East Strand Street Wastewater Treatment Facility

City of Kingston

Long-Term Capital Plan

May 2015

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East Strand Street Wastewater Treatment Facility
City of Kingston, New York

Long-Term Capital Plan

May 2015

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1.0 PROJECT PLANNING

The City of Kingston (City) retained Barton & Loguidice, D.P.C. (B&L) to develop a Long-Term Capital Plan for improvements to the City's Wastewater Treatment Plant (WWTP) due to its aging equipment, anticipated proposed development, and growth. In addition, the plan will evaluate the flooding issues encountered at the WWTP. Like many treatment plants along the Lower Hudson Valley, the City's WWTP was inundated with the storm surge and high tides associated with Superstorm Sandy, and flooding along the Rondout Creek during Tropical Storm Lee and Hurricane Irene.

1.1 Scope of Long-Term Capital Plan

The scope of work included in the preparation of this Long-Term Capital Plan:

- Review and summarize current system operating data for the most recent (3) years including data from January 2011 to July 2014;
- Preliminary condition assessment of existing WWTP equipment and processes for potential to upgrade, retrofit or relocate;
- Evaluate capacity of existing treatment processes and equipment;
- Project population and service area growth for a 20 year window (2035) to establish future flows and loads to the WWTP;
- Estimate current and future flow/loading conditions;
- Provide a growth-needs assessment for WWTP, identifying specific processes with inadequate capacity to treat the projected future flows and loading;
- Request a preliminary determination of effluent discharge parameters from the NYSDEC for the WWTP based on estimated future design flows and loads;
- Evaluate the capacity of the existing WWTP components to handle the projected design flows and loadings;

- Evaluate alternatives to address any capacity issues;
- Prepare a preliminary energy savings analysis and cost effectiveness analysis for each alternative;
- Recommend alternatives for improvements.

1.2 Location

The City of Kingston is located in the Hudson River Valley of New York State in Ulster County. Kingston is approximately 50 miles south of Albany, New York and occupies approximately 7.4 square miles of land. The City's WWTP is located at 91 East Strand Street in the southeast section of the City.

1.3 Environmental Resources Present

Since May 2011, a Kingston Conservation Advisory Council (CAC) sub-committee has been in the process of developing a Natural Resource Inventory (NRI) for Kingston. An NRI is a survey of the natural resources in a community, with the goal of informing the planning board, common council and decision makers on land use decisions. Hudsonia, Ltd, has mapped the Significant Habitats in the City of Kingston. This data represents, by polygon, habitats of significance in Kingston, including upland, tidal and wetland habitats. The map is included in Appendix E.

Kingston has more than a mile of frontage on the Hudson River and a harbor along the length of the river between New York City and the deepwater Port of Albany. It is bordered by the Esopus and Rondout Creeks which drain lush valleys that flank the Shawangunk Ridge just to the southwest and the Catskill Mountains to the west and is the gateway to Catskill State Park.

1.4 Population Trends

Table 1-1 below summarizes the population in the City of Kingston as recorded by the US Census at 10 year intervals for the year 1950 to 2010.

Table 1-1
City of Kingston Census Population Data

Year	Population
1950	28,817
1960	29,260
1970	25,544
1980	24,481
1990	23,095
2000	23,449
2010	23,893

The data shows that there was slight growth in the population for the City from 1950 to 1960, but after 1960, there was in decline in population until 1990. Slight population growth started from the year 1990 and has continued through 2010.

1.5 Community Engagement

Community engagement means involving community members in all activities from identifying the relevant issues and making decisions about how to address them, to evaluating and sharing the results with the community.

In October 2012 the Kingston Tidal Waterfront Flooding Task Force was formed that included waterfront property and business owners, representatives of waterfront cultural institutions, and others with interest or expertise that are important to dialogue about the future of the City's Rondout/Hudson waterfront. Their Final Report from September 2013, *Planning for Rising Waters,* is referenced and identifies the WWTP as one of the three most vulnerable infrastructure assets. The report identifies that the WWTP requires resiliency

and hardening or possibly relocation. This Long-Term Capital Plan will be shared with the task force.

The City has received an increasing number of complaints and concerns about odors attributed to the WWTP. The proximity of residential and commercial properties to the facility amplifies the concerns about odors and the need for odor control. Alternatives evaluated will include odor control systems to address community complaints.

In addition to odors, the general appearance of the existing WWTP is of concern due to its proximity to residential and commercial properties. A Streetscape Screen Project is included in alternatives evaluated to mitigate visual impacts of the current WWTP location.

2.0 EXISTING FACILITIES

2.1 Location Map

Figure 2-1 indicates the general location of the WWTP within the City. Figure 2-2 is an existing site plan of the WWTP.

2.2 History

The East Strand Street WWTP in the City of Kingston receives flow from the combined sewer system in the City, as well as flow from several other surrounding communities. The following briefly describes the history of the collection system and the WWTP.

Collection System: The City of Kingston maintains and operates a combined sewage collection system. Kingston's sanitary sewage collection system consists of approximately 80 miles of pipe ranging in size from 4 to 60 inches in diameter. The City of Kingston Wastewater and Stormwater Collection System was

constructed in the 1940's. Over the years the City has, as best possible, separated some sanitary and stormwater sewers as practical and economically feasible. Wastewater is conveyed to the facility for treatment from three main sources.

i. A 24-inch diameter pressure sewer (Rondout interceptor inverted siphon) that conveys stormwater and sanitary sewage from portions of the City (approximately 30 to 40 percent) served by combined sewers discharge directly to the entrance chamber at the treatment facility.
ii. A 15-inch diameter interceptor sewer that conveys wastewater from portions of the City served by separate sanitary sewers to a Pump Station located at the site of the wastewater treatment plant.
iii. A 12-inch diameter forcemain from the Sleigthsburg Pump Station which serves the Port Ewen Sewer Improvement Area in the Town of Esopus discharges directly to the entrance chamber at the treatment plant.

The wastewater is conveyed through not only gravity piping systems but also twenty-seven pumping stations and associated pressure force mains.

The collection system for the City of Kingston is a combined sewer system that is regulated at four locations. The Wilbur, Hunter, Broadway, and Hasbrouck regulators direct dry weather flows and those portions of the wet weather that are less than approximately 10.25 mgd to the WWTF through a series of siphons. Wet weather flows that exceed the WWTF's capacity are discharged to the Rondout Creek.

A Combined Sewer Overflow Long-Term Control Plan (CSO LTCP) Study was performed by Malcolm Pirnie and a report was completed in October 2010. The study concluded that City of Kingston's combined sewer system (CSS) is a high performing system that captures 89 percent of wet weather flows for full

treatment at the WWTP, exceeding the USEPA CSO Policy criteria of 85 percent capture. Of the four overflows, only the Hasbrouck overflow chronically discharges to the Rondout Creek.

The recommended CSO LTCP implements a staged approach that focuses on improving the performance of the Hasbrouck system, including upgrading the regulator to eliminate the need for daily maintenance in the prevention of dry weather overflows, provide direct measurement of CSO discharges, and modulate the wet weather discharge to maximize flow to the WWTP. Post-construction monitoring will be performed to update the characterization of the Hasbrouck system and re-evaluate water quality in Rondout Creek.

The monitoring will be used to determine if the performance is sufficient to meet water quality standards (WQS), and if it shows that CSO remaining activations appear to cause a WQS violation, additional CSO control measures will be implemented and are expected to be tank storage.

East Strand Street Wastewater Treatment Plant: The City of Kingston WWTP, located in the southeast section of the City was initially constructed in 1946 to serve the municipal wastewater treatment needs of the City. Since 1946, the City has completed several major capital improvements projects at the plant to expand capacity and upgrade the level of treatment performance. Currently the City treats domestic wastewater from the City of Kingston and neighboring communities, the Towns of Ulster and Esopus. The WWTP was updated in the early 1970's to treat sewage using a conventional activated sludge process. During that time the WWTP was designed for an average flow of 4.8 million gallons per day (MGD) through the aeration and secondary clarification processes. Modification to the WWTP included the addition of a fourth primary clarifier in the early 1980's and the construction of a third aeration tank and a

fourth secondary clarifier in the early 1990's. The current State Pollution Discharge Elimination System (SPDES) permit limits the average flow to 6.8 MGD on a 12-month rolling average. The treated plant effluent discharges to the Rondout Creek, a tributary of the Hudson River. In 2008 and 2009 upgrades and rehabilitations to the WWTP included inclusion of odor control equipment, updating of the waste activated sludge (WAS) thickening equipment to a more efficient gravity belt filter, improvements to the anaerobic sludge digesters' mixing systems, and upgrading of the ultraviolet disinfection system to provide improved energy efficient systems. In 2007-2008 the City entered into a contract with ASLAN Corporation to design, install and operate a sludge dryer/pelletizer. The terms of the agreement provide that ASLAN accept and treat the dewatered sludge from the City's WWTP and further dispose of the resultant "bio-solids" at a fixed annual cost. The agreement is a private/public relationship whereby in effect the City is leasing the equipment from ASLAN and ASLAN is providing the operation and maintenance of the equipment and providing for the disposal of the resultant residue.

2.3 Condition of Existing Facilities

The plant currently provides advanced wastewater treatment for seasonal ammonia removal utilizing a single-stage diffused air activated sludge system. In accordance with the current basis of design, the City is authorized to discharge up to 6.8 MGD of treated wastewater to the Rondout Creek on a 12 Month Rolling Average (12MRA) basis in accordance with the conditions of the facility's SPDES permit, NY-0029351, issued by the New York State Department of Environmental Conservation (NYSDEC).

2.3.1 Preliminary Treatment

Wastewater enters the facility in the Head House via gravity flow from the confluence of the three (3) main sources listed previously. Flow entering the Head House is metered in the influent channel. Flow then passes through a mechanically raked bar screen in the single influent channel. The screen is constructed with pivot bearings that allow the screen to tip forward out of the channel under high flow/obstructed conditions. The primary bar screen is 36” wide with a 30” water depth. Screenings removed in the Head House are disposed of at the Ulster County Resource Recovery Agency (UCRRA) transfer station. Screened flow exits the Head House and enters the circular grit clarifier removal system that is weir controlled, where grit particles are separated via gravity cyclonic forces. The grit chamber has a 23’ diameter with a 7’ depth and a 1’8” sloping floor. A grit screw brings the grit from the bottom of the grit clarifier to a grit pump that pumps the grit to a grit classifier that washes and dewaters the grit. Clean grit is discharged from the grit washer to a dump truck for subsequent hauling to a solid waste transfer station located in New Paltz, owned and operated by the UCRRA. The grit chamber also serves as the side-stream return point, including primary sludge degritting supernatant, gravity belt thickener subnatant, gravity thickener overflow, digester supernatant and filtrate/spent washwater from the belt filter press. After grit removal, flow then enters the Head House through a 24-inch closed conduit and is screened a second time in a 36-inch wide bar screen with 30-inch water depth.

The preliminary treatment facilities are generally in good condition and operate mostly without issue, although the second bar rack is in somewhat poor condition and is nearing the end of its useful life. The capacity of the

circular gravity grit chamber was determined to be limited to 10.25 mgd in the 2007 NYSERDA Energy Conservation Study by Malcolm Pirnie based on the hydraulic capacity to allow for 6-inches of freeboard in the process unit. The 24-inch effluent pipe that carries flow from the grit chamber to the second automatic bar screen is creating a hydraulic bottleneck.

2.3.2 Primary Treatment

Degritted wastewater enters a flow distribution channel where it is allocated to one of four (4) primary clarifiers. These tanks utilize chain and sprocket style scum collection and bottom sludge scraping. Primary sludge is collected and conveyed to the primary sludge degritting system. Grit removed from the process is disposed of in roll-off containers at the WWTP. Primary effluent flows by gravity to the settled sewage pump station wet well.

Based on 10 States Standards for surface overflow rate (SOR) and weir loading rate (WLR), the primary clarifiers are undersized for current average and peak flows, but the data showing removal efficiency of 70 to 80 percent for total suspended solids (TSS) and 48 percent for biological oxygen demand (BOD) demonstrates that the clarifiers are functioning to treat the influent flow during average and peak flow conditions.

2.3.3 Settled Sewage Pumps

The existing settled sewage pumps are Allis-Chalmers (ITT-AC) Model 14x14x17.5 pumps with 890 rpm, 50-hp motors. There are three settled sewage pumps (Pumps 1, 2, and 3) located in a pump room adjacent to the Primary Settled Sewage Wet Well (Wet Well). Each pump draws from near the base of the Wet Well with a dedicated 14-inch suction line. Each pump discharges to a 12-inch discharge line that connects to a 14-

inch discharge header that fills a splitter box located above the wet well. Each pump has a gate valve on its suction and discharge piping as well as a check valve on the discharge piping. The seals on Pump 1 leak excessively, and the seals on Pump 2 leak as well, but not as severely as Pump 1. Pump 3 appears to be the only pump operating within its design parameters. The settled sewage pumps have undergone multiple modifications since their installation in 1972, including motor and impeller changes and the addition of variable frequency drives (VFDs). Based on the available information, each of the three pumps has a rated capacity of 6.3 mgd at 29-feet of head. The 24-hour average flow data shows that the settled sewage pumps deliver 12.4 mgd, based on the information provided in the City of Kingston Wet Weather Operating Plan.

2.3.4 Secondary Treatment

The primary effluent is pumped to a splitter box at the south end of the aeration tanks prior to flowing by gravity to one of the three (3) aeration tanks where it is mixed with return activated sludge (RAS). Each aeration tank has a capacity of 386,100-gallons (111'L x 30'W x 15.5' deep). The facility operators currently operate the aeration tanks in plug flow configuration. There are two 100 hp duty blowers and one redundant blower (Marathon Electric VSD Motors), each with 2,623 scfm design air flow. The total air rate available with two duty blowers is 5,246 scfm, and 7,869 scfm with all three blowers operating. There is a diffused aeration oxygen capacity of 17,146 lbs/day. There are ceramic disc fine bubble diffusers in the first two-thirds of each aeration tank that were installed in 1993. There is baffle wall in each tank with an overflow weir and underflow orifice separating approximately the last third of each aeration tank where the ceramic disc diffusers were replaced with membrane

diffusers. Consideration should be given to replacing the blowers with turbo blowers for increased efficiency and energy savings. The original blowers were installed in 1973 and are beyond age of their expected useful life.

The mixed liquor from the aeration basins flows by gravity to a splitter box and then to one of four secondary clarifiers for final settling. Each tank is 24 feet wide by 90 feet long with a depth of 11.45 feet. These tanks also utilize chain and flight scum collection. Each tank has four effluent collection troughs the full width of the tank that feed a common channel with another tank. Flow from settling tanks 3 and 4 combines with flow from tanks 1 and 2 and flows by gravity to the UV disinfection tanks by gravity in a 30” cast iron pipe.

The sludge is either returned to the aeration tanks or wasted and pumped to the gravity belt thickener.

2.3.5 Disinfection

Clarified secondary effluent is disinfected by ultraviolet (UV) disinfection. The UV disinfection system has both primary and redundant components that include two channels of high intensity UV bulbs containing two light lamps each with five racks per bank, six bulbs per bank, resulting in 60 lamps per channel, 120 lamps total. The UV equipment is manufactured by Trojan. The redundant third channel utilizes three light banks each with 11 racks per bank, eight lamps per bank, resulting in 264 lamps total. The redundant UV equipment is manufactured by Fisher-Porter. The UV used for the disinfection system is low pressure mercury vapor lamps at 254 nm.

The UV lights are set up horizontal and parallel with the flow in open channels. Each channel is 2'8" wide by 4' deep by 41' long with 12-1/2" wide channel reduction baffles. Water levels in the channels are controlled by automatic control gates at the end of each channel. The maximum water depth is 2.15 feet with 6.8 mgd flow per channel.

2.3.6 Outfall

The final effluent is discharged through two 20-inch diameter outfalls. The lower outfall is used for normal flows and the upper outfall is used for high flows during high tide conditions. This outfall system was constructed in 2000 using City funds and grant funding obtained from the NYSDEC. The outfalls discharge into the tidal Rondout Creek, a New York State Department of Environmental Conservation (NYSDEC) Class C stream.

2.3.7 Solids Processing and Disposal

Sludge from the primary clarifiers is pumped first to the gravity sludge thickener and then pumped into the anaerobic digesters. The gravity sludge thickener has a 20 foot diameter and a 10 foot side depth and a cone bottom. The total volume is approximately 3,350 cubic feet. The mechanical sludge collector mechanism in the gravity sludge thickener requires frequent maintenance and is taken out of service often. The upper and lower bearings are also in need of repair due to a large amount of grit entering the WWTP from the Washington Ave tunnel collapse during July and August 2012. The typical useful life for this mechanical equipment is 20-25 years, and it is currently 42 years old.

The two anaerobic digesters were constructed at the time of the original facility construction in 1946. The anaerobic digesters have a 44 foot diameter and a depth of approximately 22 feet with a cone bottom. Each

digester has a volume of approximately 36,500 cubic feet. The digesters were upgraded in 1984 to install a cogeneration system that utilizes digester gas to produce heat and electricity for in-plant use. Both digesters are used as primary digesters. The digesters are generally in good condition with recent upgrades to the mixing system with Vaughan Rotamix installed in 2010 on both digesters.

Waste activated sludge (WAS) from the secondary clarifiers is pumped to the gravity belt thickener (GBT) and then into the anaerobic digesters. The gravity belt thickener was installed with the 2008-2009 improvements. The GBT is a 2-1/2 meter unit with a nominal capacity of 450 gpm (continuously). The operators typically run the GBT at 80-100 gpm for 12-hour periods. The lower operating throughput achieves the desired thickening. There are several operational variables that define GBT capacity, including feedstock solids concentrations, blend ratio of primary/secondary sludge, among other factors. These variables can be evaluated in more detail to optimize the operation of the GBT if conditions change at the WWTP in the future. Digested sludge is pumped to and dewatered in the 2-1/2 meter belt filter press and then pumped to the sludge dryer/pelletizer where it is dried and stored before land application. The belt filter press was installed in 1990 to replace a coil vacuum filter for dewatering of digested sludge. The belt filter press is nearing the end of its typical useful life of approximately 30 years. The sludge dryer/pelletizer was installed through an agreement with ASLAN in 2009 as previously discussed.

The overflow from the gravity thickener and a portion of the belt filter press filtrate are recycled back to the head of the plant. The remaining portion

of the belt filter press filtrate and digester supernatant are recycled back to the primary settling tanks for treatment.

2.3.8 Odor Control

The odor control system includes bioxide chemical addition, carbon filters, bio-cube filters, and chemical misters that were installed during the 2008 and 2009 plant upgrades.

The Head House is ventilated by forced air, with exhaust air passing through a carbon based odor control filtration system. A cover was installed on the gravity thickener for odor control and the area under the thickener cover is exhausted to a biofilter located adjacent to the thickener.

There are no specific operational or maintenance issues with the existing odor control system, however they appear to be inadequate to completely control odors produced at the WWTP as evidenced by the numerous complaints by the neighbors.

2.3.9 Building Condition, Generators, Controls

The buildings at the WWTP are generally in good condition, but require normal routine maintenance. The main building and control building roofs have had multiple repairs over the last 4 to 5 years and are currently in need of replacement. Over the course of the next 20 years, various improvements will be required to maintain the structures.

The WWTP has two generators including a 150 kW generator and a 300 kW generator. The generators are generally in good condition and have regular maintenance schedules. The 150 kW generator is serviced every

three months and has had the batteries replaced in 1999, 2004, and 2011. The 300 kW generator was replaced in 2003 and is serviced annually. As plant improvements are made over the next 20 years, the generator capacity should be evaluated to determine if additional backup power is needed.

2.3.10 Existing SPDES Permit

Table 2-1, included as an attachment, summarizes the current SPDES permit limits for the WWTP. There is a seasonal limit for Ultimate Oxygen Demand (UOD) from June 1 to October 31, which also requires seasonal monitoring of ammonia (as NH_3) and Total Kjehldahl Nitrogen (TKN) to calculate the UOD.

2.3.11 Current Flows and Loads

Tables 2-2 and 2-3 present a summary of WWTP influent flow, influent concentrations, and calculated influent loading for BOD_5, TSS, and TKN data from the daily monitoring reports (DMRs) for the period from January 2011 through July 2014. The DMRs utilized are included as Appendix A. The data included in the table summarizes the minimum, maximum, average, the standard deviation, and the average plus the standard deviation for the data evaluated. The standard deviation is a measure used to quantify the amount of variation in a set of data. The average value plus the standard deviation is being used as conservative values to represent the existing flow and load characteristics that typically occur at the WWTP, including accounting for the level of variation that can occur with the parameters evaluated.

Table 2-2 – WWTP Flow Data			
Statistic	12 MRA (mgd)	Max Flow (mgd)	Minimum Flow (mgd)
Min	4.5	0.2	0.0
Max	6.6	19.9	10.7
Average	5.2	9.3	2.6
STDEV	0.6	2.0	1.4
Average+STD	5.8	11.3	4.0

As summarized in Table 2-2, the facility receives and treats 5.8 million gallons per day (mgd) (this is the average plus one standard deviation) which is below the current plant rated capacity of 6.8 mgd. However, the sewer system is subject to inflow and infiltration of stormwater and the plant has handled flows above the permitted capacity. The peak hour flow is 11.3 mgd, which is the average maximum instantaneous flow plus one standard deviation. This gives the plant a peaking factor (PF) of 1.95. Note the average influent flow is 5.2 mgd. Using the average plus one standard deviation is a conservative step to help represent an increased potential for high flows that could occur in the system and may not represent what the plant is currently experiencing. These values are identified to represent a potential worst case scenario and need to be verified at the time of any further detailed design and analysis.

Table 2-3 below includes the 12 month rolling average flows for the calendar years of 2011, 2012, and 2013 to help clarify the variation in recent history of the influent flows due to significant weather events and demonstrate that the average flow and standard deviation calculations have been significantly influenced by the flow from the 2011 calendar year.

Table 2-3 – Annual 12 Month Rolling Average Flows	
Year	**12MRA (mgd)**
2011	6.5
2012	4.6
2013	4.8

Figure 2-3 included as an attachment shows a graphical representation of the plant influent flows including the minimum, average, and maximum flows recorded at the WWTP for January 2011 through July 2014. Also shown on this figure is the 12 month rolling average flow calculated from this data set. Figure 2-4, also included as an attachment, shows the average influent flow and the 12 month rolling average. These figures also show that the flows were significantly higher in 2011 and the more recent 2012-2014 data has lower average flows.

Some data was excluded from the data analysis to calculate the representative concentrations and loads of TSS due to out of the ordinary conditions from sewer breaks that occurred in the collection system that caused large amounts of silt to enter the sewer system and plant. Sewer breaks occurred in late July 2012 and early July 2013, therefore the data collected for TSS concentrations for several weeks following the sewer breaks were not included in the data analysis.

Table 2-4 – WWTP Influent Concentrations and Loads						
Statistic	**CBOD INF (mg/L)**	**TSS INF (mg/L)**	**TKN (N) Inf (mg/L)**	**CBOD INF (lb/day)**	**TSS INF (lb/day)**	**TKN (N) Inf (lb/day)**
Min	22	12	3	1,445	632	312
Max	311	690	35	13,367	27,699	1,463
Average	127	162	19	5,327	6,350	784
STDEV	46	70	6	1,541	3,347	160
Average+STD	173	232	24	6,868	10,444	944

Table 2-4 summarizes the representative CBOD, TSS, and TKN influent measured concentrations and calculated loads to the WWTP. Samples of the influent are collected twice weekly and analyzed for the concentrations, which are then utilized to calculate the load in pounds based on the daily average flow measured at the plant for that day. The table includes the minimum, maximum, average, standard deviation, and average plus the standard deviation for both the influent concentrations in milligrams per liter and influent loading in pounds per day.

The average plus standard deviation values are presented as a conservative estimate to provide a complete picture of the average conditions and also show the amount of variation that is present in the system. No detailed design is being completed based on these values. When components of this project are taken to the next step of detailed design, the influent flow and load numbers will have to be verified at that time. The average values for influent load and concentrations are also presented in Table 2-5.

2.3.12 Current Facility Performance and Permit Compliance

Review of all the DMR data indicates that the WWTP is generally compliant with the SPDES permit. The WWTP is not under consent order or other enforcement instrument. Table 2-5 summarizes the effluent measured concentrations and calculated loads, which are all in compliance with the SPDES permit as presented in Table 2-1. The permit was last revised in July of 2009.

Table 2-5 – WWTP Effluent Concentrations and Loads								
Statistic	**CBOD EFF (mg/L)**	**TSS EFF (mg/L)**	**TKN (N) Eff (mg/L)**	**Ammonia (NH3) Eff (mg/L)**	**CBOD EFF (lb/day)**	**TSS EFF (lb/day)**	**TKN (N) Eff (lb/day)**	**UOD Eff (lbs)**
Min	4	1	1	1	113	30	32	314
Max	104	66	20	27	3,605	2,288	834	4,835
Average	7	5	8	12	332	229	338	1,922
STDEV	6	6	5	6	232	245	218	1,110
Average+STD	13	11	13	18	564	474	556	3,031

2.4 Financial Status of Existing Facility

The City of Kingston bills their users a sewer use fee based on water usage. The sewer fee in 2014 was $6.01 per unit, which is a modest increase of approximately 3 percent from the 2013 rate of $5.85. The 2015 adopted budget is $5.2 million on 778,000 units.

The City has long term debt associated with the Sewer Fund as bonds, BANs, and installment purchase dept. The total Sewer Fund long term debt is summarized in Table 2-6 below.

Table 2-6 – City of Kingston Sewer Fund Long Term Debt Balance 12/31/2014	
Bond Balance	$ 8,107,499.84
BAN Balance	$ 2,018,268.00
Installment Purchase Dept	$ 1,780,414.00
Total	**$11,906,181.84**

The City of Kingston Sewer Fund has a 2014 End of Year Net Position of $8,018,301. The section from the annual report for the Sewer Fund is included as Appendix D. The total revenue from 2014 was $5,266,481 and the

expenditures were $5,009,817, for a net increase in the net position of $256,664 from the 2013 net position of $7,761,637.

3.0 Need for Project

3.1 Health, Sanitation and Security

There has been flooding in the Kingston waterfront over the last 100 years from at least 12 hurricanes and tropical storms. More recently, some areas of the waterfront such as low areas along East Strand where the Kingston WWTP is located occasionally flood when high tides coincide with a few inches of rain. The September 18, 2013 Final Report of the City of Kingston Tidal Waterfront Flooding Task Force identifies the WWTP as one of the three most vulnerable infrastructure assets under sea-level rise and flood scenarios evaluated. The report recommends evaluating long-term strategies to mitigate risk to the WWTP including protection in place or relocation of the plant.

Projections for future sea-level rise for the Mid-Hudson to the Capital District along the Hudson River are presented in Table 3-1 below and are from page 20 of the Task Force Report.

Table 3-1 – Sea Level Rise Along the Hudson River for the Mid-Hudson to the Capital District

Decade	2020s	2050s	2080s	2100
Sea-Level Rise	1” – 4”	5” – 9”	8” – 18”	11” – 26”
Sea-Level Rise with Rapid Ice Melt	4” – 9”	17” – 26”	8” – 50”	52” – 68”

The Task Force selected 2060 and 2100 as the time horizons for analyzing waterfront risks, along with conservative values for sea-level rise and sea-level rise with rapid ice melt. The time horizon for this study is 2035, therefore the values selected by the Task Force were linearly interpolated back to 2035 to estimate values for sea-level rise relevant to this study. Table 3-2 below includes

the Task Force projections and the interpolated values for 2035 used for this study.

Table 3-2 – Kingston Sea-Level Rise Predictions			
Year	**2035**	**2060**	**2100**
Sea-Level Rise	12”	20”	33”
Sea-Level Rise with Rapid Ice Melt	16”	36”	68”

The normal high water elevation in Rondout Creek is 2.0 feet based on the 1941 original plant drawings from Sanborn & Bogert Consult Engineers. Table 3-3 below includes the estimated Rondout Creek elevation predicted based on the sea-level rise projections included in Table 3-2 assuming a current high water elevation of 2.0 feet.

Table 3-3 – Rondout Creek Elevation Predictions in Kingston			
Year	**2035**	**2060**	**2100**
Elevation with Sea-Level Rise	3.0’	3.67’	4.75’
Elevation with Sea-Level Rise with Rapid Ice Melt	3.33’	5.0’	7.67’

The grade elevation at the WWTP is between approximately 4.5 and 5.5 feet. Therefore, based on Table 3-3, the WWTP should not be impacted by sea level rise in the short term but would be impacted longer term.

In addition to sea level rise, FEMA flood elevations were also considered based on the recommendation of Ten States Standards. The standards recommend that the plant remain operational during the 25 year flood elevation. Table 3-4 below summarizes the FEMA flood elevations for 10-year, 25-year, 100-year, and 500-year frequency floods (NGVD29 datum) for current and 2035 sea-level rise projections. The projected flood elevation range was calculated by adding the sea-level rise projections to the current FEMA flood elevations. This

simplified assumption was made because not enough information is available to project future rainfall amounts and upland flooding dynamics in this study.

Table 3-4 – FEMA Flood Elevations in Rondout Creek

Flood Frequency (year)	Current Flood Elevation (ft) NGVD29	2035 Projected Flood Elevation (ft) NGVD29
10	5.2	6.2 – 6.53
25	6.9	7.9 – 8.23
100	7.4	8.4 – 8.73
500	9.5	10.5 – 10.83

As part of a current project, mitigation to prevent future equipment flooding at the existing WWTP site will be achieved by raising critical equipment above the effective flood elevation or flood proofing buildings, such that if future floods impact the WWTP, the mechanical and electrical equipment will be protected from damage. The June 2014 Basis of Design Report for Restoration of the Kingston WWTP done by Arcadis summarizes these improvements that will protect against flood elevations of approximately 10.2 feet (NGVD 29) above sea level, which is approximately 2 feet above levels encountered by Superstorm Sandy on October 29, 2012. These improvements will be effective to harden against future sea-level rise and projected 100 year flood elevations. Additional flood elevations that may be taken into consideration for future planning include the elevations presented in the CW and DW SRF Funds to Protect from Future Storms Storm Mitigation Loan Program – (SMLP) Fact Sheet. Table 3-5 below summarizes the SMLP Elevation Criteria relevant to the WWTP, which requires that equipment critical to the ongoing operation of a treatment works or a community water system subject to tidal influence, such as pumps or electrical devices, should be designed to be placed at the best available flood hazard data plus five feet, the Sandy high water mark plus four feet, or the 500-year flood elevation, whichever is higher.

