.16%	0.00%	0.00%	0.0000
		---------	----------	----------	---------	-----------
	TOTALS	5,001.00	100.00%	100.00%	100.00%	2.5365

CHEMTREAT
ATTN: MARK CORDREY
SAMPLE: 10-06-17-27.1
DATE: NONE TIME: NONE
SPECTREX CODE: 6069

Spectrex Laser Particle Counter 800-822-3940 v8.13g

#	um	%	Interim Count
	<	0.00	0
1	1	20.77	62
2	2	17.41	52
3	3	13.74	41
4	4	9.68	29
5	5	7.96	23
6	6	5.70	17
7	7	4.06	12
8	8	2.89	8
9	9	2.26	6
10	10	2.65	7
11	11	2.42	7
12	12	0.78	2
13	13	0.55	1
14	14	0.47	1
15	15	0.94	2
16	16	0.16	0
17	17	3.79	11
18	22	1.08	3
19	27	0.54	1
20	32	1.08	3
21	37	0.54	1
22	42	0.54	1
23	47	0.00	0
24	52	0.00	0
25	57	0.00	0
26	62	0.00	0
27	67	0.00	0
28	72	0.00	0
29	77	0.00	0
30	82	0.00	0
31	87	0.00	0
32	92	0.00	0
	>	0.00	0



Filter	0%
A-T	0 s
S-T	48 s
Dilut'n	100001
Offset	0.00V
Gain	5.55x
Counts	30066967
NSF Groups	

NSF Class	Size	Total counts /cc	Counts percent	Surface area percent	Volume percent	Mass/bin ppm
#1	< 1	0.00	0.00%	0.00%	0.00%	0.0000
#2	1-5	18,518,998.41	61.59%	5.08%	1.17%	135.0447
#3	5-15	8,942,634.21	29.74%	25.15%	12.89%	1483.4523
#4	15-30	1,954,839.13	6.50%	31.17%	28.83%	3317.9534
#5	30-50	650,495.36	2.16%	38.60%	57.11%	6573.1423
#6	50-100	0.00	0.00%	0.00%	0.00%	0.0000

Total counts: 30,066,967.11/cc
Total suspended solids: 11509.59ppm (mg/liter)
Dilution factor: 100001.00:1
Spec. gravity: 1.00
Mean size: 5.54um
Standard dev: 6.47um

Sample taken on June 28, 2010 at 15:09

CHEMTREAT
ATTN: MARK CORDREY
SAMPLE: 10-06-17-27.1
DATE: NONE TIME: NONE
SPECTREX CODE: 6069

NSF Bin	Size	Total counts /cc	Counts percent	Surface area percent	Volume percent	Mass/bin ppm
	<	0.00	0.00%	0.00%	0.00%	0.0000
1	1um	6,243,413.91	20.77%	0.29%	0.03%	3.2690
2	2um	5,234,140.23	17.41%	0.96%	0.16%	18.4364
3	3um	4,130,980.63	13.74%	1.70%	0.39%	44.3747
4	4um	2,910,463.63	9.68%	2.13%	0.60%	68.9645
5	5um	2,394,091.05	7.96%	2.74%	0.91%	104.7869
6	6um	1,713,418.10	5.70%	2.83%	1.08%	123.8163
7	7um	1,220,517.01	4.06%	2.74%	1.17%	134.7603
8	8um	868,444.79	2.89%	2.55%	1.20%	138.4326
9	9um	680,672.95	2.26%	2.53%	1.30%	150.0044
10	10um	798,030.35	2.65%	3.66%	2.04%	234.9730
11	11um	727,615.91	2.42%	4.03%	2.42%	278.4394
12	12um	234,714.81	0.78%	1.55%	0.99%	114.1005
13	13um	164,300.37	0.55%	1.27%	0.86%	99.5363
14	14um	140,828.89	0.47%	1.26%	0.91%	104.6026
15	15um	281,657.77	0.94%	2.90%	2.20%	252.9131
16	16um	46,942.96	0.16%	0.55%	0.44%	50.3384
17	17um	1,138,366.88	3.79%	15.07%	12.53%	1442.1665
18	22um	325,247.68	1.08%	7.21%	7.27%	837.2886
19	27um	162,623.84	0.54%	5.43%	6.39%	735.2469
20	32um	325,247.68	1.08%	15.26%	20.39%	2346.2553
21	37um	162,623.84	0.54%	10.20%	15.19%	1748.7896
22	42um	162,623.84	0.54%	13.14%	21.53%	2478.0974
23	47um	0.00	0.00%	0.00%	0.00%	0.0000
24	52um	0.00	0.00%	0.00%	0.00%	0.0000
25	57um	0.00	0.00%	0.00%	0.00%	0.0000
26	62um	0.00	0.00%	0.00%	0.00%	0.0000
27	67um	0.00	0.00%	0.00%	0.00%	0.0000
28	72um	0.00	0.00%	0.00%	0.00%	0.0000
29	77um	0.00	0.00%	0.00%	0.00%	0.0000
30	82um	0.00	0.00%	0.00%	0.00%	0.0000
31	87um	0.00	0.00%	0.00%	0.00%	0.0000
32	92um	0.00	0.00%	0.00%	0.00%	0.0000
	>	0.00	0.00%	0.00%	0.00%	0.0000
	TOTALS	30,066,967.11	100.00%	100.00%	100.00%	11509.5926

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PHONE: 360-254-1213 • FAX: 360-896-2106

Test Results

ChemTreat, Inc. - Visionaire WWTP

Contact: Mitch Kaufman
Title:
Sampled: 7/26/2010

2 Samples

	SAMPLE ID	Before Membrane	After Membrane				
1	pH						
2	Conductivity (MMHS)						
3	Free Halogen (PPM)						
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)						
6	Calcium (PPM)						
7	Magnesium (PPM)						
8	Molybdenum (PPM)						
9	Zinc (PPM)						
10	Total Iron (PPM)						
11	Manganese (PPM)						
12	Copper (PPM)						
13	Aluminum (PPM)						
14	Silica (PPM)						
15	Nickel (PPM)						
16	Vanadium (PPM)						
17	Sodium (PPM)						
18	Potassium (PPM)						
19	Chloride (PPM)						
20	Bromide (PPM)						
21	Nitrite (PPM)						
22	Nitrate (PPM)						
23	Ammonia (PPM)						
24	Phosphonate (PPM)						
25	Ortho Phosphate (PPM)						
26	Total Phosphate (PPM)						
27	Sulfite (PPM)						
28	Sulfate (PPM)						
29	Total Azole (PPM)						
30	Glycol (PPM)						
31	Glycol E/P (%)						
32	Turbidity (NTU)	9,968.0	0.3700				
33	Aerobic Bacteria (CELLS/ML)						
34	Primary Organism						
35	Secondary Organism						
36	DEAE (PPM)						
37	Morpholine (PPM)						
38	Cyclohexylamine (PPM)						

A READING OF '0' IS LESS THAN TEST LIMITS AND NOT NECESSARILY ZERO

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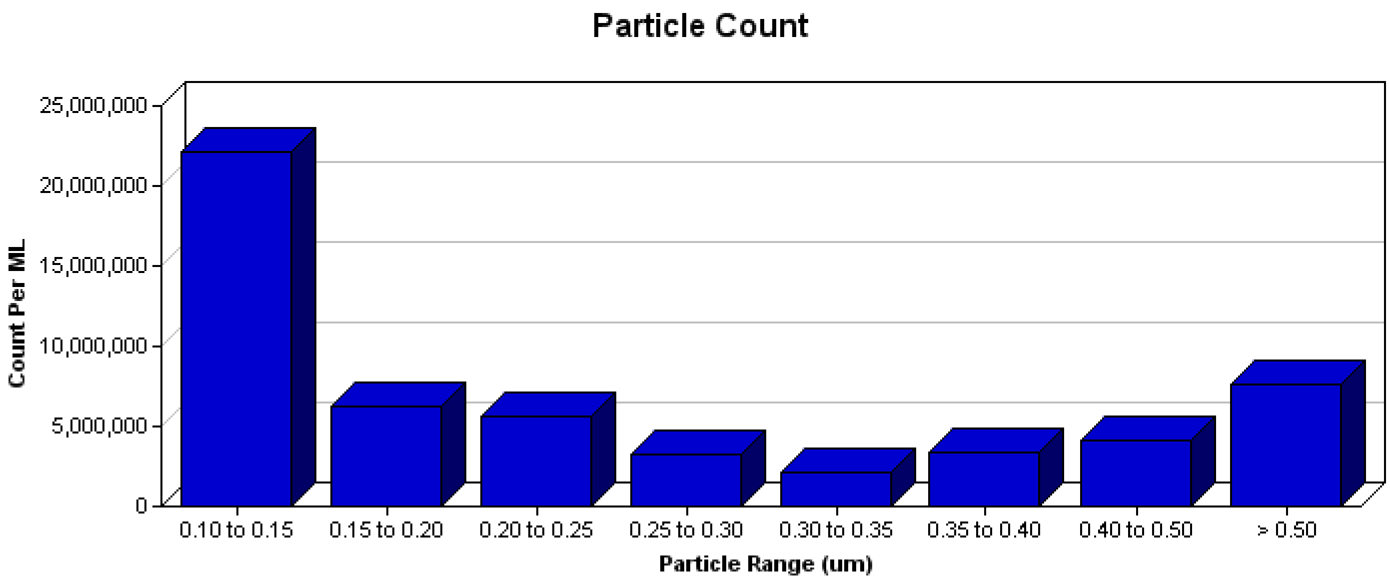
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Before Membrane
Sampled - 7/26/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	22,101,240	6,244,342	5,640,586	3,191,697	2,085,050	3,424,410	4,071,395	7,605,316
Percent of Total	40.7%	11.5%	10.4%	5.9%	3.8%	6.3%	7.5%	14.0%

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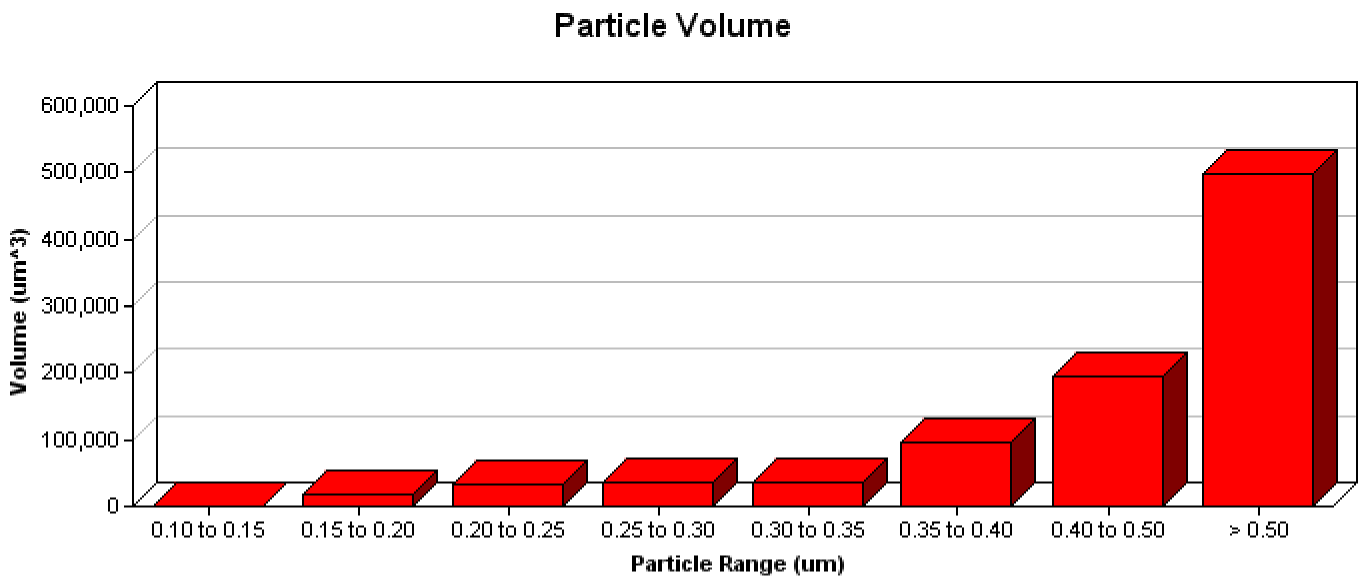
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Before Membrane
Sampled - 7/26/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	181	17,523	33,641	34,755	37,477	94,554	194,258	497,767

* Volume calculated as average particle size sphere.

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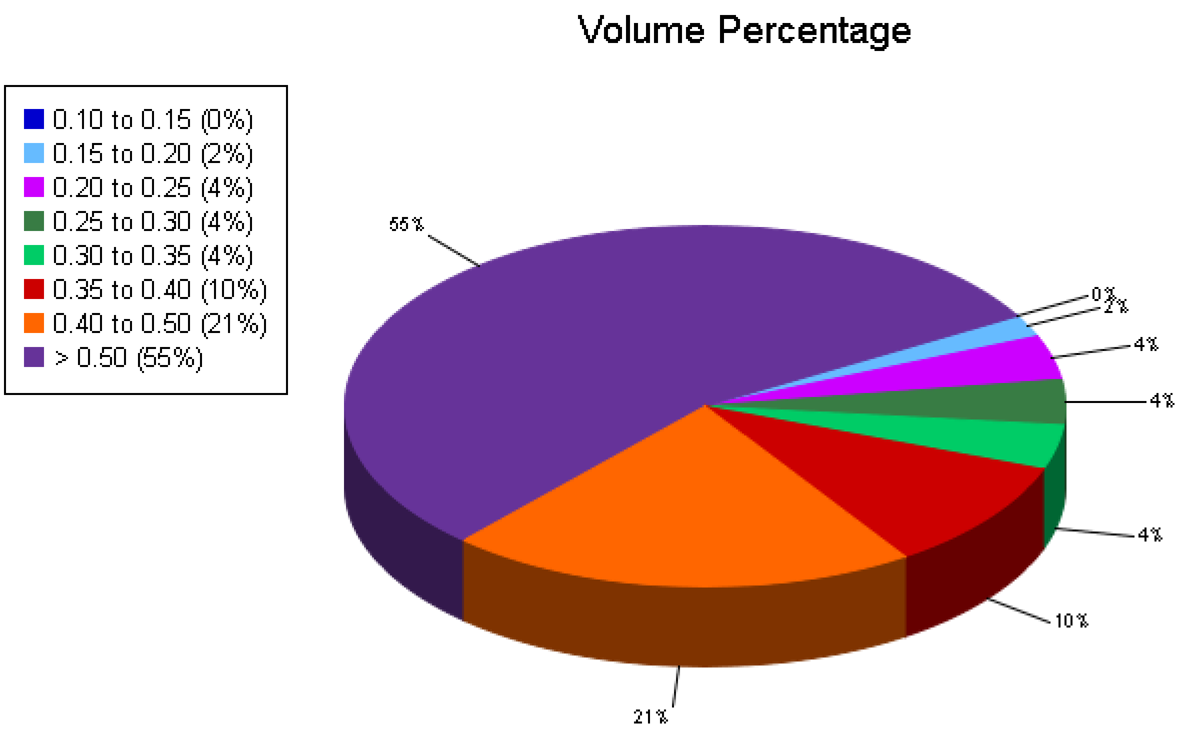
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Before Membrane
Sampled - 7/26/2010



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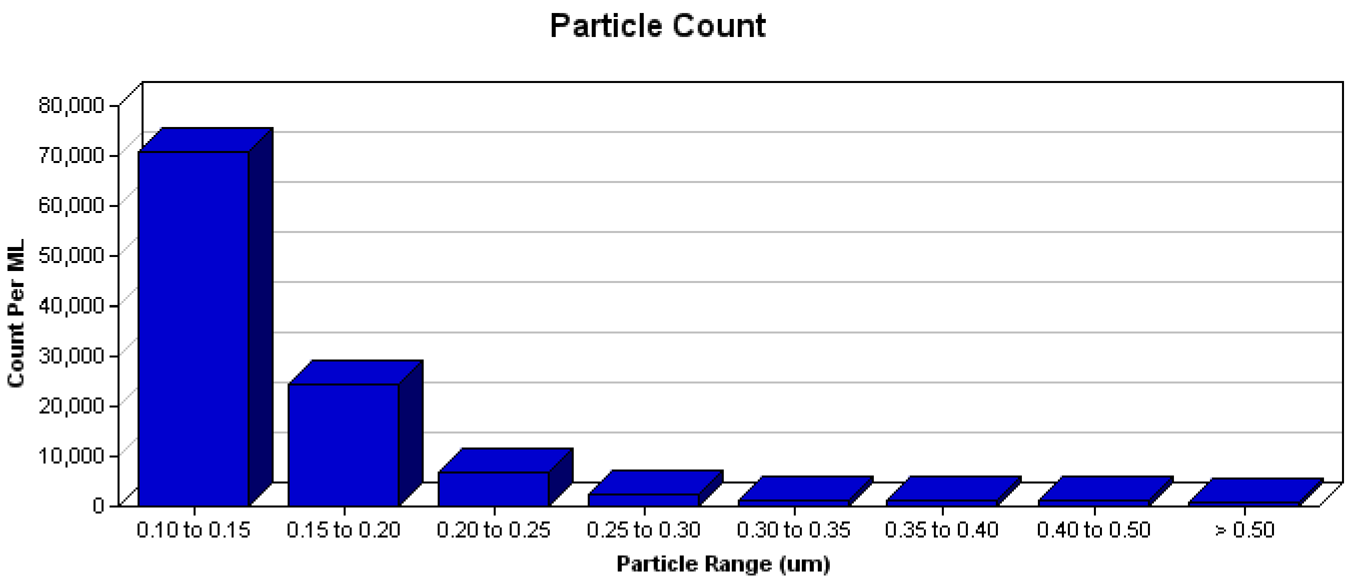
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
After Membrane
Sampled - 7/26/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	70,676	24,449	6,947	2,544	1,209	1,227	1,101	632
Percent of Total	65.0%	22.5%	6.4%	2.3%	1.1%	1.1%	1.0%	0.6%

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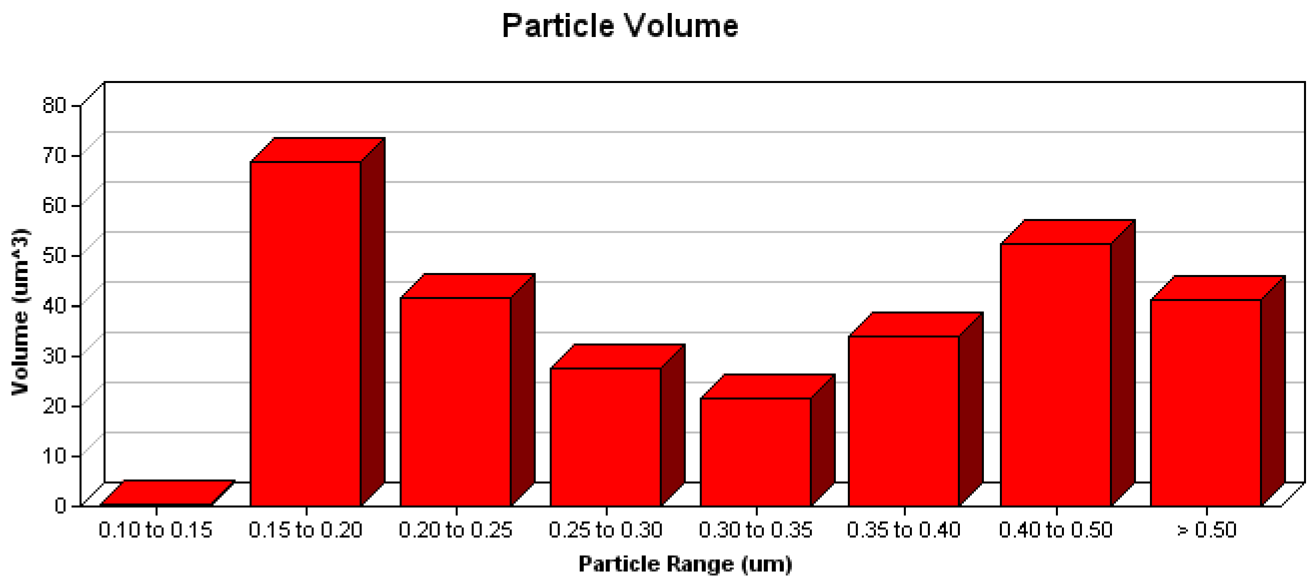
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
After Membrane
Sampled - 7/26/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (μm^3)	1	69	41	28	22	34	53	41

* Volume calculated as average particle size sphere.

Thomas M. Laronge, Inc.
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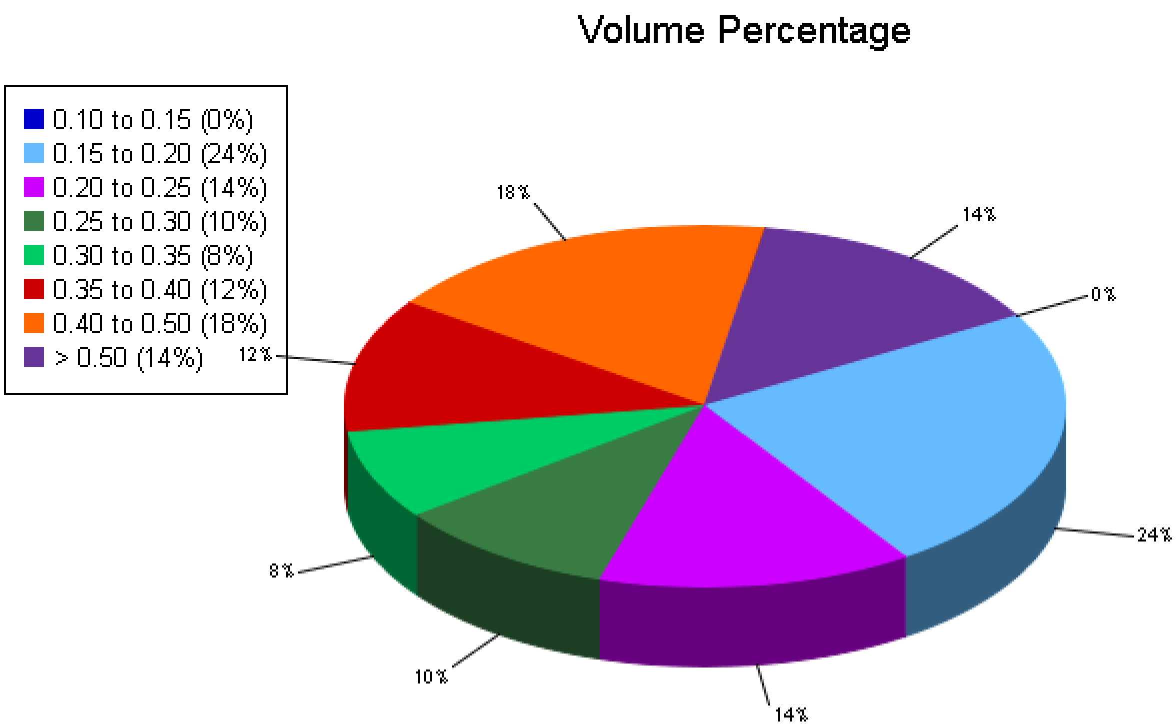
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
After Membrane
Sampled - 7/26/2010



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PHONE: 360-254-1213 • FAX: 360-896-2106

Test Results

ChemTreat, Inc. - Visionaire WWTP

Contact: Mitch Kaufman
Title:
Sampled: Wednesday, 9/1/2010

2 Samples

	SAMPLE ID	Permeate	Mixed Liquid				
1	pH						
2	Conductivity (MMHS)						
3	Free Halogen (PPM)						
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)						
6	Calcium (PPM)						
7	Magnesium (PPM)						
8	Molybdenum (PPM)						
9	Zinc (PPM)						
10	Total Iron (PPM)						
11	Manganese (PPM)						
12	Copper (PPM)						
13	Aluminum (PPM)						
14	Silica (PPM)						
15	Nickel (PPM)						
16	Vanadium (PPM)						
17	Sodium (PPM)						
18	Potassium (PPM)						
19	Chloride (PPM)						
20	Bromide (PPM)						
21	Nitrite (PPM)						
22	Nitrate (PPM)						
23	Ammonia (PPM)						
24	Phosphonate (PPM)						
25	Ortho Phosphate (PPM)						
26	Total Phosphate (PPM)						
27	Sulfite (PPM)						
28	Sulfate (PPM)						
29	Total Azole (PPM)						
30	Glycol (PPM)						
31	Glycol E/P (%)						
32	Turbidity (NTU)	0.1900	4,530.0				
33	Aerobic Bacteria (CELLS/ML)						
34	Primary Organism						
35	Secondary Organism						
36	DEAE (PPM)						
37	Morpholine (PPM)						
38	Cyclohexylamine (PPM)						

A READING OF '0' IS LESS THAN TEST LIMITS AND NOT NECESSARILY ZERO

Thomas M. Laronge, Inc.
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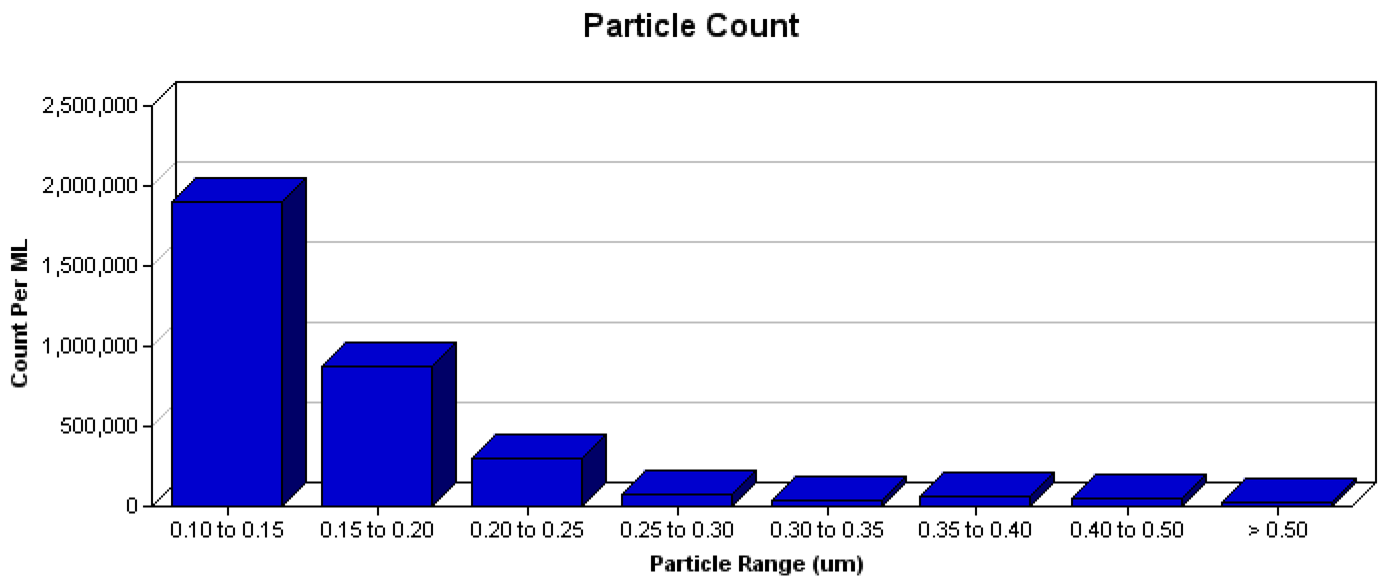
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate
Sampled - 9/1/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	1,900,213	878,718	300,185	79,064	32,721	63,136	50,019	27,820
Percent of Total	57.0%	26.4%	9.0%	2.4%	1.0%	1.9%	1.5%	0.8%

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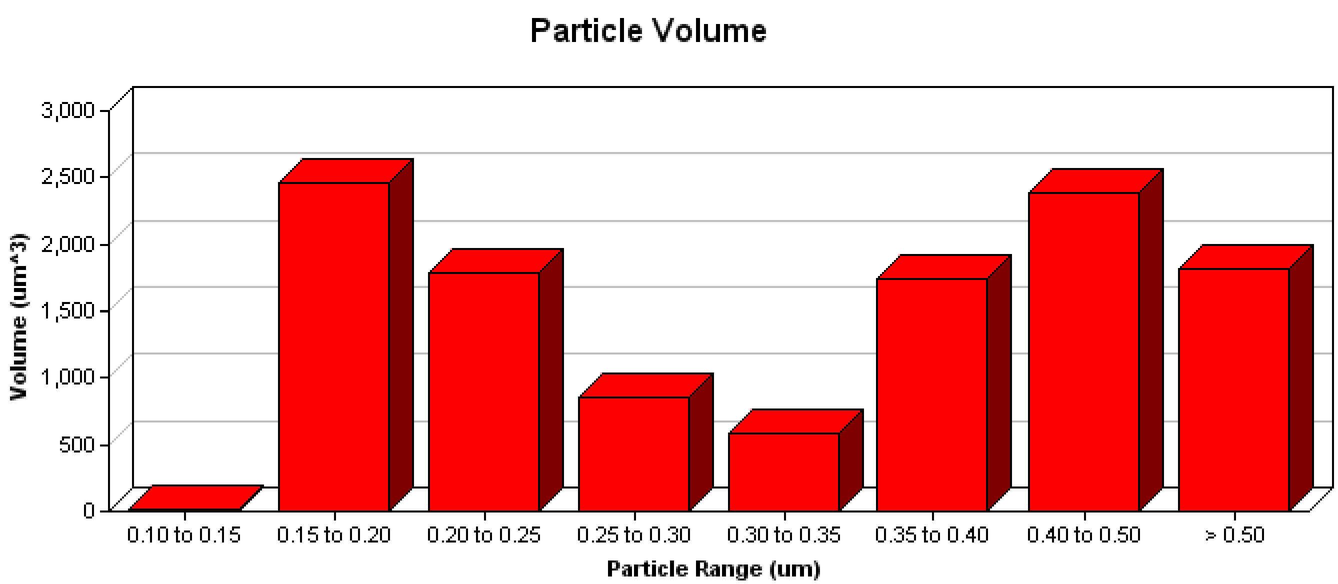
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate
Sampled - 9/1/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (μm^3)	15.55	2,465.82	1,790.34	860.94	588.13	1,743.29	2,386.55	1,820.81

* Volume calculated as average particle size sphere.

Thomas M. Laronge, Inc.
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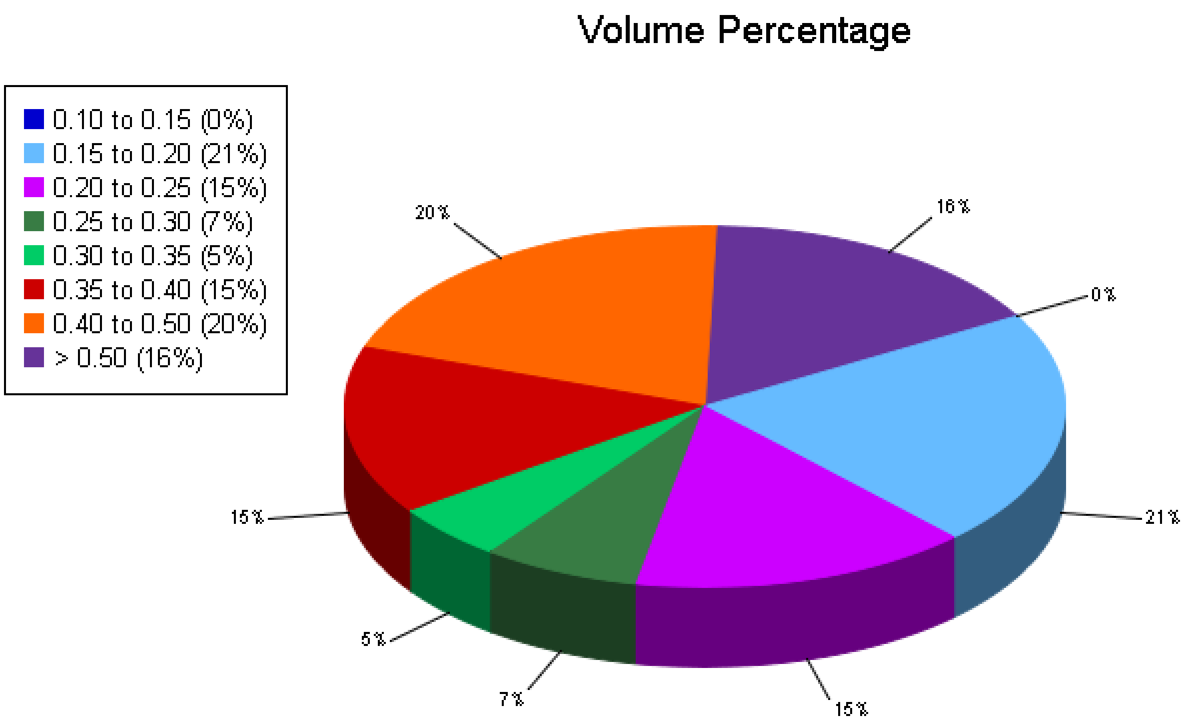
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate
Sampled - 9/1/2010



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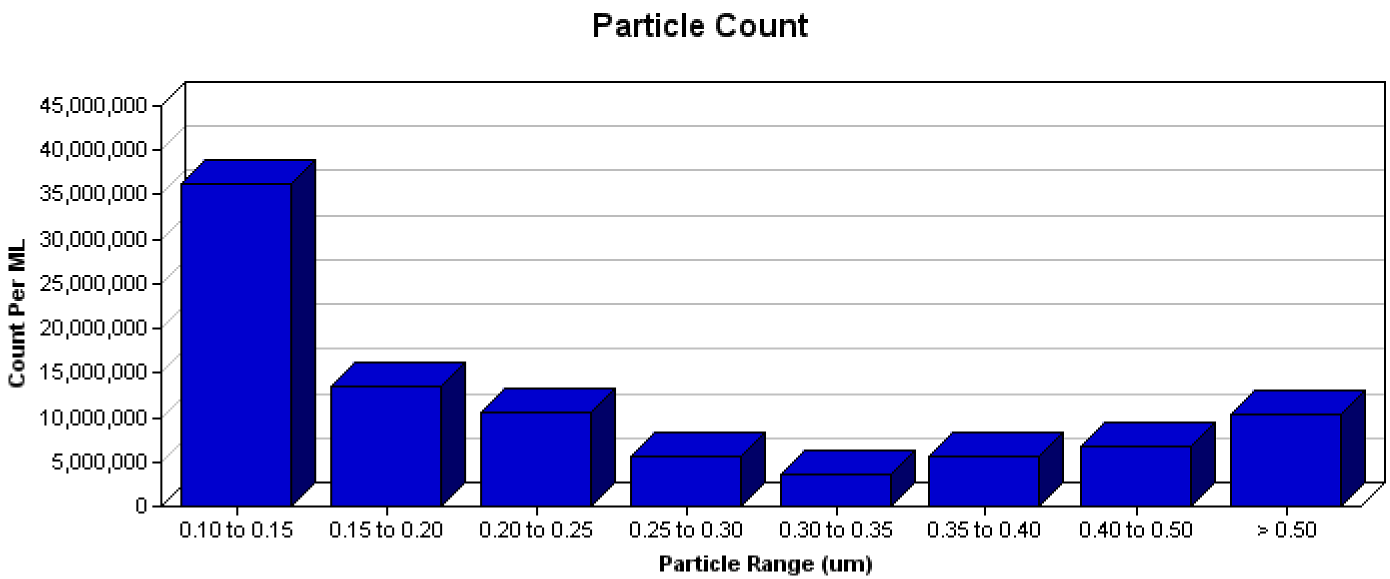
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid
Sampled - 9/1/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	36,319,708	13,550,819	10,504,784	5,592,802	3,600,056	5,610,093	6,666,983	10,434,902
Percent of Total	39.4%	14.7%	11.4%	6.1%	3.9%	6.1%	7.2%	11.3%

Thomas M. Laronge, Inc.
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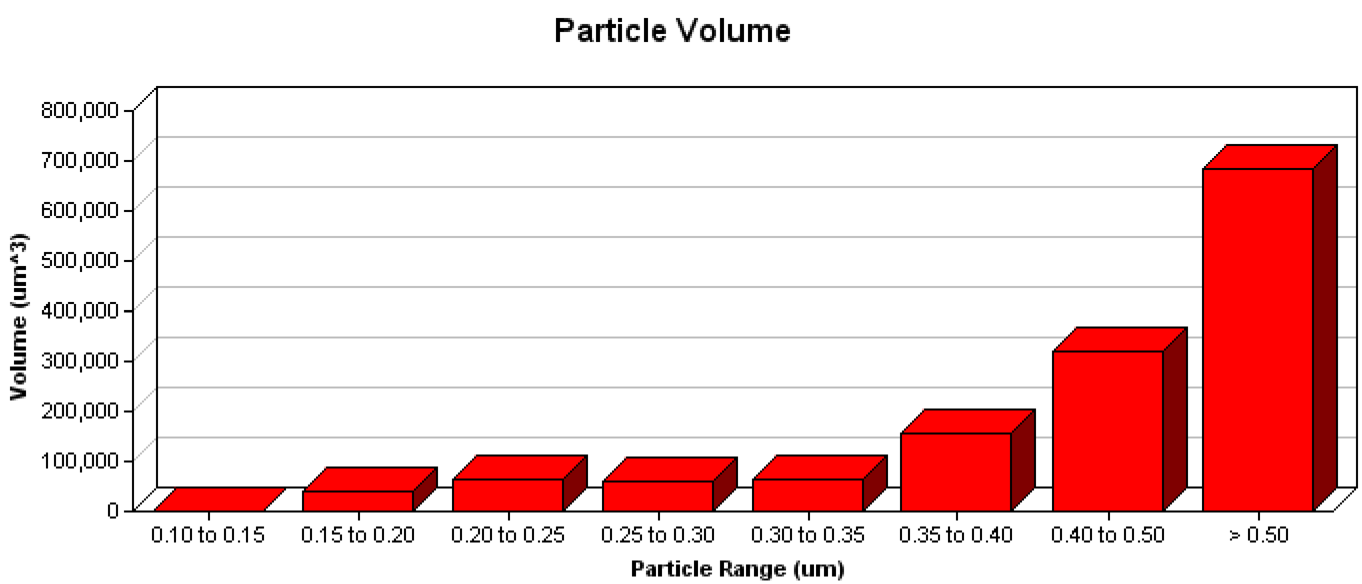
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid
Sampled - 9/1/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	297.14	38,025.79	62,651.75	60,901.23	64,707.98	154,903.92	318,101.28	682,962.60

* Volume calculated as average particle size sphere.

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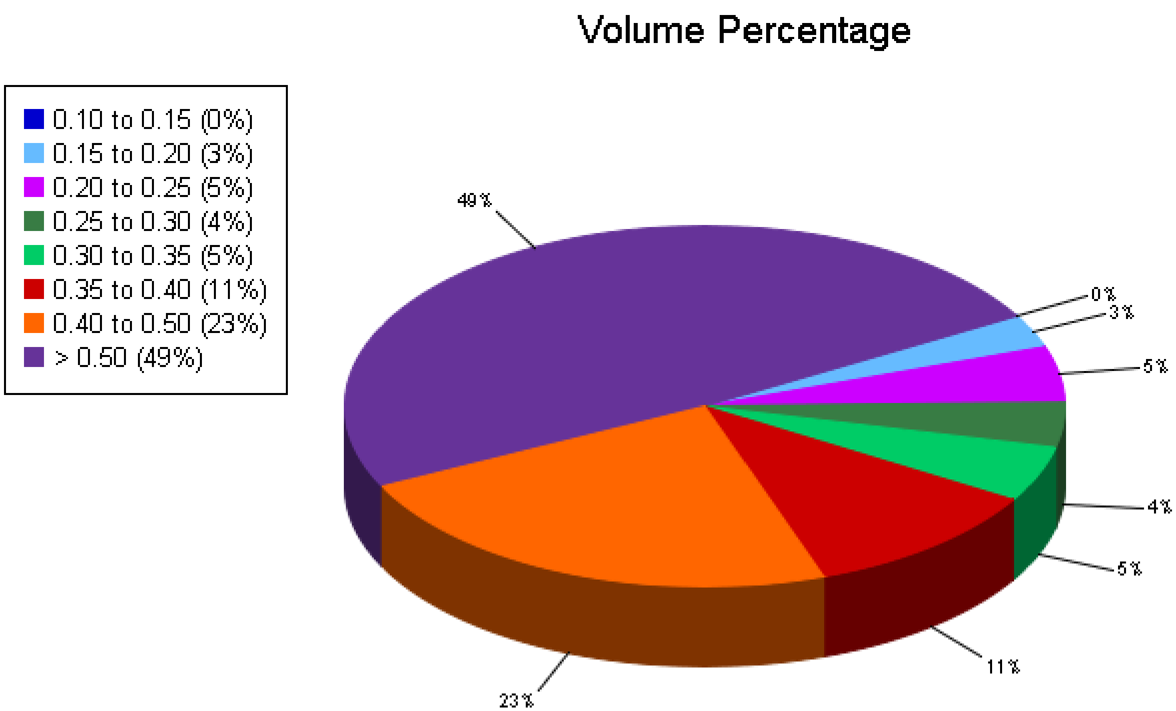
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid
Sampled - 9/1/2010



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Test Results

ChemTreat, Inc. - Visionaire WWTP

Contact: Mitch Kaufman
Title:
Sampled: Monday, 9/20/2010

3 Samples

	SAMPLE ID	Mixed Liquid	Permeate Pump #1	Permeate Pump #2			
	Date/Time Sampled	9/20/2010 @ 11:00 am	9/20/2010 @ 11:00 am	9/20/2010 @ 11:00 am			
1	pH						
2	Conductivity (MMHS)						
3	Free Halogen (PPM)						
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)						
6	Calcium (PPM)						
7	Magnesium (PPM)						
8	Molybdenum (PPM)						
9	Zinc (PPM)						
10	Total Iron (PPM)						
11	Manganese (PPM)						
12	Copper (PPM)						
13	Aluminum (PPM)						
14	Silica (PPM)						
15	Nickel (PPM)						
16	Vanadium (PPM)						
17	Sodium (PPM)						
18	Potassium (PPM)						
19	Chloride (PPM)						
20	Bromide (PPM)						
21	Nitrite (PPM)						
22	Nitrate (PPM)						
23	Ammonia (PPM)						
24	Phosphonate (PPM)						
25	Ortho Phosphate (PPM)						
26	Total Phosphate (PPM)						
27	Sulfite (PPM)						
28	Sulfate (PPM)						
29	Total Azole (PPM)						
30	Glycol (PPM)						
31	Glycol E/P (%)						
32	Turbidity (NTU)	5,120.0	0.0000	0.0000			
33	Aerobic Bacteria (CELLS/ML)						
34	Primary Organism						
35	Secondary Organism						
36	DEAE (PPM)						
37	Morpholine (PPM)						
38	Cyclohexylamine (PPM)						

A READING OF '0' IS LESS THAN TEST LIMITS AND NOT NECESSARILY ZERO

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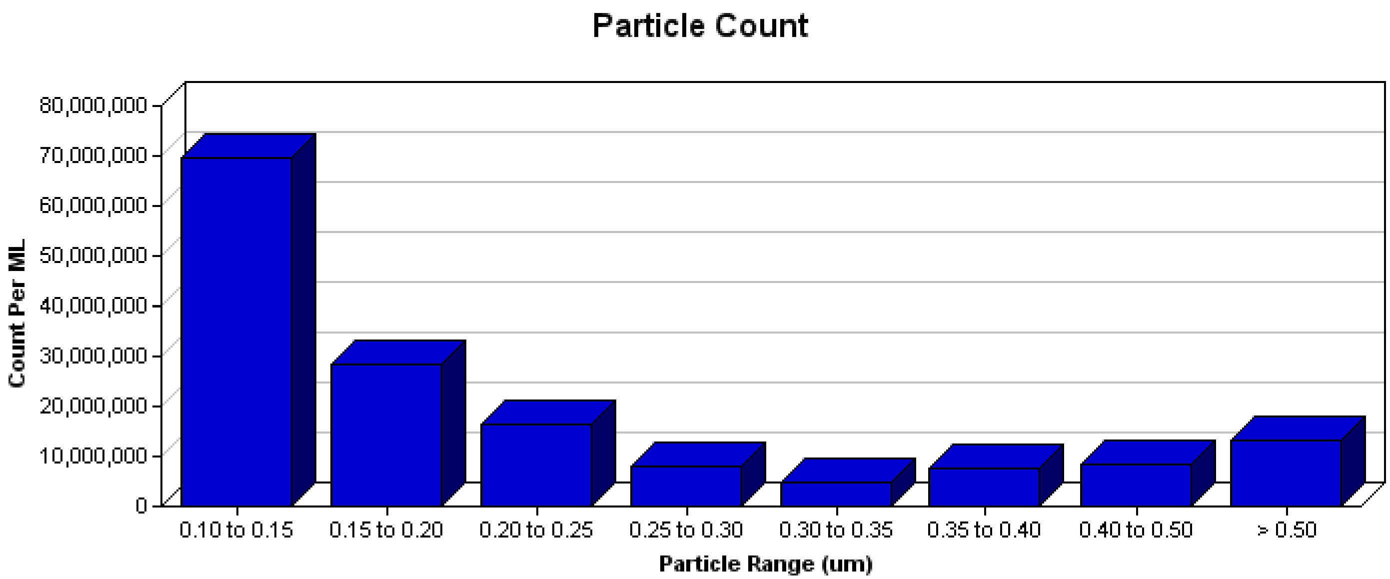
MAILING ADDRESS: P.O. BOX 820448 VANCOUVER, WA 98682-0009
PHONE: 360-254-1213 • FAX: 360-896-2106

Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid
Sampled - 9/20/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	69,440,656	28,404,198	16,284,180	7,850,671	4,799,594	7,749,808	8,377,315	13,337,567
Percent of Total	44.4%	18.2%	10.4%	5.0%	3.1%	5.0%	5.4%	8.5%

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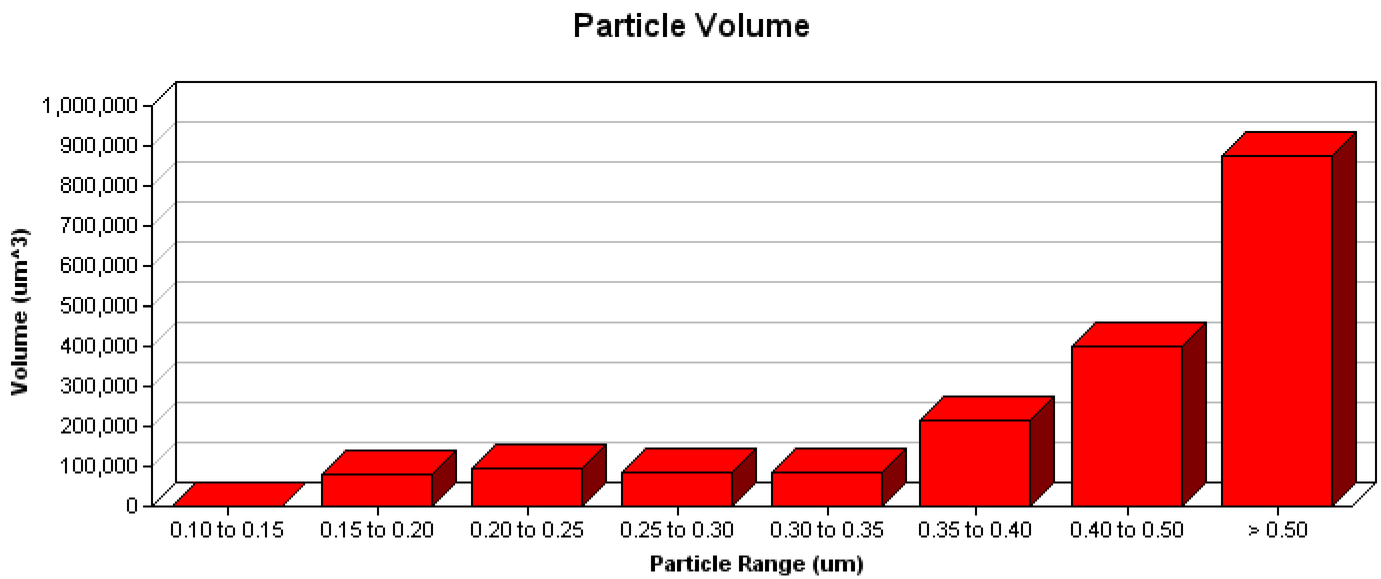
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid
Sampled - 9/20/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	568.11	79,706.77	97,120.74	85,487.65	86,268.67	213,984.97	399,706.23	872,941.54

* Volume calculated as average particle size sphere.

