EFFECTS OF RACEWAY POND WATER AND NUTRIENT RECYCLING ON MICROALGAE
PRODUCTION AND HARVESTING

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ABSTRACT

Effects of Raceway Pond Water and Nutrient Recycling on Microalgae Production and Harvesting

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To be environmentally sustainable, algae biofuel production requires extensive recycling of water and nutrients during algae cultivation. Such recycling can be in the form of reuse of external wastewaters, such as from municipal sewers, but, to achieve significant biofuels production, internal recycling at the algae farms is also needed. A potential difficulty with internal recycling is the accumulation of auto-inhibitory compounds in recycled algae pond water. An additional concern is that nutrients in the residuals from algae biofuel manufacturing will be only partly bioavailable. Both these factors can limit the extent of internal recycling. Ultimately, combining external and internal recycling might be the most sustainable as long as these limiting factors are not excessive. Another important consideration in algae biofuel feedstock production is harvesting, which can be energy intensive and expensive. Bioflocculation of algae cells followed by sedimentation is a low input harvesting method, but one that might be affected by resource recycling. In the present 7-month study, algae productivity and settleability were measured for several types of water and nutrient recycling, using pilot raceways and tubes settler tanks fed municipal wastewater.

Two control raceway sets and two types of water and nutrient recycling raceway sets were operated concurrently. Each set was comprised of duplicate raceways (33-m² surface area each, 0.3-m deep, 4-day hydraulic residence time with CO₂ supplementation). One control set was fed primary clarifier effluent while the other control set was fed nitrified, filtered reclaimed wastewater. The two experimental raceway sets were fed different nutrients. One set received anaerobically-digested algal biomass (algae digestate) and the other set chemical fertilizer. Both recycling raceway sets were monitored to determine if water and nutrient recycling had any detrimental impacts on algal biomass growth.

Productivity was reported as gross and net in terms of volatile suspended solids (VSS). Gross productivity was based on raceway effluent biomass flow, which could be harvested for biofuel production. Net productivity was based on influent minus effluent biomass flows, which better represents algae growth. As

a complement to the productivity data, measurements were made of indicators (salt, soluble chemical oxygen demand, and soluble UV absorbance) of potentially inhibitory substances and of nitrogen and phosphorus concentrations, which would have limited growth if they were too low.

After 7 months of continuous operation and 50 cycles of water reuse, the algae productivities of the water and nutrient recycling raceways matched or exceeded the productivities of the control raceways. Net productivities of the primary effluent-fed and reclaimed water-fed control ponds averaged 15.4 and 18.0 g-VSS/m²-day, respectively, while the digestate-fed and fertilizer-fed recycling ponds net productivities averaged 19.6 and 18.8 g-VSS/m²-day, respectively. The average standard deviation of the various duplicate sets ranged from 0.3 – 4.0 g-VSS/m²-day. These results do not indicate that algae were inhibited during the 7 months of continuous water recycling and digestate fertilization. In fact, the results suggest that recycling enhances productivity, although the statistical power of this experiment was low.

Indicators of potentially inhibitory substances were monitored during the experiment (salinity, soluble chemical oxygen demand, and UV absorbance). Only salt concentrations showed significant accumulation in the ponds, but not to concentrations expected to be inhibitory. A greater number of replicates and a longer experimental period are recommended in future experiments.

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1. Introduction

As the global population grows, so does the demand for water and energy resources. The high energy costs of water production, treatment, and transmission drive energy demand in many parts of the country.

Termed the “water-energy nexus,” this relationship is monitored by the International Energy Agency (IEA, 2016). The IEA reports on water demand in agricultural and energy production industries. The amount of water used per unit of kWh produced is a significant factor in determining the sustainability of energy production methods.

The impact of climate change on freshwater sources combined with increasing population and economic development will exacerbate the strain on freshwater resources in the future (IEA, 2012). With this in mind, it is important to mitigate the consumption of freshwater resources while producing energy to promote more sustainable energy infrastructures. Algae-based biofuel production is a potential source of energy in a world where freshwater resources are becoming increasingly limited.

Wastewater has been proposed as a low-cost, sustainable source of water and nutrients for algae-based biofuel production (Oswald, 1960, Park et al, 2010). Cultivating microalgae biofuel on wastewater has several potential advantages. One includes the treatment and reuse of wastewater and waste nutrients through photosynthetic oxygenation and nutrient assimilation. Another is a less expensive means of treating wastewater than conventional treatment systems in suitable locations. And also, lower greenhouse gas emissions due to the avoidance of more energy-intensive wastewater treatment technologies. Because of the potential advantages, algae-based wastewater treatment systems, with or without biofuel production, has been a subject of research since the 1950s (Gotaas, 1954).

Wastewater, as a source of water and nutrients, could just as well be used in the cultivation of other biofuel feedstocks (Poole, 2004). Several types of food and feed crops can be cultivated using partially treated wastewater (Poole, 2004, Alkhamisi, 2011). Despite this, the potential of using wastewater to produce food or fuel has not led to the elimination of research on algae biofuel production. This biofuel production via algae biomass production is a promising line of research among several funded by DOE and private enterprise. Many researchers are not able to make straightforward conclusions about the pros and cons of

biofuel production via algae biomass or by feedstock production (Wu, 2011) and thus further investigation is required.

There are several potential advantages of using wastewater to grow algae biofuel rather than animal feed crops. For algae biofuel production, pathogens do not necessarily need to be removed prior to cultivation because the biomass will be converted into fuel, not animal feed. This eliminates the need for an additional, energy-intensive treatment process. Algae-based wastewater treatment systems can assimilate nutrients year-round for a constant supply of algal based biofuel, whereas plant crops cannot (Schenk, 2008). It should be noted, however, that these systems typically assimilate nutrients at lower rates during winter months (Kraetsch, 2015).

While many decades of research have been conducted on algae-based wastewater treatment systems and algae biofuel production, there is limited published research on pilot-scale water and nutrient recycling of algae-based treatment systems, particularly in paddle wheel-mixed raceway ponds. Water and nutrient recycling using raceway ponds in series has recently been investigated (Chang, 2014). In the present research, data were collected on pilot-scale biomass production and algae-based wastewater treatment in raceway ponds with extensive water and nutrient recycling. Accumulation of algae growth inhibiting substances was a concern, and surrogates of potential inhibitors were monitored. These topics of research are detailed further in the Background section.

2. Background

2.1 Algae-Based Wastewater Treatment

Wastewater can be treated by algae-based treatment systems through photosynthetic oxygenation and nutrient assimilation. This method of wastewater treatment is catalyzed by the symbiotic algal-bacterial relationship shown in Figure 2-1. The current research utilized this method of wastewater treatment in high rate raceway ponds. Raceway ponds have been a focus of study for decades (Gotaas, 1954); their functionality is detailed in Section 2.4. In raceway ponds, algae use sunlight and the inorganic carbon, soluble nitrogen and soluble phosphorus found in wastewater for growth. The algae release oxygen as a byproduct of photosynthesis. The aerobic bacteria present in the raceways ponds consume the oxygen byproduct along with the degradable organic material found in wastewater through cellular respiration. The bacteria release CO_2 and other soluble nutrients that can in turn be consumed for further algal growth (Woertz, 2009). It is common to supplement raceway ponds with CO_2 gas sparging to promote algal growth with higher inorganic carbon concentrations and to control pH (Godos, et al., 2014, Weissman & Goebel, 1987). The raceway ponds used in this experiment had CO_2 spargers for enhanced growth.

Figure 2-1: The algal-bacterial relationship in raceway ponds for wastewater treatment (after Oswald, 1960).

Microalgae are well suited to nitrogen removal as they are 6% to 11% nitrogen by weight, depending on genera and growth conditions (Oswald, 1968). They have been shown to reduce soluble nitrogen concentrations in wastewater by 1.5 mg N/L-day in pilot-scale algae raceway ponds (Reiff, 2015).

Microalgae are comprised of 0.5% to 1% Phosphorus by weight and have been shown to reduce soluble phosphorus concentrations by 0.18 mg-P/L-day in pilot-scale algae raceway ponds (Reiff, 2015). Although this is not enough to fully remove high concentrations of phosphorus from wastewater streams in a typical 3-4-day HRT raceway pond (Powell, 2008) it is still a contributing factor.

Algae can provide a means of treating wastewater while simultaneously producing biofuels and biogases. Biorefineries can use algae grown on wastewater for biogas production via anaerobic digestion of algae (Maga, 2015), which in turn contributes to climate protection.

2.2 Algae Biofuel Production

The use of algal biomass for energy and fuel production has been a topic of research since the 1950's, when it was shown that biogas could be produced from the anaerobic digestion of algal biomass (Golueke, 1956). Other fuels and conversion pathways have been proposed, including the extraction of algal lipids for use in liquid fuels. Algal biomass grown for fuels can be cultivated in various ways, which may vary depending on the intended fuel pathway.

Some species of green algae produce intracellular oils and or lipids that can be processed into biofuels (Kenneth, 1983). These oils and lipids can be extracted by several different processes. One such process is Hydrothermal Liquefaction (HTL), a heat and pressure inducing process that can convert wet algae biomass into biocrude, gas and biochar (Li, 2016). This extraction process has been a recent focus of study for feedstock-specific optimization, self-separating products and energy and nutrient rich co-products.

Whereas many crops require freshwater, algal biomass can be grown in other growth media, including: saltwater, brackish water, agricultural runoff, or municipal wastewater. This could minimize the impact of fuel production on freshwater sources (Schenk, 2008) and could avoid some competition of biofuels with food crops for resources.

Biofuels and oils extraction from algal biomass can provide a carbon-neutral alternative (Vicente, 2004) to the use of finite fossil fuel reserves while also providing the opportunity to treat municipal wastewater (Maga, 2015) and other waste streams such as agricultural runoff (Lundquist T., 2010) and flue gas (Laws, 1991). Further research of biorefineries and commercial biofuel and biogas production on wastewater mediums will be needed before these systems are economically viable. A life cycle assessment of a biorefinery in Spain using algae biomass grown on wastewater shows promise but recognizes that further efficiencies in the technology are required before these biofuel production systems can become more widely accepted (Maga, 2015).

2.3 Water and Nutrient Recycling

For economic and sustainability reasons, production of biofuel algae feedstock must maximize biomass productivity per unit of various input resources (National Research Council, 2012, Farooq, 2015). The use of fresh, or virgin, resources such as freshwater, macronutrients (nitrogen, phosphorus, carbon, sulfur, potassium, magnesium) and other micronutrients (iron, manganese, copper, zinc) have monetary costs as well as greenhouse gas costs associated with their use (Campbell, 2009). It is important to make the most productive use of all material and energy inputs to reduce the monetary and greenhouse gas cost of algae biofuel production. Thus, the recycling of water and nutrient resources has become a focus of research in recent years (Farooq, 2015).

Digestate from anaerobic digestions has been shown to be a potential source of recycled nutrients for algae biomass production (Bjornsson, 2013). Digestate is a sludge-like byproduct of the anaerobic digestion of biodegradable materials such as manure and algae biomass. The production of methane gas by anaerobically digesting manure waste and algae biomass has been studied since the 1950's (Golueke, 1956). Research of algae digestate as a source of nutrients for raceway pond algae cultivation could reduce the economic barrier of algae biofuel production through coupling of algae oil production and methane production through anaerobic digestion (Sialve, 2009, Collet, 2011).

Providing a culture medium can represent up to 35% of algae biomass production costs (Grima, 2003). Flocculated mediums have been shown to be successfully reused for algae biomass growth (Kim, 2011).

Incorporating a water or growth medium recycling system with an algae biofuel production system is necessary to reduce production costs.

Water and nutrient recycling in algae cultivation does come with new operational considerations. The recycling of water requires a settling system that separates algae from the effluent and returns the water for reuse. This adds pumping demands. The transfer of water mixed with biomass through a settling system can lead to potential clogs that require regular maintenance to prevent any system backups. The use of a recycled nutrient source with existing organic matter and solids, such as algae digestate, may decrease productivity in the ponds due to a reduction of sunlight exposure to the algal biomass in the pond. The recycling of both water and nutrients in raceway ponds may promote the accumulation of inhibitory substances such as salt, heavy metals, or humic matter that can decrease productivity. Potential inhibitory substances and growth limiting parameters are discussed further in Section 2.5

2.4 Algae Productivity in Integrated Resource Recycling Raceway Ponds

The effectiveness of microalgae cultivation has generally been measured as some form of productivity. Productivity quantifies the amount of biomass grown per surface unit area per unit of time. In similar studies productivity has been measured in terms of grams of VSS (volatile suspended solids) per meter squared per day ($\text{g}/\text{m}^2\text{-day}$) (Lundquist T., 2010, Kraetsch, 2015). For the purposes of the present experiment productivity was calculated using Equation 4-1 and Equation 4-2 found in section 4.1.

2.4.1 Raceway Ponds

Raceway ponds or “high rate ponds” (HRPs) have been studied since the 1950s for algae biomass production (Gotaas, 1954). Despite the development of new algal cultivation systems, such as thin layer culture systems and tubular and flat plate photobioreactors, raceway ponds remain the only system capable of commercial scale production (Grobbelaar, 2012).

Theoretically, raceway ponds have the potential to produce $40 \text{ g}/\text{m}^2\text{-day}$ of algae biomass (Brennan, 2010). Much lower productivities of about $25 \text{ g-VSS}/\text{m}^2\text{-day}$ were found in previous raceway pond experiments (Park et al., 2011). One reason for the discrepancy is carbon limitation in open raceway ponds. Only a limited amount of atmospheric carbon can be absorbed by algae in raceway ponds (Stepan, 2002). CO_2 is

typically supplied to the raceway ponds via gaseous sparging to promote optimal biomass growth (Godos, et al., 2014, Weissman & Goebel, 1987).

Studies have shown that industrial flue gas (e.g. power plant stack gas) can be used as a gaseous carbon source to sparge raceway ponds with (Laws, 1991). This provides an economical opportunity to reduce the costs of algae biomass production in raceway ponds through an existing industrial byproduct, and to further reduce GHG (greenhouse gas) emissions (Stepan, 2002). However, this does require the additional challenge of placing the raceway ponds adjacent to an industrial facility. Although this experiment did not utilize industrial offgas, the raceway ponds used in this experiment had CO₂ spargers to further promote growth. The CO₂ spargers used are discussed further in Section 3.3.11.

Past experiments conducted with the same raceway pond facilities as the current study have shown annual productivity rates of 22.7 g-VSS/m²-day for algae raceway ponds with an HRT (hydraulic residence time) of 2 days (Roberts, 2015) and 14.2 g-VSS/m²-day for raceway ponds with an HRT of 3 days (Roberts, 2015). In the context of the present experiment, HRT is the length of time it takes for a unit of water to pass through a raceway pond with a defined volume. Earlier experiments almost exclusively used clarified wastewater as a nutrient medium. The traditional process flow of a raceway pond is shown in Figure 2-2, where the clarified wastewater medium enters the pond at a constant rate and the algae and water leave the raceway at the same rate.

Figure 2-2: Raceway Pond Process Flow. The model highlights the one-way process flow of a raceway pond. The nutrient source enters the pond at a constant flow rate and algae water leaves the pond at a constant flow rate.

This experiment used two sets of raceway ponds in the traditional configuration as experimental controls. One set of ponds used clarified wastewater (or primary clarifier effluent) as a nutrient medium and the other set used reclaimed water as a nutrient medium. The primary effluent fed ponds were used as a comparison to past studies. The reclaimed water ponds were used to observe the impact of reclaimed water as a nutrient source for biomass production. Table 3-1 details the experimental conditions of the control raceway ponds studied in this experiment.