Table 3-5 – SMLP Elevation Criteria	
Elevation Criteria	**Elevation for Critical Equipment (NGVD29)**
100-year + 5 feet	12.4
Sandy high-water elevation + 4 feet	12.2
500-year flood elevation	9.5

As shown in the table, the highest of these elevations is the 100-year flood elevation plus five feet, which equates to 12.4 feet. This elevation is much higher than the elevations considered in the Task Force Report, which were reported to be moderate to highly conservative elevations. The treatment plant may need to be hardened against the 12.4 feet elevation if the City would like the project to be considered for CWSRF funding.

Figure 3-1 is a summary table with WWTP building, tank, and water surface elevations as well as the Rondout Creek elevations including the sea level rise elevations, FEMA flood elevations, FEMA flood elevations with the sea level rise impact, and the SMLP elevation criteria. This figure illustrates what components of the WWTP will be impacted for different Rondout Creek elevations.

The existing top of wall tank elevations are all equal to or greater than 10 feet above sea level, so the tanks are assumed to remain in operation even for the highest 2035 projection 100-year flood elevation plus sea level rise elevation of 8.73 feet. The tanks could even remain in operation with the Superstorm Sandy levels plus sea level rise and the 500-year flood elevation. The 500-year flood with the sea level rise elevations added are above the top of the tank elevations at 10.5 to 10.83 feet, which would overtop the preliminary and primary treatment tanks. The more conservative SMLP elevation criteria of 12.2 and 12.4 feet are also above the top of the preliminary and primary treatment tank elevations. This shows that for the near term (year 2035) the tankage is generally at elevations above the Sandy elevation and the 100 year flood. For longer term

considerations such as the SMLP elevations, the tanks are not high enough and either flood walls or process tank wall modifications would be needed.

3.2 Aging Infrastructure

The City of Kingston WWTP was initially constructed in 1946. Since 1946, the City has completed several major capital improvements projects at the plant to expand capacity and upgrade the level of treatment performance. The WWTP was updated in the early 1970's to treat sewage using a conventional activated sludge process. Modification to the WWTP included the addition of a fourth primary clarifier in the early 1980's and the construction of a third aeration tank and a fourth secondary clarifier in the early 1990's. In 2008 and 2009 upgrades and rehabilitations to the WWTP included inclusion of odor control equipment, updating of the waste activated sludge (WAS) thickening equipment to a more efficient gravity belt filter, improvements to the anaerobic sludge digesters' mixing systems, and upgrading of the ultraviolet disinfection system to provide improved energy efficient systems. In 2007-2008 the City entered into a contract with ASLAN Corporation to design, install and operate a sludge dryer/pelletizer. Although there have been expansions and improvements made to the plant since the original construction, there are components of the plant that are nearing or beyond the age of their useful life and need to be upgraded including:

- Second bar screen (20 years old)
- Settled sewage pumps (42 years old)
- Aeration tank fine bubble diffusers (22 years old)
- Blowers (42 years old)
- Secondary clarifier mechanical equipment (42 years old)
- Primary sludge thickener mechanical equipment (42 years old)
- Belt filter press (26 years old)
- Anaerobic digester covers (44 years old)

- Digester gas safety equipment (31 years old)

3.3 Reasonable Growth

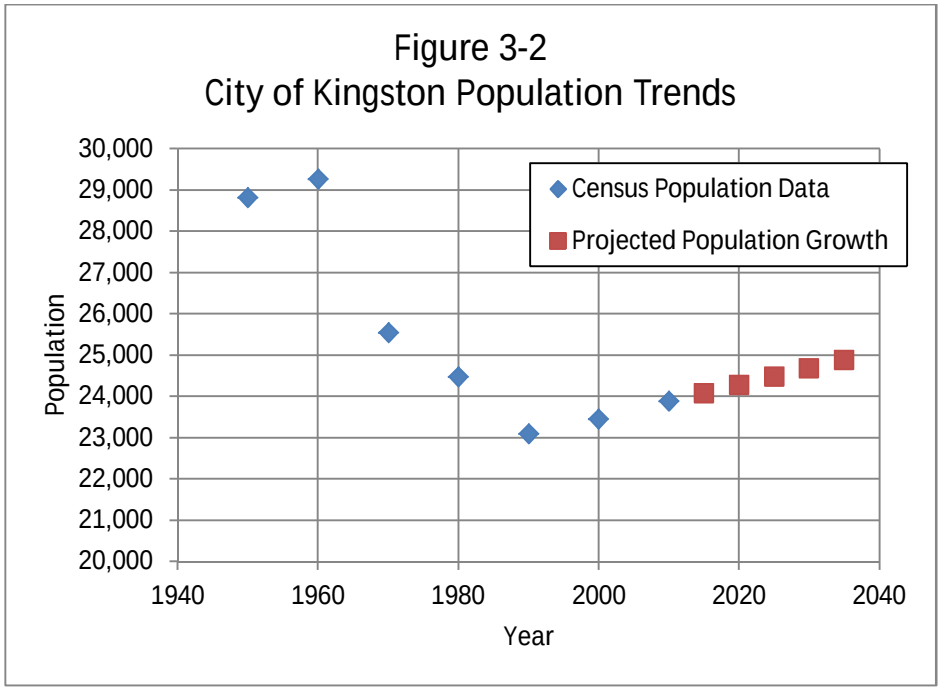
Based on the population growth trend for the most recent 20 years of census data from 1990 to 2010 discussed in Section 1.4, the population was projected based on linear extrapolation for 5 year intervals to estimate the present 2015 population for the City, as well as the projected 20 year growth for the year 2035. Table 3-6 includes the projected population until 2035. The population is expected to increase by approximately 983 people from 2010 to 2035.

Table 3-6
City of Kingston Projected Population Growth

Year	Projected Population
2015	24,078
2020	24,277
2025	24,477
2030	24,676
2035	24,876

Census data from 2000 to 2010 for the Towns of Esopus and Ulster shows a decline in population, therefore no growth was assumed in these towns from 2015 to 2035.

The overall population trends are demonstrated on Figure 3-2 which is a plot of the census population data as well as the projected future population growth. As stated in the City of Kingston, NY DRAFT Comprehensive Plan December 21, 2014 by Shuster-Turner, the City of Kingston has experienced slow, nominal growth over the last thirty years and the City remains below its population peak.



4.0 Alternatives Consideration

Alternatives for improvements were evaluated over the estimated service life of the upgrade. The alternatives evaluated were selected for their relative potential to provide an improvement in process reliability, and an increase in energy efficiency and sustainability to the WWTP. The alternatives considered were based on the unit process capacity analysis.

4.1 Design Criteria

4.1.1 Future Flows

The future flows in 2035 at the Kingston WWTP will include additional flow due to projected population growth in the City as discussed in Section 3.3, flows from neighboring communities that the WWTP is committed to receive, and may also include flows from three new developments planned for construction partially within the limits of the City of Kingston.

The flow estimated from the population growth in the City of Kingston is approximately 100,000 gallons per day (gpd) assuming a typical average daily flow of 100 gallons per capita per day per 10 States Standards.

Additional flows from neighboring communities include:

- Town of Esopus: 276,000 gpd
- Town of Ulster: 75,000 gpd
- East Kingston: 50,000 gpd

The City has a current and potential agreement with the Town of Esopus to receive up to 746,000 gpd at the WWTP. They currently contribute approximately 470,000 gpd, therefore for the purposes of this study, the balance of the full amount has been included. The City also has an agreement with the Town of Ulster to receive 75,000 gpd in the future. The East Kingston flow was calculated at 100 percent of the maximum water usage of 50,000 gpd.

The developments planned for construction partially within the limits of the City of Kingston are planning to discharge sewage to the Kingston WWTP. The estimated total flows from the developments are:

- Sailor's Cove: 110,410 gpd
- Parking Garage: 58,550 gpd
- Hudson Landing: 443,630 gpd

Flow data for the developments were based on the Desktop Capacity Evaluation – City of Kingston Wastewater Treatment Facility by Malcolm Pirnie, Inc. and the Feasibility Study for Water Supply and Distribution and Wastewater Collection Disposal for The Landing at Kingston and Ulster by Brinnier and Larios, P.C. See Table 4-1 for a summary of the future flows in year 2035.

4.1.2 Future Loadings

The future CBOD5, TSS and TKN influent loads were estimated for the WWTP based on per capita guidelines presented in the Great Lakes Upper Mississippi River Board and State and Provincial Public Health and Environmental Managers Recommended Standards for Wastewater Facilities, 2004 Edition (10 States Standards):

- 0.17 lbs of BOD5 per capita per day
- 0.20 lbs of TSS per capita per day

Concentrations were calculated based on the average future flows discussed in Section 4.1.1. The projected peak hourly flows were estimated based on the existing peaking factor of 1.95. Table 4-1 summarizes the current and future influent data. The SPDES permit does not require the WWTP to provide nitrification, but as discussed in Section 2.3.9, is does require monitoring of the effluent for both TKN and ammonia (as NH_3). The TKN is included in the UOD limit. Table 4-2 below summarizes the current $CBOD_5$ and TKN influent and effluent loads based on the DMR data as well as the calculated percent removal and effluent UOD load. The existing influent and effluent loads presented in the table are the average plus one standard deviation. The projected influent loads for CBOD5 and TKN are the values from Table 4-1, and the project effluent loads were estimated based on the calculated percent removals for the existing plant.

Table 4-1 – Current and Future Influent Data

Contribution	Average Flow (mgd)	Peak Hourly Flow (mgd)(7)	CBOD5 (mg/L)(4)	CBOD5 (lb/d)(3)	TSS (mg/L)(4)	TSS (lb/d)(3)	TKN (mg/L)(4)	TKN (lb/d)(3)
Kingston (Existing)(1)	5.8	11.3	142	6,868	216	10,444	20	944
Kingston (Projected)(2)	0.10	0.19	204	167	240	197	29	24
East Kingston(5)	0.05	0.10	204	85	240	100	29	12
Town of Esopus(5)	0.28	0.54	204	469	240	552	29	66
Town of Ulster(5)	0.08	0.15	204	128	240	150	29	18
Sailor's Cove(6)	0.11	0.22	204	188	240	221	29	26
Parking Garage(6)	0.06	0.11	204	100	240	117	29	14
Hudson Landing(6)	0.44	0.86	204	754	240	887	29	106
Total Additional	**1.1**	**2.2**	**204**	**1,890**	240	2,224	**29**	**267**
Total	**6.9**	**13.5**	**152**	**8,758**	220	12,668	**21**	**1,211**

Notes:
1. Existing influent flows and loads were calculated by adding one standard deviation to the average. The average flow is based on the calculated 12 month rolling average. The existing concentrations are calculated from the influent flows and loads.
2. The projected influent flows for Kingston are based on census data population projections interpolated for the year 2035 and assuming a typical average daily flow of 100 gal per capita per day per 10 States Standards.
3. Future CBOD5, TSS, and TKN loads to the WWTP are estimated based on the values provided by Great Lakes Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers Recommended Standards for Wastewater Facilities(10 States Standards): 0.17 lbs of BOD5 per capita per day, and 0.20 lbs of TSS per capita per day.
4. Future influent concentrations are calculated based on the projected loads and the assumed average influent flow.
5. The WWTP is committed to receive additional flows from neighboring communities. It is assumed that the full contract amount will be utilized.
6. Flows from three new completed developments were considered that are planned for construction partially within the limits of the City of Kingston.
7. The future peak hourly flows are calculated based on the peaking factor of the existing peak hourly flow divided by the existing average flow.

This is a conservative estimate assuming all of the recommended improvements are made to the treatment process to accommodate the future projected influent flows and loads. The current effluent calculated UOD is well below the effluent limit of 4,900 lb/day. The future estimated effluent UOD is also below, at 87 percent of the limit. Based on this calculation, it assumed that nitrification will not be required in the future to meet the SPDES UOD limit.

Table 4-2 – Existing and Project UOD Effluent Load Calculations

Flow Characteristics	Influent $CBOD_5$ (lbs/day)	Effluent $CBOD_5$ (lbs/day)	Calculated % Removal $CBOD_5$	Influent TKN (lbs/day)	Effluent TKN (lbs/day)	% Removal TKN	Calculated UOD (lbs/day)
Existing	6868	565	91.8%	944	557	41.0%	3354
Projected	8758	720		1211	715		4296

Notes:
1. UOD = 1.5xCBOD5 + 4.5xTKN
2. UOD SPDES Effluent Limitation is 4900 lbs/day

4.1.3 Proposed SPDES Limits

Preliminary correspondence with NYS DEC Central Office regarding future SPDES permit limits was completed. The NYS DEC indicated that the concentration limits would likely remain constant, with mass loadings scaled to the proposed 12MRA flow. Summarized proposed SPDES permit limits are listed in Table 4-3. Should the City decide to move forward with design of the recommended improvements, a SPDES modification will be required to increase the permitted discharge.

4.2 Unit Process Capacity Analysis

For each process, both the current and projected operating capacity was calculated based on guidance from the NYSDEC Design Standards, also known as the “Ten States Standards for Wastewater Treatment Facilities” (Ten States Standards) and accepted design practice. Additional process and hydraulic capacity information was also considered from previous studies completed at the facility. Calculations for the capacity of the existing process units are included in Appendix B, and are summarized in Table 4-4. The unit capacities were then compared to the existing and projected future flows to the WWTP. The future peak hour flow used in this table is 13.6 mgd rather than the value of 13.5 mgd

calculated based on the existing plant peak factor due to a requirement by the NYSDEC that if the existing WWTP makes improvements to the existing WWTP, they need to accommodate a peak hour flow of 13.6 mgd to meet 10 States Standards of having a peaking factor of 2.0. A percent utilization was calculated for each process. Percent utilization less than 100 percent indicates that there is sufficient capacity in the process to treat the influent loading. Percent utilization greater than 100% indicates the process lacks capacity to treat the influent loading. Table 4-4 (included as an attachment) summarizes the capacity of the WWTP unit processes as a function of current design standards and sound engineering practice.

Based on current flow conditions, substandard capacity is evident in the following unit processes:

- Circular Gravity Grit Chamber
- Primary Settling Tanks (based on surface overflow rate (SOR) and weir loading rate (WLR))
- Settled sewage pumps
- Secondary settling tanks (based on surface overflow rate)

The capacity of the circular gravity grit chamber was determined to be limited to 10.25 mgd in the 2007 NYSERDA Energy Conservation Study done by Malcolm Pirnie based on the hydraulic capacity to allow for 6-inches of freeboard in the process unit. The 24-inch effluent pipe that carries flow from the grit chamber to the second automatic bar screen is creating a hydraulic bottleneck. The grit unit can still currently operate with less than six inches of free board, but will be considered for an improvement for future flow conditions.

Based on the 10 States Standards for SOR and WLR, the primary clarifiers are undersized for average and peak flows, but the data showing removal efficiency

of 70 to 80 percent for total suspended solids (TSS) and 48 percent for biological oxygen demand (BOD) demonstrates that the clarifiers are functioning to treat the influent flow during average and peak flow conditions.

The capacity of the settled sewage pumps was determined to be limited to 10.5 mgd in the 2007 NYSERDA Energy Conservation Study done by Malcolm Pirnie based the 24-hour average flow data analyzed for the study. The SPDES permit currently does not require flows above the 10.5 mgd, but pumps will need to be evaluated for upgrade for future flows and loads.

Based on the 10 States Standards for SOR, the secondary clarifiers are undersized for peak flows, but the data shows that the effluent flow meets the SPDES permit limits for all parameters without any issue.

Based on projected flow conditions, substandard capacity or age beyond expected useful life is evident in the following unit processes and need to be replaced at some point in the 20 year horizon.

- Circular Gravity Grit Chamber due to hydraulic restriction
- Primary Settling Tanks (based on surface overflow rate and weir overflow rate)
- Settled sewage pumps due to hydraulic limitation
- Aeration tank fine bubble diffusers due to exceedance of useful life of ceramic discs (approximately 20 years, installed in 1993)
- Secondary settling tanks (based on surface overflow rate)
- Primary Gravity Sludge Thickener
- Belt Filter Press nearing the end of useful life (installed 26 years ago, therefore it will need to be replaced prior to 2035)

Based on the unit capacity analysis, improvements will be required to expand treatment capacity in several unit processes.

4.3 Description

Two alternatives were evaluated to accommodate future flows and loads at the Kingston WWTP including one onsite improvement alternative and one alternative to relocate the facility to another site. The onsite alternative includes upgrades to process components that are beyond their useful life, or that are more than 100 percent utilized for future flows and loads. Hardening and resiliency were also considered as part of the recommended improvements at the existing WWTP location. The relocation alternative assumes construction of a new conventional activated sludge process plant at a site that will not be impacted by sea-level rise or flooding issues. A third alternative to expand the footprint was not considered due to site constraints including the roadway adjacent to the creek and the railroad tracks behind the plant. These constraints make expansion at the plant infeasible and cost prohibitive.

Alternative 1 meets the future flows and loads at the existing facility and would require additional means to be protected from the future flood levels. Alternative 2 evaluates relocation of the WWTP to a site that is above the current, 2035 100-year flood elevations based sea-level rise projections presented in the Tidal Waterfront Flood Task Force Report, and the SMLP flood elevation criteria.

4.3.1 Alternative 1 – Onsite Upgrades of Existing Facility

This alternative includes upgrades to all the unit processes at the existing site that were shown to be greater than 100 percent utilized in Unit Process Capacity Summary (Table 4-4) as discussed in Section 4.1 or nearing or beyond the useful life. These upgrades are assumed to occur over time for the next 20 years as needed.

4.3.1.1 Land Requirements

The current location of the WWTP site is fully constrained by the railroad tracks to the north, East Strand Street and Rondout Creek to the south which does not allow for addition of process units, therefore all the improvements considered for this alternative remain within the existing tanks and footprint of the current facility with only small ancillary equipment needed to expand the capacity of the existing WWTP. The recommended unit process improvements for this alternative are discussed in the following sections.

4.3.1.2 Vortex Grit Removal

The existing circular gravity grit chamber does not have sufficient hydraulic capacity for future peak flows based on the 2007 NYSERDA Energy Conservation Study by Malcolm Pirnie. Vortex grit chambers rely on cyclonic flow pattern, induced by a propeller drive motor, to improve the settleability of grit and inorganic materials. Settled grit is typically conveyed by a grit or slurry pump to washer/classifier unit where the grit is cleaned, dewatered and deposited into a receptacle for ultimate disposal. Two vortex grit units each with a 6.9 mgd capacity are proposed to be installed to replace the existing circular grit clarifier. Two units will provide redundancy during average flow conditions and sufficient flow capacity to handle peak flows during wet weather conditions. In addition, with the reconfiguration of the grit removal component, a bypass channel will be designed so that the grit units can be bypassed.

Advantages of this system are its small footprint and improved energy and grit removal efficiency compared to other mechanical grit removal systems. Disadvantages of this system would include increased operator effort required to maintain and operate the system.

4.3.1.3 Second Bar Screen

The existing second bar rack is in poor condition and is 19 years old; therefore it is starting to reach the end of its useful life. The function of the screen has been adequate; therefore it is recommended that this screen be replaced in kind sometime in the next 20 years.

4.3.1.4 Chemically Enhanced Primary Treatment

The existing primary clarifiers do not meet the Ten States Standards recommended SOR or WLR for existing or future flows. Because there is not room at the existing site to build additional primary clarifiers, it is recommended to retrofit the four existing primary clarifiers with a chemical feed system so that they can achieve a higher overflow rate with chemically enhanced primary treatment (CEPT). It is also recommended that additional weir length be added to each of the primary tanks to meet the Ten States WLR when the CEPT improvements are made.

CEPT is the process by which chemicals, typically metal salts and/or polymers in the form of organic polyelectrolytes, are added to primary sedimentation basins to enhance primary sedimentation efficiency. The chemicals cause the suspended particles to clump

together by coagulation and flocculation creating particle aggregates (or flocs), which settle faster. The chemicals utilized in CEPT are the same as those commonly added in potable water treatment (e.g. ferric chloride and aluminum sulfate). It is proposed that CEPT be implemented by retrofitting the conventional primary treatment tanks at the Kingston WWTP.

Some advantages of CEPT include cheaper, simpler, and more efficient retrofit to conventional treatment and does not require an increase in the physical footprint of the primary treatment tanks for a higher overflow rate. CEPT only requires tanks for the chemicals and injection equipment. CEPT also provides the opportunity for increasing the capacity of the subsequent secondary treatment by reducing the loads due to increased primary removal efficiency. Table 4-5 presents removal efficiencies of conventional primary treatment compared to CEPT based on a survey of 100 wastewater treatment plants in the United States.

Table 4-5 – Comparison of Primary Removal Efficiencies

	TSS (%)	**BOD (%)**
Conventional Primary Treatment	55	35
CEPT	85	57

Source: Wastewater Management in Urban Coastal Areas, National Research Council, 1992

A disadvantage is that CEPT uses chemical addition which will make a slight contribution to the total sludge production and an increased operating cost, but the dosage is typically minimal (10-50 mg/L). The greatest portion of the increase of sludge production is due to the increased solids removal in the settling tank, which is CEPT's goal. With greater removal efficiency in the primary

treatment, an added benefit of CEPT is that fewer solids are conveyed to secondary treatment for removal there.

4.3.1.5 Settled Sewage Pumps

Based on documentation of the existing condition of the settled sewage pumps, the following upgrades are recommended at some point in time prior to the year 2035:

- Replace existing pumps with three dry-pit submersible pumps due to their age and leaking issues
- Replace existing piping and valves within the pump station with 18-inch diameter due to age, hydraulic limitation and inefficiency

Dry-pit submersible pumps offer advantages over conventional dry-pit pumps for installation and use. Submersible pumps are designed with a submersible motor that will run wet or dry so there is no damage from flooding and they require little or no maintenance. Advantages for dry-pit submersible pumps for installation include no vertical shafting, no coupling alignment, no packing or seal water leakage, they require no seal water, they have no hazardous rotating components, and they require no dry well cooling. Dry-pit submersibles also have system advantages including simple controls, frequent starts allowed, wider range of operation than conventional dry pit installations, reduced vibration, simpler support design, compact design, elimination of shaft losses, and more efficiency.

Replacing the existing 12-inch and 14-inch piping with 18-inch piping within the pump station will reduce electrical consumption and allow for more capacity from the proposed pumps.

4.3.1.6 Fine Bubble Membrane Diffusers in Aeration Tanks

The existing aeration tanks have sufficient volume and have an estimated future utilization of approximately 100 percent for the future organic loading based on 10 States Standards recommendations, but it is recommended that the ceramic disc fine bubble diffusers be replaced at some time because their life expectancy is approximately 20 years and they were installed in 1993.

It is recommended that new tubular fine-bubble membrane diffusers be installed in the existing aeration tanks to maximize efficiency while maintaining excellent uniformity across the membrane and throughout the aeration grid. The tubular geometry and micro-punched membrane enable high-density basin floor coverage and low flux, which provide high oxygen transfer using the lowest amount of energy. The appropriate system design and layout with the tubular membrane diffusers will provide uniform airflow within a grid which will eliminate hot spots, dead zones, and areas for spiral roll currents that will create optimal standard oxygen transfer efficiency (SOTE). SOTE is the ratio between the amount of oxygen actually transferred and the amount delivered. Some fine bubble membrane diffusers can deliver up to 60 percent SOTE.

It is also recommended that drop legs to each section of the aeration grid be retrofit with individual DO control to maintain optimal DO in the entire length of each aeration tank.

Fine bubble membrane diffusers also provide high standard aeration efficiency (SAE), which is the ratio between the amount of oxygen transferred to the water and the amount of energy used. These types of systems have the capacity to deliver up to 8 kg O_2 per kWh. Testing indicates that some fine bubble membrane diffusers can lower energy consumption by 20 percent over conventional fine bubble systems.

The total air required by this recommended system is 2,909 scfm. Compared to the design air flow capacity of two existing duty blowers of 5,246 scfm, the existing blowers have sufficient capacity for the upgraded membrane diffusers. Although the blowers are calculated to have sufficient capacity, consideration should be made for replacement due to age and in-efficiency. The blowers are 42 years old and could be replaced with more energy efficient blowers. This should be considered in the near term.

4.3.1.7 Ballasted Flocculation in Secondary Clarifiers

The existing secondary clarifiers do not meet the Ten States Standards recommended surface overflow rate. Similar to the primary tanks, there is insufficient area at the existing WWTP site to build additional secondary clarifiers, therefore it is recommended that the existing secondary clarifiers could be retrofitted with a magnetite ballasted flocculation system to provide higher levels of treatment within the existing footprint of the secondary clarifiers. It is also recommended that the chain and flight mechanisms and the scum skimmers be replaced at sometime within the secondary clarifiers due to their age.

Magnetite ballasted flocculation utilizes a settling agent such as magnetite, an iron oxide, to increase the density of the sludge blanket within a clarifier tank, improving settleability and increasing the solids loading rate to the tank. Magnetite has a strong affinity for biological floc. The magnetite bonds to the suspended biomass in the aeration tanks and is settled out in the secondary clarifiers. The magnetite functions as a ballast, increasing the density of the biomass to be settled in the clarifiers, increasing the acceptable solids loading rate in the clarifiers and assists in retaining these solids during high flow periods. It is anticipated that the existing secondary clarifiers would require minimal improvements to their hydraulic characteristics if ballasted flocculation were implemented. The system would be operated in the existing aeration tanks and would continue to use the existing secondary clarifiers.

A ballasted flocculation system utilizes several mechanical components to feed, recover and recycle the ballast material. Waste activated sludge (WAS) is pumped from the clarifier through an in-line shear that macerates the sludge to break the bond between the bio-solids and the ballast material, facilitating the recovery process. The WAS then flows into a recovery chamber where a magnetized drum captures the ballast material, disperses the processed WAS to the sludge holding tanks and returns the recovered ballast to the ballast feed tank. The recovered ballast and a small volume of mixed liquor from the aeration tanks are mixed and directed to the treatment tanks to recycle the ballast material.

Ballasted flocculation systems are capable of recovering between 95% and 98% of the ballast material. As such, a small ballast make-up hopper would be required to introduce additional ballast material that is lost in the treated effluent stream.

The system would consist of a small equipment storage building containing the in-line shear, recovery chamber, ballast feed tank, ballast make up hopper and chemical storage area. Modifications would be required to the existing treatment tanks, including the installation of small horsepower auxiliary mixers to suspend the ballasted floc, as well as modifications to the WAS piping to direct it to and from the ballast recovery and addition building.

Advantages of the ballasted flocculation system are its ability to achieve treatment of the design solids loading in the existing treatment tankage and the reduction in solids loss through the clarifiers due to poor settling caused by hydraulic short-circuiting and filamentous bulking. Disadvantages of this system include the requirement for additional treatment equipment for the ballast recovery and addition systems, increased operating costs included with the purchase of the ballast material, as well as increased effort hours required from the Operator to maintain this additional treatment process.

4.3.1.8 Solids Processing and Disposal

The mechanical components of the primary sludge thickener are over 40 years old and are recommended to be replaced at some time due to age. The belt filter press is also nearing the end of its useful life at 26 years old. The existing belt filter press is not

running at full capacity and will be capable of handling the future sludge production with the recommended improvements. Therefore, it is recommended that the belt filter press be replaced in kind with a new 2.5 meter belt filter press.

4.3.1.9 Odor Control

An odor reduction analysis and study was conducted at the WWTP by Stearns & Wheler in 2003. The Final Report identified the major odor sources, evaluated odor control alternatives, and made recommendations for odor control systems. The existing odor control measures at the WWTP are minimal; therefore it is recommended that the systems identified in the 2003 report be reconsidered to address odor complaints by neighbors in close proximity to the WWTP.

The recommended plan for reducing odors at the Kingston WWTP includes design and construction of two odor control units, with one unit to treat odorous air emissions associated with the plant headworks, and the other to treat odorous air emissions from the settled sewage wet well and the sludge treatment system.

4.3.1.10 Streetscape Screen

A Streetscape Screen design was completed in 2013 by Guardia Architects. It is recommended that the streetscape screen be built with this alternative to address concerns from residential and commercial neighbors. The proposed Streetscape Screen includes:

- 7 foot high gate and fence at the west end of East Strand Street and at locations along East Strand on the southern

property border to fill in between existing tanks and new green screens

- 21.5 foot high screen on the existing bar rack building to extend the total height to 29 feet
- 25 foot high green screen on the south side of the primary settling tanks and U.V. disinfection system with steel support posts and green screen trellis with plants
- Light fixtures around south digester tank
- 11.5 foot high metal screen and lighting on the south side of the pelletizer building and administration/control building to extend height to approximately 25 feet
- 16 foot high metal screen on the south side of the aeration tanks and secondary clarifiers to extend height to approximately 25 feet
- A public open space/law between the aeration tanks and secondary clarifiers
- New landscaping along the entire southern property line of the WWTP

4.3.1.11 Satellite Grit Improvements

Due to sewer breaks within the aging sewer collection system, there have been issues with large amounts of grit entering the wastewater treatment plant periodically as discussed in Section 2.3.10. A site visit was made on December 30, 2014 to the Wilbur regulator located on Wilbur Avenue to evaluate the possibility of adding additional grit removal capability at this collection system regulator. The Wilbur sewershed is the largest sewershed, encompassing approximately 2,300 acres, therefore this could be a

key area in the collection system to remove grit from the system to prevent it from entering the WWTP. At the request of the City, this regulator configuration was reviewed to determine a potential system for grit removal at this satellite location. It is recommended that a vortex grit unit and grit classifier be installed downstream of the existing bar rack and channel grinder and upstream of the Parshall flumes and channels that deliver flow to the two 24-inch siphons. The proposed vortex grit unit has an average daily flow capacity of 3.5 mgd and a peak design flow capacity of 9.0 mgd. A preliminary configuration and opinion of probable cost was prepared to install a vortex grit unit and grit classifier at the Wilbur regulator.