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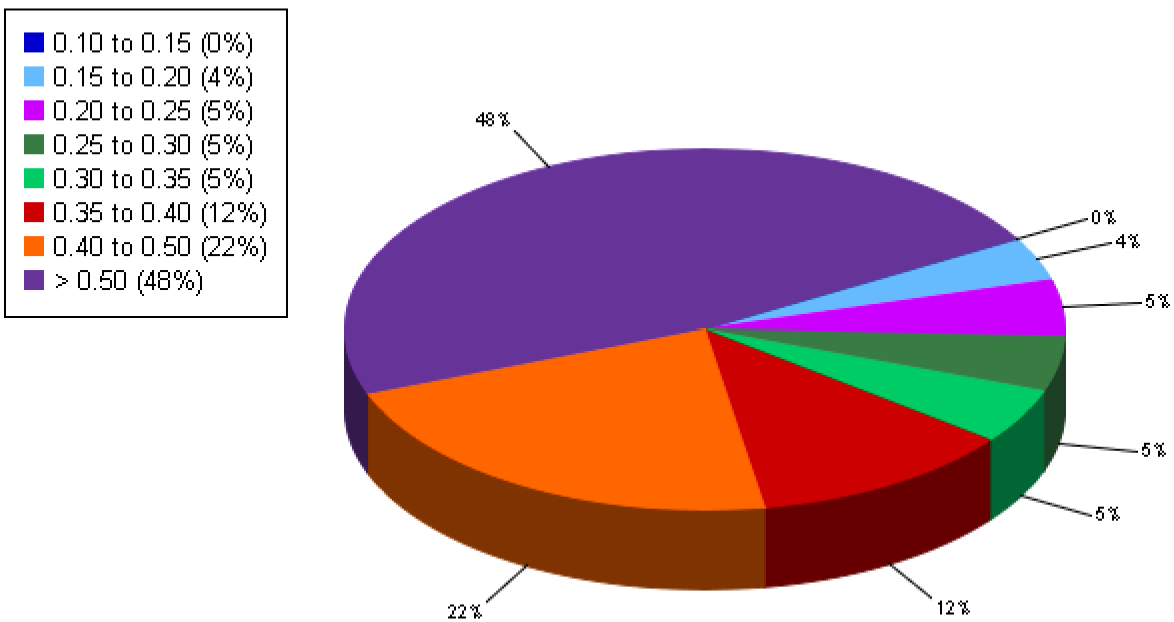
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid
Sampled - 9/20/2010

Volume Percentage



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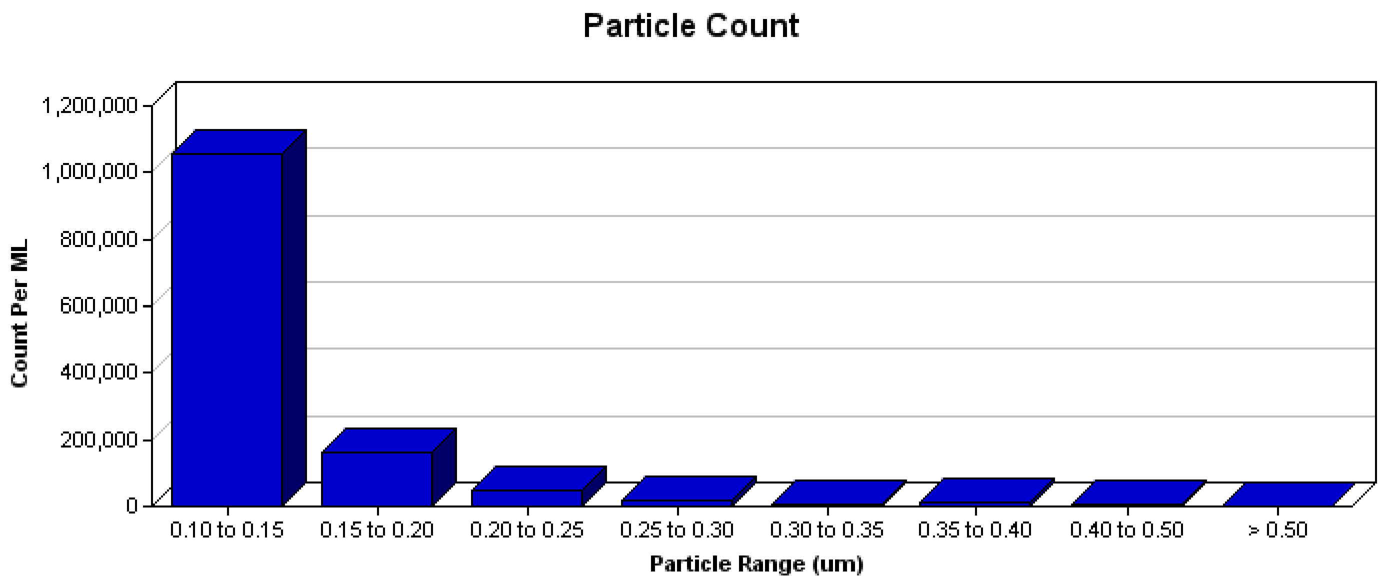
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #1
Sampled - 9/20/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	1,056,563	163,815	50,810	15,229	7,037	14,254	5,016	2,436
Percent of Total	80.3%	12.5%	3.9%	1.2%	0.5%	1.1%	0.4%	0.2%

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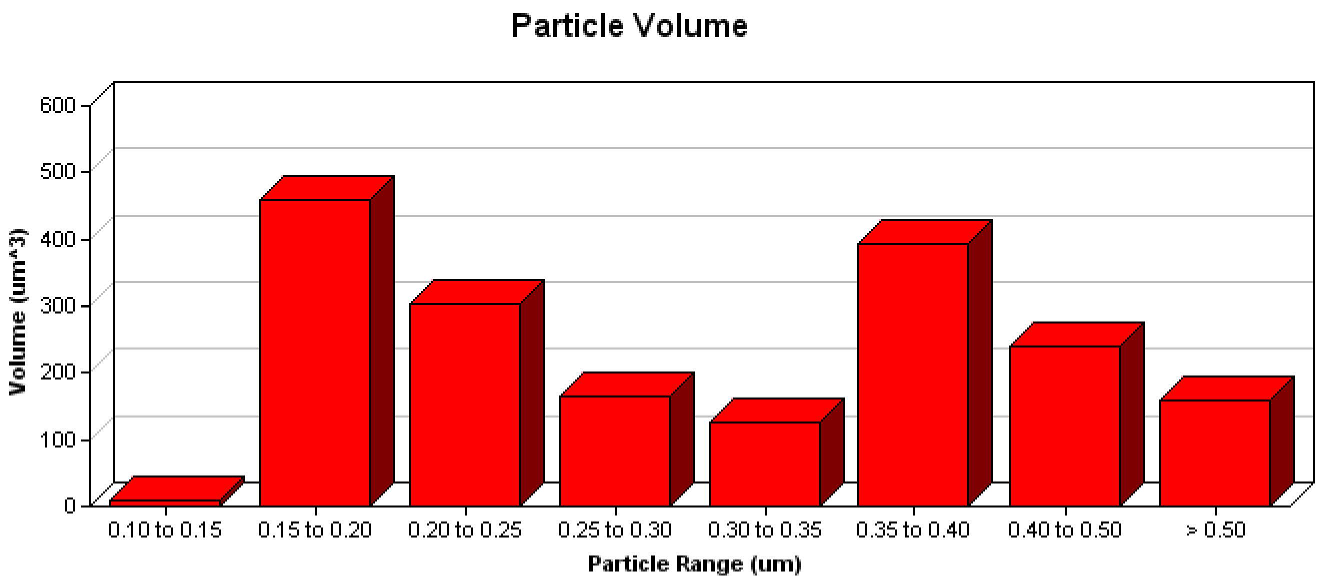
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #1
Sampled - 9/20/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	8.64	459.69	303.04	165.83	126.48	393.58	239.33	159.42

* Volume calculated as average particle size sphere.

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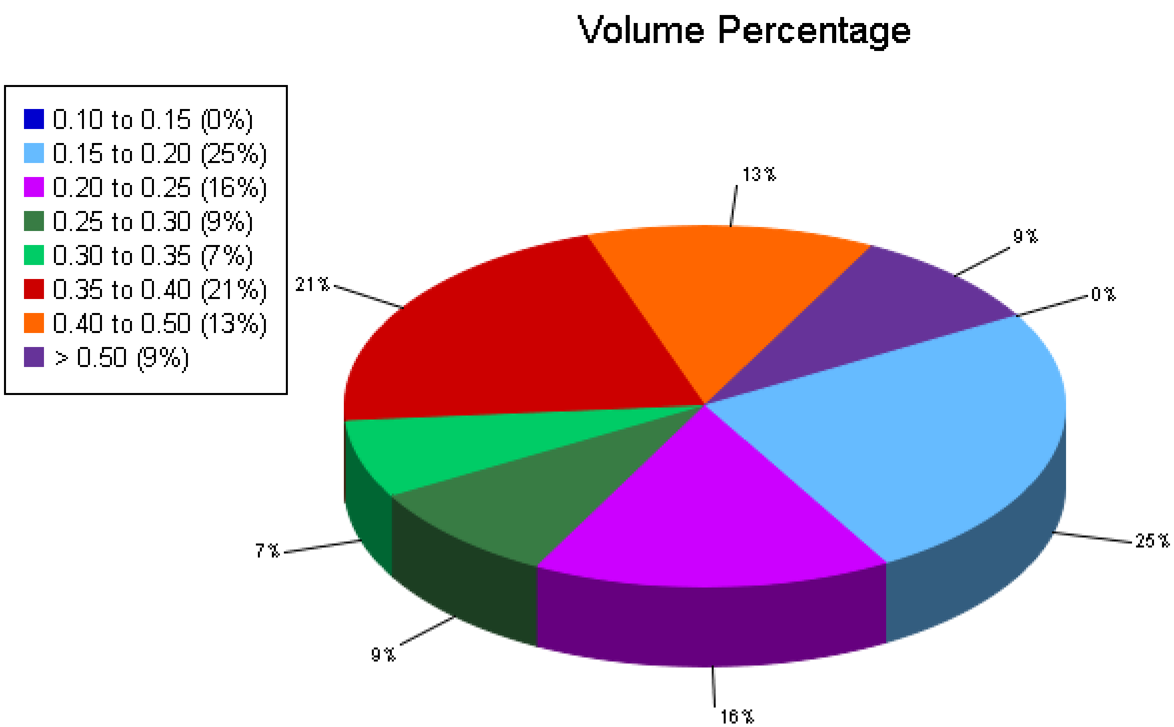
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #1
Sampled - 9/20/2010



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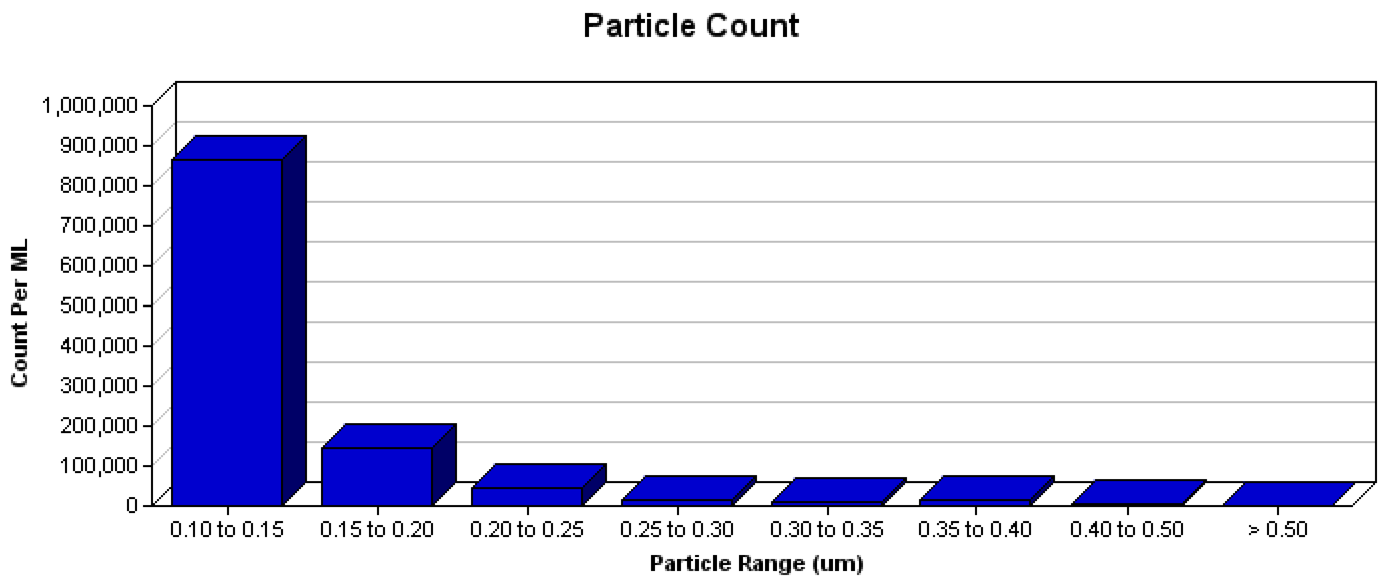
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #2
Sampled - 9/20/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	864,835	143,174	44,856	14,759	7,632	13,262	4,547	2,364
Percent of Total	78.9%	13.1%	4.1%	1.3%	0.7%	1.2%	0.4%	0.2%

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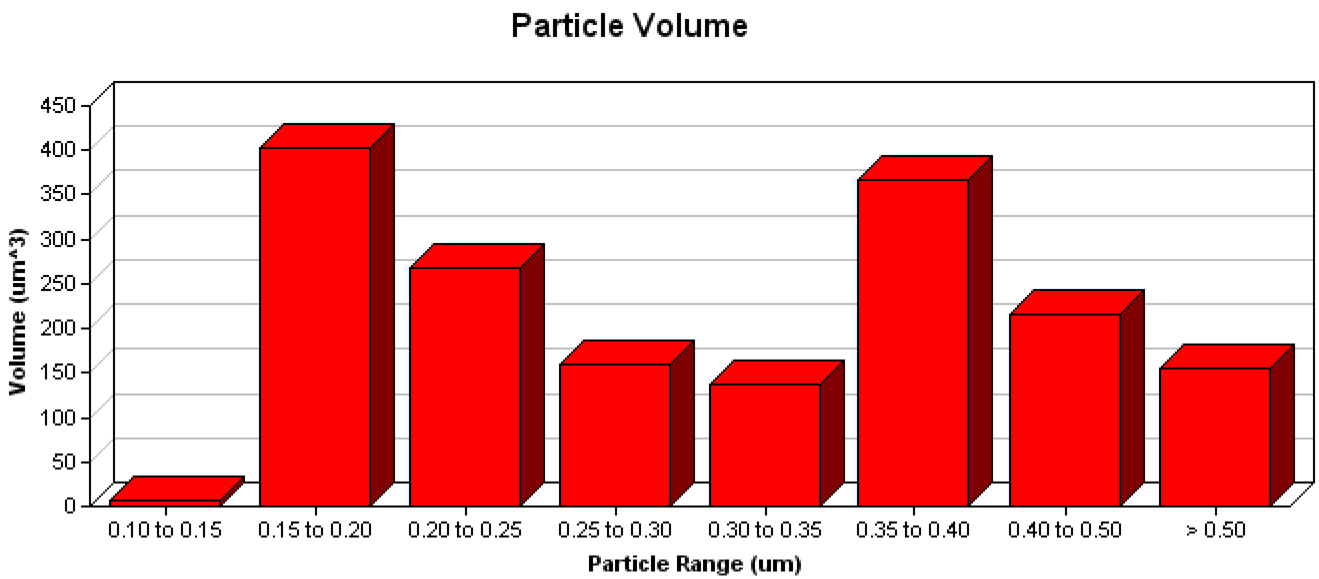
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #2
Sampled - 9/20/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	7.08	401.77	267.53	160.71	137.18	366.19	216.95	154.70

* Volume calculated as average particle size sphere.

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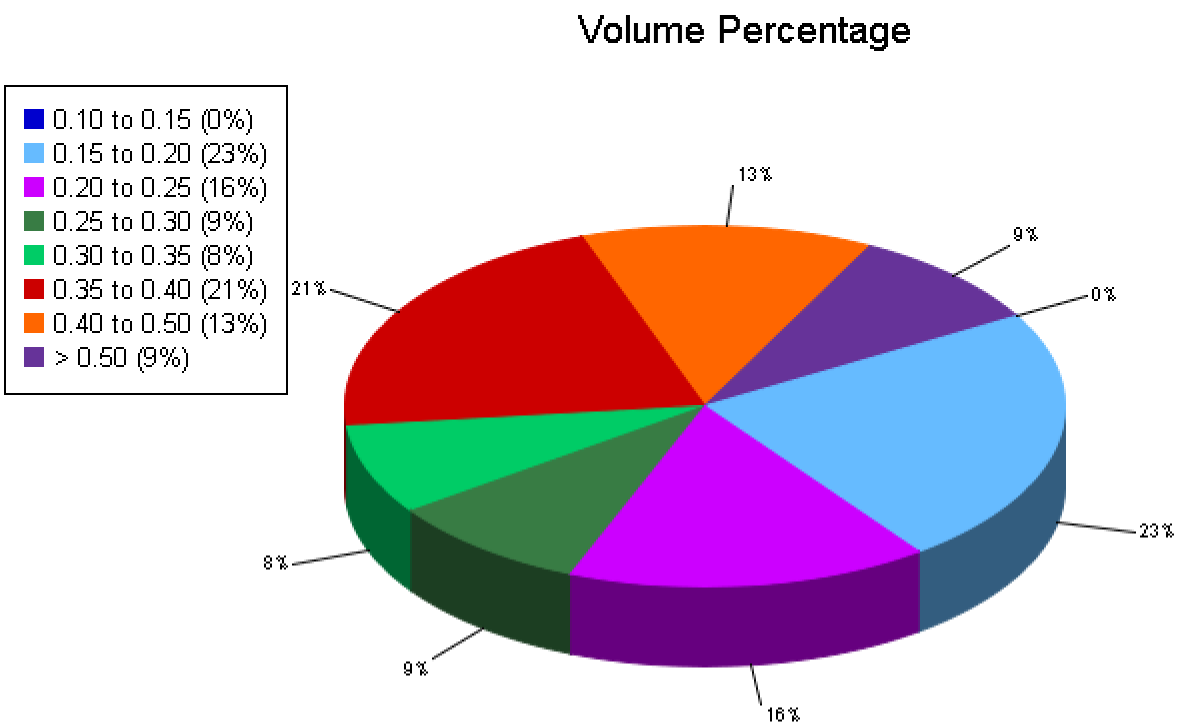
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #2
Sampled - 9/20/2010



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Test Results

ChemTreat, Inc. - Visionaire WWTP

Contact: Mitch Kaufman
Title:
Sampled: Tuesday, 10/19/2010

2 Samples

	SAMPLE ID	Permeate Pump #1	Aerator Tank				
1	pH						
2	Conductivity (MMHS)						
3	Free Halogen (PPM)						
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)						
6	Calcium (PPM)						
7	Magnesium (PPM)						
8	Molybdenum (PPM)						
9	Zinc (PPM)						
10	Total Iron (PPM)						
11	Manganese (PPM)						
12	Copper (PPM)						
13	Aluminum (PPM)						
14	Silica (PPM)						
15	Nickel (PPM)						
16	Vanadium (PPM)						
17	Sodium (PPM)						
18	Potassium (PPM)						
19	Chloride (PPM)						
20	Bromide (PPM)						
21	Nitrite (PPM)						
22	Nitrate (PPM)						
23	Ammonia (PPM)						
24	Phosphonate (PPM)						
25	Ortho Phosphate (PPM)						
26	Total Phosphate (PPM)						
27	Sulfite (PPM)						
28	Sulfate (PPM)						
29	Total Azole (PPM)						
30	Glycol (PPM)						
31	Glycol E/P (%)						
32	Turbidity (NTU)	0.0000	7,472.0				
33	Aerobic Bacteria (CELLS/ML)						
34	Primary Organism						
35	Secondary Organism						
36	DEAE (PPM)						
37	Morpholine (PPM)						
38	Cyclohexylamine (PPM)						

A READING OF '0' IS LESS THAN TEST LIMITS AND NOT NECESSARILY ZERO

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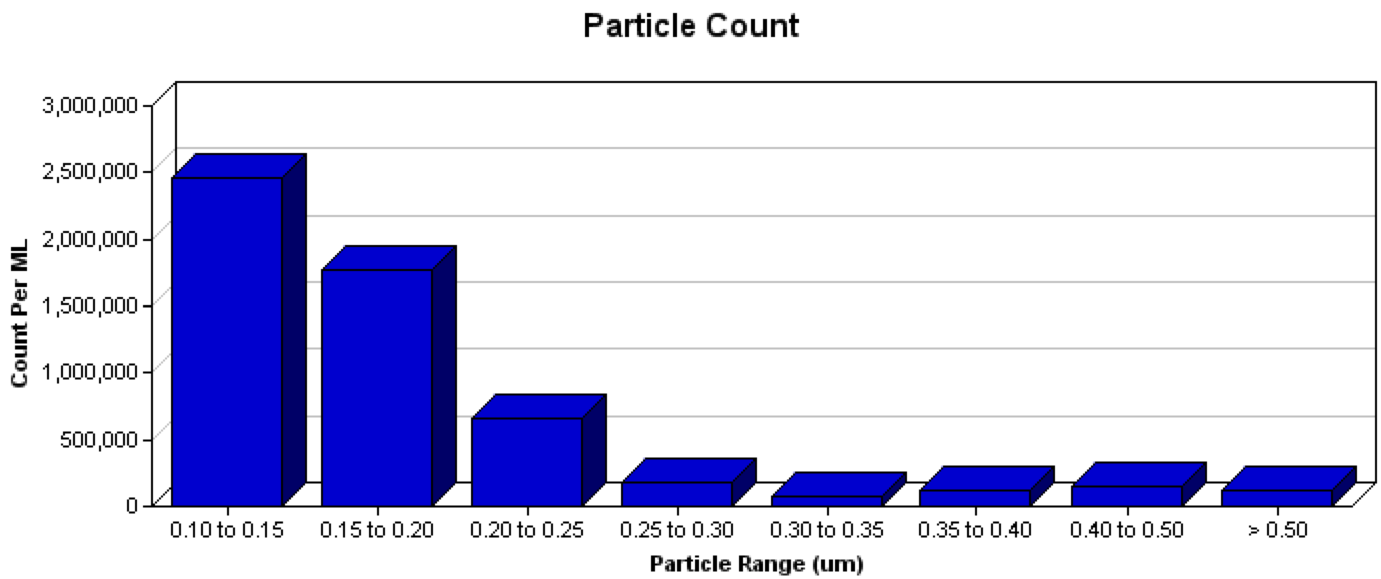
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #1
Sampled - 10/19/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	2,467,011	1,763,970	665,059	181,516	74,681	113,745	147,252	116,560
Percent of Total	44.6%	31.9%	12.0%	3.3%	1.4%	2.1%	2.7%	2.1%

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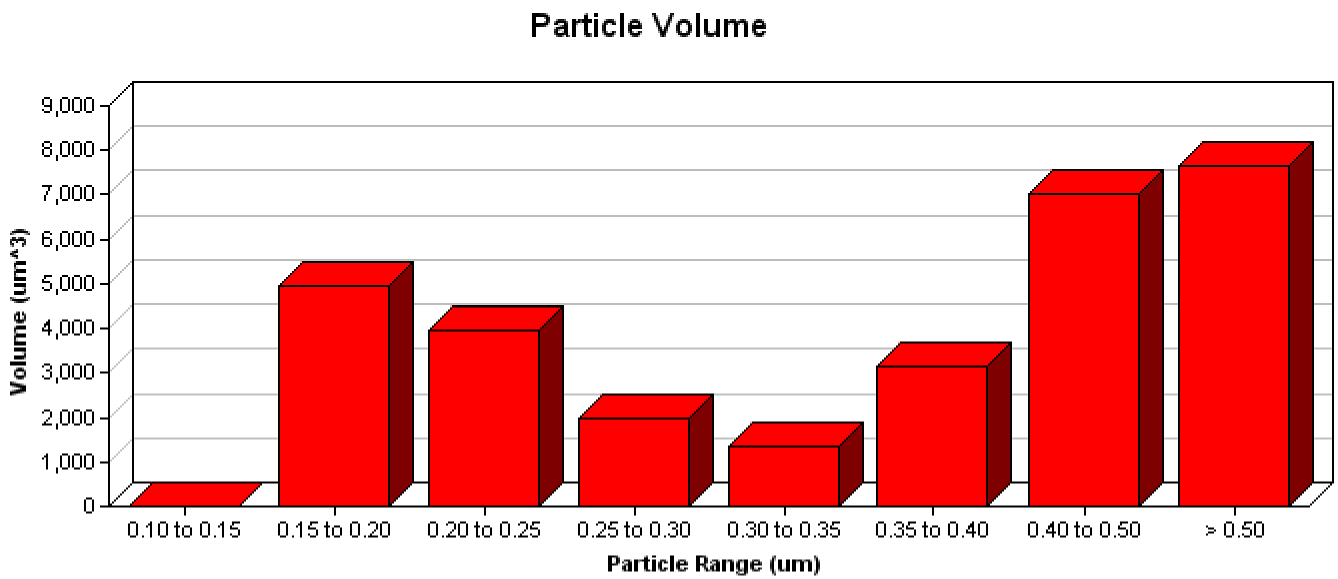
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #1
Sampled - 10/19/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	20.18	4,949.98	3,966.49	1,976.57	1,342.33	3,140.69	7,025.82	7,628.83

* Volume calculated as average particle size sphere.

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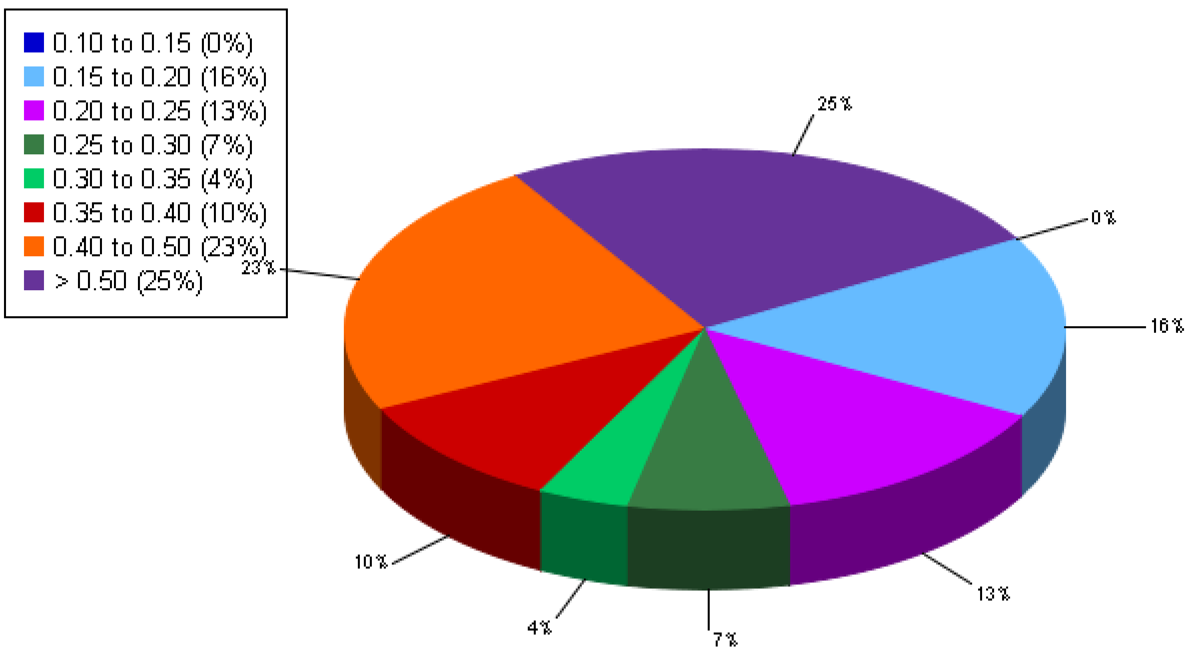
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #1
Sampled - 10/19/2010

Volume Percentage



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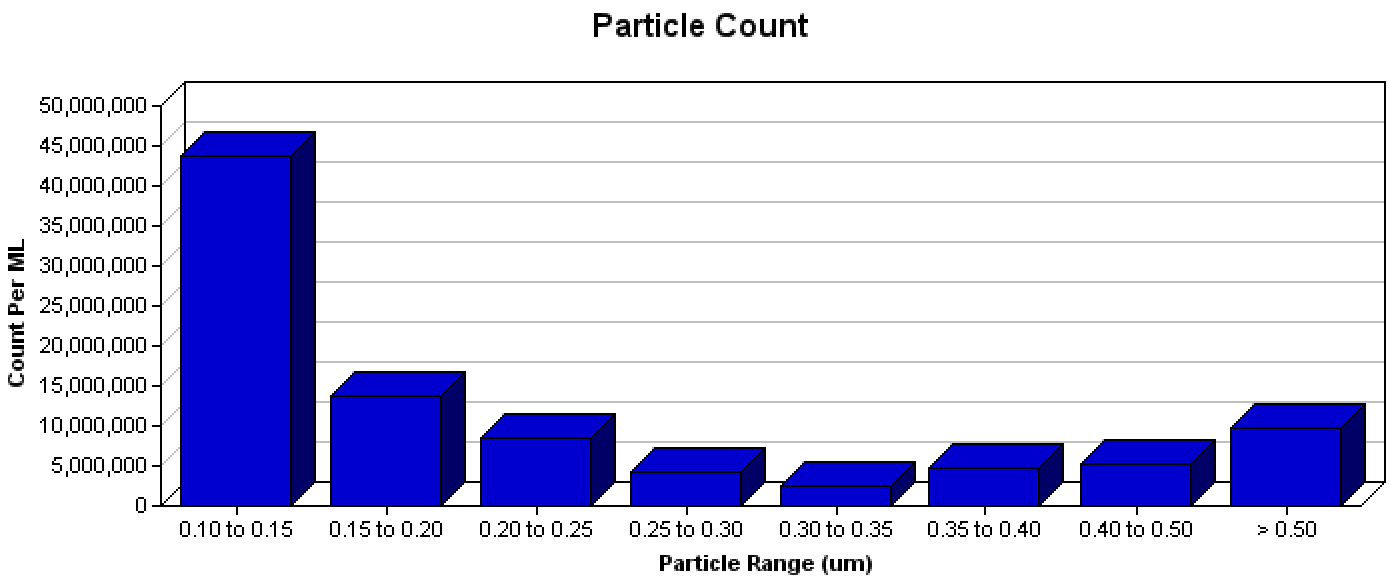
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Aerator Tank
Sampled - 10/19/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	43,629,328	13,761,188	8,460,166	4,146,872	2,525,875	4,721,065	5,164,138	9,864,310
Percent of Total	47.3%	14.9%	9.2%	4.5%	2.7%	5.1%	5.6%	10.7%

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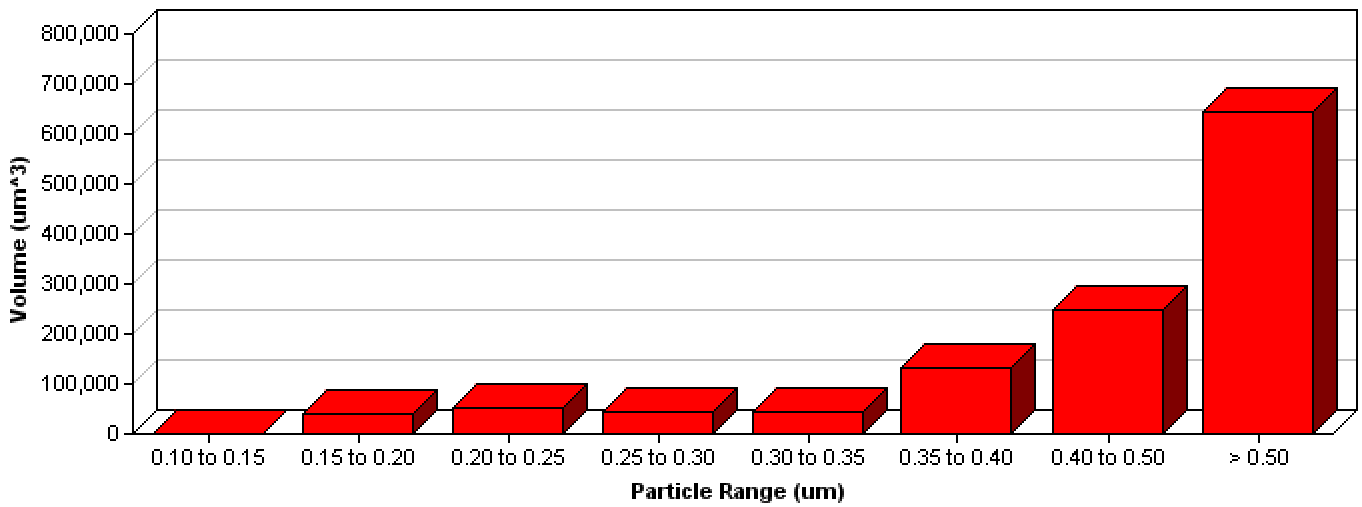
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Aerator Tank
Sampled - 10/19/2010

Particle Volume



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (μm^3)	356.94	38,616.12	50,457.41	45,156.19	45,400.48	130,356.39	246,396.15	645,617.45

* Volume calculated as average particle size sphere.

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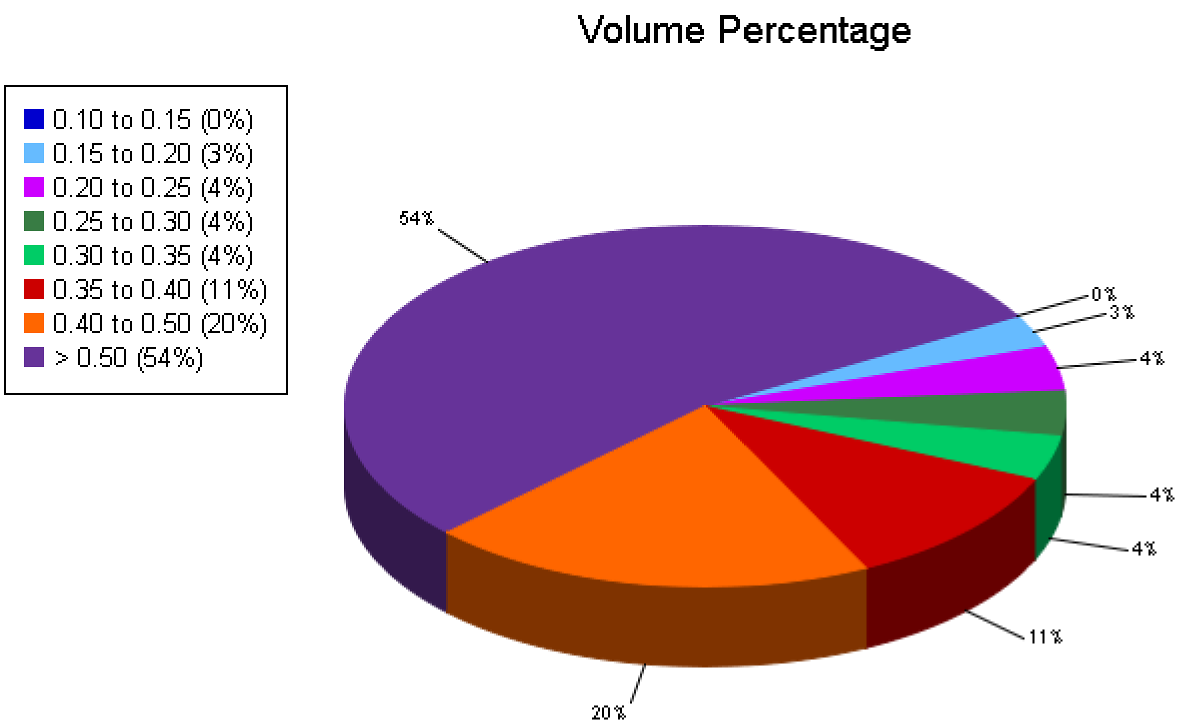
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Aerator Tank
Sampled - 10/19/2010



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Test Results

ChemTreat, Inc. - P.O. 1139352

Contact: Mitchell F. Kaufman
Title: Senior District Manager
Sampled: Wednesday, 11/17/2010

2 Samples

	SAMPLE ID	M.L.S.S	Permeate Pump #2				
1	pH						
2	Conductivity (MMHS)						
3	Free Halogen (PPM)						
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)						
6	Calcium (PPM)						
7	Magnesium (PPM)						
8	Molybdenum (PPM)						
9	Zinc (PPM)						
10	Total Iron (PPM)						
11	Manganese (PPM)						
12	Copper (PPM)						
13	Aluminum (PPM)						
14	Silica (PPM)						
15	Nickel (PPM)						
16	Vanadium (PPM)						
17	Sodium (PPM)						
18	Potassium (PPM)						
19	Chloride (PPM)						
20	Bromide (PPM)						
21	Nitrite (PPM)						
22	Nitrate (PPM)						
23	Ammonia (PPM)						
24	Phosphonate (PPM)						
25	Ortho Phosphate (PPM)						
26	Total Phosphate (PPM)						
27	Sulfite (PPM)						
28	Sulfate (PPM)						
29	Total Azole (PPM)						
30	Glycol (PPM)						
31	Glycol E/P (%)						
32	Turbidity (NTU)	7,150.0	0.5600				
33	Aerobic Bacteria (CELLS/ML)						
34	Primary Organism						
35	Secondary Organism						
36	DEAE (PPM)						
37	Morpholine (PPM)						
38	Cyclohexylamine (PPM)						

A READING OF '0' IS LESS THAN TEST LIMITS AND NOT NECESSARILY ZERO

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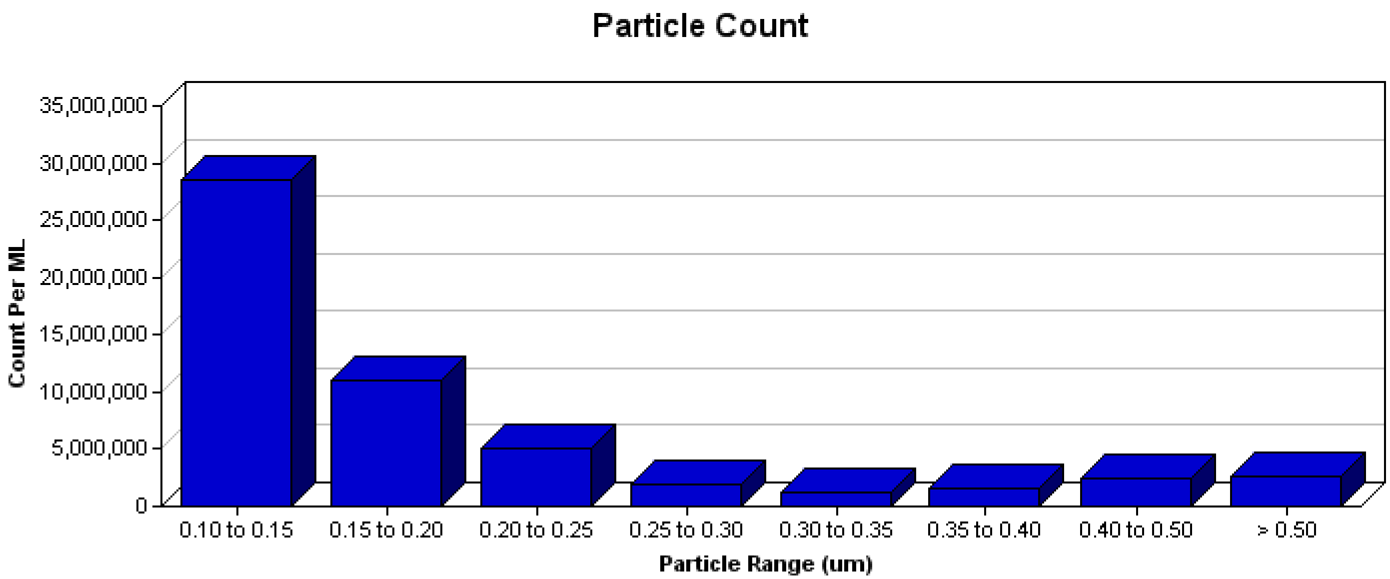
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
M.L.S.S - Small
Sampled - 11/17/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	28,467,000	10,963,100	5,104,500	2,010,000	1,144,000	1,577,000	2,457,500	2,558,500
Percent of Total	52.4%	20.2%	9.4%	3.7%	2.1%	2.9%	4.5%	4.7%

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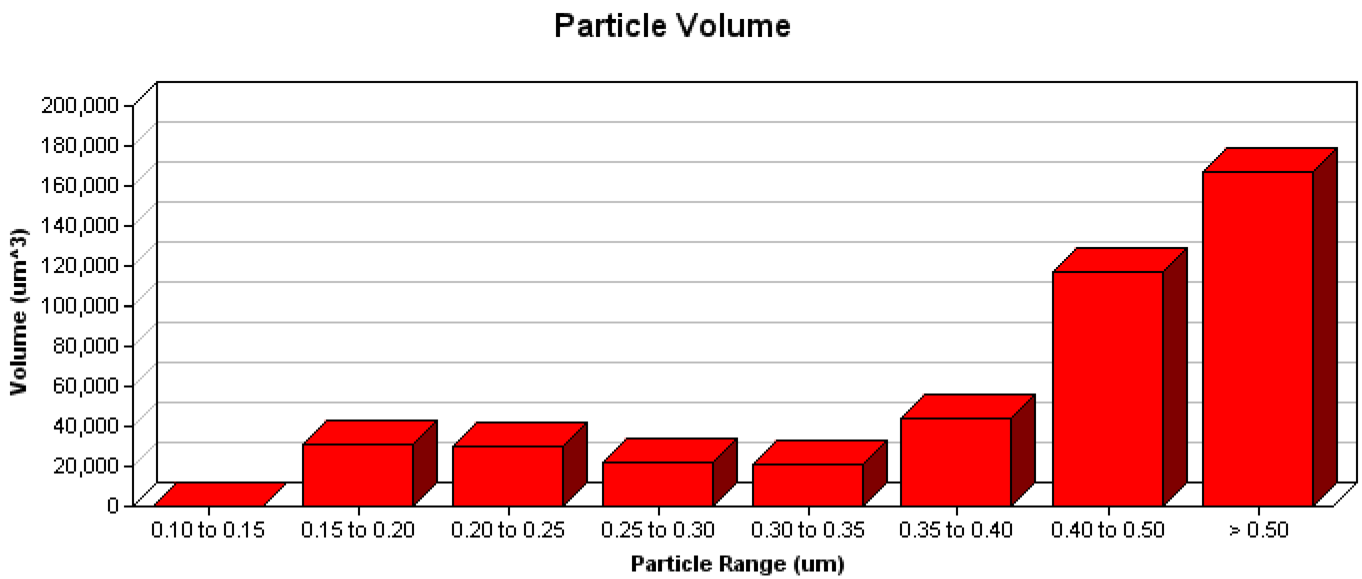
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
M.L.S.S - Small
Sampled - 11/17/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	232.90	30,764.23	30,443.83	21,887.32	20,562.44	43,543.57	117,254.52	167,453.40

* Volume calculated as average particle size sphere.

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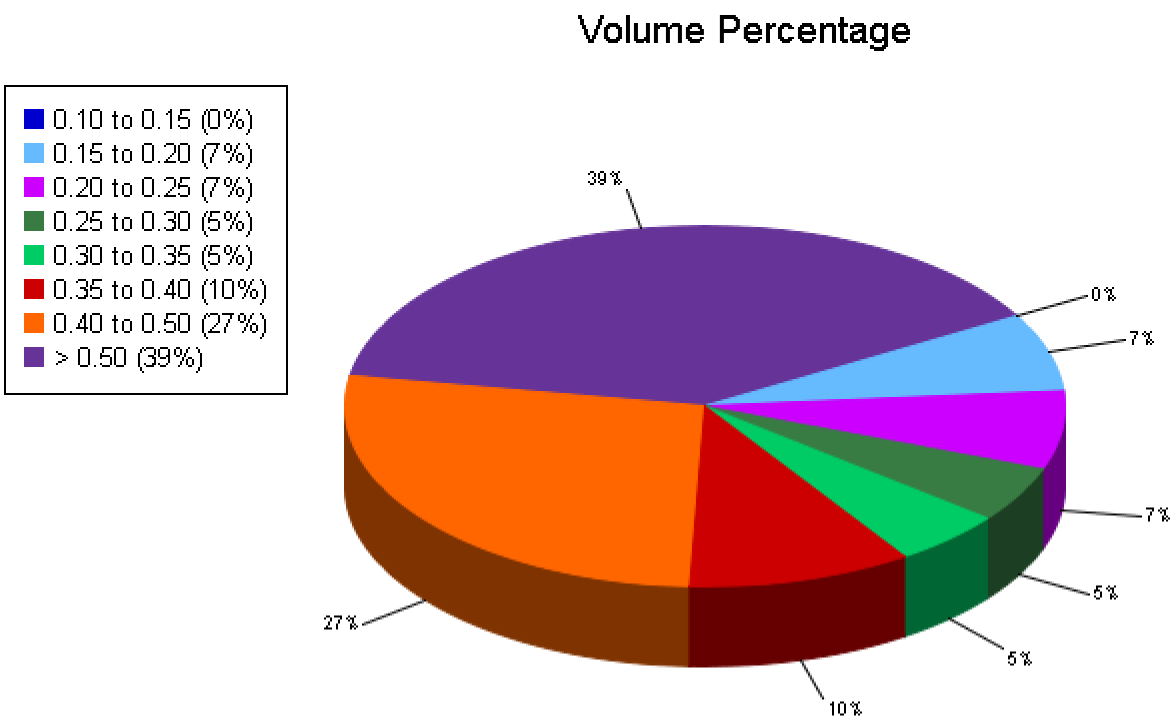
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
M.L.S.S - Small
Sampled - 11/17/2010



TML Project No. 256-10-477G

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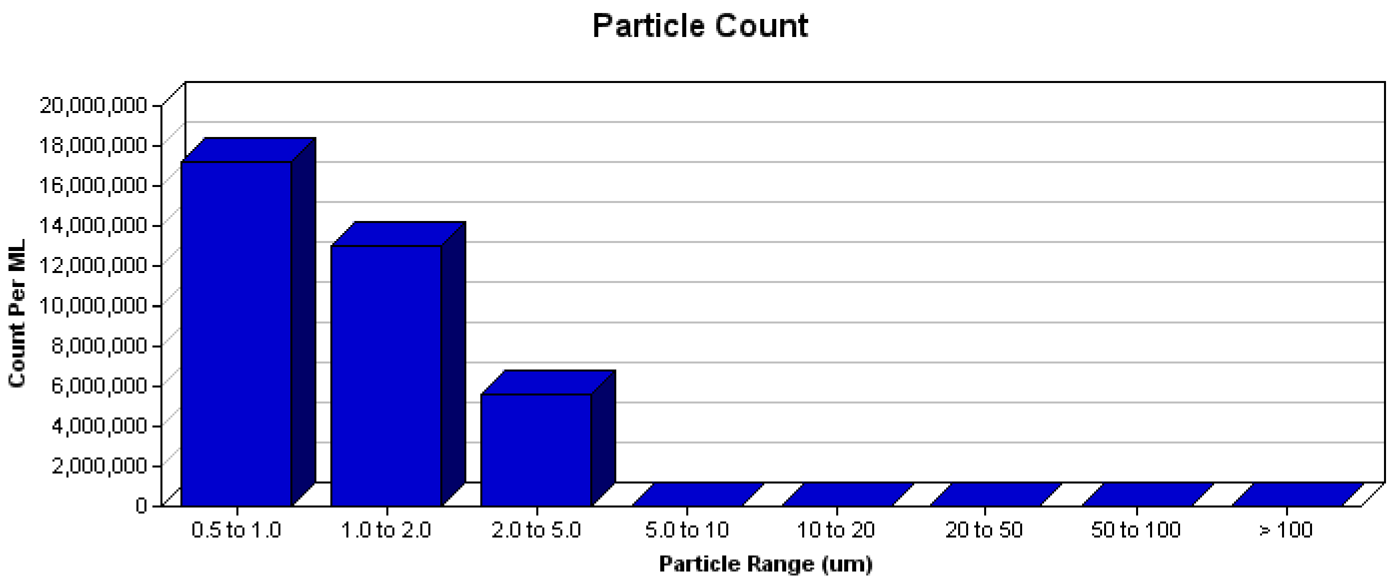
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
M.L.S.S - Large
Sampled - 11/17/2010



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Count/ml	17,223,700	12,976,800	5,575,400	36,087	12,633	1,803	0	0
Percent of Total	48.08%	36.22%	15.56%	0.10%	0.04%	0.01%	0.00%	0.00%

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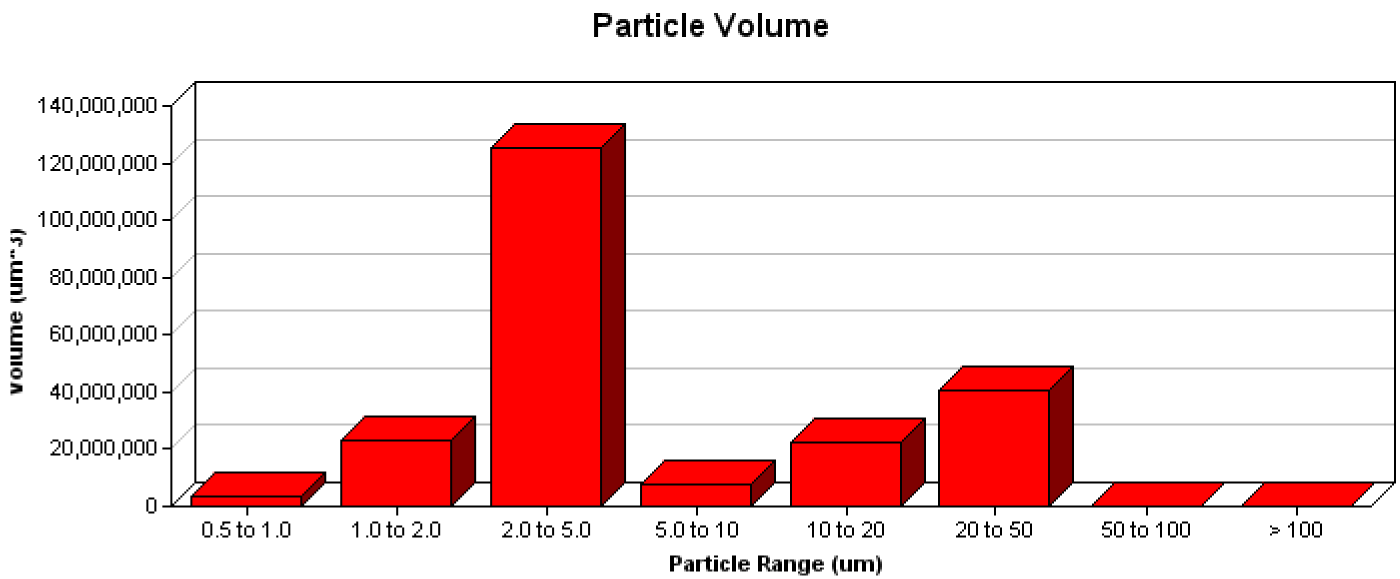
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
M.L.S.S - Large
Sampled - 11/17/2010



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Volume (μm^3)	3,804,598	22,931,894	125,163,787	7,971,372	22,324,349	40,482,810	0	0

* Volume calculated as average particle size sphere.