Primary clarified effluent is wastewater that has had some of the organic matter and solids removed through physical processes. Reclaimed water effluent is wastewater that has been treated by the wastewater treatment plant to the extent that it can be reused for irrigation and a variety of other purposes. The treatment for reclaimed water includes physical separation processes as well as biological and chemical treatment processes.

2.4.2 Integrated Raceway Recycling Ponds

Integrated raceway recycling ponds are a relatively new area of study to improve biomass yield per unit of resource/water (Oswald, 1983). The recycling system is designed to separate the pond effluent into a settled algal sludge and supernatant with leftover soluble nutrients. The settled algal sludge can be harvested for production and nutrient and pollutant removal from the system. The water supernatant can be returned to the raceway pond to support additional biomass growth. The recycling of the supernatant can also prove a useful function in improving nutrient and pollutant removal rates per unit of water.

Figure 2-3 outlines the integrated recycling pond system. Three major components in this system include the raceway pond, the nutrient source and the settling system. These components are explained in detail in Section 3.

Figure 2-3: Integrated Raceway Recycling Pond Process Flow. The model highlights the process flow of the nutrient feed, algae and recycled water through the raceway pond and the settling/recycling system. Nutrients are fed to the raceway pond at a designated rate. The algae water is pumped out of the raceway at a specified rate into the settling/recycling system where the supernatant (recycled water) and subnatant (algae harvest) are separated. The supernatant is returned to the pond to facilitate the uptake of additional soluble nutrients still found in the recycled water. The algae harvest is removed from the system.

This experiment used two sets of integrated raceway recycling systems. One set of integrated recycling systems used fertilizer as a nutrient source while the other used algae digestate as a nutrient source. The fertilizer-fed system was used as an algae productivity comparison to the digestate-fed system. The nutrient process flow for the algae digestate fed recycling systems is shown in Figure 2-4.

Figure 2-4: Complete integrated recycling process flow diagram for algal biomass production on wastewater (Lundquist T., 2010). This experiment observed the function of the High Rate Ponds and the 2° Clarifiers in the process flow diagram. The gravity thickeners and anaerobic digesters were observed under a separate yet concurrent experiment.

2.5 Algal Growth Inhibition

Algae or other microbes might release substances into the water that accumulate due to water recycling and eventually lead to productivity inhibition (DOE, 2010). A prior lab-scale experiment showed that growth rates of a microalgae culture, *Chlorella Sorokiniana*, were decreased after multiple rounds of regrowth in recycled growth media (Spence, 2016). Further research is needed to determine if algae growth rates are affected in a similar manner in pilot-scale systems.

Some potentially inhibitory substances and experimental parameters that are examined in this experiment include the availability of soluble nitrogen, decrease in solar insolation due to digestate nutrient feed additions, salt content, humic matter, and the concentration of sCOD (soluble Chemical Oxygen Demand).

2.5.1 Soluble Nitrogen Availability

Algae raceway ponds require a readily available supply of soluble nutrients to maintain optimum productivity rates. Past experiments have shown soluble nitrogen reduction rates of 1.5mg-N/L-day in raceway ponds (Reiff, 2015). If concentrations of soluble nitrogen are low or negligible in raceway ponds algae growth may be limited. This experiment observed the productivity rates and concentrations of soluble

nitrogen of control raceway ponds and experimental recycling raceway ponds with controlled nutrient feed regimes to determine if there was any growth limitation from a lack of soluble nitrogen.

2.5.2 Salinity/Conductivity

Freshwater algae growth can experience growth inhibition by rising salinity (Batterton, 1970). Due to the water and nutrient recycling processes of the experimental raceway system studied in the present research there is a potential for the accumulation of salt in the raceway ponds. This experiment measured conductivity in the control and experimental ponds daily to determine salt accumulation in the ponds. A lab-scale experiment of growing microalgae on recycled growth medium showed an increase in salinity (mS/cm) over subsequent rounds of water recycling (Spence, 2016). Seawater has a conductivity of approximately 5 Siemens per centimeter (S/cm) (Lenntech, 2016) and was used as a benchmark to determine the scale of salt accumulation over the course of the experiment.

2.5.3 sCOD

Soluble chemical oxygen demand (sCOD) is a measurement of the capacity of a filtered aqueous solution to consume oxygen through the oxidization of organic substances. In the present project, sCOD was used to monitor the build-up of dissolved organic matter in the pond water.

2.5.4 UV Absorbance

Dissolved organic matter was also monitored through absorbance of light at a wavelength of 240 nm, which is a common indicator of dissolved organic matter. A concurrent study conducted at Cal Poly by William Spence examined potentially inhibitory constituents in a lab-scale study. Absorbance of light in samples from the lab-scale and pilot-scale experiments were compared in this thesis and analyzed in Section 0.

2.6 Research Objectives

This study focused on determining the extent to which water and nutrients can be recycled in raceway ponds before inhibition occurs, decreasing areal biomass productivity. The main research objectives were:

1. Compare the areal algae productivity in raceway ponds with and without water recycling.
2. Compare the areal algae productivity in raceway ponds with and without water and nutrient recycling.

3. Measure the concentration of surrogates for potential inhibitors of algae productivity that might accumulate in raceways with water and nutrient recycling.

The experiment conducted in this study used algae raceway ponds with a water recycling and algae digestate nutrient recycling system with the goal to maximize water and nutrient utilization without decrease in biomass productivity. The experimental systems were designed to recycle water for additional rounds of algae growth and use nutrients found in biofuel production residuals, which in this study was algae digestate. The experiment compared the use of algae digestate to a control fed plant fertilizer as a nutrient source.

3. Methods and Materials

This chapter details the methods used in a set of experiments aimed at establishing nutrient and water recycling capabilities in pilot-scale algae raceway pond systems. Experimental apparatus, procedures, data collection, laboratory analyses, and equipment and maintenance are reported here.

3.1 Experiment Location

The experiment took place at a pilot facility located at the City of San Luis Obispo Water Resource Recovery Facility (WRRF). The City has supported Cal Poly investigations of algae wastewater treatment by making available a plot of land with access to primary clarifier effluent and reclaimed wastewater. Most of the pilot systems were assembled by previous graduate students since 2011. The study described here took place in eight 33-m² raceway ponds and algae settling tanks. For this experiment, modifications were made to the settling system to recycle effluent water into the ponds (Figure 3-1). These systems and modifications are described in detail in Sections 3.2 and 3.2.2.

Figure 3-1: The Algae Field Station at the City of San Luis Obispo Water Resource Recovery Facility (Google Maps, 2016). Eight of the largest raceway ponds were used in the present study.

3.2 Experimental Process Flows

This experiment had four process flow setups, each comprised of duplicate raceway ponds and associated tanks. The process flows included (1) the reclaimed water control raceways, (2) the recycled water raceways receiving chemical fertilizer, (3) the recycled water raceways receiving digestate, and (4) the raceways receiving primary clarifier effluent (Figure 3-2). The latter type of raceway pond was considered a benchmarking set. Several years of algae productivity data are available in prior experiments for Algae Field Station raceway ponds fed primary clarifier effluent (Ripley, 2013, Chang, 2014, Reiff, 2015). Because weather influences productivity and temperature/insolation patterns differ from year to year, the productivity of the past and present primary clarifier fed raceways can be used to roughly compare or “benchmark” the results of the present experimental raceways with past years, with their various weather conditions. In particular, San Luis Obispo has inconsistent fog cover and rainfall from year to year.

Figure 3-2: Experimental Process Flow Diagram

3.3 Experimental Variables

Besides independent and dependent variables, these outdoor experiments had steady controlled variables and unsteady “environmental” controlled variables. The following sections describe the main variables.

3.3.1 Independent Variables

The independent variables were water sources (fresh or recycled) and nutrient sources (algae digestate or chemical fertilizers).

The algae digestate used as a nutrient source for the digestate fed recycling ponds was a product of a concurrent Cal Poly graduate research project (Racz, 2018). It came from 30-day HRT digesters that were fed algae water from the primary clarifier control ponds used in this experiment.

3.3.2 Steady Controlled Variables

The steady controlled variables were pond volume (all at 0.30 m deep and 10 m³), hydraulic residence time (HRT; all at 4 days), carbon dioxide dosing pH setpoints (all at CO₂-On at pH 8.5; CO₂-Off at pH 8.2).

The HRT of 4 days (flow of 1.76 L/min) was chosen for all pond sets to allow a reasonably high productivity without excessive demand for digestate, which was a limited resource at the site. The pH setpoints matched what was expected to be practical at full-scale plant (Weissman, 1985).

3.3.3 Unsteady Environmental Controlled Variables

Unsteady environmental variables, which could not be controlled by the operators but were the same for all ponds, included weather, the water quality of the control pond influents and the rate of water evaporation in the ponds. Weather, through temperature and solar radiation, affects the rate of algal growth.

The influent used for the primary clarifier and reclaimed water control ponds effluents from the city wastewater treatment facility was variable and controlled by the waste streams and the methods of wastewater treatment employed by the facility.

Evaporation resulted in water losses for all of the raceway ponds. The ponds most affected by the evaporative loss were the recycling ponds as they required water additions to make up for the loss of recycled water.

3.3.4 Uncontrolled Variables

The uncontrolled variables in the experiment were those that differed among treatment and controls but were not the targeted dependent variables: coagulant dosage prior to the settling tanks of the two sets of

recycling ponds, the different nutrient concentrations and sources in each pond set, the algal genera present in each pond, and the volume of reclaimed water added to recycling ponds to compensate for evaporation.

The coagulant was used in the experimental nutrient and water recycling ponds to promote algal settling and reduce the amount of algal biomass returning to the raceway ponds in the recycled water. This uncontrolled variable affected the amount of solids in the raceway ponds, which are dependent variables.

The experiment had four different process flow setups, each having their own nutrient source. The nutrient sources were primary clarifier effluent, reclaimed wastewater, algae digestate, and plant fertilizer. The concentrations of nutrients in the ponds from these sources were mostly present in excess to ensure that algal growth rates were not influenced by a lack of nutrients.

The algae present in the raceway ponds were naturally occurring genera; no effort was made in this experiment to control the composition of genera found in the ponds.

Reclaimed water was added to the recycling raceway ponds to replace losses due to evaporation, pumping and algae harvest thus maintaining raceway pond volumes. The amount of water added to the recycling ponds varied on a weekly basis.

3.3.5 Dependent Variables

The major dependent variables were volatile suspended solids (VSS), total suspended solids (TSS), total solids (TS), chemical oxygen demand (COD), soluble nitrogen concentrations, conductivity (S/cm), and light absorbance.

3.3.6 Raceway Settings

The details of the four raceway ponds types, as described above, are summarized in Table 3-1 and the following text.

Table 3-1: Experimental Pond Characteristics

	Clarified Wastewater	Reclaimed Wastewater	Recycled Water + Digestate	Recycled Water + Fertilizer
Pond Number	P1, P2	P3, P9	P4, P5	P6, P8
Nutrient Source	Clarified Wastewater	Reclaimed Wastewater	Recycled Nutrients (Algae Digestate)	Plant Fertilizer

Water Source	Wastewater	Reclaimed Wastewater	Recycled	Recycled
Primary Nitrogen Species	Ammonium (NH_4^+)	Nitrate (NO_3^-)	NH_4^+ and NO_3^-	NH_4^+ and NO_3^-
Hydraulic Residence Time	4 days	4 days	4 days	4 days
Target Influent / Effluent Flow Rate	1.76 L/minute	1.76 L/minute	1.76 L/minute	1.76 L/minute

3.3.7 Control Ponds Description

Two sets of duplicate raceways (Ponds 1, 2, 3, and 9) were set up and run simultaneously as controls for the recycling system in this experiment, as described briefly above.

Ponds 1 and 2 (WW Ponds) were fed primary clarified wastewater effluent, in which total ammonium nitrogen (TAN) dominated as the soluble nitrogen form. Primary effluent also contained VSS, which once added to the raceways, could not be distinguished from new grown algal and bacterial biomass. The net productivity calculation, described earlier, indicated the extent of newly grown biomass, including heterotrophic bacterial growth fed by the soluble organic matter in the wastewater. Besides the benchmarking role of these ponds, they could be compared to the experimental ponds that received organic load from digestate addition, which no doubt also supported heterotrophic growth.

Ponds 3 and 9 (RW Ponds) were fed reclaimed water that had been fully treated by the City Water Resource Recovery Facility. The reclaimed water was fully nitrified in activated sludge aeration basins, passed through anthracite-sand filters, chlorinated, and de-chlorinated. The dominant soluble nitrogen form in the reclaimed water was nitrate, not the TAN of the primary clarifier fed ponds. Potable water with chemical fertilizer added was not used for the control ponds due to drought restrictions imposed at the time. The purpose of using the reclaimed water ponds as experimental controls was to quantify autotrophic algal productivity and nutrient uptake without the presence of heterotrophic growth. This strictly autotrophic growth on “fresh” water was compared to the autotrophic growth in the recycled water ponds that received chemical fertilizer.

3.3.8 Experimental Ponds Description

The water and nutrient recycling systems in this experiment were meant to increase the total biomass grown per unit of water and unit of nutrient. Ponds 4 and 5 (algae digestate fed ponds) and Ponds 6 and 8 (fertilizer fed ponds) were used in the recycling portion of the experiment. The nominal 4-day HRT was maintained with a 1.76 L/min flow of recycled water through the settling tanks and back into the raceways.

Algae productivity with recycled nutrients from algae digestate was compared to productivity with nutrients from chemical fertilizer. The goal was to provide sufficient fertilizer or digestate to maintain soluble concentrations of nitrogen and phosphorus well above their Monod half-saturation constants (typical values for green algae: <0.08 mg/L total ammonia nitrogen and <0.02 mg/L phosphate P; Klausmeier et al., 2004; Hein et al., 1995; Rhee, 1974). In this way, any decrease in productivity in the digestate ponds could be better attributed to inhibitory substances rather than nutrient limitation. The digestate supply for Ponds 4 and 5 (AD ponds) was two on-site pilot anaerobic digesters. Due to digestate supply limitations, the algae digestate provision changed over the course of the experiment leading to three experimental phases (Table 3-2). Ponds 6 and 8 (FRT ponds) were fed plant fertilizer (Miracle-Gro Azalea, Camellia, Rhododendron Plant Food, Scotts Fertilizer). The amount of fertilizer fed to Ponds 6 and 8 differed by experimental phase to provide a similar level of soluble nitrogen as the AD pond set was receiving. The primary clarifier and reclaimed water ponds contained surplus soluble N and P and did not receive supplemental nutrients.

Table 3-2: Experimental phases defined by nutrient provision levels to the algae digestate-fed and fertilizer-fed ponds. During Phase 1, nutrients were “titrated” to achieve the stated goals in the weekly or twice-weekly samplings. During Phase 2, digestate supply required a fixed digestate dosing. During Phase 3, fertilizer was added in addition to digestate to maintain excess soluble N and P.