4.3.1.12 Resiliency and Hardening Improvements

Resiliency refers to the ability of a system to recover quickly or continue working despite damage, while *hardening* refers to a physical change to make a component less susceptible to damage. Section 3.1 discusses many potential flood elevations that should be considered when considering resiliency and hardening improvements at the WWTP. These elevations should be evaluated to determine a design flood elevation at the time of detail design of any component to be upgraded at the existing WWTP.

The current project that will be partially funded by FEMA has selected 10.2 feet NGVD29 (11 feet NAVD88) as the design flood elevation for consideration of permanent recovery and mitigation. Mitigation of future flooding damage at the WWTP will be achieved through a combination of measures intended to raise the level of protection at which service disruption will occur. The scope of work

generally includes dry and wet flood proofing of walls and openings in existing structures to prevent ingress, installing equipment capable of functioning in a submerged condition, and raising the operating elevation of equipment to reduce the probability of impact.

Only the most conservative flood elevations would directly impact the preliminary process tanks by overtopping them including the 500-year flood elevation plus sea level rise and sea level rise with rapid ice melt (10.5 feet and 10.83 feet respectively), and the SMLP elevation criteria, which is the Sandy high water elevation plus 4 feet (12.2 feet) and the 100-year flood elevation plus 5 feet (12.4 feet). If any of these elevations are chosen as the design flood elevation, significant improvements would need to be implemented to raise the preliminary and primary tank walls so that they do not overtop. Other options could be a flood wall around the entire facility or flood walls around unit processes.

With selection of any of the other potential design flood elevations presented in Figure 3-1, resiliency and hardening improvements may not include modifications to the existing process tanks, but would need to include improvements to provide access to the WWTP and access throughout the plant to maintain its operation. A majority of the existing buildings are located at grade (between 4.5 feet to 5.5 feet) and are impacted by all the potential design flood elevations. Elevated walkways between buildings with added doorways and access at high elevations could provide improved accessibility to maintain operation during a flood.

The design flood elevation selected would need to be considered and may be based on potential funding options. Some funding programs require more conservative flood elevations including the SMLP elevation criteria included in Section 3.1.

4.3.1.13 Asset Management

An asset management plan (AMP) is a great tool to help the Kingston WWTP track the age, condition and capital investment needs for their infrastructure. With an AMP in place, the WWTP will have data available that will help it in detailing risks, past hazards, probability of future incidents and damages incurred as related to the WWTP assets. B&L is working with the City as part of a separate project to implement a City-wide gap analysis that can lead to an AMP that will include the WWTP. It is recommended that an AMP be implemented to help keep track of the assets at the existing WWTP.

4.3.1.14 Alternative 1 - Opinion of Probable Cost

An opinion of probable cost was estimated for Alternative 1 for the process improvements noted in the report due to age, condition, or capacity deficiencies. It is expected that these improvements would be made over a period of time as the City secures affordable financing. The estimate for the Alternative 1 improvements is $17.7 million with the breakdown included in Appendix C, Table C-1. Alternative 1 includes improvements to the existing facility to update outdated equipment and accommodate projected future flows and loads to the WWTP. As discussed in Section 3.1, as part of a separate ongoing FEMA funded project, mitigation of future

equipment flooding damage at the existing WWTP site should be achieved for a short term (20 year) level by raising critical equipment above the effective flood elevation or flood proofing buildings, such that if future floods impact the WWTP, the mechanical and electrical equipment should be protected from damage. These improvements are on-going under a separate project and therefore the costs for these improvements are not included in this cost estimate. Costs associated with long term resiliency and hardening in order to keep the wastewater plant at its current location will cost many tens of millions of dollars and would likely include a combination of pumping improvements, extensive visual and odor enhancements, raising of all electrical/mechanical/controls to high elevations, construction of flood walls, and rehabilitation of unit process tanks due to condition/age and flooding concerns, etc.

The estimated annual O&M costs for Alternative 1 are included in Table C-2 in Appendix C. As discussed, this cost is based on the existing plant O&M budget and is estimated to be approximately $2.5 million.

4.3.2 Alternative 2 – Relocation of WWTP

As discussed in Section 3.1, one of main reasons for this study is to initiate a planning process to mitigate against future risk of flooding hazards of the existing WWTP based on its location relative to the Rondout Creek and the potential impact of sea-level rise as well as its location within the FEMA 100-year flood plain. As shown in Figure 3-1, the highest potential flood elevation with the potential to impact the

existing WWTP is 12.4 feet, which is the 100-year flood elevation plus five feet.

Therefore, another alternative evaluated is relocation of the WWTP. A review of ten (10) alternative parcels identified by the City of Kingston was conducted to identify a suitable location for a future new City WWTP. Figure 4-1 shows ten parcels identified by the City as well as the location of the existing WWTP. The alternative sites for the WWTP relocation were conceptually screened for suitability based on the following site evaluation considerations including those recommended within the Recommended Standards for Wastewater Facilities (2004 edition):

- Land requirements
- Flooding Issues (See elevations in Figure 3-1)
    - Elevation relative to the 2035 sea-level rise projection estimated based on the sea-level rise and flood scenarios presented in the City of Kingston Tidal Waterfront Flooding Task Force Report.
    - Elevation of proposed properties relative to the current and projected 2035 FEMA flood elevations
    - Elevation of proposed properties relative to SMLP elevation criteria
- Potential Construction Problems
    - Accessibility and topography of the site,
    - Geologic information including depth to bedrock,
    - Soil type and suitability for construction with consideration of depth to groundwater elevations
- Environmental Impacts
    - Potential discharge location,

    - Environmental resources present (to minimize adverse impacts and major infrastructure changes)
- Energy Efficiency
    - Proximity to the existing WWTP for consideration of conveyance of wastewater to new location

Several resources and tools were utilized to compile site information for each of the proposed locations and aid in selection of a suitable site including ArcMap GIS, FEMA Firm Maps, USDA National Resource Conservation Service (NRCS) Web Soil Survey, DEC Online Environmental Resource Mapper, U.S. Fish & Wildlife Service National Wetlands Inventory Wetlands Mapper and USGS topographic maps. Resultant data was compiled so as to review the viability of each location. In addition, Federal and State wetland locations were reviewed and parcel location in relation to other environmental resources and areas with recreational significance were also taken into consideration. Table 4-5 (included as an attachment) summarizes some of the site evaluation criteria.

Based on this initial screening of these ten sites, parcel 3 is the recommended parcel for further consideration for relocation of the Kingston WWTP based on the limited evaluation as noted above. The owner is North Street Brick Work and the site is a vacant commercial parcel adjacent to the Hudson River and bisected by North Street. The site is a former clay quarry. The parcel was selected based on the site evaluation considerations discussed in detail in the following sections.

4.3.2.1 Land Requirements

The existing WWTP is very compact and located on a parcel of approximately 2.3 acres. It was assumed the footprint of the future plant would need to be at least double the area (at least 5 acres) to provide room for future expansions and to provide additional open space and access to treatment operations which does not exist on the current site. Parcel 3 is 76.3 acres, which is significantly more than the size of the existing site location. Consideration should be made to determine if only a portion of the site (possibly 10 to 15 acres) may be purchased to reduce land acquisition costs as the entire 76.3 acre parcel is not required.

4.3.2.2 Flooding Issues

As discussed in detail in Section 3.1, sea-level rise and FEMA flood elevations will impact the existing WWTP site. The eastern portion of the selected Parcel 3 to the east of North Street is at an elevation that may be impacted by sea-level rise and existing and projected FEMA flood elevations; however, the portion of the site to the west of North Street is at a higher elevation with areas 50 feet above sea level and greater. This portion of the site is assumed to be the site of the WWTP because it is significantly above the flood elevation and projected sea-level rise elevation.

4.3.2.3 Potential Construction Problems

The identified parcels generally consist of similar soils according to information obtained from the NRCS, however, some of the sites were identified as having shallow bedrock or restrictive soil layers or rock outcrops. Construction of a new WWTP will require site

work including excavation for tanks, building foundations and pipe trenches, sites with shallow restrictive layers were eliminated. Other identified parcels were eliminated due to extreme elevations or significant elevation changes across the parcel.

4.3.2.4 Environmental Impacts

Consideration was given to the possible outfall discharge locations for the proposed site location. Parcel 3 would likely have a proposed outfall discharge location in the Hudson River.

All of the evaluated parcels lie within an area identified as containing rare plants and rare animals or a significant natural community buffer and will therefore require further field investigation upon permitting and site design. Federal and State wetland locations were reviewed and the wetlands are identified on Figure 4-1. The selected Parcel 3 has a small area of wetlands identified on the north-eastern portion of the site, but this is not within the area that is recommended for WWTP consideration.

4.3.2.5 Energy Efficiency

Evaluation of site elevation and proximity to the existing WWTP was considered a key component in reducing long term energy costs and equipment costs in regards to the pumping required to convey flows to the new treatment plant. It was assumed all flows would be pumped from the existing treatment plant location to the new plant. It is recommended that a more detailed evaluation of the collection system be conducted to determine if all existing and future flows need to be pumped to the proposed relocated WWTP site, or if some flows can reach the proposed site by gravity, or

would some of the flow be pumped to the site directly from existing pump stations.

4.3.2.6 Alternative 2 - Opinion of Probable Cost

A conceptual opinion of probable cost range was estimated for Alternative 2 and includes construction of a 7.0 mgd conventional activated sludge process plant with a peak capacity of 13.6 mgd, conveyance pump station, a 1 mile long force main and ½ mile outfall pipe that discharges to the Hudson River. The probable cost also includes the demolition of the existing plant as the site may be reused for recreation or possibly development along the Hudson River and Rondout Creek waterfront. It is assumed that if the WWTP is relocated, it will be a conventional activated sludge process plant. A conventional WWTP is assumed because the existing facility is a conventional plant and provides excellent treatment and high effluent quality for the City of Kingston and has no issue meeting the SPDES permit requirements for discharge. The force main would be located within existing City owned right of ways. The estimated range is $100,000,000 to $120,000,000. The estimated O&M budget was developed based on the existing plant O&M budget and is approximately $2.2 million, with the breakdown included in Table C-2 in Appendix C.

5.0 Conclusions and Recommendations

The goal of this engineering planning study is to initiate a planning process to review the near term (20 year) and long term alternatives for wastewater treatment for the City and its service area. Specific concerns include age of the equipment/processes, condition of the equipment/processes, ability of the treatment technologies to meet current and

future flows and loads (capacity review) and resiliency and hardening of the facilities. One particular concern is flooding at the current treatment facilities due to recent past flood events such as Superstorm Sandy.

The study included the following:

- Determine current flow and load characteristics
- Project future flow and load characteristics
- Review current condition (age and condition) and performance of the treatment facilities including a unit capacity analysis for each treatment component
- Review unit processes against current and future flow and load characteristics as well as current and anticipated future environmental regulations
- Review alternative unit processes to meet future flow and load characteristics
- Review various treatment facility locations including the current site and ten other potential sites. Initial desktop site screenings for the alternative sites were completed.
- Review the current and future flood level elevations including the proposed Kingston Task Force recommended design flood levels, FEMA flood elevations and newly published SMLP flood level design elevations.
- Evaluate the impacts these flood elevations may have on the various treatment facilities locations.

The recommendations from this initial planning study are to consider the following:

- The current location of the treatment plant could continue for the near term (year 2035). Improvements are currently underway to improve resiliency and hardening by either replacing or relocating numerous electrical, controls and mechanical components to help avoid damage from flooding. This work will raise this equipment to elevation 10.2 feet, which is above the 500 year flood elevation of 9.5 feet. The Sandy high water elevation was 8.2 feet. In conjunction with these

improvements, the City is looking to complete Phase I improvements from their Long Term Control Plan.

- Complete phased improvements to the current treatment facilities based on securing affordable financing, ability to meet treatment requirements and replace aged equipment. Several processes have aged equipment well beyond their anticipated useful life. We recommend that the City submit funding applications immediately for these improvements. These phased in over time improvements are in the $18M range but could be less if the planning advances more quickly on a new location.
- A major concern with the current location is flooding. With the most recent flood events, the current mitigation project will help minimize the impacts to the plant. However, as evidenced by the proposed flood elevations from the state under the SMLP program, the state is looking for critical facilities to be located away from flood waters. For the proposed SMLP flood elevations, only the top of the final settling tanks and aeration tanks are above these flood design elevations. Thus, the City should also submit funding applications to secure funding to complete a more detailed study of the long term improvements, which would be relocation of the facilities. From the initial screening, a 76 acre parcel along the Hudson River northeast of the existing WWTP is a potential location (parcel 3 shown on Figure 4-1).

Once the new location has been studied more in depth and a location selected, the City could look to commence land acquisition negotiations for an option on the land. A site profile could then be completed. This would include boundary and topographic survey, geotechnical, archeological and environmental investigations and screenings. Preliminary discussions with funding agencies and regulatory agencies would also be initiated.

An additional consideration for relocation of the WWTP would be the positive economic impact that may occur. The presence of the WWTP may detract from growth in the vicinity, so if it is relocated to an area outside of the City, the existing WWTP can be redeveloped for another use and the WWTP site can be converted to taxable growth.

If a new location can't be secured, the current location could be hardened versus the flood events. However, the cost would be significant and would have other concerns to resolve for the long term viability of this location. These concerns include:

- Visual impacts from the construction of walls around either the individual components or a large wall around the entire facility.
- Odor impacts which have been a recurring problem at this location.
- Site constraints as the site is not large enough for expansion of the treatment facility if expansion beyond the capacity required for the next 20 years is ultimately required.

5.1 Project Schedule

A detailed project schedule has not been developed because of the high level planning nature of this study. The next steps would include:

- Funding applications for short term WWTP improvements at the current site.
- Funding applications for a long term detailed study of a new WWTP.
- Consideration of land option discussions.
- Consideration of parcel site profiling for new WWTP site (after detailed study).

In general, it is recommended that aged equipment should be upgraded as it fails, and funding is secured with a longer term schedule for relocation after 2035.

5.2 Permit Requirements

A majority of the recommended improvements for Alternative 1 do not have significant site work, so minimal environmental permits will be required for this alternative. Phasing of the proposed improvements for Alternative 1 will be required to facilitate ease of construction. The WWTP does not have excess tankage or significant bypass facilities. Consultation with regional NYSDEC is recommended prior to construction to develop a temporary treatment program that is acceptable to both the Owner and the NYS DEC.

A significant level of permitting would be required to relocate the treatment facilities. A more detailed engineering report would be required. SEQR review may result in a positive declaration, which would require an Environmental Impact Statement. Local, County, State and Federal permits would eventually be required for site location, environmental considerations, visual/noise/odor at the plant, pipe routes, etc.

5.3 Sustainability Considerations

5.3.1 Energy Efficiency

Technologies selected for the recommended Alternative 1 improvements included options that improved upon the energy efficiency of the existing processes including the dry pit submersible pumps, membrane diffusers, and the magnetite ballasted flocculation for enhanced secondary clarification. Once the project moves into the detailed design phase, the energy efficiency can be quantified and optimized for each process unit. For Alternative 2, the sewersheds and existing pump stations within the collection system should be evaluated to determine the most efficient way to deliver flow to the new WWTP location. The assumption made for this

study was that one pump station located at the existing WWTP location would deliver all the flow to the new WWTP site, but there may be more direct ways to deliver flows to the new site from other pump stations within the collection system.

5.3.2 Green Infrastructure

As stated in the 2014 DRAFT Comprehensive Plan, Green infrastructure including large forests, meadows, wetlands, floodplains and riparian buffers should be retained where feasible in order to naturally store, infiltrate and treat stormwater runoff and reduce flow that enters the combined sewer system. This could potentially reduce peak hour flows at the WWTP.

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Tables and Figures

TABLE 2-2 CITY OF KINGSTON WWTP EXISTING SPDES PERMIT LIMITS		
PARAMETER	BASIS FOR LIMIT	LIMITATION All Year
Flow	12MRA (1)	6.8 MGD
$CBOD_5$	M30CDAM (2), (3)	30 mg/L; 1400 lbs/day
$CBOD_5$	M7CDAM (4)	40 mg/L; 2300 lbs/day
UOD (June 1 - Oct. 31)	M30CDAM (2), (5)	4900 lbs/day
TKN (June 1 - Oct. 31)	Daily Max (6)	Monitor
TSS	M30CDAM (2), (3)	30 mg/L; 1700 lbs/day
TSS	M7CDAM (4)	45 mg/L; 2600 lbs/day
Settleable Solids	Daily Max	0.3 ml/L
Coliform, Fecal	M30CDGM (7)	200/100mL
Coliform, Fecal	M7CDGM (8)	400/100 mL
Nitrogen, Ammonia (as NH_3)	Daily Max	Monitor
Copper, Total	Daily Max	2.0 lbs/day
Lead, Total	Daily Max	0.45 lbs/day
Zinc, Total	Daily Max	Monitor
Temperature	Daily Max	Monitor
pH	Range	6.0 to 9.0 SU

(1) 12MRA - 12 Month Rolling Average

(2) M30CDAM - Maximum 30 consecutive day arithmetic mean

(3) Effluent shall not exceed 15% and 15% of influent concentrations values for $CBOD_5$ and TSS respectively.

(4) M7CAM - Maximum 7 consecutive day arithmetic mean

(5) Ultimate Oxygen Demand is calculated: UOD = 1.5 x $CBOD_5$ + 4.5 x TKN

(6) Samples of CBOD5 and TKN are to be collected at the same time.

(7) M7CDGM - Maximum 7 consecutive day geometric mean

(8) M30CDGM - Maximum 30 consecutive day geometric mean

Ulster County

Permittee Name and Address:	City Of Kingston 420 Broadway Kingston NY 12401
Facility Name:	Kingston (c) Wastewater Treatment Plant
Facility Type:	Sewerage System
(C)ity, (T)own, (V)illage:	Kingston (C)
Deadline for Comments:	Friday, October 5, 2007
DEC Number:	3-5108-00044/00003
SPDES Number:	NY0029351
Ranking Score:	15
Receiving Waters:	Rondout Creek
Water Classification:	C
Type of Waste/Flow Rate:	Sanitary/ 6.8000 MGD

Contact and Additional Information

TABLE 4-4
CITY OF KINGSTON WWTP
UNIT PROCESS CAPACITY SUMMARY

Unit Process	Capacity Rating Parameter	Capacity Rating Standard	Existing Condition	Capacity Rating	Current Condition	Current % Utilization	Future Condition	Future % Utilization	Age (years)	Comments
Liquid Stream										
Influent Bar Screen	Manufacturer Rated Capacity	Peak Hourly Flow	1 Screen	15 mgd (1)	11.3 mgd	75%	13.6 mgd	91%	8	Replaced in 2007 with screen that pivots out of flow in event of clogging or high flows to act as bypass.
Circular Gravity Grit Chamber	Hydraulic Capacity (Effluent Pipe is a bottleneck)	Peak Hourly Flow	1 vortex grit	10.25 mgd (2)	11.3 mgd	110%	13.6 mgd	133%	20	Effluent pipe from grit chamber limits hydraulic capacity based on NYSERDA Energy Conservation Study
Secondary Bar Screen	Manufacturer Rated Capacity	Peak Hourly Flow	1 screen	15 mgd (1)	11.3 mgd	75%	13.6 mgd	91%	20	Replaced in 2007 with screen that pivots out of flow in event of clogging or high flows to act as bypass.
Primary Settling Tanks	Surface Overflow Rate	1,000 gpd/SF @ ADF	4 tanks @ 1359 SF each	5.44 mgd	5.8 mgd	107%	6.9 mgd	127%	69	demonstrates high removal efficiency at all flows
		1,750 gpd/SF @PHF		9.51 mgd	11.3 mgd	119%	13.8 mgd	143%	69	demonstrates high removal efficiency at all flows
	Weir Loading Rate	30,000 gpd /LF of weir @ PHF	4 tanks @ 72 LF/Tank	8.64 mgd	11.3 mgd	131%	13.6 mgd	167%	69	demonstrates high removal efficiency at all flows
Settled Sewage Pumps	Rated Capacity	4200 gpm at 30' TDH	2/3 pumps	12.4 mgd (2)	11.3 mgd	107.6%	13.6 mgd	130%	42	Capacity rating based on 24-hr average flow data
Aeration Tanks	Hydraulic Capacity	Contact Time is 2.04 hrs at 13.6 mgd	6-inches freeboard	13.6 mgd	11.3 mgd	83.1%	13.6 mgd	100%	42, 22	Original blowers and diffusers installed in 1973, fine bubble diffuser upgrade in 1993
	Organic Loading	Conventional Complete Mix Aeration	Current Primary BOD removal 48%, future assumed 30%	40 lb BOD/(d*1000 ft^3)	23.1 lb BOD/(d*1000 ft^3)	57.8%	39.6 lb BOD/(d*ft^3)	99%	42, 22	Original blowers and diffusers installed in 1973, fine bubble diffuser upgrade in 1993
Secondary Settling Tanks	Surface Loading Rate	1200 gpd/SF @ PHF	4 tanks @ 2160 SF each	10.37 mgd	11.3 mgd	109.0%	13.6 mgd	131%	42	
	Weir Overflow Rates	30,000 gpd /LF of weir at PHF	4 tanks @ 184 LF/Tank	22.08 mgd	11.3 mgd	51.2%	13.6 mgd	62%	42	
UV Disinfection System	Rated Capacity	2 banks per channel / 120 HP Lamps	2 Trojan Channels	6.8 mgd per channel	11.3 mgd	55.4%	13.6 mgd	67%	8	2 Channels with Instantaneous Peak Flow at 30 mg/L TSS
	Rated Capacity	3 Banks / 11 Racks per Bank / 8 Lamps per Rack / 264 LP Lamps total	1 Fisher-Porter Channel	6.8 mgd					8	redundant third channel provides an additional 6.8 mgd of capacity
Outfall Pipe	Calculated Capacity	24-inch Outlet Orifice with 6.9' head	2 20-inch diameter outfalls	22.3 mgd	11.3	50.7%	13.6 mgd	62%	14	Lower outfall utilized during aveage flow conditions. Higher outfall utilized during high flow and high tide conditions.

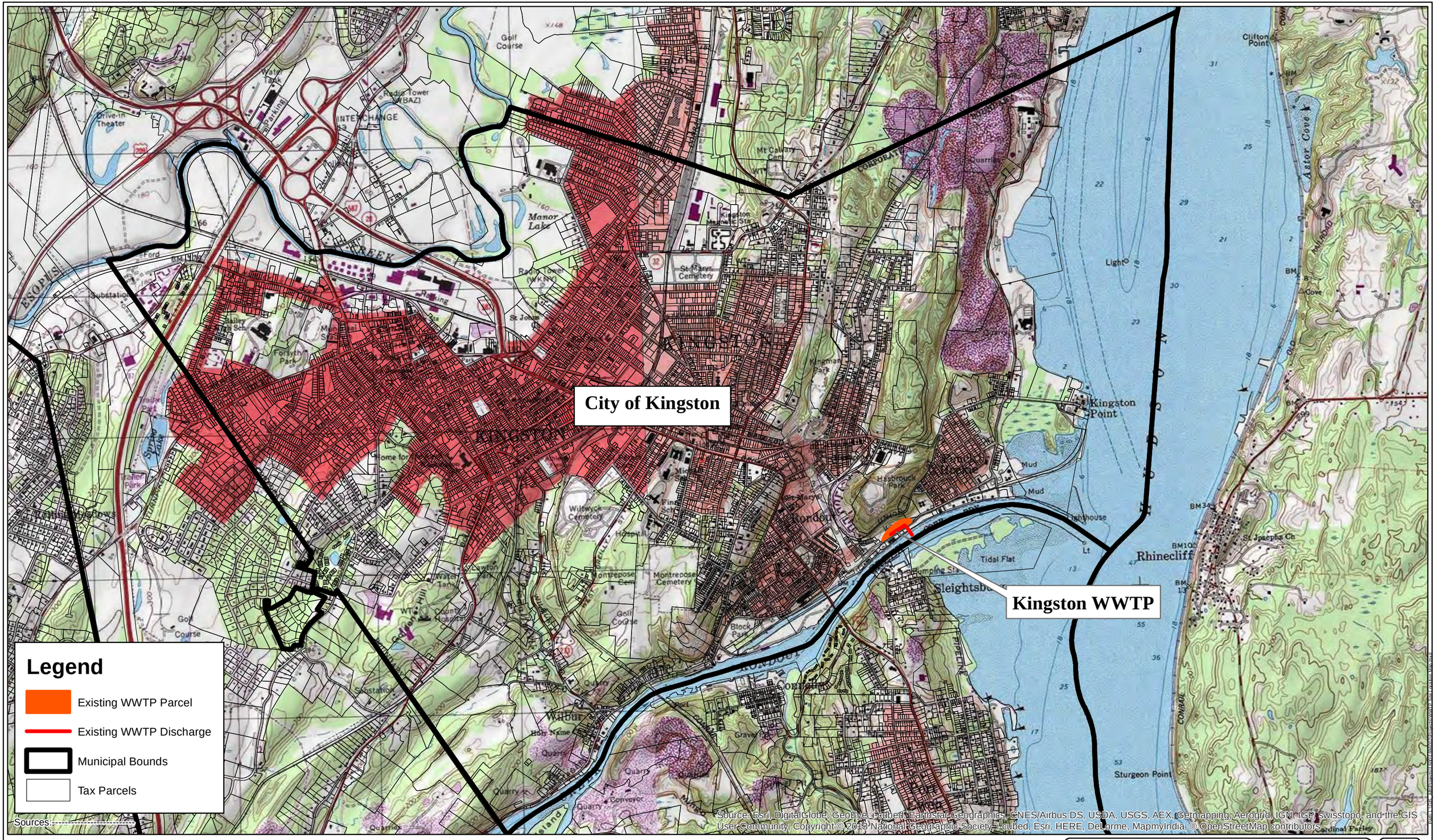
TABLE 4-4
CITY OF KINGSTON WWTP
UNIT PROCESS CAPACITY SUMMARY

Unit Process	Capacity Rating Parameter	Capacity Rating Standard	Existing Condition	Capacity Rating	Current Condition	Current % Utilization	Future Condition	Future % Utilization	Age (years)	Comments
Solid Stream										
Primary Sludge Thickener	Solids Mass Loading	20-30 lb/day/ft^2	20 ft diameter	6284 to 9426 lb/day	3297 lb/day	52%	2627 lb/day	42%	42	
	Waste Sludge Loading	1 day volume	20' diam., 10' deep	V=3,346 ft^3	2621 ft^3/day	78.3%	2089 ft^3/day	62%	42	
WAS Gravity Belt Thickener	Rated Capacity	BDP Nominal Capacity	Receives WAS	450 gpm continuously	2,317 gal/hr	21.5%	2,757 gal/hr	26%	8	Current operation is 80-100 gpm for 12-hr periods
Anaerobic Digesters	Sludge Loading	80 lb/day*1000 ft^3	2 primary digesters	Total Volume = 72,970 ft^3	68.5 lb/day*1000f t^3	85.6%	81.5 lb/day/1000 ft^3	102%	69	10 States recommended sludge loading is only nominally exceeded and should be evaluated during detail design of process improvements.
Belt Filter Press	Rated Capacity	2250 - 3750 lbs/hr	2.5 meter press	2250 - 3750 lbs/hr	1.35 hours/day	5.6%	1.75 hours/day	7.3%	26	

Sources:
(1) City of Kingston Wet Weather Operating Plan
(2) NYSERDA Energy Conservation Study, Malcolm Pirnie, April 2007

Table 4-5
City of Kingston Potential WWTP Relocation Evaluation

Map ID #	Parcel Number	Owner	Property Class	Site Size (Acres)	Wetlands Present	Within Sea-Level Rise and FEMA 100 Year Flood Plain	Approximate Site Elevation Range (ft)	NRCS - Soil Type	NRCS - Hydrologic Soil Group	NRCS - Approx. Depth to bedrock/restrictive feature (inches)	NRCS Rock outcrop %	NRCS - Slope (%)	NRCS - Depth to watertable (inches)
1	48.16-6-1.100	Kgn Landing Dev LLC	Vacant	56.9	Yes	No	~30-260	QU, FAE	D	0-40, 16-20 - unweathered bedrock (rockoutcrop is 0-60) and 0-20 to lithic bedrock	5, 30	0-15, 25-60	>80
2	48.20-1-3	Kgn Landing Dev LLC	Vacant	64.0	Yes	No	~30-260	FAE, SmC, Qu, ML, GP, CP	D, C/D,B	16-20 - unweathered bedrock (rockoutcrop is 0-60) and 0-20 to lithic bedrock, 40-80/10-20 to lithic bedrock, 0-40, >80, 40-80, 40-60	30, 1, 5	25-60, 8-15, 0-15, 0-5, 0-15, 0-5	>80, >80, 24-36
3	48.84-1-4	North Street Brick Works	Vacant	76.3	No	Part of Site	~0-260	CP, CF, ML	B, B	40-60, >80, >80	0	0-5, 0-8, 0-5	36, 24-36
4	48.84-1-5.110	Kingston Local Dev Corp	Vacant	79.4	Yes	No	~100-300	FAE, STD	D, D/C	16-20 - unweathered bedrock (rockoutcrop is 0-60) and 0-20 to lithic bedrock, 10-20/40-80/0	30, 20	25-60, 15-25	>80
5	48.83-7-43	Kingston Local Dev Corp	Lite Industrial Manfacturing	6.9	No	No	~260-300	STD	D/C	10-20/40-80/0	20	15-25	>80
6	56.27-6-42	Kingston Local Dev Corp	Manufacture	15.4	Yes	No	~200-260	STD	D/C	10-20/40-80/0	20	15-25	>80
7	56.28-1-1	Kingston Caves LLC	Vacant	3.1	No	No	~100-200	FAE	D	16-20 - unweathered bedrock (rockoutcrop is 0-60) and 0-20 to lithic bedrock	30	25-60	>80
8	56.35-9-16.100	City of Kingston	City Park/Caves Below	45.2	No	No	~100-200	FAE, STD	D, D/C	16-20 - unweathered bedrock (rockoutcrop is 0-60) and 0-20 to lithic bedrock, 10-20/40-80/0	30, 20	25-60, 15-25	>80, >80
9	56.36-1-6	Historic Kingston Waterfront	Fuel Storage & Distribution	3.8	No	Yes	~0-100	CF, FAE	B, D	>80, 16-20 - unweathered bedrock (rockoutcrop is 0-60) and 0-20 to lithic bedrock	30	0-8, 25-60	36, >80
10	56.36-1-7	B Millens & Son Inc	Vacant	2.3	No	Yes	~0-100	CF, FAE	B, D	>80, 16-20 - unweathered bedrock (rockoutcrop is 0-60) and 0-20 to lithic bedrock	30	0-8, 25-60	36, >80