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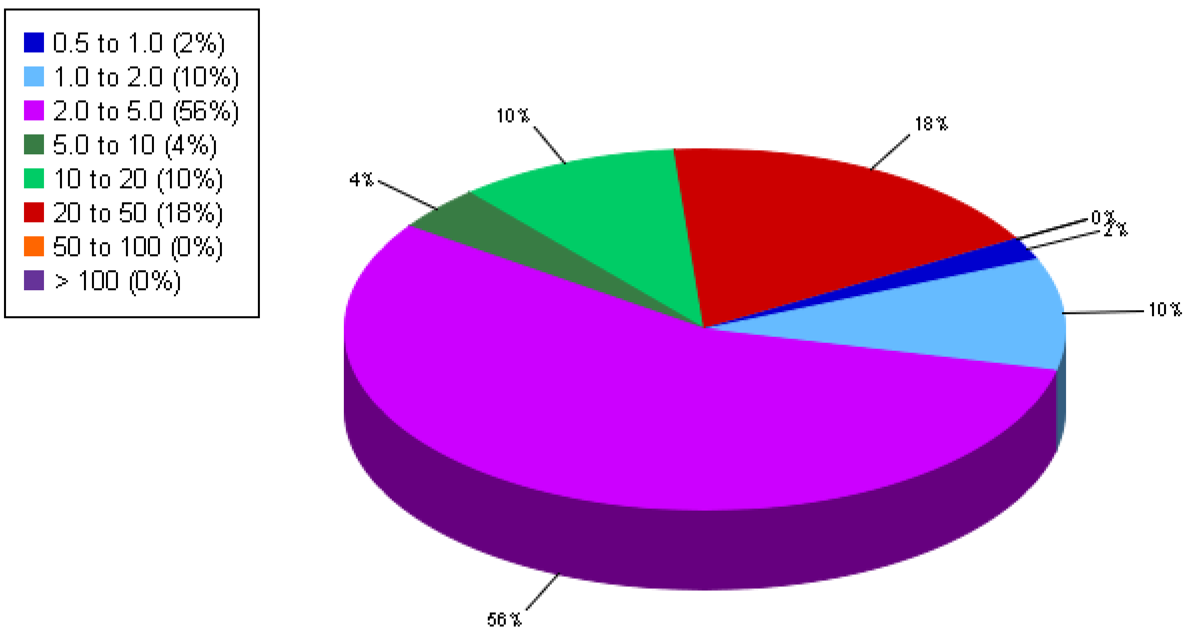
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
M.L.S.S - Large
Sampled - 11/17/2010

Volume Percentage



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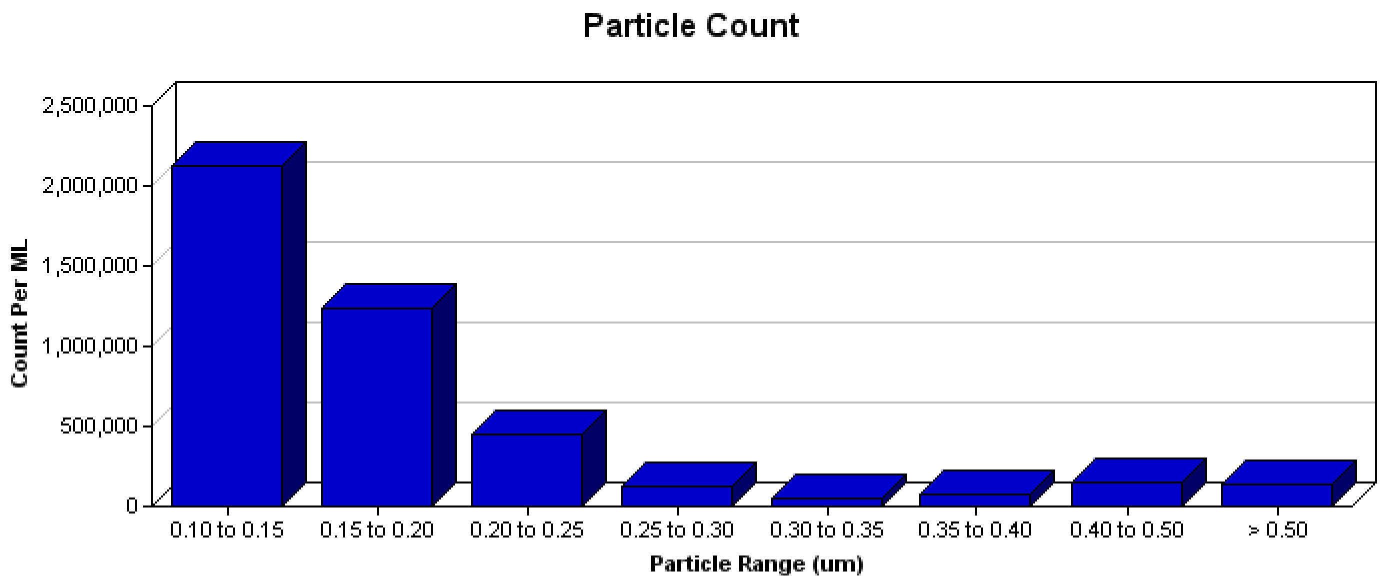
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
Permeate Pump #2 - Small
Sampled - 11/17/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	2,127,129	1,231,927	446,230	121,432	47,057	74,050	149,218	132,673
Percent of Total	49.1%	28.5%	10.3%	2.8%	1.1%	1.7%	3.4%	3.1%

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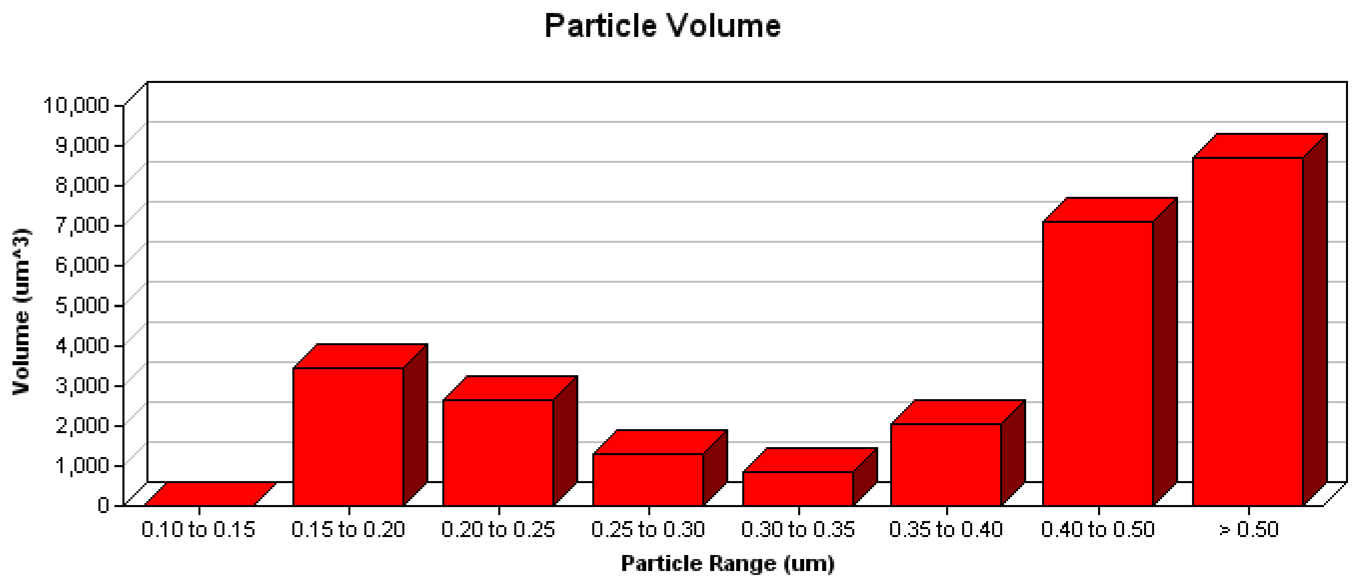
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
Permeate Pump #2 - Small
Sampled - 11/17/2010



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	17.40	3,456.99	2,661.37	1,322.30	845.81	2,044.64	7,119.63	8,683.43

* Volume calculated as average particle size sphere.

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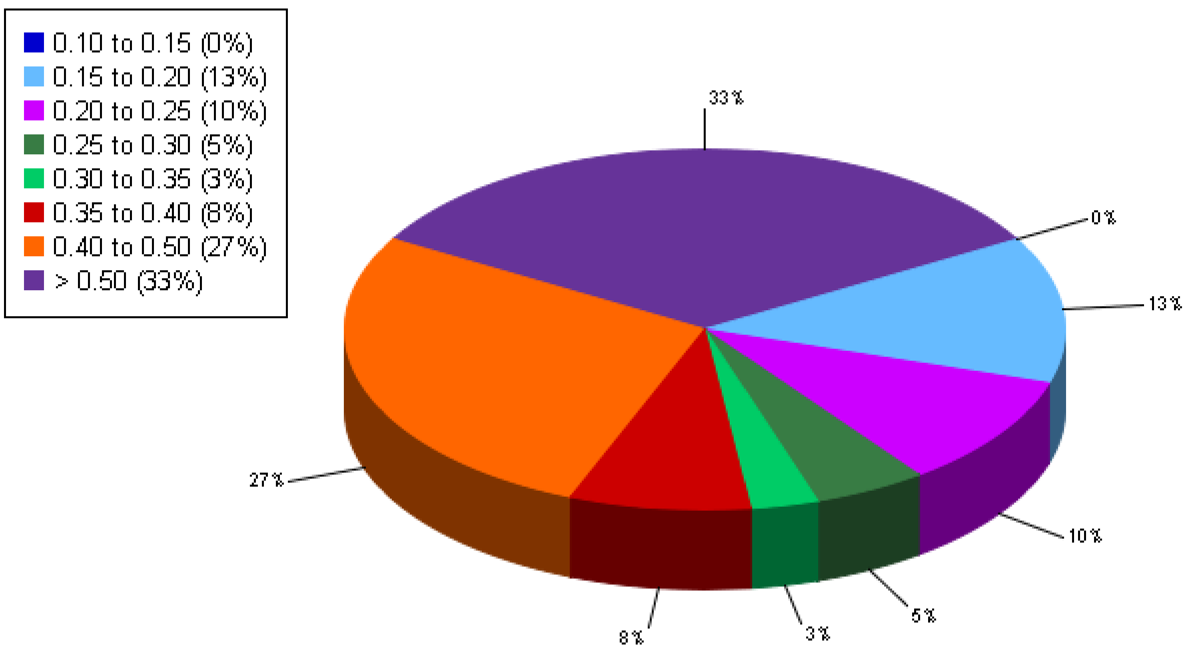
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
Permeate Pump #2 - Small
Sampled - 11/17/2010

Volume Percentage



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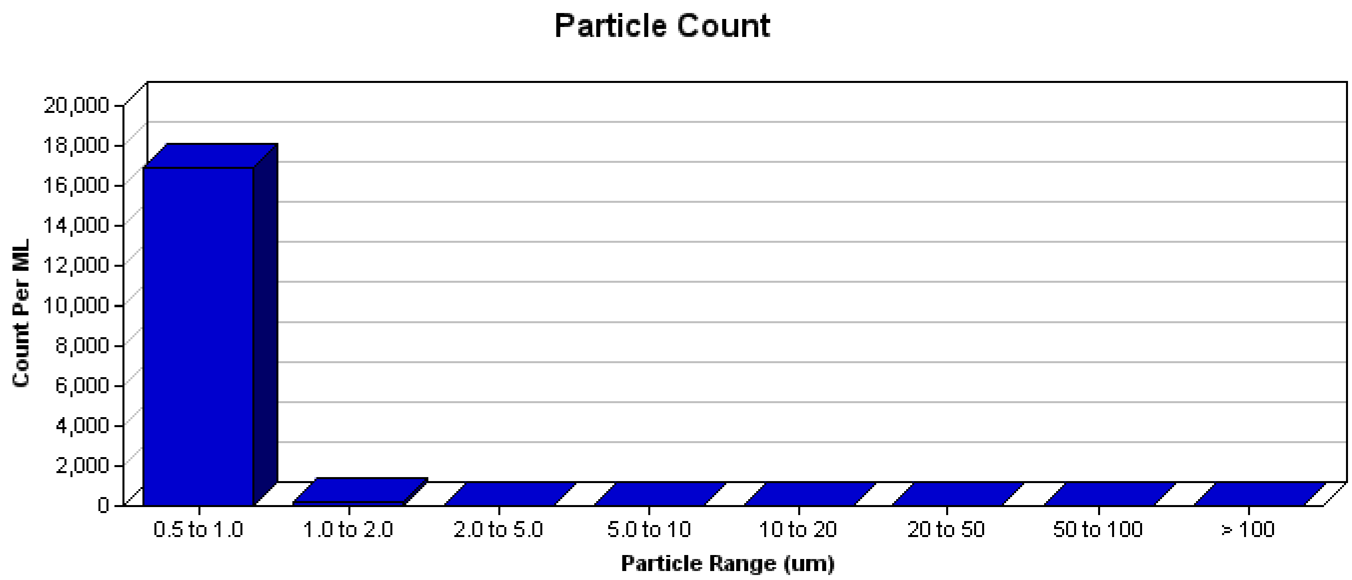
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
Permeate Pump #2 - Large
Sampled - 11/17/2010



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Count/ml	16,888	163	0	0	0	0	0	0
Percent of Total	99.05%	0.95%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

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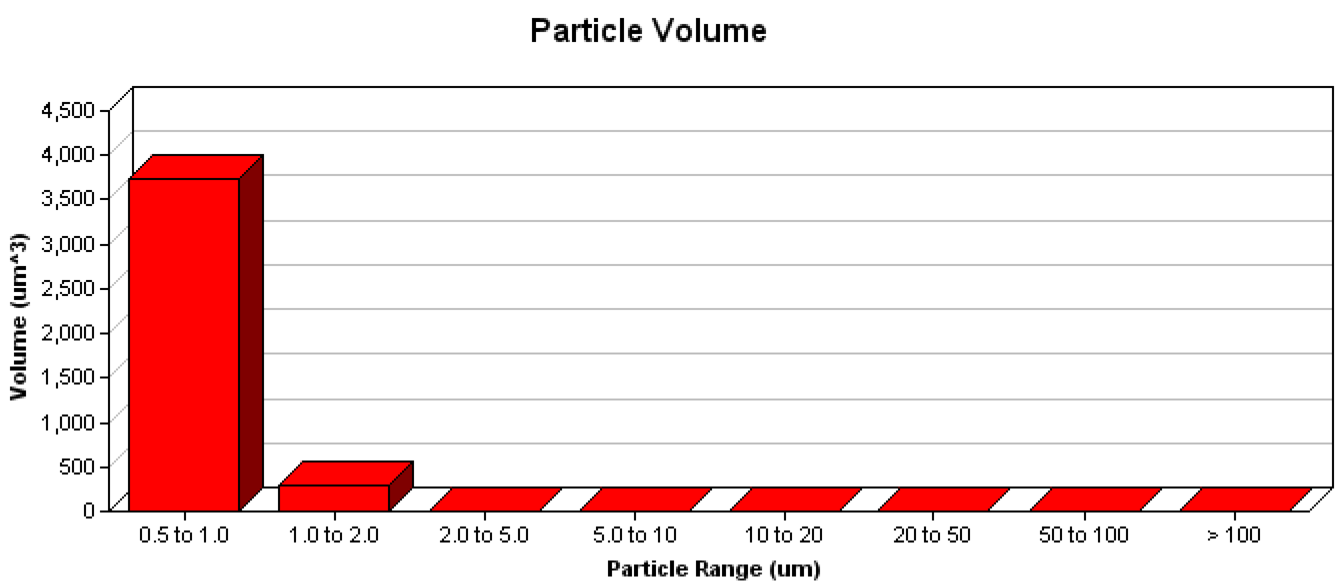
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
Permeate Pump #2 - Large
Sampled - 11/17/2010



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Volume (µm³)	3,730	287	0	0	0	0	0	0

* Volume calculated as average particle size sphere.

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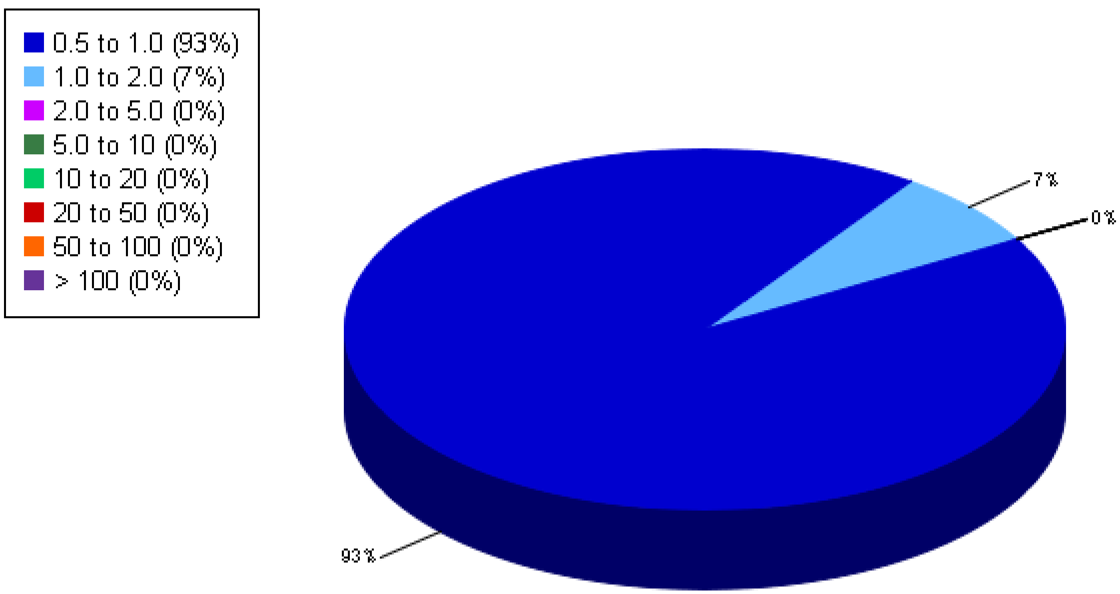
Particle Size Distribution Study

ChemTreat, Inc. - P.O. 1139352
Permeate Pump #2 - Large
Sampled - 11/17/2010

Volume Percentage



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Test Results

ChemTreat, Inc. - Visionaire WWTP

Contact: Mitch Kaufman
Title:
Sampled: Thursday, 1/27/2011

2 Samples

	SAMPLE ID	Mixed Liquid	Permeate Pump #2				
1	pH						
2	Conductivity (MMHS)						
3	Free Halogen (PPM)						
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)						
6	Calcium (PPM)						
7	Magnesium (PPM)						
8	Molybdenum (PPM)						
9	Zinc (PPM)						
10	Total Iron (PPM)						
11	Manganese (PPM)						
12	Copper (PPM)						
13	Aluminum (PPM)						
14	Silica (PPM)						
15	Nickel (PPM)						
16	Vanadium (PPM)						
17	Sodium (PPM)						
18	Potassium (PPM)						
19	Chloride (PPM)						
20	Bromide (PPM)						
21	Nitrite (PPM)						
22	Nitrate (PPM)						
23	Ammonia (PPM)						
24	Phosphonate (PPM)						
25	Ortho Phosphate (PPM)						
26	Total Phosphate (PPM)						
27	Sulfite (PPM)						
28	Sulfate (PPM)						
29	Total Azole (PPM)						
30	Glycol (PPM)						
31	Glycol E/P (%)						
32	Turbidity (NTU)	7,120.0	1.8900				
33	Aerobic Bacteria (CELLS/ML)						
34	Primary Organism						
35	Secondary Organism						
36	DEAE (PPM)						
37	Morpholine (PPM)						
38	Cyclohexylamine (PPM)						

A READING OF '0' IS LESS THAN TEST LIMITS AND NOT NECESSARILY ZERO

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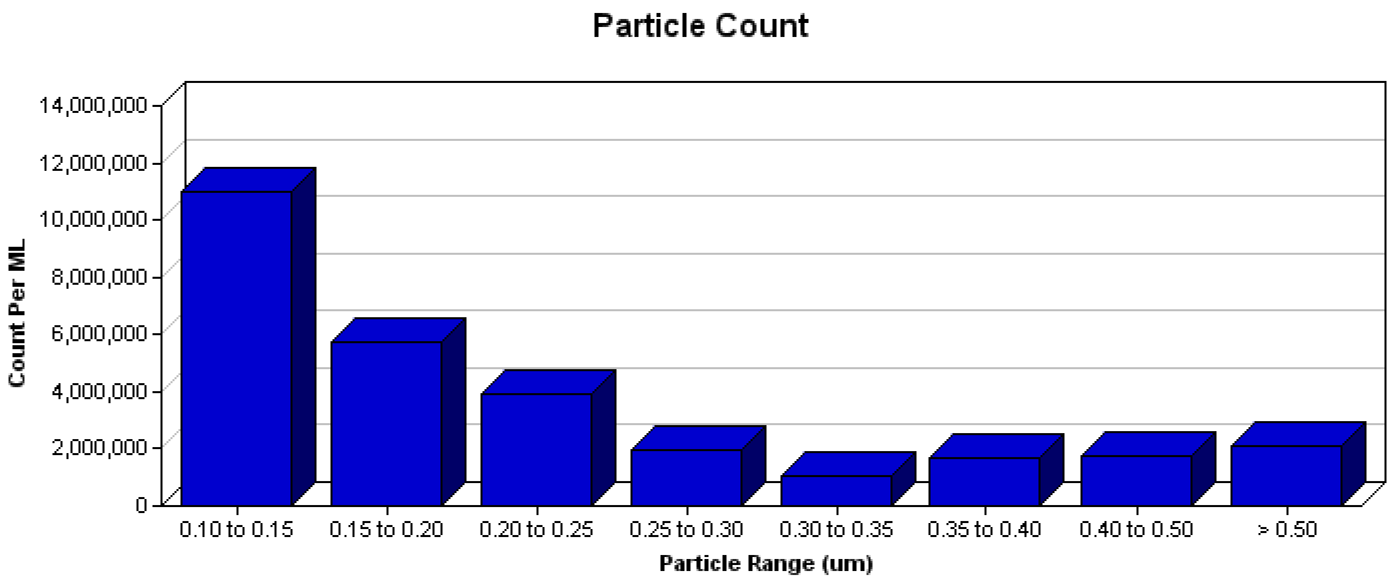
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Small
Sampled - 1/27/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	11,009,814	5,714,557	3,948,030	1,930,068	1,078,504	1,648,374	1,765,086	2,077,759
Percent of Total	37.7%	19.6%	13.5%	6.6%	3.7%	5.7%	6.1%	7.1%

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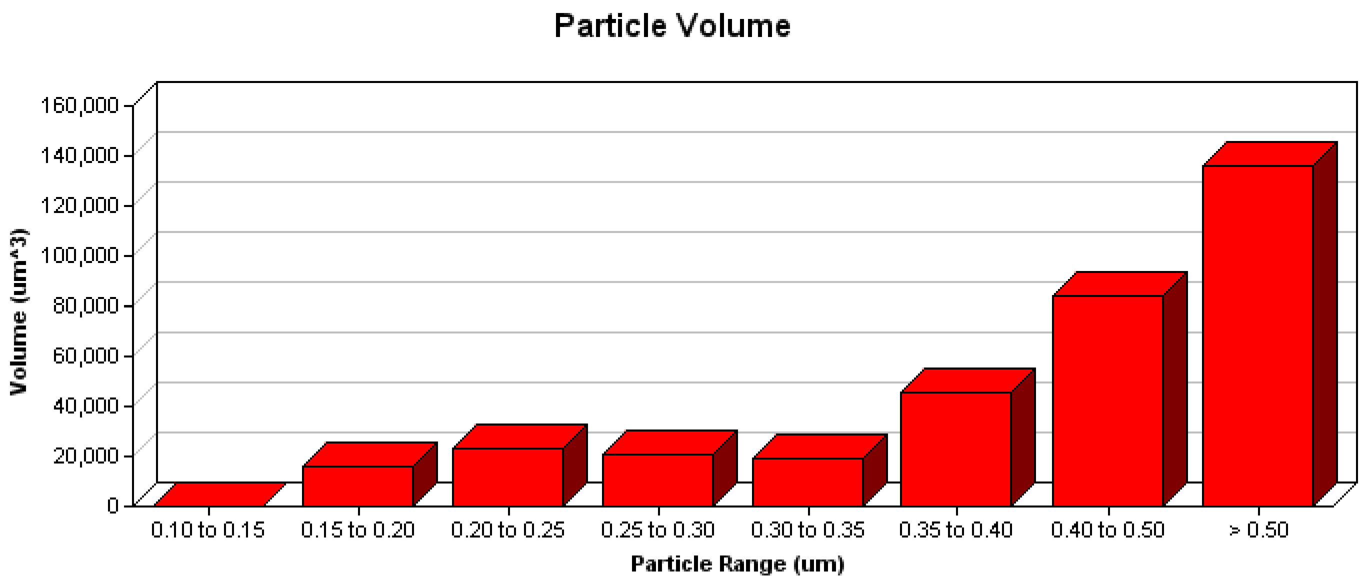
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Small
Sampled - 1/27/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	90.07	16,035.97	23,546.51	21,016.93	19,385.20	45,514.32	84,217.42	135,988.98

* Volume calculated as average particle size sphere.

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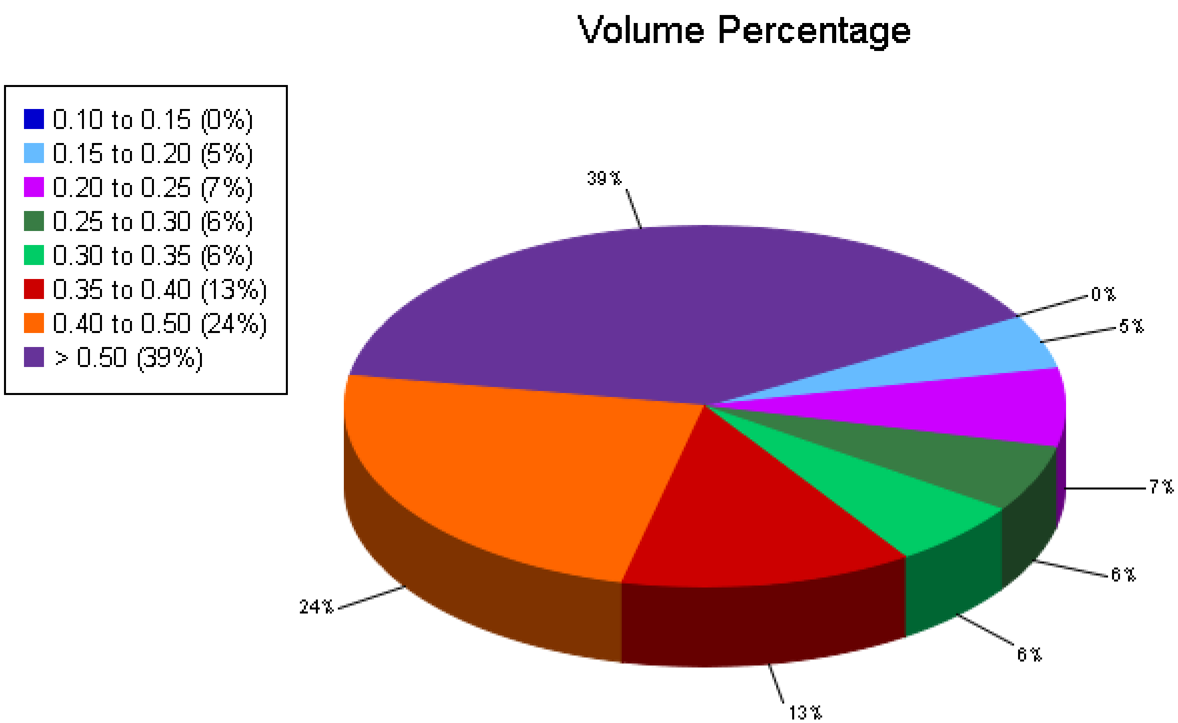
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Small
Sampled - 1/27/2011



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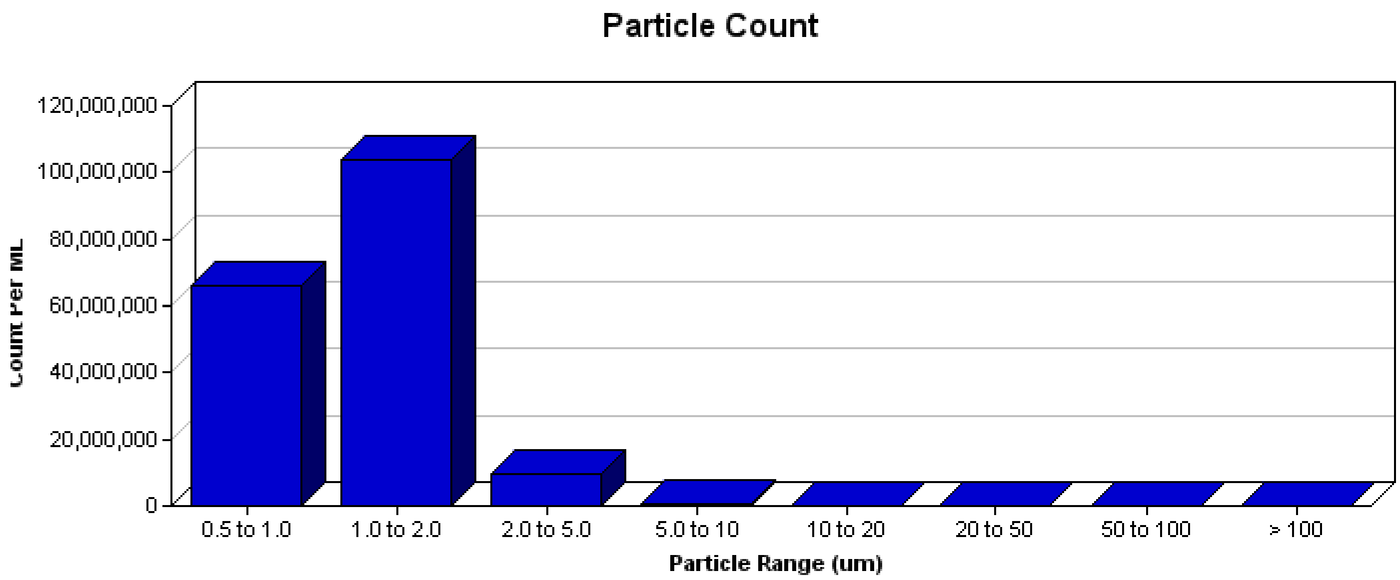
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Large
Sampled - 1/27/2011



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Count/ml	66,063,248	104,000,000	9,761,287	668,571	79,969	28,818	720	1,441
Percent of Total	36.58%	57.58%	5.40%	0.37%	0.04%	0.02%	0.00%	0.00%

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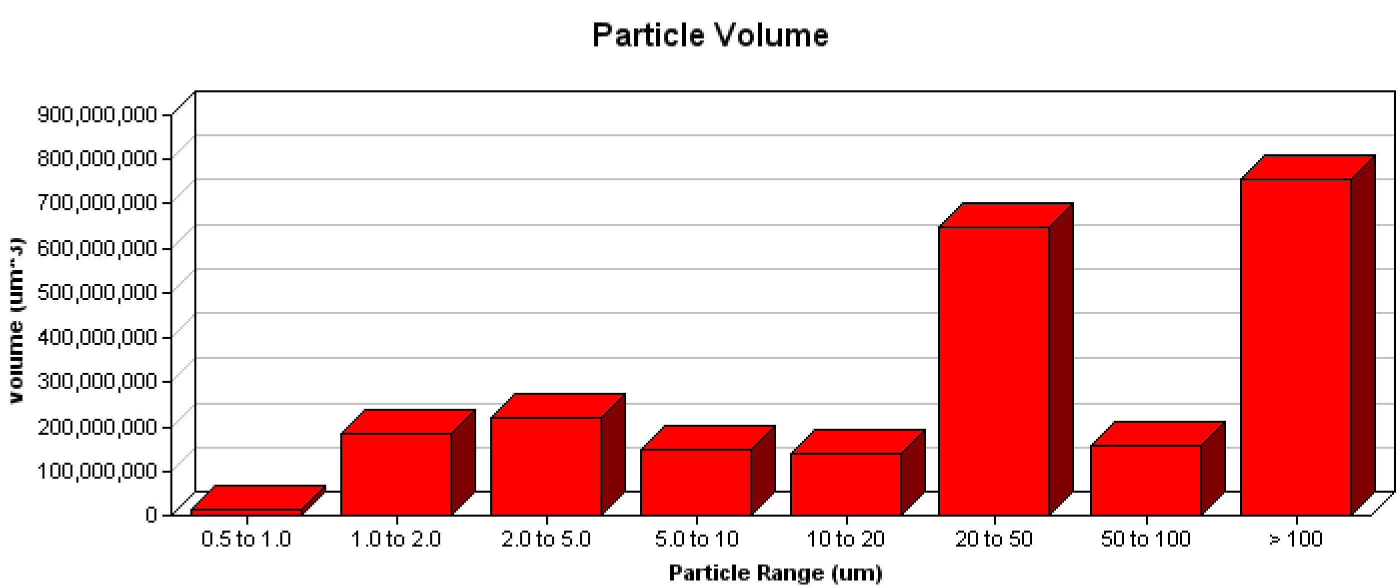
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Large
Sampled - 1/27/2011



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Volume (µm³)	14,592,921	183,783,132	219,133,990	147,682,779	141,316,858	646,943,721	159,043,095	754,505,679

* Volume calculated as average particle size sphere.

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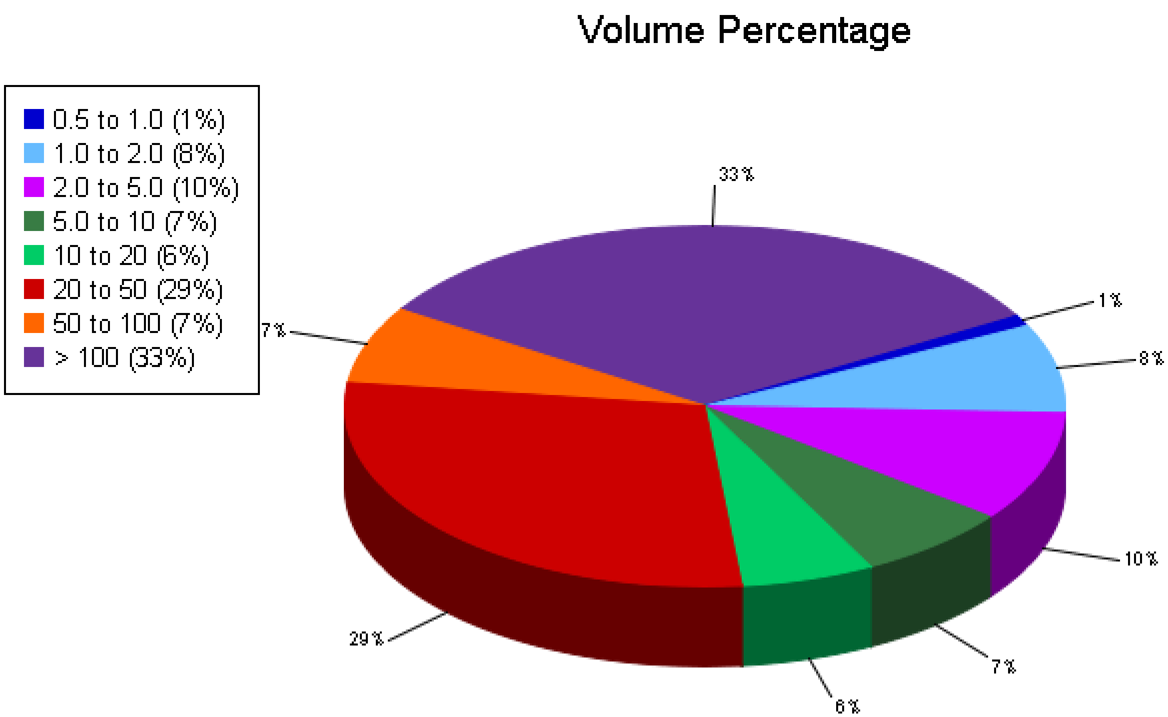
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Large
Sampled - 1/27/2011



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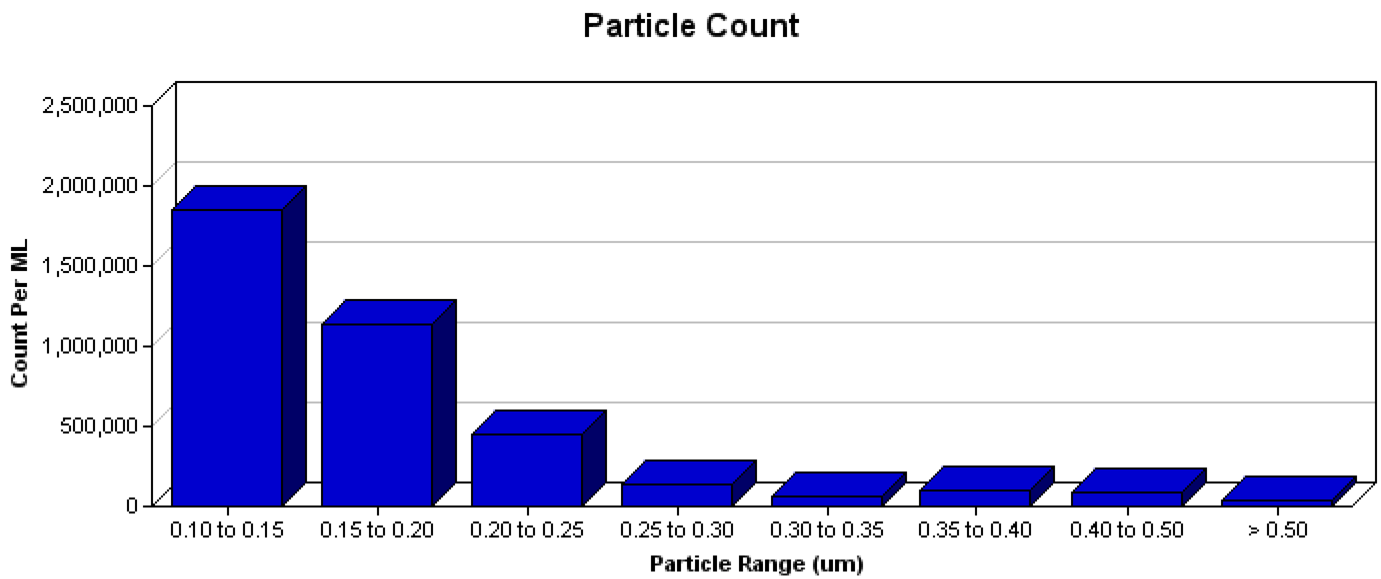
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #2 - Small
Sampled - 1/27/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	1,846,555	1,141,133	450,795	139,349	59,597	100,014	91,534	35,275
Percent of Total	47.8%	29.5%	11.7%	3.6%	1.5%	2.6%	2.4%	0.9%

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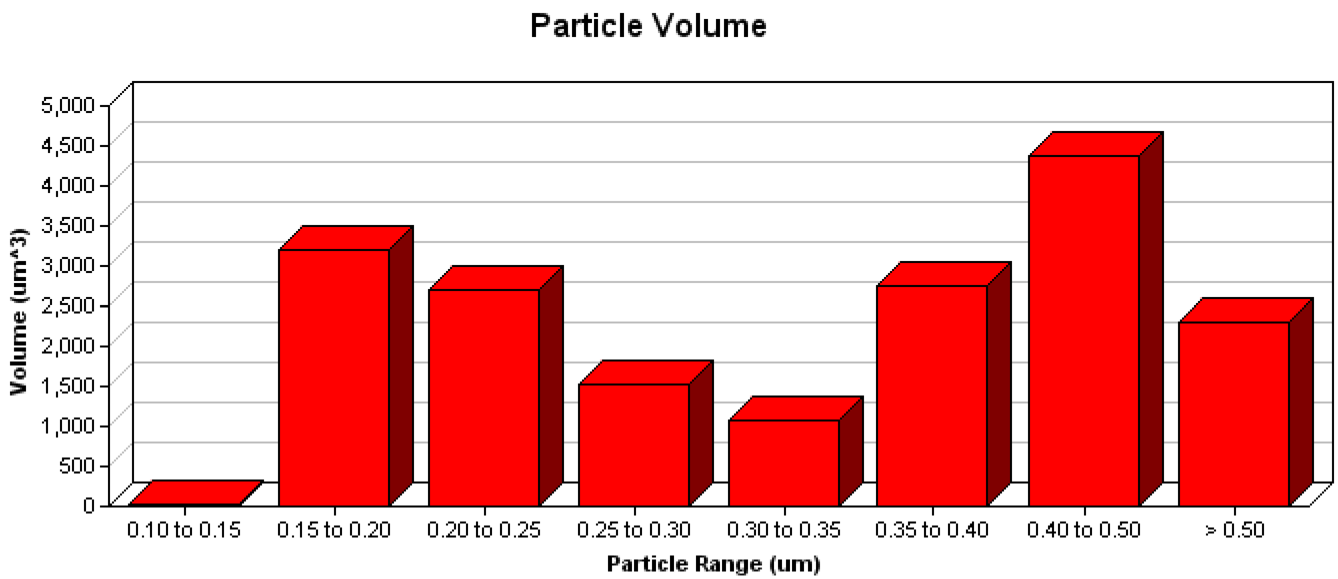
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #2 - Small
Sampled - 1/27/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (μm^3)	15.11	3,202.20	2,688.59	1,517.40	1,071.21	2,761.55	4,367.36	2,308.74

* Volume calculated as average particle size sphere.

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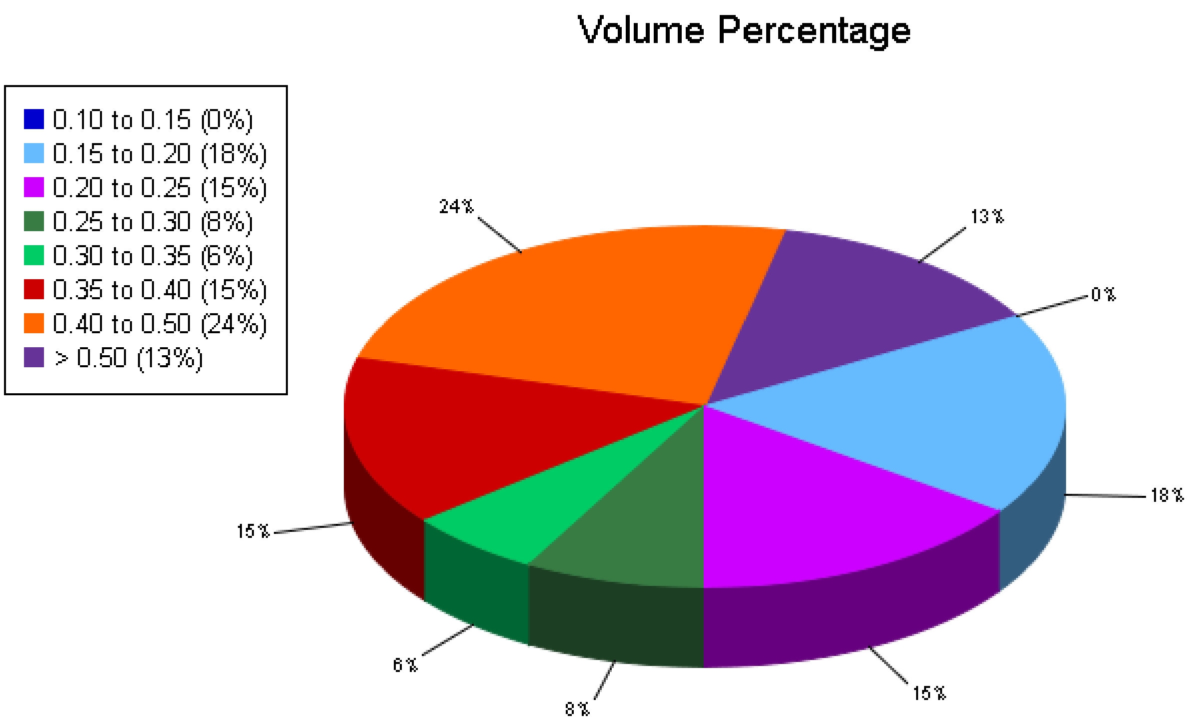
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #2 - Small
Sampled - 1/27/2011



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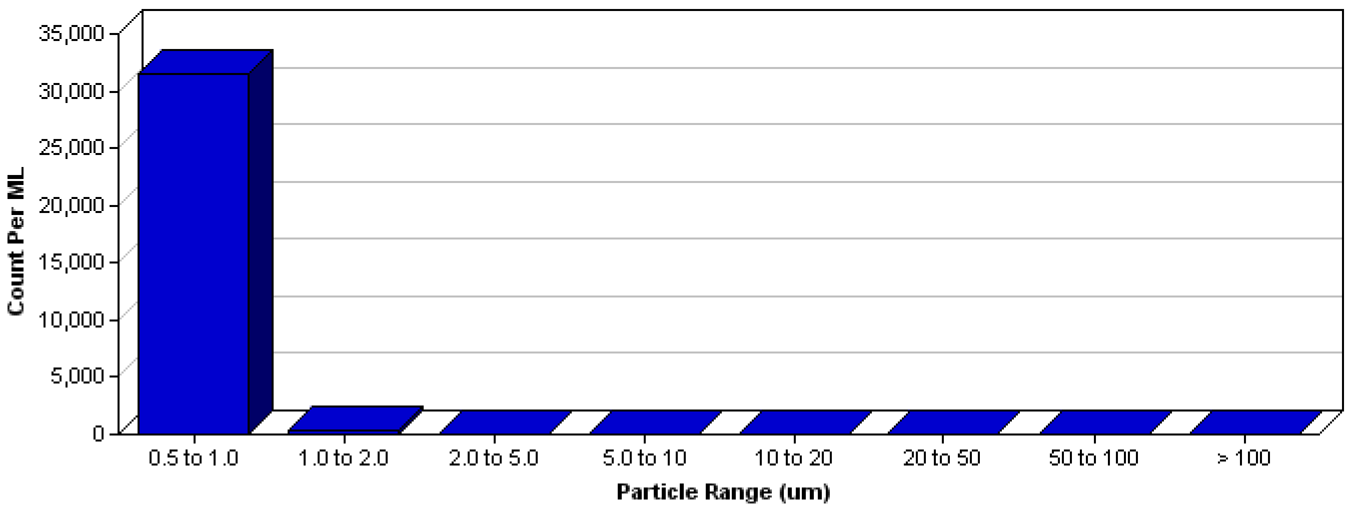
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #2 - Large
Sampled - 1/27/2011

Particle Count



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Count/ml	31,449	289	18	0	0	0	0	0
Percent of Total	99.03%	0.91%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%

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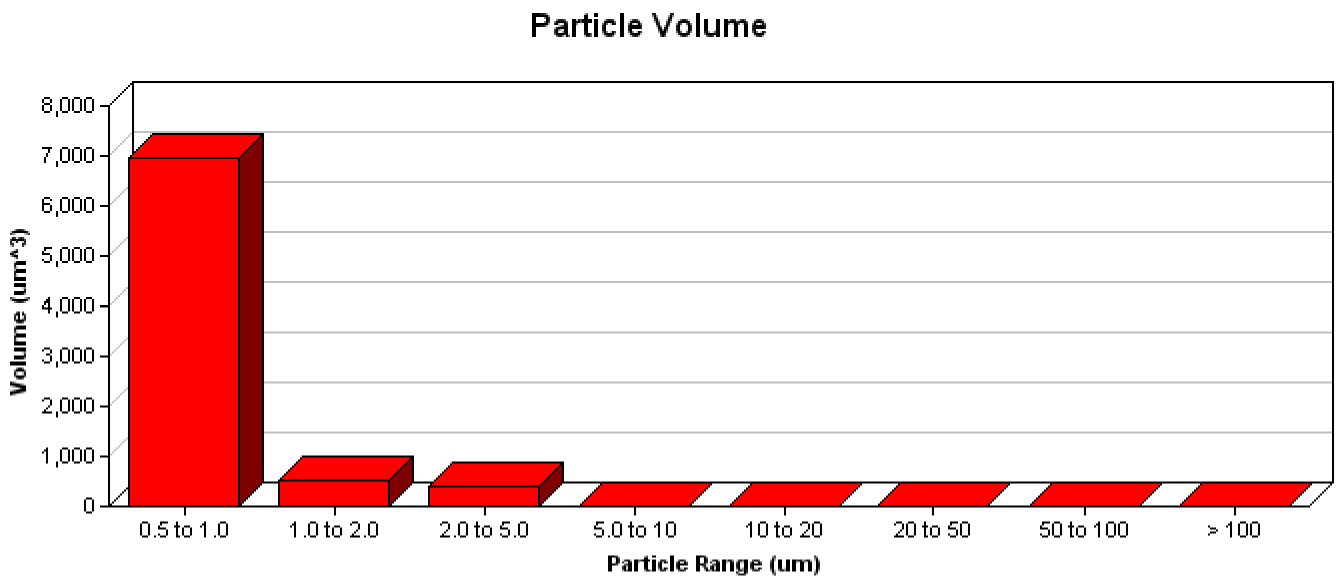
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #2 - Large
Sampled - 1/27/2011



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Volume (µm³)	6,947	511	405	0	0	0	0	0

* Volume calculated as average particle size sphere.

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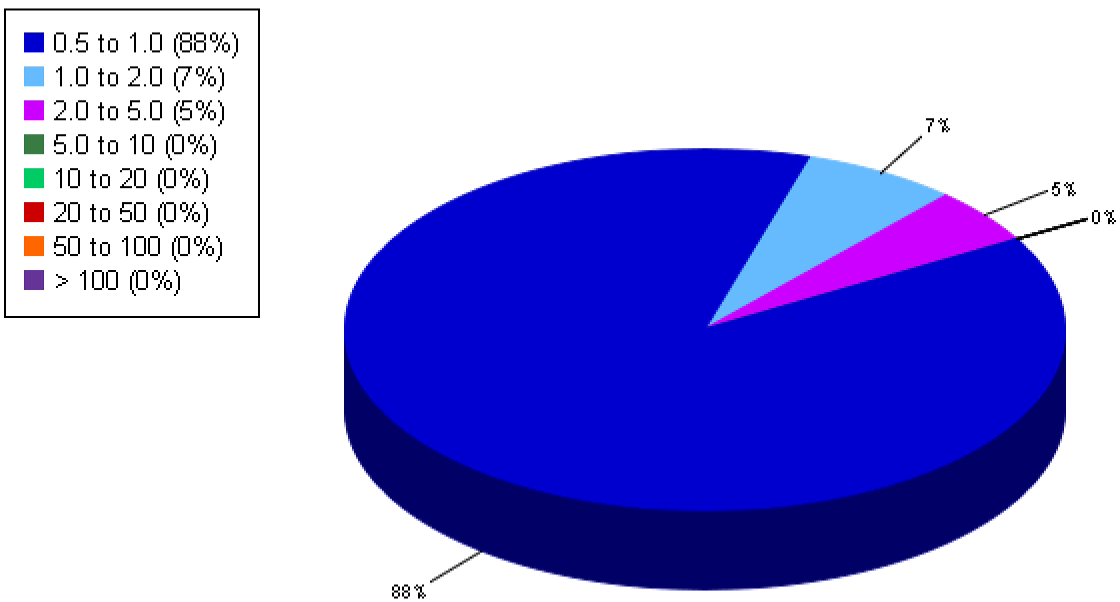
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate Pump #2 - Large
Sampled - 1/27/2011

Volume Percentage



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Test Results

ChemTreat, Inc. - Visionaire WWTP

Contact:
Title:
Sampled: Tuesday, 2/15/2011

2 Samples

	SAMPLE ID	Mixed Liquid	Permeate				
1	pH						
2	Conductivity (MMHS)						
3	Free Halogen (PPM)						
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)						
6	Calcium (PPM)						
7	Magnesium (PPM)						
8	Molybdenum (PPM)						
9	Zinc (PPM)						
10	Total Iron (PPM)						
11	Manganese (PPM)						
12	Copper (PPM)						
13	Aluminum (PPM)						
14	Silica (PPM)						
15	Nickel (PPM)						
16	Vanadium (PPM)						
17	Sodium (PPM)						
18	Potassium (PPM)						
19	Chloride (PPM)						
20	Bromide (PPM)						
21	Nitrite (PPM)						
22	Nitrate (PPM)						
23	Ammonia (PPM)						
24	Phosphonate (PPM)						
25	Ortho Phosphate (PPM)						
26	Total Phosphate (PPM)						
27	Sulfite (PPM)						
28	Sulfate (PPM)						
29	Total Azole (PPM)						
30	Glycol (PPM)						
31	Glycol E/P (%)						
32	Turbidity (NTU)	6,550.0	0.0000				
33	Aerobic Bacteria (CELLS/ML)						
34	Primary Organism						
35	Secondary Organism						
36	DEAE (PPM)						
37	Morpholine (PPM)						
38	Cyclohexylamine (PPM)						

A READING OF '0' IS LESS THAN TEST LIMITS AND NOT NECESSARILY ZERO

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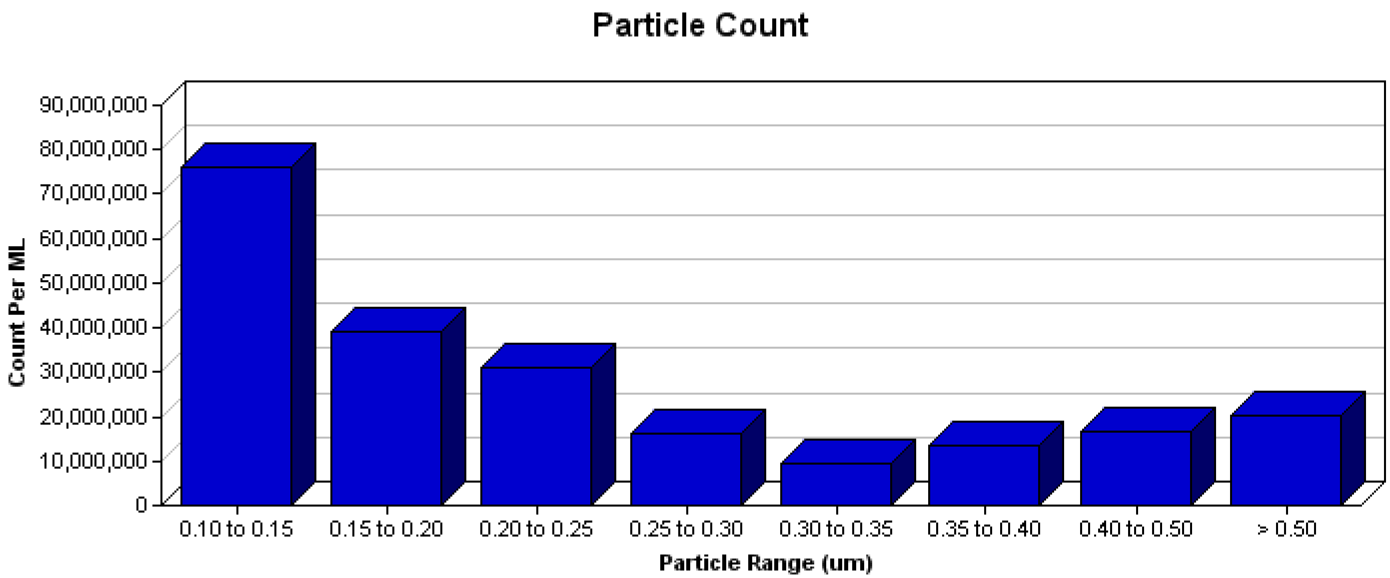
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Small
Sampled - 2/15/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	75,978,700	39,090,900	31,251,100	16,152,400	9,593,600	13,610,100	16,578,200	20,457,500
Percent of Total	34.1%	17.6%	14.0%	7.3%	4.3%	6.1%	7.4%	9.2%

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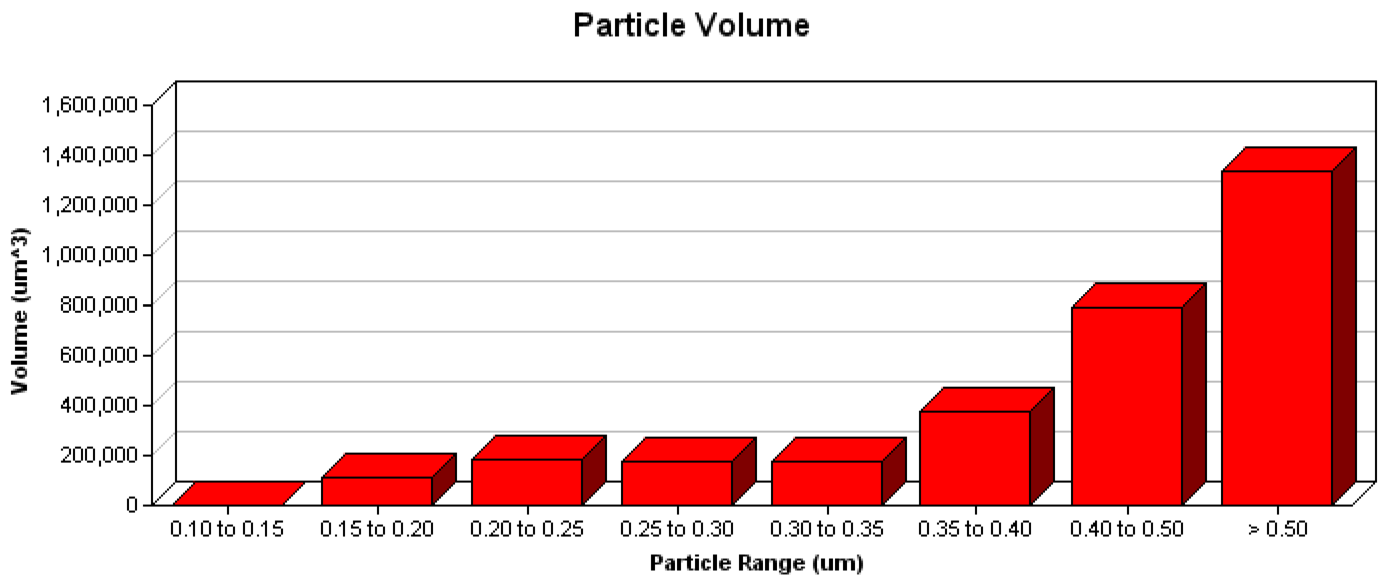
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Small
Sampled - 2/15/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	621.60	109,695.38	186,385.19	175,886.97	172,436.91	375,797.30	790,994.47	1,338,939.97

* Volume calculated as average particle size sphere.