Phase	Date	Digestate (DIG) Pond Nutrient Load	Fertilizer (FRT) Pond Nutrient Load
Phase 1: 15 mg-N/L Soluble Nitrogen Goal	4/27/2015 – 6/17/2015	Calculated gallons of algae digestate/pond /day to achieve 15 mg-N/L Goal	Calculated grams of nitrogen/pond/day to achieve 15 mg-N/L
Phase 2: Constant Additions	6/18/15 – 9/2/15	7.5 gallons/pond/day + excess nitrogen in fertilizer to achieve 5 mg-N/L	10 g of N/pond/day
Phase 3: 5 mg-N/L Soluble Nitrogen Goal	9/3/15 – 12/3/15	7.5 gallons/pond/day + excess nitrogen in fertilizer to achieve 5 mg-N/L	Grams of nitrogen/pond/day to achieve 15 mg-N/L

Both Phase 1 (15 mg-N/L soluble nitrogen goal) and Phase 3 (5 mg-N/L soluble nitrogen goal) of the experiment required the use of a soluble nitrogen calculator spreadsheet to calculate the required amount of nutrient feed for a given week (Appendix A). Table 3-3 details the assumed constants used in the calculator. Phase 3 was given a lower soluble nitrogen target to account for the expected reduction in algal growth rates during the fall and winter months. The calculator used the weekly soluble nitrogen measurement in the ponds, calculated rate of soluble nitrogen leaving the pond and other assumptions to estimate the soluble nitrogen required for each recycling pond for a given week.

Table 3-3: Soluble Nitrogen Calculator Assumed Constants for both 5mg-N/L and 15 mg-N/L Phases

Soluble Nitrogen Calculator Constants	
NH _x from Algae Digestate (mg/L) (average as measured by Tiffany, 2017)	375
Average Volume of Reclaimed Water added per day (L/day)	84
Average Soluble Nitrogen Concentration in Reclaimed Water (mg-N/L)	29
Pond Volume (Liters)	10,000
Pond Surface Area (m ²)	33
Hydraulic Residence Time (days)	4
Nitrogen in Algal Biomass (g-N/g-VSS)	8%

3.3.9 Control Ponds Hydraulic Operation

For the two control sets, receiving either primary clarifier effluent or reclaimed water, the influent entered the ponds at a constant flow rate and was discharged via an overflow standpipe that kept the ponds at 30-cm depth.

Primary clarifier effluent was drawn from the clarifier with a sump pump placed between the scum baffle and the overflow weir of the primary clarifier (Figure 3-3). Reclaimed water came from the WRRF “3-water” pressurized piping system.

Due to the changing characteristics of wastewater that flowed into the wastewater treatment plant, the characteristics of the clarified effluent and reclaimed water were inconsistent. Concentrations of nutrients and pollutants varied on a day-to-day basis, but the constituent concentrations in these waters was monitored in weekly grab samples, as described in a later section.

Figure 3-3: Sump Pump Connection to Primary Clarifier (Chang, 2014)

The influent for each pond set continuously flowed from its source into the head tank of a water wheel pump that distributed the flow to the raceway ponds (Figure 3-4). Both the wastewater and reclaimed water flowed continuously into the head tanks, with excess flow wasted to a sump that discharged back to the WRRF.

Figure 3-4: Head Tank w/ Water Wheel Distribution System (Chang, 2014)

The head tanks were provided with excess flow so the head tank standpipes were constantly draining. This resulted in a constant flow of fresh effluent to the head tanks and maintained a constant water level in the head tanks. The desired flow rate into each control pond was 1.76 L/min to achieve a HRT of 4 days. Flow tests were conducted 7 days a week.

Figure 3-5: Raceway Ponds (33m²) at the San Luis Obispo Water Resource Recovery Facility with gently sloped piping shown distributing flow to each pond.

Each raceway pond had 33 m² of surface area and was 0.3-m deep (Figure 3-5). The overflow standpipe had a 10-cm diameter. Each pond had a mounted ruler to show the average depth. The water and nutrient recycling ponds were subject to water losses from evaporation, pumping leaks and algae harvest. The rulers allowed the user to refill the pond back to the designated depth on a daily basis.

Once the influent had entered each pond, it was immediately dispersed and transported throughout the raceway by the current created by a paddle wheel located at the center of the raceway stretch (Figure 3-5). The blades of the paddle wheels were made of HPDE (high-density polyethylene) supported by aluminum spokes on a steel shaft. The shaft was rotated by a motor controlled by a VFD (variable-frequency drive).

Each motor drove the paddle wheels of three adjacent raceways. Each pond had a datalogging and CO₂ sparging control system (Neptune brand), which is described in the operations section below

For each control pond (Figure 3-6), the effluent spilled over a standpipe and was pumped back to the WRRF primary clarifier effluent trough for disposal with the main wastewater flow. Some effluent from each primary clarifier control pond was intermittently pumped to tube settler tanks. Algae slurry supernatant was drained daily to feed two 1.1-m³ anaerobic digesters (Racz, 2018). The effluent from these digesters was then fed to the digestate raceways (Ponds 4 and 5).

Figure 3-6: Raceway Control Pond Process Flow Diagram

The process flow for the digestate is explained in detail in the next section.

3.3.10 Experimental Ponds Hydraulic Operation

Operation of the recycling ponds was similar to that of the control ponds but with some additional steps. Nutrients, whether digestate or fertilizer, were added to the recycling ponds at regular intervals depending on the experimental phase of the experiment (Table 3-4) (The routine weekly water samples were collected before addition). Effluent was pumped out of the recycle ponds into settling tanks, and the supernatant of

these tanks flowed back into the raceways. Coagulant addition is described later. The settled algae slurry was drained three to four times a week from the settling tanks and discarded.

Table 3-4: Recycling Ponds Nutrient Dosing Intervals by Experimental Phase

Recycling Ponds Nutrient Dosing Intervals		
Experimental Phase	Dates	Nutrient Dosing Intervals
Phase 1	4/27/2015 – 6/17/2015	3-4 days a week
Phase 2	6/18/2015 – 9/2/2015	7 days a week
Phase 3	9/3/2015 – 12/3/2015	7 days a week

Two nutrient sources were used in the recycle ponds: algae digestate and fertilizer. The fertilizer ponds (FRT; Ponds 6 and 8) recycled only water, while the digestate ponds (DIG; Ponds 4 and 5) recycled both water and nutrients (algae digestate).

The quantity of fertilizer added depended on the experimental phase of the project (Table 3-4). The fertilizer used was Miracle-Gro brand Azalea, Camellia, Rhododendron Plant Food (The Scotts Company), which was selected for its known (label) trace metal content and, relative to other products, low copper content (product data in Appendix B). The fertilizer contained 30% total nitrogen by mass of which 3% was ammoniacal nitrogen and 27% was urea nitrogen. The mass percentage of nitrogen was used to calculate the mass of nitrogen required for the FRT recycle ponds. The fertilizer was measured on a lab scale and then mixed with 5 gallons of tap water before pouring in the recycling ponds.

Table 3-2 details the amount of algae digestate that was added to the pond during the experiment. The algae digestate effluent came from unmixed, unheated anaerobic digesters with 30-day HRTs that were a part of a separate, concurrent experiment occurring at the WRRF (Racz, 2018). The digesters were fed daily, 7 days/week with settled algae from the primary clarifier control ponds.

The algae digestate was tested weekly for ammonium concentration to determine how much readily available nitrogen was being added to the DIG recycling ponds. The mass of total ammonia nitrogen (TAN)

added to the ponds with digestate was calculated. This TAN mass was then matched with the chemical fertilizer N addition to the FRT recycling ponds

Figure 3-7: Tube Settlers used for Primary Clarifier Pond Algae Harvest (Chang, 2014)

Figure 3-7 above shows the two tube settlers used for algae harvesting from the primary clarifier control ponds for the anaerobic digesters. Algae-water from the pond was pumped to the middle of the tube settler where gravity separates the biomass from the water. The supernatant water was discharged to the facility waste sump. The algae biomass settled at the bottom of the tube settler from where it was drained into thickener tanks before being fed to the digesters (Racz, 2018).

The tube settlers were designed at a tilt of 60° from the horizontal and were fitted with nine 10-cm diameter PVC tubes each that ran parallel to the length of the settler. These tubes were added to induce further settling of algae by providing a surface area for the algae to adhere to (Chang, 2014).

Figure 3-8: Diagram Water Recycling and Algae Settling System for Integrated Recycling Ponds

The recycling pond effluents also flowed to tube settlers, but the supernatant of these was passed through a second settling tank to improve suspended solids removal prior to the water returning to the ponds. These secondary tanks were cone-bottom tanks without inserted tubes (Figure 3-11). A coagulant dosing and rapid mix tank was located between the tube settlers and the cone settlers. The tube settlers in these systems had the same design as those shown in Figure 3-8.

A cationic starch coagulant was dosed in a coagulation rapid mix tank to induce further flocculation and settling of the biomass in the final cone settlers. The starch coagulant (DeLaval Product #WWT 6100S) was used to avoid adding metals or salts to the recycled flow.

Biomass that settled was drained as a slurry from the cone tanks and was disposed of. Separate slurry samples of each tube settler and cone bottom tank were taken for solids and nutrient analysis. The cone bottom tank supernatant overflowed a standpipe back into the pond for further cycles of algae grown.

Figure 3-9, Figure 3-10 and Figure 3-11 below show the major components of the recycling and settling system: tube settlers, a coagulation vessel, and a cone bottom tank.

Over the duration of the experiment, the experimental ponds recycled experienced 50 cycles of water reuse. The amount of calculated water cycles was based on the nominal HRT rate and the amount of water top-off

the experimental ponds received on average over the course of the experiment (Appendix L) (Equation 3-1).

Equation 3-1: Cycles of Reused Water within Experimental Ponds

$$\begin{aligned} \text{Cycles} &= \frac{\text{Corrected HRT}}{\text{Days of Experiment}}, \text{ where the Corrected HRT} \\ &= \frac{\text{Volume of Pond}}{\text{Volume of Pond} - \text{Volume of Average Daily Topoff}} \end{aligned}$$

The experimental ponds were topped off daily with reclaimed water to maintain a constant pond depth and volume to account for evaporation, algae harvest water losses and leak losses throughout the system.

Figure 3-9: Integrated Recycling Pond Tube Settlers

Figure 3-10:Coagulant Rapid Mixing Tank with a 450 RPM Motor

Figure 3-11: Cone Bottom Settling Tank used in recycling pond systems

Figure 3-12: Typical algae slurry drained from the bottom of the settling tanks

3.3.11 Algae Field Station Operations

This section details the operational procedures and equipment used to keep the experimental ponds operating continuously, including descriptions of some abnormal operations that occurred despite twice per day inspection and maintenance.

Table 3-5 below details the experimental conditions that were kept constant. Conditions that were controlled and changed over the course of the experiment are listed in Table 3-6 below. Experimental conditions that could not be controlled are listed in Table 3-7 below.

Table 3-5: Constant Experimental Conditions

Constant Experimental Conditions	
Nominal Hydraulic residence time	4 days
Pond volume	10,000 liters
Pond influent/effluent flowrate	1.76 L/m
Sampling time	8:00 to 9:00 AM weekly
pH	8.2 to 8.5

Table 3-6: Variable Experimental Conditions

Variable Experimental Conditions
Volume of Nutrient Additions to Recycling Ponds
Coagulant Dosing Rate
Sludge Harvested from Settlers

Table 3-7: Uncontrolled Experimental Conditions

Uncontrolled Experimental Conditions
Annual Solar Insolation
Weather
Rate of Evaporation
Nutrient Content of Influent into Ponds (primary clarifier effluent, reclaimed water effluent, algae digestate additions)
Bioflocculation and Settling Behavior of Biomass

Scheduled operation and maintenance procedures included general cleaning, system upkeep, settled sludge collection, inspection of flow rates, adding nutrient feed and calibration of continuously operating equipment and system components. A list of routine operation and maintenance procedures is in Table 3-8 below.

Table 3-8: Pilot Scale Routine Operations and Maintenance

Pilot Scale Plant Daily Operations and Maintenance
Measured pond influent flow rates and recalibrated if necessary
Confirmed that the Neptune SCADA system was operating and still collecting data
Ensured there was sufficient CO ₂ sparging pressure
Measured and added nutrient feed to integrated recycling ponds
Drained settled algae sludge from the tube settlers and cone bottom tanks
Topped off coagulant dosing tank as needed to ensure uninterrupted dosing.
Removed floating scum from the top of the tube settlers, coagulant dosing vessels and cone bottom tanks
Filled recycling ponds with reclaimed water to accommodate for evaporation losses
Measured DO, Temperature, and pH with hand-held meters for comparison to continuously logged data

Table 3-9: Pilot Scale Plant Operational Equipment

Pilot Scale Plant Operational Equipment
VFD Controlled Motorized Paddle Wheels
Peristaltic Pumps to transfer Recycling Pond Effluent to Recycling and Settling System
Coagulant Dosing Peristaltic Pump
Coagulant Vessel Mixer
Neptune SCADA Monitoring System
CO ₂ Sparging Lines
Sensorex pH Probes
Neptune DO Probes
Temperature Probes
Motorized Head Tank Distribution System

The uninterrupted operation of some pilot functions was essential to the project, including continuous mixing by the paddle wheels, flow to the head tank, consistent influent distribution, and effluent transport from the recycling ponds using peristaltic pumps.

The paddle wheels operated continuously during the experiment, only stopping for brief, intermittent, routine maintenance or power interruptions.

Head tanks were supplied with water continuously for the duration of the experiments. Head tank water wheels controlled the rate of influent flow to the raceway ponds. These systems were non-operational only during times of routine maintenance or when power was disconnected to the pilot plant. Periods of non-operation only lasted a couple of hours, about every other month.

Both the paddle wheels and head tanks were controlled by variable frequency drives (VFDs). These VFDs were kept in pump house sheds that also housed the peristaltic pumps for the recycling ponds. Each pump house had a VFD that controlled the paddle wheels and a VFD that controlled the head tank water wheel for the pond sets. Figure 3-13 below gives an example of one of the VFD Controller sets for an experimental pond set.

Figure 3-13: VFDs controlling the motors of the paddle wheels and head tank water wheels of an experimental pond set (Chang,2014).

The peristaltic pumps used in this experiment transferred the effluent from the recycling raceway ponds to the recycling and settling system and were used to control pond flow rate. Peristaltic pumps were used as they were expected to be less likely break apart naturally occurring algal flocs from the raceway pond system than other pump systems (Figure 3-14). The pumps were manually calibrated weekly to and adjusted to target the desired flow rate of 1.76 L/min for each pond.

Figure 3-14: Peristaltic Pumps for Integrated Recycling Ponds

A peristaltic pump was used to deliver the diluted coagulant to the coagulant mixing vessel in the recycling and settling system of the integrated recycling raceway ponds. The coagulant was diluted to a concentration of 100 ppt by hand in a separate vessel and was then transferred to the pumping system. This dilution facilitated dosing into the coagulant mixing vessel. Jar tests were conducted weekly at the pilot plant to determine the appropriate coagulant requirement for the week. The coagulant dosing target in the algae-water-mixture ranged from 25-300 ppm over the course of the experiment depending on the turbidity results of the weekly jar test. The jar testing method is detailed in Section 3.4.2.

The raceway pond systems required continuous monitoring systems to track variable environmental conditions. A supervisory control and data acquisition (SCADA) system was used to monitor the pH, temperature, and dissolved oxygen (DO) concentration of all eight of the control and experimental ponds. It was also used to control the pH of the ponds. A Neptune Systems SCADA system was used. The system was controlled remotely and onsite through an online interface. Apex Aqua data loggers were used to capture and collect the pH, temperature, and DO data over the course of the experiment. This data was collected at hourly intervals. Figure 3-15 below outlines the Neptune Systems SCADA configuration and module connections. Figure 3-16 shows an example of the probe mount constructed to support the SCADA

monitoring equipment for each raceway pond. Probes were located just upstream of where the influent entered the system to ensure readings of a well-mixed system.