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N W E S

1 inch = 2,000 feet

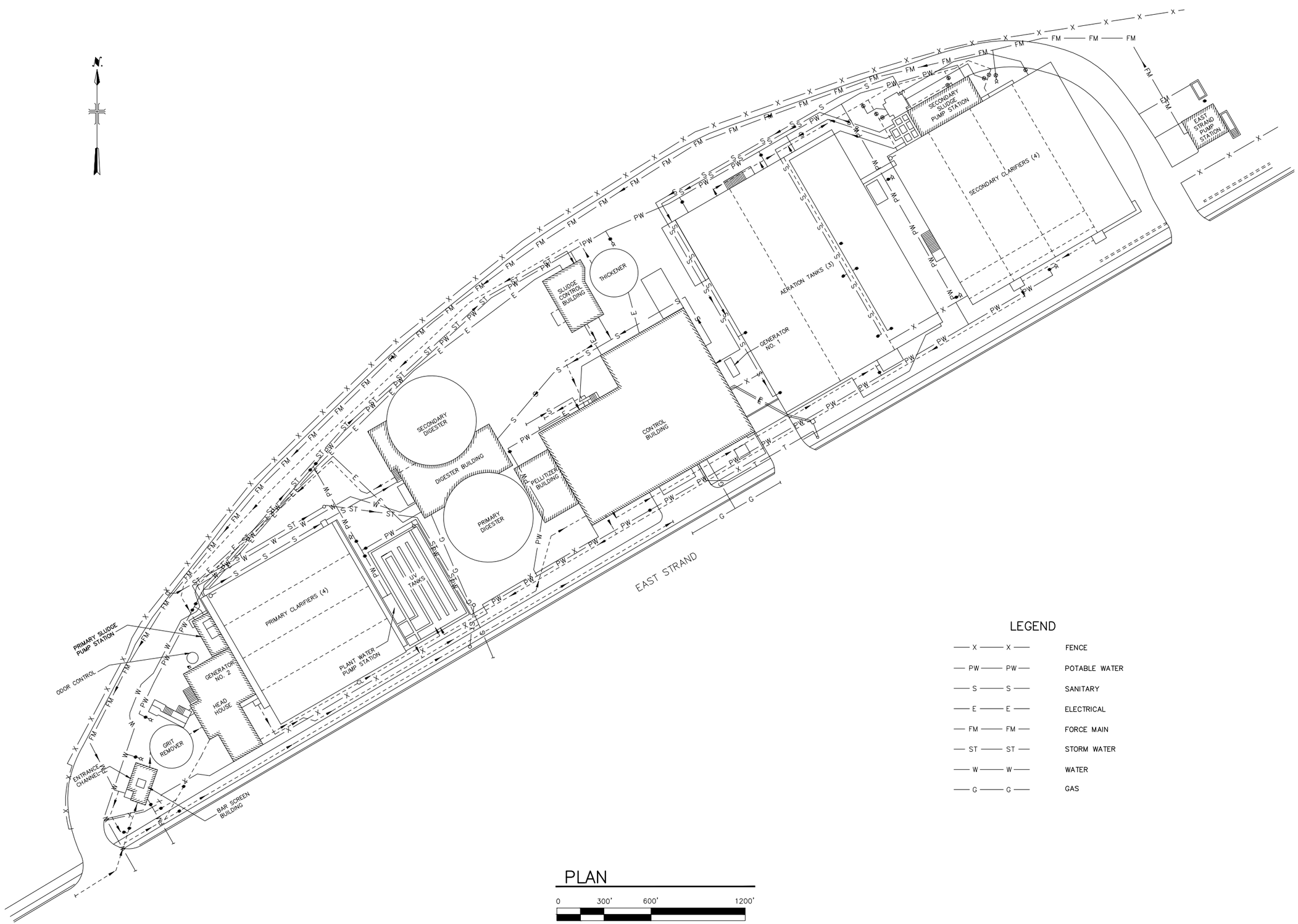
City of Kingston

Site Location Map

Ulster County April 2015 New York

Figure 2-1

Project No. 1696.002



PLAN

0 300' 600' 1200'

SCALE: 1"=600'

LEGEND

— X — X —	FENCE
— PW — PW —	POTABLE WATER
— S — S —	SANITARY
— E — E —	ELECTRICAL
— FM — FM —	FORCE MAIN
— ST — ST —	STORM WATER
— W — W —	WATER
— G — G —	GAS

MALCOLM PIRNIE | ARCADIS

The Water Division of ARCADIS

CONSULTANTS

SEALS

CITY OF KINGSTON
ULSTER COUNTY, NEW YORK

RESTORATION OF THE KINGSTON WWTP

NO.	DATE	ISSUED FOR	BY

COPYRIGHT:

DATE: JUNE 2014

PROJECT NO.: 05744027.0000

FILE NAME: FIGURE 2-1

DESIGNED BY: J. LAPLANTE

DRAWN BY: S. HAUSMANN

CHECKED BY: R. OSTAPCZUK

SHEET TITLE

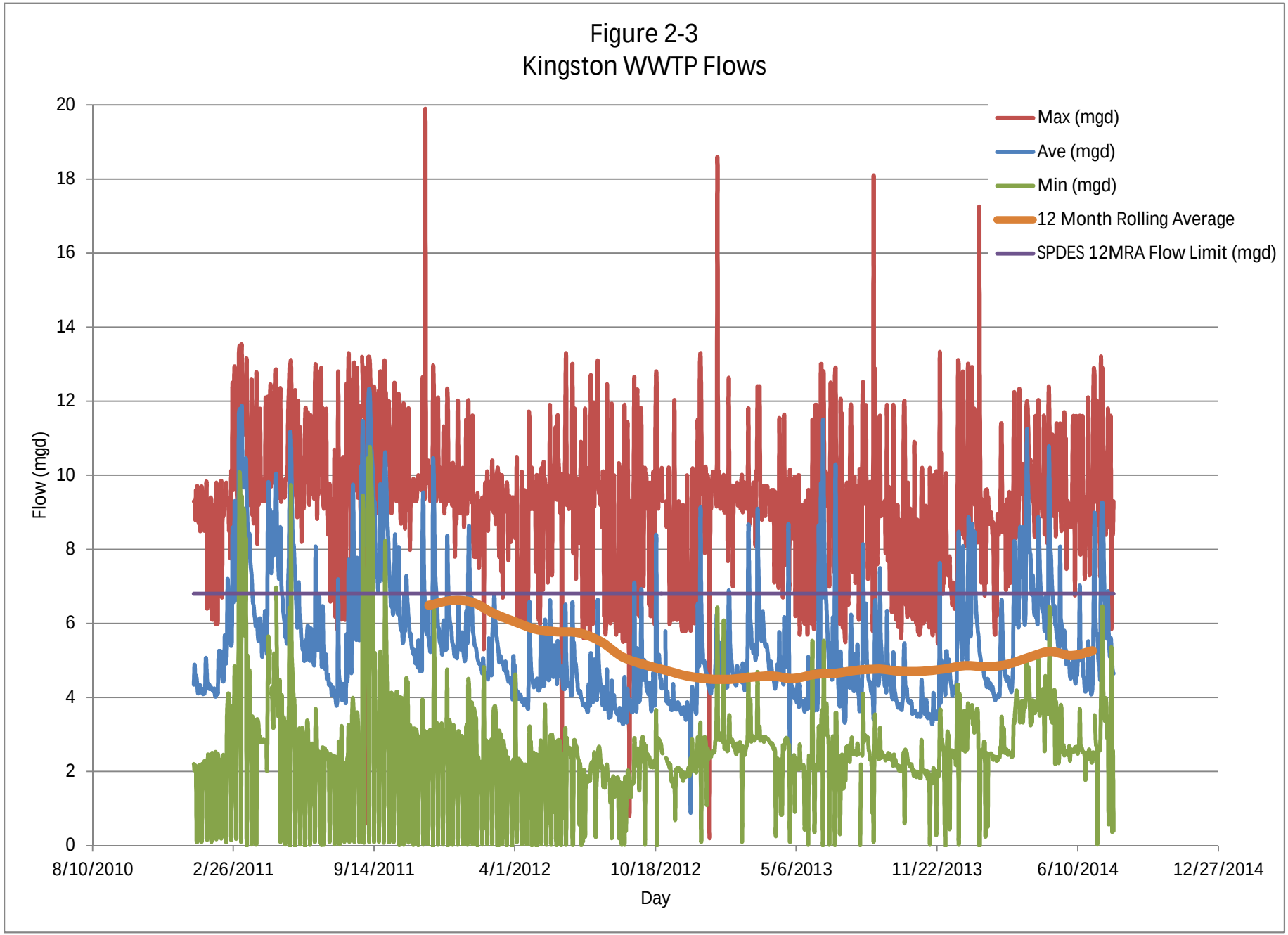
GENERAL

EXISTING SITE PLAN

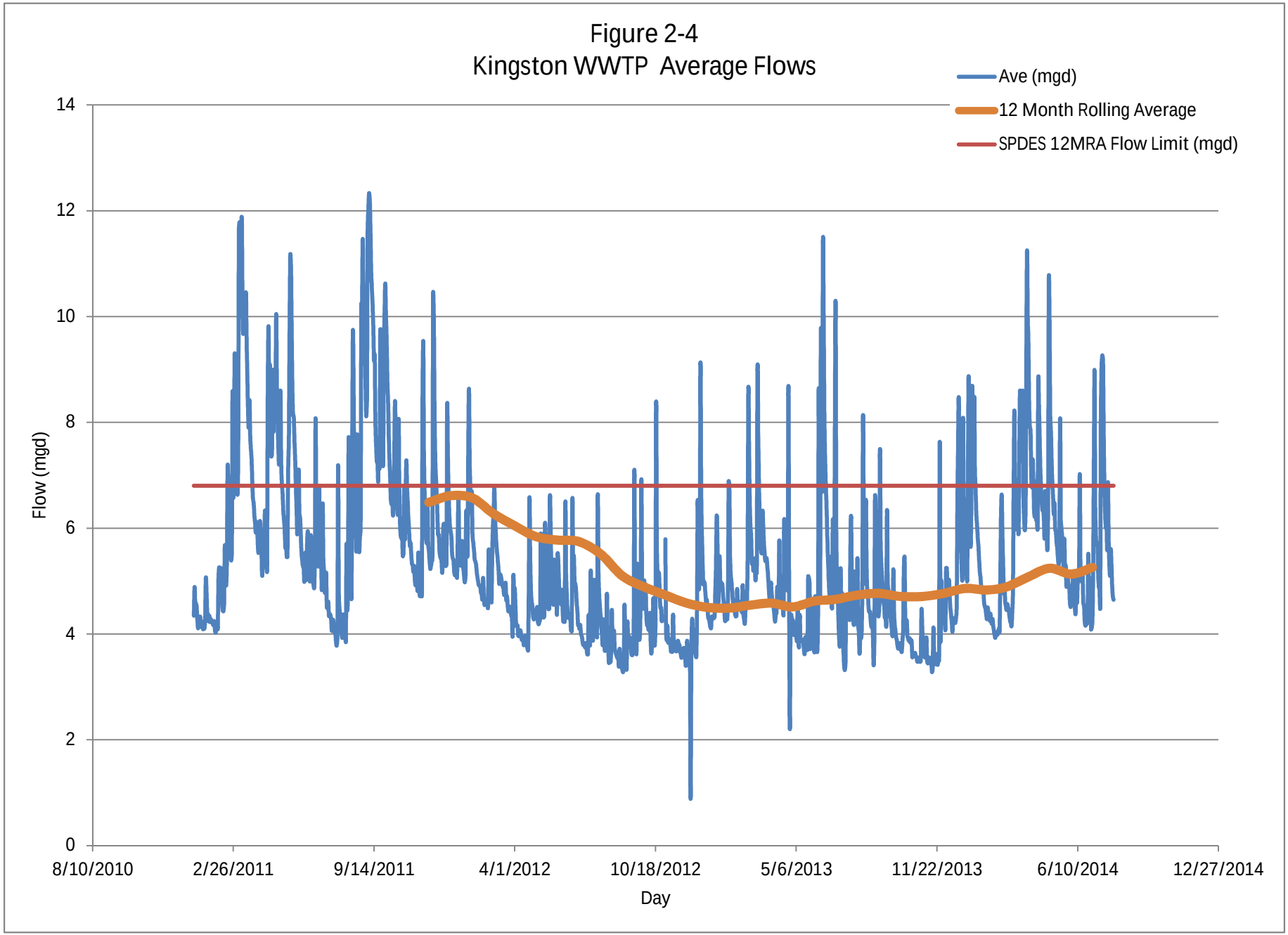
SCALE: AS SHOWN

Figure 2-2

User:HAUSMANN Spec:AUS-NCSMOD File:G:\ACAD\PROJ\05744027.0000\FIGURES\FIGURE 2-1.DWG Scale:1:1 SavedDate:6/18/2014 Time:11:53 Plot Date: Hausmann, Steve; 6/18/2014; 11:55 ; Layout:BLANK



Z:\BL-Vault\ID2\18217AD2-1C71-4823-8927-99D5C4054147\0\651000-651999\651939\L\L\Capacity Utilization Summary (ID 651939).xlsx



Z:\BL-Vault\ID2\18217AD2-1C71-4823-8927-99D5C4054147\0\651000-651999\651939\L\L\Capacity Utilization Summary (ID 651939).xlsx

Figure 3-1 – Kingston WWTP Elevations and Rondout Creek Flood Elevations

	Elevation (ft)	WWTP Tank, Building, or Process Water Surface Elevation	Elevation (ft)	Rondout Creek Elevations
17				
16.75				
16.5	16.5	Top of Aeration Tanks		
16.25				
16				
15.75				
15.5				
15.25				
15	15.08	Top of Final Settling Tanks		
14.75				
14.5				
14.25				
14				
13.75	13.9	Aeration Tank Water Level		
13.5				
13.25				
13	13.01	Top of Screen Channel		
12.75				
12.5	12.6	Final Settling Tank Water Level	12.4	100-year flood + 5 feet
12.25			12.2	Sandy High Water Level + 4 feet
12				
11.75				
11.5	11.39	Top of Grit Tank		
11.25				
11	11	Screen Water Level		
10.75	10.9	Grit Tank Water Level	10.83	500-year flood + sea level rise with rapid ice melt
10.5			10.5	500-year flood + sea level rise
10.25			10.2	ARCADIS FEMA Flood Mitigation Measures
10	10.0	Top of Primary Settling Tanks and UV Tanks		
9.75			9.53	Hurrican Sandy + sea level rise with rapid ice melt
9.5			9.5	500-year flood
9.25			9.2	Hurricane Sandy + sea level rise
9	8.8	Primary Settling Tank Water Level		
8.75	8.7	Control Building First Floor	8.73	100-year flood +sea level rise with rapid ice melt
8.5			8.4	100-year flood + sea level rise
8.25			8.23	25-year flood + sea level rise with rapid ice melt
8			8.2	Superstorm Sandy High Water Level
7.75			7.9	25-year flood + sea level rise
7.5			7.4	100-year flood
7.25			6.9	25-year flood
7				
6.75				
6.5			6.53	10-year flood + sea level rise with rapid ice melt
6.25	6.3	Secondary Sludge 1st Floor & East Strand PS 1st Floor	6.2	10-year flood + sea level rise
6				
5.75				
5.5	5.5	Digester Building Floor		
5.25			5.2	10-year flood
5	5	Sludge Control/Degritter Building		
4.75				
4.5	4.5	Lowest Existing Grade at WWTP		
4.25				
4				
3.75				
3.5				
3.25			3.33	2035 Sea Level Rise with rapid ice melt
3			3.0	2035 Sea Level Rise
2.75				
2.5				
2.25				
2			2.0	Normal High Rondout Creek
1.75	1.7	Control Building Basement Floor		
1.5				
1.25				
1				
0.75				
0.5				
0.25				
0				

Legend:
- Plant HGLs
- Building Elevations

Legend:
- SMLP Elevation Criteria
- Task Force Sea Level Rise with Rapid Ice Melt
- Task Force Sea Level Rise
- Superstorm Sandy and FEMA Flood Mitigation
- FEMA Flood Elevations

Note: Elevations are presented with the NGVD29 datum.

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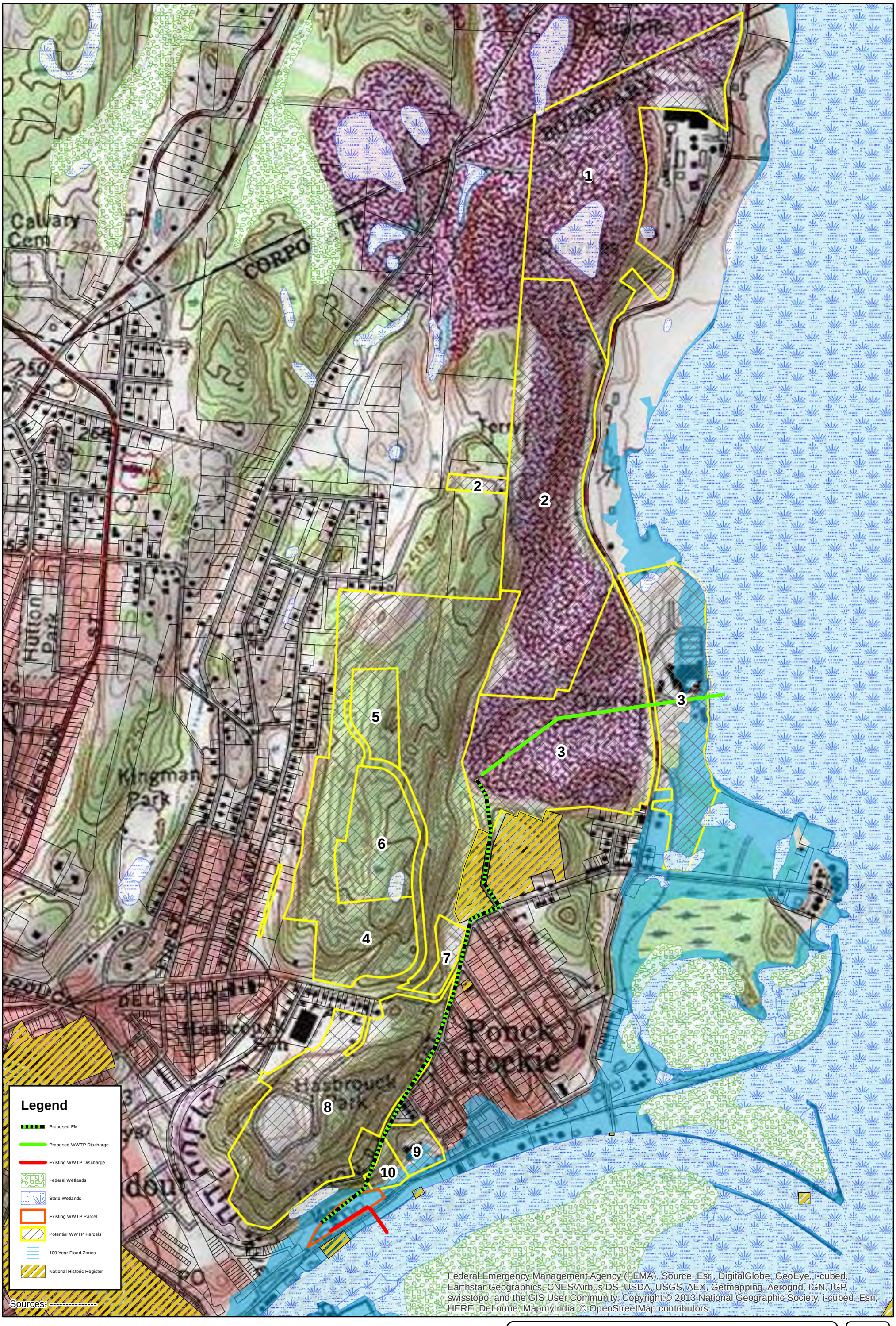

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N W E S

1 inch = 750 feet

City of Kingston

Potential WWTP Locations

Ulster County April 2015 New York

Figure 4-1

Project No. 1696.002

Appendix A

WWTP DMR Data

Kingston WWTP
DMR Data

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
Min	0.2	0.9	0.0	22	4	12	1	1,445	113	632	30	3	1	1	314	312	32
Max	19.9	12.3	10.7	311	104	690	66	13,367	3,605	27,699	2,288	35	20	27	4,835	1,463	834
Median	9.4	4.9	2.5	124	7	159	4	5,297	305	6,350	165	19	6	12	1,679	751	301
Average	9.3	5.4	2.6	127	7	162	5	5,327	332	7,098	229	19	8	12	1,922	784	338
STDEV	2.0	1.7	1.4	46	6	70	6	1,541	232	3,347	245	6	5	6	1,110	160	218
Average+STD	11.3	7.0	4.0	173	13	232	11	6,868	565	10,444	474	24	13	19	3,031	944	557

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
1/1/2011	9.3	4.346	2.2														
1/2/2011	9.3	4.885	2.03														
1/3/2011	8.8	4.561	2.14	146	9	187	3	5,554	342	7,113	114						
1/4/2011	9.6	4.575	2.15	144	8	147	3	5,494	305	5,609	114			21			
1/5/2011	9.6	4.51	0.1														
1/6/2011	9.7	4.258	0.1														
1/7/2011	9.3	4.107	1.37														
1/8/2011	8.7	4.254	2.06														
1/9/2011	9.5	4.304	2.15														
1/10/2011	8.5	4.326	2.18	195	25	163	6	7,035	902	5,881	216						
1/11/2011	9	4.139	2.08	213	14	181	7	7,353	483	6,248	242						
1/12/2011	9.7	4.238	0.1														
1/13/2011	9.2	4.168	2.2														
1/14/2011	8.9	4.092	2.13														
1/15/2011	9.3	4.094	2.1														
1/16/2011	8.5	4.104	2.28														
1/17/2011	9.4	4.254	2.13														
1/18/2011	9.5	5.052	2.27														
1/19/2011	9.8	4.788	0.18	159	11	155	3	6,349	439	6,189	120						
1/20/2011	6.4	4.383	0.16	206	9	188	2	7,530	329	6,872	73						
1/21/2011	9.2	4.375	2.44														
1/22/2011	8.8	4.239	2.22														
1/23/2011	9	4.343	2.17														
1/24/2011	8.5	4.227	2.25	156	9	144	3	5,499	317	5,076	106						
1/25/2011	9.4	4.281	2.27	167	7	161	2	5,962	250	5,748	71						
1/26/2011	9.3	4.246	0.1														
1/27/2011	6.1	4.233	2.48														
1/28/2011	8.9	4.184	2.25														
1/29/2011	9.2	4.17	2.15														
1/30/2011	8.6	4.242	2.16														
1/31/2011	8.5	4.059	2.44														
2/1/2011	6	4.023	2.52														
2/2/2011	9.8	4.142	0.17	180	10	156	2	6,218	345	5,389	69						
2/3/2011	6.1	4.19	2.39	184	10	181	5	6,430	349	6,325	175						

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
2/4/2011	6	4.098	2.48														
2/5/2011	9.1	5.064	2.38														
2/6/2011	8.9	5.258	2.23														
2/7/2011	9.1	4.839	2.19	70	7	45	2	2,825	283	1,816	81						
2/8/2011	8.7	5.251	2.3	134	6	168	2	5,868	263	7,357	88						
2/9/2011	9.8	4.719	0.19														
2/10/2011	6.7	4.592	2.24														
2/11/2011	9.3	4.447	2.3														
2/12/2011	8.9	4.43	2.45														
2/13/2011	9.2	4.571	2.22														
2/14/2011	9.6	5.675	2.18	177	10	328	2	8,377	473	15,524	95			17			
2/15/2011	9.2	4.975	2.26	176	9	165	2	7,303	373	6,846	83						
2/16/2011	9.8	4.919	0.1														
2/17/2011	9.3	5.441	3.39														
2/18/2011	9.4	7.175	3.92														
2/19/2011	9.3	6.492	4.11														
2/20/2011	8.5	6.264	4.02														
2/21/2011	8.6	5.735	3.71	146	11	120	2	6,983	526	5,740	96						
2/22/2011	7.8	5.627	3.61	163	11	168	3	7,649	516	7,884	141						
2/23/2011	10.1	5.389	0.16														
2/24/2011	9.7	5.501	2.38														
2/25/2011	12.5	8.578	3.25														
2/26/2011	9.6	6.595	3.78														
2/27/2011	12.4	7.034	3.61														
2/28/2011	12.9	9.296	4.84														
3/1/2011	10	7.821	3.25														
3/2/2011	12.7	7.789	0.18	82	11	96	7	5,327	715	6,236	455						
3/3/2011	9.6	7.218	3.43	112	8	95	2	6,742	482	5,719	120						
3/4/2011	9	6.632	3.25														
3/5/2011	9.6	7.294	3.46														
3/6/2011	13.3	11.66	7.47														
3/7/2011	13.5	11.785	10.08	24	6	36	5	2,359	590	3,538	491						
3/8/2011	12.5	11.191	9.58	39	11	56	8	3,640	1,027	5,227	747						
3/9/2011	13.2	10.409	0.1														
3/10/2011	13.5	11.885	9.33														
3/11/2011	12	10.546	8.27														
3/12/2011	11.1	9.673	8.86														
3/13/2011	11.6	10.408	9.1														
3/14/2011	11.6	10.301	8.74	60	9	266	3	5,155	773	22,852	258						
3/15/2011	12.6	9.939	5.66	39	10	27	3	3,233	829	2,238	249						
3/16/2011	12.4	10.453	8.15														
3/17/2011	13.1	9.577	0.03														
3/18/2011	10.6	8.856	5.03														
3/19/2011	9.8	8.215	4.08														

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
3/20/2011	9.5	7.9	4.26														
3/21/2011	10.3	8.422	4.72	70	12	152	6	4,917	843	10,676	421						
3/22/2011	9.4	7.774	3.48	82	9	124	3	5,316	584	8,040	195						
3/23/2011	9.2	7.51	3.49														
3/24/2011	12.6	7.307	0.03														
3/25/2011	9	6.889	3.42														
3/26/2011	9.7	6.561	2.78														
3/27/2011	8.7	6.471	2.82														
3/28/2011	9.6	6.241	2.79	118	9	167	5	6,142	468	8,692	260						
3/29/2011	9.1	6.104	2.78	120	6	163	3	6,109	305	8,298	153						
3/30/2011	11	5.916	0.03														
3/31/2011	12.7	6.116	0.03														
4/1/2011	8.2	5.978	3.41														
4/2/2011	10.2	5.66	3.38														
4/3/2011	9.2	5.543	3.24														
4/4/2011	9.9	6.022	2.81	133	8	230	2	6,680	402	11,551	100			12			
4/5/2011	11.8	6.136	2.93	133	9	209	3	6,806	461	10,695	154						
4/6/2011	10.1	5.96															
4/7/2011	9.3	5.619	2.79														
4/8/2011	9.3	5.103	2.79														
4/9/2011	9.5	5.349	2.82														
4/10/2011	9.8	5.41	2.86														
4/11/2011	9.3	5.379	2.81														
4/12/2011	9.6	6.328	2.79														
4/13/2011	12.1	5.793		140	11	198	2	6,764	531	9,566	97						
4/14/2011	9.7	5.595	2.85	140	9	198	2	6,533	420	9,239	93						
4/15/2011	9.7	5.212	2.06														
4/16/2011	12.1	8.438	4.38														
4/17/2011	11.9	9.818	5.65														
4/18/2011	11.4	8.7	4.41	90	8	176	3	6,530	580	12,770	218						
4/19/2011	11.9	9.078	5.28	72	7	117	2	5,451	530	8,858	151						
4/20/2011	12.4	8.067															
4/21/2011	9.7	7.356	4.09														
4/22/2011	12	7.393	4.25														
4/23/2011	12.2	8.992	3.39	60	8	53	4	4,500	600	3,975	300						
4/24/2011	9.8	7.824	3.2	95	4	180	1	6,199	261	11,745	65						
4/25/2011	11.7	8.606	5.14														
4/26/2011	11	8.817	4.72														
4/27/2011	12.3	8.424															
4/28/2011	12.8	10.046	6.97														
4/29/2011	10.6	8.731	4.96														
4/30/2011	9.8	8.038	3.75														
5/1/2011	9.5	7.544	3.49														
5/2/2011	9.4	7.201	3.57	95	5	162	2	5,705	300	9,729	120			12.7			

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
5/3/2011	11.8	7.555	4.39	98	5	164	1	6,175	315	10,333	63						
5/4/2011	12.3	8.599	0.1														
5/5/2011	9.3	7.33	3.62														
5/6/2011	9.5	6.846	4.06														
5/7/2011	9.6	6.681	2.83														
5/8/2011	9.5	6.344	2.76														
5/9/2011	9.7	6.17	3.46	81	7	213	3	4,168	360	10,961	154						
5/10/2011	9.4	5.995	2.97	88	7	127	3	4,400	350	6,350	150						
5/11/2011	9.9	5.632	0.03														
5/12/2011	9.9	5.712	3.29														
5/13/2011	9.9	5.454	3.03														
5/14/2011	10.1	5.456	3.34														
5/15/2011	11.7	7.097	3.29														
5/16/2011	12.3	7.684	3.66	115	9	210	4	7,370	577	13,458	256						
5/17/2011	12.9	9.672	6.33	71	7	118	4	5,727	565	9,518	323						
5/18/2011	13	11.157	0.02														
5/19/2011	13.1	10.951	9.62														
5/20/2011	11.9	9.81	5.3														
5/21/2011	10.2	8.655	4.75														
5/22/2011	9.7	8.129	4.27														
5/23/2011	9.7	8.114	3.97	97	7	188	3	6,564	474	12,722	203						
5/24/2011	9.5	7.621	3.94	92	5	153	1	5,847	318	9,725	64						
5/25/2011	12.3	7.291	0.03														
5/26/2011	9.8	6.766	1.66														
5/27/2011	9.2	6.354	2.71														
5/28/2011	8.9	5.883	2.69														
5/29/2011	12	6.531	2.67														
5/30/2011	10.1	7.106	3.09														
5/31/2011	10	6.29	3.16														
6/1/2011	11.3	6.188	0.03	108	9	256	4	5,574	464	13,212	206	21	16	15	4412	1,084	826
6/2/2011	9.9	5.849	3.14	114	8	193	2	5,561	390	9,415	98	18	17		4317	878	829
6/3/2011	8.2	5.54	3.05														
6/4/2011	9.9	5.387	3.18														
6/5/2011	9.9	5.28	3.04														
6/6/2011	9.1	5.261	2.47	161	8	226	8	7,064	351	9,916	351	16	19		4278	702	834
6/7/2011	9.6	4.988	1.24	126	7	162	3	5,242	291	6,739	125	18	20		4181	749	832
6/8/2011	11.5	5.433	0.02														
6/9/2011	11.8	5.532	2.49														
6/10/2011	9.9	5.023	2.39														
6/11/2011	11.7	5.733	3.37														
6/12/2011	11.7	5.935	3.3														
6/13/2011	11.4	5.352	2.41	166	7	236	5	7,410	312	10,534	223	22	16		3682	982	714
6/14/2011	9.2	5.165	2.33	108	6	155	3	4,652	258	6,677	129	16	18		3877	689	775
6/15/2011	11.3	5.011	0.02														