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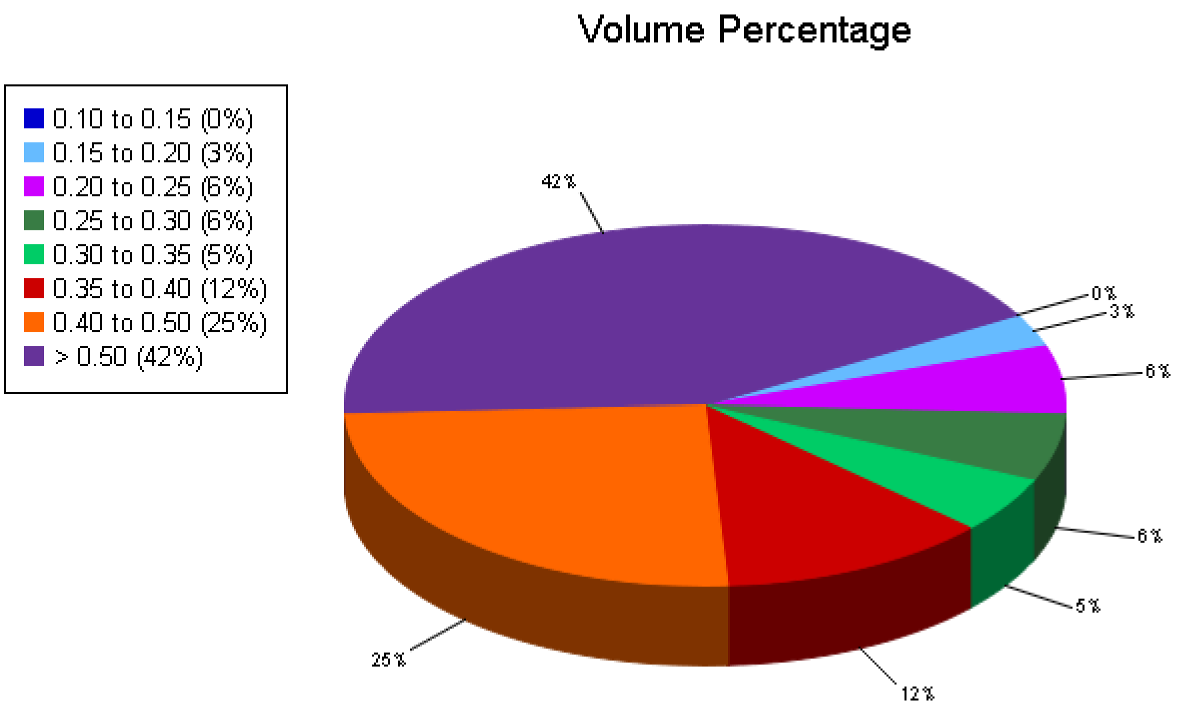
PHONE: 360-254-1213 • FAX: 360-896-2106

Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Small
Sampled - 2/15/2011



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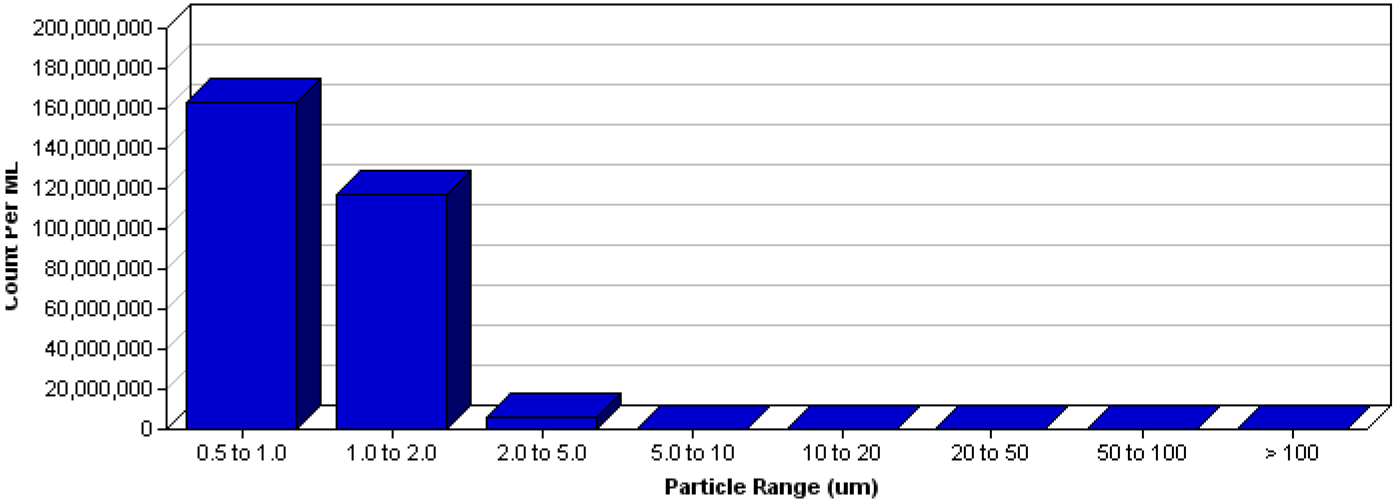
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Large
Sampled - 2/15/2011

Particle Count



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Count/ml	162,941,333	116,760,200	5,867,667	415,000	43,303	10,827	0	0
Percent of Total	56.96%	40.82%	2.05%	0.15%	0.02%	0.00%	0.00%	0.00%

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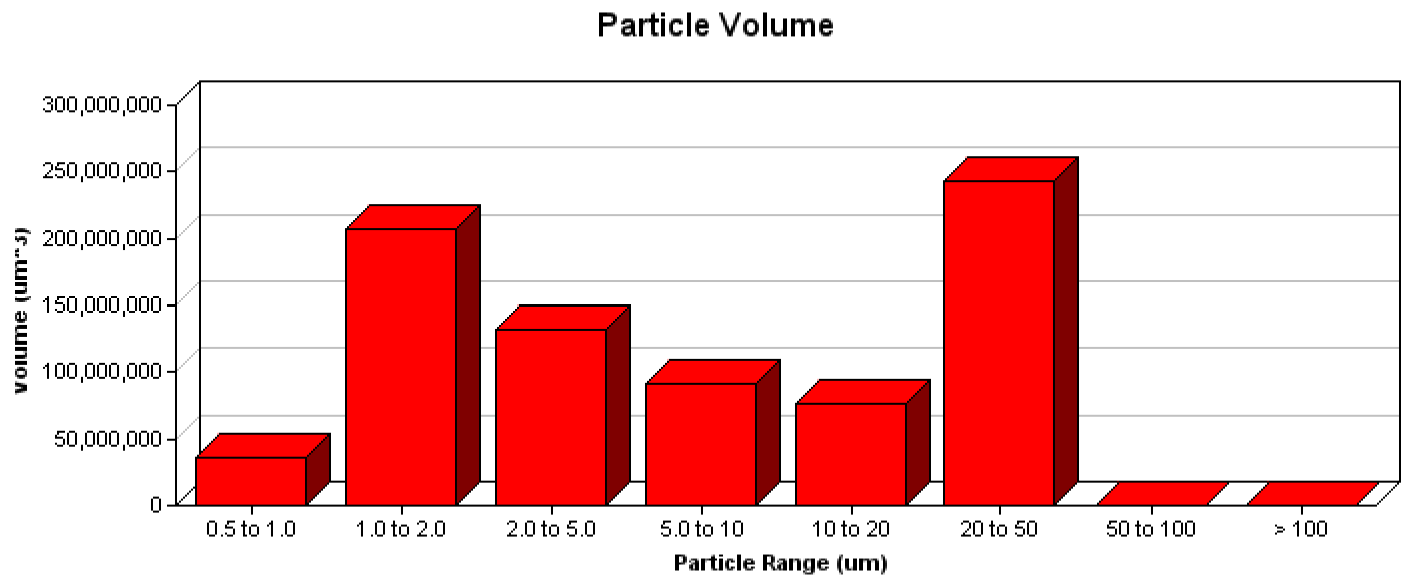
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Large
Sampled - 2/15/2011



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Volume (μm^3)	35,992,630	206,332,262	131,724,975	91,670,673	76,522,702	243,058,494	0	0

* Volume calculated as average particle size sphere.

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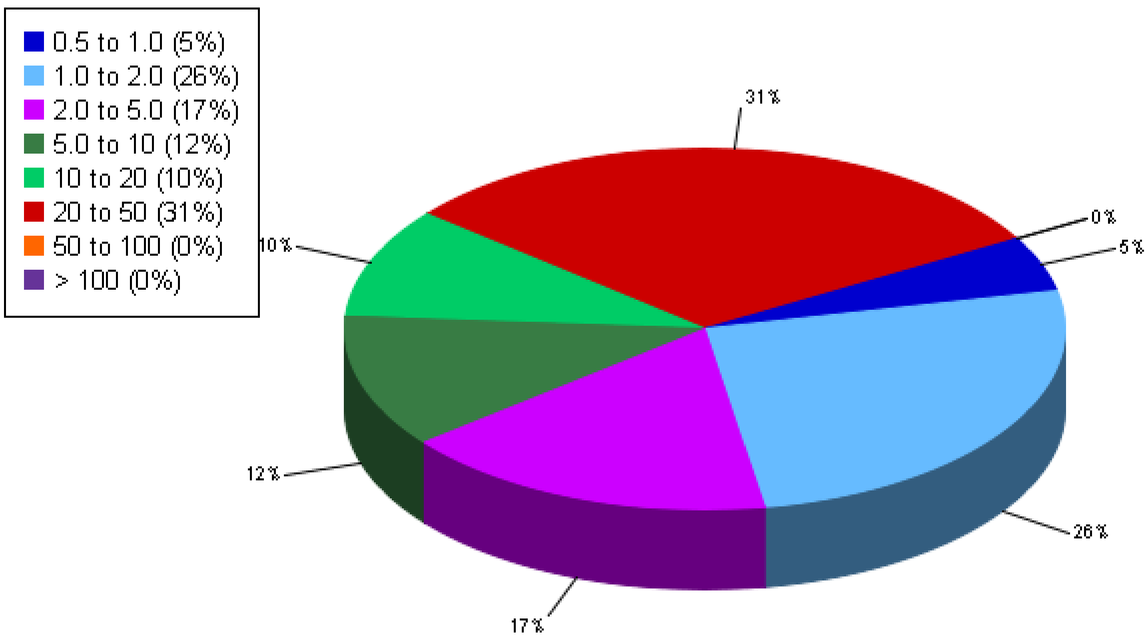
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Mixed Liquid - Large
Sampled - 2/15/2011

Volume Percentage



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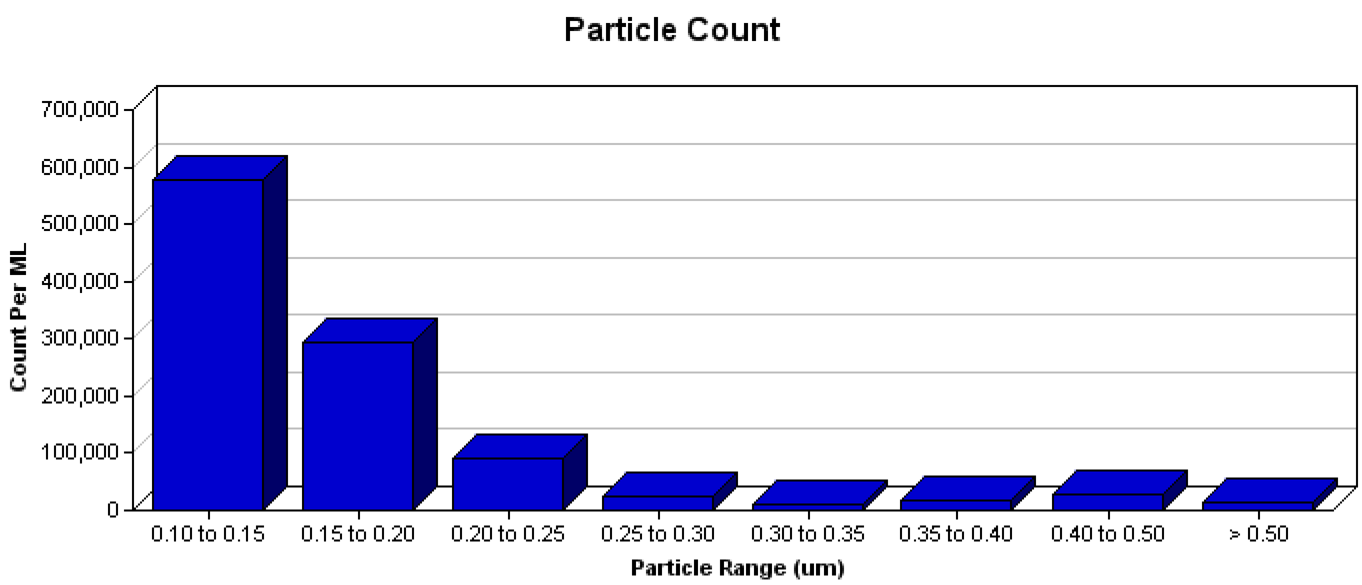
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate - Small
Sampled - 2/15/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	576,232	293,547	92,292	26,145	12,089	18,603	26,578	14,254
Percent of Total	54.4%	27.7%	8.7%	2.5%	1.1%	1.8%	2.5%	1.3%

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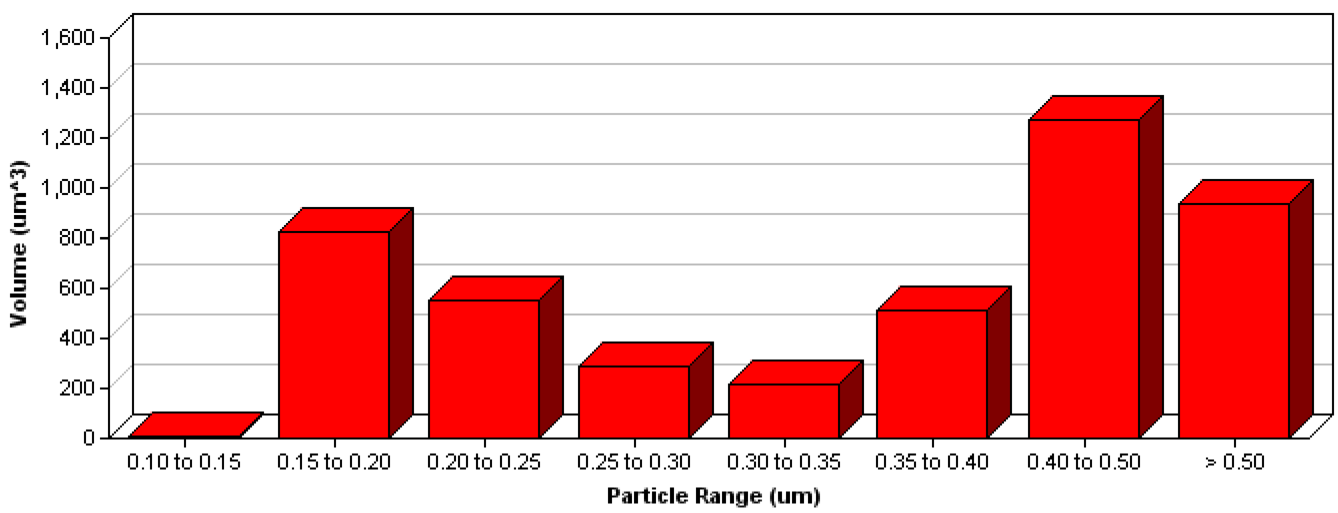
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate - Small
Sampled - 2/15/2011

Particle Volume



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (μm^3)	4.71	823.74	550.44	284.70	217.29	513.66	1,268.11	932.92

* Volume calculated as average particle size sphere.

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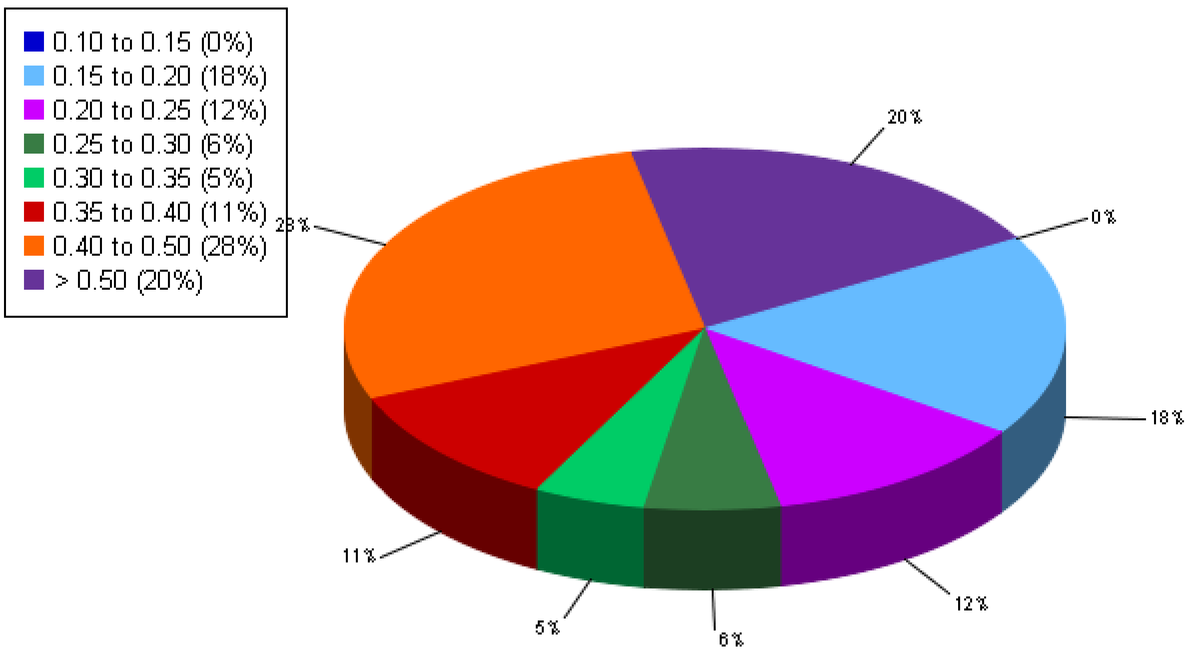
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate - Small
Sampled - 2/15/2011

Volume Percentage



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Particle Size Distribution Study

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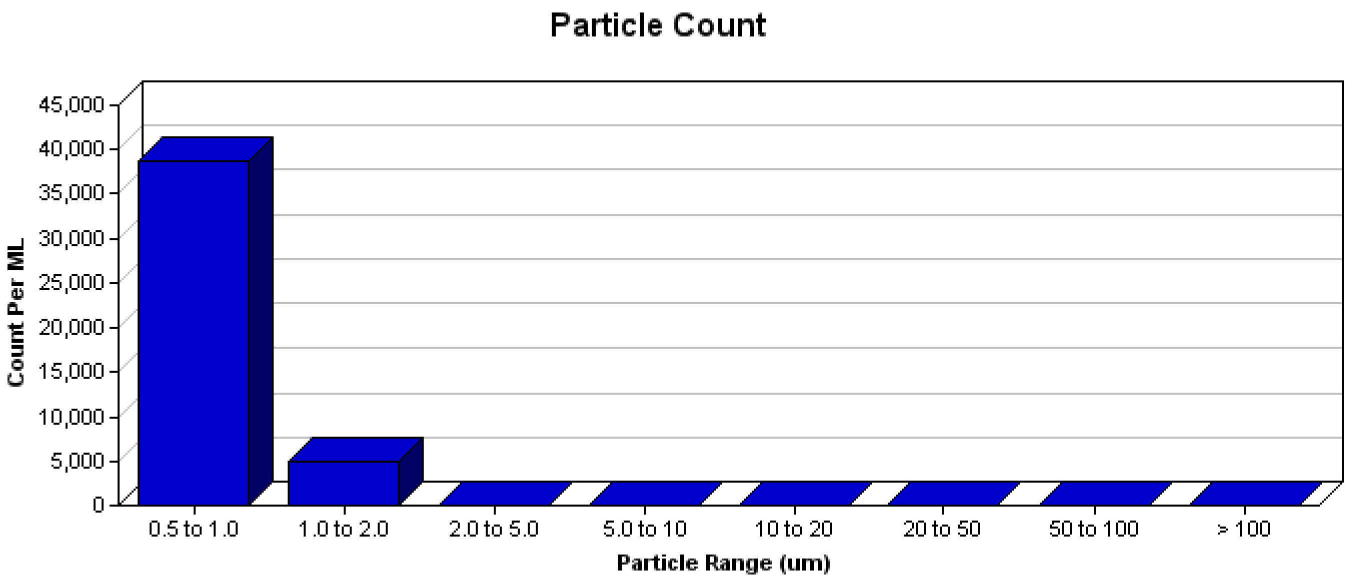
Permeate - Large
Sampled - 2/15/2011



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Count/ml	38,597	4,890	90	0	0	0	0	0
Percent of Total	88.57%	11.22%	0.21%	0.00%	0.00%	0.00%	0.00%	0.00%

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Permeate - Large
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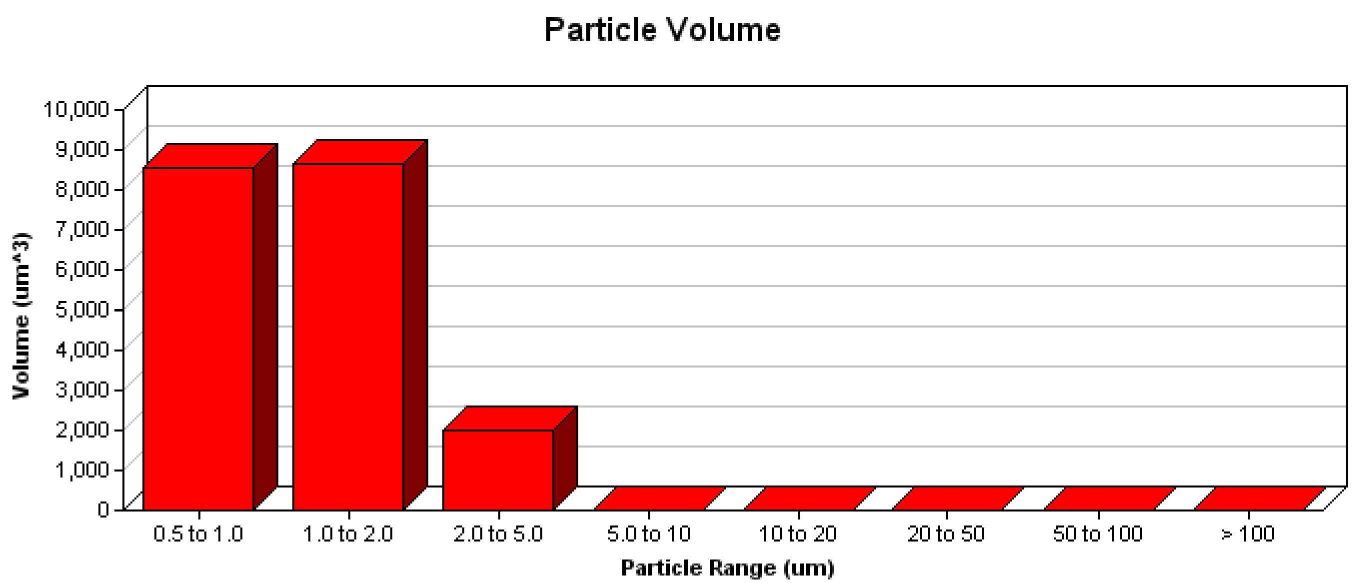

Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Volume (µm³)	8,526	8,641	2,020	0	0	0	0	0

* Volume calculated as average particle size sphere.

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Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate - Large
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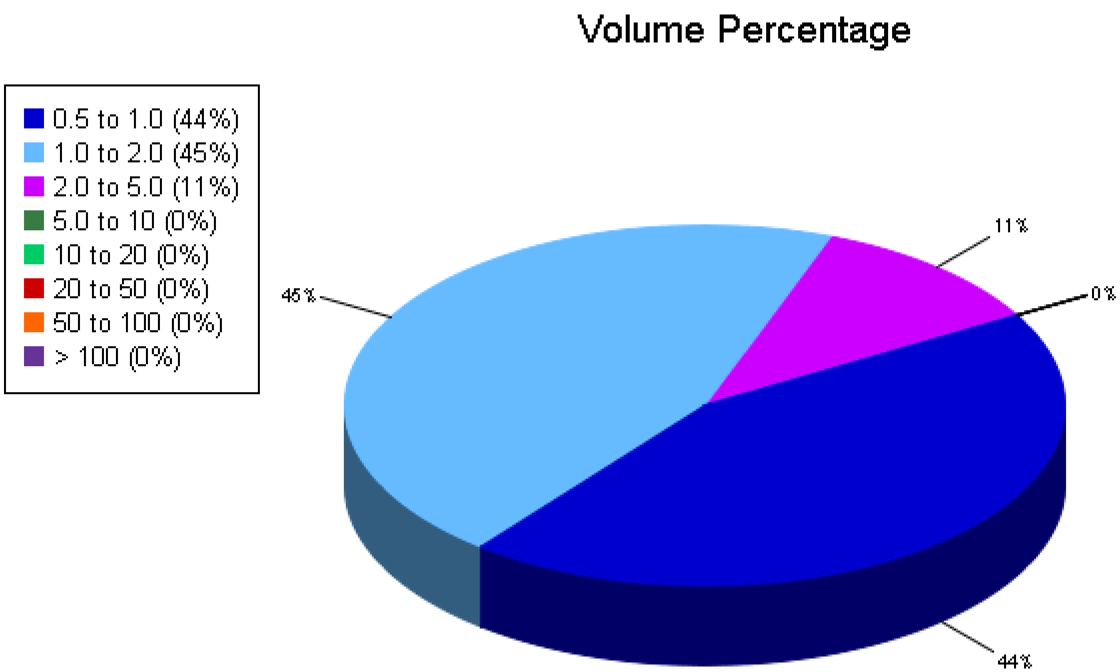

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Test Results

ChemTreat, Inc. - Visionaire WWTP

Contact: Mitch Kaufman
Title:
Sampled: Tuesday, 3/15/2011

2 Samples

	SAMPLE ID	M.L.S.S.	Permeate				
1	pH						
2	Conductivity (MMHS)						
3	Free Halogen (PPM)						
4	P-Alkalinity (PPM)						
5	M-Alkalinity (PPM)						
6	Calcium (PPM)						
7	Magnesium (PPM)						
8	Molybdenum (PPM)						
9	Zinc (PPM)						
10	Total Iron (PPM)						
11	Manganese (PPM)						
12	Copper (PPM)						
13	Aluminum (PPM)						
14	Silica (PPM)						
15	Nickel (PPM)						
16	Vanadium (PPM)						
17	Sodium (PPM)						
18	Potassium (PPM)						
19	Chloride (PPM)						
20	Bromide (PPM)						
21	Nitrite (PPM)						
22	Nitrate (PPM)						
23	Ammonia (PPM)						
24	Phosphonate (PPM)						
25	Ortho Phosphate (PPM)						
26	Total Phosphate (PPM)						
27	Sulfite (PPM)						
28	Sulfate (PPM)						
29	Total Azole (PPM)						
30	Glycol (PPM)						
31	Glycol E/P (%)						
32	Turbidity (NTU)	63,200	0.7200				
33	Aerobic Bacteria (CELLS/ML)						
34	Primary Organism						
35	Secondary Organism						
36	DEAE (PPM)						
37	Morpholine (PPM)						
38	Cyclohexylamine (PPM)						

A READING OF '0' IS LESS THAN TEST LIMITS AND NOT NECESSARILY ZERO

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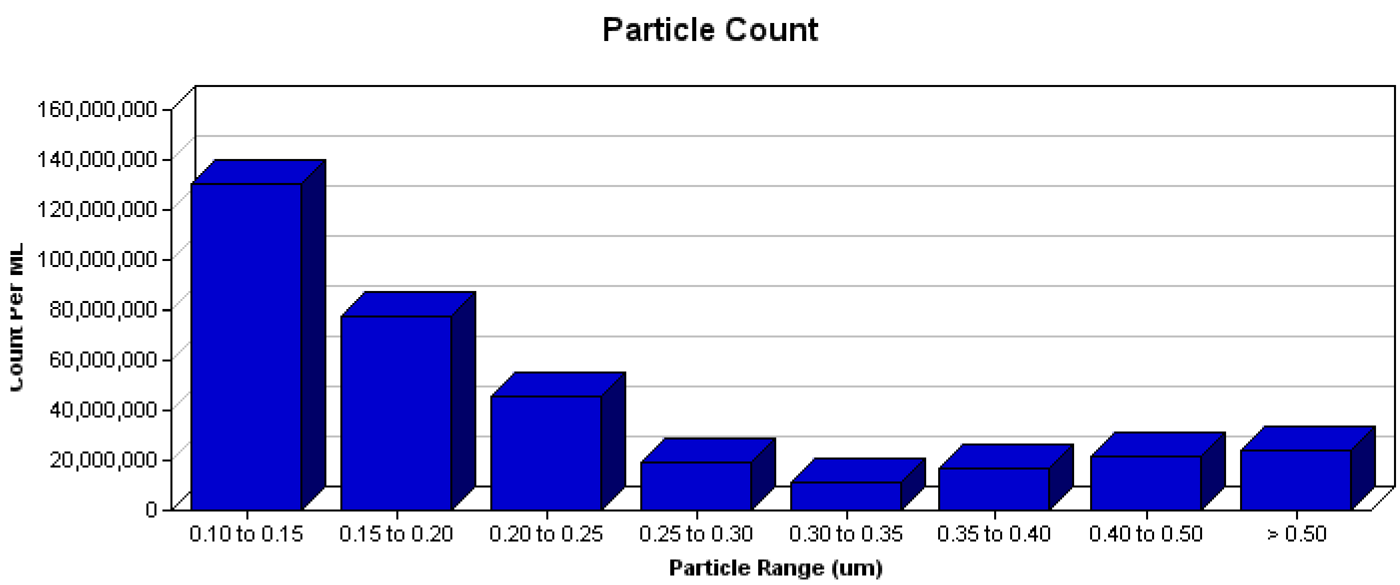
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
M.L.S.S. - Small
Sampled - 3/15/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	130,359,500	77,629,600	45,860,700	19,030,300	10,831,400	16,848,900	21,875,700	23,708,900
Percent of Total	37.7%	22.4%	13.2%	5.5%	3.1%	4.9%	6.3%	6.8%

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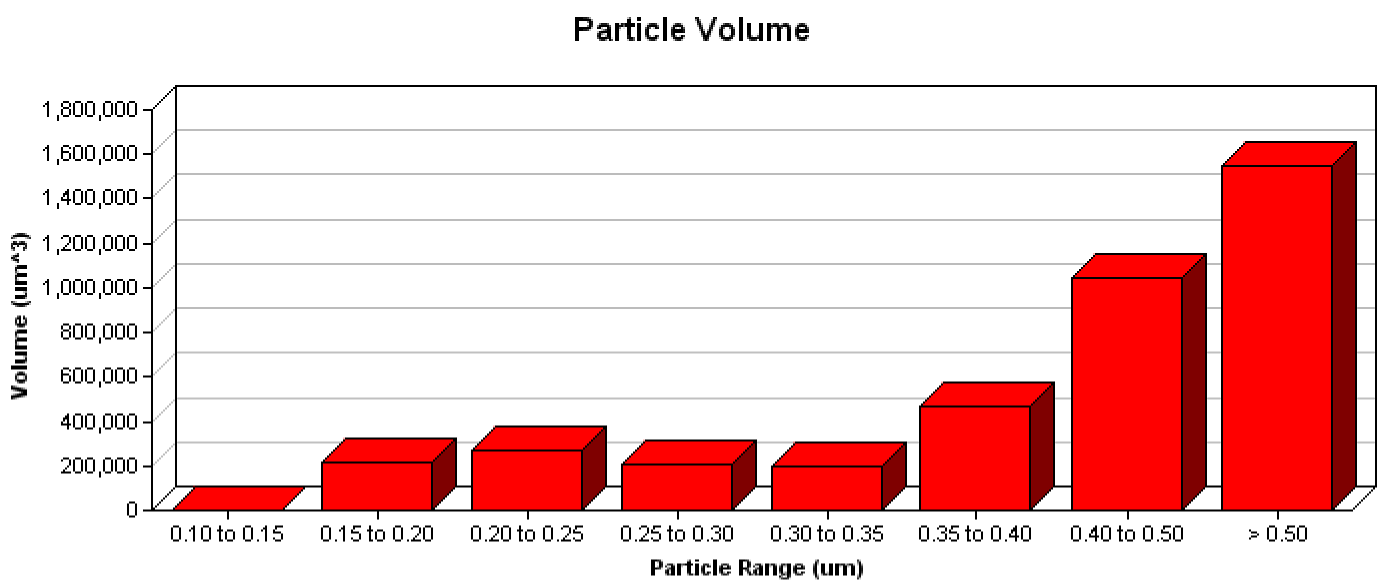
ChemTreat, Inc. - Visionaire WWTP
M.L.S.S. - Small
Sampled - 3/15/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (μm^3)	1,066.50	217,841.20	273,518.54	207,225.05	194,685.32	465,225.90	1,043,753.71	1,551,743.55

* Volume calculated as average particle size sphere.

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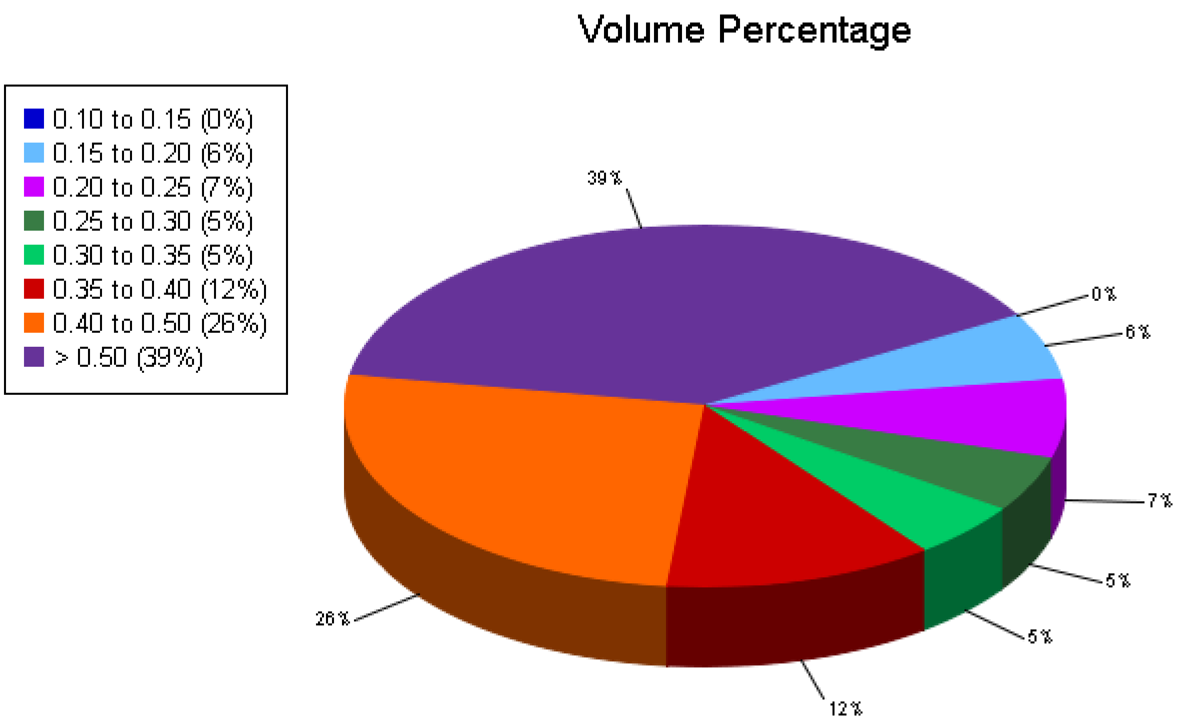
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
M.L.S.S. - Small
Sampled - 3/15/2011



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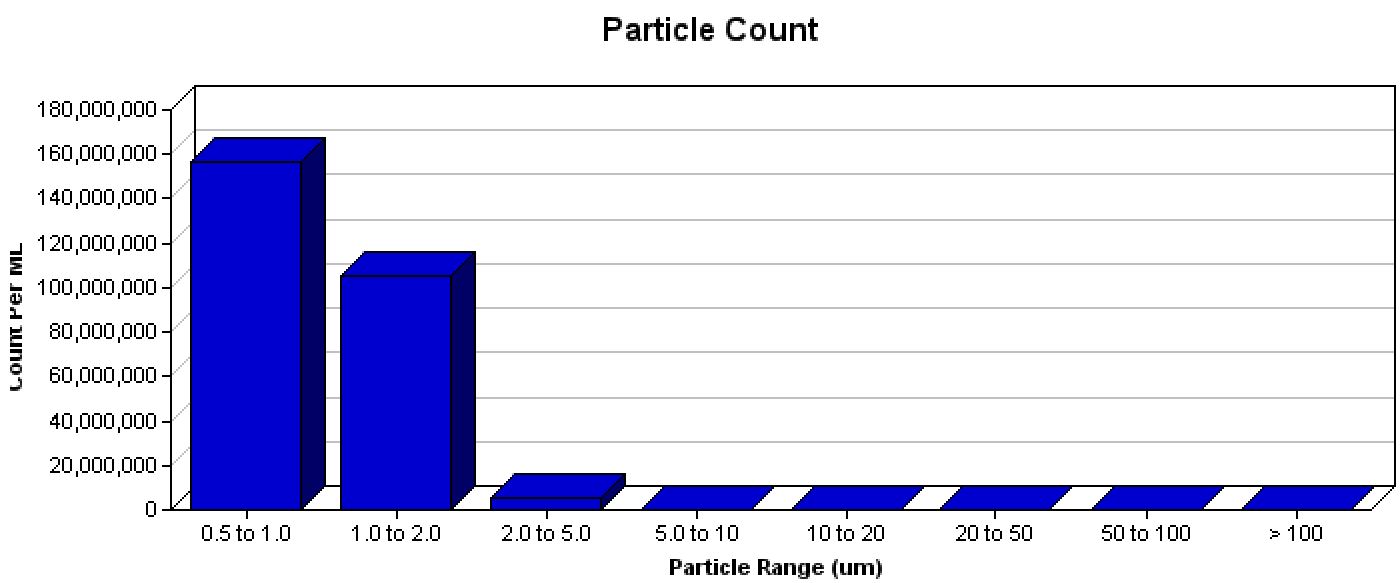
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
M.L.S.S. - Large
Sampled - 3/15/2011



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Count/ml	156,375,300	104,968,900	5,129,700	335,600	39,693	14,437	1,803	0
Percent of Total	58.60%	39.33%	1.92%	0.13%	0.01%	0.01%	0.00%	0.00%

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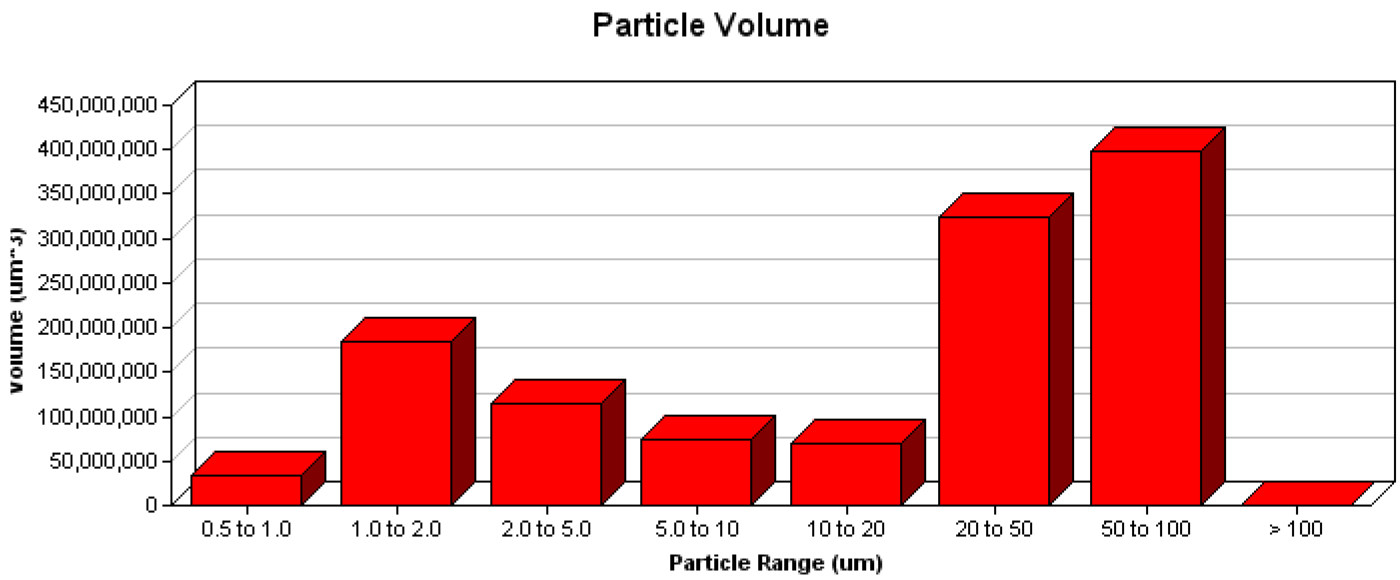
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
M.L.S.S. - Large
Sampled - 3/15/2011



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Volume (µm³)	34,542,238	185,495,319	115,158,137	74,131,754	70,143,306	324,100,441	398,336,685	0

* Volume calculated as average particle size sphere.

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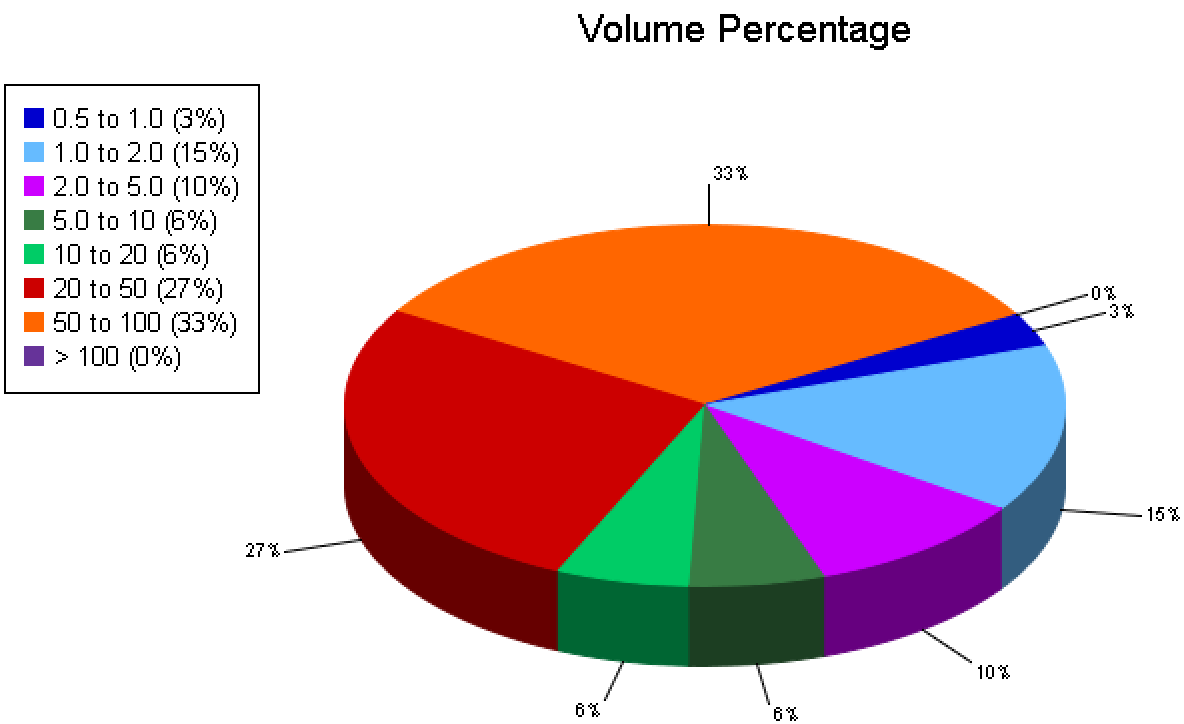
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
M.L.S.S. - Large
Sampled - 3/15/2011



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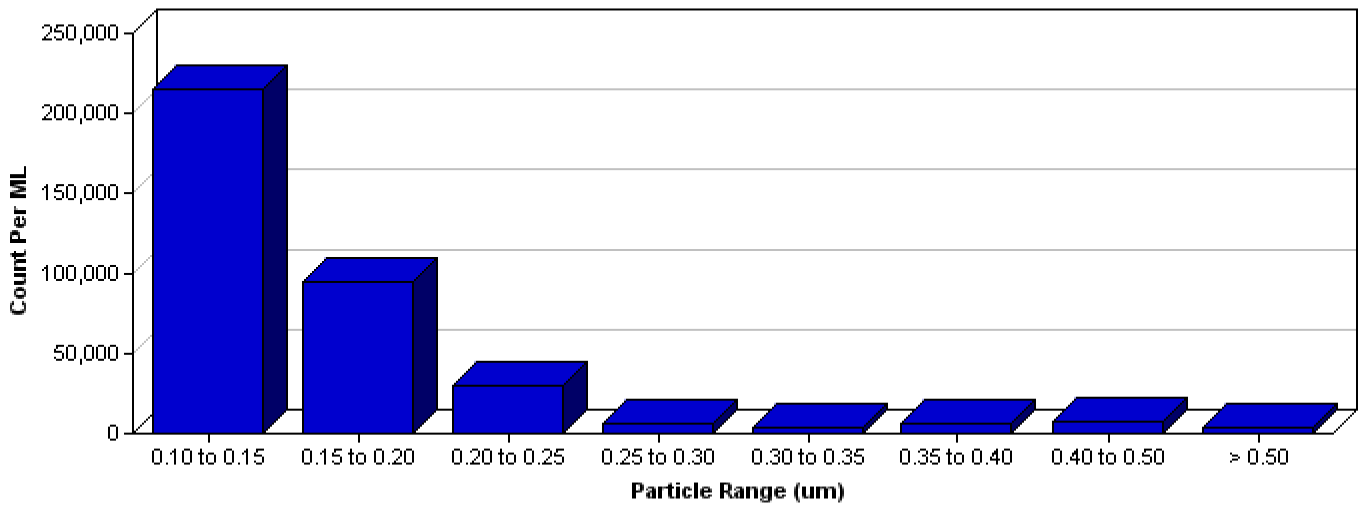
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate - Small
Sampled - 3/15/2011

Particle Count



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Count/ml	214,445	94,709	29,681	6,424	3,248	5,846	7,939	3,988
Percent of Total	58.5%	25.9%	8.1%	1.8%	0.9%	1.6%	2.2%	1.1%

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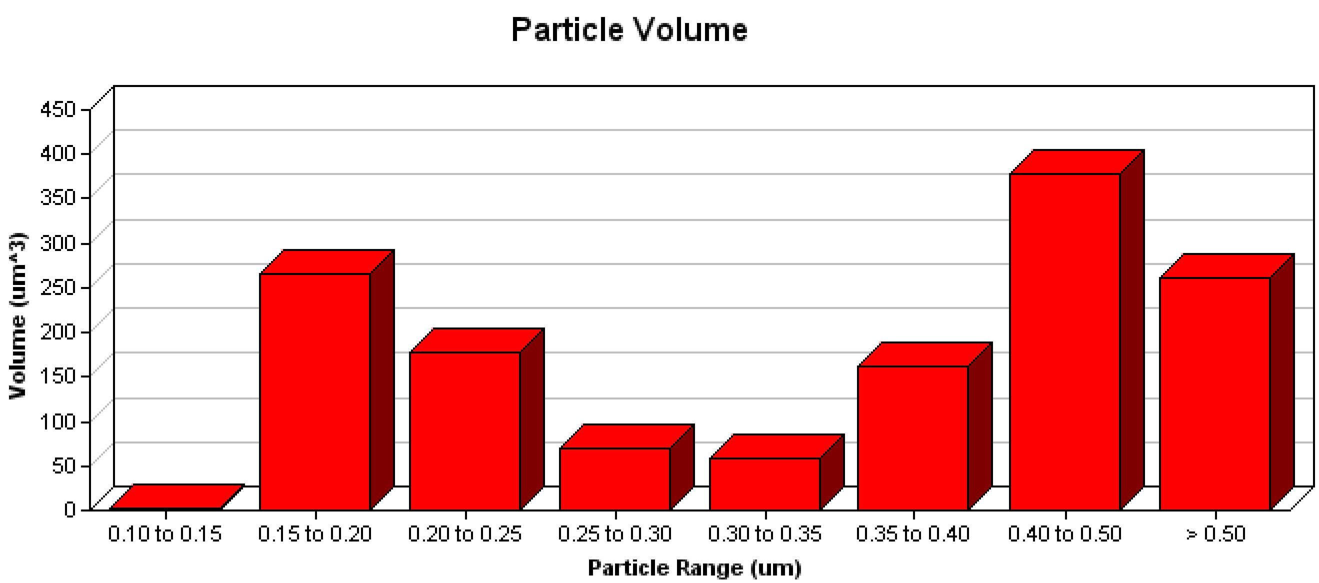
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate - Small
Sampled - 3/15/2011



Particle Size	0.10 to 0.15	0.15 to 0.20	0.20 to 0.25	0.25 to 0.30	0.30 to 0.35	0.35 to 0.40	0.40 to 0.50	> 0.50
Volume (µm³)	1.75	265.77	177.02	69.95	58.38	161.42	378.80	260.99

* Volume calculated as average particle size sphere.