Figure 3-15: Schematic of the Neptune SCADA System that measured and recorded pH, temperature, and DO levels in the raceway ponds. The SCADA system was also connected to solenoids that sparged CO₂ into the ponds when pH reached the upper acceptable limit

Figure 3-16: pH, Temperature and DO Probe Stand in each Raceway Pond (Chang, 2014)

Algal photosynthesis elevates the pH of waters as it consumes CO_2 . Algae cannot thrive in a high pH environment; thus it was important to maintain a pH between 8.2 and 8.5 in the raceway ponds (Weissman J. T., 1989). The Neptune SCADA system was used to control the pH in the raceway ponds. Once the pH rose to levels at or above 8.5 solenoids connected to CO_2 gas tanks released pressurized gas to the ponds through perforated plastic tubing. Figure 3-17 and Figure 3-18 below show the CO_2 sparging system used in the raceway ponds.

Figure 3-17: CO₂ sparging line for a raceway pond . A black, micro-perforated foam tubing attached to PVC pipe to allow sparging to cross the whole channel of raceway pond (Reiff, 2015)

Figure 3-18: CO₂ tanks used to sparge and acidify ponds (Left). Solenoids connected to SCADA system that released CO₂ to ponds when triggered (Right) (Chang, 2014)

3.4 Experimental Analyses

Experimental data were collected in field and in the lab at regular intervals over the duration of the experiment. Data collected from the field site included probe readings as well as quantitative and qualitative observations. Laboratory data collection included water quality testing methods as detailed in *Standard Methods for the Examination of Water and Wastewater*. Table 3-10 outlines the constituents for which data was collected throughout the experiment.

Table 3-10: Collected Experimental Data

Field Data	Laboratory Water Quality Analyses
SCADA Data: pH, Temperature, Dissolved Oxygen (DO)	Solids: Total Suspended Solids (TSS), Volatile Suspended Solids (VSS), 2-hour and 24-hour settling solids, Total Solids
Probe Measurements: Salinity, pH, Dissolved Oxygen (DO), Temperature	Phosphorus: Total and Total Reactive Phosphorus
Flow Rates	Nitrogen: Nitrite (NO ₂ ⁻), Nitrate (NO ₃ ⁻), Ammonium (NH ₄ ⁺) and Total Nitrogen
Nutrient Additions: Fertilizer and Algae Digestate	Oxygen Demand: Biological Oxygen Demand (BOD), total Chemical Oxygen Demand (tCOD) and soluble Chemical Oxygen Demand (sCOD)
Algae Harvest: Volume and Solids Analysis of Harvests	Other: Alkalinity, Microscopy/Grazers

3.4.1 Laboratory Water Quality Analyses

This experiment required extensive water quality testing using methods as defined by *Standard Methods for the Examination of Water and Wastewater*. Table 3-4 lists the water quality tests performed for each constituent.

Table 3-11: Laboratory Water Quality Analyses

Test	Analytical Method
Total and Volatile Suspended Solids	Gravimetric with 1.2-µm G4 Glass Fiber filter filtration (APHA Standard Methods 1995, sections 2540 D and E)
2 and 24-Hr Total Suspended Solids	Imhoff Cone Settling at an ambient temperature of 20°C (APHA Standard Methods 1995, sections 2540 Solids A, B and E)
Total Solids	Total Solids Dried at 103-105°C (APHA Standard Methods 2540B)
Total Phosphorus	HACH TNT 845 TP Kit (HACH Method 10210) (APHA Standard Methods 1995, section 4500-P E)
Total Reactive Phosphorus	Ascorbic Acid Analysis (Modified from EPA Standard Methods https://archive.epa.gov/water/archive/web/html/vms56.html) The test samples were

	dosed with the reagent, allowed to fully react and then filtered using 1.2µm filters and acid-washed glassware before the absorbance reading.
Nitrite (NO₂-)	Nitrite Ion Determination by Spectrophotometric Analysis (APHA Standard Methods 1995, section 4500-NO ₂ ⁻ B)
Nitrate (NO₃-)	HACH TNTplus 835/836 Nitrate Test Kit (HACH Method 10206) (APHA Standard Methods 1995, section 4500-NO ₃ ⁻)
Total Ammonia Nitrogen	Soluble Ammonium Nitrogen Analysis using Timberline TL-2800 (APHA Standard Methods 1995, section 4500-NH ₃ D)
Total Nitrogen	Persulfate Digestion Total Nitrogen Test Kit (HACH Method 10072)
5-Day Soluble and Total Carbonaceous Biochemical Oxygen Demand	5-day incubation at 20°C in autoclaved bottles, 1.2-µm Fisher brand G4 Glass Fiber filtration (APHA Standard Methods 1995, section 5210 B)
Total Chemical Oxygen Demand	HACH DR/890 Colormetric Method (APHA Standard Methods 1995, sections 5220-COD A and D)
Soluble Chemical Oxygen Demand	HACH DR/890 Colormetric Method (APHA Standard Methods 1995, sections 5220-COD A and D) using 1.2- µm G4 Glass Fiber filter filtration
Alkalinity	Sulfuric Acid Titration (APHA Standard Methods 1995, sections 2320 A & B)
Algal Identification	Selected Taxonomic References, Optical Microscope (APHA Standard Methods 1995, section 10900 E. 2.)
Zooplankton Enumeration	Numerical enumeration, Optical Microscope (APHA Standard Methods 1995, sections 10900 E. 6, 9, 17.)
Light Absorbance	Wavelength Scan from 190 nm to 490 nm of 0.45-µm filtered samples using Shimadzu UV-1700

Comprehensive laboratory testing of water quality was conducted weekly on samples collected from different points in the process train of each pond. Grab samples were taken from the influent stream and the effluent stream of the control ponds and from the nutrient feed, recycled supernatant influent, raceway pond effluent, and the harvested algae of the integrated recycling ponds. The samples were taken between 7:00 and 8:00 AM at least once each week. Sample times were based on the clock time only, which shifted for daylight savings time. Figure 3-19 identifies the sampling points. Immediately after sampling, the samples were transported to the water quality analysis laboratory in a cooler with ice for processing. Samples were either processed immediately or preserved for future testing as shown in Figure 3-20 and Figure 3-21.

Figure 3-19: Sampling Point Diagram. The regular sampling points are delineated by the red circles.

These samples were processed for water quality analysis tests as soon as possible. Subsamples were preserved for testing some analytes, per APHA standards, at a later date, typically within a week of the sample date. Most water quality tests were performed within 6 hours of the time of sampling. A variety of water quality analyses were conducted on different samples. Samples from the influent and effluent of the raceway ponds were processed according to Figure 3-20. Algae digestate was only tested for TAN and 0-Hour Solids. 0-Hour Solids represents the solids content of a sample right when it was collected.

Figure 3-20: Raceway Pond Effluent/Influent Sample Water Quality Analysis Process Flow Chart. TRP was measured using a modified version of the Ascorbic Acid Method by the EPA. TRP Samples were dosed with the reagent, allowed to fully react and then filtered through a 1.2 µm filter and acid-washed glassware before analysis.

Figure 3-21: Algal Harvest Sample Water Quality Analysis Processing Flow Chart

3.4.2 Field Water Quality Analyses

Some water quality analyses were conducted on site at the experimental ponds. These included the measurement of pH, temperature, and DO concentrations using hand probes and the SCADA system, and of algal biomass settling characteristics using a jar test.

Jar tests were conducted weekly to adjust the rate of coagulant addition to the ponds and improve settling of algae. Each test was conducted according to *APHA* standard methods. The jar test tested the turbidity of multiple samples of the supernatant flowing into the coagulant dosing bucket. Multiple dosing rates were tested on the samples. Whichever dosing rate resulted in the lowest turbidity value was used for the following week.

4. Results and Discussion

The purpose of these experiments was to determine the productivity of recycling raceway ponds and to explore whether inhibitory substances might impede the growth of algae in recycled water. Biomass productivity results are discussed first, followed by discussions of potentially inhibition.

4.1 Experimental Algae Productivity

Net productivity was the principal measurement used to assess the productivity of the algae raceway ponds. Gross productivity was also used as an indicator of the condition of the ponds. Net productivity uses the effluent biomass concentration minus the biomass concentration found in the influent for the calculation whereas gross productivity just uses the effluent biomass concentration for the calculation. Net productivity represents the growth within the system and gross productivity represents the total biomass harvested. Equations for calculating gross and net productivities are shown in Equation 4-1 and Equation 4-2. Water depth is given in meters, VSS is in mg/L, and HRT is in days. with productivity units in g-VSS/m² pond surface per day.

Equation 4-1: Gross Productivity Calculation

$$\text{Gross Productivity} = \frac{VSS_{\text{Pond}} * \text{Water Depth}}{HRT}$$

Equation 4-2: Net Productivity Calculation

$$\text{Net Productivity} = \frac{(VSS_{\text{Pond}} - VSS_{\text{Inf}}) * \text{Water Depth}}{HRT}$$

The gross and net productivity equations were determined for both control and integrated recycling ponds. One limitation of these measurements is that they do not distinguish between heterotrophic and autotrophic growth. Gross productivities will always be a larger value than the net productivity of a pond set on any given sample date.

4.1.1 Gross Productivity

Gross productivity is important to compare between the pond sets because it described the total potential biomass harvest from the ponds. The following sections detail the gross productivity results of the control and experimental recycling ponds through the duration of the experiment. Standard deviations are based on

the population of an experimental pond set. In this experiment, each pond set had two ponds to calculate a mean average and standard deviation.

4.1.1.1 Control Ponds Gross Productivity

. The mean average gross productivities for each experimental phase are shown in Table 4-1. The average gross productivities of the control pond sets are also delineated in a line graph with standard deviations based on measurements taken from the respective ponds in each control pond set in Figure 4-1. This graph provides insight into the change in productivity of pond sets on a week-by-week basis. The standard deviations on the graph highlight the differences between duplicate ponds.

Table 4-1: Average Gross Productivities of the Primary Clarifier Pond Sets and Reclaimed Water Pond Sets over the course of the experimental phases. The experimental phases represent changes in nutrient additions to the recycling ponds. There were no operational changes in the control ponds from phase to phase. In Phase 1 recycle ponds were fed nutrients (i.e. digestate or fertilizer) to maintain 15 mg-N/L of Soluble nitrogen in the recycle ponds at all times. During Phase 2 the recycle ponds were fed a consistent amount of nitrogen on a daily basis. In Phase 3 recycling ponds were fed enough nitrogen to maintain a 5 mg-N/L concentration of soluble nitrogen. The table shows the average productivity of a pond set with the corresponding standard deviation over the course of the experimental phase. The table also tabulates the productivity over the entire course of the experimental (long averages) with the corresponding standard deviation.

Primary Effluent Ponds			Reclaimed Water Ponds	
	Average Gross Productivity (g-VSS/m ² -day)	Std. Dev. (g-VSS/m ² -day)	Average Gross Productivity (g-VSS/m ² -day)	Std. Dev. (g-VSS/m ² -day)
Phase 1: 15 mg-N/L Soluble Nitrogen (4/27/2015-6/17/2015)	24.4	0.7	23.9	3.6
Phase 2: Constant Additions (6/18/2015-9/2/2015)	19.2	0.4	20.8	3.6
Phase 3: 5 mg-N/L Soluble Nitrogen (9/3/2015-12-3-2015)	15.2	0.3	11.4	1.6
Experiment Long Average (4/27/2015-12/3/2015)	19.6	0.5	18.7	3.0

Figure 4-1: Average Gross Productivities of the Primary Clarifier Pond Sets and Reclaimed Water Pond Sets over the course of the experimental phases. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. Standard deviations are represented in the error bars.

Figure 4-1 shows the average gross productivities of both control pond sets. During the fall and winter months (October through December) the primary effluent ponds had higher gross productivities than the reclaimed water ponds. The primary effluent ponds appeared to experience a “crash” in productivity around the month of July. Productivity crashes can occur due to a multitude of factors including, but not limited to solar insolation levels, a large zooplankton population, and or limitations of soluble nutrients (Owen-Smith, 2008). Hypotheses on algal raceway productivity crashes have been tested in previous studies at these raceway ponds. Although these previously mentioned factors may have contributed to the productivity crash, the data in Alexander Roberts’ experiment indicates a correlation between solar insolation levels and concentrations of sustainable biomass concentrations in a raceway pond (Roberts, 2015). When biomass concentrations exceed sustainable levels of biomass by a large margin this introduces the possibility of a productivity crash (Roberts, 2015).

The productivities of the control pond sets appear to follow annual solar insolation patterns. In San Luis Obispo, where the algae raceway ponds were located, solar insolation tends to decrease as the season transitions from summer to winter (the timeframe for this experiment) (CIMIS, 2016). As the solar

insolation decreased, so did productivity. A correlation with an average R^2 of 0.36 between solar insolation and algal productivity was documented in previous experiments using algal raceway ponds from the same Algae Field Station that the present experiment was conducted at. (Roberts, 2015).

Average productivities of the control pond sets decreased over time following solar insolation patterns. Experimental highs of almost 30 g-VSS/m²-day were observed in both control pond sets during Phase 1. Experimental lows of about 10 g-VSS/m²-day were seen in the ponds during Phase 3 of the experiment. The primary effluent control ponds had higher gross productivity values during Phase 3 of the fall/winter months of the experiment. The data in Roberts' experiment indicated that ponds receiving primary clarifier effluent, with higher BOD removal, had higher heterotrophic growth in winter months than in summer months (Roberts, 2015).

4.1.1.2 Integrated Recycling Ponds Gross Productivity

The gross productivities of the digestate fed recycling ponds and fertilizer fed recycling ponds are shown in the tables and graphs of this section. Mean average gross productivities for each experimental phase and the duration of the experiment are shown in Table 4-2 below. The average gross productivities of the recycle pond sets are also delineated in the line graph with shown in Figure 4-2. This graph provides insight into the change in productivity of pond sets on a week-by-week basis. The standard deviations on the graph highlight the difference between duplicate ponds.

Table 4-2: Recycling Ponds Average Gross Productivities over the course of the experimental phases. The experimental phases represent changes in nutrient additions to the recycling ponds. There were no operational changes in the control ponds from phase to phase. In Phase 1 recycle ponds were fed nutrients (i.e. digestate or fertilizer) to maintain 15 mg-N/L of Soluble nitrogen in the recycle ponds at all times. During Phase 2 the recycle ponds were fed a consistent amount of nitrogen on a daily basis. In Phase 3 recycling ponds were fed enough nitrogen to maintain a 5 mg-N/L concentration of Soluble nitrogen. The table shows the average productivity of a pond set with the corresponding standard deviation between those ponds over the course of the experimental phase. The table also tabulates the experimental long averages and standard deviations of the pond sets.