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
6/16/2011	11.6	5.858	2.66														
6/17/2011	9.7	5.78	1.12														
6/18/2011	9.5	5.063	2.72														
6/19/2011	9.7	5.011	2.4														
6/20/2011	9.7	4.933	2.28	102	6	172	4	4,196	247	7,076	165	21	15		3147	864	617
6/21/2011	9.4	4.871	2.54	120	4	152	2	4,875	162	6,175	81	18	14		2803	731	569
6/22/2011	12.4	5.416	0.1														
6/23/2011	13	8.069	3.68														
6/24/2011	11.9	6.26	3.58														
6/25/2011	8.9	5.609	2.65														
6/26/2011	9.7	5.426	2.45														
6/27/2011	9.5	5.289	2.13	111	7	168	5	4,896	309	7,411	221	20	4		1257	882	176
6/28/2011	12.8	6.757	2.5	42	13	43	4	2,367	733	2,423	225	13	6.4		2722	733	361
6/29/2011	10	5.877	0.1														
6/30/2011		5.6															
7/1/2011	12.9	5.3	0.02														
7/2/2011	10.4	4.872	0.02														
7/3/2011	11.8	6.461	2.64														
7/4/2011	9.2	5.422	2.54														
7/5/2011	9.1	5.175	0.02														
7/6/2011	9.8	4.783	2.62	207	6	184	9	8,257	239	7,340	359	19	11		2334	758	439
7/7/2011	9.5	4.777	2.56	112	4	144	6	4,462	159	5,737	239	16	5.4		1207	637	215
7/8/2011	11.8	5.156	2.56														
7/9/2011	9.4	4.499	2.54														
7/10/2011	8.8	4.533	2.37														
7/11/2011	8.4	4.606	2.44	105	4	122	1	4,033	154	4,687	38	19	13	12	2478	730	499
7/12/2011	9.1	4.34	2.06	126	4	168	4	4,561	145	6,081	145	17	8.3		1569	615	300
7/13/2011	9.7	4.375	0.1														
7/14/2011	6.6	4.365	2.46														
7/15/2011	8.6	4.292	2.34														
7/16/2011	8.8	4.061	2.4														
7/17/2011	9.3	4.151	2.38														
7/18/2011	7.1	4.268	2.32	146	4	164	1	5,197	142	5,838	36	23	7.1		1351	819	253
7/19/2011	9	4.14	2.42	130	4	176	2	4,489	138	6,077	69	21	3.4		735	725	117
7/20/2011	10.6	4.024	0.03														
7/21/2011	6.2	4.062	2.38														
7/22/2011	8.9	3.844	2.22														
7/23/2011	9.2	3.78	2.23														
7/24/2011	5.9	3.953	2.19														
7/25/2011	12.7	7.184	0.59	90	4	149	4	5,392	240	8,927	240	11	7.9		2489	659	473
7/26/2011	10	4.782	2.81	72	4	138	2	2,871	160	5,504	80	15	11		2213	598	439
7/27/2011	10.4	4.466	0.03														
7/28/2011	6.4	4.343	2.57														
7/29/2011	6.4	4.204	2.46														

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7/30/2011	6.1	3.988	3.23														
7/31/2011	6.2	3.933	2.35														
8/1/2011	10.4	4.37	0.29	142	5	238	4	5,175	182	8,674	146	19	14	13	2569	692	510
8/2/2011	9.5	4.014	2.23	136	6	144	2	4,553	201	4,821	67	21	14		2410	703	469
8/3/2011	10.1	4.041	0.1														
8/4/2011	6.1	3.984	2.22														
8/5/2011	6.2	3.858	2.16														
8/6/2011	12.4	5.701	0.35														
8/7/2011	9.8	4.451	2.35														
8/8/2011	12.1	4.78	2.4	102	4	140	4	4,066	159	5,581	159	20	9		1854	797	359
8/9/2011	13.3	7.7	3.17	63	4	126	3	4,046	257	8,091	193	13	6		2119	835	385
8/10/2011	12.2	6.1	0.1														
8/11/2011	10.1	5.353	3.08														
8/12/2011	7.5	4.849	2.99														
8/13/2011	9.2	4.677	2.83														
8/14/2011	12.4	7.365	3.6														
8/15/2011	12.6	9.707	3.99	30	4	102	2	2,429	324	8,258	162	7.6	4.8		2234	615	389
8/16/2011	12.4	8.719	3.54	40	9	80	7	2,909	654	5,817	509	9.2	8.2		3665	669	596
8/17/2011	13	7.042	0.1														
8/18/2011	10.9	7.117	3.16														
8/19/2011	9.6	6.042	3.18														
8/20/2011	9.9	5.612	3.14														
8/21/2011	12.9	7.758	3.59														
8/22/2011	9.4	6.535	3.41	57	4	86	1	3,107	218	4,687	55	11	5.9		1774	600	322
8/23/2011	9.4	5.958	2.99	70	4	80	1	3,478	199	3,975	50	14	6.1		1662	696	303
8/24/2011	10.3	5.546	0.1														
8/25/2011	11.8	5.839	2.92														
8/26/2011	7.9	5.987	2.97														
8/27/2011		10.245															
8/28/2011	13.2	10.248	0.1														
8/29/2011	12.5	11.469	9.4	24	4	56	2	2,296	383	5,356	191	5.2	1.7		1306	497	163
8/30/2011	11.6	10.117	8.95	24	5	84	6	2,025	422	7,088	506	5.6	4.3		2265	473	363
8/31/2011	12.9	9.48	0.1														
9/1/2011	10.6	9.339	6.35														
9/2/2011	10	8.686	5.19														
9/3/2011	0.6	8.115	4.57														
9/4/2011	11.2	8.425	4.62														
9/5/2011	13	11.575	5.34	42	4	122	1	4,054	386	11,777	97	5.9	2.2		1535	570	212
9/6/2011	13.2	12.05	10.36	22	4	62	3	2,211	402	6,231	301	3.1	2		1507	312	201
9/7/2011	13.2	12.333	0.1														
9/8/2011	13.1	12.216	10.74														
9/9/2011	12.5	11.628	10.5														
9/10/2011	11.8	10.863	9.94														
9/11/2011	11.4	10.553	9.43														

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9/12/2011	11.5	10.191	8.86	62	4	90	1	5,270	340	7,649	85	7.8	4.8		2346	663	408
9/13/2011	12.1	9.826	6.35	96	4	338	2	7,867	328	27,699	164	14	3		1598	1,147	246
9/14/2011	12.4	9.165	0.1														
9/15/2011	12.2	9.275	5.06														
9/16/2011	9.7	8.008	3.79														
9/17/2011	9.3	7.56	3.05														
9/18/2011	9.2	7.26	2.97														
9/19/2011	10.6	7.223	3.14	72	4	146	4	4,337	241	8,795	241	13	6.6		2151	783	398
9/20/2011	9	6.887	2.86	70	4	116	11	4,021	230	6,663	632	11	2.4	1.7	965	632	138
9/21/2011	12.3	7.702	0.1														
9/22/2011	9.4	7.176	3.06														
9/23/2011	12.8	9.74	5.24														
9/24/2011	10.3	8.366	3.45														
9/25/2011	9.1	7.726	3.34														
9/26/2011	9.9	7.403	2.85	84	4	112	1	5,186	247	6,915	62	11	4.4		1593	679	272
9/27/2011	11.8	7.196	3.2	62	4	94	1	3,721	240	5,641	60	9.4	4.5		1575	564	270
9/28/2011	13	9.259	0.1														
9/29/2011	13.1	10.083	5.18														
9/30/2011	12.3	10.623	8.22														
10/1/2011	12.2	10.024	6.26														
10/2/2011	11.1	9.541	4.95														
10/3/2011	10.3	8.807	4.65	57	4	108	1	4,187	294	7,933	73	11	5.4	3.8	2226	808	397
10/4/2011	10.3	8.38	3.83	58	4	96	1	4,054	280	6,709	70	12	4		1677	839	280
10/5/2011	12	7.778	0.1														
10/6/2011	10.8	7.276	0.1														
10/7/2011	9.5	6.95	3.44														
10/8/2011	9.3	6.516	3.98														
10/9/2011	9	6.452	4.11														
10/10/2011	10	6.544	3.17	78	4	118	2	4,257	218	6,440	109	14	2.2		868	764	120
10/11/2011	9.4	6.239	2.54	72	4	125	1	3,746	208	6,504	52	14	4.8		1436	728	250
10/12/2011	12	6.421	0.1														
10/13/2011	12.5	7.661	3.13														
10/14/2011	12.4	8.394	3.41														
10/15/2011	9.4	7.142	3.35														
10/16/2011	9.3	6.896	4.15														
10/17/2011	9.9	6.598	4.15	90	4	110	4	4,952	220	6,053	220	13	3.4		1172	715	187
10/18/2011	9.5	6.284	2.59	82	4	118	2	4,298	210	6,184	105	14	4.3		1329	734	225
10/19/2011	12.2	8.063	0.1														
10/20/2011	10.2	6.755	0.02														
10/21/2011	9.2	6.053	4														
10/22/2011	8.7	5.853	3.97														
10/23/2011	8.7	5.807	3.99														
10/24/2011	9.3	5.829	0.6	62	4	106	2	3,014	194	5,153	97	14	5.5		1495	681	267
10/25/2011	9.3	5.469	2.25	160	4	150	2	7,298	182	6,842	91	15	6.5		1608	684	296

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10/26/2011	11.9	5.54	0.03														
10/27/2011	11.2	6.783	1.59														
10/28/2011	8.6	5.785	3.94														
10/29/2011	9.6	6.712	4.15														
10/30/2011	9.9	7.282	4.52														
10/31/2011	9.3	6.759	4.36														
11/1/2011	9.1	6.464	4.41	90	4	84	4	4,852	216	4,528	216			3.6			
11/2/2011	11.8	6.163	0.1	67	4	96	2	3,444	206	4,934	103						
11/3/2011	10	5.907	2.87														
11/4/2011	8	5.663	3.25														
11/5/2011	9.1	5.719	3.2														
11/6/2011	9.7	5.496	3.05														
11/7/2011	9.8	5.326	2.43	114	5	148	6	5,064	222	6,574	267						
11/8/2011	9.3	5.299	2.46	117	4	104	6	5,171	177	4,596	265						
11/9/2011	9.9	5.175	0.02														
11/10/2011	9.6	5.284	3.14														
11/11/2011	9.7	5.034	2.9														
11/12/2011	9.3	4.921	3.05														
11/13/2011	9.3	4.982	3.14														
11/14/2011	9.4	4.968	3.01	106	5	124	1	4,392	207	5,138	41						
11/15/2011	9.8	4.827	2.85	100	4	124	1	4,026	161	4,992	40						
11/16/2011	10	5.539	0.01														
11/17/2011	9.7	4.953	2.84														
11/18/2011	9.8	4.719	2.78														
11/19/2011	9.8	4.714	2.84														
11/20/2011	9.6	4.781	2.97														
11/21/2011	10	4.717	2.91	65	5	68	8	2,557	197	2,675	315						
11/22/2011	12.6	8.452	3.84	113	5	232	5	7,965	352	16,354	352						
11/23/2011	12	9.525	0.03														
11/24/2011	9.8	7.398	3.1														
11/25/2011	9.4	6.631	3.03														
11/26/2011	19.9	6.153	0.07														
11/27/2011	9.8	5.856	2.99														
11/28/2011	10.1	5.731	3.05	84	4	116	1	4,015	191	5,544	48						
11/29/2011	9.9	6.5	2.84	108	4	166	3	5,855	217	8,999	163						
11/30/2011	10.4	5.717	0.03														
12/1/2011	9.8	5.568	3.06														
12/2/2011	10.1	5.376	2.83														
12/3/2011	9.3	5.23	3.13														
12/4/2011	9.8	5.294	3.06														
12/5/2011	9.6	5.371	2.46	107	4	146	3	4,793	179	6,540	134			5.8			
12/6/2011	9.7	5.407	2.97	90	4	182	2	4,058	180	8,207	90						
12/7/2011	12.9	10.419	0.03														
12/8/2011	12.4	10.005	6.27														

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12/9/2011	10.4	8.284	4.92														
12/10/2011	9.5	7.34	3.07														
12/11/2011	9.3	6.981	2.87														
12/12/2011	9.4	6.646	3.32														
12/13/2011	10	6.311	3.25	98	4	12	1	5,158	211	632	53						
12/14/2011	12.1	5.879	0.02	83	4	86	1	4,070	196	4,217	49						
12/15/2011	9.9	5.879	2.99														
12/16/2011	10.2	5.583	3.08														
12/17/2011	10.2	5.464	3.07														
12/18/2011	9.3	5.427	3.17														
12/19/2011	9.9	5.369	3.3	87	4	114	2	3,896	179	5,105	90						
12/20/2011	9.4	5.168	3.24	150	4	172	1	6,465	172	7,413	43						
12/21/2011	10.1	5.794	0.03														
12/22/2011	11.3	6.083	2.86														
12/23/2011	9	5.856	2.98														
12/24/2011	9.9	5.457	2.74														
12/25/2011	9.2	5.284	3.03														
12/26/2011	9.7	5.314	3.2	118	6	106	7	5,230	266	4,698	310						
12/27/2011	12.3	8.297	4.65	78	12	130	18	5,397	830	8,996	1,246						
12/28/2011	11.9	7.372	0.02														
12/29/2011	9.5	6.664	3.14														
12/30/2011	9.3	6.286	3.39														
12/31/2011	9.9	6.017	3.28														
1/1/2012	10.3	5.93	0.04														
1/2/2012	9.8	5.833	3.1	102	4	208	2	4,962	195	10,119	97			4.8			
1/3/2012	9.2	5.509	3.17	100	5	114	3	4,595	230	5,238	138						
1/4/2012	10.3	5.429	0.02														
1/5/2012	10	5.39	3.23														
1/6/2012	9.4	5.177	3														
1/7/2012	7.8	5.11	2.97														
1/8/2012	9.1	5.143	2.76														
1/9/2012	8.7	5.135	2.67	146	5	334	6	6,253	214	14,304	257						
1/10/2012	9.4	5.067	2.67	136	6	184	6	5,747	254	7,776	254						
1/11/2012	12	5.83	0.02														
1/12/2012	10.5	6.652	3.07														
1/13/2012	9.8	5.825	2.84														
1/14/2012	9.3	5.484	2.85														
1/15/2012	9	5.293	2.75														
1/16/2012	10	5.38	2.87														
1/17/2012	9.5	5.759	2.95														
1/18/2012	10.2	5.299	0.03	72	7	28	2	3,182	309	1,237	88						
1/19/2012	9.4	5.228	2.89	128	7	190	3	5,581	305	8,284	131						
1/20/2012	8.6	5.092	0.1														
1/21/2012	9.8	4.977	2.34														

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1/22/2012	9.3	5.087	2.28														
1/23/2012	11.5	6.295	3.22	60	7	29	2	3,150	368	1,523	105						
1/24/2012	9	6.013	3.25	110	7	125	2	5,516	351	6,269	100						
1/25/2012	9.5	5.521	0.03														
1/26/2012	12	7.619	4.49														
1/27/2012	10.8	8.631	4.37														
1/28/2012	9.8	7.232	3.33														
1/29/2012	9.5	6.736	3.21														
1/30/2012	9.6	6.297	3.27														
1/31/2012	9.3	6.69	3.81														
2/1/2012	11.6	5.856	0.03	64	9	32	8	3,126	440	1,563	391			11			
2/2/2012	8.1	5.733	3.65	60	8	47	5	2,869	383	2,247	239						
2/3/2012	7.8	5.6	3.71														
2/4/2012	8.2	5.415	3.62														
2/5/2012	7.8	5.372	3.45														
2/6/2012	7.8	5.322	3.45	66	8	38	2	2,929	355	1,687	89						
2/7/2012	8.2	5.17	2.31	73	6	33	1	3,148	259	1,423	43						
2/8/2012	9.5	5.075	0														
2/9/2012	9	4.988	2.38														
2/10/2012	7.5	4.922	2.23														
2/11/2012	8.4	4.913	2.25														
2/12/2012	9.1	4.909	2.21														
2/13/2012	9.3	4.782	2.25	68	9	42	4	2,712	359	1,675	160						
2/14/2012	8.8	4.748	2.16	82	9	68	4	3,247	356	2,693	158						
2/15/2012	9.4	4.658	0.03														
2/16/2012	8.8	5.059	2.35														
2/17/2012	5.3	4.739	4.82														
2/18/2012	8.7	4.552	2.17														
2/19/2012	9.8	4.6	0.48														
2/20/2012	9	4.654	2.83														
2/21/2012	9.1	4.556	2.83	96	10	47	2	3,648	380	1,786	76						
2/22/2012	10.1	4.582	0.03	89	8	29	2	3,401	306	1,108	76						
2/23/2012	8.5	4.496	2.64														
2/24/2012	9.8	5.596	2.79														
2/25/2012	9.6	4.816	2.81														
2/26/2012	9.4	4.729	2.77														
2/27/2012	9.1	4.647	2.79	66	6	50	3	2,558	233	1,938	116						
2/28/2012	9.3	4.601	2.86	84	8	34	2	3,223	307	1,305	77						
2/29/2012	10.4	5.457	0.03														
3/1/2012	9.5	6.052	2.91														
3/2/2012	9	6.316	3.67														
3/3/2012	9.6	6.784	3.75														
3/4/2012	9.3	6.222	3.77														
3/5/2012	8.7	5.93	3.56	55	6	31	2	2,720	297	1,533	99			19			

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
3/6/2012	10	5.68	2.95	66	5	34	2	3,126	237	1,611	95						
3/7/2012	10.1	5.528	0														
3/8/2012	10.2	5.378	0														
3/9/2012	9.4	5.21	0														
3/10/2012	7.8	4.946	3.09														
3/11/2012	10	5.125	2.98														
3/12/2012	9.8	5.112	3.01	70	8	40	2	2,984	341	1,705	85						
3/13/2012	7.4	5.039	2.95	64	8	25	2	2,690	336	1,051	84						
3/14/2012	10	4.942	0.03														
3/15/2012	6.7	4.898	2.82														
3/16/2012	9.2	4.857	2.83														
3/17/2012	9	4.735	2.67														
3/18/2012	9.3	4.863	2.57														
3/19/2012	9.2	4.963	2.56	146	16	168	3	6,043	662	6,954	124						
3/20/2012	9.6	4.639	0.08	129	8	196	6	4,991	310	7,583	232						
3/21/2012	9.8	4.713	0.01														
3/22/2012	9.3	4.531	2.37														
3/23/2012	7.7	4.427	2.2														
3/24/2012	9.4	4.429	2.27														
3/25/2012	8.9	4.472	2.23														
3/26/2012	8.2	4.51	2.14	154	9	222	4	5,792	339	8,350	150						
3/27/2012	8.6	4.345	2.16	157	7	220	3	5,689	254	7,972	109						
3/28/2012	9.4	4.323	0.03														
3/29/2012	9	3.971	0.77														
3/30/2012	9.4	5.092	2.32														
3/31/2012	8.6	4.843	2.23														
4/1/2012	9.2	4.865	2.11														
4/2/2012	8.3	4.542	4.62	112	8	148	4	4,243	303	5,606	152						
4/3/2012	9	4.156	1.74	122	104	144	66	4,229	3,605	4,991	2,288			21			
4/4/2012	10.4	4.172	0.1														
4/5/2012	6	4.159	2.33														
4/6/2012	6	3.967	2.34														
4/7/2012	6.1	4.008	2.34														
4/8/2012	6.1	3.956	2.29														
4/9/2012	6.1	4.07	2.16	168	9	188	2	5,703	305	6,381	68						
4/10/2012	6.1	3.992	2.24	168	8	254	3	5,593	266	8,456	100						
4/11/2012	10.1	3.889	0.03														
4/12/2012	6	3.903	2.11														
4/13/2012	6.2	3.873	2.19														
4/14/2012	6.1	3.787	2.12														
4/15/2012	9.6	3.929	2.07														
4/16/2012	6.3	3.964	2.19	136	9	192	9	4,496	298	6,347	298						
4/17/2012	6	3.885	2.08	155	14	200	7	5,022	454	6,480	227						
4/18/2012	9.3	3.799	0.03														

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4/19/2012	5.9	3.733	1.98														
4/20/2012	5.9	3.689	1.91														
4/21/2012	11.7	4.99	1.88														
4/22/2012	11.5	6.581	3.19														
4/23/2012	9.7	5.415	2.78	115	8	110	4	5,194	361	4,968	181						
4/24/2012	9.1	4.829	2.8	138	6	112	4	5,558	242	4,511	161						
4/25/2012	10.2	4.614	0.01														
4/26/2012	9.6	4.538	0.02														
4/27/2012	9.1	4.36	2.48														
4/28/2012	9.2	4.277	2.51														
4/29/2012	9.7	4.306	2.34														
4/30/2012	9.8	4.382	2.4														
5/1/2012	7.4	4.44	2.47														
5/2/2012	10	4.454	0.03	104	8	188	6	3,863	297	6,984	223						
5/3/2012	10	4.505	0.68	108	8	138	6	4,058	301	5,185	225	19					
5/4/2012	6.5	4.221	2.44														
5/5/2012	6.1	4.182	2.38														
5/6/2012	6.2	4.234	2.41														
5/7/2012	6	4.277	2.41														
5/8/2012	9.5	5.887	2.8														
5/9/2012	10.2	5.052	0.03	96	5	146	8	4,045	211	6,152	337						
5/10/2012	9.8	4.784	2.75	104	5	120	6	4,149	199	4,788	239						
5/11/2012	6.9	4.343	2.66														
5/12/2012	10.3	4.308	2.58														
5/13/2012	9.7	4.342	2.51														
5/14/2012	9.9	6.075	3.81														
5/15/2012	9.4	5.844	2.37														
5/16/2012	9.7	5.258	0.03	87	5	154	4	3,815	219	6,753	175						
5/17/2012	9.5	4.66	1.52	98	4	144	3	3,809	155	5,596	117						
5/18/2012	7.1	4.58	2.32														
5/19/2012	9.5	4.469	2.35														
5/20/2012	8.8	4.477	2.31														
5/21/2012	11.9	6.558	0.6	138	5	208	4	7,548	273	11,376	219						
5/22/2012	9.4	6.039	2.98	64	4	83	4	3,223	201	4,180	201						
5/23/2012	10.2	5.271	0.02														
5/24/2012	7.3	4.994	2.98														
5/25/2012	9.7	4.807	2.83														
5/26/2012	9.4	4.576	2.75														
5/27/2012	9.6	5.395	2.63														
5/28/2012	10	5.286	0.9	113	10	158	15	4,982	441	6,965	661						
5/29/2012	11.3	5.223	2.79	106	11	176	14	4,617	479	7,667	610						
5/30/2012	10.1	4.881	0.02														
5/31/2012	9.4	4.377	0.02														
6/1/2012	11.6	5.508	2.83														

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6/2/2012	10.5	5.342	2.85														
6/3/2012	10.1	4.927	2.79														
6/4/2012	9	4.74	2.83	78	9	106	17	3,083	356	4,190	672	19	10	9.4	2313	751	395
6/5/2012	9.8	4.622	2.73	122	12	164	4	4,703	463	6,322	154	18	11		2602	694	424
6/6/2012	10	4.569	0.01														
6/7/2012	0.8	4.835	2.38														
6/8/2012	10	4.465	2.39														
6/9/2012	9.6	4.235	2.25														
6/10/2012	9.3	4.338	2.47														
6/11/2012	9.5	4.236	0.75	133	10	180	19	4,699	353	6,359	671	18	5.6		1420	636	198
6/12/2012	12.2	6.493	3.17	115	8	200	12					20	4.2		1023	1,083	227
6/13/2012	13.2	5.157	0.02														
6/14/2012	9.2	4.712	2.89														
6/15/2012	9.2	4.431	2.72														
6/16/2012	10	4.305	2.58														
6/17/2012	9.1	4.384	2.56														
6/18/2012	9.2	4.348	2.64	120	5	162	5	4,351	181	5,874	181	21	8.3		1626	762	301
6/19/2012	9.7	4.298	2.52	136	6	150	10	4,875	215	5,377	358	22	2		645	789	72
6/20/2012	9.6	4.063	2.38														
6/21/2012	9.2	4.05	2.4														
6/22/2012	13	6.551	0.02														
6/23/2012	8	5.253	0.02														
6/24/2012	9.7	5.48	2.84														
6/25/2012	11.8	5.001	2.85	114	4	148	3	4,755	167	6,173	125	16	6		1376	667	250
6/26/2012	10.1	4.951	2.76	112	4	112	3	4,625	165	4,625	124	18	5		1177	743	206
6/27/2012	7.2	4.851	2.69														
6/28/2012	9.9	4.598	2.66														
6/29/2012	9.7	4.433	2.49														
6/30/2012	9.4	4.168	2.34														
7/1/2012	8.7	4.163	2.29														
7/2/2012	8.2	4.098	0.56														
7/3/2012	9.5	4.172	2.21														
7/4/2012	10.9	4.014	0.02	103	4	138	3	3,448	134	4,620	100	21	1.3		397	703	44
7/5/2012	10	3.97	0.02	138	4	160	1	4,569	132	5,298	33	21	3.1		661	695	103
7/6/2012	6	3.901	2.03														
7/7/2012	5.7	3.801	0.11														
7/8/2012	5.6	3.79	1.97														
7/9/2012	5.6	3.79	2.03	138	11	198	13	4,362	348	6,259	411	22	16		2797	695	506
7/10/2012	11.8	3.75	0.24	162	5	252	5	5,067	156	7,881	156	24	8.6		1445	751	269
7/11/2012	6	3.828	1.87														
7/12/2012	6.3	3.743	1.736														
7/13/2012	6	3.615	1.71														
7/14/2012	6	3.616	1.74														
7/15/2012	10.2	4.358	1.8														

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7/16/2012	6.3	3.894	1.9														
7/17/2012	5.7	3.791	1.75														
7/18/2012	12.6	5.188	2.15	96	11	272	7	4,154	476	11,769	303	20	15		3635	865	649
7/19/2012	9.9	4.477	2.23	138	11	222	10	5,153	411	8,289	373	21	18		3640	784	672
7/20/2012	9.9	4.987	2.25														
7/21/2012	6	3.884	2.02														
7/22/2012	11.9	4.412	2.03														
7/23/2012	9.2	5.025	2.52	81	4		1	3,395	168		42	21	3.6		930	880	151
7/24/2012	10.2	4.408	2.21	110	4		2	4,044	147		74	9.9	17		3033	364	625
7/25/2012	10.2	4.287	0.24														
7/26/2012	9.9	4.322	1.5														
7/27/2012	10.1	3.971	1.93														
7/28/2012	13.1	6.62	2.42														
7/29/2012	9.8	5.178	2.63														
7/30/2012	9.5	4.746	2.67														
7/31/2012	9.6	4.518	2.53														
8/1/2012	9.2	4.35	2.27	84	4		3	3,047	145		109	24	14	13	2503	871	508
8/2/2012	9.8	4.165	2.08	118	4		6	4,099	139		208	21	13		2240	729	452
8/3/2012	8.6	3.994	2.16														
8/4/2012	10.1	3.794	2.06														
8/5/2012	10.1	4.275	1.58														
8/6/2012	6.2	3.884	1.91	134	4		2	4,341	130		65	22	3.6		719	713	117
8/7/2012	6.2	3.682	1.56	140	7		4	4,299	215		123	20	2		599	614	61
8/8/2012	5.7	3.702	1.86														
8/9/2012	6	3.691	1.94														
8/10/2012	12.3	4.759	2.19														
8/11/2012	10.2	3.973	1.93														
8/12/2012	6.1	3.666	1.79														
8/13/2012	6.1	3.455	1.77	138	4		2	3,976	115		58	25	1.2		328	720	35
8/14/2012	9.6	3.853	1.78	177	4		2	5,688	129		64	30	1.1		352	964	35
8/15/2012	6	3.47	1.16														
8/16/2012	10.2	3.67	1.45														
8/17/2012	11.8	4.455	0.2														
8/18/2012	6.1	3.724	1.77														
8/19/2012	6.2	3.78	1.87														
8/20/2012	10	4.064	1.68	138	4		8	4,677	136		271	19	3		661	644	102
8/21/2012	6.8	3.734	1.32	171	4		6	5,325	125		187	22	4.3		789	685	134
8/22/2012	6.2	3.671	1.77														
8/23/2012	5.7	3.617	1.81														
8/24/2012	6	3.575	1.4														
8/25/2012	5.9	3.546	1.84														
8/26/2012	5.8	3.59	1.82														
8/27/2012	10.3	3.384	0.2	152	4	253	2	4,290	113	7,140	56	29	5		804	818	141
8/28/2012	7.6	3.719	1.7	127	4	184	2	3,939	124	5,707	62	22	5		884	682	155