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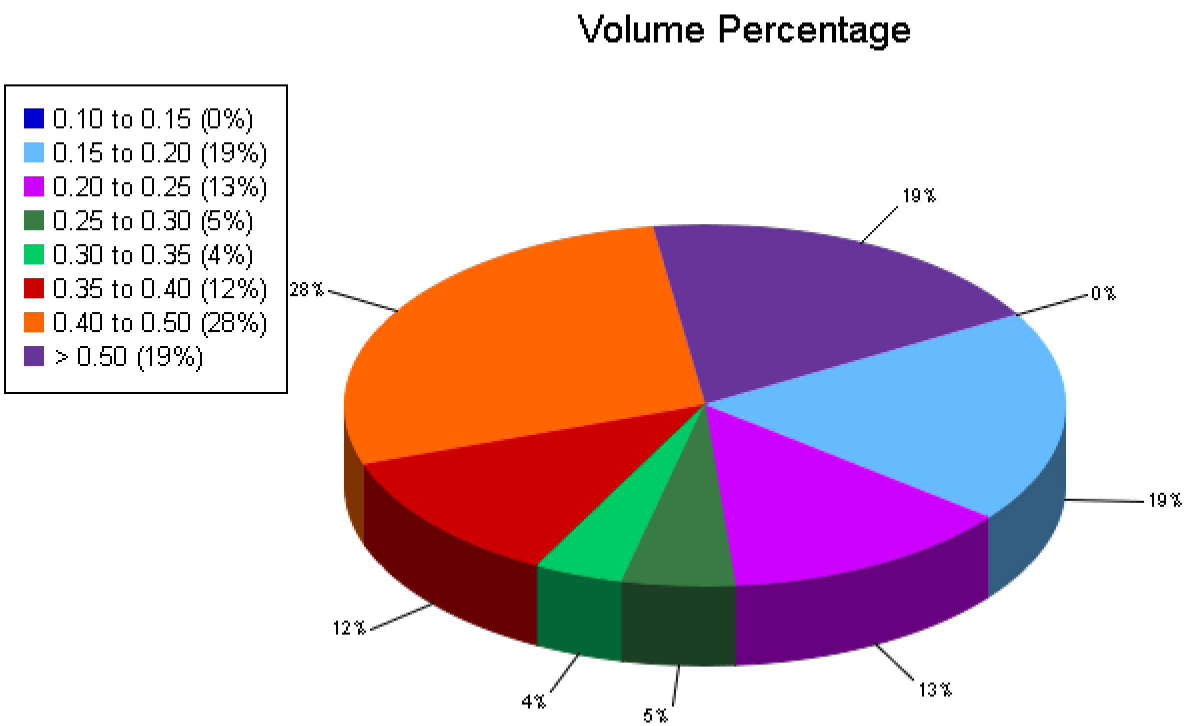
Particle Size Distribution Study

ChemTreat, Inc. - Visionaire WWTP
Permeate - Small
Sampled - 3/15/2011



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Particle Size Distribution Study

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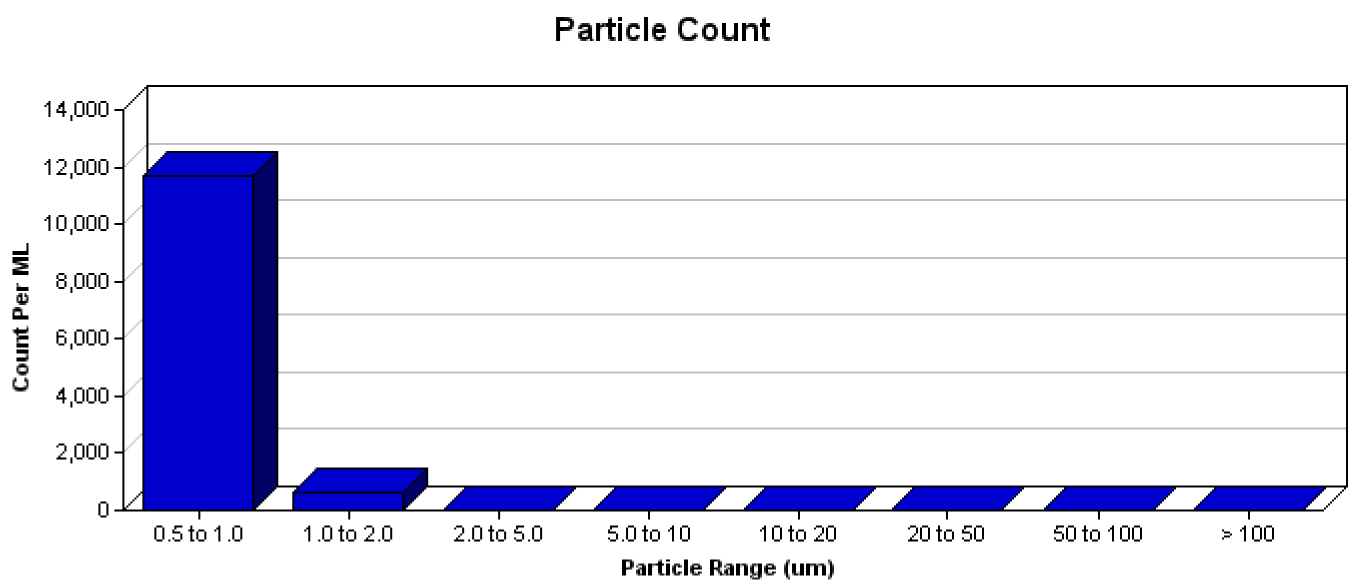
Permeate - Large
Sampled - 3/15/2011



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Count/ml	11,687	632	0	0	0	0	0	0
Percent of Total	94.87%	5.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

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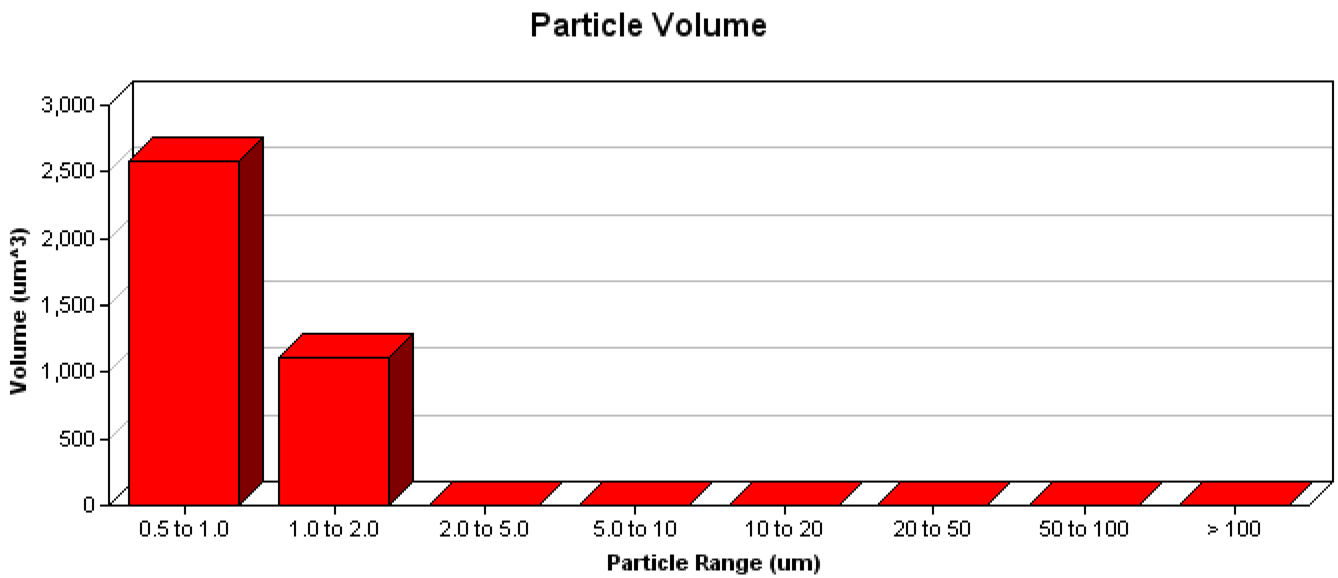
Sampled - 3/15/2011



Particle Size	0.5 to 1.0	1.0 to 2.0	2.0 to 5.0	5.0 to 10	10 to 20	20 to 50	50 to 100	> 100
Volume (µm³)	2,582	1,117	0	0	0	0	0	0

* Volume calculated as average particle size sphere.

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Particle Size Distribution Study

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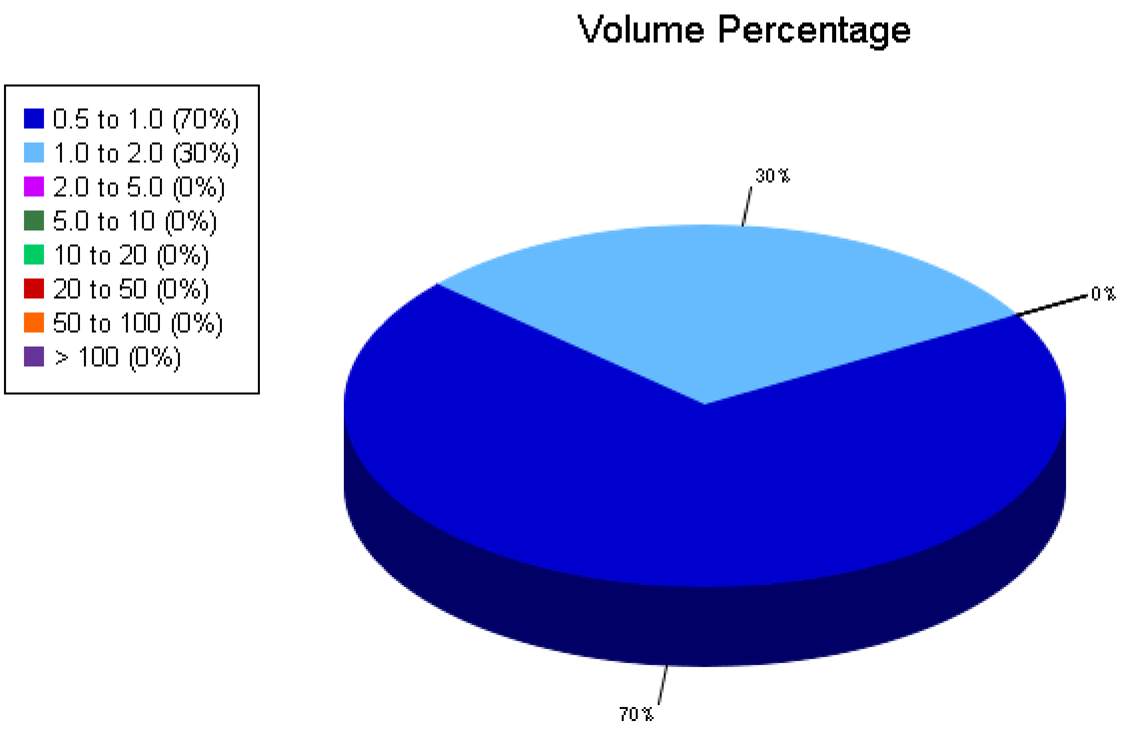
Sampled - 3/15/2011



Appendix G: Garden State Laboratory reports

Garden State Laboratories, Inc.

Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

ACCREDITED IN ACCORDANCE WITH nelac

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300111088.0
CLIENT # APP24
DATE SUBMITTED: 1/11/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONARE

DATE SAMPLED: 1/11/10 TIME SAMPLED: 14:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/11/10-16:12
T. Suspended Solids, SM2540D	<1	mg/l		1/13/10
Turbidity, SM 2130 B	0.20	NTU's		1/12/10-20:19
E. coli, EPA 1603	<1	organisms per 100 ml		1/11/10-15:55
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/11/10-15:55

< = less than, not detected.

Harvey Klein

205968

Garden State Laboratories, Inc.

Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

PURETEST SYSTEM OF LABORATORY CONTROL

ACCREDITED IN ACCORDANCE WITH nelac

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Internet: www.gslabs.com

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 300112032.0
CLIENT # APP24
DATE SUBMITTED: 1/12/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/12/10 TIME SAMPLED: 12:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/13/10-14:00
E. coli, EPA 1603	<1	organisms per 100 ml		1/12/10-14:24
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/12/10-14:24
T. Suspended Solids, SM2540D	<1	mg/l		1/14/10
Turbidity, SM 2130 B	0.30	NTU's		1/12/10-20:24

< = less than, not detected.

Harvey Klein

206013

Garden State Laboratories, Inc.

Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300113036.0
CLIENT # APP24
DATE SUBMITTED: 1/13/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/13/10 TIME SAMPLED: 14:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/13/10-17:17
T. Suspended Solids, SM2540D	1	mg/l		1/19/10
Turbidity, SM 2130 B	0.35	NTU's		1/13/10-16:55
E. coli, EPA 1603	<1	organisms per 100 ml		1/13/10-16:02
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/13/10-16:02

< = less than, not detected.

Harvey Klein

206132

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

PURETEST SYSTEM OF LABORATORY CONTROL

ACCREDITED IN ACCORDANCE WITH nelac

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 300114082.0
CLIENT # APP24
DATE SUBMITTED: 1/14/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/14/10 TIME SAMPLED: 14:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/14/10-16:23
E. coli, EPA 1603	<1	organisms per 100 ml		1/14/10-15:53
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/14/10-15:53
T. Suspended Solids, SM2540D	<1	mg/l		1/20/10
Turbidity, SM 2130 B	0.30	NTU's		1/14/10-18:41

< = less than, not detected.

Harvey Klein

206195

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Bacteriological and Chemical Testing
410 Hillside Avenue
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Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300115028.0
CLIENT # APP24
DATE SUBMITTED: 1/15/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/15/10 TIME SAMPLED: 12:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/15/10-14:45
E. coli, EPA 1603	<1	organisms per 100 ml		1/15/10-14:57
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/15/10-14:57
T. Suspended Solids, SM2540D	<1	mg/l		1/21/10
Turbidity, SM 2130 B	0.25	NTU's		1/15/10-17:32

< = less than, not detected.

Harvey Klein

206255

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410 Hillside Avenue
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PURETEST SYSTEM OF LABORATORY CONTROL

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Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300118021.0
CLIENT # APP24
DATE SUBMITTED: 1/18/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/18/10 TIME SAMPLED: 13:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/18/10-16:28
T. Suspended Solids, SM2540D	<1	mg/l		1/21/10
Turbidity, SM 2130 B	0.35	NTU's		1/19/10-19:35
E. coli, EPA 1603	<1	organisms per 100 ml		1/18/10-15:39
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/18/10-15:39

< = less than, not detected.

Harvey Klein

206381

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300119058.0
CLIENT # APP24
DATE SUBMITTED: 1/19/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/19/10 TIME SAMPLED: 11:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/20/10-13:16
E. coli, EPA 1603	<1	organisms per 100 ml		1/19/10-15:36
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/19/10-15:36
T. Suspended Solids, SM2540D	<1	mg/l		1/22/10
Turbidity, SM 2130 B	0.35	NTU's		1/19/10-19:37

< = less than, not detected.

Harvey Klein

206465

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300120034.0
CLIENT # APP24
DATE SUBMITTED: 1/20/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/20/10 TIME SAMPLED: 14:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/20/10-15:28
T. Suspended Solids, SM2540D	<1	mg/l		1/25/10
Turbidity, SM 2130 B	0.50	NTU's		1/20/10-17:48
E. coli, EPA 1603	<1	organisms per 100 ml		1/20/10-15:14
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/20/10-15:14

< = less than, not detected.

Harvey Klein

206577

Garden State Laboratories, Inc.

Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300121055.0
CLIENT # APP24
DATE SUBMITTED: 1/21/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION:

DATE SAMPLED: 1/21/10 TIME SAMPLED: 14:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/21/10-16:09
T. Suspended Solids, SM2540D	2	mg/l		1/28/10
Turbidity, SM 2130 B	0.40	NTU's		1/22/10-19:15
E. coli, EPA 1603	<1	organisms per 100 ml		1/21/10-15:17
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/21/10-15:17

< = less than, not detected.

Harvey Klein

206630

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300122098.0
CLIENT # APP24
DATE SUBMITTED: 1/22/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/22/10 TIME SAMPLED: 14:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/22/10-16:42
T. Suspended Solids, SM2540D	<1	mg/l		1/28/10
Turbidity, SM 2130 B	0.40	NTU's		1/22/10-19:18
E. coli, EPA 1603	<1	organisms per 100 ml		1/22/10-15:55
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/22/10-15:55

< = less than, not detected.

Harvey Klein

206739

Garden State Laboratories, Inc.

Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300129024.0
CLIENT # APP24
DATE SUBMITTED: 1/29/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/29/10 TIME SAMPLED: 12:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/29/10-15:27
T. Suspended Solids, SM2540D	<1	mg/l		2/2/10
Turbidity, SM 2130 B	0.35	NTU's		1/29/10-19:09
E. coli, EPA 1603	<1	organisms per 100 ml		1/29/10-14:49
Total Coliform, SM 9222 B	<1	organisms per 100 ml		1/29/10-14:49

< = less than, not detected.

Harvey Klein

207019

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PURETEST SYSTEM OF LABORATORY CONTROL

Bacteriological and Chemical Testing
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Hillside, New Jersey 07205

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Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 300203045.0
CLIENT # APP24
DATE SUBMITTED: 2/3/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 2/3/10 TIME SAMPLED: 13:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		2/4/10-13:27
T. Suspended Solids, SM2540D	<1	mg/l		2/8/10
Turbidity, SM 2130 B	0.60	NTU's		2/4/10-19:36
E. coli, EPA 1603	<1	organisms per 100 ml		2/3/10-15:14
Total Coliform, SM 9222 B	<1	organisms per 100 ml		2/3/10-15:14

< = less than, not detected.

Harvey Klein

207314

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

PURETEST SYSTEM OF LABORATORY CONTROL

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Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 300209093.0
CLIENT # APP24
DATE SUBMITTED: 2/9/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

john.tekula@amwater.com

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 2/9/10 TIME SAMPLED: 14:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		2/9/10-16:16
T. Suspended Solids, SM2540D	<1	mg/l		2/11/10
Turbidity, SM 2130 B	0.75	NTU's		2/9/10-20:00
E. coli, EPA 1603	<1	organisms per 100 ml		2/9/10-15:36
Total Coliform, SM 9222 B	<1	organisms per 100 ml		2/9/10-15:36

< = less than, not detected.

Harvey Klein

207531

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300219062.0
CLIENT # APP24
DATE SUBMITTED: 2/19/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 2/19/10 TIME SAMPLED: 14:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		2/19/10-16:40
T. Suspended Solids, SM2540D	<1	mg/l		2/24/10
Turbidity, SM 2130 B	0.70	NTU's		2/19/10-17:33
E. coli, EPA 1603	<1	organisms per 100 ml		2/19/10-15:37
Total Coliform, SM 9222	<1	organisms per 100 ml		2/19/10-15:37

< = less than, not detected.

Harvey Klein

207886

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300227004.0
CLIENT # APP24
DATE SUBMITTED: 2/27/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 2/27/10 TIME SAMPLED: 09:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		2/27/10-15:13
T. Suspended Solids, SM2540D	<1	mg/l		3/3/10
Turbidity, SM 2130 B	0.20*	NTU's		3/1/10-19:41
E. coli, EPA 1603	<1	organisms per 100 ml		2/27/10-10:42
Total Coliform, SM 9222	<1	organisms per 100 ml		2/27/10-10:42

< = less than, not detected.

*Analyzed past holding time

Harvey Klein

208086

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Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300302023.0
CLIENT # APP24
DATE SUBMITTED: 3/2/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 3/2/10 TIME SAMPLED: 12:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		3/3/10-13:07
T. Suspended Solids, SM2540D	<1.0	mg/l		3/4/10
Turbidity, SM 2130 B	0.45	NTU's		3/3/10-16:09
E. coli, EPA 1603	<1	organisms per 100 ml		3/2/10-15:02
Total Coliform, SM 9222	<1	organisms per 100 ml		3/2/10-15:02

< = less than, not detected.

Harvey Klein

208185

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Bacteriological and Chemical Testing
410 Hillside Avenue
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PURETEST SYSTEM OF LABORATORY CONTROL

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

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Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300312031.0
CLIENT # APP24
DATE SUBMITTED: 3/12/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 3/12/10 TIME SAMPLED: 13:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		3/12/10-15:46
T. Suspended Solids, SM2540D	<1	mg/l		3/17/10
Turbidity, SM 2130 B	0.50	NTU's		3/12/10-18:52
E. coli, EPA 1603	<1	organisms per 100 ml		3/12/10-15:54
Total Coliform, SM 9222	<1	organisms per 100 ml		3/12/10-15:54

< = less than, not detected.

Harvey Klein

208706

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Certified by U.S. Public Health Service, NJ Dept. of Health, NJDEP #20044, NY Dept. of Health #11550 and PADEP #68-03680

Garden State Laboratories, Inc.

Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

PURETEST SYSTEM OF LABORATORY CONTROL

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Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

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Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300318047.0
CLIENT # APP24
DATE SUBMITTED: 3/18/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 3/18/10 TIME SAMPLED: 13:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		3/18/10-15:29
T. Suspended Solids, SM2540D	<1	mg/l		3/24/10
Turbidity, SM 2130 B	0.70	NTU's		3/18/10-17:31
E. coli, EPA 1603	<1	organisms per 100 ml		3/18/10-15:20
Total Coliform, SM 9222	<1	organisms per 100 ml		3/18/10-15:20

< = less than, not detected.

Harvey Klein

208907

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

PURETEST SYSTEM OF LABORATORY CONTROL

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Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300326064.0
CLIENT # APP24
DATE SUBMITTED: 3/26/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONARY

DATE SAMPLED: 3/26/10 TIME SAMPLED: 13:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		3/26/10-15:10
T. Suspended Solids, SM2540D	<1	mg/l		4/1/10
Turbidity, SM 2130 B	0.40	NTU's		3/27/10-13:29
E. coli, EPA 1603	<1	organisms per 100 ml		3/26/10-15:15
Total Coliform, SM 9222	<1	organisms per 100 ml		3/26/10-15:15

< = less than, not detected.

Harvey Klein

209179

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410 Hillside Avenue
Hillside, New Jersey 07205

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Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 300402010.0
CLIENT # APP24
DATE SUBMITTED: 4/2/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID:
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 4/2/10 TIME SAMPLED: 12:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		4/2/10-14:45
T. Suspended Solids, SM2540D	<1	mg/l		4/7/10
Turbidity, SM 2130 B	0.50	NTU's		4/2/10-18:41
E. coli, EPA 1603	<1	organisms per 100 ml		4/2/10-13:42
Total Coliform, SM 9222	<1	organisms per 100 ml		4/2/10-13:42

< = less than, not detected.

Harvey Klein

209389

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Bacteriological and Chemical Testing
410 Hillside Avenue
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Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300406012.0
CLIENT # APP24
DATE SUBMITTED: 4/6/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 4/6/10 TIME SAMPLED: 11:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		4/6/10-15:07
T. Suspended Solids, SM2540D	<1	mg/l		4/12/10
Turbidity, SM 2130 B	0.15	NTU's		4/7/10-18:07
E. coli, EPA 1603	<1	organisms per 100 ml		4/6/10-12:30
Total Coliform, SM 9222	<1	organisms per 100 ml		4/6/10-12:30

< = less than, not detected.

Harvey Klein

209518

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Harvey Klein, M.S., Laboratory Director

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Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300415038.0
CLIENT # APP24
DATE SUBMITTED: 4/15/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 4/15/10 TIME SAMPLED: 13:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		4/15/10-16:07
T. Suspended Solids, SM2540D	<1	mg/l		4/21/10
Turbidity, SM 2130 B	0.45	NTU's		4/16/10-18:43
E. coli, EPA 1603	<1	organisms per 100 ml		4/15/10-15:59
Total Coliform, SM 9222	<1	organisms per 100 ml		4/15/10-15:59

< = less than, not detected.

Harvey Klein

210009

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Fax 908-688-8966
email: info@gslabs.com
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Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 300423009.0
CLIENT # APP24
DATE SUBMITTED: 4/23/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 4/23/10 TIME SAMPLED: 11:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		4/23/10-13:28
T. Suspended Solids, SM2540D	<1	mg/l		4/28/10
Turbidity, SM 2130 B	0.35	NTU's		4/23/10-19:17
E. coli, EPA 1603	<1	organisms per 100 ml		4/23/10-12:38
Total Coliform, SM 9222	<1	organisms per 100 ml		4/23/10-12:38

< = less than, not detected.

Harvey Klein

210475

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Harvey Klein, M.S., Laboratory Director

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Fax 908-688-8966
email: info@gslabs.com
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REPORT OF ANALYSIS

REPORT # 300519028.0
CLIENT # APP24
DATE SUBMITTED: 5/19/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 5/19/10 TIME SAMPLED: 12:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		5/19/10-14:17
T. Suspended Solids, SM2540D	<1	mg/l		5/25/10
Turbidity, SM 2130 B	0.35	NTU's		5/20/10-17:27
E. coli, EPA 1603	<1	organisms per 100 ml		5/19/10-15:05
Total Coliform, SM 9222	LA*	organisms per 100 ml		

< = less than, not detected.

*LA-Lab accident

Harvey Klein

211549

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Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 300621062.0
CLIENT # APP24
DATE SUBMITTED: 6/21/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 6/21/10 TIME SAMPLED: 12:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		6/21/10-15:26
T. Suspended Solids, SM2540D	<1	mg/l		6/24/10
Turbidity, SM 2130 B	0.20	NTU's		6/22/10-18:22
E. coli, EPA 1603	<1	organisms per 100 ml		6/21/10-15:24
Total Coliform, SM 9222	<1	organisms per 100 ml		6/21/10-15:24

< = less than, not detected.

Harvey Klein

212950

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410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300820009.0
CLIENT # APP24
DATE SUBMITTED: 8/20/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 8/20/10 TIME SAMPLED: 11:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		8/20/10-13:33
T. Suspended Solids, SM2540D	<1	mg/l		8/25/10
Turbidity, SM 2130 B	0.40	NTU's		8/20/10-18:56
E. coli, EPA 1603	<1	organisms per 100 ml		8/20/10-13:19
Total Coliform, SM 9222	<1	organisms per 100 ml		8/20/10-13:19

< = less than, not detected.

Harvey Klein

215877

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Harvey Klein, M.S., Laboratory Director

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Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 300914132.0
CLIENT # APP24
DATE SUBMITTED: 9/14/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 9/14/10 TIME SAMPLED: 14:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		9/14/10-13:57
T. Suspended Solids, SM2540D	<1	mg/l		9/17/10
Turbidity, SM 2130 B	0.25	NTU's		9/15/10-16:39
Fecal Coliform, SM 9222 D	<1	organisms per 100 ml		9/14/10-16:36

< = less than, not detected.

Harvey Klein

216924

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Harvey Klein, M.S., Laboratory Director

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Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 301007020.0
CLIENT # APP24
DATE SUBMITTED: 10/7/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 10/7/10 TIME SAMPLED: 14:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		10/7/10-13:16
T. Suspended Solids, SM2540D	1	mg/l		10/13/10
Turbidity, SM 2130 B	0.10	NTU's		10/7/10-18:19
Fecal Coliform, SM 9222 D	<1	organisms per 100 ml		10/7/10-15:44

< = less than, not detected.

Harvey Klein

218057

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410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 301111059.0
CLIENT # APP24
DATE SUBMITTED: 11/11/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 11/11/10 TIME SAMPLED: 13:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		11/11/10-15:37
T. Suspended Solids, SM2540D	<1	mg/l		11/17/10
Turbidity, SM 2130 B	0.35	NTU's		11/11/10-16:39
E. coli, EPA 1603	<1	organisms/100ml		11/11/10-15:37
Fecal Coliform, SM 9222 D	<1	organisms/100ml		11/11/10-15:37

< = less than, not detected.

Harvey Klein

219805

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410 Hillside Avenue
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Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 301215041.0
CLIENT # APP24
DATE SUBMITTED: 12/15/10

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 12/15/10 TIME SAMPLED: 12:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		12/15/10-18:07
T. Suspended Solids, SM2540D	<1	mg/l		12/17/10
Turbidity, SM 2130 B	0.40	NTU's		12/15/10-19:58
E. coli, EPA 1603	<1	organisms/100ml		12/15/10-15:04
Total Coliform, SM 9222	<1	organisms/100ml		12/15/10-15:04

< = less than, not detected.

Harvey Klein

221191

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Harvey Klein, M.S., Laboratory Director

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Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 310114061.0
CLIENT # APP24
DATE SUBMITTED: 1/14/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 1/14/11 TIME SAMPLED: 11:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		1/15/11-15:20
T. Suspended Solids, SM2540D	2	mg/l		1/20/11
Turbidity, SM 2130 B	0.35	NTU's		1/14/11-19:01
E. coli, EPA 1603	<1	organisms/100ml		1/14/11-14:43
Total Coliform, SM 9222	<1	organisms/100ml		1/14/11-14:43

< = less than, not detected.

Harvey Klein

222098

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

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Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

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Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 310215037.1
CLIENT # APP24
DATE SUBMITTED: 2/15/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONARE

DATE SAMPLED: 2/15/11 TIME SAMPLED: 11:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		2/16/11-12:23
T. Suspended Solids, SM2540D	<1	mg/l		2/18/11
Turbidity, SM 2130 B	0.35	NTU's		2/16/11-17:56
E. coli, EPA 1603	<10	organisms/100ml		2/15/11-14:19
Total Coliform, SM 9222	<10	organisms/100ml		2/15/11-14:19

< = less than, not detected.

Harvey Klein

223263

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Harvey Klein, M.S., Laboratory Director

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Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 310317034.0
CLIENT # APP24
DATE SUBMITTED: 3/17/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 3/17/11 TIME SAMPLED: 12:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		3/18/11-14:37
T. Suspended Solids, SM2540D	<1	mg/l		3/23/11
Turbidity, SM 2130 B	0.55	NTU's		3/18/11-16:58
E. coli, EPA 1603	<1	organisms/100ml		3/17/11-14:20
Total Coliform, SM 9222	<1	organisms/100ml		3/17/11-14:20

< = less than, not detected.

Harvey Klein

224525

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Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

REPORT OF ANALYSIS

REPORT # 310408051.0
CLIENT # APP24
DATE SUBMITTED: 4/8/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 4/8/11 TIME SAMPLED: 14:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		4/8/11-16:02
T. Suspended Solids, SM2540D	<1	mg/l		4/14/11
Turbidity, SM 2130 B	0.15	NTU's		4/8/11-19:06
E. coli, EPA 1603	<1	organisms/100ml		4/8/11-15:16
Fecal Coliform, SM 9222 D	<1	organisms/100ml		4/8/11-15:16

< = less than, not detected.

Harvey Klein

225305

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Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 310527012.0
CLIENT # APP24
DATE SUBMITTED: 5/27/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONARE

DATE SAMPLED: 5/27/11 TIME SAMPLED: 09:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		5/27/11-12:08
T. Suspended Solids, SM2540D	<1	mg/l		6/2/11
Turbidity, SM 2130 B	0.15	NTU's		5/27/11-17:40
E. coli, EPA 1603	<1	organisms/100ml		5/27/11-11:55
Total Coliform, SM 9222	<1	organisms/100ml		5/27/11-11:55

< = less than, not detected.

Harvey Klein

227329

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 310627023.0
CLIENT # APP24
DATE SUBMITTED: 6/27/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 6/27/11 TIME SAMPLED: 13:15

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		6/27/11-17:12
T. Suspended Solids, SM2540D	<1	mg/l		6/29/11
Turbidity, SM 2130 B	0.15	NTU's		6/28/11-15:21
E. coli, EPA 1603	1	organisms/100ml		6/27/11-15:13
Total Coliform, SM 9222	<1	organisms/100ml		6/27/11-15:13

< = less than, not detected.

Harvey Klein

228584

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Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 310727033.0
CLIENT # APP24
DATE SUBMITTED: 7/27/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 7/27/11 TIME SAMPLED: 11:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		7/27/11-16:00
T. Suspended Solids, SM2540D	<1	mg/l		7/28/11
Turbidity, SM 2130 B	0.40	NTU's		7/28/11-17:24
E. coli, EPA 1603	<1	organisms/100ml		7/27/11-15:23
Total Coliform, SM 9222	<1	organisms/100ml		7/27/11-15:23

< = less than, not detected.

Harvey Klein

229871

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410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

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Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 310727033.0
CLIENT # APP24
DATE SUBMITTED: 7/27/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 7/27/11 TIME SAMPLED: 11:00

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		7/27/11-16:00
T. Suspended Solids, SM2540D	<1	mg/l		7/28/11
Turbidity, SM 2130 B	0.40	NTU's		7/28/11-17:24
E. coli, EPA 1603	<1	organisms/100ml		7/27/11-15:23
Total Coliform, SM 9222	<1	organisms/100ml		7/27/11-15:23

< = less than, not detected.

Harvey Klein

229871

Garden State Laboratories, Inc.

Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 310805017.0
CLIENT # APP24
DATE SUBMITTED: 8/5/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 8/5/11 TIME SAMPLED: 11:30

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		8/5/11-13:48
T. Suspended Solids, SM2540D	<1	mg/l		8/11/11
Turbidity, SM 2130 B	0.20	NTU's		8/5/11-15:59
E. coli, EPA 1603	<1	organisms/100ml		8/5/11-12:53
Total Coliform, SM 9222	<1	organisms/100ml		8/5/11-12:53

< = less than, not detected.

Harvey Klein

230318

Garden State Laboratories, Inc.

Bacteriological and Chemical Testing
410 Hillside Avenue
Hillside, New Jersey 07205

Mathew Klein, M.S., Founder (1916-1996)
Harvey Klein, M.S., Laboratory Director

ACCREDITED IN ACCORDANCE WITH nelac

Toll Free 800-273-8901
Telephone 908-688-8900
Fax 908-688-8966
email: info@gslabs.com
Internet: www.gslabs.com

REPORT OF ANALYSIS

REPORT # 310927017.0
CLIENT # APP24
DATE SUBMITTED: 9/27/11

TO: Applied Water MGMT-J. Tekula
2 Clerico Lane

Hillsborough NJ 08844
ATT: John Tekula

SAMPLE TYPE: WASTEWATER, GRAB SAMPLE
SAMPLE ID: EFFLUENT
SAMPLE LOCATION: VISIONAIRE

DATE SAMPLED: 9/27/11 TIME SAMPLED: 10:45

ANALYSIS	RESULT	UNITS		DATE ANALYZED
BOD, SM 5210 B	<6	mg/l		9/28/11-16:28
T. Suspended Solids, SM2540D	<1	mg/l		9/30/11
Turbidity, SM 2130 B	0.15	NTU's		9/28/11-14:45
E. coli, EPA 1603	<1	organisms/100ml		9/27/11-15:25
Total Coliform, SM 9222	<1	organisms/100ml		9/27/11-15:25

< = less than, not detected.

Harvey Klein

232651

The liability of Garden State Laboratories, Inc. for services rendered shall in no event exceed the amount of the invoice.
Certified by U.S. Public Health Service, NJ Dept. of Health, NJDEP #20044, NY Dept. of Health #11550 and PADEP #68-03680

Appendix H: Chemtreat service report and certificate of analysis

HVAC SERVICE REPORT

ChemTreat, Inc
445 Park Avenue
New York, NY 10022
Phone: (212) 836-4721 FAX: (212) 836-4720
email: mitchk@chemtreat.com

Company: THE VISIONAIRE
Address: 70 Little West Street
City: New York
State: NY Zip: 10280
Phone: (212) 406-8036
To: Kevin Grady

Copy: Michael Gubbins
Copy: Miroslav Salon
Copy: Michael Gubbins
Copy:
Copy:

Report Date: 05/19/2010

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH		7.58		7.96	8.95	10.26	7.4/7/6	9.0/10.0	pH units
Conductivity	90	615		605	365	1390	1400/1600	400/800	
Total Hardness	20.4	70.0		108.0			< 200		
Ca Hardness	15.0	50.0		78.0			< 150		
Mg Hardness	5.4	20.0		30.0			< 50		
Phosphate	1.80	1.0		7.9			<25		
Molybdate				6.50	91.0		0.4/0.8	100/125	ppm Mo
Bromine				0.15			0.2/0.4		ppm Br2
Tolyltriazole				1.7			2.0/4.0	5.0/10.0	ppm TTA
Iron				0.36	1.10	0.15	< 1.0	< 1.0	ppm Fe
Copper				0.42	0.01	0.01	< 0.5	< 0.5	ppm Cu
Total Bacteria				100	0		< 10,000	< 1,000	col/ml
INVENTORY	CL-4894	on order	CL-3856	on order	C-2188	100 lbs	CL-2112	10 gallons	

Today's test results are as follows:

CITY WATER- Tower on 100% city water makeup

GRAY WATER- Excellent PO4 removal, but high pH. The pH needs to be below 7.0 to prevent high pH conditions in the cooling tower once on partial gray water makeup.

MIXED MAKEUP- No sample at this time.

TOWER- Low conductivity due to excessive bleed off cause by a conductivity electrode needing recalibration, which was completed. Chemical levels are low as expected.

Technical Representative: Mitch Kaufman

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CHILLED- Low molybdate and pH. I added 5 gallons of CL-2874 to the bypass feeder in order to raise both.

HOT WATER- Low nitrite level. I added 5 gallons of BL-180 to the bypass feeder. No further action required at this time.

Technical Representative: Mitch Kaufman

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Copy: Michael Gubbins
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Report Date: 06/29/2010 Page: 1

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH	7.16	7.90	7.29	8.38	9.53	10.14	7.4/7/6	9.0/10.0	pH units
Conductivity	75	705	165	2300	420	1360	1400/1600	400/800	
Total Hardness	17.2	76.0	26.0	350.0			< 200		
Ca Hardness	13.1	58.0	19.0	262.0			< 150		
Mg Hardness	4.1	18.0	7.0	88.0			< 50		
Phosphate	2.50	3.8	2.50	11.7			<25		
Molybdate/				2.50	108.0	550	0.4/0.8	100/125	ppm Mo
Bromine				0.06			0.2/0.4		ppm Br2
Tolyltriazole				1.2			2.0/4.0	5.0/10.0	ppm TTA
Iron				0.24	5.20	0.13	< 1.0	< 1.0	ppm Fe
Copper				0.23	0.01	0.01	< 0.5	< 0.5	ppm Cu
Total Bacteria		0		100			< 10,000	< 1,000	col/ml
INVENTORY	CL-4816	60 gallons	CL-49	discontinu	C-2188	50 lbs	CL-2156	50 gallons	

Today's test results are as follows:

BLACK WATER- Very high pH and high PO4. I notified John from Applied Water that this is a problem for our program.

MIXED MAKEUP- Operating at approximately 80% city water at the moment.

TOWER- Very high conductivity! The conductivity electrode had to be recalibrated. This will restore system to proper levels.

CHILLED- Molybdate and pH are in range. No action required at this time.

Technical Representative: Mitch Kaufman

HVAC SERVICE REPORT

ChemTreat, Inc
445 Park Avenue
New York, NY 10022
Phone: (212) 836-4721 FAX: (212) 836-4720
email: mitchk@chemtreat.com

Company:	THE VISIONAIRE	Copy:	Michael Gubbins
Address:	70 Little West Street	Copy:	
City:	New York	Copy:	
State:	NY Zip: 10280	Copy:	
Phone:	(212) 406-8036	Copy:	
To:	Kevin Grady		

Report Date: 06/29/2010 THE VISIONAIRE Page: 2

HW HEATING- Nitrite is just below range. I added 5 gallons of BL-180 to the bypass feeder.

Technical Representative: Mitch Kaufman

HVAC SERVICE REPORT

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Phone: (212) 406-8036
To: Kevin Grady

Copy: Michael Gubbins
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Report Date: 07/19/2010 Page: 1

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH		7.57	7.65	7.73	9.19	10.54	7.4/7/6	9.0/10.0	pH units
Conductivity	80	610	145	655	385	1790	1400/1600	400/800	
Total Hardness	18.2	68.0	24.0	112.0			< 200		
Ca Hardness	13.9	49.0	17.8	84.0			< 150		
Mg Hardness	4.3	19.0	6.2	28.0			< 50		
Phosphate	2.60	2.7	2.60	8.8			<25		
Molybdate/Nitrite				0.45	94.5	780	0.4/0.8	100/125	ppm Mo
Bromine				0.14			0.2/0.4		ppm Br2
Tolyltriazole				1.6			2.0/4.0	5.0/10.0	ppm TTA
Iron					4.85	0.18	< 1.0	< 1.0	ppm Fe
Copper					0.01	0.04	< 0.5	< 0.5	ppm Cu
Total Bacteria							< 10,000	< 1,000	col/ml
INVENTORY	CL-4816	60 gallons	CL-49	discontinu	C-2188	on order	CL-2156	60 gallons	

Today's test results are as follows:

BLACK WATER- Continued operation at very high pH. I notified John from Applied Water that this is a problem for our program. Please make sure that pH electrode is cleaned and calibrated weekly.

MIXED MAKEUP- Operating at approximately 80% city water at the moment.

TOWER- Low conductivity! Tower was cleaned over the weekend.

CHILLED- Low molybdate due to recent water loss. I added 5 gallons of CL-2874 to the bypass feeder.

HW HEATING- Nitrite is back in range. No action required at this time.

Technical Representative: Mitch Kaufman

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Phone: (212) 406-8036
To: Kevin Grady

Copy: Michael Gubbins
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Report Date: 08/16/2010 Page: 1

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH		6.94	6.95	7.85		10.50	7.4/7/6	9.0/10.0	pH units
Conductivity	80	550	145	945	475	1730	1400/1600	400/800	
Total Hardness	18.4	74.0	25.6	154.0			< 200		
Ca Hardness	14.0	52.0	19.0	110.0			< 150		
Mg Hardness	4.4	22.0	6.6	44.0			< 50		
Phosphate	1.80	0.8	1.70	7.5			<25		
Molybdate				0.53	130.0		0.4/0.8	100/125	ppm Mo
Bromine				0.05			0.2/0.4		ppm Br2
Tolyltriazole				1.2			2.0/4.0	5.0/10.0	ppm TTA
Iron				0.15	4.00	0.07	< 1.0	< 1.0	ppm Fe
Copper				0.18	0.01	0.02	< 0.5	< 0.5	ppm Cu
Total Bacteria			0	10			< 10,000	< 1,000	col/ml
INVENTORY	CL-4816	55 gallons	CL-49	discontinu	C-2188	150 lbs	CL-2156	60 gallons	

Today's test results are as follows:

BLACK WATER- The pH and phosphate level are both under control. Please make sure that pH electrode is cleaned and calibrated weekly.

MIXED MAKEUP- Operating at approximately 80% city water at the moment.

TOWER- Excellent readings! No action required at this time!

CHILLED- Low molybdate due to recent water loss. I added 5 gallons of CL-2874 to the bypass feeder.

HW HEATING- Nitrite is back in range. No action required at this time.

Technical Representative: Mitch Kaufman

HVAC SERVICE REPORT

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State: NY Zip: 10280
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To: Kevin Grady

Copy: Michael Gubbins
Copy:
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Report Date: 09/28/2010 Page: 1

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH		8.06	7.90	8.40	9.63	10.45	7.4/7/6	9.0/10.0	pH units
Conductivity	80	830	90	5450	240	1540	1400/1600	400/800	
Total Hardness	18.5	88.0	21.8	500.0			< 200		
Ca Hardness	14.1	64.0	16.2	500.0			< 150		
Mg Hardness	4.4	24.0	5.6	300.0			< 50		
Phosphate	2.40	1.4	2.00	11.9			<25		
Molybdate				3.07	38.5		0.4/0.8	100/125	ppm Mo
Bromine				0.07			0.2/0.4		ppm Br2
Tolyltriazole				3.3			2.0/4.0	5.0/10.0	ppm TTA
Iron				0.65		0.40	< 1.0	< 1.0	ppm Fe
Copper				0.59	0.01	0.04	< 0.5	< 0.5	ppm Cu
Total Bacteria		10		100			< 10,000	< 1,000	col/ml
INVENTORY	CL-4816	50 gallons	CL-49	discontinu	C-2188	150 lbs	CL-2156	50 gallons	

Today's test results are as follows:

BLACK WATER- Continued operation at very high pH. I notified John from Applied Water that this is a problem for our program. Please make sure that pH electrode is cleaned and calibrated weekly.

MIXED MAKEUP- Operating at approximately 80% city water at the moment. The pH is high due to the affects from the black water

TOWER- Very high conductivity! Trackster was not working properly. Computer needs to be in administrative mode for program to work.

CHILLED- Low molybdate due to recent water loss. I added 5 gallons of CL-2874 to the bypass feeder.

Technical Representative: Mitch Kaufman

HVAC SERVICE REPORT

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To: Kevin Grady

Copy: Michael Gubbins
Copy:
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Copy:
Copy:

HW HEATING- Nitrite and pH are in range. No action required at this time.

Technical Representative: Mitch Kaufman

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To: Kevin Grady

Copy: Michael Gubbins
Copy:
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Report Date: 10/19/2010 Page: 1

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH		6.86	6.88	7.92	9.37	10.06	7.4/7/6	9.0/10.0	pH units
Conductivity	80	840	830	695	510	1710	1400/1600	400/800	
Total Hardness	17.9	90.0	85.0	72.0			< 200		
Ca Hardness	13.8	57.0	55.0	48.0			< 150		
Mg Hardness	4.1	32.0	30.0	24.0			< 50		
Phosphate	2.50	2.1	2.20	4.2			<25		
Molybdate				0.45	147.5		0.4/0.8	100/125	ppm Mo
Bromine				0.20			0.2/0.4		ppm Br2
Tolyltriazole				0.9			2.0/4.0	5.0/10.0	ppm TTA
Iron				0.35	10.00	0.85	< 1.0	< 1.0	ppm Fe
Copper				0.19	0.01	0.03	< 0.5	< 0.5	ppm Cu
Total Bacteria			10	0			< 10,000	< 1,000	col/ml
INVENTORY	CL-4894	50 gallons	CL-49	5 gallons	C-2188	150 lbs	CL-2156	45 gallons	

Today's test results are as follows:

GRAY WATER- Phosphate and pH are in range. Concerned about high conductivity.

MIXED MAKEUP- Almost 100% Gray Water at time of sampling.

TOWER- Low conductivity due to fluctuations in the makeup conductivity after installing new regulating valves. This should be corrected shortly. All other readings are good.

CHILLED- Molybdate and pH are in range. No action required at this time

HOT WATER- Nitrite and pH are in range. No action required at this time.

Technical Representative: Mitch Kaufman

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To: Kevin Grady

Copy: Michael Gubbins
Copy:
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Copy:

Report Date: 11/18/2010 Page: 1

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH		6.82	6.85	7.50	9.31	10.21	7.4/7/6	9.0/10.0	pH units
Conductivity	95	845	105	710	500	1655	1400/1600	400/800	
Total Hardness	20.8	91.0	21.0	92.0			< 200		
Ca Hardness	16.0	58.0	16.0	62.0			< 150		
Mg Hardness	4.8	33.0	5.0	30.0			< 50		
Phosphate	1.60	1.0	1.50	4.5			<25		
Molybdate				0.40	133.0		0.4/0.8	100/125	ppm Mo
Bromine				0.20			0.2/0.4		ppm Br2
Tolyltriazole				0.8			2.0/4.0	5.0/10.0	ppm TTA
Iron				0.40	6.10	0.75	< 1.0	< 1.0	ppm Fe
Copper				0.20	0.01	0.02	< 0.5	< 0.5	ppm Cu
Total Bacteria			0	0			< 10,000	< 1,000	col/ml
INVENTORY	CL-4816	45 gallons	CL-49	N/A	C-2188	100 lbs	CL-2156	30 gallons	

Today's test results are as follows:

GRAY WATER- Phosphate and pH are in range. Concerned about high conductivity.

MIXED MAKEUP- Almost 100% City Water at time of sampling.

TOWER- Low conductivity due to fluctuations in the makeup conductivity after installing new regulating valves. This should be corrected shortly. All other readings are good.

CHILLED- Molybdate and pH are in range. No action required at this time

HOT WATER- Nitrite and pH are in range. No action required at this time.

Technical Representative: Mitch Kaufman

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To: Kevin Grady

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Report Date: 12/14/2010 Page: 1

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH		6.98		7.96	9.35	10.22	7.4/7/6	9.0/10.0	pH units
Conductivity	85	745		1385	485	1595	1400/1600	400/800	
Total Hardness	18.6	86.0		184.0			< 200		
Ca Hardness	14.3	54.0		136.0			< 150		
Mg Hardness	4.2	32.0		48.0			< 50		
Phosphate	2.20	1.5		6.3			<25		
Molybdate				0.62	128.0		0.4/0.8	100/125	ppm Mo
Bromine				0.14			0.2/0.4		ppm Br2
Tolyltriazole				2.5			2.0/4.0	5.0/10.0	ppm TTA
Iron				0.68	5.95	0.74	< 1.0	< 1.0	ppm Fe
Copper				0.18	0.01	0.04	< 0.5	< 0.5	ppm Cu
Total Bacteria		0		10			< 10,000	< 1,000	col/ml
INVENTORY	CL-4816	50 gallons	C-2188	150 lbs	CL-2156	65 gallons	CL-2874	15 gallons	
	BL-180	out							

Today's test results are as follows:

GRAY WATER- Phosphate is under control, while the pH is slightly elevated. Please keep pH below 6.8.

TOWER- Excellent readings! No action required at this time.

CHILLED- Molybdate and pH are in range. No action required at this time.

HW HEATING- Nitrite and pH are in range. No action required at this time.

Technical Representative: Mitch Kaufman

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Report Date: 01/11/2011 Page: 1

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH		7.49		7.84	9.32	10.25	7.4/7/6	9.0/10.0	pH units
Conductivity	90	725		1100	465	1535	1400/1600	400/800	
Total Hardness	19.4	80.0		134.0			< 200		
Ca Hardness	15.1	60.0		98.0			< 150		
Mg Hardness	4.3	20.0		36.0			< 50		
Phosphate	2.20	1.9		4.3			<25		
Molybdate				0.56	123.5		0.4/0.8	100/125	ppm Mo
Bromine				0.06			0.2/0.4		ppm Br2
Tolyltriazole				2.8			2.0/4.0	5.0/10.0	ppm TTA
Iron				1.15	5.35	0.72	< 1.0	< 1.0	ppm Fe
Copper				0.26	0.01	0.05	< 0.5	< 0.5	ppm Cu
Total Bacteria		10		10			< 10,000	< 1,000	col/ml
INVENTORY	CL-4816	40 gallons	C-2188	125 lbs	CL-2156	65 gallons	CL-2874	15 gallons	
	BL-180	on order							

Today's test results are as follows:

GRAY WATER- The pH is on the high side. Please maintain between 6.4 and 6.8 in order to keep the condenser water pH below 8.0.

TOWER- Using 100% gray water makeup through Winter. Low conductivity due to low load conditions and high precipitation. I refilled the brominator with C-2188 tablets.

CHILLED WATER- Molybdate and pH are in range. No action required at this time.

HW HEATING- Nitrite and pH are in range. No action required at this time.