Digestate Recycling Ponds			Fertilizer Recycling Ponds	
	Average Gross Productivity (g-VSS/m ² -day)	Std. Dev. (g-VSS/m ² -day)	Average Gross Productivity (g-VSS/m ² -day)	Std. Dev. (g-VSS/m ² -day)
Phase 1: 15 mg-N/L Soluble Nitrogen (4/27/2015-6/17/2015)	28.1	1.6	24.3	0.5

Phase 2: Constant Additions (6/18/2015-9/2/2015)	26.3	0.3	21.1	0.8
Phase 3: 5 mg-N/L Soluble Nitrogen (9/3/2015-12-3-2015)	18.7	0.2	21.3	0.6
Experiment Long Average (4/27/2015-12/3/2015)	24.3	0.7	22.2	0.6

Figure 4-2: Average Gross Productivities of Digestate Fed Recycle Ponds and Fertilizer Fed Recycling Ponds over the course of the experimental phases. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. Standard deviations are represented in the error bars.

Figure 4-2 shows the mean productivities of both recycling pond sets. These gross productivity values are not as good of an indication of the success of the recycling systems as the net productivity value, because net productivity calculations exclude the organic content entering the pond. There were several dates during the experiment where a significant amount of algal biomass did not settle out in the settling system of the recycling system resulting in recycling of high amounts of biomass back into the pond. These instances can be observed by the spikes in Figure 4-3 and Figure 4-4. Thus, some of the productivity values were artificially higher due to the influent VSS.

A downward trend in productivity was observed as the season changed from summer to fall and then winter, indicating that gross productivity in integrated recycling ponds have a degree of correlation with solar insolation, as was similar to the phenomenon seen in the control raceway ponds and previous experiments. (Roberts, 2015).

The digestate-fed recycling ponds appeared to have higher gross productivity values than the fertilizer fed recycling ponds during the first two phases of the experiment. At about a month into the third phase fertilizer fed recycling ponds appeared to outperform the digestate-fed ponds.

Figure 4-3: Influent VSS vs. Gross Productivity of Digestate Fed Recycle Ponds over the course of the experimental phase. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. Volatile Suspended Solids (VSS) was a measurement of the biomass in a given sample and was used to quantitate the gross or net productivity in an algae raceway pond. Influent VSS was used to help calculate the net productivity in an algae raceway pond. Standard deviations are represented by the error bars.

Figure 4-4: Average Influent VSS vs. Gross Productivity of Fertilizer Fed Recycle Ponds over the course of the experimental phases. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. Volatile Suspended Solids (VSS) was a measurement of the biomass in a given sample. It was used to quantitate the gross or net productivity in an algae raceway pond. Influent VSS was used to help calculate the net productivity in an algae raceway pond. Standard deviations are represented by the error bars.

Figure 4-2 through Figure 4-4 compare the average gross productivity and influent VSS of the recycle pond sets. This graph gives a visual representation of when the gross productivity was artificially inflated due to a significant amount of algal biomass not settling in the settling system of the recycle ponds. The instances when a large amount of algal biomass escaped the settling system was due to a temporarily high concentration of colloidal algal genera in the ponds, ineffective coagulant at the time or a malfunction in the settling apparatus. Due to the limited scope of the experiment it was difficult to ascertain the exact cause for these deviations.

4.1.1.3 Gross Productivity Comparison

Figure 4-5 shows the mean average gross productivities of all the experimental pond sets (primary clarifier fed control ponds, reclaimed water fed control ponds, digestate fed recycling ponds and fertilizer fed recycling ponds) to compare the results over the duration of the experiment. The graph in Figure 4-5 and

productivity averages in Table 4-3 seems to indicate that the experimental integrated recycling ponds seemed to perform as well as the control ponds in terms of gross productivity. All ponds performed similarly in terms of gross productivity during the summer months of the experiment in Phases 1 and 2. The recycling ponds even appeared to crash like the primary effluent ponds did around June and July. During the fall and winter months, the recycling ponds tended to outperform the control ponds in regards to gross productivity measurements. This could be due to higher VSS influents in the recycling ponds during the fall and winter months.

Table 4-3: Average Gross Productivity Comparison of Control and Integrated Recycling Ponds over the course of the experimental phases. The experimental phases represent changes in nutrient additions to the recycling ponds. There were no operational changes in the control ponds from phase to phase. In Phase 1 recycle ponds were fed nutrients (i.e. digestate or fertilizer) to maintain 15 mg-N/L of Soluble nitrogen in the recycle ponds at all times. During Phase 2 the recycle ponds were fed a consistent amount of nitrogen on a daily basis. In Phase 3 recycling ponds were fed enough nitrogen to maintain a 5 mg-N/L concentration of Soluble nitrogen. The table also tabulates the experimental long averages of the pond sets.

Average Gross Productivity (g-VSS/m ² -day)				
	Primary Effluent Control Ponds	Reclaimed Water Control Ponds	Digestate Fed Recycling Ponds	Fertilizer Fed Recycling Ponds
Phase 1: 15 mg-N/L Soluble Nitrogen (4/27/2015-6/17/2015)	24.4	23.9	24.1	21.1
Phase 2: Constant Additions (6/18/2015-9/2/2015)	19.2	20.8	21.7	18.9
Phase 3: 5 mg-N/L Soluble Nitrogen (9/3/2015-12-3-2015)	15.2	11.4	14.4	16.3
Experiment Long Average (4/27/2015-12/3/2015)	19.6	18.7	20.1	18.8

Figure 4-5: Average Gross Productivity Comparison of Control and Integrated Recycling Ponds over the course of the experimental phases. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds.

4.1.2 Net Productivity

The following sections detail the net productivity results of the control and experimental recycling ponds through the duration of the experiment. The only difference between gross and net productivity calculations was that net productivity subtracts the VSS solids content of the influent going into the respective pond.

4.1.2.1 Control Ponds Net Productivity

Mean net productivities of the primary clarifier control ponds and the reclaimed water control ponds for each experimental phase and for the duration of the experiment are shown in Figure 4-6. The reclaimed water control ponds outperformed the primary control ponds in terms of biomass production except for during the winter months, when the ponds performed similarly, based on a visual comparison. This was significant as reclaimed water algal raceway ponds have not been simultaneously compared to a primary effluent control pond set before.

The average net productivities of the control pond duplicates are also shown in a line graph with standard deviations in Figure 4-6. This graph details the change in productivity of the control pond sets on a weekly basis. The standard deviations on the graph highlight the difference between the duplicate ponds.

Table 4-4: Control Ponds Average Net Productivities over the course of the experimental phases. The experimental phases had different nutrient addition regimes to the recycling ponds. There were no operational changes in the control ponds from phase to phase. In Phase 1 recycle ponds were fed nutrients (i.e. digestate or fertilizer) to maintain 15 mg-N/L of Soluble nitrogen in the recycle ponds at all times. During Phase 2 the recycle ponds were fed a consistent amount of nitrogen on a daily basis. In Phase 3 recycling ponds were fed enough nitrogen to maintain a 5 mg-N/L concentration of soluble nitrogen. The table shows the average productivity of a pond set with the corresponding standard deviation between those ponds over the course of the experimental phase.

		Primary Effluent Ponds		Reclaimed Water Ponds	
		Average Net Productivity (g-VSS/m ² -d)	Std. Dev. (g-VSS/m ² -day)	Average Net Productivity (g-VSS/m ² -day)	Std. Dev. (g-VSS/m ² -day)
Phase 1: 15 mg-N/L Soluble Nitrogen	4/27/2015 to 6/17/2015	20.7	0.7	23.0	3.7
Phase 2: Constant Additions	6/18/2015 to 9/2/2015	14.4	0.4	19.8	3.4
Phase 3: 5 mg-N/L Soluble Nitrogen	9/3/2015 to 12-3-2015	11.1	0.3	11.1	1.6
Experiment Long Average	4/27/2015 to 12/3/2015	15.4	0.5	18.0	2.9

Figure 4-6: Average Net Productivities of Primary Effluent Control Ponds and Reclaimed Water Control Ponds over the course of the experimental phases. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. Standard deviations are represented by the error bars.

It is important to note that the difference between the gross and net productivity values for the primary effluent control ponds is larger than the difference between gross and net productivity values for reclaimed water ponds. This was due to a higher VSS content in the influent for the primary effluent ponds than in the influent for the reclaimed water ponds. Figure 4-7 below is a graphical representation of the influent VSS concentrations of the control pond sets which shows a distinct difference in the amount of influent VSS between the primary effluent control ponds and the reclaimed water control ponds.

For most of the second phase of the experiment the reclaimed water ponds performed better than the primary control ponds as most data points of each pond set were outside of the standard deviation ranges of the other pond set. During the fall/winter months both control pond sets appeared to perform on an equal level in terms of net productivity. Figure 4-6 still shows the “crash” in the June/July months as was discussed in Section 4.1.1.1.

Average productivities of the control pond sets decreased over time following solar insolation patterns. Experimental highs of nearly 30 g-VSS/m²-day were observed in both control pond sets during Phase 1.

Experimental lows of approximately 10 g-VSS/m²-day were observed in the ponds during Phase 3 of the experiment. These results are similar to those seen in the gross productivity as discussed in previous sections, but are slightly lower due to the difference in calculations between gross and net productivity as shown in Equation 4-1 and Equation 4-2. The reclaimed water control ponds performed slightly better than the primary clarifier control ponds in terms of net productivity during the months of the year with higher solar insolation. As solar insolation decreased in the winter months, the primary effluent control ponds performed on a similar level as the reclaimed water control ponds.

Figure 4-7: Influent VSS of Primary Effluent and Reclaimed Water Control Ponds over the course of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. Volatile Suspended Solids (VSS) was a measurement of the biomass in a given sample. Influent VSS was used to help calculate the net productivity in an algae raceway pond. The control ponds provide a comparison basis for the integrated recycling ponds.

4.1.2.2 Integrated Recycling Ponds Net Productivity

The net productivities of the digestate fed recycling ponds and the fertilizer fed recycling ponds are shown in the Table 4-5 and Figure 4-8 through Figure 4-11. Mean average net productivities for each experimental phase and the duration of the experiment are shown in Table 4-5 below. In terms of net productivity, the digestate fed recycling ponds seemed to perform slightly better than the fertilizer fed recycling ponds

through Phase 1 and 2 of the experiment. During Phase 3 of the experiment the fertilizer fed recycle ponds surpassed the digestate fed recycle ponds in terms of net productivity.

The mean net productivities of the recycle pond sets are shown in a line graph with standard deviations in Figure 4-8. This graph details the change in productivity of pond sets on a week-by-week basis. The standard deviations on the graph highlight the difference between duplicate pond sets.

Table 4-5: Recycling Ponds Average Net Productivities over the course of the experimental phases. The experimental phases represent changes in nutrient additions to the recycling ponds. There were no operational changes in the control ponds from phase to phase. In Phase 1 recycle ponds were fed nutrients (i.e. digestate or fertilizer) to maintain 15 mg-N/L of soluble nitrogen in the recycle ponds at all times. During Phase 2 the recycle ponds were fed a consistent amount of nitrogen on a daily basis. In Phase 3 recycling ponds were fed enough nitrogen to maintain a 5 mg-N/L concentration of soluble nitrogen. The table shows the average productivity of a pond set with the corresponding standard deviation between those ponds over the course of the experimental phase. The table also tabulates the experimental long averages and standard deviation of the pond sets.

	Digestate Recycling Ponds		Fertilizer Recycling Ponds	
	Average Net Productivity (g-VSS/m ² -day)	Std. Dev. (g-VSS/m ² -day)	Average Net Productivity (g-VSS/m ² -day)	Std. Dev. (g-VSS/m ² -day)
Phase 1: 15 mg-N/L Soluble Nitrogen (4/27/2015-6/17/2015)	23.8	1.6	21.1	0.4
Phase 2: Constant Additions (6/18/2015-9/2/2015)	21.0	0.3	18.9	0.8
Phase 3: 5 mg-N/L Soluble Nitrogen (9/3/2015-12-3-2015)	14.2	0.2	16.3	0.9
Experiment Long Average (4/27/2015-12/3/2015)	19.6	0.7	18.8	0.7

Figure 4-8: Average Net Productivities of Digestate Fed Recycle Ponds and Fertilizer Fed Recycle Ponds over the course of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. Standard deviations are represented by the error bars.

Figure 4-8 shows the mean average net productivities of the digestate fed recycle ponds and the fertilizer fed recycle pond sets. The net productivity graphs are a better comparison than the gross productivity graphs as they account for weeks of high VSS influent that inflated the gross productivities of the recycle pond sets. The mean average net productivity lines for each recycle pond set seem to follow each other relatively closely.

A slight downward trend in net productivity occurred as the season changed from summer to fall and winter months. This indicates a degree of correlation to solar insolation trends, as discussed in previous sections, There was a significant drop in net productivity for the recycle ponds during fall/winter months. This was most likely attributed to decreased solar insolation and higher VSS concentrations in the influent for the integrated recycling ponds during this period.

Figure 4-9: Influent VSS of Digestate Fed Integrated Recycling Ponds and Fertilizer Fed Integrated Recycling Ponds over the course of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. Volatile Suspended Solids (VSS) was a measurement of the biomass in a given sample. Influent VSS was used to help calculate the net productivity in an algae raceway pond. This graph provides a visual representation of the concentration of organic matter being returned to the pond through the water recycling system on a week-by-week basis.

Figure 4-9 above provides a graphical representation of the VSS influent values for each integrated recycling pond set. The first half of the experiment shows a steady level of Influent VSS concentrations. Around the middle of August, the influent VSS of the digestate fed recycle pond sets started spiking about every month or so. In mid-October the same phenomenon began with the influent VSS for the fertilizer fed recycle ponds. This could be a naturally occurring cyclical phenomenon or could be due to an imperfect settling system and operations for the integrated recycling ponds.

Figure 4-10: Influent VSS vs. Net Productivity of Digestate Fed Recycle Ponds over the course of the experimental phases. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. Volatile Suspended Solids (VSS) was a measurement of the biomass in a given sample. It was used to quantitate the gross or net productivity in an algae raceway pond. Influent VSS was used to help calculate the net productivity in an algae raceway pond. Standard deviations are represented by the error bars.

Figure 4-11: Influent VSS vs. Net Productivity of Fertilizer Fed Recycle Ponds over the course of the experimental phases. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. Volatile Suspended Solids (VSS) was a measurement of the biomass in a given sample. It was used to quantitate the gross or net productivity in an algae raceway pond. Influent VSS was used to help calculate the net productivity in an algae raceway pond. Standard deviations are represented by the error bars.

Figure 4-10 and Figure 4-11 compare the net productivities and the influent VSS concentrations of both the digestate fed and fertilizer fed integrated recycling pond sets. Whenever the influent VSS had a high concentration the net productivity for that same week tended to have a lower corresponding value. Toward the fall and winter months, the influent VSS of the recycle pond sets tended to increase intermittently. This indicates that the settling system and operations during the period were not as effective in separating the organic biomass from the water as they were during the summer months. This could be due to operational error where the coagulant dosing system was not dosing at an optimal rate or that it could be a naturally occurring situation where there was a higher abundance of an algae genera that easily bypassed the settling system.

4.1.2.3 Net Productivity Comparison

Table 4-6: Average Net Productivity Comparison of Control and Integrated Recycling Ponds over the course of the experimental phases. The experimental phases represent changes in nutrient additions to the recycling ponds. There were no operational changes in the control ponds from phase to phase. In Phase 1 recycle ponds were fed nutrients (i.e. digestate or fertilizer) to maintain 15 mg-N/L of soluble nitrogen in the recycle ponds at all times. During Phase 2 the recycle ponds were fed a consistent amount of nitrogen on a daily basis. In Phase 3 recycling ponds were fed enough nitrogen to maintain a 5 mg-N/L concentration of soluble Nitrogen. The table also shows the experiment long averages of the pond sets.