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8/29/2012	5.8	3.449	1.62														
8/30/2012	5.8	3.48	1.5														
8/31/2012	10.2	3.364	0.02														
9/1/2012	5.6	3.312	1.67														
9/2/2012	5.5	3.281	1.5														
9/3/2012	5.9	3.448	1.65	178	4	230	5	5,119	115	6,614	144	30	2.2		457	863	63
9/4/2012	11.9	4.55	0.02	149	4	296	2	5,654	152	11,232	76	24	5.6		1184	911	213
9/5/2012	6.8	3.832	1.85														
9/6/2012	6.3	3.633	0.4														
9/7/2012	5.6	3.341	1.58														
9/8/2012	11.3	4.218	1.87														
9/9/2012	9.9	3.934	2.03														
9/10/2012	6	3.84	1.88	51	5	130	7	1,633	160	4,163	224	17	10		1681	544	320
9/11/2012	0.8	3.945	1.75	138	4	690	5	4,540	132	22,702	165	34	14		2270	1,119	461
9/12/2012	5.7	3.861	1.62														
9/13/2012	9.3	3.765	1.31														
9/14/2012	5.9	3.613	1.72														
9/15/2012	5.8	3.598	1.65														
9/16/2012	5.9	3.659	1.69														
9/17/2012	10.1	3.814	1.71														
9/18/2012	12.6	7.1	2.88	102	4	70	4	6,040	237	4,145	237	11	13		3819	651	770
9/19/2012	7.7	4.423	2.48	57	8	126	12	2,103	295	4,648	443	25	6.1		1455	922	225
9/20/2012	9.5	3.934	2.19														
9/21/2012	6.3	3.649	2.17														
9/22/2012	12.2	5.306	2.6														
9/23/2012	10.2	4.588	2.62														
9/24/2012	9.7	4.259	2.31	120	4	156	5	4,262	142	5,541	178	21	17		2930	746	604
9/25/2012	6.2	3.889	1.49	120	4	158	2	3,892	130	5,125	65	21	19		2968	681	616
9/26/2012	8.8	3.982	2.21														
9/27/2012	11.8	4.874	2.26														
9/28/2012	11.5	6.924	2.82														
9/29/2012	7.9	4.999	2.8														
9/30/2012	10.2	4.86	2.93														
10/1/2012	7	4.479	2.59	81	4	204	4	3,026	149	7,620	149	20	11	12	2073	747	411
10/2/2012	9.7	5.013	2.74									35	7.1		1336	1,463	297
10/3/2012	10.2	4.493	0.02														
10/4/2012	9.8	4.939	2.68														
10/5/2012	10	4.376	2.53														
10/6/2012	9.1	4.167	2.43														
10/7/2012	9.8	4.169	2.46														
10/8/2012	9.6	4.084	2.32	116	5	164	3	3,951	170	5,586	102	22	7.6		1420	749	259
10/9/2012	6.5	4.073	2.4	122	6	148	7	4,144	204	5,027	238	22	16		2751	747	544
10/10/2012	9.8	4.398	2.31														
10/11/2012	6.2	3.929	2.12														

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10/12/2012	6.2	3.635	2.19														
10/13/2012	6.2	3.746	2.22														
10/14/2012	6.2	3.829	2.11														
10/15/2012	10.1	4.678	2.27	162	8	246	4	6,320	312	9,598	156	22	12		2575	858	468
10/16/2012	6.2	3.909	2.21	168	6	146	6	5,477	196	4,760	196	22	16		2641	717	522
10/17/2012	6	3.782	2.13														
10/18/2012	11.5	4.219	2.12														
10/19/2012	12.8	8.379	3.61														
10/20/2012	12.3	5.63	0														
10/21/2012	9.4	5.147	2.89														
10/22/2012	9.1	5.038	2.9	130	9	150	10	5,462	378	6,303	420	18	9.6		2382	756	403
10/23/2012	9.9	5.148	2.79	112	6	138	5	4,809	258	5,925	215	17	3.7		1101	730	159
10/24/2012	10.1	4.763	2.84														
10/25/2012	9.8	4.497	2.78														
10/26/2012	9.5	4.496	2.73														
10/27/2012	10.2	4.247	2.56														
10/28/2012	9.3	4.336	2.49														
10/29/2012				188	8	192	4					24	10				
10/30/2012				121	5	112	3					17	8.5				
10/31/2012																	
11/1/2012		5.789															
11/2/2012	9.3	4.078	2.36														
11/3/2012	8.6	3.882	2.34														
11/4/2012	9.2	4.155	2.26														
11/5/2012	9.1	3.84	2.21	173	5	140	9	5,540	160	4,484	288						
11/6/2012	10.1	3.91	2.23	202	6	220	10	6,587	196	7,174	326			3			
11/7/2012	6	3.884	2.1														
11/8/2012	6.2	3.823	2.19														
11/9/2012	9	3.6675	1.9														
11/10/2012	6.2	3.669	1.72														
11/11/2012	6.1	3.665	1.8														
11/12/2012	6.1	4.364	1.6	208	5	304	6	7,570	182	11,064	218						
11/13/2012	9.9	3.845	1.66	151	8	170	5	4,842	257	5,451	160						
11/14/2012	11.9	3.846	1.8														
11/15/2012	6.2	3.76	0.69														
11/16/2012	6.2	3.675	2.05														
11/17/2012	6.1	3.675	2.04														
11/18/2012	6.1	3.833	2.1														
11/19/2012	6.2	3.871	2.09	229	8	280	2	7,393	258	9,040	65						
11/20/2012	9.3	3.787	2.02	232	10	270	2	7,327	316	8,528	63						
11/21/2012	6.2	3.792	2.08														
11/22/2012	6.1	3.658	2.02														
11/23/2012	6.2	3.617	2.04														
11/24/2012	5.9	3.552	1.85														

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
11/25/2012	5.8	3.715	2														
11/26/2012	9.2	3.594	1.75														
11/27/2012	6.1	3.737	1.83														
11/28/2012	5.9	3.616	1.83	150	5	258	2	4,524	151	7,781	60						
11/29/2012	5.8	3.594	1.96	191	5	202	1	5,725	150	6,055	30						
11/30/2012	5.8	3.399	1.86														
12/1/2012	5.9	3.412	1.89														
12/2/2012	10	3.871	1.96														
12/3/2012	6.1	3.572	1.93	166	7	184	20	4,945	209	5,481	596			18			
12/4/2012	5.9	3.6	2.1	138	5	204	2	4,143	150	6,125	60						
12/5/2012	5.9	3.483	1.88														
12/6/2012	6.1	3.484	1.91														
12/7/2012	5.8	0.883	2.36														
12/8/2012	6	3.608	2.03														
12/9/2012	8.9	4.266	2.87														
12/10/2012	10.1	4.095	2.29	227	8	254	3	7,753	273	8,675	102						
12/11/2012	6.2	3.787	2.07	180	4	216	3	5,685	126	6,822	95						
12/12/2012	6.1	3.715	2.03														
12/13/2012	6	3.705	2.03														
12/14/2012	6.2	3.606	2.05														
12/15/2012	6.1	3.564	1.98														
12/16/2012	9	4.405	2.35														
12/17/2012	11.5	6.51	2.92	164	7	268	4	8,904	380	14,551	217						
12/18/2012	9.6	5.496	2.81	117	6	218	4	5,363	275	9,992	183						
12/19/2012	8.2	4.845	2.14														
12/20/2012	13	5.69	2.7														
12/21/2012	13.3	9.125	3.26														
12/22/2012	12.2	6.65	0.1														
12/23/2012	9.6	5.865	2.79														
12/24/2012	9.5	5.346	2.88														
12/25/2012	9.6	4.939	2.86														
12/26/2012	9.7	4.989	2.87	186	8	210	4	7,739	333	8,738	166						
12/27/2012	7.9	4.953	2.93	142	8	126	3	5,866	330	5,205	124						
12/28/2012	10.2	4.755	2.85														
12/29/2012	9.9	4.603	2.55														
12/30/2012	9.5	4.641	1.09														
12/31/2012	10	4.484	2.61														
1/1/2013	9.8	4.301	2.47														
1/2/2013	9	4.291	2.35	120	12	186	18	4,294	429	6,656	644						
1/3/2013	0.2	4.207	2.49	143	10	162	2	5,017	351	5,684	70			27			
1/4/2013	9.3	4.129	2.47														
1/5/2013	9.1	4.109	2.4														
1/6/2013	9.7	4.327	2.53														
1/8/2013	10.1	4.301	2.5	181	8	214	7	6,493	287	7,676	251						

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
1/9/2013	9.6	4.297	2.57														
1/10/2013	9.7	4.332	2.54														
1/11/2013	10	4.799	2.83														
1/12/2013	9.6	5.301	2.94														
1/13/2013	9.2	6.231	3.96														
1/14/2013	18.6	5.813	6.42	116	8	176	6	5,624	388	8,533	291						
1/15/2013	9.9	4.57	2.87	112	7	164	10	4,269	267	6,251	381						
1/16/2013	10.1	4.965	2.88														
1/17/2013	9.6	5.472	2.94														
1/18/2013	9.1	4.993	2.85														
1/19/2013	9.1	4.981	2.97														
1/20/2013	9.9	4.944	3.04														
1/21/2013	9.9	4.944	2.95														
1/22/2013	9.9	4.74	2.81	147	7	222	3	5,811	277	8,776	119						
1/23/2013	10	4.571	6.08	165	7	314	4	6,290	267	11,970	152						
1/24/2013	9	4.435	2.62														
1/25/2013	9.6	4.243	2.62														
1/27/2013	9.6	4.379	2.66														
1/28/2013	9.2	4.283	2.55	228	8	230	4	8,144	286	8,216	143						
1/29/2013	7.8	4.765	2.57	184	8	174	3	7,312	318	6,915	119						
1/30/2013	12.6	6.876	2.95														
1/31/2013	9.9	6.759	3.52														
2/1/2013	9	5.472	2.8														
2/2/2013	9.3	5.119	2.81														
2/3/2013	9.5	4.98	2.8														
2/4/2013	9.7	4.802	2.86	156	17	160	18	6,248	681	6,408	721			18			
2/5/2013	7	4.625	2.78	149	13	152	6	5,747	501	5,863	231						
2/6/2013	9.3	4.544	2.66														
2/7/2013	9.7	4.451	2.73														
2/9/2013	9.6	4.332	2.52														
2/10/2013	9.3	4.34	2.47														
2/11/2013	9.8	4.846	2.76	146	16	216	37	5,901	647	8,730	1,495						
2/12/2013	9.2	4.575	2.56	172	10	184	4	6,563	382	7,021	153						
2/13/2013	9.4	4.486	2.56														
2/14/2013	9.7	4.511	2.61														
2/15/2013	9.7	4.586	2.79														
2/16/2013	9.1	4.608	2.69														
2/17/2013	9.9	4.448	2.63														
2/18/2013	10	4.414	0.1	166	7	190	6	6,111	258	6,994	221						
2/19/2013	9	4.922	2.66	156	8	192	7	6,404	328	7,882	287						
2/20/2013	9.8	4.354	2.47														
2/21/2013	9.8	4.274	2.47														
2/22/2013	9.8	4.199	2.45														
2/23/2013	9.2	4.488	2.57														

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
2/24/2013	9.1	4.642	2.66														
2/25/2013	9.3	4.644	2.72	116	6	295	4	4,493	232	11,426	155						
2/26/2013	9.7	5.494	3	140	7	302	4	6,415	321	13,838	183						
2/27/2013	11.8	8.611	4.63														
2/28/2013	8.7	7.513	2.95														
3/1/2013	9.3	6.491	3.58														
3/2/2013	9.1	6.035	3.91														
3/3/2013	9.3	5.833	2.82														
3/4/2013	8.9	5.333	2.97	156	12	172	7	6,938	534	7,650	311			16			
3/5/2013	9.5	5.412	2.86	107	10	136	5	4,830	451	6,139	226						
3/6/2013	9.8	5.199	2.9														
3/7/2013	9.8	5.226	2.84														
3/8/2013	9.8	5.425	2.84														
3/9/2013	8.1	5.022	2.9														
3/10/2013	10.1	5.152	2.95														
3/11/2013	10.1	5.154	2.91	162	8	134	4	6,963	344	5,760	172						
3/12/2013	12.4	9.003	4.69	104	6	168	4	7,809	451	12,614	300						
3/13/2013	12.4	7.823	3.22														
3/14/2013	12.4	6.863	3.22														
3/15/2013	12.4	6.293	3.2														
3/16/2013	9.2	5.817	2.84														
3/17/2013	9.7	5.602	2.9														
3/18/2013	8.8	5.531	2.9	126	7	142	3	5,812	323	6,550	138						
3/19/2013	9.7	6.31	2.84	106	6	138	4	5,578	316	7,262	211						
3/20/2013	9.3	6.09	2.94														
3/21/2013	9.6	5.745	2.8														
3/22/2013	9.7	5.543	2.92														
3/23/2013	8.9	5.382	2.94														
3/24/2013	9.6	5.413	2.89														
3/25/2013	9.6	5.431	2.89	113	8	126	5	5,118	362	5,707	226						
3/26/2013	9.7	5.265	2.89	114	9	118	6	5,006	395	5,181	263						
3/27/2013	9.4	5.096	2.87														
3/28/2013	9.4	4.888	2.84														
3/29/2013	9.3	4.68	2.8														
3/30/2013	8.8	4.583	2.77														
3/31/2013	9	4.968	2.78														
4/1/2013	9.6	4.775	2.72	142	11	106	31	5,655	438	4,221	1,235			16			
4/2/2013	9.6	4.653	2.75	150	11	116	6	5,821	427	4,501	233						
4/3/2013	9.6	4.579	2.69														
4/4/2013	9.6	4.488	2.6														
4/5/2013	7.1	4.347	2.64														
4/6/2013	9.5	4.235	2.53														
4/7/2013	9	4.379	0.25														
4/8/2013	9	4.395	2.36	157	11	166	5	5,755	403	6,085	183						

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
4/9/2013	9.4	4.88	2.36	210	4	204	4	8,547	163	8,303	163						
4/10/2013	9.3	4.807	2.29														
4/11/2013	7	4.591	2.29														
4/12/2013	11.5	5.768	2.32														
4/13/2013	9.4	4.772	2.32														
4/14/2013	9.9	4.741	0.84														
4/15/2013	9.2	4.592	0.84	124	6	122	4	4,749	230	4,672	153						
4/16/2013	10	4.625	0.84	179	5	158	3	6,904	193	6,094	116						
4/17/2013	6.7	4.504	2.7														
4/18/2013	9.5	4.364	2.6														
4/19/2013	11.6	6.162	2.6														
4/20/2013	7.6	5.068	2.84														
4/21/2013	9.9	4.915	2.88														
4/22/2013	9.9	4.843	2.91	116	8	144	3	4,685	323	5,816	121						
4/23/2013	9.7	4.863	2.89	130	9	140	4	5,272	365	5,678	162						
4/24/2013	9.7	4.821	2.76														
4/25/2013	9.2	8.688	2.75														
4/26/2013	6.9	4.468	2.69														
4/27/2013	10.1	2.202	0.1														
4/28/2013	8.9	4.307	2.21														
4/29/2013	8.9	4.366	2.21														
4/30/2013	9.2	4.238	2.23														
5/1/2013	8.3	4.27	2.36	144	7	254	5	5,128	249	9,045	178			20			
5/2/2013	9.3	4.199	2.4	148	7	172	3	5,183	245	6,023	105						
5/3/2013	9.3	3.981	2.44														
5/4/2013	9.9	4.006	0.91														
5/5/2013	6.2	4.105	2.35														
5/6/2013	9.4	4.155	2.2	159	7	188	4	5,510	243	6,515	139						
5/7/2013	9.5	3.87	2.2	156	10	166	8	5,035	323	5,358	258						
5/8/2013	9.9	4.555	2.2														
5/9/2013	10	3.966	2.06														
5/10/2013	10	3.756	2.06														
5/11/2013	5.7	4.361	2.73														
5/12/2013	9	3.884	2.22														
5/13/2013	9	3.884	2.13	158	7	206	4	5,118	227	6,673	130						
5/14/2013	9.2	3.868	2.16	207	7	178	5	6,678	226	5,742	161						
5/15/2013	9.2	3.888	2.1														
5/16/2013	6.1	3.854	2.18														
5/17/2013	6.1	3.701	2.1														
5/18/2013	6	3.627	0.43														
5/19/2013	9.3	3.94	1.98														
5/20/2013	9.3	3.726	1.93	220	4	218	2	6,836	124	6,774	62						
5/21/2013	9.3	3.721	1.93	194	6	196	4	6,020	186	6,082	124						
5/22/2013	5.7	3.699	1.98														

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5/23/2013	9.6	5.09	0.02														
5/24/2013	9.6	5.059	2.42														
5/25/2013	7.4	4.95	2.3														
5/26/2013	6.1	3.723	2.17														
5/27/2013	6	3.805	2.11	253	10	164	10	8,029	317	5,204	317						
5/28/2013	6.1	3.996	2.11	257	10	182	9	8,565	333	6,065	300						
5/29/2013	11.5	4.51	5.53														
5/30/2013	11.5	3.811	2.07														
5/31/2013	5.9	3.728	2.07														
6/1/2013	6.4	3.659	0.36														
6/2/2013	11.9	4.71	2.18														
6/3/2013	11.9	3.955	2.16	143	10	220	15	4,717	330	7,257	495	26	11	10	2128	858	363
6/4/2013	11.9	3.773	2.08	184	13	220	25	5,790	409	6,923	787	26	11		2171	818	346
6/5/2013	6.1	3.671	2.05														
6/6/2013	11.6	4.262	2.05														
6/7/2013	11.1	8.64	3.21														
6/8/2013	9.7	5.324	2.68														
6/9/2013	8.8	4.705	2.79														
6/10/2013	13	9.639	2.79	96	11	246	14	7,717	884	19,776	1,125	15	9.7		4835	1,206	780
6/11/2013	13	8.47	3.53	101	8	172	12	7,135	565	12,150	848	12	5.7		2660	848	403
6/12/2013	9.4	6.772	3.65														
6/13/2013	12.8	11.374	0.02														
6/14/2013	12.8	10.068	5.39														
6/15/2013	10	8.168	3.91														
6/16/2013	10.1	7.349	3.08														
6/17/2013	10.1	6.852	3.08	102	6	154	2	5,829	343	8,800	114	15	9.3		2906	857	531
6/18/2013	9.2	6.451	3.84	106	6	148	1	5,703	323	7,963	54	16	11		3147	861	592
6/19/2013	9.5	5.926	2.99														
6/20/2013	10	5.488	2.95														
6/21/2013	8.8	5.098	2.83														
6/22/2013	7	4.795	0.02														
6/23/2013	9.6	4.69	2.77														
6/24/2013	12.5	5.459		151	13	222	16	6,875	592	10,107	728	19	3.9		1687	865	178
6/25/2013	8.9	4.634	2.68	129	9	132	10	4,986	348	5,101	386	18	11		2435	696	425
6/26/2013	8.7	4.497	2.7														
6/27/2013	12	6.139	2.95														
6/28/2013	9.4	5.504	2.63														
6/29/2013	7.5	4.816	2.45														
6/30/2013	12.7	7.891	0.02														
7/1/2013	12.9	10.258	3.58	44	5		25	3,764	428		2,139	9.4	5.5	5.1	2759	804	471
7/2/2013	9.6	5.925	3.58	98	4		7	4,843	198		346	16	3.6		1097	791	178
7/3/2013	9	4.955	2.44														
7/4/2013	9.5	4.749	2.45														
7/5/2013	9	4.255	2.24														

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
7/6/2013	6	3.922	2.23														
7/7/2013	6	3.776	0.33														
7/8/2013	12	5.241	1.24	177	4		3	7,737	175		131	22	2.4		734	962	105
7/9/2013	9.3	4.118	2.12	83	4		1	2,851	137		34	16	1		361	550	34
7/10/2013	11.6	4.777	2.46														
7/11/2013	5.9	3.963	2.14														
7/12/2013	6.1	3.711	1.55														
7/13/2013	6	3.421	1.74														
7/14/2013	5.6	3.317	1.76														
7/15/2013	5.5	3.434	1.75	196	4		2	5,613	115		57	28	1.1		314	802	32
7/16/2013	9.5	4.642	2.65	138	4		3	5,343	155		116	20	1		406	774	39
7/17/2013	9.8	4.58	2.61														
7/18/2013	8.9	4.537	2.68														
7/19/2013	6.5	4.338	2.38														
7/20/2013	9.2	4.382	2.56														
7/21/2013	9.7	4.274	2.26														
7/22/2013	11.8	5.659	2.75	187	4		4	8,826	189		189	23	1.4		581	1,086	66
7/23/2013	11.9	6.219	2.55	75	4		3	3,890	207		156	12	1.5		661	622	78
7/24/2013	9.7	4.999	2.92														
7/25/2013	7.4	4.513	2.48														
7/26/2013	9.1	4.378	2.55														
7/27/2013	9.1	4.191	2.46														
7/28/2013	9.9	5.18	2.52														
7/29/2013	7.1	4.344	2.5														
7/30/2013	9.1	4.254	2.55														
7/31/2013	8.9	4.192	2.45														
8/1/2013	9.7	5.434	2.76														
8/2/2013	9.5	4.197	2.5														
8/3/2013	6.1	4.036	2.48														
8/4/2013	10.1	3.627															
8/5/2013	9.4	3.99	0.01	122	7	150	12	4,060	233	4,991	399	17	1.4	1	559	566	47
8/6/2013	9.4	3.913	2.19	160	6	180	9	5,222	196	5,874	294	19	2		587	620	65
8/7/2013	6.2	4.008															
8/8/2013	11.9	4.975	2.43														
8/9/2013	12.5	8.131	4.1														
8/10/2013	9.3	5.877	2.81														
8/11/2013	10.2	5.409	2.99														
8/12/2013	9.8	4.995	2.96	94	5	80	11	3,916	208	3,333	458	21	2.6		800	875	108
8/13/2013	11.9	6.535	2.89	188	4	424	1	10,246	218	23,109	55	18	5.8		1750	981	316
8/14/2013	9.5	5.287	2.95														
8/15/2013	8.8	4.806	2.88														
8/16/2013	7.2	4.717	2.91														
8/17/2013	9.3	4.472	2.61														
8/18/2013	9.3	4.412	2.52														

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
8/19/2013	9.8	4.419	2.32	176	4	340	2	6,486	147	12,531	74	22	5.1		1067	811	188
8/20/2013	8.5	4.22	2.33	205	4	422	5	7,215	141	14,852	176	26	4.7		956	915	165
8/21/2013	8.7	4.133	2.26														
8/22/2013	8.9	4.278	0.89														
8/23/2013	6.1	3.954	2.24														
8/24/2013	18.1	3.407	0.1														
8/25/2013	6	3.847	2.21														
8/26/2013	12.8	6.544	3.54	151	4	154	3	8,241	218	8,405	164	17	5.6		1703	928	306
8/27/2013	9.7	5.84	2.52	106	4	270	5	5,163	195	13,151	244	14	1		511	682	49
8/28/2013	9.2	4.891	2.51														
8/29/2013	7.6	4.507	2.54														
8/30/2013	8.7	4.349	2.39														
8/31/2013	8.9	4.335	2.34														
9/1/2013	11.5	4.538	2.34														
9/2/2013	11.6	7.48	3.18	99	6	262	5	6,176	374	16,344	312	14	1.4	1	954	873	87
9/3/2013	9.1	5.733	2.54	82	4	118	1	3,921	191	5,642	48	15	3.6		1061	717	172
9/4/2013	8.9	5.309	2.37														
9/5/2013	9	5.064	2.51														
9/6/2013	9	4.806	2.47														
9/7/2013	9.1	4.6	2.42														
9/8/2013	9.2	4.525	2.41														
9/9/2013	9.3	4.305	2.41	187	5	168	2	6,714	180	6,032	72	20	1.6		528	718	57
9/10/2013	7.9	4.457	2.3	188	4	172	1	6,988	149	6,393	37	19	3.2		758	706	119
9/11/2013	8.5	4.165	2.39														
9/12/2013	11.9	6.334	2.33														
9/13/2013	7.8	4.946	2.45														
9/14/2013	8.9	4.831	2.5														
9/15/2013	9.6	4.716	2.35														
9/16/2013	6.9	4.398	2.47	157	5	164	4	5,759	183	6,015	147	20	5.8		1232	734	213
9/17/2013	9.4	4.301	2.41	156	4	172	5	5,596	143	6,170	179	19	1		377	682	36
9/18/2013	9.1	4.203	2.39														
9/19/2013	6.3	4.065	2.3														
9/20/2013	8.8	3.967	2.43														
9/21/2013	11.9	5.217	2.15														
9/22/2013	9.5	4.434	2.46														
9/23/2013	6.7	4.173	2.26	166	7	170	8	5,777	244	5,916	278	21	4.2		1023	731	146
9/24/2013	9.1	4.062	2.32	170	7	190	8	5,759	237	6,437	271	23	3.6		905	779	122
9/25/2013	6.1	3.931	2.17														
9/26/2013	6.1	3.88	2.15														
9/27/2013	9.2	3.772	2.13														
9/28/2013	5.9	3.724	2.16														
9/29/2013	8.8	3.824	2.03														
9/30/2013	6	3.817	2.14														
10/1/2013	6.6	3.737	2.03														

Kingston WWTP
DMR Data

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
10/2/2013	5.6	3.686	2.03	188	4	266	7	5,779	123	8,177	215	29	1.8		433	891	55
10/3/2013	6	3.662	2.01	149	4	202	3	4,551	122	6,169	92	22	4.6		815	672	140
10/4/2013	8.7	3.883	2.09														
10/5/2013	9.7	4.087	2.33														
10/6/2013	11.9	5.23	2.51														
10/7/2013	12	5.445	0.6	116	4	186	3	5,268	182	8,447	136	15	7.9		1887	681	359
10/8/2013	9.9	4.242	2.58	144	4	112	6	5,094	142	3,962	212	18	5.7		1120	637	202
10/9/2013	6.5	4.115	2.46											8			
10/10/2013	6.5	4.258	2.52											13			
10/11/2013	6.2	3.966	2.37														
10/12/2013	9.8	3.914	2.28														
10/13/2013	6.3	3.873	2.21														
10/14/2013	6.3	3.921	2.2	188	6	222	12	6,148	196	7,260	392	25	1.5		515	818	49
10/15/2013	9.1	3.838	2.13	206	4	220	2	6,594	128	7,042	64	24	4.4		826	768	141
10/16/2013	6.3	3.887	2.19														
10/17/2013	6.2	3.866	2.19														
10/18/2013	6.2	3.564	2.03														
10/19/2013	6.1	3.612	2.06														
10/20/2013	6.2	3.626	1.89														
10/21/2013	10.9	3.626	1.94	160	7	178	28	4,839	212	5,383	847	31	6.2		1161	937	187
10/22/2013	6.2	3.641	2.01	195	8	206	17	5,921	243	6,255	516	29	5.9		1171	881	179
10/23/2013	6.1	3.567	1.91														
10/24/2013	6	3.56	1.85														
10/25/2013	8.8	3.477	1.99														
10/26/2013	5.8	3.498	1.97														
10/27/2013	6.2	3.554	1.91														
10/28/2013	5.7	3.505	1.87														
10/29/2013	5.8	3.471	1.82	168	11	204	21	4,863	318	5,905	608						
10/30/2013	5.9	3.49	1.83	202	11	216	32	5,880	320	6,287	931						
10/31/2013	10.1	4.45	2.85														
11/1/2013	10.2	4.161	2.11														
11/2/2013	9	3.759	2.03														
11/3/2013	6	3.651	2.01														
11/4/2013	8.9	3.602	2.03	196	5	196	3	5,888	150	5,888	90						
11/5/2013	6.1	3.559	1.97	176	5	176	9	5,224	148	5,224	267			5.9			
11/6/2013	9.1	3.696	1.91														
11/7/2013	8.1	3.932	1.91														
11/8/2013	6.1	3.489	2.01														
11/9/2013	6.1	3.443	1.79														
11/10/2013	6	3.537	1.97														
11/11/2013	5.9	3.556	1.91	208	4	194	2	6,169	119	5,753	59						
11/12/2013	10.2	3.52	0.02	200	6	194	4	5,871	176	5,695	117						
11/13/2013	6.1	3.508	1.9														
11/14/2013	6	3.447	1.91														

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11/15/2013	5.9	3.278	1.83														
11/16/2013	5.7	3.363	1.69														
11/17/2013	10	4.121	2.09														
11/18/2013	6.1	3.542	1.88	311	7	322	6	9,187	207	9,512	177						
11/19/2013	5.8	3.439	1.84	257	5	188	3	7,371	143	5,392	86						
11/20/2013	6	3.432	1.81														
11/21/2013	10.1	3.619	0.28														
11/22/2013	7.1	3.545	2														
11/23/2013	5.5	3.415	1.87														
11/24/2013	5.9	3.587	1.86														
11/25/2013	5.9	3.499	1.92	175	8	152	2	5,107	233	4,436	58						
11/26/2013	13.2	7.632	3.34	210	10	210	12	13,367	637	13,367	764						
11/27/2013	10.6	3.931	3.67														
11/28/2013	10.6	4.994	2.8														
11/29/2013	7.3	4.571	2.86														
11/30/2013	6.8	4.322	2.73														
12/1/2013	7.2	4.357	2.61														
12/2/2013	7.1	4.256	2.46	74	9	92	4	2,627	319	3,266	142						
12/3/2013	8.8	4.212	0.59	145	8	142	4	5,094	281	4,988	141			18			
12/4/2013	9.5	4.083	0.01														
12/5/2013	10	5.246	2.49														
12/6/2013	7.5	5.245	2.5														
12/7/2013	7.8	4.858	3.07														
12/8/2013	7.3	4.685	2.91														
12/9/2013	7.4	5.025	2.96	152	10	138	1	6,370	419	5,783	42						
12/10/2013	7.8	4.748	0.44	158	8	144	4	6,257	317	5,702	158						
12/11/2013	7	4.499	2.55														
12/12/2013	7	4.373	2.56														
12/13/2013	6.7	4.228	2.57														
12/14/2013	6.5	4.041	2.54														
12/15/2013	7.1	4.294	2.48														
12/16/2013	6.7	4.217	2.38	168	7	174	2	5,909	246	6,120	70						
12/17/2013	6.4	4.264	2.56	178	9	148	2	6,330	320	5,263	71						
12/18/2013	6.5	4.207	2.44														
12/19/2013	6.5	4.29	2.19														
12/20/2013	6.7	4.477	2.93														
12/21/2013	8.8	6.42	4.34														
12/22/2013	13.1	7.591	4.34														
12/23/2013	13	8.45	0.02														
12/24/2013	9.3	6.552	4.05														
12/25/2013	8.4	5.697	3.61	88	6	108	3	4,181	285	5,131	143						
12/26/2013	8.9	5.617	3.34	109	6	120	2	5,106	281	5,621	94						
12/27/2013	12.3	5.303	2.64														
12/28/2013	9.2	5.036	2.6														