Technical Representative: Mitch Kaufman

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New York, NY 10022
Phone: (212) 836-4721 FAX: (212) 836-4720
email: mitchk@chemtreat.com

Company: THE VISIONAIRE
Address: 70 Little West Street
City: New York
State: NY Zip: 10280
Phone: (212) 406-8036
To: Kevin Grady

Copy: Michael Gubbins
Copy:
Copy:
Copy:
Copy:

Report Date: 02/17/2011 Page: 1

	CITY MAKEUP	GRAY WATER	MIXED MAKEUP	TOWER	CHILLED	HOT WATER	TOWER LIMITS	CLOSED LIMITS	UNITS
pH		6.80		7.44	9.30	10.31	7.4/7/6	9.0/10.0	pH units
Conductivity	80	560		1630	430	1480	1400/1600	400/800	
Total Hardness	17.8	56.0		215.0			< 200		
Ca Hardness	14.0	43.0		160.0			< 150		
Mg Hardness	3.8	13.0		55.0			< 50		
Phosphate	2.00	1.2		4.8			<25		
Molybdate				0.55	115.0		0.4/0.8	100/125	ppm Mo
Bromine				0.20			0.2/0.4		ppm Br2
Tolyltriazole				1.3			2.0/4.0	5.0/10.0	ppm TTA
Iron				0.80	4.95	0.68	< 1.0	< 1.0	ppm Fe
Copper				0.24	0.01	0.03	< 0.5	< 0.5	ppm Cu
Total Bacteria		10		0			< 10,000	< 1,000	col/ml
INVENTORY	CL-4816	45 gallons	C-2188	100 lbs	CL-2156	60 gallons	CL-2874	15 gallons	
	BL-180	on order							

Today's test results are as follows:

GRAY WATER- Good pH and phosphate control.

TOWER- Using 100% gray water makeup through Winter. High conductivity due to blockage in Wye Strainer, resulting in a "no-flow" condition. This locked out the bleed off and the chemical feed. I cleaned out the strainer and restored flow to the flow switch.

CHILLED WATER- Molybdate and pH are in range. No action required at this time.

HW HEATING- Low nitrite! I will add 5 gallons of BL-180 to the bypass feeder.

Technical Representative: Mitch Kaufman

ChemTreat,Inc.

Water Treatment Service Report

Company:	The Visionaire	Copy:	Michael Gubbins
Address:	70 Little West Street	Copy:	
City:	New York	Copy:	
State:	New York Zip: 102809	Copy:	
To:	Albert Dutchin	Copy:	

Report Date: 05.10.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chillled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				0.41	0.5 -1.0 ppm			
pH		10.14		8.45	8.8 max			
Conductivity	100	466	176	789	1,200 max			
Chlorine (Bromine)				0.14	0.1 – 0.5			
Ortho-Phosphate		1.5		4.5	record			
Nitrite							1,200	900-1000 ppm
Conductivity							1,489	1,500 – 3,500
pH							9.81	record
Molybdenum						118		70-90 ppm
Conductivity						423		Record
pH						9.34		8.5-10.5

Cooling Tower –
- Molybdenum level slightly low – inhibitor feed rate increased.
- Good conductivity level.

Chilled Loop –
- Good Chemical residual. Good pH level.

Hot Loop –
- Good Chemical Level. Good pH value.

Chemical Inventory Order							

ChemTreat Representative: John Nicolai 914-522-3458

Water Treatment Service Report

Company:	The Visionaire	Copy:	Michael Gubbins
Address:	70 Little West Street	Copy:	
City:	New York	Copy:	
State:	New York Zip: 102809	Copy:	
To:	Albert Dutchin	Copy:	

Report Date: 05.31.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chilled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				0.38	0.5 -1.0 ppm			
pH		7.96		8.59	8.8 max			
Conductivity	98	538		1,452	1,200 max			
Chlorine (Bromine)				0.08	0.1 – 0.5			
Ortho-Phosphate		0.8		8.4	record			
Nitrite							1,100	900-1000 ppm
Conductivity							1,411	1,500 – 3,500
pH							10.41	record
Molybdenum						116		70-90 ppm
Conductivity						417		Record
pH						9.14		8.5-10.5

Cooling Tower –
- Molybdenum level slightly low – inhibitor feed rate increased.
- New injection fitting ordered for CL1473 feed – drip leak observed.
- Conductivity level was high – conductivity probe calibrated..

Chilled Loop –
- Good Chemical residual. Good pH level.

Hot Loop –
- Good Chemical Level. Good pH value.

Chemical							
Inventory							
Order							

ChemTreat Representative: John Nicolai 914-522-3458

Water Treatment Service Report

Company:	The Visionaire	Copy:	Michael Gubbins
Address:	70 Little West Street	Copy:	
City:	New York	Copy:	
State:	New York Zip: 102809	Copy:	
To:	Albert Dutchin	Copy:	

Report Date: 06.07.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chillled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				0.61	0.5 -1.0 ppm			
pH				8.43	8.8 max			
Conductivity	98			1,019	1,200 max			
Chlorine (Bromine)				0.11	0.1 – 0.5			
Ortho-Phosphate				7.1	record			
Nitrite								900-1000 ppm
Conductivity								1,500 – 3,500
pH								record
Molybdenum								70-90 ppm
Conductivity								Record
pH								8.5-10.5

Today's service was to replace leaking CL4816 fitting and test the cooling tower system

Cooling Tower –

- **Conductivity probe calibrated. Flow sensor cleaned. Strainer flushed.**
- **Chemical pumps tested. Replacement injection fitting installed for CL4816 feed.**
- **Conductivity level is now within control after servicing controller on 5/31.**
- **Brominator fresh water make-up feed (3 x 20 minutes daily) was reviewed with Paul.**

Chemical							
Inventory							
Order							

ChemTreat Representative: **John Nicolai 914-522-3458**

Water Treatment Service Report

Company:	The Visionaire	Copy:	Michael Gubbins
Address:	70 Little West Street	Copy:	
City:	New York	Copy:	
State:	New York Zip: 102809	Copy:	
To:	Albert Dutchin	Acct #:	25682-00

Report Date: 06.28.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chillled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				6.1	0.5 -1.0 ppm			
pH		8.21		8.65	8.8 max			
Conductivity	90	491		1,763	1,200 max			
Chlorine (Bromine)				0.22	0.1 – 0.5			
Ortho-Phosphate		1.6		14.6	record			
Nitrite							950	900-1000 ppm
Conductivity							1480	1,500 – 3,500
pH							9.32	record
Molybdenum						112		70-90 ppm
Conductivity						416		Record
pH						8.81		8.5-10.5

Cooling Tower –
- Conductivity probe calibrated.
- Chemical feed rate lowered
- Corrosion coupons exchanged – visually look improved over last months coupons – lab results to follow

Chilled Loop –
- Good Chemical residual. Good pH level.

Hot Loop –
- Good Chemical Level. Good pH value.
- BL180 Added to system to maintain desired chemical residuals

Chemical Inventory Order							

ChemTreat Representative: John Nicolai 914-522-3458

ChemTreat, Inc.

Water Treatment Service Report

Company: The Visionaire
Address: 70 Little West Street
City: New York
State: New York Zip: 102809
To: Albert Dutchin

Copy: Michael Gubbins
Copy:
Copy:
Copy:
Acct #: 25682-00

Report Date: 07.14.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chillled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				4.2	0.5 -1.0 ppm			
pH		7.23		8.64	8.8 max			
Conductivity	82	525		1,892	record			
Chlorine (Bromine)		0.05		0.29	0.1 – 0.5			
Ortho-Phosphate		2.2		5.3	record			
Nitrite							1,100	900-1000 ppm
Conductivity							1621	1,500 – 3,500
pH							9.46	record
Molybdenum						109		70-90 ppm
Conductivity						409		Record
pH						8.93		8.5-10.5

Cooling Tower –
- Good conductivity and chemical levels.
- Bromine tablets added to brominator.
- Deposit Monitor coupon inspected – visually looks excellent

Chilled Loop –
- Good Chemical residual. Good pH level.

Hot Loop –
- Good Chemical Level. Good pH value.
- Nitrite level has risen slightly from recent BL180 addition.

Chemical							
Inventory							
Order							

ChemTreat Representative: John Nicolai 914-522-3458

Water Treatment Service Report

ChemTreat, Inc.

Company:	The Visionaire	Copy:	Michael Gubbins
Address:	70 Little West Street	Copy:	
City:	New York	Copy:	
State:	New York Zip: 102809	Copy:	
To:	Albert Dutchin	Acct #:	25682-00

Report Date: 07.26.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chillled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				5.4	0.5 -1.0 ppm			
pH		7.07		8.59	8.8 max			
Conductivity	80	629		1,965	record			
Chlorine (Bromine)				0.37	0.1 – 0.5			
Ortho-Phosphate		2.3		13.1	record			
Nitrite							1,050	900-1000 ppm
Conductivity							1640	1,500 – 3,500
pH							9.42	record
Molybdenum						104		70-90 ppm
Conductivity						409		Record
pH						9.04		8.5-10.5

Cooling Tower –

- Good conductivity and chemical levels.
- Bromine tablets added to brominator.
- Deposit Monitor coupon inspected – visually looks excellent
- Corrosion coupons exchanged. Bypass strainter pulled and cleaned today by Albert – Thank You!

Chilled Loop –

- Good Chemical residual. Good pH level.

Hot Loop –

- Good Chemical Level. Good pH value.

Chemical							
Inventory							
Order							

ChemTreat Representative: John Nicolai 914-522-3458

ChemTreat, Inc.

Water Treatment Service Report

Company:	The Visionaire	Copy:	Michael Gubbins
Address:	70 Little West Street	Copy:	
City:	New York	Copy:	
State:	New York Zip: 102809	Copy:	
To:	Albert Dutchin	Acct #:	25682-00

Report Date: 08.04.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chillled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				8.1	0.5 -1.0 ppm			
pH		7.21		8.33	8.8 max			
Conductivity	84	584		2,378	record			
Chlorine (Bromine)				0.19	0.1 – 0.5			
Ortho-Phosphate		1.5		14.7	record			
Nitrite							1,000	900-1000 ppm
Conductivity							1621	1,500 – 3,500
pH							9.45	record
Molybdenum						102		70-90 ppm
Conductivity						387		Record
pH						9.05		8.5-10.5

Cooling Tower –
- Good conductivity and chemical levels.
- Deposit Monitor coupon inspected – visually looks excellent

Chilled Loop –
- Good Chemical residual. Good pH level.

Hot Loop –
- Good Chemical Level. Good pH value.

Chemical							
Inventory							
Order							

ChemTreat Representative: John Nicolai 914-522-3458

Water Treatment Service Report

Company:	The Visionaire	Copy:	Michael Gubbins
Address:	70 Little West Street	Copy:	
City:	New York	Copy:	
State:	New York Zip: 102809	Copy:	
To:	Albert Dutchin	Acct #:	25682-00

Report Date: 08.11.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chilled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				4.8	0.5 -1.0 ppm			
pH		7.41		8.34	8.8 max			
Conductivity	81	451		3,314	record			
Chlorine (Bromine)				0.21	0.1 – 0.5			
Ortho-Phosphate		1.6		15.8	record			
Nitrite							1,050	900-1000 ppm
Conductivity							1643	1,500 – 3,500
pH							9.52	record
Molybdenum						105		70-90 ppm
Conductivity						392		Record
pH						9.28		8.5-10.5

<u>Cooling Tower</u> –
- Good conductivity and chemical levels.
- Conductivity setpoint is gradually being increased to increase water savings
- Deposit Monitor coupon inspected – visually looks excellent

<u>Chilled Loop</u> –
- Good Chemical residual. Good pH level.

<u>Hot Loop –</u>
- Good Chemical Level. Good pH value.

Chemical Inventory Order							

ChemTreat Representative: John Nicolai 914-522-3458

ChemTreat, Inc.

Water Treatment Service Report

Company: The Visionaire
Address: 70 Little West Street
City: New York
State: New York Zip: 102809
To: Albert Dutchin

Copy: Michael Gubbins
Copy:
Copy:
Copy:
Acct #: 25682-00

Report Date: 09.15.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chilled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				8.4	0.5 -1.0 ppm			
pH		7.35		8.59	8.8 max			
Conductivity	86	444		4,975	record			
Chlorine (Bromine)				0.30	0.1 – 0.5			
Ortho-Phosphate	1.7	1.2		17.5	record			
Nitrite							1,050	900-1000 ppm
Conductivity							1618	1,500 – 3,500
pH							9.57	record
Molybdenum						105		70-90 ppm
Conductivity						391		Record
pH						9.27		8.5-10.5

Cooling Tower –
- Good conductivity and chemical levels.
- Deposit Monitor coupon inspected – visually looks excellent

Chilled Loop –
- Good Chemical residual. Good pH level.

Hot Loop –
- Good Chemical Level. Good pH value.

Chemical							
Inventory							
Order							

ChemTreat Representative: John Nicolai 914-522-3458

ChemTreat, Inc.

Water Treatment Service Report

Company: The Visionaire
Address: 70 Little West Street
City: New York
State: New York Zip: 102809
To: Albert Dutchin

Copy: Michael Gubbins
Copy:
Copy:
Copy:
Acct #: 25682-00

Report Date: 09.26.2011

	CITY	GREY WATER	STORM WATER	COOLING TOWER	LIMITS	Chilled Loop	Hot Loop	LIMITS
				ON				
Molybdenum				4.7	0.5 -1.0 ppm			
pH		7.24		8.65	8.8 max			
Conductivity	101	465		5,112	record			
Chlorine (Bromine)				0.30	0.1 – 0.5			
Ortho-Phosphate	1.8	1.4		16.2	record			
Nitrite							1,050	900-1000 ppm
Conductivity							1618	1,500 – 3,500
pH							9.57	record
Molybdenum						106		70-90 ppm
Conductivity						397		Record
pH						9.29		8.5-10.5

Cooling Tower –
- Good conductivity and chemical levels.
- Deposit Monitor coupon inspected – visually looks excellent

Chilled Loop –
- Good Chemical residual. Good pH level.

Hot Loop –
- Good Chemical Level. Good pH value.
- BL280 added to system to maintain desired residuals.

Chemical							
Inventory							
Order							

ChemTreat Representative: John Nicolai 914-522-3458

ChemTreat, Inc.

Certificate of Analysis

May 24, 2010

Laboratory No. 10−05−24−26
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date May 19, 2010
Sample Class Waters

Analysis	CITY WATER	GRAY WATER	CONDENSER	CHILLED
pH	7.11	7.58	8.09	8.95
Conductivity, µmho	98	614	612	363
"M"−Alkalinity, as $CaCO_3$, mg/L	15	34	104	86
Calcium Hardness, as $CaCO_3$, mg/L	15	50	78	15
Magnesium Hardness, as $CaCO_3$, mg/L	5.4	20	30	4.7
Iron, as Fe, mg/L	<0.05	<0.05	0.68	0.41
Copper, as Cu, mg/L	<0.05	<0.05	0.37	0.07
Zinc, as Zn, mg/L	<0.05	<0.05	0.37	<0.05
Sodium, as Na, mg/L	6.4	89	76	70
Potassium, as K, mg/L	0.39	13	25	4.5
Chloride, as Cl, mg/L	14	69	85	−
Sulfate, as SO_4, mg/L	−	−	31	−
Nitrate, as NO_3, mg/L	−	131	−	−
Ortho−Phosphate, as PO_4, mg/L	1.8	0.95	6.7	2.3
Silica, as SiO_2, mg/L	2.8	5.4	14	3.8
Ammonia, as NH_3, mg/L	−	0.11	0.40	−
Tolyltriazole, mg/L	−	−	1.7	1.9
Total Iron, as Fe, mg/L	0.07	−	2.0	1.1
Total Copper, as Cu, mg/L	0.14	−	0.58	0.89
Bromide, as Br, mg/L	−	−	6.4	−
Total Zinc, as Zn, mg/L	<0.05	−	0.61	<0.05
Nitrite, as NO_2, mg/L	−	−	−	<0.50
Total Phosphate, as PO_4, mg/L	1.8	0.95	7.9	3.4
Molybdenum, as Mo, mg/L	<0.05	<0.05	7.0	91

Comments MIXED MU SAMPLE NOT RECEIVED

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: MITCH KAUFMAN

Certificate of Analysis

May 24, 2010

Laboratory No. 10−05−24−26
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date May 19, 2010
Sample Class Waters

Analysis	HW HEATING
pH	10.26
Conductivity, µmho	1389
"M"−Alkalinity, as $CaCO_3$, mg/L	208
Calcium Hardness, as $CaCO_3$, mg/L	2.6
Magnesium Hardness, as $CaCO_3$, mg/L	0.54
Iron, as Fe, mg/L	<0.05
Copper, as Cu, mg/L	0.06
Zinc, as Zn, mg/L	<0.05
Sodium, as Na, mg/L	290
Potassium, as K, mg/L	6.8
Chloride, as Cl, mg/L	−
Sulfate, as SO_4, mg/L	−
Nitrate, as NO_3, mg/L	−
Ortho−Phosphate, as PO_4, mg/L	<0.50
Silica, as SiO_2, mg/L	4.2
Ammonia, as NH_3, mg/L	−
Tolyltriazole, mg/L	26
Total Iron, as Fe, mg/L	0.14
Total Copper, as Cu, mg/L	2.7
Bromide, as Br, mg/L	−
Total Zinc, as Zn, mg/L	<0.05
Nitrite, as NO_2, mg/L	393
Total Phosphate, as PO_4, mg/L	0.97
Molybdenum, as Mo, mg/L	26

ChemTreat, Inc.

Certificate of Analysis

August 18, 2010

Laboratory No. 10−08−18−14
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date August 16, 2010
Sample Class Waters

Analysis	CITY WATER	BLACK WATER	MIXED MU	CONDENSER
pH	6.91	6.94	6.93	7.74
Conductivity, µmho	78	551	142	946
"M"−Alkalinity, as $CaCO_3$, mg/L	15	20	20	65
Calcium Hardness, as $CaCO_3$, mg/L	14	52	19	110
Magnesium Hardness, as $CaCO_3$, mg/L	4.4	22	6.6	44
Iron, as Fe, mg/L	<0.05	<0.05	<0.05	0.11
Copper, as Cu, mg/L	0.08	<0.05	<0.05	0.17
Zinc, as Zn, mg/L	−	<0.05	<0.05	0.10
Sodium, as Na, mg/L	7.0	72	18	−
Potassium, as K, mg/L	0.36	7.5	1.1	−
Chloride, as Cl, mg/L	11	98	22	159
Sulfate, as SO_4, mg/L	−	−	6.0	42
Nitrate, as NO_3, mg/L	−	85	11	−
Ortho−Phosphate, as PO_4, mg/L	1.8	0.70	2.2	6.3
Silica, as SiO_2, mg/L	1.9	4.6	2.3	13
Ammonia, as NH_3, mg/L	−	<0.10	−	0.17
Total Iron, as Fe, mg/L	0.06	−	−	0.13
Tolyltriazole, mg/L	−	−	−	<1.0
Total Copper, as Cu, mg/L	0.24	−	−	0.17
Total Zinc, as Zn, mg/L	0.17	−	−	1.1
Bromide, as Br, mg/L	−	−	−	2.6
Nitrite, as NO_2, mg/L	−	−	−	−
Total Phosphate, as PO_4, mg/L	1.8	0.72	−	6.5
Molybdenum, as Mo, mg/L	−	−	−	0.47

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: MITCH KAUFMAN

Certificate of Analysis

August 18, 2010

Laboratory No. 10−08−18−14
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date August 16, 2010
Sample Class Waters

Analysis	CHILLED	HW HEATING
pH	9.09	10.10
Conductivity, µmho	477	1729
"M"−Alkalinity, as $CaCO_3$, mg/L	122	239
Calcium Hardness, as $CaCO_3$, mg/L	14	1.7
Magnesium Hardness, as $CaCO_3$, mg/L	4.6	0.28
Iron, as Fe, mg/L	3.4	<0.05
Copper, as Cu, mg/L	0.21	0.09
Zinc, as Zn, mg/L	−	−
Sodium, as Na, mg/L	−	−
Potassium, as K, mg/L	−	−
Chloride, as Cl, mg/L	−	−
Sulfate, as SO_4, mg/L	−	−
Nitrate, as NO_3, mg/L	−	−
Ortho−Phosphate, as PO_4, mg/L	2.7	0.80
Silica, as SiO_2, mg/L	5.3	5.9
Ammonia, as NH_3, mg/L	−	−
Total Iron, as Fe, mg/L	4.0	<0.05
Tolyltriazole, mg/L	2.7	41
Total Copper, as Cu, mg/L	4.1	0.09
Total Zinc, as Zn, mg/L	0.16	0.14
Bromide, as Br, mg/L	−	−
Nitrite, as NO_2, mg/L	<0.50	421
Total Phosphate, as PO_4, mg/L	4.0	1.1
Molybdenum, as Mo, mg/L	130	24

ChemTreat, Inc.

Certificate of Analysis

November 18, 2010

Laboratory No. 10−11−18−16
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date November 16, 2010
Sample Class Waters

Analysis	CITY WATER	GRAY WATER	MIXED MU	CONDENSER
pH	6.67	6.79	6.80	7.42
Conductivity, µmho	108	846	105	707
"M"−Alkalinity, as $CaCO_3$, mg/L	21	24	21	47
Calcium Hardness, as $CaCO_3$, mg/L	16	58	16	62
Magnesium Hardness, as $CaCO_3$, mg/L	4.8	33	5.0	30
Iron, as Fe, mg/L	0.55	<0.05	<0.05	0.25
Copper, as Cu, mg/L	0.08	<0.05	<0.05	0.18
Zinc, as Zn, mg/L	0.14	<0.05	<0.05	0.12
Sodium, as Na, mg/L	10	114	9.4	97
Potassium, as K, mg/L	0.43	10	0.68	9.9
Chloride, as Cl, mg/L	12	165	13	126
Sulfate, as SO_4, mg/L	−	−	−	27
Nitrate, as NO_3, mg/L	−	154	1.3	−
Ortho−Phosphate, as PO_4, mg/L	1.6	1.0	1.9	3.9
Silica, as SiO_2, mg/L	2.4	4.5	2.5	6.5
Ammonia, as NH_3, mg/L	−	<0.10	−	0.13
Molybdenum, as Mo, mg/L	−	−	−	0.42
Total Iron, as Fe, mg/L	0.62	−	−	0.41
Total Copper, as Cu, mg/L	0.12	−	−	0.22
Total Zinc, as Zn, mg/L	0.21	−	−	0.17
Tolyltriazole, mg/L	−	−	−	<1.0
Bromide, as Br, mg/L	−	−	−	0.63
Nitrite, as NO_2, mg/L	−	−	−	−
Total Phosphate, as PO_4, mg/L	1.6	1.0	−	3.9

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: MITCH KAUFMAN

Certificate of Analysis

November 18, 2010

Laboratory No. 10−11−18−16
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date November 16, 2010
Sample Class Waters

Analysis	CHILLED	HW HEATING
pH	9.31	10.21
Conductivity, µmho	500	1654
"M"−Alkalinity, as $CaCO_3$, mg/L	133	242
Calcium Hardness, as $CaCO_3$, mg/L	15	1.2
Magnesium Hardness, as $CaCO_3$, mg/L	4.1	0.25
Iron, as Fe, mg/L	4.4	0.38
Copper, as Cu, mg/L	0.28	0.14
Zinc, as Zn, mg/L	<0.05	<0.05
Sodium, as Na, mg/L	102	349
Potassium, as K, mg/L	5.5	6.8
Chloride, as Cl, mg/L	−	−
Sulfate, as SO_4, mg/L	−	−
Nitrate, as NO_3, mg/L	−	−
Ortho−Phosphate, as PO_4, mg/L	3.6	<0.50
Silica, as SiO_2, mg/L	5.8	5.2
Ammonia, as NH_3, mg/L	−	−
Molybdenum, as Mo, mg/L	136	23
Total Iron, as Fe, mg/L	6.1	2.9
Total Copper, as Cu, mg/L	1.0	4.9
Total Zinc, as Zn, mg/L	0.05	0.09
Tolyltriazole, mg/L	9.1	45
Bromide, as Br, mg/L	−	−
Nitrite, as NO_2, mg/L	<0.50	529
Total Phosphate, as PO_4, mg/L	3.6	0.58

ChemTreat, Inc.

Certificate of Analysis

November 18, 2010

Laboratory No. 10−11−18−16
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date November 16, 2010
Sample Class Waters

Analysis	CITY WATER	GRAY WATER	MIXED MU	CONDENSER
pH	6.67	6.79	6.80	7.42
Conductivity, µmho	108	846	105	707
"M"−Alkalinity, as $CaCO_3$, mg/L	21	24	21	47
Calcium Hardness, as $CaCO_3$, mg/L	16	58	16	62
Magnesium Hardness, as $CaCO_3$, mg/L	4.8	33	5.0	30
Iron, as Fe, mg/L	0.55	<0.05	<0.05	0.25
Copper, as Cu, mg/L	0.08	<0.05	<0.05	0.18
Zinc, as Zn, mg/L	0.14	<0.05	<0.05	0.12
Sodium, as Na, mg/L	10	114	9.4	97
Potassium, as K, mg/L	0.43	10	0.68	9.9
Chloride, as Cl, mg/L	12	165	13	126
Sulfate, as SO_4, mg/L	−	−	−	27
Nitrate, as NO_3, mg/L	−	154	1.3	−
Ortho−Phosphate, as PO_4, mg/L	1.6	1.0	1.9	3.9
Silica, as SiO_2, mg/L	2.4	4.5	2.5	6.5
Ammonia, as NH_3, mg/L	−	<0.10	−	0.13
Molybdenum, as Mo, mg/L	−	−	−	0.42
Total Iron, as Fe, mg/L	0.62	−	−	0.41
Total Copper, as Cu, mg/L	0.12	−	−	0.22
Total Zinc, as Zn, mg/L	0.21	−	−	0.17
Tolyltriazole, mg/L	−	−	−	<1.0
Bromide, as Br, mg/L	−	−	−	0.63
Nitrite, as NO_2, mg/L	−	−	−	−
Total Phosphate, as PO_4, mg/L	1.6	1.0	−	3.9

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: MITCH KAUFMAN

ChemTreat, Inc.

Certificate of Analysis

November 18, 2010

Laboratory No. 10−11−18−16
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date November 16, 2010
Sample Class Waters

Analysis	CHILLED	HW HEATING
pH	9.31	10.21
Conductivity, µmho	500	1654
"M"−Alkalinity, as $CaCO_3$, mg/L	133	242
Calcium Hardness, as $CaCO_3$, mg/L	15	1.2
Magnesium Hardness, as $CaCO_3$, mg/L	4.1	0.25
Iron, as Fe, mg/L	4.4	0.38
Copper, as Cu, mg/L	0.28	0.14
Zinc, as Zn, mg/L	<0.05	<0.05
Sodium, as Na, mg/L	102	349
Potassium, as K, mg/L	5.5	6.8
Chloride, as Cl, mg/L	−	−
Sulfate, as SO_4, mg/L	−	−
Nitrate, as NO_3, mg/L	−	−
Ortho−Phosphate, as PO_4, mg/L	3.6	<0.50
Silica, as SiO_2, mg/L	5.8	5.2
Ammonia, as NH_3, mg/L	−	−
Molybdenum, as Mo, mg/L	136	23
Total Iron, as Fe, mg/L	6.1	2.9
Total Copper, as Cu, mg/L	1.0	4.9
Total Zinc, as Zn, mg/L	0.05	0.09
Tolyltriazole, mg/L	9.1	45
Bromide, as Br, mg/L	−	−
Nitrite, as NO_2, mg/L	<0.50	529
Total Phosphate, as PO_4, mg/L	3.6	0.58

ChemTreat, Inc.

Certificate of Analysis

February 11, 2011

Laboratory No. 11−02−11−68
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date January 25, 2011
Sample Class Deposits

Analysis (% by Weight)	CHILLER #2
Loss on Ignition @ 650°C	25.2
Calcium, as CaO	13.2
Magnesium, as MgO	0.7
Iron Oxides, as Fe_2O_3	15.9
Copper, as CuO	16.1
Zinc, as ZnO	4.1
Nickel, as NiO	1.5
Aluminum, as Al_2O_3	1.4
Bromide, as Br	0.1
Chloride, as Cl	0.4
Manganese, as MnO	0.3
Molybdenum, as MoO_3	0.3
Potassium, as K_2O	0.2
Titanium, as TiO_2	0.2
Phosphate, as P_2O_5	13.1
Sulfate, as SO_3	1.1
Silica, as SiO_2	6.0

Comments Oven−Dried @ 105°C

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: MITCH KAUFMAN

ChemTreat, Inc.

Certificate of Analysis

February 17, 2011

Laboratory No. 11−02−18−1
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date February 15, 2011
Sample Class Waters

Analysis	GRAY WATER	CONDENSER	CHILLED	HW HEATING
pH	6.59	7.44	9.33	10.31
Conductivity, µmho	561	1629	430	1480
"M"−Alkalinity, as $CaCO_3$, mg/L	19	62	112	229
Calcium Hardness, as $CaCO_3$, mg/L	43	160	14	2.2
Magnesium Hardness, as $CaCO_3$, mg/L	13	55	4.7	0.42
Iron, as Fe, mg/L	<0.05	0.76	1.9	0.40
Copper, as Cu, mg/L	<0.05	0.23	0.22	0.14
Zinc, as Zn, mg/L	<0.05	0.23	<0.05	<0.05
Sodium, as Na, mg/L	72	209	83	305
Potassium, as K, mg/L	13	34	4.7	6.7
Chloride, as Cl, mg/L	49	171	−	−
Sulfate, as SO_4, mg/L	−	65	−	−
Nitrate, as NO_3, mg/L	148	336	<0.10	2.8
Ortho−Phosphate, as PO_4, mg/L	0.76	3.3	2.3	1.1
Silica, as SiO_2, mg/L	5.3	14	4.0	4.9
Ammonia, as NH_3, mg/L	0.13	0.79	−	−
Molybdenum, as Mo, mg/L	<0.05	0.55	115	21
Total Iron, as Fe, mg/L	−	0.80	12	2.5
Total Copper, as Cu, mg/L	−	0.24	0.82	8.5
Total Zinc, as Zn, mg/L	−	0.28	<0.05	0.17
Tolyltriazole, mg/L	−	<1.0	5.0	35
Bromide, as Br, mg/L	−	13	−	−
Nitrite, as NO_2, mg/L	−	−	<0.50	365
Total Phosphate, as PO_4, mg/L	0.76	3.3	2.6	1.1

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: MITCH KAUFMAN

ChemTreat, Inc.

Certificate of Analysis

March 7, 2011

Laboratory No. 11−03−09−8
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date March 1, 2011
Sample Class Waters

Analysis	GRAY/BLACK WATER
pH	6.04
Conductivity, µmho	592
"M"−Alkalinity, as $CaCO_3$, mg/L	23
Calcium Hardness, as $CaCO_3$, mg/L	48
Magnesium Hardness, as $CaCO_3$, mg/L	14
Iron, as Fe, mg/L	<0.05
Copper, as Cu, mg/L	0.05
Zinc, as Zn, mg/L	<0.05
Sodium, as Na, mg/L	88
Potassium, as K, mg/L	16
Chloride, as Cl, mg/L	50
Nitrate, as NO_3, mg/L	141
Ortho−Phosphate, as PO_4, mg/L	0.93
Silica, as SiO_2, mg/L	5.9
Ammonia, as NH_3, mg/L	<0.10
Total Phosphate, as PO_4, mg/L	1.0

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: MITCH KAUFMAN

ChemTreat, Inc.

Certificate of Analysis

March 18, 2011

Laboratory No. 11−03−18−27
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer MITCH KAUFMAN
Sample Date March 15, 2011
Sample Class Waters

Analysis	GRAY WATER
pH	7.21
Conductivity, µmho	511
"M"−Alkalinity, as $CaCO_3$, mg/L	18
Calcium Hardness, as $CaCO_3$, mg/L	39
Magnesium Hardness, as $CaCO_3$, mg/L	12
Iron, as Fe, mg/L	<0.05
Copper, as Cu, mg/L	<0.05
Zinc, as Zn, mg/L	<0.05
Sodium, as Na, mg/L	65
Potassium, as K, mg/L	13
Chloride, as Cl, mg/L	54
Nitrate, as NO_3, mg/L	135
Ortho−Phosphate, as PO_4, mg/L	1.1
Silica, as SiO_2, mg/L	4.9
Ammonia, as NH_3, mg/L	<0.10
Total Phosphate, as PO_4, mg/L	1.3

Comments CHILLED & HW HEATING SAMPLES NOT RECEIVED

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: MITCH KAUFMAN

ChemTreat, Inc.

Certificate of Analysis

May 27, 2011

Laboratory No. 11−05−27−26
Company VISIONAIRE
Address NEW YORK, NY
Engineer JOHN NICOLAI
Sample Date May 20, 2011
Sample Class Waters

Analysis	CITY	GREY WATER	MIXED MU	COOLING TOWER
pH	6.90	7.07	7.05	8.44
Conductivity, µmho	99	499	98	1392
"P"−Alkalinity, as $CaCO_3$, mg/L	−	−	−	12
"M"−Alkalinity, as $CaCO_3$, mg/L	15	21	15	147
Calcium Hardness, as $CaCO_3$, mg/L	13	51	15	189
Magnesium Hardness, as $CaCO_3$, mg/L	5.1	16	5.3	89
Iron, as Fe, mg/L	0.17	<0.05	<0.05	0.18
Copper, as Cu, mg/L	0.16	<0.05	<0.05	0.31
Zinc, as Zn, mg/L	<0.05	<0.05	<0.05	<0.05
Sodium, as Na, mg/L	6.9	61	6.8	177
Potassium, as K, mg/L	0.43	14	0.43	13
Chloride, as Cl, mg/L	15	66	15	242
Sulfate, as SO_4, mg/L	6.0	29	6.0	99
Nitrate, as NO_3, mg/L	0.56	85	0.60	28
Ortho−Phosphate, as PO_4, mg/L	1.8	1.5	2.0	5.3
Silica, as SiO_2, mg/L	3.3	7.3	3.3	44
Molybdenum, as Mo, mg/L	−	−	−	0.41
Tolyltriazole, mg/L	−	−	−	<1.0
Bromide, as Br, mg/L	−	−	−	2.1
Nitrite, as NO_2, mg/L	−	<0.50	<0.50	<5.0
Total Phosphate, as PO_4, mg/L	2.0	1.8	2.3	5.6

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: JOHN NICOLAI

ChemTreat, Inc.

Certificate of Analysis

May 27, 2011

Laboratory No. 11−05−27−26
Company VISIONAIRE
Address NEW YORK, NY
Engineer JOHN NICOLAI
Sample Date May 20, 2011
Sample Class Waters

Analysis	CHILLED LOOP	HOT LOOP
pH	8.96	10.23
Conductivity, µmho	432	1430
"P"−Alkalinity, as $CaCO_3$, mg/L	18	115
"M"−Alkalinity, as $CaCO_3$, mg/L	117	227
Calcium Hardness, as $CaCO_3$, mg/L	14	2.2
Magnesium Hardness, as $CaCO_3$, mg/L	4.2	0.44
Iron, as Fe, mg/L	0.10	<0.05
Copper, as Cu, mg/L	0.07	<0.05
Zinc, as Zn, mg/L	<0.05	<0.05
Sodium, as Na, mg/L	87	291
Potassium, as K, mg/L	4.2	5.8
Chloride, as Cl, mg/L	14	13
Sulfate, as SO_4, mg/L	6.2	6.0
Nitrate, as NO_3, mg/L	<0.10	1.5
Ortho−Phosphate, as PO_4, mg/L	1.5	0.90
Silica, as SiO_2, mg/L	4.2	5.3
Molybdenum, as Mo, mg/L	118	21
Tolyltriazole, mg/L	2.6	33
Bromide, as Br, mg/L	−	−
Nitrite, as NO_2, mg/L	<0.50	348
Total Phosphate, as PO_4, mg/L	1.5	0.90

ChemTreat, Inc.

Certificate of Analysis

September 8, 2011

Laboratory No.	11−09−08−30
Company	THE VISIONAIRE
Address	70 LITTLE WEST STREET, NEW YORK, NY
Engineer	JOHN NICOLAI
Sample Date	September 1, 2011
Sample Class	Waters

Analysis	CITY WATER	GREY WATER
pH	7.18	7.30
Conductivity, µmho	71	531
"M"−Alkalinity, as $CaCO_3$, mg/L	12	20
Calcium Hardness, as $CaCO_3$, mg/L	12	45
Magnesium Hardness, as $CaCO_3$, mg/L	4.0	22
Iron, as Fe, mg/L	<0.05	<0.05
Copper, as Cu, mg/L	0.13	0.07
Zinc, as Zn, mg/L	<0.05	<0.05
Sodium, as Na, mg/L	6.2	63
Potassium, as K, mg/L	0.35	14
Chloride, as Cl, mg/L	9.8	96
Sulfate, as SO_4, mg/L	4.1	25
Nitrate, as NO_3, mg/L	0.43	<0.10
Ortho−Phosphate, as PO_4, mg/L	1.6	0.77
Silica, as SiO_2, mg/L	2.7	5.3
Ammonia, as NH_3, mg/L	<0.10	<0.10
Nitrite, as NO_2, mg/L	<0.50	<0.50
Total Phosphate, as PO_4, mg/L	1.9	0.98

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: JOHN NICOLAI

Appendix I: WTRS component energy use by month for the study timeline

MAY 2010 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 5/4/2010 Period End Date 5/31/2010 Period Length (days) 28

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	46	50	1394	1396	814	28	25	382	382	1796	90111	28348	14962	14761	15149		2866	3178	25850
Meter End Value	62	67	1731	1731	1010	33	30	463	463	2468	90111	33866	20479	20272	20666		3440	4381	33399
Meter Change	16	17	337	335	196	5	5	81	81	672	0	551.8	551.7	551.1	551.7	16.5	574	1203	7549
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	16	17	337	335	196	5	5	81	81	672	0	552	552	551	552	17	574	123	
Total power consumption (kW-hr)	21	22	2791	2774	458	3	3	95	99	414	0	445	80	143	540	22	153	1203	7549
Daily power consumption (kW-hr/day)	0.75	0.80	99.67	99.08	16.35	0.12	0.12	3.40	3.53	14.77	0.00	15.91	2.87	5.12	19.27	0.79	5.46	43	270
% Power	0.2%	0.2%	30.1%	29.9%	4.9%	0.0%	0.0%	1.0%	1.1%	4.5%	0.0%	4.8%	0.9%	1.5%	5.8%	0.2%	1.7%	13.0%	
Power consumption rank	15	13	1	2	5	16	16	11	10	7	18	6	12	9	4	14	8	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		239	6681
Booster Pump	1.79	43	1203
BMR Log	**11.23**	270	**7549**
Power accounted for by BMR			95.8%
Primary Treatment		0.79	
Secondary Treatment		266.78	
Tertiary Treatment		63.41	
TOTAL		**330.98**	
DESIGN TOTAL		**793.57**	

JUNE 2010 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 6/1/2010 Period End Date 6/30/2010 Period Length (days) 30

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	62	67	1731	1731	1010	33	30	463	463	2468	90111	33866	20479	20272	20666		3440	4381	33399
Meter End Value	81	85	2092	2091	1221	40	37	562	562	3188	90111	42030	28643	28409	28794		4189	5813	41586
Meter Change	19	18	361	360	211	7	7	99	99	720	0	816.4	816.4	813.7	812.8	18.5	749	1433	8187
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	19	18	361	360	211	7	7	99	99	720	0	816	816	814	813	19	749	147	
Total power consumption (kW-hr)	25	24	2989	2981	493	5	5	116	121	443	0	659	119	212	795	25	200	1433	8187
Daily power consumption (kW-hr/day)	0.83	0.79	99.65	99.37	16.43	0.16	0.16	3.87	4.03	14.77	0.00	21.97	3.97	7.05	26.50	0.83	6.65	48	273
% Power	0.2%	0.2%	28.1%	28.0%	4.6%	0.0%	0.0%	1.1%	1.1%	4.2%	0.0%	6.2%	1.1%	2.0%	7.5%	0.2%	1.9%	13.5%	
Power consumption rank	13	15	1	2	6	16	16	12	10	7	18	5	11	8	4	14	9	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		240	7202
Booster Pump	1.99	48	1433
BMR Log	**11.37**	273	**8187**
Power accounted for by BMR			94.8%
Primary Treatment		0.83	
Secondary Treatment		273.06	
Tertiary Treatment		80.92	
TOTAL		**354.80**	
DESIGN TOTAL		**793.57**	

JULY 2010 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 7/1/2010 Period End Date 7/31/2010 Period Length (days) 31

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	81	85	2092	2091	1221	40	37	562	562	3188	90111	42269	28882	28648	29033		4189	5813	41586
Meter End Value	97	101	2463	2463	1440	48	44	665	665	3932	90111	49473	36086	35840	36238		4909	7265	50090
Meter Change	16	16	371	372	219	8	7	103	103	744	0	720.4	720.4	719.2	720.5	16	720	1452	8503
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	16	16	371	372	219	8	7	103	103	744	0	720	720	719	721	16	720	149	
Total power consumption (kW-hr)	21	21	3072	3081	512	5	5	121	126	458	0	582	105	187	705	21	192	1452	8503
Daily power consumption (kW-hr/day)	0.68	0.68	99.10	99.37	16.50	0.18	0.15	3.90	4.06	14.77	0.00	18.76	3.39	6.03	22.73	0.69	6.19	47	274
% Power	0.2%	0.2%	28.8%	28.9%	4.8%	0.1%	0.0%	1.1%	1.2%	4.3%	0.0%	5.5%	1.0%	1.8%	6.6%	0.2%	1.8%	13.6%	
Power consumption rank	14	14	2	1	6	16	17	11	10	7	18	5	12	9	4	13	8	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		239	7421
Booster Pump	1.95	47	1452
BMR Log	**11.43**	274	**8503**
Power accounted for by BMR			95.8%
Primary Treatment		0.69	
Secondary Treatment		271.47	
Tertiary Treatment		71.88	
TOTAL		**344.04**	
DESIGN TOTAL		**793.57**	

AUGUST 2010 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 8/1/2010 Period End Date 8/31/2010 Period Length (days) 31

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	97	101	2463	2463	1440	48	44	665	665	3932	90111	49717	34330	36082	36482		4909	7265	50090
Meter End Value	113	117	2836	2834	1657	54	50	753	753	4676	90138	56907	43523	43265	43673		5701	8754	58522
Meter Change	16	16	373	371	217	6	6	88	88	744	27	719	919.3	718.3	719.1	16	792	1489	8432
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	16	16	373	371	217	6	6	88	88	744	27	719	919	718	719	16	792	153	
Total power consumption (kW-hr)	21	21	3089	3072	507	4	4	103	108	458	35	580	134	187	703	21	211	1489	8432
Daily power consumption (kW-hr/day)	0.68	0.68	99.64	99.10	16.35	0.13	0.13	3.33	3.47	14.77	1.13	18.72	4.32	6.02	22.69	0.69	6.81	48	272
% Power	0.2%	0.2%	28.7%	28.6%	4.7%	0.0%	0.0%	1.0%	1.0%	4.3%	0.3%	5.4%	1.2%	1.7%	6.5%	0.2%	2.0%	13.9%	
Power consumption rank	15	15	1	2	6	17	17	12	11	7	13	5	10	9	4	14	8	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		238	7387
Booster Pump	2.00	48	1489
BMR Log	**11.33**	272	**8432**
Power accounted for by BMR			95.0%
Primary Treatment		1.82	
Secondary Treatment		271.54	
Tertiary Treatment		73.35	
TOTAL		**346.71**	
DESIGN TOTAL		**793.57**	

SEPTEMBER 2010 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 9/1/2010 Period End Date 9/30/2010 Period Length (days) 30

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	113	117	2836	2834	1657	54	50	753	753	4676	90138	57148	43762	43506	43913		5701	8754	58522
Meter End Value	132	134	3197	3193	1869	62	57	856	856	5397	90138	64104	50721	50455	50866		6469	9531	66890
Meter Change	19	17	361	359	212	8	7	103	103	721	0	695.6	695.9	694.9	695.3	18	768	777	8368

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	19	17	361	359	212	8	7	103	103	721	0	696	696	695	695	18	768	80	
Total power consumption (kW-hr)	25	22	2989	2973	495	5	5	121	126	444	0	562	101	181	680	24	205	777	8368
Daily power consumption (kW-hr/day)	0.83	0.75	99.65	99.09	16.51	0.18	0.16	4.03	4.19	14.79	0.00	18.72	3.38	6.02	22.67	0.81	6.82	26	279
% Power	0.3%	0.2%	30.7%	30.5%	5.1%	0.1%	0.0%	1.2%	1.3%	4.6%	0.0%	5.8%	1.0%	1.9%	7.0%	0.2%	2.1%	8.0%	
Power consumption rank	13	15	1	2	6	16	17	11	10	7	18	5	12	9	4	14	8	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		240	7206
Booster Pump	1.08	26	777
BMR Log	**11.62**	279	**8368**
Power accounted for by BMR			104.8%
Primary Treatment		0.81	
Secondary Treatment		251.29	
Tertiary Treatment		72.41	
TOTAL		**324.51**	
DESIGN TOTAL		**793.57**	

OCTOBER 2010 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 10/1/2010 Period End Date 10/31/2010 Period Length (days) 31

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	132	134	3197	3193	1869	62	57	856	856	5397	90138	64104	50721	50455	50866		6469	9531	66890
Meter End Value	152	154	3558	3562	2088	70	64	970	970	6141	90138	71305	57921	57649	58066		7211	11113	75648
Meter Change	20	20	361	369	219	8	7	114	114	744	0	720.1	720	719.4	720	20	742	1582	8759
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	20	20	361	369	219	8	7	114	114	744	0	720	720	719	720	20	742	162	
Total power consumption (kW-hr)	26	26	2989	3056	512	5	5	134	139	458	0	581	105	187	704	27	198	1582	8759
Daily power consumption (kW-hr/day)	0.85	0.85	96.43	98.57	16.50	0.18	0.15	4.32	4.49	14.77	0.00	18.75	3.39	6.03	22.72	0.87	6.38	51	283
% Power	0.2%	0.2%	27.8%	28.5%	4.8%	0.1%	0.0%	1.2%	1.3%	4.3%	0.0%	5.4%	1.0%	1.7%	6.6%	0.3%	1.8%	14.7%	
Power consumption rank	14	14	2	1	6	16	17	11	10	7	18	5	12	9	4	13	8	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		237	7351
Booster Pump	2.13	51	1582
BMR Log	**11.77**	283	**8759**
Power accounted for by BMR			98.1%
Primary Treatment		0.87	
Secondary Treatment		273.38	
Tertiary Treatment		72.04	
TOTAL		**346.29**	
DESIGN TOTAL		**793.57**	

NOVEMBER 2010 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 11/1/2010 Period End Date 11/30/2010 Period Length (days) 30

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	152	154	3558	3562	2088	70	64	970	970	6141	90138	71802	58417	58145	58562		7211	11113	75648
Meter End Value	163	164	3919	3921	2300	74	69	1029	1029	6862	90138	78755	63074	62796	65283		7933	12445	83953
Meter Change	11	10	361	359	212	4	5	59	59	721	0	695.3	465.7	465.1	672.1	10.5	722	1331	8304
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	11	10	361	359	212	4	5	59	59	721	0	695	466	465	672	11	722	137	
Total power consumption (kW-hr)	14	13	2989	2973	495	3	3	69	72	444	0	561	68	121	657	14	192	1331	8304
Daily power consumption (kW-hr/day)	0.48	0.44	99.65	99.09	16.51	0.09	0.11	2.31	2.40	14.79	0.00	18.71	2.26	4.03	21.91	0.47	6.42	44	277
% Power	0.1%	0.1%	29.8%	29.7%	4.9%	0.0%	0.0%	0.7%	0.7%	4.4%	0.0%	5.6%	0.7%	1.2%	6.6%	0.1%	1.9%	13.3%	
Power consumption rank	13	15	1	2	6	17	16	11	10	7	18	5	12	9	4	14	8	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		236	7076
Booster Pump	1.85	44	1331
BMR Log	**11.53**	277	**8304**
Power accounted for by BMR			98.8%
Primary Treatment		0.47	
Secondary Treatment		265.47	
Tertiary Treatment		68.13	
TOTAL		**334.06**	
DESIGN TOTAL		**793.57**	

DECEMBER 2010 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 12/1/2010 Period End Date 12/31/2010 Period Length (days) 31

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	163	164	3919	3921	2300	74	69	1029	1029	6862	90138	78755	63074	62796	65283		7933	12445	83953
Meter End Value	171	173	4293	4290	2519	77	72	1075	1075	7606	90138	86204	70193	69911	72721		8628	13808	92522
Meter Change	8	9	374	369	219	3	3	46	46	744	0	744.9	711.9	711.5	743.8	8.5	695	1363	8569
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	8	9	374	369	219	3	3	46	46	744	0	745	712	712	744	9	695	140	
Total power consumption (kW-hr)	11	12	3097	3056	512	2	2	54	56	458	0	601	104	185	728	11	185	1363	8569
Daily power consumption (kW-hr/day)	0.34	0.38	99.91	98.57	16.50	0.07	0.07	1.74	1.81	14.77	0.00	19.40	3.35	5.97	23.47	0.37	5.98	44	276
% Power	0.1%	0.1%	29.7%	29.3%	4.9%	0.0%	0.0%	0.5%	0.5%	4.4%	0.0%	5.8%	1.0%	1.8%	7.0%	0.1%	1.8%	13.1%	
Power consumption rank	15	13	1	2	6	16	16	12	11	7	18	5	10	9	4	14	8	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		234	7259
Booster Pump	1.83	44	1363
BMR Log	**11.52**	276	**8569**
Power accounted for by BMR			99.4%
Primary Treatment		0.37	
Secondary Treatment		263.36	
Tertiary Treatment		72.93	
TOTAL		**336.66**	
DESIGN TOTAL		**793.57**	

JANUARY 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 1/1/2011 Period End Date 1/31/2011 Period Length (days) 31

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	171	173	4293	4290	2519	77	72	1075	1075	7606	90138	86204	70193	69911	72721		8628	13808	92522
Meter End Value	181	182	4657	4650	2660	81	75	1126	1126	8350	90138	93645	77633	77353	80163		9372	15198	100930
Meter Change	10	9	364	360	141	4	3	51	51	744	0	744.1	744	744.2	744.2	9.5	744	1390	8408

	Feed Pump 1	Feed Pump 2	Blower 1	Blower 2	Recirc. Pump	B/P Pump 1	B/P Pump 2	Perm. Pump 1	Perm. Pump 2	UV Pump	Trash Pump	Odor Control	Ozone Pump	Ozone Gen.	Ozone Compr.	Inline Grinder	UV System	Booster Pump	BMR
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	10	9	364	360	141	4	3	51	51	744	0	744	744	744	744	10	744	143	
Total power consumption (kW-hr)	13	12	3014	2981	329	3	2	60	62	458	0	601	108	193	728	13	198	1390	8408
Daily power consumption (kW-hr/day)	0.43	0.38	97.23	96.17	10.62	0.09	0.07	1.93	2.01	14.77	0.00	19.38	3.50	6.24	23.48	0.41	6.40	45	271
% Power	0.1%	0.1%	29.6%	29.3%	3.2%	0.0%	0.0%	0.6%	0.6%	4.5%	0.0%	5.9%	1.1%	1.9%	7.2%	0.1%	2.0%	13.7%	
Power consumption rank	13	15	1	2	7	16	17	12	11	6	18	5	10	9	4	14	8	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		224	6935
Booster Pump	1.87	45	1390
BMR Log	**11.30**	271	**8408**
Power accounted for by BMR			101.0%
Primary Treatment		0.41	
Secondary Treatment		253.77	
Tertiary Treatment		73.77	
TOTAL		**327.95**	
DESIGN TOTAL		**793.57**	

FEBRUARY 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 2/1/2011 Period End Date 2/27/2011 Period Length (days) 27