Average Net Productivity (g-VSS/m ² -day)				
	Primary Effluent Control Ponds	Reclaimed Water Control Ponds	Digestate Fed Recycling Ponds	Fertilizer Fed Recycling Ponds
Phase 1: 15 mg-N/L Soluble Nitrogen (4/27/2015-6/17/2015)	20.7	23.0	23.8	21.1
Phase 2: Constant Additions (6/18/2015-9/2/2015)	14.4	19.8	21.0	18.9
Phase 3: 5 mg-N/L Soluble Nitrogen (9/3/2015-12-3-2015)	11.1	11.1	14.2	16.3
Experiment Long Average (4/27/2015-12/3/2015)	15.4	18.0	19.6	18.8

Figure 4-12: Average Net Productivity Comparison of Control and Integrated Recycling Ponds over the duration of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds.

Figure 4-12 shows the mean net productivities of all the experimental pond sets (primary clarifier fed control ponds, reclaimed water fed control ponds, digestate fed integrated recycling ponds and fertilizer fed integrated recycling ponds) to compare the results over the duration of the experiment. The graph in Figure 4-12 and net productivity mean averages in Table 4-6 indicate that the experimental integrated recycling ponds seemed to perform just as well as the control ponds in terms of net productivity. The recycling ponds met and sometimes exceeded the net productivity values of the control ponds at times. For example, both of the recycling ponds had higher mean net productivities than either of the control ponds during Phase 3 of the experiment during the fall and winter months. All experimental and control ponds do show a general downward trend in data during this time period.

4.1.3 Gross and Net Productivity Comparison

Both gross and net productivity give insight into how productive the experimental ponds were. They were also helpful in detailing differences in results between the integrated recycling pond systems and the control ponds. The recycling pond systems had a larger discrepancy between gross and net productivity values than the control ponds. The larger difference was due to the higher amount of VSS in the recycle pond influent that was not captured by the integrated solids settling system. The reclaimed water control ponds had a smaller discrepancy between the gross and net productivities than the primary effluent control ponds. This was due to much less VSS content being present in reclaimed water from the wastewater treatment plant. The reclaimed water was taken from the end of the wastewater treatment train whereas the primary clarifier effluent was taken near the beginning of the treatment train. Table 4-7 and Table 4-8, and Figures Figure 4-13 through Figure 4-18 provide a visual comparison of the gross and net productivity results for all of the experimental ponds.

Table 4-7: Average gross and net productivity comparison of all experimental ponds.

Average Gross & Net Productivity Comparison of All Experimental Ponds (g-VSS/m ² -day)					
		Primary Effluent Control Ponds	Reclaimed Water Control Ponds	Digestate Fed Recycling Ponds	Fertilizer Fed Recycling Ponds
Phase 1: 15 mg-N/L Soluble Nitrogen (4/27/2015-6/17/2015)	Gross	24.4	23.9	28.1	24.3
	Net	20.7	23.0	23.8	21.1
	Gross	19.2	20.8	26.3	21.1

Phase 2: Constant Additions (6/18/2015-9/2/2015)	Net	14.4	19.8	21.0	18.9
Phase 3: 5 mg-N/L Soluble Nitrogen (9/3/2015-12-3-2015)	Gross	15.2	11.4	18.7	21.3
	Net	11.1	11.1	14.1	16.3
Experiment Long Average (4/27/2015-12/3/2015)	Gross	19.6	18.7	24.3	22.2
	Net	15.4	18.0	19.6	18.8

Table 4-8: Average productivity difference between net and gross productivity of all experimental pond sets.

Average Gross and Net Productivity Differences (g-VSS/m ² -day)				
	Primary Effluent Control Ponds	Reclaimed Water Control Ponds	Digestate Fed Recycling Ponds	Fertilizer Fed Recycling Ponds
Phase 1: 15 mg-N/L Soluble Nitrogen (4/27/2015-6/17/2015)	3.7	0.9	4.3	3.2
Phase 2: Constant Additions (6/18/2015-9/2/2015)	4.8	1.0	5.3	2.2
Phase 3: 5 mg-N/L Soluble Nitrogen (9/3/2015-12-3-2015)	4.1	0.3	4.6	5.3
Experiment Long Average (4/27/2015-12/3/2015)	4.2	0.7	4.7	3.4

Table 4-7 and Table 4-8 compare the gross and net productivity results of all the experimental pond sets.

The reclaimed water control ponds had the least difference between the productivities while the digestate fed recycling ponds had the most over the course of the experiment.

Figure 4-13: Average Net and Gross Productivity for Primary Effluent Control Ponds over the duration of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. The difference between the two productivities was that net productivity subtracts the VSS concentration found in the influent from the VSS concentration found in the pond sample.

Figure 4-14: Average Net and Gross Productivity for Reclaimed Water Control Ponds over the duration of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental

phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. The difference between the two productivities was that net productivity subtracts the VSS concentration found in the influent from the VSS concentration found in the pond sample.

Figure 4-15: Average Net and Gross Productivity for Digestate Fed Integrated Recycling Ponds over the duration of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. The difference between the two productivities was that net productivity subtracts the VSS concentration found in the influent from the VSS concentration found in the pond sample.

Figure 4-16: Average Net and Gross Productivity for Primary Effluent Control Ponds over the duration of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. The difference between the two productivities was that net productivity subtracts the VSS concentration found in the influent from the VSS concentration found in the pond sample.

Figure 4-13 through Figure 4-16 show the week-to-week differences in gross and net productivities for each pond set. A visual inspection of these figures would indicate that the recycling ponds had larger fluctuations in the difference between the pond sets than the control ponds did. These are most likely attributed to operational errors and changing concentrations of algae genera in the recycling ponds that behaved differently in the settling system.

Figure 4-17: Average gross and net productivities of each experimental pond set during each experimental phase. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The gross productivities are represented by the hovering data point while the bars represent the net productivities. The control ponds provide a comparison for the integrated recycling ponds. The difference between the two productivities was that net productivity subtracts the VSS concentration found in the influent from the VSS concentration found in the pond sample. Standard deviations are represented as error bars.

Figure 4-18: Average gross and net productivities of each experimental pond set for the total duration of the experiment. The control ponds provide a comparison for the integrated recycling ponds. The gross productivities are

represented by the hovering data point while the bars represent the net productivities. The difference between the two productivities was that net productivity subtracts the VSS concentration found in the influent from the VSS concentration found in the pond sample. Standard deviations are represented as error bars.

Figure 4-17 and Figure 4-18 shows an overall visual comparison of the gross and net productivities of the pond sets in each experimental phase and in the experimental total. Figure 4-17 compares the productivities of the experimental and control ponds during each nutrient feed regime of the experiment. Figure 4-18 shows mean of productivities of the experimental and control ponds over the entire study.

The graphs in this section reveal that, although some pond sets were more productive than others during specific times of the experiment, the digestate fed integrated recycling ponds were the highest performing ponds over time, having the highest gross and net productivity. The fertilizer fed recycling ponds performed almost as well. There was a difference between the primary effluent control ponds and the recycling ponds, indicating that the recycling ponds were more productive than the primary effluent control ponds. The reclaimed water control ponds were almost as productive as the recycling ponds.

4.2 Algal Growth Inhibition

It is possible that the operations and configuration of the recycling system could inhibit algal growth in algae cultivation systems. The addition of algae digestate with high concentrations of organic solids could contribute to reduction in solar insolation that the raceway pond of the system. The nutrient and water recycling aspect of the systems could increase the concentration of inhibitory substances that are not easily removed through gravity settling. The potentially inhibitory and growth limiting experimental conditions examined in the recycling pond sets include the availability of nitrogen, solar limitation due to the algae digestate solids content, presence of salt and the concentration of soluble chemical oxygen demand (sCOD).

4.2.1 Soluble Nitrogen Availability

Algal biomass requires certain nutrients to grow. One of the greatest needs for algal productivity is availability of soluble nitrogen. This section examines the concentrations of soluble nitrogen in the ponds and determines whether it was a limiting factor in algal growth. Refer to Equation 4-3 and Equation 4-4 for the relationship between the different soluble forms of nitrogen. Figure 4-19 through Figure 4-22 provide a visual comparison of soluble nitrogen concentrations to the net productivities of the experimental pond sets.

Equation 4-3: Relationship of Total Nitrogen to Soluble Nitrogen (SN) and Organic Nitrogen (ON). Nitrogen measured in (mg-N/L)

$$\text{Total Nitrogen} = \text{Soluble Nitrogen} - \text{Organic Nitrogen}$$

Equation 4-4: Relationship of Soluble Nitrogen to Ammonium, Nitrate and Nitrite. Nitrogen measured in (mg-N/L)

$$\text{Soluble Nitrogen} = \text{NH}_4^+ + \text{NO}_3^- + \text{NO}_2^-$$

Figure 4-19: Average net productivity vs. average soluble nitrogen concentrations in the primary effluent fed control ponds over the duration of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. The combined concentrations of the soluble nitrogen forms represent the total available soluble nitrogen in the pond set. Nitrate data for 4/27/2015 and 5/4/2015 was missing due to test failure. Missing net productivity data on 6/8/2015 and 7/23/2015 was due to test failure. Standard deviations in net productivity are delineated by the error bars.

Figure 4-20: Average net productivity vs. average soluble nitrogen concentrations in the reclaimed water fed control ponds over the duration of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. The combined concentrations of the soluble nitrogen forms represent the total available soluble nitrogen in the pond set. Nitrate data for 4/27/2015 and 5/4/2015 was missing due to test failure. Missing net productivity data on 7/23/2015 was due to test failure. Standard deviations in net productivity are delineated by the error bars.

Figure 4-19 and Figure 4-20 compare the mean net productivities of the control pond sets to the average soluble nitrogen. The graphs reveal that soluble nitrogen of some form was consistently available in the medium throughout the experiment. The different influent sources provided different types of soluble nitrogen. The primary effluent control ponds had more soluble nitrogen forms available than the reclaimed water control ponds did. A visual comparison of the two figures shows that the reclaimed water fed control ponds had a slightly higher concentrations of total soluble nitrogen than the primary effluent control ponds. The graphs suggest that there was no significant correlation between net productivity and soluble nitrogen concentrations nor was there algal growth inhibition due to nitrogen limitation in the raceway control pond sets of the experiment.

Figure 4-21: Average net productivity vs. average soluble nitrogen concentrations in the digestate fed integrated recycling ponds over the duration of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. The combined concentrations of the soluble nitrogen forms represent the total available soluble nitrogen in the pond set. Missing net productivity data on 5/18/2015 and 7/23/2015 was due to test failure. Nitrate data for 4/27/2015 and 5/4/2015 was missing due to test failure. Standard deviations in net productivity are delineated by the error bars.

Figure 4-22: Average net productivity vs. average soluble nitrogen concentrations in the fertilizer fed integrated recycling ponds over the duration of the experiment. Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes in the control ponds from phase to phase. The control ponds provide a comparison for the integrated recycling ponds. The combined concentrations of the soluble nitrogen forms represent the total available soluble nitrogen in the pond set. Missing net productivity data on 7/23/2015 was due to test failure. Nitrate data for 4/27/2015 and 5/4/2015 was missing due to test failure. The NO₃⁻ concentration on 7/23/2015 passed QA/QC but appears to be an outlier due to unknown reasons. Standard deviations in net productivity are delineated by the error bars.

The mean average net productivities and average concentrations of available soluble nitrogen in the integrated recycling ponds are compared in Figure 4-21 and Figure 4-22. Throughout the experiment, some form of soluble nitrogen was available for assimilation. The relative concentrations of each form of nitrogen were consistent between the recycling pond sets in the first two phases of the experiment. In the third phase, more ammonium was present in the fertilizer fed recycling ponds than in the digestate fed recycling ponds. The fertilizer fed recycling ponds had less soluble nitrogen available than the digestate fed recycling ponds.

The average total soluble nitrogen concentration of both recycling pond sets were similar when compared visually in a graph. This indicates that the experiment was relatively successful in duplicating the concentrations of soluble nitrogen between the recycling pond sets for the different feed regimes in each experimental phase. Each phase had a nutrient addition regime that was designed to attain some degree of soluble nitrogen availability in each integrated recycling raceway pond. Phase 1 had a soluble nitrogen goal

of 15mg-N/L, Phase 2 had a constant nitrogen addition rate of about 10 grams a day, and Phase 3 had a soluble nitrogen goal of 5mg-N/L (Section 3 and Table 3-2 detail the experimental phases further).

Around the month of August 2015 the recycling ponds had low measurable concentrations of soluble nitrogen. This indicates that the recycling ponds were consuming soluble nitrogen at a rate equal to or faster than it was being added. This could indicate that the integrated recycling ponds were limited in productivity due to soluble nitrogen concentrations in the ponds. This is discussed further in the Conclusion section.

Table 4-9: Average net productivity and soluble nitrogen concentrations in integrated recycling pond sets over the course of the experiment as well as the experimental long average. The experimental phases represent changes in nutrient additions to the recycling ponds. There were no operational changes in the control ponds from phase to phase. In Phase 1 recycle ponds were fed nutrients (i.e. digestate or fertilizer) to maintain 15 mg-N/L of soluble nitrogen in the recycle ponds at all times. During Phase 2 the recycle ponds were fed a consistent amount of nitrogen on a daily basis. In Phase 3 recycling ponds were fed enough nitrogen to maintain a 5 mg-N/L concentration of Soluble nitrogen.

Average Net Productivity and Soluble Nitrogen Concentrations in Integrated Recycling Pond Sets				
	Digestate Fed Recycling Ponds		Fertilizer Fed Recycling Ponds	
	Net Productivity (g-VSS/m ² -day)	Soluble Nitrogen (mg-N/L)	Net Productivity (g-VSS/m ² -day)	Soluble Nitrogen (mg-N/L)
Phase 1: 15 mg-N/L Soluble Nitrogen (4/27/2015-6/17/2015)	23.8	3.54	21.1	5.45
Phase 2: Constant Additions (6/18/2015-9/2/2015)	21.0	3.33	18.9	2.53
Phase 3: 5 mg-N/L Soluble Nitrogen (9/3/2015-12-3-2015)	14.1	12.16	16.3	6.12
Experiment Long Average (4/27/2015-12/3/2015)	19.6	7.32	18.8	4.65

Table 4-9 compares the mean net productivities and soluble nitrogen concentrations of the pond sets during each experimental phase of the project and also shows an experiment-long mean. The table and graphs show that the integrated recycling ponds did not meet their soluble nitrogen concentration goals of Phase 1 and 3. Only the fertilizer fed recycling ponds were close to the 5 mg-N/L soluble nitrogen goal of Phase 3. Additionally, the soluble nitrogen concentrations during Phase 1 were lower than in Phase 3, even though

Phase 1 had a higher soluble nitrogen goal and more nitrogen additions than Phase 3. This means that each recycling pond system was consuming less nitrogen in the fall/winter months than in the summer months of the experiment.

4.2.2 Solar Inhibition due to Algae Digestate Solids Content

To a certain extent, higher levels of solar insolation can lead to higher levels of algal productivity (Chang, 2014). However, physical barriers, screens or other particulate matter filter sunlight in the water column, limiting the light available for algal growth. The introduction of algae digestate with relatively high concentrations of solids into the integrated recycling ponds could potentially increase inert or non-photosynthetic biomass that would absorb sunlight and inhibit algal growth. This section examines the concentration of the solids from algae digestate in the ponds to determine if it had a limiting effect on algal growth. Total solids of the digestate was determined by evaporation, per the Methods section.