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12/29/2013	12.8	8.058	2.6														
12/30/2013	9.3	6.532	3.62														
12/31/2013	8.3	5.873	3.63														
1/1/2014	9.4	5.326	2.55	94	11	127	10	4,175	489	5,641	444			11			
1/2/2014	8.1	5.244	2.64	117	8	135	4	5,117	350	5,904	175						
1/3/2014	9.3	5.102	2.64														
1/4/2014	9.9	5.003	2.6														
1/5/2014	13	6.976	3.82														
1/6/2014	12.9	8.872	3.43	83	7	240	6	6,141	518	17,758	444						
1/7/2014	9.5	6.757	3.74	141	5	114	3	7,946	282	6,424	169						
1/8/2014	8.4	6.074	3.61														
1/9/2014	7.9	5.662	3.52														
1/10/2014	12.4	6.622	3.74														
1/11/2014	12.9	8.662	3.79														
1/12/2014	9.9	7.791	3.27														
1/13/2014	9.4	7.045	3.45	82	8	106	4	4,818	470	6,228	235						
1/14/2014	11.8	8.483	3.05	179	7	106	2	12,664	495	7,499	141						
1/15/2014	9.2	7.076	3.35														
1/16/2014	9.2	6.703	3.59														
1/17/2014	8.8	6.249	3.58														
1/18/2014	8.4	6.047	3.7														
1/19/2014	8.2	5.819	3.63														
1/20/2014	8.8	5.647	2.56	141	11	122	2	6,641	518	5,746	94						
1/21/2014	17.2	5.376	0	134	10	108	5	6,008	448	4,842	224						
1/22/2014	12.4	5.165	0														
1/23/2014	9.1	5.052	2.56														
1/24/2014	7.1	4.835	2.45														
1/25/2014	9.3	4.8	2.46														
1/26/2014	8.6	4.799	2.42														
1/27/2014	8.7	4.798	2.57	140	14	167	9	5,602	560	6,683	360						
1/28/2014	7.2	4.602	2.81	145	13	162	6	5,565	499	6,218	230						
1/29/2014	6.8	4.517	2.77														
1/30/2014	9.6	4.48	0.24														
1/31/2014	7.1	4.375	2.49														
2/1/2014	9.6	4.284	2.38														
2/2/2014	9.4	4.5	0.5														
2/3/2014	9.4	4.404	2.33	160	16	166	12	5,877	588	6,097	441			20			
2/4/2014	8.7	4.392	2.48	163	11	147	6	5,971	403	5,385	220						
2/5/2014	8.8	4.252	2.48														
2/6/2014	8.7	4.383	2.49														
2/7/2014	9	4.243	2.49														
2/8/2014	8.7	4.194	2.46														
2/9/2014	8.4	4.283	2.42														
2/10/2014	8.7	4.151	2.32	144	12	356	10	4,985	415	12,324	346						

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2/11/2014	6.4	4.054	2.35	158	10	168	6	5,342	338	5,680	203						
2/12/2014	5.7	3.972	2.4														
2/13/2014	5.7	3.929	2.35														
2/14/2014	8.6	4.029	2.39														
2/15/2014	6.2	4.024	2.28														
2/16/2014	8.9	3.986	2.39														
2/17/2014	8.5	4.027	2.31	192	13	173	5	6,448	437	5,810	168						
2/18/2014	8.4	4.099	2.4	175	10	152	3	5,982	342	5,196	103						
2/19/2014	8.7	4.039	2.38														
2/20/2014	9	5.031	2.66														
2/21/2014	11.4	6.237	2.66														
2/22/2014	11.4	6.631	3.48														
2/23/2014	8.5	5.915	2.61														
2/24/2014	8.8	5.357	2.52	134	9	131	4	5,987	402	5,853	179						
2/25/2014	8.9	4.778	3.17	146	6	120	3	5,818	239	4,782	120						
2/26/2014	9.2	4.922	2.53														
2/27/2014	9.1	4.614	2.5														
2/28/2014	6.9	4.52	2.61														
3/1/2014	8.6	4.454	2.56														
3/2/2014	9.3	4.564	2.57														
3/3/2014	7	4.505	2.45	183	4	160	3	6,876	150	6,011	113			19			
3/4/2014	8.9	4.456	2.54	226	4	134	2	8,399	149	4,980	74						
3/5/2014	9.5	4.343	2.49														
3/6/2014	7.1	4.244	2.49														
3/7/2014	8.7	4.215	2.5														
3/8/2014	8.9	4.152	2.39														
3/9/2014	9.1	4.409	2.4														
3/10/2014	8.1	4.816	2.44	143	11	154	2	5,744	442	6,185	80						
3/11/2014	11.3	6.792	3.37	133	10	190	3	7,534	566	10,763	170						
3/12/2014	12.2	8.224	3.31														
3/13/2014	9.2	6.648	3.62														
3/14/2014	8.3	5.976	3.86														
3/15/2014	9.1	6.744	4.18														
3/16/2014	9.3	6.553	4.09														
3/17/2014	8.4	6.187	3.91	82	9	133	5	4,231	464	6,863	258						
3/18/2014	8.4	5.917	3.73	98	9	119	6	4,836	444	5,872	296						
3/19/2014	12.3	7.456	3.73														
3/20/2014	10.3	8.592	3.33														
3/21/2014	9.8	8.02	3.57														
3/22/2014	9.5	7.799	3.59														
3/23/2014	9.7	7.286	3.9														
3/24/2014	10.3	8.592	3.33	89	8	138	8	6,377	573	9,889	573						
3/25/2014	9.2	6.553	3.61	104	8	130	4	5,684	437	7,105	219						
3/26/2014	8.4	6.137	3.84														

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
3/27/2014	8.4	5.966	3.71														
3/28/2014	9.6	6.398	3.9														
3/29/2014	11.8	9.187	5.07														
3/30/2014	12	11.239	4.36														
3/31/2014	11.8	10.021	4.79														
4/1/2014	11.1	9.491	4.82														
4/2/2014	10.2	8.344	4.54	76	9	122	4	5,289	626	8,490	278						
4/3/2014	10.2	7.917	3.79	85	7	108	3	5,612	462	7,131	198			6.4			
4/4/2014	10.4	7.853	3.25														
4/5/2014	9.4	6.994	3.56														
4/6/2014	9.4	6.776	3.32														
4/7/2014	9.3	7.3	3.91	87	12	124	3	5,297	731	7,549	183						
4/8/2014	9.5	6.914	3.78	83	8	126	3	4,786	461	7,266	173						
4/9/2014	8.9	6.34	3.79														
4/10/2014	8.4	6.226	3.58														
4/11/2014	11.6	6.881	3.7														
4/12/2014	8.5	6.155	3.89														
4/13/2014	8.4	6.176	3.79														
4/14/2014	8.6	5.989	3.68	114	8	134	4	5,694	400	6,693	200						
4/15/2014	12	8.812	5.07	75	7	120	3	5,512	514	8,819	220						
4/16/2014	10.3	8.312	3.95														
4/17/2014	9.7	7.681	3.51														
4/18/2014	9.4	7.082	3.8														
4/19/2014	9.2	6.739	3.95														
4/20/2014	9.1	6.478	3.58														
4/21/2014	8.9	6.337	3.94	113	9	139	6	5,972	476	7,346	317						
4/22/2014	9.4	6.395	4.23	115	9	132	4	6,133	480	7,040	213						
4/23/2014	11.6	6.147	3.73														
4/24/2014	8.4	5.818	2.56														
4/25/2014	11.2	6.705	4.56														
4/26/2014	8.7	5.996	3.62														
4/27/2014	8.5	5.802	3.66														
4/28/2014	8.2	5.607	3.62														
4/29/2014	11.3	6.491	3.55														
4/30/2014	12.4	10.691	4.19														
5/1/2014	11.4	9.955	6.44	74	7	97	2	6,144	581	8,053	166			7.5			
5/2/2014	10.6	8.105	4.78	62	6	141	6	4,191	406	9,531	406						
5/3/2014	9.7	7.83	3.44														
5/4/2014	9.5	7.264	3.65														
5/5/2014	11.1	6.852	3.32														
5/6/2014	9.2	6.59	3.63														
5/7/2014	8.9	6.262	3.77														
5/8/2014	9.4	6.475	4.16														
5/9/2014	9.5	5.979	2.2														

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
5/10/2014	8.4	5.933	3.85														
5/11/2014	11.4	5.728	3.52														
5/12/2014	9.1	5.615	2.43	148	12	144	5	6,931	562	6,743	234						
5/13/2014	9.4	5.425	2.47	165	10	180	1	7,465	452	8,144	45						
5/14/2014	11.2	5.31	2.23														
5/15/2014	9.4	5.505	2.63														
5/16/2014	11.4	8.071	3.56														
5/17/2014	8.9	6.156	3.8														
5/18/2014	8.5	5.995	3.71														
5/19/2014	9.5	5.822	2.61	123	9	168	4	5,972	437	8,157	194						
5/20/2014	8.9	5.534	2.52	117	7	25	3	5,400	323	1,154	138						
5/21/2014	9.6	5.272	2.71														
5/22/2014	11.7	5.801	2.44														
5/23/2014	8.8	5.193	2.49														
5/24/2014	11	5.292	2.56														
5/25/2014	7.5	4.9	2.49														
5/26/2014	9.3	4.992	2.54	138	8	224	5	5,745	333	9,326	208						
5/27/2014	9.3	5.066	2.45	144	6	150	4	6,084	254	6,338	169						
5/28/2014	8.8	4.909	2.49														
5/29/2014	9.1	4.905	2.68														
5/30/2014	9.2	4.579	2.29														
5/31/2014	8.6	4.51	2.6														
6/1/2014	8.9	4.592	2.56														
6/2/2014	9.2	4.561	2.52	38	10	206	8	1,445	380	7,836	304	16	19	19	3823	609	723
6/3/2014	11.5	4.998	2.55	150	8	234	4	6,252	333	9,754	167	18	17		3689	750	709
6/4/2014	11.6	5.188	2.59														
6/5/2014	10.3	5.117	2.54														
6/6/2014	6.8	4.498	2.65														
6/7/2014	8.5	4.377	2.61														
6/8/2014	11.6	4.824	2.67														
6/9/2014	9.1	4.588	2.61	129	9	192	6	4,936	344	7,347	230	24	14		2927	918	536
6/10/2014	9.5	4.951	2.48	177	16	222	26	7,309	661	9,167	1,074	21	20		4707	867	826
6/11/2014	11.4	5.091	2.57														
6/12/2014	11.5	5.303	2.71														
6/13/2014	11.6	7.021	3.69														
6/14/2014	7.9	5.203	2.74														
6/15/2014	9.5	4.999	2.64														
6/16/2014	9.1	4.996	2.63	145	7	200	5	6,042	292	8,333	208	21	16		3437	875	667
6/17/2014	11.6	5.096	2.53	160	6	202	4	6,800	255	8,585	170	22	13		2869	935	553
6/18/2014	9.1	4.58	2.51														
6/19/2014	9.4	4.537	2.51														
6/20/2014	7.2	4.226	2.39														
6/21/2014	8.9	4.156	1.77														
6/22/2014	8.4	4.307	2.5														

Date	Max (mgd)	Ave (mgd)	Min (mgd)	CBOD INF (mg/L)	CBOD EFF (mg/L)	TSS INF (mg/L)	TSS EFF (mg/L)	CBOD INF (lb/day)	CBOD EFF (lb/day)	TSS INF (lb/day)	TSS EFF (lb/day)	TKN (N) Inf (mg/L)	TKN (N) Eff (mg/L)	Ammonia (NH3) Eff (mg/L)	UOD Eff (lbs)	TKN (N) Inf (lb/day	TKN (N) Eff (lb/day)
6/23/2014	9	4.187	2.43	184	14	204	8	6,425	489	7,124	279	29	13		2776	1,013	454
6/24/2014	9.5	4.233	2.34	202	16	170	11	7,131	565	6,002	388	25	12		2754	883	424
6/25/2014	12.1	5.512	2.33														
6/26/2014	9.1	4.662	2.59														
6/27/2014	7.3	4.344	2.52														
6/28/2014	8.7	5.052	2.35														
6/29/2014	9.1	4.087	2.33														
6/30/2014	9.5	4.118	2.24														
7/1/2014	8.5	4.272	2.26	112	14	92	6	3,990	499	3,278	214	24	15	14	3153	855	534
7/2/2014	12	5.238	2.52	130	11	212	2	5,679	481	9,261	87	24	12		3080	1,048	524
7/3/2014	12.9	7.336															
7/4/2014	12.7	8.977	3.52														
7/5/2014	9.3	6.375	3.08														
7/6/2014	9.4	5.808	2.72														
7/7/2014	12	5.685	2.64	124	10	170	1	5,879	474	8,060	47	18	8.7		2567	853	412
7/8/2014	11.8	5.708	0.03	134	7	178	4	6,379	333	8,474	190	18	5.9		1764	857	281
7/9/2014	8.8	5.181	2.46														
7/10/2014	8.8	4.891	2.55														
7/11/2014	8.6	4.836	2.58														
7/12/2014	7.4	4.507	2.59														
7/13/2014	13.1	8.111	3.8														
7/14/2014	11.3	9.1	4.92	40	9	148	7	3,036	683	11,232	531	15	7.8		3688	1,138	592
7/15/2014	12.9	9.267	6.46	52	4	140	5	4,019	309	10,820	386	14	5		2203	1,082	386
7/16/2014	11.1	9.161	4.78														
7/17/2014	10.5	7.785	3.47														
7/18/2014	9.4	6.81	3.52														
7/19/2014	8.5	6.269	3.38														
7/20/2014	8.4	6.011	3.98														
7/21/2014	9.1	6.059	3.69	114	10	140	7	5,761	505	7,074	354	20	13		3714	1,011	657
7/22/2014	9	5.605	2.9	110	9	122	9	5,142	421	5,703	421	25	12		3155	1,169	561
7/23/2014	11.8	6.869	3.42														
7/24/2014	9.6	5.796	0.58														
7/25/2014	8.6	5.306	2.63														
7/26/2014	9.5	5.107	2.62														
7/27/2014	11.5	5.602	2.65														
7/28/2014	5.9	5.291	5.32	96	11	138	3	4,236	485	6,090	132	20	15		3707	883	662
7/29/2014	8.8	4.917	0.42	104	9	78	5	4,265	369	3,199	205	22	16		3506	902	656
7/30/2014	8.4	4.702	2.57														
7/31/2014	9.3	4.648	0.4														

Appendix B

WWTP Capacity Calculations

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JOB	1696.002.001 (C) Kingston WWTP		
SHEET NO.	1	OF	1
CALCULATED BY	LRZ	DATE	January 13, 2015
CHECKED BY		DATE	
SUBJECT	Existing Primary Clarifier Capacity		

***Primary Clarifiers**

Existing Condition:

Tank No.	4
Tank Width (ft)	18
Tank Length (ft)	75.5
Tank Depth (ft)	11

Weir length per tank = 72 LF

***Surface Overflow Rate (SOR) - Per Ten States Standards, 2004:**

Surface overflow rate of 1000 gpd/sd at Design Average Flow

4 Tanks x 18 ft x 75.5 ft = 5436 SF $\frac{(5{,}436\ \text{SF}) \times (1{,}000\ \text{gpd/sf})}{10^6}$ = 5.44 MGD

Maximum surface overflow rate of 1,500 gpd/sd to 2,000 gpd/sf at Peak Hourly Flow

**BOD Removal efficiency decreases significantly at SOR's greater than 1,500 gpd/sf

***Use** 1750 gpd/sf

4 Tanks x 18 ft x 75.5 ft = 5436 SF $\frac{(5{,}436\ \text{SF}) \times (1{,}750\ \text{gpd/sf})}{10^6}$ = 9.51 MGD

***Weir Loading Rate (WLR) - Per Ten States Standards:**

For 1 MGD or larger facility, weir loading rate shall not exceed 30000 gpd/LF of weir

$\frac{4\ \text{Tanks} \times 72\ \text{LF weir per tank} \times 30{,}000\ \text{gpd/LF}}{10^6}$ = 8.64 MGD

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JOB	1696.002.001 (C) Kingston WWTP		
SHEET NO.	1	OF	1
CALCULATED BY	LRZ	DATE	April 4, 2015
CHECKED BY		DATE	
SUBJECT	Existing Primary Clarifier Capacity		

Additional Capacity Required:

SOR: 13.6 mgd - 9.51 mgd = 4.09 mgd

WLR: 13.6 mgd - 8.64 mgd = 4.96 mgd

***Surface Overflow Rate (SOR) - Per Ten States Standards:**

$\frac{4.09 \text{ MGD} * 10^6}{1{,}750 \text{ gpd/sf}}$ = 2,337 ft^2 additional area required

need two additional tanks at the same dimensions

***Weir Loading Rate (WLR) - Per Ten States Standards:**

$\frac{4.96 \text{ MGD} * 10^6}{30{,}000 \text{ gpd/LF}}$ = 165.3 ft additional weir length required

Additional length required for four existing tanks:

165.3 ft/4 = 41 ft per tank

Total weir length per tank if there are 6 tanks total:

72 ft x 4 tanks + 165.3 ft / 6 tanks = 76 ft total weir length per tank

(existing tanks will need an additional 4 feet of weir length

or new tanks will each need 82.5 feet of weir length)

***Design:**

2 additional clarifiers 75.5 ft long

18 wide

***Check**

SOR = $\frac{6 \text{ Tank x } 18 \text{ ft x } 75.5 \text{ ft x } 1{,}750 \text{ gpd/s}}{10^6}$ = 14.27 mgd > 13.6 mgd **OK**

WRL = $\frac{6 \text{ Tank x } 76 \text{ ft weir per tank x } 30{,}000 \text{ gpd/LF}}{10^6}$ = 13.68 > 13.6 MGD **OK**

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JOB	1696.002.001 Kingston Long Term Capital Plan		
SHEET NO.	1	OF	1
CALCULATED BY	LRZ	DATE	April 4, 2015
CHECKED BY		DATE	
SUBJECT	Aeration Tank Loading		

Aeration, Complete Mix - Existing Conditions

Tanks:	3.0	Tank Volume:	51,615	ft^3
Length:	111.0 ft	Total Volume:	154,845	ft^3
Width:	30.0 ft			
Depth:	15.5 ft			

EXISTING

Existing Plant Influent CBOD5 = 6,868 lb/day

Existing Plant Primary Removal for BOD = 48%

Aeration Tank BOD Loading = 6,868*(1-48%) = 3,571 lb/day

Calculate Organic Loading for Aeration Tanks = 3,571 lb/day/154,845 ft3 *1000 ft^3 = 23.06 lb BOD/d*1000 ft^3

Ten States Standards Recommendation for Organic Loading is 40 lb BOD/d*1000 ft^3

Existing Aeration Tanks have sufficient Capacity

FUTURE

Project Plant Influent CBOD5 = 8,758 lb/day

Estimated Plant Primary Removal for BOD = 30% Metcalf & Eddy Typical Primary Removal (25-40%)

Aeration Tank BOD Loading =BOD*(1-30%) = 6,131 lb/day

Calculate Organic Loading for Aeration Tanks = 6131 lb/day/154,845 ft3 *1000 ft^3 = 39.59 lb BOD/d*1000 ft^3

Ten States Standards Recommendation for Organic Loading is 40 lb BOD/d*1000 ft^3

Existing Aeration Tanks have sufficient Capacity

Peak Flow Contact Time (hrs)

Q = V/Θ --> Θ = V/Q

Θ = **2.04** **hrs**

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JOB	1696.002.001 Kingston WWTP		
SHEET NO.	1	OF	2
CALCULATED BY	LRZ	DATE	March 10, 2015
CHECKED BY		DATE	
SUBJECT	Existing Secondary Clarifiers		

***Existing Secondary Clarifiers**

Design Flow and Loading

***Surface Overflow Rate (SOR) - Per Ten States Standards:**

Maximum surface overflow rate of 1200 gpd/SF at Peak Hourly Flow **SOR** 1200 gpd/SF

***Weir Loading Rate (WLR) - Per Ten States Standards:**

For a plant capacity greater than 1.0 MGD, weir loading rate shall not exceed 30,000 gpd/LF of weir **WLR** 30,000 gpd/LF

***Peak Solids Loading Rate (SLR)(lb/day/ft^2)**

For conventional, step aeration, complete mix, etc., 50 lb/day/ft^2 **SLR** 50 lb/day/SF

Existing Design Flow and Loading:			**Proposed Design Flow and Loading:**		
12MRA	5.8	MGD	12MRA:	6.9	MGD
PHF:	11.3	MGD	PHF:	13.6	MGD
Design BOD:	142	lb/day	Design BOD:	152	lb/day
Design TSS:	354	lb/day	Design TSS:	336	lb/day

Dimensions:

No. of Units	4	
Width	24	ft
Length	90	ft
Depth to Cone	11	ft
Depth to bottom	11	ft
Weir Length	184	ft

each tank has 4 troughs, 2 sides each, 23 feet length each

<u>Existing Conditions:</u>

SOR:

Allowable:	10.368	MGD		
Current Loading:	11.300	MGD	Percent Utilization:	109.0%
Proposed Loading:	13.600	MGD	Percent Utilization:	131.2%

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JOB	1696.002.001 Kingston WWTP		
SHEET NO.	1	OF	2
CALCULATED BY	LRZ	DATE	March 10, 2015
CHECKED BY		DATE	
SUBJECT	Existing Secondary Clarifiers		

WLR:

Allowable:	22.080	MGD		
Current Loading:	11.300	MGD	Percent Utilization:	51.2%
Proposed Loading:	13.600	MGD	Percent Utilization:	61.6%

PEAK SLUDGE PRODUCTION

Current 12MRA Flow	5.800	MGD
Proposed 12MRA Flow	6.900	MGD
Current Max BOD In	311	mg/L
Proposed Max BOD In	311	mg/L
Avg Temp	15	C
Proposed No. Basins	4	
Site Elev	4.75	ft

Mass of Sludge Produced

$$\Delta M = \left(\frac{Y \times (BODin - BODout)}{1 + (B \times \theta^{(T-20)} \times SRT)} + Zio + Zno \right) \times \frac{Q \times 8.34}{1{,}000{,}000}$$

(Lawrence-McCarty Equation as presented in WEF MOP/8 4th Edition, pg 11-11, Eqn. 11.7)

where ΔM = Mass of Sludge Produced (lb/day/basin)
Y = Volatile cell yield (VSS/BODremoved)
θ = Arrhenius Temperature Correction Factor
B = Decay Rate, day^{-1}
Zio = Inert Sollids, mg/l
Zno = Non-volatile suspended solids, mg/l
T = Wastewater Temperature, °C

Current Mass Sludge Produced Peak	16,363	**lb/day**	**Assumed Values**		
Proposed Mass Sludge Produced Peak	19,467	**lb/day**	**Y =**	0.60	
			BOD out =	13.00	
			B =	0.07	
MLSS Under Aeration	1060	mg/L	**Θ =**	1.04	
			SRT =	2.30	
Current Total Biomass	36,299	lb	**Zio =**	46%	BOD in
Proposed Total Biomass	43,183	lb	**Zno =**	12%	BOD in

SLR:

Allowable:	50	lb/day		
Current Loading:	6.095	lb/day	Percent Utilization:	12.2%
Proposed Loading:	7.251	lb/day	Percent Utilization:	14.5%

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JOB	Kingston Long-Term Capital Plan 1696.002.001		
SHEET NO.	1	OF	1
CALCULATED BY	LRZ	DATE	April 9, 2015
CHECKED BY		DATE	
SUBJECT	UV Reactor Capacity		

UV Reactor Capacity

Existing Units: Trojan UV4000

*Two (2) channels of TROJAN high intensity UV bulb's containing 2 light lamps each with 5 racks per bank,

6 bulbs per bank, resulting in 60 lamps per channel, 120 lamps total.

*One (1) channel of Risher-Porter with 3 light banks each with 11 racks per bank, 8 lamps per bank, 264 lamps total.

*Per Ten States Standards, Min. 65% UV transmittance at 254 nm and Max. BOD effluent TSS at 30 mg/L based on PHF.

*Per existing facilities, unit is hydraulically limited to 20.4 MGD (6.8 mgd per channel, with 1 redundant channel) at PHF

Current PHF is 11.3 MGD

Proposed PHF is 13.6 MGD

Current Capacity = 11.3 MGD / 20.4 MGD = 55% utilized

Proposed Capacity = 13.6 MGD / 20.4 MGD = 67% utilized

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JOB	Kingston WWTP Facilities Plan		
SHEET NO.	1	OF	2
CALCULATED BY	LRZ	DATE	December 9, 2014
CHECKED BY		DATE	
SUBJECT	Outfall Sewer Capacity		

Outfall Sewer Capacity

Per Ten States Standards, capacity should be based on the maximum effluent flow rate

Mannings Eqn:

$$Q = \frac{1.49 \times A \times (R^{0.667}) \times (s^{0.5})}{n}$$

n = Manning's roughness coefficient (0.013 for Steel)

A = Flowing area

s = pipe slope

R = hydraulic radius

***Pipe is at maximum capacity when flow at 94% of full pipe depth;**

Reference: Hydrology & Hydraulic Systems, 2nd Edition, Gupta, 2001

TABLE 10.1 GEOMETRIC ELEMENTS FOR CIRCULAR SECTION

$\frac{y}{d_0}$	$\frac{A}{d_0^2}$	$\frac{P}{d_0}$	$\frac{R}{d_0}$	$\frac{T}{d_0}$	$\frac{D}{d_0}$	$\frac{A\sqrt{D}}{d_0^{5/2}}$	$\frac{AR^{2/3}}{d_0^{8/3}}$
0.01	0.0013	0.2003	0.0066	0.1990	0.0066	0.0001	0.0000
0.05	0.0147	0.4510	0.0326	0.4359	0.0336	0.0027	0.0015
0.10	0.0409	0.6435	0.0635	0.6000	0.0682	0.0107	0.0065
0.15	0.0739	0.7954	0.0929	0.7141	0.1034	0.0238	0.0152
0.20	0.1118	0.9273	0.1206	0.8000	0.1398	0.0418	0.0273
0.25	0.1535	1.0472	0.1466	0.8660	0.1774	0.0646	0.0427
0.30	0.1982	1.1593	0.1709	0.9165	0.2162	0.0921	0.0610
0.35	0.2450	1.2661	0.1935	0.9539	0.2568	0.1241	0.0820
0.40	0.2934	1.3694	0.2142	0.9798	0.2994	0.1603	0.1050
0.45	0.3428	1.4706	0.2331	0.9950	0.3446	0.2011	0.1298
0.50	0.3927	1.5708	0.2500	1.0000	0.3928	0.2459	0.1558
0.55	0.4426	1.6710	0.2649	0.9950	0.4448	0.2949	0.1825
0.60	0.4920	1.7722	0.2776	0.9798	0.5022	0.3438	0.2092
0.65	0.5404	1.8755	0.2881	0.9539	0.5666	0.4066	0.2358
0.70	0.5872	1.9823	0.2962	0.9165	0.6408	0.4694	0.2608
0.75	0.6318	2.0944	0.3017	0.8660	0.7296	0.5392	0.2840
0.80	0.6736	2.2143	0.3042	0.8000	0.8420	0.6177	0.3045
0.85	0.7115	2.3462	0.3033	0.7141	0.9964	0.7098	0.3212
0.90	0.7445	2.4981	0.2980	0.6000	1.2408	0.8285	0.3324
0.94[a]	0.7662	2.6467	0.2896	0.4750	1.6130	0.9725	0.3353
0.95	0.7707	2.6906	0.2864	0.4359	1.7682	1.0242	0.3349
1.00	0.7854	3.1416	0.2500	0.0000	∞	∞	0.3117

[a]Maximum flow occurs at 0.94 full depth.

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JOB	Kingston WWTP Facilities Plan		
SHEET NO.	2	OF	2
CALCULATED BY	LRZ	DATE	December 9, 2014
CHECKED BY		DATE	
SUBJECT	Outfall Sewer Capacity		

Outfall

two 20-inch diameter — L= 365 ft

For 94% full pipe, 20 inch — s= 0.0219

assume an 8 ft depth at discharge — n= 0.013

(from table on page 1) — d_o= 1.67 ft

A = 0.7662 x (d_o^2) = 2.16 ft^2

R = 0.2896 x (d_o) = 0.48 in

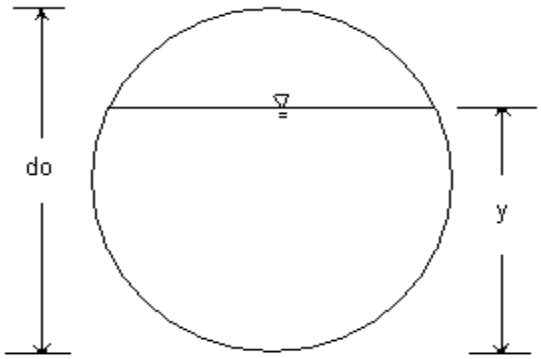

Figure 10.2 Partial full circular channel

$$Q = \frac{1.49 \times A \times (R^{0.667}) \times (s^{0.5})}{n}$$

Q = 22.5 CFS

= 14.5 MGD

Maximum Flow is 14.5 MGD under free flowing conditions

Each 20-inch outfall pipe can handle 14.5 mgd.

The lower outfall is used for normal flows and the upper outfall is used for high flows during high tide conditions.