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	181	182	4657	4650	2660	81	75	1126	1126	8350	90138	93884	77872	77592	80402		9418	15198	100930
Meter End Value	192	195	4981	4973	2752	85	78	1181	1181	8998	90164	99877	83817	83537	86337		9615	16475	108147
Meter Change	11	13	324	323	92	4	3	55	55	648	26	599.3	594.5	594.5	593.5	12	197	1277	7217

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	11	13	324	323	92	4	3	55	55	648	26	599	595	595	594	12	197	131	
Total power consumption (kW-hr)	14	17	2683	2675	215	3	2	65	67	399	34	484	87	155	580	16	53	1277	7217
Daily power consumption (kW-hr/day)	0.54	0.63	99.37	99.06	7.96	0.10	0.08	2.39	2.49	14.77	1.25	17.92	3.21	5.72	21.50	0.60	1.94	47	267
% Power	0.2%	0.2%	30.4%	30.3%	2.4%	0.0%	0.0%	0.7%	0.8%	4.5%	0.4%	5.5%	1.0%	1.8%	6.6%	0.2%	0.6%	14.5%	
Power consumption rank	16	14	1	2	7	17	18	11	10	6	13	5	9	8	4	15	12	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		227	6140
Booster Pump	1.97	47	1277
BMR Log	**11.14**	267	**7217**
Power accounted for by BMR			97.3%
Primary Treatment		1.85	
Secondary Treatment		259.93	
Tertiary Treatment		65.07	
TOTAL		**326.84**	
DESIGN TOTAL		**793.57**	

MARCH 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 3/1/2011 Period End Date 3/31/2011 Period Length (days) 31

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	193	196	4994	4985	2756	85	79	1185	1186	9022	90164	100595	84534	84254	87054		9615	16518	108410
Meter End Value	215	215	5365	5356	2862	92	85	1280	1281	9765	90164	107784	91724	91433	94241		9615	18140	116695
Meter Change	22	19	371	371	106	7	6	95	95	743	0	718.9	719	717.9	718.7	20.5	0	1622	8285

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	22	19	371	371	106	7	6	95	95	743	0	719	719	718	719	21	0	166	
Total power consumption (kW-hr)	29	25	3072	3072	248	5	4	112	116	457	0	580	105	187	703	28	0	1622	8285
Daily power consumption (kW-hr/day)	0.94	0.81	99.10	99.10	7.99	0.15	0.13	3.60	3.74	14.75	0.00	18.72	3.38	6.02	22.68	0.89	0.00	52	267
% Power	0.3%	0.2%	29.6%	29.6%	2.4%	0.0%	0.0%	1.1%	1.1%	4.4%	0.0%	5.6%	1.0%	1.8%	6.8%	0.3%	0.0%	15.7%	
Power consumption rank	12	14	1	1	7	15	16	10	9	6	17	5	11	8	4	13	17	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		230	7140
Booster Pump	2.18	52	1622
BMR Log	**11.14**	267	**8285**
Power accounted for by BMR			94.6%
Primary Treatment		0.89	
Secondary Treatment		267.89	
Tertiary Treatment		65.55	
TOTAL		**334.33**	
DESIGN TOTAL		**793.57**	

APRIL 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 4/1/2011 Period End Date 4/30/2011 Period Length (days) 30

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	215	215	5365	5356	2862	92	85	1280	1281	9765	90164	108026	91966	91675	94483		9615	18140	116695
Meter End Value	229	228	5750	5669	2965	93	87	1353	1377	10485	90164	115005	94679	94388	97382		9615	100588	123214
Meter Change	14	13	385	313	103	1	2	73	96	720	0	697.9	271.3	271.3	289.9	13.5	0	82448	6519

Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	14	13	385	313	103	1	2	73	96	720	0	698	271	271	290	14	0	8463	
Total power consumption (kW-hr)	18	17	3188	2592	241	1	1	86	117	443	0	563	40	71	284	18	0	82448	6519
Daily power consumption (kW-hr/day)	0.61	0.57	106.27	86.40	8.02	0.02	0.05	2.86	3.91	14.77	0.00	18.78	1.32	2.35	9.45	0.60	0.00	2748	217
% Power	0.0%	0.0%	3.5%	2.9%	0.3%	0.0%	0.0%	0.1%	0.1%	0.5%	0.0%	0.6%	0.0%	0.1%	0.3%	0.0%	0.0%	91.5%	
Power consumption rank	12	14	2	3	7	16	15	9	8	5	17	4	11	10	6	13	17	1	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		223	6705
Booster Pump	114.51	2748	82448
BMR Log	**9.05**	217	**6519**
Power accounted for by BMR			7.3%
Primary Treatment		0.60	
Secondary Treatment		2956.98	
Tertiary Treatment		46.68	
TOTAL		**3004.26**	
DESIGN TOTAL		**793.57**	

MAY 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 5/1/2011 Period End Date 5/31/2011 Period Length (days) 31

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	229	228	5750	5669	2965	93	87	1353	1377	10485	90164	115005	94679	94388	97382		9615	100588	123214
Meter End Value	241	238	6115	6033	3095	97	91	1414	1440	11222	90189	122432	101001	100810	103804		9615	112677	130720
Meter Change	12	10	365	364	130	4	4	61	63	737	25	742.7	632.2	642.2	642.2	11	0	12089	7507
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	12	10	365	364	130	4	4	61	63	737	25	743	632	642	642	11	0	1241	
Total power consumption (kW-hr)	16	13	3023	3014	304	3	3	72	77	454	32	600	92	167	628	15	0	12089	7507
Daily power consumption (kW-hr/day)	0.51	0.43	97.50	97.23	9.80	0.09	0.09	2.31	2.48	14.64	1.05	19.34	2.97	5.38	20.26	0.48	0.00	390	242
% Power	0.1%	0.1%	14.7%	14.6%	1.5%	0.0%	0.0%	0.3%	0.4%	2.2%	0.2%	2.9%	0.4%	0.8%	3.0%	0.1%	0.0%	58.7%	
Power consumption rank	13	15	2	3	7	16	16	11	10	6	12	5	9	8	4	14	18	1	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		225	6977
Booster Pump	16.25	390	12089
BMR Log	**10.09**	242	**7507**
Power accounted for by BMR			39.4%
Primary Treatment		1.52	
Secondary Treatment		600.40	
Tertiary Treatment		62.60	
TOTAL		**664.52**	
DESIGN TOTAL		**793.57**	

JUNE 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 6/1/2011 Period End Date 6/30/2011 Period Length (days) 30

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	241	238	6115	6033	3095	97	91	1414	1440	11222	90189	122666	101336	101045	104039		9615	112677	130720
Meter End Value	276	269	6476	6392	3147	107	101	1565	1592	11942	90189	129387	108057	107766	110760		9615	114153	138123
Meter Change	35	31	361	359	52	10	10	151	152	720	0	672.1	672.1	672.1	672.1	33	0	1476	7403
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	35	31	361	359	52	10	10	151	152	720	0	672	672	672	672	33	0	152	
Total power consumption (kW-hr)	46	41	2989	2973	121	7	7	177	186	443	0	543	98	175	657	44	0	1476	7403
Daily power consumption (kW-hr/day)	1.54	1.36	99.65	99.09	4.05	0.23	0.23	5.91	6.19	14.77	0.00	18.09	3.27	5.82	21.91	1.48	0.00	49	247
% Power	0.5%	0.4%	29.9%	29.8%	1.2%	0.1%	0.1%	1.8%	1.9%	4.4%	0.0%	5.4%	1.0%	1.7%	6.6%	0.4%	0.0%	14.8%	
Power consumption rank	12	14	1	2	10	15	15	8	7	6	17	5	11	9	4	13	17	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		233	6991
Booster Pump	2.05	49	1476
BMR Log	**10.28**	247	**7403**
Power accounted for by BMR			87.4%
Primary Treatment		1.48	
Secondary Treatment		267.45	
Tertiary Treatment		63.86	
TOTAL		**332.79**	
DESIGN TOTAL		**793.57**	

JULY 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date	7/1/2011	Period End Date	7/30/2011	Period Length (days)	30

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	276	269	6476	6392	3147	107	101	1565	1592	11942	90189	129865	108535	108244	111238		9615	114153	138123
Meter End Value	318	313	6836	6752	3216	117	111	1718	1742	12662	90216	136874	115541	115250	118234		9615	116234	145336
Meter Change	42	44	360	360	69	10	10	153	150	720	27	700.9	700.6	700.6	699.6	43	0	2080	7213

Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	42	44	360	360	69	10	10	153	150	720	27	701	701	701	700	43	0	214	
Total power consumption (kW-hr)	55	58	2981	2981	161	7	7	180	183	443	35	566	102	182	684	58	0	2080	7213
Daily power consumption (kW-hr/day)	1.84	1.93	99.37	99.37	5.37	0.23	0.23	5.99	6.11	14.77	1.17	18.86	3.41	6.07	22.81	1.92	0.00	69	240
% Power	0.5%	0.5%	27.7%	27.7%	1.5%	0.1%	0.1%	1.7%	1.7%	4.1%	0.3%	5.3%	0.9%	1.7%	6.4%	0.5%	0.0%	19.3%	
Power consumption rank	14	12	1	1	10	16	16	9	7	6	15	5	11	8	4	13	18	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		235	7057
Booster Pump	2.89	69	2080
BMR Log	**10.02**	240	**7213**
Power accounted for by BMR			78.9%
Primary Treatment		3.09	
Secondary Treatment		289.79	
Tertiary Treatment		65.92	
TOTAL		**358.80**	
DESIGN TOTAL		**793.57**	

AUGUST 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 8/1/2011 Period End Date 8/30/2011 Period Length (days) 30

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	318	313	6844	6767	3225	117	111	1718	1742	12686	90216	137309	115976	115685	118670		9615	116273	145600
Meter End Value	370	358	7204	7127	3514	130	124	1913	1937	13406	90216	143065	121731	121440	124425		9615	117920	154029
Meter Change	52	45	360	360	289	13	13	195	195	720	0	575.6	575.5	575.5	575.5	48.5	0	1648	8429
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	52	45	360	360	289	13	13	195	195	720	0	576	576	576	576	49	0	169	
Total power consumption (kW-hr)	69	59	2981	2981	675	9	9	229	238	443	0	465	84	150	563	65	0	1648	8429
Daily power consumption (kW-hr/day)	2.28	1.98	99.37	99.37	22.50	0.30	0.30	7.63	7.94	14.77	0.00	15.49	2.80	4.99	18.76	2.17	0.00	55	281
% Power	0.6%	0.6%	27.9%	27.9%	6.3%	0.1%	0.1%	2.1%	2.2%	4.2%	0.0%	4.4%	0.8%	1.4%	5.3%	0.6%	0.0%	15.4%	
Power consumption rank	12	14	1	1	4	15	15	9	8	7	17	6	11	10	5	13	17	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		256	7693
Booster Pump	2.29	55	1648
BMR Log	**11.71**	281	**8429**
Power accounted for by BMR			90.2%
Primary Treatment		2.17	
Secondary Treatment		296.60	
Tertiary Treatment		56.81	
TOTAL		**355.58**	
DESIGN TOTAL		**793.57**	

SEPTEMBER 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 9/1/2011 Period End Date 9/30/2011 Period Length (days) 29

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	372	359	7220	7135	3523	130	125	1919	1944	13430	90216	144745	123412	123121	126106		9615	117964	154310
Meter End Value	416	397	7565	7485	3802	144	138	2109	2132	14126	90216	151712	130379	130088	133073		9615	120112	162643
Meter Change	44	38	345	350	279	14	13	190	188	696	0	696.7	696.7	696.7	696.7	41	0	2148	8333
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	44	38	345	350	279	14	13	190	188	696	0	697	697	697	697	41	0	220	
Total power consumption (kW-hr)	58	50	2857	2898	652	10	9	223	230	428	0	562	102	181	681	55	0	2148	8333
Daily power consumption (kW-hr/day)	2.00	1.73	98.51	99.94	22.47	0.33	0.31	7.69	7.92	14.77	0.00	19.40	3.50	6.24	23.50	1.90	0.00	74	287
% Power	0.5%	0.4%	25.6%	26.0%	5.8%	0.1%	0.1%	2.0%	2.1%	3.8%	0.0%	5.0%	0.9%	1.6%	6.1%	0.5%	0.0%	19.3%	
Power consumption rank	12	14	2	1	5	15	16	9	8	7	17	6	11	10	4	13	17	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		256	7415
Booster Pump	3.09	74	2148
BMR Log	**11.97**	287	**8333**
Power accounted for by BMR			87.1%
Primary Treatment		1.90	
Secondary Treatment		314.97	
Tertiary Treatment		67.42	
TOTAL		**384.28**	
DESIGN TOTAL		**793.57**	

OCTOBER 2011 The Visionaire (NYSERDA Project No. 10624) Wastewater Reuse System Power Consumption Tracker

Period Start Date 10/1/2011 Period End Date 10/15/2011 Period Length (days) 15

	Feed Pump 1 Run Hrs	Feed Pump 2 Run Hrs	Blower 1 Run Hrs	Blower 2 Run Hrs	Recirc. Pump Run Hrs	B/P Pump 1 Run Hrs	B/P Pump 2 Run Hrs	Perm. Pump 1 Run Hrs	Perm. Pump 2 Run Hrs	UV Pump Run Hrs	Trash Pump Run Hrs	Odor Control run hours	Ozone Pump run hours	Ozone Gen. run hours	Ozone Compr. Run hours	Inline Grinder	UV System	Booster Pump KWh	BMR kWh
Meter Start Value	417	398	7580	7494	3812	144	138	2114	2137	14150	90216	151947	130614	130323	133308		9615	120112	162643
Meter End Value	433	413	7758	7677	3956	150	144	2190	2214	14510	90216	155307	133974	133683	136668		9615	120759	166527
Meter Change	16	15	178	183	144	6	6	76	77	360	0	336	336	336	336	15.5	0	647	3884
Voltage (V)	208	208	208	208	208	120	120	208	208	120	208	208	208	230	208	208	120	200	
Ampage (A)	5	5	26.3	26.3	9.1	8	8	4.9	5.1	7.2	4.8	2.7	0.5	0.9	3.6	5.23	1.8	38	
Power Factor	0.77	0.77	0.92	0.92	0.75	0.75	0.75	0.7	0.7	0.75	0.75	0.83	0.88	0.75	0.75	0.75	0.75	1	
Power (kW)	1.3	1.3	8.3	8.3	2.3	0.7	0.7	1.2	1.2	0.6	1.3	0.8	0.1	0.3	1.0	1.3	0.3	9.7	
Run Hours (hr)	16	15	178	183	144	6	6	76	77	360	0	336	336	336	336	16	0	66	
Total power consumption (kW-hr)	21	20	1474	1515	336	4	4	89	94	222	0	271	49	87	329	21	0	647	3884
Daily power consumption (kW-hr/day)	1.41	1.32	98.27	101.03	22.42	0.27	0.27	5.95	6.27	14.77	0.00	18.08	3.27	5.82	21.91	1.39	0.00	43	259
% Power	0.4%	0.4%	28.4%	29.2%	6.5%	0.1%	0.1%	1.7%	1.8%	4.3%	0.0%	5.2%	0.9%	1.7%	6.3%	0.4%	0.0%	12.5%	
Power consumption rank	12	14	2	1	4	15	15	9	8	7	17	6	11	10	5	13	17	3	

Totals for period	Average kW	Daily average kW-hr	Total kW-hr
Hour Timer Components		252	3780
Booster Pump	1.80	43	647
BMR Log	**10.79**	259	**3884**
Power accounted for by BMR			87.7%
Primary Treatment		1.39	
Secondary Treatment		280.35	
Tertiary Treatment		63.86	
TOTAL		**345.60**	
DESIGN TOTAL		**793.57**	

Appendix J: Cooling tower chemical inventory

Cooling Tower Chemicals Inventory (gal)

	CL-4816 (Polymer) (gal)	CL-2156 (Biocide) (gal)
5/10/2011	38	22
5/31/2011	68	52
6/7/2011	68	51
6/15/2011	66.5	47
6/28/2011	48	41
7/5/2011	48	41
7/14/2011	45.5	36.5
7/26/2011	36	35
8/4/2011	60	61
8/11/2011	54	59
9/1/2011	38	52.5
9/15/2011	29	48
9/26/2011	23.5	46
10/3/2011	77	74.5

Appendix K: Chemtreat corrosion test data reports

ChemTreat, Inc.

Corrosion Test Data Report

June 20, 2011

Laboratory No. 11−06−20−32
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer JOHN NICOLAI
Sample Class Exposed Coupons

Analysis	Cooling Tower	Cooling Tower
Specimen Number	60635	149625
Specimen Type	Copper	Mild Steel
Date Installed	05/20/11	05/20/11
Date Removed	06/15/11	06/15/11
Exposure Period (days)	26	26
Initial Weight (g)	9.7585	8.4383
Final Weight (g)	9.7538	8.2931
Weight Loss (g)	0.0047	0.1452
Corrosion Rate (mpy)	**0.2**	**5.5**

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: JOHN NICOLAI

ChemTreat, Inc.

Corrosion Test Data Report

July 11, 2011

Laboratory No. 11−07−11−72
Company THE VISIONAIRE
Address 70 LITTLE WEST STREET, NEW YORK, NY
Engineer JOHN NICOLAI
Sample Class Exposed Coupons

Specimen Number	1
Specimen Type	Stainless Steel 316
Date Installed	06/02/11
Date Removed	07/05/11
Exposure Period (days)	33
Initial Weight (g)	122.0275
Final Weight (g)	122.0275
Weight Loss (g)	0.0000
Corrosion Rate (mpy)	**<0.1**

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: JOHN NICOLAI

Corrosion Test Data Report

July 15, 2010

Laboratory No. 10−07−15−40
Company Visionaire
Address 70 Little West Street, New York, NY
Engineer CHRIS GONZALES
Sample Class Exposed Coupons

Analysis	Condenser Water	Condenser Water
Specimen Number	137612	60636
Specimen Type	Mild Steel	Copper
Date Installed	06/09/10	06/09/10
Date Removed	07/12/10	07/12/10
Exposure Period (days)	33	33
Initial Weight (g)	8.7037	9.6879
Final Weight (g)	8.6233	9.6855
Weight Loss (g)	0.0804	0.0024
Corrosion Rate (mpy)	**2.4**	**<0.1**

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: CHRIS GONZALES

ChemTreat, Inc.

Corrosion Test Data Report

August 1, 2011

Laboratory No.	11−08−01−88
Company	THE VISIONAIRE
Address	70 LITTLE WEST STREET, NEW YORK, NY
Engineer	JOHN NICOLAI
Sample Class	Exposed Coupons

Analysis	Cooling Tower	Cooling Tower
Specimen Number	149645	67590
Specimen Type	Mild Steel	Copper
Date Installed	06/15/11	06/15/11
Date Removed	07/26/11	07/26/11
Exposure Period (days)	41	41
Initial Weight (g)	8.6033	8.5181
Final Weight (g)	8.2740	8.5166
Weight Loss (g)	0.3293	0.0015
Corrosion Rate (mpy)	**7.9**	**<0.1**

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: JOHN NICOLAI

ChemTreat, Inc.

Corrosion Test Data Report

September 8, 2011

Laboratory No.	11−09−08−85
Company	THE VISIONAIRE
Address	70 LITTLE WEST STREET, NEW YORK, NY
Engineer	JOHN NICOLAI
Sample Class	Exposed Coupons

Analysis	Cooling Tower	Cooling Tower
Specimen Number	149628	67606
Specimen Type	Mild Steel	Copper
Date Installed	07/26/11	07/26/11
Date Removed	09/01/11	09/01/11
Exposure Period (days)	37	37
Initial Weight (g)	8.3920	8.5849
Final Weight (g)	8.2889	8.5845
Weight Loss (g)	0.1031	0.0004
Corrosion Rate (mpy)	**2.7**	**<0.1**

Respectfully Submitted,

Mark A. Cordrey

Mark A. Cordrey
Manager Customer Service Analytical Lab
ChemTreat, Inc.

CC: JOHN NICOLAI

Appendix L: Full study analysis of actual potable water demand, sewer discharge, and cost by month comparing The Visionaire to a baseline building and a conserving building

Time Period: FULL STUDY - excluding October
System: The Visionaire WTRS actual data
Average Flow: 7,941gpd without October, 8,203gpd with October

POTABLE DEMAND

	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**41,132**	**49,354**	**59,125**	**54,955**	**44,965**	**40,566**	**34,329**	**31,737**	**31,773**	**32,846**	**34,530**	**37,488**	**43,927**	**53,615**	**63,148**	**52,531**	**49,259**	44,428
Annualized	1,110,564	1,480,622	1,832,884	1,703,614	1,348,949	1,257,544	1,029,879	983,859	984,954	919,676	1,070,420	1,124,652	1,361,739	1,608,459	1,957,587	1,628,476	1,477,771	22,881,649
no wtrs (avg gpd)	**34,013**	**40,822**	**52,889**	**46,072**	**40,543**	**34,913**	**29,422**	**25,257**	**26,375**	**26,894**	**29,373**	**30,312**	**34,044**	**43,808**	**57,909**	**41,914**	**40,828**	37,376
% Reduction from baseline	17%	17%	11%	16%	10%	14%	14%	20%	17%	18%	15%	19%	22%	18%	8%	20%	17%	16%
Annualized (gal/month)	918,357	1,224,655	1,639,559	1,428,222	1,216,287	1,082,303	882,648	782,952	817,611	753,033	910,550	909,358	1,055,372	1,314,226	1,795,170	1,299,326	1,224,855	19,254,484
current	**28,515**	**32,620**	**43,108**	**36,757**	**31,654**	**26,290**	**24,941**	**21,870**	**22,161**	**21,405**	**21,742**	**23,928**	**28,284**	**30,499**	**42,705**	**26,521**	**25,628**	28,743
% Reduction from baseline	31%	34%	27%	33%	30%	35%	27%	31%	30%	35%	37%	36%	36%	43%	32%	50%	48%	35%
Annualized (gal/month)	769,915	978,585	1,336,359	1,139,476	949,622	814,975	748,219	677,967	686,992	599,351	674,012	717,845	876,798	914,957	1,323,862	822,160	768,826	14,799,923

SEWER DISCHARGE

	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**28,753**	**30,826**	**32,604**	**32,194**	**30,913**	**30,210**	**30,474**	**31,013**	**31,516**	**32,232**	**33,332**	**33,426**	**36,782**	**36,499**	**38,815**	**36,302**	**37,337**	33,131
Annualized	776,331	924,782	1,010,738	998,012	927,396	936,523	914,213	961,401	976,989	902,503	1,033,297	1,002,780	1,140,239	1,094,968	1,203,269	1,125,374	1,120,108	17,048,924
no wtrs (avg gpd)	**23,330**	**23,133**	**27,297**	**26,131**	**27,009**	**24,558**	**25,570**	**24,532**	**26,118**	**26,259**	**27,963**	**26,245**	**26,899**	**28,464**	**34,622**	**26,162**	**28,907**	26,659
% Reduction from baseline	19%	25%	16%	19%	13%	19%	16%	21%	17%	19%	16%	21%	27%	22%	11%	28%	23%	20%
Annualized (gal/month)	629,908	693,981	846,212	810,057	810,273	761,283	767,089	760,495	809,646	735,240	866,857	787,357	833,859	853,932	1,073,269	811,018	867,207	13,717,682
current (avg gpd)	**17,321**	**14,867**	**17,817**	**14,972**	**17,603**	**20,547**	**19,506**	**20,273**	**20,560**	**20,441**	**20,901**	**20,248**	**22,545**	**16,639**	**23,088**	**10,872**	**13,423**	18,331
% Reduction from baseline	40%	52%	45%	53%	43%	32%	36%	35%	35%	37%	37%	39%	39%	54%	41%	70%	64%	45%
Annualized (gal/month)	467,662	446,022	552,341	464,130	528,092	636,955	585,168	628,469	637,356	572,343	647,934	607,434	698,908	499,160	715,729	337,044	402,680	9,427,427

Time Period: FULL STUDY - excluding October
System: The Visionaire WTRS actual data
Average Flow: 7,941gpd without October, 8,203gpd with October

	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
Water Rate ($/gal)	0.0035	0.0035	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0041	0.0042	0.0042	0.0042	
Sewer Rate ($/gal)	0.0056	0.0056	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0065	0.0067	0.0067	0.0067	
ENERGY																		
baseline & conserving																		
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
current																		
cost ($/month)	$ 892	$ 957	$ 962	$ 811	$ 834	$ 848	$ 961	$ 868	$ 773	$ 957	$ 696	$ 788	$ 5,905	$ 694	$ 956	$ 1,245	$ 494	$ 19,642
													$ 788					$ 14,525
POTABLE DEMAND																		
baseline (avg gpd	**41,132**	**49,354**	**59,125**	**54,955**	**44,965**	**40,566**	**34,329**	**31,737**	**31,773**	**32,846**	**34,530**	**37,488**	**43,927**	**53,615**	**63,148**	**52,531**	**49,259**	**44,428**
Annualized	1,110,564	1,480,622	1,832,884	1,703,614	1,348,949	1,257,544	1,029,879	983,859	984,954	919,676	1,070,420	1,124,652	1,361,739	1,608,459	1,957,587	1,628,476	1,477,771	22,881,649
Cost	$ 3,887	$ 5,188	$ 7,228	$ 6,718	$ 5,320	$ 4,959	$ 4,057	$ 3,876	$ 3,880	$ 3,623	$ 4,217	$ 4,430	$ 5,364	$ 6,547	$ 8,304	$ 6,908	$ 6,269	$ 90,775
no wtrs (avg gpd)	**34,013**	**40,822**	**52,889**	**46,072**	**40,543**	**34,913**	**29,422**	**25,257**	**26,375**	**26,894**	**29,373**	**30,312**	**34,044**	**43,808**	**57,909**	**41,914**	**40,828**	**37,376**
% Reduction from baseline	17%	17%	11%	16%	10%	14%	14%	20%	17%	18%	15%	19%	22%	18%	8%	20%	17%	16%
Annualized (gal/month)	918,357	1,224,655	1,639,559	1,428,222	1,216,287	1,082,303	882,648	782,952	817,611	753,033	910,550	909,358	1,055,372	1,314,226	1,795,170	1,299,326	1,224,855	19,254,484
Cost	$ 3,214	$ 4,291	$ 6,466	$ 5,632	$ 4,797	$ 4,268	$ 3,477	$ 3,084	$ 3,221	$ 2,966	$ 3,587	$ 3,582	$ 4,157	$ 5,349	$ 7,615	$ 5,512	$ 5,196	$ 76,415
current	**28,515**	**32,620**	**43,108**	**36,757**	**31,654**	**26,290**	**24,941**	**21,870**	**22,161**	**21,405**	**21,742**	**23,928**	**28,284**	**30,499**	**42,705**	**26,521**	**25,628**	**28,743**
% Reduction from baseline	31%	34%	27%	33%	30%	35%	27%	31%	30%	35%	37%	36%	36%	43%	32%	50%	48%	35%
Annualized (gal/month)	769,915	978,585	1,336,359	1,139,476	949,622	814,975	748,219	677,967	686,992	599,351	674,012	717,845	876,798	914,957	1,323,862	822,160	768,826	14,799,923
Cost	$ 2,695	$ 3,429	$ 5,270	$ 4,494	$ 3,745	$ 3,214	$ 2,947	$ 2,671	$ 2,706	$ 2,361	$ 2,655	$ 2,828	$ 3,454	$ 3,724	$ 5,616	$ 3,488	$ 3,261	$ 58,557
Rate with CWRP	$ 2,021	$ 2,572	$ 3,953	$ 3,370	$ 2,809	$ 2,410	$ 2,210	$ 2,003	$ 2,030	$ 1,771	$ 1,991	$ 2,121	$ 2,590	$ 2,793	$ 4,212	$ 2,616	$ 2,446	$ 43,918
SEWER DISCHARGE																		
baseline (avg gpd)	**28,753**	**30,826**	**32,604**	**32,194**	**30,913**	**30,210**	**30,474**	**31,013**	**31,516**	**32,232**	**33,332**	**33,426**	**36,782**	**36,499**	**38,815**	**36,302**	**37,337**	**33,131**
Annualized	776,331	924,782	1,010,738	998,012	927,396	936,523	914,213	961,401	976,989	902,503	1,033,297	1,002,780	1,140,239	1,094,968	1,203,269	1,125,374	1,120,108	17,048,924
Cost	$ 4,320	$ 5,153	$ 6,338	$ 6,258	$ 5,815	$ 5,872	$ 5,726	$ 6,021	$ 6,119	$ 5,653	$ 6,472	$ 6,281	$ 7,142	$ 7,087	$ 8,116	$ 7,591	$ 7,555	$ 107,517
no wtrs (avg gpd)	**23,330**	**23,133**	**27,297**	**26,131**	**27,009**	**24,558**	**25,570**	**24,532**	**26,118**	**26,259**	**27,963**	**26,245**	**26,899**	**28,464**	**34,622**	**26,162**	**28,907**	**26,659**
% Reduction from baseline	19%	25%	16%	19%	13%	19%	16%	21%	17%	19%	16%	21%	27%	22%	11%	28%	23%	20%
Annualized (gal/month)	629,908	693,981	846,212	810,057	810,273	761,283	767,089	760,495	809,646	735,240	866,857	787,357	833,859	853,932	1,073,269	811,018	867,207	13,717,682
Cost	$ 3,505	$ 3,867	$ 5,306	$ 5,079	$ 5,081	$ 4,773	$ 4,804	$ 4,763	$ 5,071	$ 4,605	$ 5,429	$ 4,931	$ 5,223	$ 5,527	$ 7,239	$ 5,470	$ 5,849	$ 86,524
current (avg gpd)	**17,321**	**14,867**	**17,817**	**14,972**	**17,603**	**20,547**	**19,506**	**20,273**	**20,560**	**20,441**	**20,901**	**20,248**	**22,545**	**16,639**	**23,088**	**10,872**	**13,423**	**18,331**
% Reduction from baseline	40%	52%	45%	53%	43%	32%	36%	35%	35%	37%	37%	39%	39%	54%	41%	70%	64%	45%
Annualized (gal/month)	467,662	446,022	552,341	464,130	528,092	636,955	585,168	628,469	637,356	572,343	647,934	607,434	698,908	499,160	715,729	337,044	402,680	9,427,427
Cost	$ 2,603	$ 2,485	$ 3,463	$ 2,910	$ 3,311	$ 3,994	$ 3,665	$ 3,936	$ 3,992	$ 3,585	$ 4,058	$ 3,804	$ 4,377	$ 3,231	$ 4,828	$ 2,273	$ 2,716	$ 59,232
Cost with CWRP	$ 1,952	$ 1,864	$ 2,598	$ 2,183	$ 2,483	$ 2,995	$ 2,749	$ 2,952	$ 2,994	$ 2,689	$ 3,044	$ 2,853	$ 3,283	$ 2,423	$ 3,621	$ 1,705	$ 2,037	$ 44,424
Cost with CWRP and excep.	$ 1,952	$ 1,864	$ 2,598	$ 2,183	$ 2,483	$ 2,995	$ 1,520	$ 1,632	$ 1,656	$ 1,487	$ 1,683	$ 1,578	$ 1,815	$ 1,340	$ 2,002	$ 943	$ 1,126	$ 30,857
Cost with just exception	$ 2,603	$ 2,485	$ 3,463	$ 2,910	$ 3,311	$ 3,994	$ 2,027	$ 2,177	$ 2,207	$ 1,982	$ 2,244	$ 2,104	$ 2,421	$ 1,786	$ 2,669	$ 1,257	$ 1,502	$ 41,142
AWM CONTRACT																		
baseline	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
current	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 6,206	$ 105,498

Appendix M: Theoretical year analysis of potable water demand, sewer discharge, energy use, and cost comparing The Visionaire at full build-out to a baseline building and a conserving building

Time Period: Theoretical Year: October 2010 - September 2011
System: The Visionaire at Full Build-out population = 610 residents
Average Flow 13,061 gpd

ENERGY FOR REUSE TREATMENT

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline	-	-	-	-	-	-	-	-	-	-	-	-	-
no wtrs	-	-	-	-	-	-	-	-	-	-	-	-	-
Current (kWh)	11,098	10,399	10,485	10,428	9,468	10,586	10,419	10,963	10,874	11,392	11,302	10,831	128,244

POTABLE DEMAND

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**53,746**	**46,946**	**43,791**	**43,263**	**43,773**	**44,894**	**47,290**	**53,165**	**62,290**	**71,260**	**60,080**	**56,244**	52,228
Annualized	1,666,121	1,408,382	1,357,522	1,341,160	1,225,643	1,391,711	1,418,686	1,648,117	1,868,704	2,209,050	1,862,482	1,687,335	19,084,911
no wtrs (avg gpd)	**39,136**	**32,338**	**29,185**	**28,657**	**29,165**	**30,276**	**32,663**	**37,333**	**45,313**	**53,800**	**45,236**	**41,633**	37,061
% Reduction from baseline	27%	31%	33%	34%	33%	33%	31%	30%	27%	25%	25%	26%	29%
Annualized (gal/month)	1,213,217	970,155	904,742	888,380	816,611	938,561	979,887	1,157,309	1,359,387	1,667,805	1,402,305	1,248,991	13,547,350
current	**23,211**	**23,212**	**23,211**	**23,211**	**23,211**	**23,211**	**23,211**	**23,211**	**24,097**	**26,469**	**23,449**	**23,211**	23,576
% Reduction from baseline	57%	51%	47%	46%	47%	48%	51%	56%	61%	63%	61%	59%	55%
Annualized (gal/month)	719,528	696,371	719,528	719,528	649,896	719,528	696,317	719,528	722,916	820,547	726,925	696,325	8,606,934

SEWER DISCHARGE

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**43,390**	**43,091**	**43,067**	**43,006**	**43,160**	**43,696**	**43,227**	**46,020**	**45,174**	**46,927**	**43,851**	**44,322**	44,078
Annualized	1,345,100	1,292,716	1,335,064	1,333,195	1,208,470	1,354,588	1,296,813	1,426,616	1,355,213	1,454,732	1,359,380	1,329,671	16,091,559
no wtrs (avg gpd)	**28,785**	**28,485**	**28,461**	**28,401**	**28,554**	**29,091**	**28,621**	**31,414**	**30,568**	**32,321**	**29,245**	**29,717**	29,472
% Reduction from baseline	34%	34%	34%	34%	34%	33%	34%	32%	32%	31%	33%	33%	33%
Annualized (gal/month)	892,321	854,542	882,284	880,416	799,508	901,809	858,640	973,837	917,039	1,001,953	906,600	891,498	10,760,446
current (avg gpd)	**12,859**	**19,359**	**22,486**	**22,954**	**22,589**	**21,919**	**19,167**	**17,292**	**9,352**	**4,867**	**7,459**	**11,294**	15,966
% Reduction from baseline	70%	55%	48%	47%	48%	50%	56%	62%	79%	90%	83%	75%	64%
Annualized (gal/month)	398,631	580,759	697,070	711,563	632,482	679,490	575,006	536,049	280,567	150,867	231,219	338,831	5,812,536

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11
Residents	610	610	610	610	610	610	610	610	610	610	610	610
Guests	65	65	65	65	65	65	65	65	65	65	65	65
Days per month	31	30	31	31	28	31	30	31	30	31	31	30

Baseline

Toilet	10945	10945	10945	10945	10945	10945	10945	10945	10945	10945	10945	10945
Showers	10669	10669	10669	10669	10669	10669	10669	10669	10669	10669	10669	10669
Faucets	12353	12353	12353	12353	12353	12353	12353	12353	12353	12353	12353	12353
Dishwasher	975	975	975	975	975	975	975	975	975	975	975	975
Clothes Washer	6094	6094	6094	6094	6094	6094	6094	6094	6094	6094	6094	6094
Irrigation	8	4	0	0	5	24	42	2453	4743	5707	477	11
Cooling Load	10918	4123	971	443	948	2050	4428	7892	14727	22732	16783	13413
Other	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785

Conserving

Toilet	5004	5004	5004	5004	5004	5004	5004	5004	5004	5004	5004	5004
Showers	8083	8083	8083	8083	8083	8083	8083	8083	8083	8083	8083	8083
Faucets	10870	10870	10870	10870	10870	10870	10870	10870	10870	10870	10870	10870
Dishwasher	374	374	374	374	374	374	374	374	374	374	374	374
Clothes Washer	2099	2099	2099	2099	2099	2099	2099	2099	2099	2099	2099	2099
Irrigation	4	2	0	0	2	12	21	1227	2371	2854	239	6
Cooling Load	10918	4123	971	443	948	2050	4428	7892	14727	22732	16783	13413
Other	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785
Stormwater Capture	4	0	0	0	14	118	23	1227	1485	2331	0	5
blowdown avg gpd	566	271	247	186	326	759	384	1973	869	1776	1031	1497

WTRS

Can treat (gpd)	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	
Net needed for irrigation	0	2	0	0	0	0	0	0	887	523	239	0	
Cooling tower top up	0	0	0	0	0	0	0	0	0	2736	0	0	
Total Potable Top Up	0	2	0	0	0	0	0	0	887	3259	239	0	
Untreatable - to sewer	12859	19359	22486	22954	22589	21919	19167	17292	9352	4867	7459	11294	
Demand for reuse water	15921	9126	5975	5447	5952	7054	9431	12895	19731	27736	21786	18417	
Total Treated (avg gpd)	15921	9126	5975	5447	5952	7054	9431	12895	19731	25000	21786	18417	
Total treated (gal/month)	**493565.3043**	**273783.3517**	**185214.5929**	**168852.637**	**166645.3807**	**218662.1787**	**282944.7857**	**399752.9959**	**591927.5571**	**775000**	**675380.756**	**552503.6276**	4784233.168

Time Period: Theoretical Year: October 2010 - September 2011
System: The Visionaire at Full Build-out population = 610 residents
Average Flow 13,061 gpd

Energy Rate ($/kWh)	0.083	0.083	0.091	0.076	0.076	0.076	0.065	0.063	0.069	0.091	0.044	0.063
Water Rate ($/gal)	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0041	0.0042	0.0042	0.0042
Sewer Rate ($/gal)	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0065	0.0067	0.0067	0.0067

ENERGY FOR REUSE TREATMENT

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline	-	-	-	-	-	-	-	-	-	-	-	-	-
Cost	-	-	-	-	-	-	-	-	-	-	-	-	$ -
no wtrs	-	-	-	-	-	-	-	-	-	-	-	-	-
Cost	-	-	-	-	-	-	-	-	-	-	-	-	$ -
Current	11,098	10,399	10,485	10,428	9,468	10,586	10,419	10,963	10,874	11,392	11,302	10,831	10,687
Cost	$ 921	$ 863	$ 954	$ 793	$ 720	$ 805	$ 677	$ 691	$ 750	$ 1,037	$ 497	$ 682	$ 9,389

POTABLE DEMAND

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**53,746**	**46,946**	**43,791**	**43,263**	**43,773**	**44,894**	**47,290**	**53,165**	**62,290**	**71,260**	**60,080**	**56,244**	52,228
Annualized	1,666,121	1,408,382	1,357,522	1,341,160	1,225,643	1,391,711	1,418,686	1,648,117	1,868,704	2,209,050	1,862,482	1,687,335	19,084,911
Cost	$ 6,570	$ 5,554	$ 5,354	$ 5,289	$ 4,833	$ 5,488	$ 5,595	$ 6,499	$ 7,369	$ 8,712	$ 7,345	$ 6,654	$ 75,263
no wtrs (avg gpd)	**39,136**	**32,338**	**29,185**	**28,657**	**29,165**	**30,276**	**32,663**	**37,333**	**45,313**	**53,800**	**45,236**	**41,633**	37,061
% Reduction from baseline	27%	31%	33%	34%	33%	33%	31%	30%	27%	25%	25%	26%	29%
Annualized (gal/month)	1,213,217	970,155	904,742	888,380	816,611	938,561	979,887	1,157,309	1,359,387	1,667,805	1,402,305	1,248,991	13,547,350
Cost	$ 4,784	$ 3,826	$ 3,568	$ 3,503	$ 3,220	$ 3,701	$ 3,864	$ 4,564	$ 5,361	$ 6,577	$ 5,530	$ 4,926	$ 53,425
Rate with CWRP	$ 3,588	$ 2,869	$ 2,676	$ 2,628	$ 2,415	$ 2,776	$ 2,898	$ 3,423	$ 4,021	$ 4,933	$ 4,148	$ 3,694	$ 40,069
current	**23,211**	**23,212**	**23,211**	**23,211**	**23,211**	**23,211**	**23,211**	**23,211**	**24,097**	**26,469**	**23,449**	**23,211**	23,576
% Reduction from baseline	57%	51%	47%	46%	47%	48%	51%	56%	61%	63%	61%	59%	55%
Annualized (gal/month)	719,528	696,371	719,528	719,528	649,896	719,528	696,317	719,528	722,916	820,547	726,925	696,325	8,606,934
Cost	$ 2,838	$ 2,746	$ 2,838	$ 2,838	$ 2,563	$ 2,838	$ 2,746	$ 2,838	$ 2,851	$ 3,236	$ 2,867	$ 2,746	$ 33,942
Rate with CWRP	$ 2,128	$ 2,060	$ 2,128	$ 2,128	$ 1,922	$ 2,128	$ 2,059	$ 2,128	$ 2,138	$ 2,427	$ 2,150	$ 2,060	$ 25,457

SEWER DISCHARGE

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**48,488**	**43,091**	**43,067**	**43,006**	**43,160**	**43,696**	**43,227**	**46,020**	**45,174**	**46,927**	**43,851**	**44,322**	44,502
Annualized	1,503,118	1,292,716	1,335,064	1,333,195	1,208,470	1,354,588	1,296,813	1,426,616	1,355,213	1,454,732	1,359,380	1,329,671	16,249,576
Cost	$ 9,425	$ 8,106	$ 8,371	$ 8,360	$ 7,577	$ 8,494	$ 8,131	$ 8,945	$ 8,498	$ 9,122	$ 8,524	$ 8,337	$ 101,890
no wtrs (avg gpd)	**33,882**	**28,485**	**28,461**	**28,401**	**28,554**	**29,091**	**28,621**	**31,414**	**30,568**	**32,321**	**29,245**	**29,717**	29,897
% Reduction from baseline	30%	34%	34%	34%	34%	34%	34%	34%	36%	36%	33%	33%	33%
Annualized (gal/month)	1,050,214	854,542	882,284	880,416	799,128	898,153	857,951	935,802	872,495	929,695	906,600	891,335	10,758,615
Cost	$ 6,585	$ 5,352	$ 5,526	$ 5,514	$ 5,005	$ 5,625	$ 5,374	$ 5,861	$ 5,647	$ 6,271	$ 6,115	$ 6,012	$ 68,887
Cost with CWRP	$ 4,939	$ 4,014	$ 4,144	$ 4,136	$ 3,754	$ 4,219	$ 4,030	$ 4,396	$ 4,235	$ 4,703	$ 4,586	$ 4,509	$ 51,665
Cost with CWRP and excep.	$ 3,318	$ 2,697	$ 2,784	$ 2,778	$ 2,522	$ 2,834	$ 2,707	$ 2,953	$ 2,845	$ 3,160	$ 3,081	$ 3,029	$ 34,709
Cost just exception	$ 4,424	$ 3,596	$ 3,712	$ 3,704	$ 3,362	$ 3,779	$ 3,610	$ 3,937	$ 3,793	$ 4,213	$ 4,108	$ 4,039	$ 46,278

current (avg gpd)	**17,956**	**19,359**	**22,486**	**22,954**	**22,589**	**21,919**	**19,167**	**17,292**	**9,352**	**4,867**	**7,459**	**11,294**	16,391
% Reduction from baseline	63%	55%	48%	47%	48%	50%	56%	62%	79%	90%	83%	75%	68%
Annualized (gal/month)	556,649	580,759	697,070	711,563	632,482	679,490	575,006	536,049	280,567	150,867	231,219	338,831	5,970,553
Cost	$ 3,490	$ 3,637	$ 4,366	$ 4,457	$ 3,961	$ 4,256	$ 3,601	$ 3,357	$ 1,816	$ 1,018	$ 1,560	$ 2,285	$ 37,805
Cost with CWRP	$ 2,618	$ 2,728	$ 3,274	$ 3,343	$ 2,971	$ 3,192	$ 2,701	$ 2,518	$ 1,362	$ 763	$ 1,170	$ 1,714	$ 28,354
Cost with CWRP and excep.	$ 830	$ 865	$ 1,039	$ 1,060	$ 943	$ 1,013	$ 857	$ 799	$ 432	$ 242	$ 371	$ 544	$ 8,995
Cost just exception	$ 1,107	$ 2,444	$ 2,933	$ 2,994	$ 2,661	$ 2,859	$ 2,419	$ 2,255	$ 1,220	$ 684	$ 1,048	$ 1,535	$ 24,160

Appendix N: Potential energy and costs savings from implementing energy saving measures and operating the WTRS off-peak.

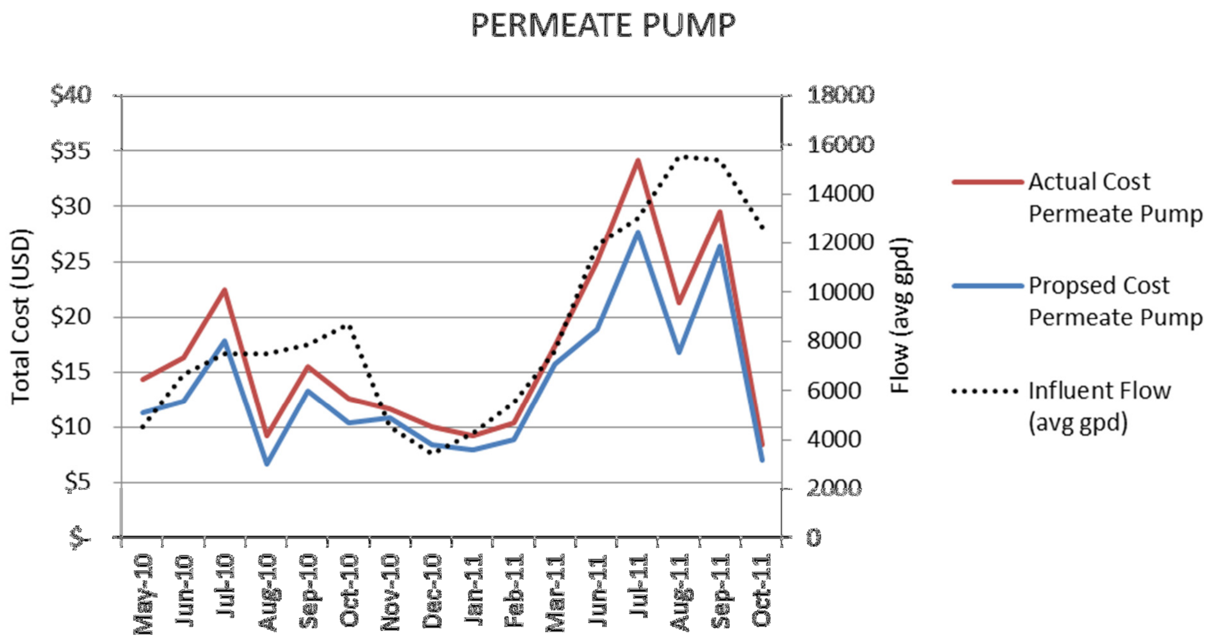

Figure 1. Proposed and actual cost of permeate pump totalized by month over the study timeline. Proposed costs were determined based on the energy reduction potential of the proposed measures. Note the close correlation to the feed pump cost.

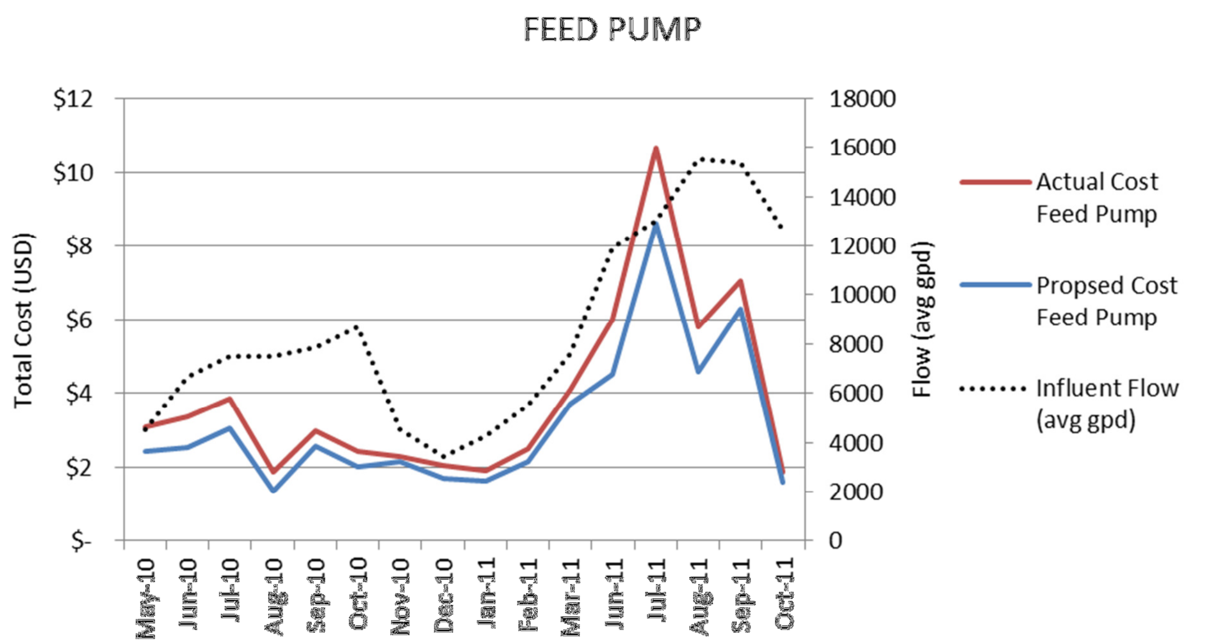

Figure 2. Proposed and actual cost of feed pump totalized by month over the study timeline. Proposed costs were determined based on the energy reduction potential of the proposed measures. Note the close correlation to the permeate pump costs.

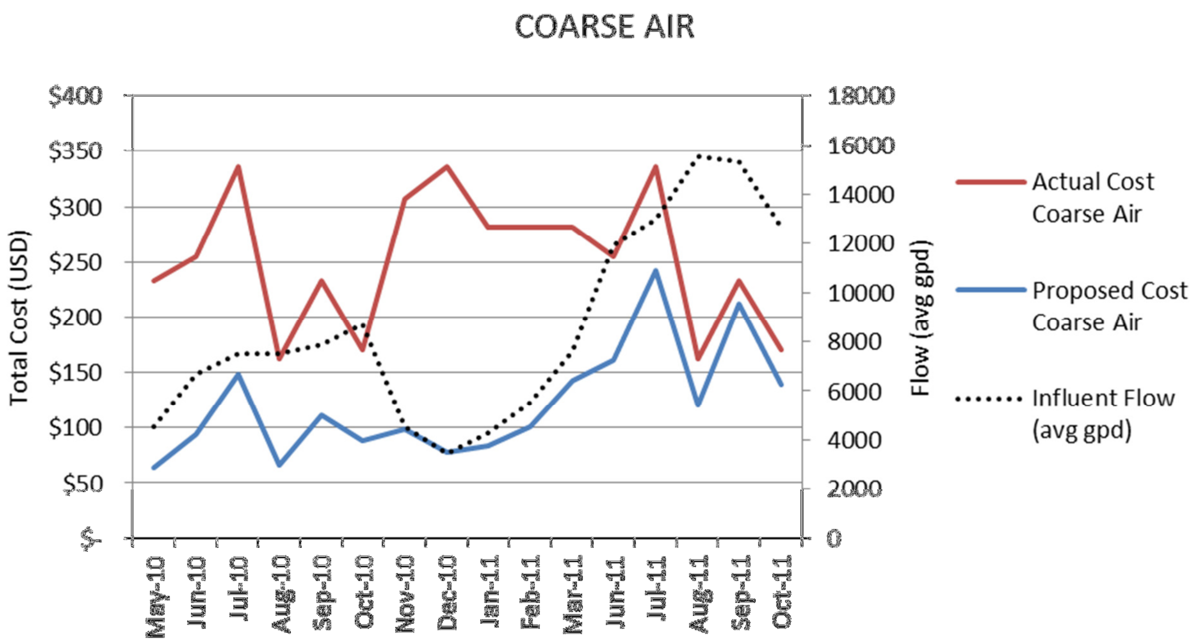

Figure 3. Proposed and actual cost of coarse aeration totalized by month over the study timeline. Proposed costs were determined based on the energy reduction potential of the proposed measures.