Figure 4-23: Average concentrations of Digestate TS and Pond TSS versus net productivity of digestate fed recycle ponds over the duration of the experiment. Standard deviations for the productivity are represented by the error bars.

Experimental phases are separated by the vertical dashed lines in the line graph. Each experimental phase represented a different nutrient feed regime for the recycling pond sets. There were no operational changes

in the control ponds from phase to phase. The missing pond TSS values for 6/8/2015 and 9/10/2015 were due to QA/QC failure in the solids test. Productivity is still shown for those dates as the VSS data passed QA/QC. The concentration of solids for the raceway ponds are represented by Total Suspended Solids (TSS) while the concentration of solids for the algae digestate additions are represented by Total Solids (TS). The relationship between TS and TSS is shown in Figure 4-23

The amount of TS in the digestate was low enough that, when mixed with raceway water, the resulting TSS due to digestate was small compared to the overall pond TSS (Figure 4-23). The first phase of the experiment with a 15 mg-N/L of soluble nitrogen goal had the highest relative concentrations of the algae digestate due to the large amount of digestate added to sustain that concentration.

Table 4-10 details the mean concentrations of digestate in the ponds over the course of the experiment.

The concentration of solids for the raceway ponds are represented by Total Suspended Solids (TSS) while the concentration of solids for the algae digestate additions are represented by Total Solids (TS). The samples for measuring the TSS of the raceway ponds were taken before the algae digestate was added to the ponds on the corresponding sampling date. The TS concentration of the algae digestate was represented by the algae digestate mass added divided by the pond volume on an average weekly basis. Weeks that have missing TSS or TS values were not analyzed for percent concentration.

Table 4-10: Percent of total solids in integrated recycling ponds due to average algae digestate additions over the duration of the experiment

. Percent of Total Solids in Integrated Recycling Ponds due to Algae Digestate Additions			
Sampling Date	Average TSS of Digestate Fed Recycling Raceway Ponds	Average TS of Algae Digestate Additions	Percent of Solids in Raceway Pond from Algae Digestate Additions
4/27/2015	426.2	-	-
5/4/2015	327.1	-	-
5/11/2015	368.3	6.7	1.18%
5/18/2015	388.5	25.3	6.5%
5/25/2015	434.9	17.5	4.0%
6/1/2015	490.4	45.2	9.2%
6/8/2015	-	33.7	-
6/18/2015	596.7	28.0	4.7%
6/25/2015	436.0	7.6	1.8%
7/2/2015	320.7	7.7	2.4%

7/9/2015	296.7	12.7	4.3%
7/16/2015	312.7	9.2	3.0%
7/23/2015	299.4	5.4	1.8%
7/30/2015	297.3	3.5	1.2%
8/6/2015	549.0	5.7	1.0%
8/13/2015	445.0	5.1	1.2%
8/20/2015	463.3	9.7	2.1%
8/27/2015	406.7	15.3	3.8%
9/3/2015	401.3	5.2	1.5%
9/10/2015	-	9.4	-
9/17/2015	435.1	8.8	2.0%
9/24/2015	336.3	5.9	1.7%
10/1/2015	390.7	9.3	2.4%
10/8/2015	386.5	6.0	1.5%
10/15/2015	414.0	8.3	2.0%
10/22/2015	219.2	6.5	3.0%
10/29/2015	220.5	4.4	2.0%
11/5/2015	263.3	5.3	2.0%
11/12/2015	313.3	2.2	0.7%
11/19/2015	197.8	6.2	3.1%
11/24/2015	192.0	8.9	4.6%
12/3/2015	166.4	2.6	1.5%

Table 4-10 shows the relative concentration of the algae digestate in the digestate-fed integrated recycling ponds. Over the course of the experiment, the highest concentration of digestate in the ponds occurred during phase 1 of the experiment (15 mg-N/L of soluble nitrogen) at 9.2%. At that point, almost a tenth of the solids content in the pond was due to algae digestate additions. The digestate-fed recycling ponds had a calculated net productivity rate of 23.0 g/m²-day that same week. Note that added digestate VS solids and influent VSS were both subtracted from the effluent VSS to calculate net productivity.

The digestate-fed recycling ponds performed on a similar level to the control ponds in Phase 2 and 3 of the experiment. It does not appear that the concentrations of algae digestate in the digestate fed recycle ponds in this experiment had any significance on algal productivity.

4.2.3 Conductivity

The water recycling and settling system provide an opportunity for soluble nutrients and salts to accumulate within the raceway pond system. If these nutrients and salts do not leave the system through the settled biomass the nutrients and salts will recycle within the system for multiple rounds and eventually increase in

concentration. Salt can become an inhibitory compound to freshwater algae systems at high enough concentrations. The accumulation of salt content as measured through conductivity in the integrated recycling ponds was a point of study in this experiment.

To provide perspective on the range of salt concentrations: freshwater algae systems tend to have conductivity concentrations ranging from 1,000-1,500 $\mu\text{S}/\text{cm}$ whereas seawater will have a typical conductivity concentration of 5,000,000 $\mu\text{S}/\text{cm}$ (5 S/cm) (Lenntech, 2016). Salt concentrations would be considered inhibitory to freshwater algae systems as the concentration approaches that of seawater.

Figure 4-24: Average Conductivity ($\mu\text{S}/\text{cm}$) of all experimental pond sets measured over the course of the experiment. The different phases of the experiment are delineated by the vertical dashed lines. Each phase had a different feeding regime for the integrated recycling algae raceway ponds based on soluble nitrogen concentrations in the ponds. Operational parameters were not changed for the control raceway ponds (primary effluent fed and reclaimed water fed control ponds) for the entirety of the experiment. Conductivity data was collected on a daily basis by a hand probe. The gap in conductivity readings around July was due to malfunctioning of a probe which was then replaced..

Figure 4-24 shows the average conductivity measurements of the experimental pond sets over the course of the experiment. The figure shows the difference in the conductivity concentrations between the control ponds and the integrated recycling ponds.

For the duration of the experiment, the control ponds averaged between 1,000 and 1,500 $\mu\text{S}/\text{cm}$. The salt concentration in the control ponds declined slightly during the fall and winter months starting around October. No distinct hypothesis could be made as to why salt concentrations began to decline. Further research would be necessary to determine a reason for such a phenomena

Both experimental integrated recycling pond sets increased linearly in conductivity from the beginning of their operation through the beginning of October, when the concentration declined in a linear manner similar to the initial increase in conductivity. The recycling pond sets reached an experimental maximum conductivity of about 3,500 $\mu\text{S}/\text{cm}$ in late September, with the lowest concentrations at the outset of the experiment around 1,000 $\mu\text{S}/\text{cm}$. The maximum of 3,500 $\mu\text{S}/\text{cm}$ was significantly closer to freshwater salt concentrations than it was to seawater conditions. The maximum conductivity only reached 0.07% of saltwater conductivity concentrations after 50 rounds of water cycling over 7 months. This indicates that accumulation of salts in a pilot-scale raceway pond may not be an inhibitor to algae growth rates, which is supported by the productivity rates observed in the present research.

4.2.4 Soluble Chemical Oxygen Demand

Figure 4-25 through Figure 4-28 compare the mean sCOD to the calculated pCOD in each experimental pond set from September to the end of November of 2015. Due to experimental limitations, sCOD and pCOD were only measured during the third phase of the experiment (5 mg-N/L soluble nitrogen target). The relationship between total chemical oxygen demand (tCOD), soluble chemical oxygen demand (sCOD) and particulate chemical oxygen demand (pCOD) is outlined in Equation 4-5 below. Figures Figure 4-29 through Figure 4-32 compare the average sCOD of each experimental pond set to their respective net productivity during the same time period.

Equation 4-5: COD balance equation

$$tCOD \left(\frac{\text{mg}}{\text{L}} \right) = sCOD + pCOD$$

Figure 4-25: Average pCOD versus average sCOD in primary effluent fed control ponds during Phase 3 (5mg-N/L soluble nitrogen goal) of the experiment. tCOD was represented by the total of the stacked bars on each sampling date. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase. The standard error bars denote standard deviations. Missing data for 10/8/2015 was due to QA/QC failure.

Figure 4-26: Average pCOD versus average sCOD in reclaimed water fed control ponds during Phase 3 (5mg-N/L soluble nitrogen goal) of the experiment. tCOD was represented by the total of the stacked bars on each sampling date. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase. The standard error bars denote standard deviations. Missing data for 10/8/2015 and 11/19/2015 was due to QA/QC failure.

Figure 4-27: Average pCOD versus average sCOD in digestate fed recycling ponds during Phase 3 (5mg-N/L soluble nitrogen goal) of the experiment. tCOD was represented by the total of the stacked bars on each sampling date. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase. The standard error bars denote standard deviations. Missing data for 10/8/2015 was due to QA/QC failure.

Figure 4-28: Average pCOD versus average sCOD in fertilizer fed recycling ponds during Phase 3 (5mg-N/L soluble nitrogen goal) of the experiment. tCOD was represented by the total of the stacked bars on each sampling date. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase. The standard error bars denote standard deviations. Missing data for 10/8/2015 was due to QA/QC failure.

Figure 4-25 through Figure 4-28 show that pCOD concentrations change over the course of the experiment while sCOD concentrations remained relatively stable for all experimental pond sets, measuring between 46 mg/L and 145 mg/L. The integrated recycling ponds showed slightly higher concentrations of sCOD over the sampling time period compared to the control ponds.

Figure 4-29: Average net productivity versus average sCOD in primary effluent fed control ponds during Phase 3 (5mg-N/L soluble nitrogen goal) of the experiment. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase. The standard error bars denote standard deviations. Missing data for sCOD on 10/8/2015 was due to QA/QC failure.

Figure 4-30: Average net productivity versus average sCOD in reclaimed water fed control ponds during Phase 3 (5mg-N/L soluble nitrogen goal) of the experiment. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase

to phase. The standard error bars denote standard deviations. Missing data for sCOD on 10/8/2015 and 11/19/2015 was due to QA/QC failure.

Figure 4-31: Average net productivity versus average sCOD in digestate fed recycling ponds during Phase 3 (5mg-N/L soluble nitrogen goal) of the experiment. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase. The standard error bars denote standard deviations. Missing data for sCOD on 10/8/2015 was due to QA/QC failure.

Figure 4-32: Average net productivity versus average sCOD in fertilizer fed recycling ponds during Phase 3 (5 mg-N/L soluble nitrogen goal) of the experiment. Each experimental phase represented a change in nutrient addition

regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase. The standard error bars denote standard deviations. Missing data for sCOD on 10/8/2015 was due to QA/QC failure.

Given that the sCOD concentrations for all pond sets were relatively stable during Phase 3 of the experiment it does not appear that there was any correlation between sCOD and net productivity as shown in Figures Figure 4-29 through Figure 4-32. This analysis does not account for any potential correlation during the earlier phases of the experiment when sCOD data was not collected and where the nutrient dosage and productivities of the pond systems were higher.

4.2.5 Soluble Humic Organic Matter

Soluble humic organic matter buildup was estimated through a wavelength scan to determine if it was a potentially inhibitory variable in integrated recycling systems. Humic organic matter can be measured as a soluble component of organic matter which absorbs at a wavelength of 240 nm. The following figures in this section examine the absorbance at the wavelength of at 240 nm for samples taken during Phase 2 (constant nutrient addition regime) of this experiment. Humic matter buildup was also measured in a concurrent, lab-scale study (Spence, 2016).

Figure 4-33: Absorbance at the wavelength of 240 nm of all experimental pond sets during Phase 2 (constant nutrient feed additions) of the experiment. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase.

Figure 4-33 shows that during the time period of wavelength absorbance test measurements the absorbance of samples at the wavelength of 240 nm remained relatively level for most pond sets. The digestate fed integrated recycling ponds had consistently higher absorbance than the other pond sets.

Figure 4-34: Absorbance at a wavelength 240 nm of pond samples and influent samples for digestate fed recycling ponds during Phase 2 (constant nutrient feed additions) of the experiment. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase.

Figure 4-35: Absorbance at a wavelength of 240 nm of pond samples and influent samples for fertilizer fed recycling ponds during Phase 2 (constant nutrient feed additions) of the experiment. Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase.

Figure 4-34 and Figure 4-35 compare the absorbance of influent and pond samples of each integrated recycling system. Both the pond sample and influent sample of each recycling system had comparable absorbance values with visual correlations on the graphs. This suggests that the settling system of the recycling ponds did not separate humic matter from the pond effluent before it was returned as recycled water influent. During this sampling period the absorbance at 240 nm for digestate fed recycling ponds remained relatively level while the absorbance for the fertilizer fed recycling ponds decreased. This indicates that the fertilizer fed recycling system may behave differently than the digestate fed recycling system in attenuating humic organic matter. This could be due to the addition of algae digestate to the digestate fed recycling ponds, which had high solids concentrations and may have added humic organic matter to that recycling system.

Figure 4-36: Wavelength scan of digestate and fertilizer fed recycling ponds from samples taken on 6/23/2015 (the point of transition from a 15mg-N/L soluble nitrogen goal nutrient addition regime to a constant nutrient addition regime). Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds. Control ponds did not experience any operational changes from phase to phase. The vertical dashed line delineates the absorbance at a wavelength of 240 nm. DI water scan was used for QA/QC.

Figure 4-37: Wavelength scan of digestate and fertilizer fed recycling ponds from samples taken on 9/3/2015 (the point of transition from a constant nutrient addition regime to a 5mg-N/L soluble nitrogen goal nutrient addition regime). Each experimental phase represented a change in nutrient addition regime for integrated recycling ponds.

Control ponds did not experience any operational changes from phase to phase. The vertical dashed line delineates the absorbance at the wavelength of 240nm. DI water scan was used for QA/QC.

The absorbance data in this experiment was compared to the pilot-scale absorbance data in this experiment as shown in Figure 4-38 and Figure 4-39.

Figure 4-38: Wavelength scan of lab-scale samples after multiple rounds of water recycling. The vertical dashed line delineates the absorbance at the wavelength of 240 nm. Lab-scale data provided by a concurrent study at California Polytechnic State University (Spence, 2016).

Figure 4-39: A comparison of wavelength absorbance between lab and pilot-scale samples after multiple rounds of water recycling. The vertical dashed line delineates the absorbance of the wavelength at 240. Lab-scale data provided by a concurrent study at California Polytechnic State University (Spence, 2016). The pilot-scale data was taken from samples when the nutrient addition regimes changed in the pilot-scale integrated recycling raceway systems.

Figure 4-36 through Figure 4-39 compare the absorbances between lab and pilot-scale algae recycling systems through multiple rounds of recycling. The lab-scale results show distinguishable increases of absorbance of the wavelength at 240 nm after succeeding rounds of recycling. Between the 13th round and 29th round the digestate fed ponds increased in absorbance at the 240 nm wavelength, while the fertilizer ponds decreased in absorbance over the same period. The pilot-scale results show a less significant changes in absorbance than the lab-scale data did over multiple rounds of recycling. See Appendix L for data and calculations on rounds of water recycling within the ponds.