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JOB	Kingston - Long Term Capital Plan		
SHEET NO.	1	OF	1
CALCULATED BY	LRZ	DATE	March 19, 2015
CHECKED BY		DATE	
SUBJECT	Gravity Sludge Thickener Capacity		

***Gravity Sludge Thickener**

Current Volume: Thickener is a cylindrical cone shape

V = pi x h x (R^2)+ (pi/3) x R^2 x d

= 3,346 ft^3

$A = \pi * R^2$ 314.2 ft^2

h(ft) 10

R (ft) 10

h_{cone}(ft) 1.95

CURRENT

Assume approximately 48% of influent BOD5 is wasted to thickener based on plant provided data.

Influent BOD5 = 6,868 lb/day 48% primary BOD removal

BOD5 to GST = 3,297 lb/day

Current Solids Mass Loading:

10.5 $lb/day/ft^2$

52% utilized Recommended solids mass loading is 20-30 $lb/day/ft^2$ from WEF Manual of Practice No. 8

Current Waste Sludge Loading:

Assume primary sludge is 2.0% solids:

$$\frac{3{,}297 \text{ lb per day solids}}{2.0\% \text{ solids}} = 164{,}832 \text{ lbs total weight}$$

*Assume wastewater sludge solids have specific gravity of approximately 1.65

$$\text{Sludge Specific Weight} = \left[\frac{100\%}{\frac{98\%}{1} + \frac{2.0\%}{1.65}}\right] \times 62.4 = 62.9 \text{ lb/ft}^3 \text{ or } 0.0159 \text{ ft}^3\text{/lb}$$

Volume of sludge per day = 164,850 lbs/day x 0.0159 cf/lb = 2,621 cf/day

*Capacity: (2 days *2633 cf/day) / 3346 CF = 157% utilized

FUTURE

Assume approximately 30% of influent BOD5 is wasted to thickener based on typcial primary BOD removal.

Influent BOD5 = 8,758 lb/day 30% primary BOD removal

BOD5 to GST = 2,627 lb/day

Current Solids Mass Loading:

8.4 $lb/day/ft^2$

42% utilized Recommended solids mass loading is 20-30 $lb/day/ft^2$ from WEF Manual of Practice No. 8

Current Waste Sludge Loading:

Assume primary sludge is 2.0% solids:

$$\frac{2{,}627 \text{ lb per day solids}}{2.0\% \text{ solids}} = 131{,}370 \text{ lbs total weight}$$

Volume of sludge per day = 131,370 lbs/day x 0.01597 cf/lb = 2,089 cf/day

*Capacity: (2 days * 2,089 cf/day) / 3,346 CF = 125% utilized

***Sludge Thickener should have sufficient volume to hold 2 days volume of sludge**

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JOB	1696.002.001 Kingston WWTP Long-Term Capital Plan		
SHEET NO.	1	OF	1
CALCULATED BY	LRZ	DATE	April 8, 2014
CHECKED BY		DATE	
SUBJECT	Gravity Belt Thickener		

Gravity Belt Thickener

Currently, the gravity belt thickener receives WAS from the secondary tanks.

Solids % from Secondary WAS: 0.75%

Average weight of Dry Solids: 3,479 lb/day dry solids

Average weight of Wet Solids: 463,927 lb/day wet solids

Average Volume of WAS: 2,317 gallons/hr

BDP Gravity Belt Thickener can process 450 gpm continuously:

For Existing Secondary WAS:

Hours of Operation for GBT at 450 gpm: 5.15 hrs per day

Based on operator information, they currently operate the press at 80-100 gpm for 12 hour periods.

Hours of Operation for GBT at 100 gpm: 23.17 hrs per day

In the future:

The belt press will receives anaerobically digested primary and WAS sludge.

The influent solids loading the plant is estimated to increase:

Existing Average Flow(mgd): 5.8

Projected Average Flow(mgd): 6.9

% Increase in Flow: 19%

Future estimated average Volume of WAS: 2,757 gallons/hr

BDP Gravity Belt Thickener can process 450 gpm continuously:

For Future Secondary WAS:

Hours of Operation for GBT at 450 gpm: 6.13 hrs per day

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JOB	1696.002.001 Kingston WWTP Long-Term Capital Plan		
SHEET NO.	1	OF	1
CALCULATED BY	LRZ	DATE	April 8, 2014
CHECKED BY		DATE	
SUBJECT	Belt Press Capacity		

Belt Press Operation

Currently, the belt press receives anaerobically digested primary and WAS sludge.

Solids % from Anaerobic Digesters: 4%

Average weight of Dry Solids: 3,370 lb/day dry solids

Average weight of Wet Solids 84,250 lb/day wet solids

2.5 Meter Belt Press can process 2250 to 3750 lb/hr-m (Use 2500 lb/hr-m)

For anaerobically digested primary and WAS sludge:

Hours of Operation for 2.5-Meter Press: 1.35 hrs per day

In the future:

The belt press will receives anaerobically digested primary and WAS sludge.

The influent solids loading the plant is estimated to increase:

TSS (lb/day) existing: 10,444

TSS (lb/day) projected: 12,668

% Increase in solids loading: 21%

Assume enhanced removal from additional plant improvements of 30%

Future estimated average weight of dry solids: 4,381 lb/day dry solids

Solids % from Anaerobic Digesters: 4%

Average weight of Wet Solids 109,525 lb/day wet solids

2.5 Meter Belt Press can process 2250 to 3750 lb/hr-m (Use 2500 lb/hr-m)

For anaerobically digested primary and WAS sludge:

Hours of Operation for 2.5-Meter Press: 1.75 hrs per day

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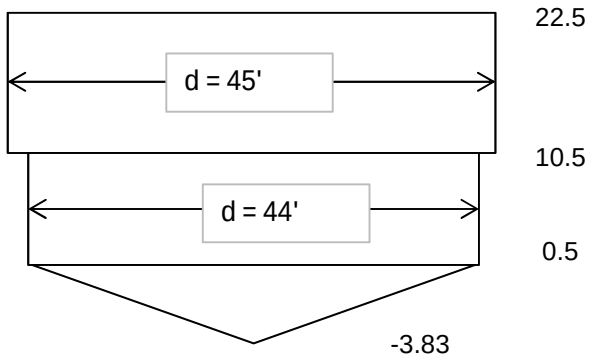
JOB	1696.002.001 (C) Kingston WWTP		
SHEET NO.	1	OF	1
CALCULATED BY	LRZ	DATE	April 4, 2015
CHECKED BY		DATE	
SUBJECT	Existing Anaerobic Digester Capacity		

EXISTING DIGESTER CAPACITY

Existing Facilities:

2 circular primary digester tanks



Top cyliner volume = π*22.5^2*(22.5-10.5) =	19,085	ft^3
Bottom cyliner volume = π*22^2*(10.5-0.5) =	15,205	ft^3
Cone volume = π*22^2*(0.5-(-3.83))/3 =	2,195	ft^3
1 Digester Volume =	36,485	ft^3
Total Digester Volume =	72,970	ft^3

EXISTING CONDITIONS

Current Sludge Loading (provided by the plant operator): 5,000 lb/day

10 States Standards for Completely Mixed Systems for Anaerobic Digestion: 80 lb/day*1,000 ft^3

Calculate Sludge Loading Rate = 5,000/72.970 = 68.52 lb/day*1,000 ft^3

Current Capacity Utilized = 68.52 / 80 *100% = 86% Existing Digesters have sufficient capacity

FUTURE CONDITIONS

Future Sludge Loading (assumed based on increase in average flow): 5,948 lb/day

Calculate Sludge Loading Rate = 5,948/72.970 = 81.52 lb/day*1,000 ft^3

Current Capacity Utilized = 68.52 / 80 *100% = 102% Existing Digesters do not have sufficient capacity

Appendix C

WWTP Alternative Costs

City of Kingston - Long Term Capital Plan
ESTIMATED COSTS OF IMPROVEMENTS - Alternative 1
Table C-1

PROJECT TITLE:
City of Kingston
Long Term Capital Plan

B&L JOB NO: 1696.002.001

DATE PREPARED: 4/4/2015

LOCATION:
City of Kingston WWTP

ESTIMATED BY: LRZ
CHECKED BY:

ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
	WASTEWATER TREATMENT PLANT UPGRADES				
1.	INSTALL VORTEX GRIT REMOVAL SYSTEM	2	EA	$ 275,000	$ 550,000
2.	REPLACE SECOND BAR RACK	1	EA	$ 175,000	$ 175,000
3.	INSTALL CHEMICAL FEED SYSTEM AND CHEMICAL FEED PUMPS FOR CEPT	2	EA	$ 25,000	$ 50,000
4.	REPLACE SETTLED SEWAGE PUMPS WITH DRY PIT SUBMERSIBLE PUMPS & PIPING	3	EA	$ 175,000	$ 525,000
5.	REPLACE AERATION DIFFUSERS	1	LS	$ 250,000	$ 250,000
6.	REPLACE SECONDARY CLARIFIER CHAIN AND FLIGHT MECHANISMS	4	EA	$ 100,000	$ 400,000
7.	REPLACE SECONDARY CLARIFIER SCUM SKIMMERS	4	EA	$ 25,000	$ 100,000
8.	INSTALL BIOMAG BALLASTED FLOC SYSTEM IN SECONDARY CLARIFIERS	1	LS	$ 3,200,000	$ 3,200,000
9.	REPLACE PRIMARY SLUDGE THICKENER MECHANICAL COMPONENTS	1	EA	$ 75,000	$ 75,000
10.	REPLACE DIGESTER FLOATING COVERS AND GAS SAFETY COMPONENTS	1	LS	$ 800,000	$ 800,000
11.	REPLACE BELT FILTER PRESS	1	EA	$ 750,000	$ 750,000
12.	REPLACE AND UPGRADE ODOR CONTROL SYSTEMS	2	EA	$ 500,000	$ 1,000,000
13.	INSTALL STREETSCAPE SCREENING	1	LS	$ 1,750,000	$ 1,750,000
14.	INSTALL VORTEX GRIT AND GRIT CLASSIFIER AT WILBUR REGULATOR	1	LS	$ 375,000	$ 375,000
15.	WWTP ASSET MANAGEMENT PLAN	1	LS	$ 75,000	$ 75,000
16.	SITE, ELECTRICAL SERVICE, AND BUILDING IMPROVEMENTS	1	LS	$ 1,000,000	$ 1,000,000
17.	SCADA	1	LS	$ 250,000	$ 250,000
	CONSTRUCTION SUBTOTAL				**$ 11,325,000**
	CONTINGENCIES / GENERAL CONDITIONS/ OVERHEAD & PROFIT			25%	$ 2,831,000
	CONSTRUCTION TOTAL				$ 14,156,000
	ENGINEERING/ LEGAL/ CONSTRUCTION ADMINISTRATION & OBSERVATION, MISC			25%	$ 3,539,000
	ESTIMATED TOTAL CONSTRUCTION COST (2015 DOLLARS)				**$ 17,700,000**

Notes:
1. Unit prices developed using equipment vendor quotes.

City of Kingston - Long Term Capital Plan
2015 Kingston WWTP Operation and Maintenance Budget
Table C-2

EXISTING PLANT 2015 O&M BUDGET

Category	Cost	Notes
Personal Services	$ 555,466	10 existing employees
Employee Benefits	$ 337,006	
Equipment	$ 59,616	includes motor vehicles and other equipment
Operating Expenses		
General Contract Expense	$ 40,508	
ASLAN Contract	$ 295,775	
Consultants	$ 346,500	
Contracted Services	$ 83,951	
Utilities	$ 262,875	Gas, electric, fuel, etc.
Equipment Maintenance	$ 77,346	
Materials and Supplies	$ 106,761	
Sludge Disposal	$ 20,796	
Insurance, Dues, Seminar Fees	$ 77,500	
Building and Vehicle Maintenance	$ 8,830	
Office Expenses	$ 1,455	
SUBTOTAL:	$ 1,322,297	
TOTAL	**$ 2,274,385**	

Alternative 1 O&M BUDGET

Category	Cost	Notes
Personnel Services	$ 611,012.60	Assumes one additional employee required for increased O&M for advanced technologies being implemented.
Employee Benefits	$ 370,706.60	
Equipment	$ 77,500.80	Assumes a 30 percent increase in cost due to specialized equipment needs.
Operating Expenses	$ 1,322,297	Assumes at least the existing operating expenses
Additional Operating Expenses		
CEPT Annual Chemical Costs	$ 52,511	20 mg/L for average flow and $250/ton for PAC
BioMag Chemical Costs	$ 2,626	1.0 mg/L for average flow and $250/ton for PAC
BioMag Magnetite Make-up	$ 4,380	5% make-up based on 800 lb/day at average flow at $0.30/lb
BioMag Power Cost	$ 47,791	2,150 kWh/d at $0.0609 per kWh
SUBTOTAL:	$ 107,308	
TOTAL	**$ 2,488,825**	

Alternative 2 O&M BUDGET

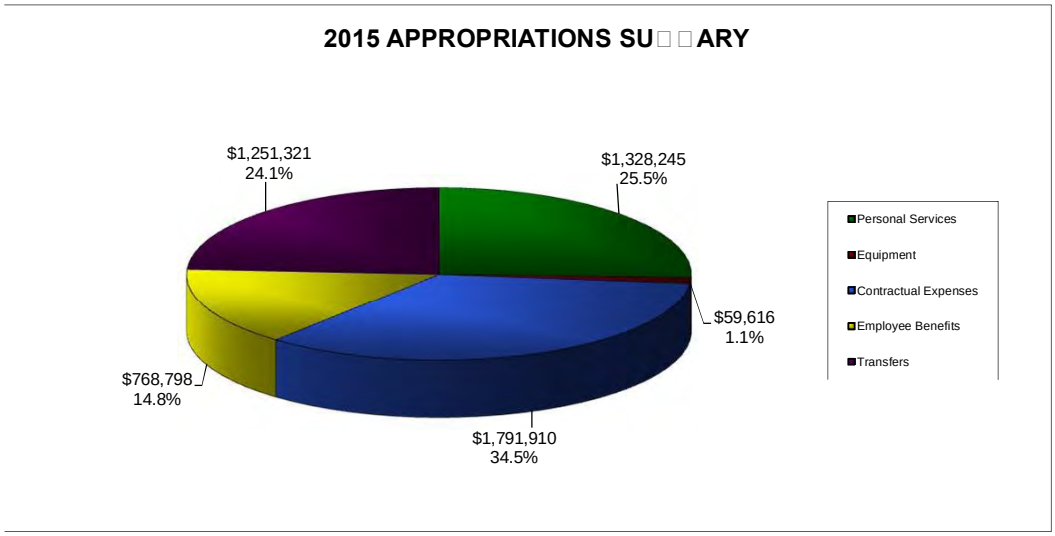
Category	Cost	Notes
Personnel Services	$ 444,372.80	Assumes eight employees due to new equipment and reduced O&M.
Employee Benefits	$ 269,604.80	
Equipment	$ 65,577.60	Assumes a 10 percent increase in cost due to larger facility.
Operating Expenses	$ 1,454,527	Assumes 10 percent additional operating cost for larger facility
TOTAL	**$ 2,234,082**	

Appendix D

City of Kingston Annual Report for Sewer Fund

CITY OF KINGSTON
SEWER FUND
OVERALL BUDGET SU□□ARY

	201□ A□tual	201□ Budget As □□di□ied	2015 Re□uested Budget	2015 Re□□mmended Budget	2015 Ad□pted Budget
Appr□priati□ns□					
Pers□nal Ser□i□es	$1,178,776	$1,286,271	$1,305,064	$1,328,245	$1,328,245
E□uipment	48,374	55,147	77,966	59,616	59,616
C□ntra□tual E□penses	2,240,727	1,825,740	1,789,423	1,791,910	1,791,910
Empl□□ee Bene□its	1,011,844	720,264	760,318	768,798	768,798
Trans□ers	302,629	1,482,163	1,251,321	1,251,321	1,251,321
T□tal	$4,782,350	$5,369,585	$5,184,092	$5,199,890	$5,199,890
Re□enues□					
L□□al S□ur□es	$5,169,945	$5,274,893	$5,184,092	$5,199,890	$5,199,890
Appr□priated Fund Balan□e	(387,595)	94,692			
T□tal	$4,782,350	$5,369,585	$5,184,092	$5,199,890	$5,199,890



(ES) ENTERPRISE SEWER

Statement of Net Position

Code Description	2013	EdpCode	2014
Assets			
Cash	1,125,278	ES200	660,859
Cash With Fiscal Agent	129,956	ES223	
TOTAL Cash	**1,255,234**		**660,859**
Accounts Receivable	1,238,940	ES380	1,247,943
TOTAL Other Receivables (net)	**1,238,940**		**1,247,943**
Due From Other Funds	1,281,077	ES391	2,102,742
TOTAL Due From Other Funds	**1,281,077**		**2,102,742**
Due From Other Governments	237,477	ES440	254,222
TOTAL Due From Other Governments	**237,477**		**254,222**
Prepaid Expenses	41,646	ES480	44,842
Deferred Charges		ES485	
TOTAL Prepaid Expenses	**41,646**		**44,842**
Improvements Other Than Buildings	12,275,198	ES103	12,275,198
Machinery And Equipment	1,482,898	ES104	1,564,355
Construction Work In Progress	404,509	ES105	653,892
Infrastructure	20,484,689	ES106	20,798,238
Accum Deprec, Infrastructure	-14,866,837	ES116	-15,791,600
TOTAL Fixed Assets (net)	**19,780,457**		**19,500,083**
TOTAL Assets and Deferred Outflows of Resources	**23,834,831**		**23,810,691**

(ES) ENTERPRISE SEWER

Statement of Net Position

Code Description	2013	EdpCode	2014
Accounts Payable	260,166	ES600	200,620
TOTAL Accounts Payable	**260,166**		**200,620**
Accrued Liabilities	31,920	ES601	41,581
TOTAL Accrued Liabilities	**31,920**		**41,581**
Retained Percentages-Contracts Payable	18,966	ES605	6,725
TOTAL Retained Percentages	**18,966**		**6,725**
Bond Anticipation Notes Payable	1,868,992	ES626	2,018,268
TOTAL Notes Payable	**1,868,992**		**2,018,268**
Other Post Employment Benefits	2,197,395	ES683	2,637,385
Installment Purchase Debt	1,975,407	ES685	1,780,414
Compensated Absences	241,873	ES687	245,872
TOTAL Other Liabilities	**4,414,675**		**4,663,671**
Due To Other Funds	317,381	ES630	430,760
TOTAL Due To Other Funds	**317,381**		**430,760**
Due To Employees' Retirement System	191,152	ES637	242,906
TOTAL Due To Other Governments	**191,152**		**242,906**
Bonds Payable	8,959,250	ES628	8,107,500
Bond Interest And Matured Bonds Payable	86,017	ES629	77,807
TOTAL Bond And Long Term Liabilities	**9,045,267**		**8,185,307**
TOTAL Liabilities	**16,148,519**		**15,789,838**
Deferred Inflows of Resources			
Deferred Inflow of Resources		ES691	2,552
TOTAL Deferred Inflows of Resources	**0**		**2,552**
TOTAL Deferred Inflows of Resources	**0**		**2,552**
Fund Balance			
Net Assets-Invsted In Cap Asts, Net Rltd D	6,861,107	ES920	7,368,336
Net Assets-Unrestricted (deficit)	825,205	ES924	649,965
TOTAL Net Position	**7,686,312**		**8,018,301**
TOTAL Fund Balance	**7,686,312**		**8,018,301**
TOTAL Liabilities, Deferred Inflows And Fund Balance	**23,834,831**		**23,810,691**

(ES) ENTERPRISE SEWER

Results of Operation

Code Description	2013	EdpCode	2014
Revenues			
Sewer Charges	4,586,606	ES2122	4,755,431
Int & Penalties On Sewer Accts	22,806	ES2128	24,045
TOTAL Charges For Services Within Locality	**4,609,412**		**4,779,476**
Sewer Service - Other Gov'Ts	421,660	ES2374	415,949
TOTAL Charges For Services To Other Localities	**421,660**		**415,949**
Insurance Recoveries	2,281	ES2680	5,872
TOTAL Sale of Property And Compensation For Loss	**2,281**		**5,872**
Interfund Transfers	12,288	ES5031	
TOTAL Interfund Transfers	**12,288**		**0**
Interest And Earnings	4,191	ES2401	4,796
TOTAL Use of Money And Property	**4,191**		**4,796**
Employees Contributions	14,662	ES2709	15,662
Unclassified (specify)	2,417	ES2770	1,622
TOTAL Other	**17,080**		**17,284**
St Aid, Oper & Main of Sewer		ES3901	12,447
TOTAL State Aid	**0**		**12,447**
Fed Aid, Other Home & Comm Svc	27,989	ES4989	30,657
TOTAL Federal Aid	**27,989**		**30,657**
TOTAL Revenues	**5,094,900**		**5,266,481**
TOTAL Operating Revenue	**5,094,900**		**5,266,481**

(ES) ENTERPRISE SEWER

Results of Operation

Code Description	2013	EdpCode	2014
Expenses			
Sanitary Sewers, Pers Serv	734,190	ES81201	747,505
TOTAL Sanitary Sewers	**734,190**		**747,505**
Sewage Treatment And Disposal-Pers Serv	444,586	ES81301	484,253
TOTAL Sewage Treatment And Disposal-Pers Serv	**444,586**		**484,253**
TOTAL Personal Services	**1,178,776**		**1,231,758**
Depreciation	921,165	ES19944	924,764
TOTAL Depreciation	**921,165**		**924,764**
Sanitary Sewers, Contr Expend	374,776	ES81204	347,167
TOTAL Sanitary Sewers	**374,776**		**347,167**
Sewage Treatment And Disposal-Contr Expend	993,160	ES81304	1,047,218
TOTAL Sewage Treatment And Disposal-Contr Expend	**993,160**		**1,047,218**
TOTAL Contractual Expenses	**2,289,101**		**2,319,149**
Sanitary Sewers, Empl Bnfts	730,360	ES81208	866,889
TOTAL Sanitary Sewers	**730,360**		**866,889**
Sewage Treatment And Disposal-Empl Bnfts	281,485	ES81308	282,522
TOTAL Sewage Treatment And Disposal-Empl Bnfts	**281,485**		**282,522**
TOTAL Employee Benefits	**1,011,844**		**1,149,411**
Debt Interest, Serial Bonds	224,844	ES97107	203,119
Debt Interest, Bond Anticipation Notes	2,276	ES97307	17,400
Install Pur Debt, Interest	75,510	ES97857	68,904
TOTAL Interest Expense	**302,630**		**289,423**
TOTAL Expenses	**4,782,352**		**4,989,741**
Transfers, Other Funds		ES99019	20,076
TOTAL Transfers	**0**		**20,076**
TOTAL Other Uses	**0**		**20,076**
TOTAL Operating Expenses	**4,782,352**		**5,009,817**

(ES) ENTERPRISE SEWER

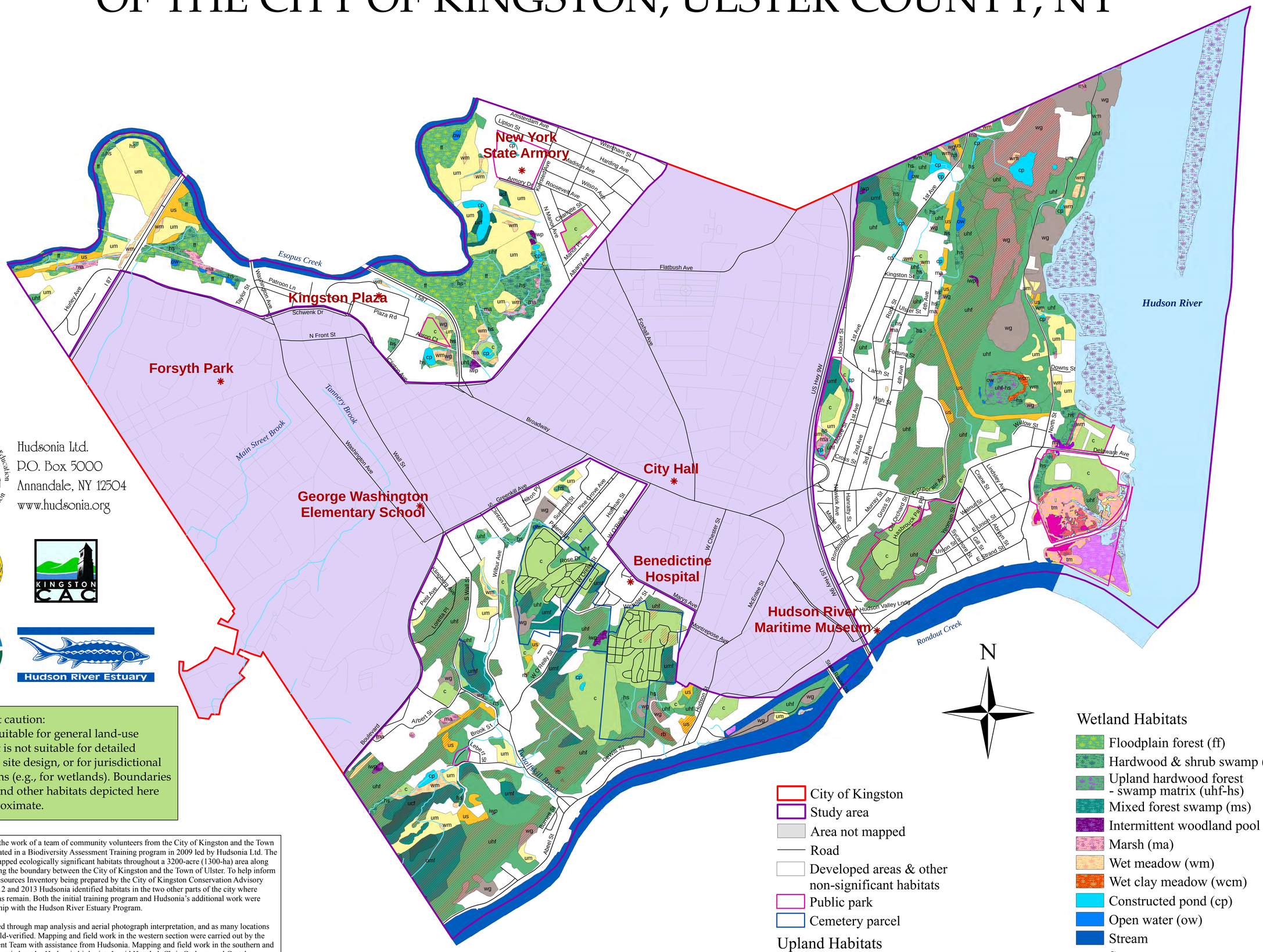
Analysis of Changes in Net Position

Code Description	2013	EdpCode	2014
Analysis of Changes in Net Position			
Net Position - Beginning of Year	7,319,114	ES8021	7,686,311
Prior Period Adj -Increase In Net Position	54,649	ES8012	75,326
Restated Net Position - Beg of Year	7,373,763	ES8022	7,761,637
ADD - REVENUES AND OTHER SOURCES	5,094,900		5,266,481
DEDUCT - EXPENDITURES AND OTHER USES	4,782,352		5,009,817
Net Position - End of Year	7,686,311	ES8029	8,018,301

Appendix E

Habitats of Significance in Kingston

SIGNIFICANT HABITATS IN SELECTED AREAS OF THE CITY OF KINGSTON, ULSTER COUNTY, NY



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An important caution:
This map is suitable for general land-use planning, but is not suitable for detailed planning and site design, or for jurisdictional determinations (e.g., for wetlands). Boundaries of wetlands and other habitats depicted here are only approximate.

This map grew out of the work of a team of community volunteers from the City of Kingston and the Town of Ulster who participated in a Biodiversity Assessment Training program in 2009 led by Hudsonia Ltd. The team identified and mapped ecologically significant habitats throughout a 3200-acre (1300-ha) area along Esopus Creek straddling the boundary between the City of Kingston and the Town of Ulster. To help inform a city-wide Natural Resources Inventory being prepared by the City of Kingston Conservation Advisory Council (CAC), in 2012 and 2013 Hudsonia identified habitats in the two other parts of the city where substantial habitat areas remain. Both the initial training program and Hudsonia's additional work were carried out in partnership with the Hudson River Estuary Program.

Habitats were identified through map analysis and aerial photograph interpretation, and as many locations as practicable were field-verified. Mapping and field work in the western section were carried out by the Biodiversity Assessment Team with assistance from Hudsonia. Mapping and field work in the southern and eastern sections were carried out by Hudsonia biologists Ingrid Haeckel, Chris Graham, and Gretchen Stevens. Color infrared photographs in the USGS NAPP series, taken in spring 1994 (scale 1:40,000), were used for stereoscopic photointerpretation. Habitats were digitized onscreen over color infrared orthophoto images taken in spring 2001 and 2009 obtained from the New York State GIS Clearinghouse. Habitat data for Hudson River submerged aquatic vegetation (2007) and tidal wetlands (2007) produced by the NYSDEC Hudson River Estuary Program were obtained from the Hudson River National Estuarine Research Reserve.

The report prepared by the Biodiversity Assessment Training team in conjunction with the western portion of the map (Budziak et al. 2009, "Esopus Valley Biodiversity Assessment Report") explains the habitat identification and mapping methods, describes the ecological significance of many of the habitat types shown on this map, and offers conservation recommendations.

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1:10,000

0 0.5 1 Kilometer

0 0.5 1 Mile

N

- City of Kingston
- Study area
- Area not mapped
- Road
- Developed areas & other non-significant habitats
- Public park
- Cemetery parcel

Upland Habitats

- Upland hardwood forest (uhf)
- Upland mixed forest (umf)
- Upland conifer forest (ucf)
- Rocky barren (rb)
- Upland shrubland (us)
- Upland meadow (um)
- Cultural (c)
- Waste ground (wg)
- Calcareous crest, ledge, & talus

Wetland Habitats

- Floodplain forest (ff)
- Hardwood & shrub swamp (hs)
- Upland hardwood forest - swamp matrix (uhf-hs)
- Mixed forest swamp (ms)
- Intermittent woodland pool (iwp)
- Marsh (ma)
- Wet meadow (wm)
- Wet clay meadow (wcm)
- Constructed pond (cp)
- Open water (ow)
- Stream
- Stream

Tidal Habitats

- Hudson River
- Submerged aquatic vegetation
- Lower intertidal mix
- Upper intertidal mix
- Water chestnut
- Common reed
- Cattail