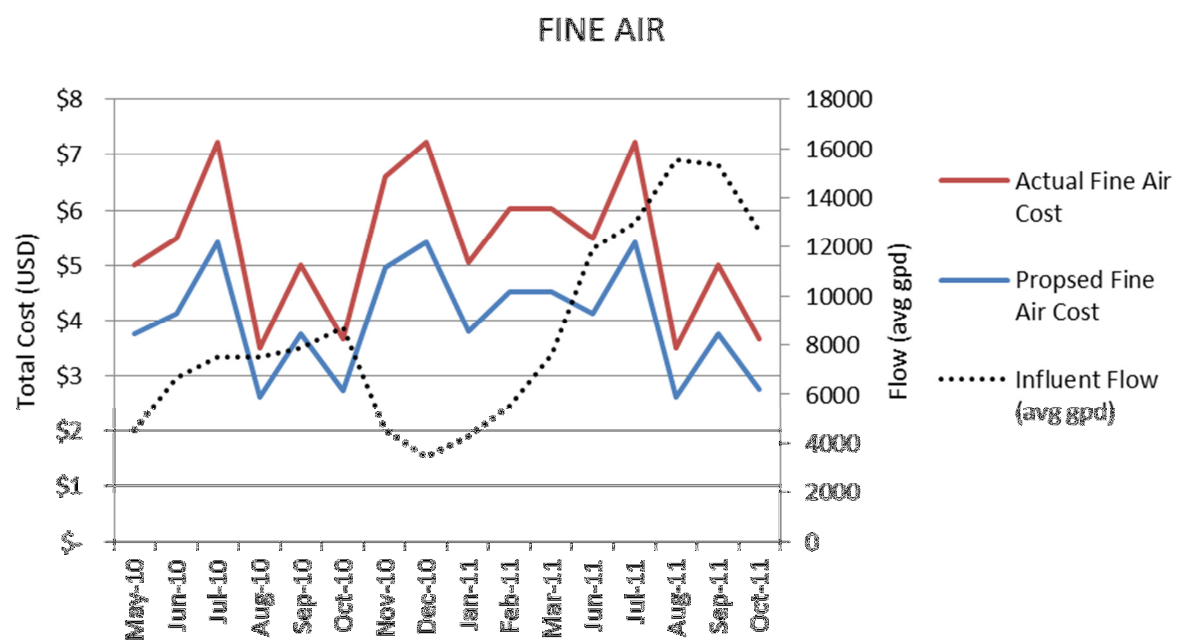

Figure 4. Proposed and actual cost of fine aeration totalized by month over the study timeline. Proposed costs were determined based on the energy reduction potential of the proposed measures.

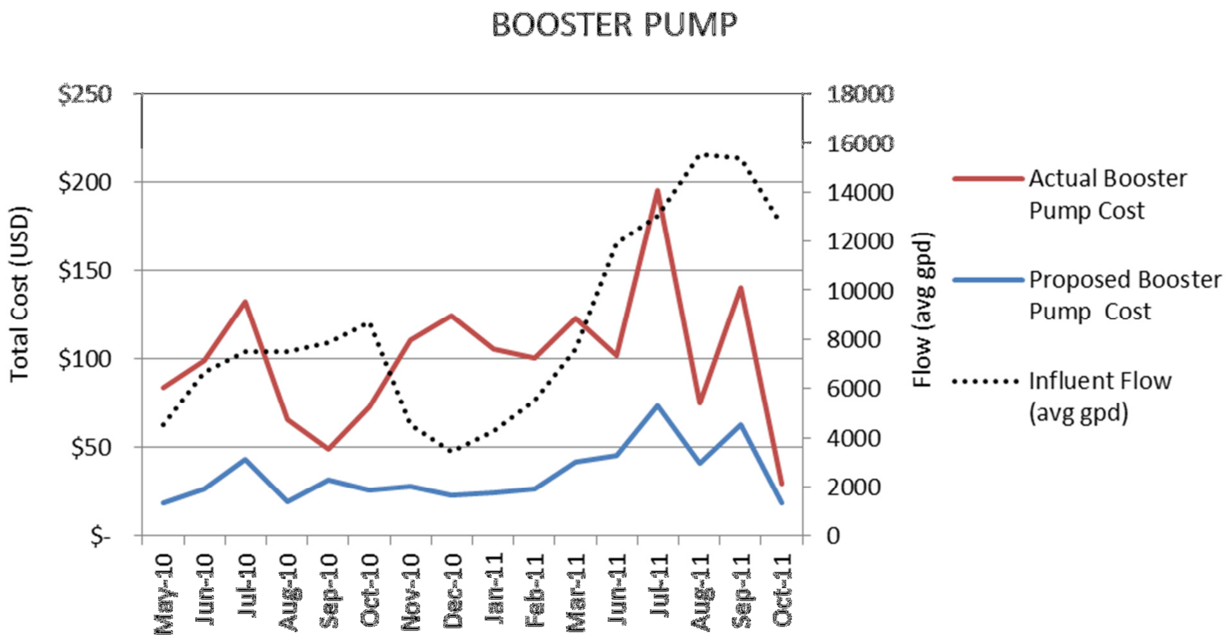

Figure 5. Proposed and actual cost of booster pump totalized by month over the study timeline. Proposed costs were determined based on the energy reduction potential of the proposed measures.

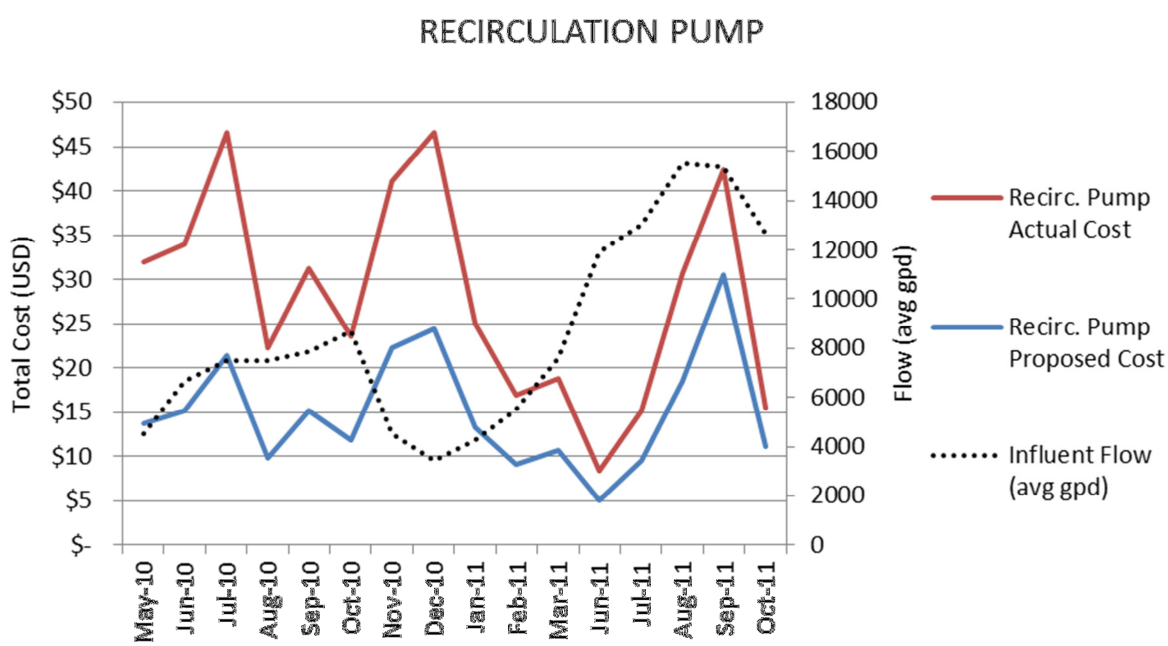

Figure 6. Proposed and actual cost of recirculation pump totalized by month over the study timeline. Proposed costs were determined based on the energy reduction potential of the proposed measures.

SUMMARY RESULTS

Component	Total Proposed Cost	Total Actual Cost	Total Savings
Permeate Pump	$ 248	$ 301	$ 53
Course Air	$ 1,938	$ 4,361	$ 2,423
Fine Air	$ 2,472	$ 2,997	$ 524
Booster Pump	$ 618	$ 1,810	$ 1,192
Feed Pump	$ 57	$ 69	$ 12
Recirculation Pump	$ 271	$ 506	$ 235
Backpulse Pump	$ 20	$ 21	$ 1
Inline Grinder	$ 32	$ 34	$ 2
TOTAL	$ 5,605	$ 10,045	$ 4,439

Component	Total Proposed kWh	Total Actual kWh	kWh saved
Permeate Pump	4,172	4,172	-
Course Air	34,794	57,240	22,446
Fine Air	28,320	37,761	9,440
Booster Pump	10,258	21,097	10,839
Feed Pump	959	959	-
Recirculation Pump	4,265	7,051	2,786
Backpulse Pump	301	301	-
Inline Grinder	488	488	-
TOTAL	82,768	128,279	45,512

Appendix O: Theoretical year analysis of potable water demand, sewer discharge, energy use, and cost comparing The Visionaire under various scenarios.

Time Period: Theoretical Year: October 2010 - September 2011
System: The Visionaire at Full Build-out population = 610 residents; optimized energy profile
Average Flow 15,000 gpd (reuse water used for clothes washing)

ENERGY FOR REUSE TREATMENT

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline	-	-	-	-	-	-	-	-	-	-	-	-	-
no wtrs	-	-	-	-	-	-	-	-	-	-	-	-	-
Current (kWh)	9,942	8,427	7,940	7,791	7,166	8,224	8,491	9,443	10,152	10,896	10,758	9,977	109,209

POTABLE DEMAND

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**53,746**	**46,946**	**43,791**	**43,263**	**43,773**	**44,894**	**47,290**	**53,165**	**62,290**	**71,260**	**60,080**	**56,244**	52,228
Annualized	1,666,121	1,408,382	1,357,522	1,341,160	1,225,643	1,391,711	1,418,686	1,648,117	1,868,704	2,209,050	1,862,482	1,687,335	19,084,911
no wtrs (avg gpd)	**39,136**	**32,338**	**29,185**	**28,657**	**29,165**	**30,276**	**32,663**	**37,333**	**45,313**	**53,800**	**45,236**	**41,633**	37,061
% Reduction from baseline	27%	31%	33%	34%	33%	33%	31%	30%	27%	25%	25%	26%	29%
Annualized (gal/month)	1,213,217	970,155	904,742	888,380	816,611	938,561	979,887	1,157,309	1,359,387	1,667,805	1,402,305	1,248,991	13,547,350
current	**21,112**	**21,113**	**21,112**	**21,112**	**21,112**	**21,112**	**21,112**	**21,112**	**21,998**	**24,370**	**21,350**	**21,112**	21,477
% Reduction from baseline	61%	55%	52%	51%	52%	53%	55%	60%	65%	66%	64%	62%	59%
Annualized (gal/month)	654,458	633,401	654,458	654,458	591,124	654,458	633,347	654,458	659,945	755,478	661,855	633,354	7,840,795

SEWER DISCHARGE

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**43,390**	**43,091**	**43,067**	**43,006**	**43,160**	**43,696**	**43,227**	**46,020**	**45,174**	**46,927**	**43,851**	**44,322**	44,078
Annualized	1,345,100	1,292,716	1,335,064	1,333,195	1,208,470	1,354,588	1,296,813	1,426,616	1,355,213	1,454,732	1,359,380	1,329,671	16,091,559
no wtrs (avg gpd)	**28,785**	**28,485**	**28,461**	**28,401**	**28,554**	**29,091**	**28,621**	**31,414**	**30,568**	**32,321**	**29,245**	**29,717**	29,472
% Reduction from baseline	34%	34%	34%	34%	34%	33%	34%	32%	32%	31%	33%	33%	33%
Annualized (gal/month)	892,321	854,542	882,284	880,416	799,508	901,809	858,640	973,837	917,039	1,001,953	906,600	891,498	10,760,446
current (avg gpd)	**10,760**	**17,260**	**20,387**	**20,855**	**20,490**	**19,820**	**17,068**	**15,193**	**7,253**	**6,966**	**5,360**	**9,195**	14,217
% Reduction from baseline	75%	60%	53%	52%	53%	55%	61%	67%	84%	85%	88%	79%	68%
Annualized (gal/month)	333,562	517,789	632,000	646,494	573,710	614,421	512,035	470,980	217,597	215,936	166,150	275,861	5,176,536

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11
Residents	610	610	610	610	610	610	610	610	610	610	610	610
Guests	65	65	65	65	65	65	65	65	65	65	65	65
Days per month	31	30	31	31	28	31	30	31	30	31	31	30

Baseline												
Toilet	10945	10945	10945	10945	10945	10945	10945	10945	10945	10945	10945	10945
Showers	10669	10669	10669	10669	10669	10669	10669	10669	10669	10669	10669	10669
Faucets	12353	12353	12353	12353	12353	12353	12353	12353	12353	12353	12353	12353
Dishwasher	975	975	975	975	975	975	975	975	975	975	975	975
Clothes Washer	6094	6094	6094	6094	6094	6094	6094	6094	6094	6094	6094	6094
Irrigation	8	4	0	0	5	24	42	2453	4743	5707	477	11
Cooling Load	10918	4123	971	443	948	2050	4428	7892	14727	22732	16783	13413
Other	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785
Conserving												
Toilet	5004	5004	5004	5004	5004	5004	5004	5004	5004	5004	5004	5004
Showers	8083	8083	8083	8083	8083	8083	8083	8083	8083	8083	8083	8083
Faucets	10870	10870	10870	10870	10870	10870	10870	10870	10870	10870	10870	10870

Dishwasher	374	374	374	374	374	374	374	374	374	374	374	374	
Clothes Washer	2099	2099	2099	2099	2099	2099	2099	2099	2099	2099	2099	2099	
Irrigation	4	2	0	0	2	12	21	1227	2371	2854	239	6	
Cooling Load	10918	4123	971	443	948	2050	4428	7892	14727	22732	16783	13413	
Other	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	1785	
Stormwater Capture	4	0	0	0	14	118	23	1227	1485	2331	0	5	
blowdown avg gpd	566	271	247	186	326	759	384	1973	869	1776	1031	1497	
WTRS													
Can treat (gpd)	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	
Net needed for irrigation	0	2	0	0	0	0	0	0	887	523	239	0	
Cooling tower top up	0	0	0	0	0	0	0	0	0	2736	0	0	
Total Potable Top Up	0	2	0	0	0	0	0	0	887	3259	239	0	
Untreatable - to sewer	10760	17260	20387	20855	20490	19820	17068	15193	7253	6966	5360	9195	
Demand for reuse water	18020	11225	8074	7546	8051	9153	11531	14994	21830	29835	23885	20516	
Total Treated (avg gpd)	18020	11225	8074	7546	8051	9153	11531	14994	21830	25000	23885	20516	
Total treated (gal/month)	**558634.6143**	**336753.6517**	**250283.9029**	**233921.947**	**225417.6607**	**283731.4887**	**345915.0857**	**464822.3059**	**654897.8571**	**775000**	**740450.066**	**615473.9276**	5485302.508

Time Period: Theoretical Year: October 2010 - September 2011
System: The Visionaire at Full Build-out population = 610 residents; optimized energy profile
Average Flow 15,000 gpd (reuse water used for clothes washing)

Energy Rate ($/kWh)	0.083	0.083	0.091	0.076	0.076	0.076	0.065	0.063	0.069	0.091	0.044	0.063
Water Rate ($/gal)	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0041	0.0042	0.0042	0.0042
Sewer Rate ($/gal)	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0065	0.0067	0.0067	0.0067

ENERGY FOR REUSE TREATMENT

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	**STUDY TOTAL**
baseline	-	-	-	-	-	-	-	-	-	-	-	-	-
Cost	-	-	-	-	-	-	-	-	-	-	-	-	
no wtrs	-	-	-	-	-	-	-	-	-	-	-	-	-
Cost	-	-	-	-	-	-	-	-	-	-	-	-	
The Visionaire WTRS	9,942	8,427	7,940	7,791	7,166	8,224	8,491	9,443	10,152	10,896	10,758	9,977	109,209
Cost	$ 825	$ 699	$ 723	$ 592	$ 545	$ 625	$ 552	$ 595	$ 700	$ 992	$ 473	$ 629	$ 7,950

POTABLE DEMAND

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	**STUDY TOTAL**
baseline (avg gpd)	**53,746**	**46,946**	**43,791**	**43,263**	**43,773**	**44,894**	**47,290**	**53,165**	**62,290**	**71,260**	**60,080**	**56,244**	52,228
Annualized	1,666,121	1,408,382	1,357,522	1,341,160	1,225,643	1,391,711	1,418,686	1,648,117	1,868,704	2,209,050	1,862,482	1,687,335	19,084,911
Cost	$ 6,570	$ 5,548	$ 5,347	$ 5,283	$ 4,828	$ 5,482	$ 5,588	$ 6,492	$ 7,606	$ 9,371	$ 7,901	$ 7,158	$ 77,176
no wtrs (avg gpd)	**39,136**	**32,338**	**29,185**	**28,657**	**29,165**	**30,276**	**32,663**	**37,333**	**45,313**	**53,800**	**45,236**	**41,633**	37,061
% Reduction from baseline	27%	31%	33%	34%	33%	33%	31%	30%	27%	25%	25%	26%	29%
Annualized (gal/month)	1213217.1	970154.5	904742.2	888380.2	816611.1	938560.8	979886.9	1157308.9	1359387.4	1667804.7	1402305.3	1248990.9	13,547,350
Cost	$ 4,784	$ 3,822	$ 3,564	$ 3,499	$ 3,217	$ 3,697	$ 3,860	$ 4,559	$ 5,533	$ 7,075	$ 5,949	$ 5,298	$ 54,857
Rate with CWRP	$ 3,588	$ 2,866	$ 2,673	$ 2,625	$ 2,413	$ 2,773	$ 2,895	$ 3,419	$ 4,150	$ 5,306	$ 4,462	$ 3,974	$ 41,143
current	**21,112**	**21,113**	**21,112**	**21,112**	**21,112**	**21,112**	**21,112**	**21,112**	**21,998**	**24,370**	**21,350**	**21,112**	21,477
% Reduction from baseline	61%	55%	52%	51%	52%	53%	55%	60%	65%	66%	64%	62%	59%
Annualized (gal/month)	654,458	633,401	654,458	654,458	591,124	654,458	633,347	654,458	659,945	755,478	661,855	633,354	7,840,795
Cost	$ 2,581	$ 2,495	$ 2,578	$ 2,578	$ 2,329	$ 2,578	$ 2,495	$ 2,578	$ 2,686	$ 3,205	$ 2,808	$ 2,687	$ 31,597
Rate with CWRP	$ 1,936	$ 1,871	$ 1,933	$ 1,933	$ 1,746	$ 1,933	$ 1,871	$ 1,933	$ 2,015	$ 2,404	$ 2,106	$ 2,015	$ 23,698

SEWER DISCHARGE

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	**STUDY TOTAL**
baseline (avg gpd)	**43,390**	**43,091**	**43,067**	**43,006**	**43,160**	**43,696**	**43,227**	**46,020**	**45,174**	**46,927**	**43,851**	**44,322**	44,078
Annualized	1,345,100	1,292,716	1,335,064	1,333,195	1,208,470	1,354,588	1,296,813	1,426,616	1,355,213	1,454,732	1,359,380	1,329,671	16,091,559
Cost	$ 8,434	$ 8,097	$ 8,362	$ 8,350	$ 7,569	$ 8,484	$ 8,122	$ 8,935	$ 8,771	$ 9,812	$ 9,169	$ 8,969	$ 103,074
no wtrs (avg gpd)	**28,785**	**28,485**	**28,461**	**28,401**	**28,554**	**29,091**	**28,621**	**31,414**	**30,568**	**32,321**	**29,245**	**29,717**	29,472
% Reduction from baseline	34%	34%	34%	34%	34%	33%	34%	32%	32%	31%	33%	33%	33%
Annualized (gal/month)	892,321	854,542	882,284	880,416	799,508	901,809	858,640	973,837	917,039	1,001,953	906,600	891,498	10,760,446
Cost	$ 5,595	$ 5,352	$ 5,526	$ 5,514	$ 5,007	$ 5,648	$ 5,378	$ 6,099	$ 5,935	$ 6,758	$ 6,115	$ 6,013	$ 68,942
Cost with CWRP	$ 4,196	$ 4,014	$ 4,144	$ 4,136	$ 3,756	$ 4,236	$ 4,033	$ 4,575	$ 4,451	$ 5,069	$ 4,586	$ 4,510	$ 51,706
Cost with CWRP and excep.	$ 2,806	$ 2,684	$ 2,771	$ 2,766	$ 2,511	$ 2,833	$ 2,697	$ 3,059	$ 2,977	$ 3,389	$ 3,067	$ 3,016	$ 34,576

Cost just exception	$ 3,741	$ 3,579	$ 3,695	$ 3,687	$ 3,349	$ 3,777	$ 3,596	$ 4,079	$ 3,969	$ 4,519	$ 4,089	$ 4,021	$ 46,101
current (avg gpd)	**10,760**	**17,260**	**20,387**	**20,855**	**20,490**	**19,820**	**17,068**	**15,193**	**7,253**	**6,966**	**5,360**	**9,195**	14,217
% Reduction from baseline	75%	60%	53%	52%	53%	55%	61%	67%	84%	85%	88%	79%	68%
Annualized (gal/month)	333,562	517,789	632,000	646,494	573,710	614,421	512,035	470,980	217,597	215,936	166,150	275,861	5,176,536
Cost	$ 2,092	$ 3,243	$ 3,958	$ 4,049	$ 3,593	$ 3,848	$ 3,207	$ 2,950	$ 1,408	$ 1,456	$ 1,121	$ 1,861	$ 32,787
Cost with CWRP	$ 1,569	$ 2,432	$ 2,969	$ 3,037	$ 2,695	$ 2,886	$ 2,405	$ 2,212	$ 1,056	$ 1,092	$ 841	$ 1,396	$ 24,590
Cost with CWRP and excep.	$ 505	$ 782	$ 955	$ 977	$ 867	$ 928	$ 774	$ 712	$ 340	$ 351	$ 270	$ 449	$ 7,910
Cost just exception	$ 673	$ 2,169	$ 2,647	$ 2,708	$ 2,403	$ 2,573	$ 2,145	$ 1,973	$ 942	$ 974	$ 749	$ 1,244	$ 21,199

Time Period: Theoretical Year: October 2010 - September 2011
System: The Visionaire at block scale = 2440 residents (4x The Visionaire); optimized energy profile
Average Flow 60,000 gpd (reuse water used for clothes washing)

ENERGY FOR REUSE TREATMENT	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline	23,519	22,374	22,990	22,941	20,802	23,300	22,443	24,347	23,391	25,059	23,985	23,298	-
no wtrs	15,732	14,837	15,202	15,153	13,767	15,511	14,906	16,514	15,769	17,166	16,188	15,761	-
WTRS (kWh WTRS)	12,114	11,405	11,563	11,517	10,442	11,647	11,423	11,985	11,854	12,346	12,313	11,811	140,421
WTRS (KWh municipal)	6,122	9,045	10,897	11,129	9,889	10,616	8,953	8,321	4,273	4,362	3,453	5,174	92,234
WTRS TOTAL	18,236	20,450	22,460	22,647	20,331	22,263	20,376	20,306	16,128	16,707	15,766	16,985	232,655

POTABLE DEMAND	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**214,983**	**187,784**	**175,164**	**173,053**	**175,092**	**179,576**	**189,158**	**212,660**	**249,161**	**285,039**	**240,320**	**224,978**	208,914
Annualized	6,664,483	5,633,529	5,430,086	5,364,639	4,902,572	5,566,845	5,674,743	6,592,467	7,474,815	8,836,201	7,449,927	6,749,339	76,339,646
no wtrs (avg gpd)	**156,544**	**129,354**	**116,741**	**114,630**	**116,659**	**121,105**	**130,652**	**149,330**	**181,252**	**215,201**	**180,943**	**166,532**	148,245
% Reduction from baseline	27%	31%	33%	34%	33%	33%	31%	30%	27%	25%	25%	26%	29%
Annualized (gal/month)	4,852,868	3,880,618	3,618,969	3,553,521	3,266,444	3,754,243	3,919,548	4,629,236	5,437,550	6,671,219	5,609,221	4,995,963	54,189,400
Building w/ WTRS (gpd)	**84,446**	**84,453**	**84,446**	**84,446**	**84,446**	**84,446**	**84,446**	**84,446**	**87,993**	**97,481**	**85,401**	**84,447**	85,908
% Reduction from baseline	61%	55%	52%	51%	52%	53%	55%	60%	65%	66%	64%	62%	59%
Annualized (gal/month)	2,617,833	2,533,604	2,617,833	2,617,833	2,364,494	2,617,833	2,533,387	2,617,833	2,639,781	3,021,910	2,647,421	2,533,418	31,363,180

SEWER DISCHARGE	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**173,549**	**172,362**	**172,266**	**172,025**	**172,598**	**174,432**	**172,840**	**180,399**	**176,241**	**180,715**	**175,404**	**177,273**	175,009
Annualized	5,380,029	5,170,863	5,340,255	5,332,781	4,832,740	5,407,384	5,185,186	5,592,361	5,287,219	5,602,156	5,437,518	5,318,197	63,886,689
no wtrs (avg gpd)	**115,126**	**113,939**	**113,843**	**113,602**	**114,175**	**116,009**	**114,416**	**121,976**	**117,817**	**122,292**	**116,981**	**118,850**	116,585
% Reduction from baseline	34%	34%	34%	34%	34%	33%	34%	32%	33%	32%	33%	33%	33%
Annualized (gal/month)	3,568,911	3,418,169	3,529,137	3,521,663	3,196,891	3,596,267	3,432,491	3,781,243	3,534,524	3,791,039	3,626,401	3,565,503	42,562,239
Building w/ WTRS (gpd)	**43,040**	**69,038**	**81,548**	**83,419**	**81,959**	**79,280**	**68,271**	**60,772**	**29,013**	**27,863**	**21,439**	**36,781**	56,869
% Reduction from baseline	75%	60%	53%	52%	53%	55%	61%	66%	84%	85%	88%	79%	68%
Annualized (gal/month)	1,334,248	2,071,154	2,528,002	2,585,975	2,294,841	2,457,685	2,048,142	1,883,919	870,389	863,744	664,600	1,103,444	20,706,143

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11
Residents	2440	2440	2440	2440	2440	2440	2440	2440	2440	2440	2440	2440
Guests	260	260	260	260	260	260	260	260	260	260	260	260
Days per month	31	30	31	31	28	31	30	31	30	31	31	30
Baseline												
Toilet	43782	43782	43782	43782	43782	43782	43782	43782	43782	43782	43782	43782
Showers	42676	42676	42676	42676	42676	42676	42676	42676	42676	42676	42676	42676
Faucets	49410	49410	49410	49410	49410	49410	49410	49410	49410	49410	49410	49410
Dishwasher	3899	3899	3899	3899	3899	3899	3899	3899	3899	3899	3899	3899
Clothes Washer	24376	24376	24376	24376	24376	24376	24376	24376	24376	24376	24376	24376
Irrigation	32	14	0	0	20	96	167	9814	18971	22830	1909	45
Cooling Load	43671	16490	3884	1773	3792	8200	17712	31567	58909	90929	67132	53653
Other	7138	7138	7138	7138	7138	7138	7138	7138	7138	7138	7138	7138
Conserving												
Toilet	20014	20014	20014	20014	20014	20014	20014	20014	20014	20014	20014	20014
Showers	32330	32330	32330	32330	32330	32330	32330	32330	32330	32330	32330	32330
Faucets	43481	43481	43481	43481	43481	43481	43481	43481	43481	43481	43481	43481

Dishwasher	1497	1497	1497	1497	1497	1497	1497	1497	1497	1497	1497	1497	
Clothes Washer	8396	8396	8396	8396	8396	8396	8396	8396	8396	8396	8396	8396	
Irrigation	16	7	0	0	10	48	83	4907	9486	11415	954	23	
Cooling Load	43671	16490	3884	1773	3792	8200	17712	31567	58909	90929	67132	53653	
Other	7138	7138	7138	7138	7138	7138	7138	7138	7138	7138	7138	7138	
Stormwater Capture	16	0	0	0	54	472	92	4908	5939	9324	0	22	
blowdown avg gpd	2265	1082	986	745	1304	3034	1537	7892	3476	7104	4124	5988	
WTRS													
Can treat (gpd)	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	100000	
Net needed for irrigation	0	7	0	0	0	0	0	0	3546	2091	954	1	
Cooling tower top up	0	0	0	0	0	0	0	0	0	10943	0	0	
Total Potable Top Up	0	7	0	0	0	0	0	0	3546	13035	954	1	
Untreatable - to sewer	43040	69038	81548	83419	81959	79280	68271	60772	29013	27863	21439	36781	
Demand for reuse water	72082	44900	32295	30183	32203	36611	46122	59977	87320	119339	95542	82063	
Total Treated (avg gpd)	72082	44900	32295	30183	32203	36611	46122	59977	87320	100000	95542	82063	
Total treated (gal/month)	**2234538.457**	**1347014.607**	**1001135.611**	**935687.7881**	**901670.643**	**1134925.955**	**1383660.343**	**1859289.223**	**2619591.429**	**3100000**	**2961800.264**	**2461895.71**	21941210.03

Time Period: Theoretical Year: October 2010 - September 2011
System: The Visionaire at block scale = 2440 residents (4x The Visionaire); optimized energy profile
Average Flow 60,000 gpd

Energy Rate ($/kWh)	0.083	0.083	0.091	0.076	0.076	0.076	0.065	0.063	0.069	0.091	0.044	0.063
Water Rate ($/gal)	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0041	0.0042	0.0042	0.0042
Sewer Rate ($/gal)	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0065	0.0067	0.0067	0.0067

ENERGY FOR REUSE TREATMENT

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline													
Cost	-	-	-	-	-	-	-	-	-	-	-	-	
no wtrs													
Cost	-	-	-	-	-	-	-	-	-	-	-	-	
WTRS													
Cost	$ 1,005	$ 947	$ 1,052	$ 875	$ 794	$ 885	$ 743	$ 755	$ 818	$ 1,123	$ 542	$ 744	$ 10,283

POTABLE DEMAND

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**214,983**	**187,784**	**175,164**	**173,053**	**175,092**	**179,576**	**189,158**	**212,660**	**249,161**	**285,039**	**240,320**	**224,978**	208,914
Annualized	6,664,483	5,633,529	5,430,086	5,364,639	4,902,572	5,566,845	5,674,743	6,592,467	7,474,815	8,836,201	7,449,927	6,749,339	76,339,646
Cost	$ 26,282	$ 22,191	$ 21,390	$ 21,132	$ 19,312	$ 21,929	$ 22,354	$ 25,969	$ 30,426	$ 37,484	$ 31,604	$ 28,632	$ 308,703
no wtrs (avg gpd)	**156,544**	**129,354**	**116,741**	**114,630**	**116,659**	**121,105**	**130,652**	**149,330**	**181,252**	**215,201**	**180,943**	**166,532**	148,245
% Reduction from baseline	27%	31%	33%	34%	33%	33%	31%	30%	27%	25%	25%	26%	29%
Annualized (gal/month)	4852868.4	3880618.1	3618968.7	3553520.9	3266444.3	3754243.1	3919547.6	4629235.6	5437549.5	6671218.8	5609221.2	4995963.5	54,189,400
Cost	$ 19,138	$ 15,286	$ 14,256	$ 13,998	$ 12,867	$ 14,788	$ 15,440	$ 18,235	$ 22,133	$ 28,300	$ 23,795	$ 21,194	$ 219,430
Rate with CWRP	$ 14,353	$ 11,465	$ 10,692	$ 10,498	$ 9,650	$ 11,091	$ 11,580	$ 13,676	$ 16,600	$ 21,225	$ 17,846	$ 15,895	$ 164,572
current	**84,446**	**84,453**	**84,446**	**84,446**	**84,446**	**84,446**	**84,446**	**84,446**	**87,993**	**97,481**	**85,401**	**84,447**	85,908
% Reduction from baseline	61%	55%	52%	51%	52%	53%	55%	60%	65%	66%	64%	62%	59%
Annualized (gal/month)	2,617,833	2,533,604	2,617,833	2,617,833	2,364,494	2,617,833	2,533,387	2,617,833	2,639,781	3,021,910	2,647,421	2,533,418	31,363,180
Cost	$ 10,324	$ 9,980	$ 10,312	$ 10,312	$ 9,314	$ 10,312	$ 9,979	$ 10,312	$ 10,745	$ 12,819	$ 11,231	$ 10,747	$ 126,387
Rate with CWRP	$ 7,743	$ 7,485	$ 7,734	$ 7,734	$ 6,986	$ 7,734	$ 7,485	$ 7,734	$ 8,059	$ 9,615	$ 8,423	$ 8,060	$ 94,791

SEWER DISCHARGE

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**173,549**	**172,362**	**172,266**	**172,025**	**172,598**	**174,432**	**172,840**	**180,399**	**176,241**	**180,715**	**175,404**	**177,273**	175,009
Annualized	5,380,029	5,170,863	5,340,255	5,332,781	4,832,740	5,407,384	5,185,186	5,592,361	5,287,219	5,602,156	5,437,518	5,318,197	63,886,689
Cost	$ 33,734	$ 32,386	$ 33,447	$ 33,400	$ 30,269	$ 33,868	$ 32,476	$ 35,026	$ 34,219	$ 37,787	$ 36,676	$ 35,871	$ 409,159
no wtrs (avg gpd)	**115,126**	**113,939**	**113,843**	**113,602**	**114,175**	**116,009**	**114,416**	**121,976**	**117,817**	**122,292**	**116,981**	**118,850**	116,585
% Reduction from baseline	34%	34%	34%	34%	34%	33%	34%	32%	32%	31%	33%	33%	33%
Annualized (gal/month)	3,568,911	3,418,169	3,529,137	3,521,663	3,196,891	3,596,267	3,432,491	3,781,243	3,534,524	3,791,039	3,626,401	3,565,503	42,562,239
Cost	$ 22,378	$ 21,409	$ 22,104	$ 22,057	$ 20,023	$ 22,524	$ 21,498	$ 23,683	$ 22,875	$ 25,571	$ 24,460	$ 24,049	$ 272,631
Cost with CWRP	$ 16,784	$ 16,057	$ 16,578	$ 16,543	$ 15,017	$ 16,893	$ 16,124	$ 17,762	$ 17,157	$ 19,178	$ 18,345	$ 18,037	$ 204,473
Cost with CWRP and excep.	$ 11,181	$ 10,697	$ 11,044	$ 11,021	$ 10,005	$ 11,254	$ 10,742	$ 11,833	$ 11,430	$ 12,777	$ 12,222	$ 12,017	$ 136,223
Cost just exception	$ 14,909	$ 14,263	$ 14,726	$ 14,695	$ 13,339	$ 15,006	$ 14,323	$ 15,778	$ 15,240	$ 17,035	$ 16,296	$ 16,022	$ 181,631

current (avg gpd)	**43,040**	**69,038**	**81,548**	**83,419**	**81,959**	**79,280**	**68,271**	**60,772**	**29,013**	**27,863**	**21,439**	**36,781**	56,869
% Reduction from baseline	75%	60%	53%	52%	53%	55%	61%	67%	84%	85%	88%	79%	68%
Annualized (gal/month)	1,334,248	2,071,154	2,528,002	2,585,975	2,294,841	2,457,685	2,048,142	1,883,919	870,389	863,744	664,600	1,103,444	20,706,143
Cost	$ 8,366	$ 12,972	$ 15,833	$ 16,197	$ 14,373	$ 15,393	$ 12,828	$ 11,799	$ 5,633	$ 5,826	$ 4,483	$ 7,443	$ 131,146
Cost with CWRP	$ 6,275	$ 9,729	$ 11,875	$ 12,147	$ 10,780	$ 11,545	$ 9,621	$ 8,850	$ 4,225	$ 4,369	$ 3,362	$ 5,582	$ 98,360
Cost with CWRP and excep.	$ 2,034	$ 3,153	$ 3,849	$ 3,937	$ 3,494	$ 3,742	$ 3,118	$ 2,868	$ 1,369	$ 1,416	$ 1,090	$ 1,809	$ 31,879
Cost just exception	$ 2,712	$ 8,642	$ 10,548	$ 10,790	$ 9,576	$ 10,255	$ 8,546	$ 7,861	$ 3,753	$ 3,881	$ 2,986	$ 4,958	$ 84,509

Time Period: Theoretical Year: October 2010 - September 2011
System: The Visionaire at 6.14 times full build-out = 3744 residents; optimized energy profile
Average Flow 95,000 gpd

ENERGY FOR REUSE TREATMENT

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline	36,093	34,335	35,281	35,205	31,922	35,748	34,440	37,282	35,801	38,302	36,808	35,752	426,968
no wtrs	24,141	22,769	23,330	23,253	21,127	23,796	22,873	25,261	24,105	26,188	24,843	24,186	285,872
WTRS (kWh - municipal)	9,395	13,880	16,723	17,079	15,175	16,292	13,739	12,770	6,558	6,537	5,298	7,940	141,386
WTRS (kWh - WTRS)	12,453	11,725	11,886	11,840	10,734	11,973	11,743	12,321	12,186	12,823	12,658	12,142	144,485
WTRS TOTAL	21,848	25,605	28,610	28,919	25,910	28,265	25,482	25,091	18,744	19,360	17,957	20,082	285,872

POTABLE DEMAND

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**329,915**	**288,176**	**268,808**	**265,569**	**268,698**	**275,579**	**290,284**	**326,350**	**382,364**	**437,423**	**368,798**	**345,253**	320,601
Annualized	10,227,380	8,645,269	8,333,063	8,232,626	7,523,534	8,542,934	8,708,515	10,116,863	11,470,924	13,560,120	11,432,730	10,357,601	117,151,561
no wtrs (avg gpd)	**240,234**	**198,508**	**179,152**	**175,912**	**179,026**	**185,848**	**200,499**	**229,164**	**278,151**	**330,249**	**277,676**	**255,562**	227,498
% Reduction from baseline	27%	31%	33%	34%	33%	33%	31%	30%	27%	25%	25%	26%	29%
Annualized (gal/month)	7,447,259	5,955,234	5,553,704	5,453,268	5,012,717	5,761,298	6,014,976	7,104,070	8,344,516	10,237,717	8,607,965	7,666,854	83,159,579
Building w/ WTRS (gpd)	**129,592**	**129,603**	**129,592**	**129,592**	**129,592**	**129,592**	**129,592**	**129,592**	**135,034**	**132,801**	**131,057**	**129,594**	130,436
% Reduction from baseline	61%	55%	52%	51%	52%	53%	55%	60%	65%	70%	64%	62%	59%
Annualized (gal/month)	4,017,352	3,888,093	4,017,352	4,017,352	3,628,576	4,017,352	3,887,760	4,017,352	4,051,034	4,116,846	4,062,758	3,887,808	47,609,635

SEWER DISCHARGE

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	STUDY TOTAL
baseline (avg gpd)	**266,328**	**264,509**	**264,362**	**263,992**	**264,863**	**267,622**	**265,229**	**276,186**	**269,667**	**276,080**	**269,176**	**272,042**	268,338
Annualized	8,256,178	7,935,257	8,195,207	8,183,737	7,416,166	8,296,270	7,956,868	8,561,758	8,090,004	8,558,494	8,344,469	8,161,270	97,955,677
no wtrs (avg gpd)	**176,672**	**174,852**	**174,705**	**174,335**	**175,206**	**177,965**	**175,572**	**186,529**	**180,010**	**186,424**	**179,520**	**182,386**	178,681
% Reduction from baseline	34%	34%	34%	34%	34%	34%	34%	32%	33%	32%	33%	33%	33%
Annualized (gal/month)	5,476,819	5,245,555	5,415,849	5,404,378	4,905,777	5,516,911	5,267,166	5,782,399	5,400,301	5,779,135	5,565,110	5,471,568	65,230,968
Building w/ WTRS (gpd)	**66,050**	**105,947**	**125,145**	**128,015**	**125,774**	**121,664**	**104,770**	**93,261**	**44,524**	**42,758**	**32,900**	**56,445**	87,271
% Reduction from baseline	75%	60%	53%	52%	53%	55%	60%	66%	83%	85%	88%	79%	68%
Annualized (gal/month)	2,047,550	3,178,413	3,879,496	3,968,462	3,521,685	3,771,587	3,143,098	2,891,081	1,335,707	1,325,510	1,019,902	1,693,356	31,775,849

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11
Residents	3744	3744	3744	3744	3744	3744	3744	3744	3744	3744	3744	3744
Guests	399	399	399	399	399	399	399	399	399	399	399	399
Days per month	31	30	31	31	28	31	30	31	30	31	31	30

Baseline												
Toilet	67188	67188	67188	67188	67188	67188	67188	67188	67188	67188	67188	67188
Showers	65490	65490	65490	65490	65490	65490	65490	65490	65490	65490	65490	65490
Faucets	75825	75825	75825	75825	75825	75825	75825	75825	75825	75825	75825	75825
Dishwasher	5984	5984	5984	5984	5984	5984	5984	5984	5984	5984	5984	5984
Clothes Washer	37407	37407	37407	37407	37407	37407	37407	37407	37407	37407	37407	37407
Irrigation	49	22	0	0	31	147	256	15060	29114	35035	2929	70
Cooling Load	67019	25306	5961	2721	5819	12584	27180	48442	90403	139540	103021	82336
Other	10954	10954	10954	10954	10954	10954	10954	10954	10954	10954	10954	10954
Conserving												
Toilet	30714	30714	30714	30714	30714	30714	30714	30714	30714	30714	30714	30714

Showers	49614	49614	49614	49614	49614	49614	49614	49614	49614	49614	49614	49614
Faucets	66726	66726	66726	66726	66726	66726	66726	66726	66726	66726	66726	66726
Dishwasher	2298	2298	2298	2298	2298	2298	2298	2298	2298	2298	2298	2298
Clothes Washer	12885	12885	12885	12885	12885	12885	12885	12885	12885	12885	12885	12885
Irrigation	25	11	0	0	15	73	128	7530	14557	17518	1465	35
Cooling Load	67019	25306	5961	2721	5819	12584	27180	48442	90403	139540	103021	82336
Other	10954	10954	10954	10954	10954	10954	10954	10954	10954	10954	10954	10954
Stormwater Capture	25	0	0	0	83	724	141	7531	9114	14308	0	33
blowdown avg gpd	3477	1661	1514	1144	2002	4656	2358	12111	5334	10902	6329	9189

WTRS

Can treat (gpd)	183139	183139	183139	183139	183139	183139	183139	183139	183139	183139	183139	183139	
Net needed for irrigation	0	11	0	0	0	0	0	0	5442	3209	1465	2	
Cooling tower top up	0	0	0	0	0	0	0	0	0	0	0	0	
Total Potable Top Up	0	11	0	0	0	0	0	0	5442	3209	1465	2	
Untreatable - to sewer	66050	105947	125145	128015	125774	121664	104770	93261	44524	42758	32900	56445	
Demand for reuse water	110618	68905	49560	46320	49418	56183	70779	92041	134002	183139	146620	125935	
Total Treated (avg gpd)	110618	68905	49560	46320	49418	56183	70779	92041	134002	183139	146620	125935	
Total treated (gal/month)	**3429144.406**	**2067141.691**	**1536352.427**	**1435915.562**	**1383712.521**	**1741668.386**	**2123378.593**	**2853283.29**	**4020050.434**	**5677320.663**	**4545207.434**	**3778049.054**	34591224.46

Time Period:	**Theoretical Year: October 2010 - September 2011**
System:	**The Visionaire at 6.14 times full build-out = 3744 residents; optimized energy profile**
Average Flow	**95,000 gpd**

Energy Rate ($/kWh)	0.083	0.083	0.091	0.076	0.076	0.076	0.065	0.063	0.069	0.091	0.044	0.063
Water Rate ($/gal)	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0041	0.0042	0.0042	0.0042
Sewer Rate ($/gal)	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0063	0.0065	0.0067	0.0067	0.0067

ENERGY FOR REUSE TREATMENT

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	**STUDY TOTAL**
baseline													
Cost	-	-	-	-	-	-	-	-	-	-	-	-	
no wtrs													
Cost													
WTRS (kWh - WTRS)	12,453	11,725	11,886	11,840	10,734	11,973	11,743	12,321	12,186	12,823	12,658	12,142	
Cost	$ 1,034	$ 973	$ 1,082	$ 900	$ 816	$ 910	$ 763	$ 776	$ 841	$ 1,167	$ 557	$ 765	$ 10,583

POTABLE DEMAND

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	**STUDY TOTAL**
baseline (avg gpd)	**329,915**	**288,176**	**268,808**	**265,569**	**268,698**	**275,579**	**290,284**	**326,350**	**382,364**	**437,423**	**368,798**	**345,253**	320,601
Annualized	10,227,380	8,645,269	8,333,063	8,232,626	7,523,534	8,542,934	8,708,515	10,116,863	11,470,924	13,560,120	11,432,730	10,357,601	117,151,561
Cost	$ 40,333	$ 34,055	$ 32,825	$ 32,429	$ 29,636	$ 33,652	$ 34,304	$ 39,852	$ 46,692	$ 57,524	$ 48,499	$ 43,938	$ 473,738
no wtrs (avg gpd)	**240,234**	**198,508**	**179,152**	**175,912**	**179,026**	**185,848**	**200,499**	**229,164**	**278,151**	**330,249**	**277,676**	**255,562**	227,498
% Reduction from baseline	27%	31%	33%	34%	33%	33%	31%	30%	27%	25%	25%	26%	29%
Annualized (gal/month)	7447259.0	5955234.2	5553704.5	5453267.6	5012717.1	5761297.8	6014975.9	7104069.8	8344516.3	10237717.2	8607965.3	7666854.1	83,159,579
Cost	$ 29,369	$ 23,458	$ 21,877	$ 21,481	$ 19,746	$ 22,695	$ 23,694	$ 27,984	$ 33,966	$ 43,430	$ 36,516	$ 32,524	$ 336,739
Rate with CWRP	$ 22,027	$ 17,594	$ 16,408	$ 16,111	$ 14,809	$ 17,021	$ 17,770	$ 20,988	$ 25,474	$ 32,572	$ 27,387	$ 24,393	$ 252,554
current	**129,592**	**129,603**	**129,592**	**129,592**	**129,592**	**129,592**	**129,592**	**129,592**	**135,034**	**132,801**	**131,057**	**129,594**	130,436
% Reduction from baseline	61%	55%	52%	51%	52%	53%	55%	60%	65%	66%	64%	62%	59%
Annualized (gal/month)	4,017,352	3,888,093	4,017,352	4,017,352	3,628,576	4,017,352	3,887,760	4,017,352	4,051,034	4,116,846	4,062,758	3,887,808	47,609,635
Cost	$ 15,843	$ 15,316	$ 15,825	$ 15,825	$ 14,293	$ 15,825	$ 15,314	$ 15,825	$ 16,489	$ 17,464	$ 17,235	$ 16,493	$ 191,747
Rate with CWRP	$ 11,882	$ 11,487	$ 11,869	$ 11,869	$ 10,720	$ 11,869	$ 11,486	$ 11,869	$ 12,367	$ 13,098	$ 12,926	$ 12,369	$ 143,810

SEWER DISCHARGE

	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	**STUDY TOTAL**
baseline (avg gpd)	**266,328**	**264,509**	**264,362**	**263,992**	**264,863**	**267,622**	**265,229**	**276,186**	**269,667**	**276,080**	**269,176**	**272,042**	268,338
Annualized	8,256,178	7,935,257	8,195,207	8,183,737	7,416,166	8,296,270	7,956,868	8,561,758	8,090,004	8,558,494	8,344,469	8,161,270	97,955,677
Cost	$ 51,769	$ 49,700	$ 51,328	$ 51,257	$ 46,449	$ 51,961	$ 49,836	$ 53,624	$ 52,358	$ 57,727	$ 56,283	$ 55,048	$ 627,341
no wtrs (avg gpd)	**176,672**	**174,852**	**174,705**	**174,335**	**175,206**	**177,965**	**175,572**	**186,529**	**180,010**	**186,424**	**179,520**	**182,386**	178,681
% Reduction from baseline	34%	34%	34%	34%	34%	33%	34%	32%	32%	31%	33%	33%	33%
Annualized (gal/month)	5,476,819	5,245,555	5,415,849	5,404,378	4,905,777	5,516,911	5,267,166	5,782,399	5,400,301	5,779,135	5,565,110	5,471,568	65,230,968
Cost	$ 34,341	$ 32,854	$ 33,921	$ 33,849	$ 30,726	$ 34,554	$ 32,989	$ 36,216	$ 34,951	$ 38,980	$ 37,537	$ 36,906	$ 417,824
Cost with CWRP	$ 25,756	$ 24,641	$ 25,440	$ 25,387	$ 23,044	$ 25,915	$ 24,742	$ 27,162	$ 26,213	$ 29,235	$ 28,153	$ 27,679	$ 313,368
Cost with CWRP and excep.	$ 17,152	$ 16,409	$ 16,941	$ 16,906	$ 15,346	$ 17,258	$ 16,476	$ 18,088	$ 17,456	$ 19,468	$ 18,747	$ 18,432	$ 208,679
Cost just exception	$ 22,869	$ 21,878	$ 22,589	$ 22,541	$ 20,461	$ 23,010	$ 21,968	$ 24,117	$ 23,274	$ 25,958	$ 24,997	$ 24,576	$ 278,238
current (avg gpd)	**66,050**	**105,947**	**125,145**	**128,015**	**125,774**	**121,664**	**104,770**	**93,261**	**44,524**	**42,758**	**32,900**	**56,445**	87,271
% Reduction from baseline	75%	60%	53%	52%	53%	55%	61%	67%	84%	85%	88%	79%	68%
Annualized (gal/month)	2,047,550	3,178,413	3,879,496	3,968,462	3,521,685	3,771,587	3,143,098	2,891,081	1,335,707	1,325,510	1,019,902	1,693,356	31,775,849

Cost	$ 12,839	$ 19,907	$ 24,298	$ 24,855	$ 22,057	$ 23,622	$ 19,686	$ 18,107	$ 8,645	$ 8,941	$ 6,879	$ 11,422	$ 201,258
Cost with CWRP	$ 9,629	$ 14,930	$ 18,224	$ 18,642	$ 16,543	$ 17,717	$ 14,764	$ 13,581	$ 6,483	$ 6,705	$ 5,159	$ 8,566	$ 150,944
Cost with CWRP and excep.	$ 3,124	$ 4,843	$ 5,912	$ 6,047	$ 5,366	$ 5,747	$ 4,789	$ 4,405	$ 2,103	$ 2,175	$ 1,674	$ 2,779	$ 48,965
Cost just exception	$ 4,165	$ 13,257	$ 16,181	$ 16,552	$ 14,688	$ 15,731	$ 13,109	$ 12,058	$ 5,757	$ 5,954	$ 4,581	$ 7,606	$ 129,638

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New York State Energy Research and Development Authority

17 Columbia Circle
Albany, New York 12203-6399

toll free: 866-NYSERDA
local: 518-862-1090
fax: 518-862-1091

info@nyserda.ny.gov
nyserda.ny.gov

Evaluation of the Water Treatment and Recycling System at The Visionaire

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Andrew M. Cuomo, Governor

New York State Energy Research and Development Authority
Richard L. Kauffman, Chair | John B. Rhodes, President and CEO