The impact of the wavelength absorbance data is discussed in Section 5.2.5

5. Conclusions

To further the economic and environmental benefit of microalgae-based treatment systems the viability of integrated algae raceway recycling ponds should be investigated. This study observed the productivity potential of integrated recycling ponds and the presence of any potential inhibitory substances that could be present in an integrated recycling system. The conclusions of the productivity and inhibition study objectives are discussed in the following sections

5.1 Productivity

In past experiments, standard 3-day HRT ponds have shown net productivities that average 15 g-VSS/m²-day and 2-day HRT ponds have shown average net productivities of 30 g-VSS/m²-day (Roberts, 2015). These algae raceway ponds were operated in a similar manner to the control ponds in this experiment. To compare, our 4-day HRT control ponds performed in a similar manner to previous experiments as shown in Section 4.1.

One of the most significant results to improve upon in the integrated algae raceway recycling systems was the potential for algal growth and the rate of productivity. Productivity will dictate the amount of biofuels that can be extracted per algal pond and thus its economic viability. Over the duration of this experiment the integrated recycling ponds almost consistently outperformed the control ponds in terms of net productivity as shown in Table 5-1. This shows that integrated recycling ponds can be just as productive or even more productive than traditional flow-through raceway ponds.

Table 5-1: Average Net Productivity Comparison of Control and Integrated Recycling Ponds over the course of the experimental phases. The experimental phases represent changes in nutrient additions to the recycling ponds. There were no operational changes in the control ponds from phase to phase. In Phase 1 recycle ponds were fed nutrients (i.e. digestate or fertilizer) to maintain 15 mg-N/L of soluble nitrogen in the recycle ponds at all times. During Phase 2 the recycle ponds were fed a consistent amount of nitrogen on a daily basis. In Phase 3 recycling ponds were fed enough nitrogen to maintain a 5 mg-N/L concentration of soluble Nitrogen. The table also tabulates the experimental long averages of the pond sets.

Average Net Productivity (g-VSS/m ² -day)				
	Primary Effluent Control Ponds	Reclaimed Water Control Ponds	Digestate Fed Recycling Ponds	Fertilizer Fed Recycling Ponds
Phase 1: 15 mg-N/L Soluble Nitrogen (4/27/2015-6/17/2015)	20.7	23.0	23.8	21.1
Phase 2: Constant Additions	14.4	19.8	21.0	18.9

(6/18/2015-9/2/2015)				
Phase 3: 5 mg-N/L Soluble Nitrogen (9/3/2015-12-3-2015)	11.1	11.1	14.2	16.3
Experiment Long Average (4/27/2015-12/3/2015)	15.4	18.0	19.6	18.8

5.2 Inhibition

Multiple sources of potentially inhibitory substances or experimental conditions were analyzed in the recycling pond systems to determine their presence and if they had any inhibitory impact on algal growth. This experiment looked at the availability of soluble nitrogen, the concentration of solids in the ponds due to digestate additions, the accumulation of salt in the ponds through conductivity measurements, soluble COD and the absorbance at the wavelength of 240 nm that could indicate the accumulation of humic organic matter.

5.2.1 Soluble Nitrogen Availability

The results of the experiment indicate that the integrated recycling ponds were not limited in growth by the availability of soluble nitrogen. At almost every point in time in the experiment there was some form of available soluble nitrogen in the recycling ponds.

The integrated recycling ponds could have been susceptible to inhibition due to nitrogen limitation during Phase 2 (constant nutrient addition regime) of the experiment when soluble nitrogen concentrations were relatively low. There appears to be a dip in the average net productivity of the fertilizer fed recycling pond set during Phase 2 (constant nutrient feed addition) of the experiment where soluble nitrogen concentrations in the recycling ponds were lower than at other points of the experiment. The net productivity of the digestate fed ponds did not show a change similar to the fertilizer fed recycling ponds, even though they had similarly low levels of soluble nitrogen available. Inhibition from a lack of soluble nitrogen most likely did not occur as the integrated recycling ponds had net productivity levels that were similar to or better than the control ponds during the same time period as shown in Table 4-6.

The integrated recycling ponds had significantly less soluble nitrogen available than the control ponds during the experiment. This was most likely because the recycling ponds had less exposure to nutrient sources than the control ponds. The recycling ponds were exposed to about 3-25 gallons of nutrient feed every day whereas the control ponds were exposed to about 650 gallons of influent each day at an HRT of 4 days. Even with the difference in soluble nitrogen available in the raceway ponds between the control and recycling pond sets it did not appear to inhibit algal growth in the integrated recycling pond systems.

An interesting difference between the two recycling pond sets was that the fertilizer fed recycling ponds appeared to have had less soluble nitrogen available during the experiment than the digestate fed recycling ponds. The reason for this could be that the fertilizer feed soluble nitrogen was more bioavailable for assimilation than the digestate nitrogen and or there was a delayed release in the soluble nitrogen from the digestate feed in the digestate fed recycling ponds. Further research would be required to confirm this hypothesis.

5.2.2 Inhibition due to Solids from Digestate Additions

For most of the experiment the solids from the digestate additions constituted approximately 1-3% of total solids in the ponds at any given point. Phase 1 of the experiment did see higher concentrations of solids from the digestate, up to 9.2% at one point. This concentration did not appear to be inhibitory as the net productivity rates of the digestate fed integrated recycling system was 23.8 g/m²-day on average for the duration of Phase 1, which was the highest average net productivity rate for the recycling system out of all the experimental phases. These results indicate that the solids content from the digestate additions did not have an inhibitory impact on the productivity of the digestate fed recycling system, but more thorough research and data collection would be required for a conclusive finding.

5.2.3 Inhibition due to Salt Content

There was an observed increase in conductivity concentrations in the experimental recycling ponds over the course of the experiment. The increase was not significant enough to inhibit algal growth as the max concentration of salt seen in the recycling ponds only reached 0.07% of saltwater conductivity concentrations. The correlation in which the conductivity of both the control and recycling pond sets both seemed to decline around October of 2015 shows that seasonal conditions could potentially affect the

conductivity in the ponds regardless of water and nutrient recycling conditions. Another possibility is that a more prevalent genera of microorganism present in the pond during the winter months of the experiment resulted in the decline in salt concentrations. Further research and data collection would be required to determine a more conclusive determination on the effects of salt conglomeration and pathways for which salt can enter and leave a water recycling system.

5.2.4 Inhibition due to sCOD

Although the limited data indicated the presence of soluble COD in the control and integrated recycling ponds it was inconclusive as to whether that presence had an inhibitory effect on algal productivity. Productivity results for the integrated recycling systems indicate that measured concentrations of sCOD was not inhibitory.

5.2.5 Inhibition due to Humic-Like Organic Matter

The lab-scale data showed distinguishable increases in absorbance at the 240 nm wavelength after multiple rounds of recycling. The pilot-scale did not show such significant changes in absorbance between succeeding rounds of recycling. The digestate fed ponds showed an increase in absorbance between the 13th round and 29th round of recycling, but the fertilizer ponds showed a decrease in absorbance in the same period.

The digestate fed recycling ponds had a higher absorbance reading than the fertilizer fed recycling ponds in both Round 12 samples and Round 29 samples. Given that the recycling pond systems were identical except for the nutrient feed source this would suggest that additional humic organic matter was being accumulated in the digestate fed recycling ponds due to the digestate additions.

There could be a multitude of reasons why the pilot-scale data did not more closely match the trends found in the pilot-scale data. Pilot-scale data was more limited and so a direct round to round comparison could not be made between the pilot-scale and lab-scale data. Experimental and operational conditions could have had significant impacts on the conglomeration of humic organic matter in the pond.

The increase in humic organic matter over the course of the experiment did not appear to have an inhibitory impact on the productivity of the integrated recycling ponds. Even though the integrated recycling ponds

decreased in productivity over the duration of the experiment, the decrease more closely followed a seasonal change in productivity that was linked to solar insolation levels. As well, the recycling ponds outperformed the control ponds in terms of net productivity during the winter months where solar insolation levels are seasonally low.

The current research on humic organic matter as an inhibitory compound in water and nutrient recycling ponds was inconclusive. More research and thorough data collection with statistical analysis would be required to define a more conclusive finding.

5.3 Recommendations for Future Studies

Raceway ponds with integrated water and nutrient recycling systems are a relatively new variation of a thoroughly researched algae production method. The current experiment produced results that show that nutrient and water recycling within a raceway pond system can increase productivity and resource utilization, but improvements can be made to better these results.

The settling and recycling system used in this experiment may have selected for more colloidal algae genera as the system returned algae not captured by the settlers back into the pond through the recycled supernatant water. A possible solution to this would be to return a specific amount of settled algae back into the raceway ponds at regular intervals, to inoculate for algae genera with better settling efficiency (Park 2013).

A gravity fed recycling system could potentially improve overall algae bioflocculation and settling as the system utilized in this experiment pumped algae water out of the raceway pond into the recycling system, where the supernatant water flowed back into the pond via gravity. The use of a pump could have broken up bioflocs of algae from the pond that would have improved overall settling in the settlers had they not been disturbed.

The coagulant system used to promote settling in the settlers could be improved. The coagulant dosing system was regularly calibrated, but apparently not frequently enough as the recycling ponds experienced days where the coagulant was either under or over dosed and a significant portion of algae did not settle and returned to the ponds with the supernatant. There was also the possibility that the coagulant used was

not fully captured in the harvested algae sludge. Days where more algae escaped the settling system through the supernatant could have carried back more algae biomass into the ponds and remained. The improved use of a coagulant dosing system could significantly increase effective settling rates within these experimental ponds. The possibility of coagulant accumulating in the raceway ponds or settling systems should be further investigated.

More data collection and statistical analysis in future experiments will be required to more accurately determine inhibitory substances or components in a water and nutrient recycling system and what effect they may have on productivity.

6. References

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7. Appendices

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Appendix A. Soluble Nitrogen Addition Calculator

Daily Addition Calculator September 2015 (Soluble N goal of 5mg/L)						
		Pond 4	Pond 5	Pond 6	Pond 8	Notes
Deficit Calculations	Soluble Nitrogen Concentrations GOAL [mg-N/L]	5.0	5.0	5.0	5.0	Goal of what we want in the ponds.
	Soluble Nitrogen Concentrations ACTUAL [mg-N/L]	6.7	6.9	2.7	2.9	What we actually have in the ponds.
	Nitrogen Deficit to catch up on [mg-N/L]	-1.7	-1.9	2.3	2.1	= [Goal] - [Actual]
	Nitrogen Missed Mark Reduction [mg-N/L]	8.0	2.1	0.3	0.2	Extra Reduction to make up for how much we missed last week's mark. (Current week Soluble N in ponds - last week Soluble N in ponds)
	Average Nitrogen to add over week to catch up (g-N/day)	-13.9	-5.6	2.9	2.7	What needs to be added each day of the week to make up for deficit
Soluble IN/OUT Calculations		-9.8		2.8		
	Soluble N IN/OUT (g-N/day)	0.0	0.0	0.0	0.0	N leaves the ponds and thus is the amount of N that needs to be added to the
	Nitrogen from Reclaimed Water (g-N/day)	2.4	2.4	2.4	2.4	
	Nitrogen from Reycle Influent (g-N/day)	18.0	18.0	8.7	8.7	pulled from Recorded Values. and converted to g/day
	Nitrogen from Algae Digestate (g-N/day)	10.6	10.6	0.0	0.0	
	Nitrogen from Fertilizer (g-N/day)	###	###	###	###	Mass of N needed per pond per day
Notes:	Fertilizer to Add (g-day)	###	###	###	###	Amount of Fertilizer to add each day of sample week to respective ponds.
	Calculator takes Current Soluble N concentration in the ponds and the Rate at which Soluble Nitrogen leaves to determine how much fertilizer to add each day of the sample week					

Current Week of Calculation =

###/###/###

Constants as of 8/28/15		
375	mg/L NHx-N from Algae Digestate	
7.5	gallons/day of AD	
28.3875	liters/day of AD	
10.6453125	grams of N from AD/day	
35.484375	Fertilizer Equivalent of AD addition	
29.23	Average Soluble N Conc. of RW (mg-N/L) (7/30/15-8/27/15)	
83.8	Average Volume added per day of RW (L/day) [assumed from 8/28/15]	
2.449474	Average Soluble N from RW added per day (g-N/day)	
10000	Liters/pond	
4	HRT (days)	
1.74	Flow to achieve 4 day HRT (L/min)	
2505.6	Flow per day (L/day)	
Date	Edits	
8/26/2015	Calculator created on 8/26/15. Set to 6mg/L Addition Goal with 1mg/L currently in Ponds. Will update Soluble N weekly and adjust dosing accordingly	
8/28/2015	Added the Soluble N Calculator	
8/28/2015	Reformatted the Calculator to account for Nitrogen IN/OUT and any deficit from the target goal of 5mg/L	
8/30/2015	Tryg makes a checker tab	
8/31/2015	Duplicate Productivities are averaged to keep ponds similar	
8/31/2015	Nitrogen deficit calculations will be based on pond with less Soluble N to make sure that it can catch up and at least be betwwen 3-5mg/L	
11/2/2015	Added the extra deficit calculation suggested by Erik. It takes the difference between previous weeks' and current weeks soluble nitrogen values and subtracts the difference from what should be added	

Soluble N Out Calculator						
Sample Date		Pond 4	Pond 5	Pond 6	Pond 8	Comments
8/20/2015	Productivity (g/m^2*day)	20.95		23.37		AD subtraction still needs to be accounted for this is weird cause we only add 35.5 grams of N per day recently
	Soluble N Out (g-N/day)	55.308		61.6968		
8/27/2015	Productivity (g/m^2*day)	18.9		19.5		
	Soluble N Out (g-N/day)	49.896		51.48		
9/3/2015	Productivity (g/m^2*day)	20.2		14.8		
	Soluble N Out (g-N/day)	53.328		39.072		
9/10/2015	Productivity (g/m^2*day)	25.8		22.6		
	Soluble N Out (g-N/day)	68.112		59.664		
9/17/2015	Productivity (g/m^2*day)	25.8		22.6		
	Soluble N Out (g-N/day)	68.112		59.664		
9/24/2015	Productivity (g/m^2*day)	18.9		23.1		
	Soluble N Out (g-N/day)	49.896		60.984		
10/1/2015	Productivity (g/m^2*day)	19.2		28.3		
	Soluble N Out (g-N/day)	50.688		74.712		
10/8/2015	Productivity (g/m^2*day)	23.3		25.8		
	Soluble N Out (g-N/day)	61.512		68.112		
10/15/2015	Productivity (g/m^2*day)					calculator was not run this
	Soluble N Out (g-N/day)					
10/22/2015	Productivity (g/m^2*day)	7.5		13.1		
	Soluble N Out (g-N/day)	19.8		34.584		
10/29/2015	Productivity (g/m^2*day)	6.5		11.7		
	Soluble N Out (g-N/day)	17.16		30.888		
Notes:	This calculator puts out the amount of Nitrogen leaving the pond per day based on EQN 3 from the experimental plan. Input in Orange and Output in Green. It looks like we will need to calculate our own % gN/gVSS					

Constants		Soluble N Out Calculator						
		Sample Date		Pond 4	Pond 5	Pond 6	Pond 8	Comments
Area	33	11/5/2015	Productivity (g/m^2*day)	10.1		11.3		
			Soluble N Out (g-N/day)	26.664		29.832		
8% gN/gVSS	0.08	11/12/2015	Productivity (g/m^2*day)	12.6		19.8		
			Soluble N Out (g-N/day)	33.264		52.272		
		11/19/2015	Productivity (g/m^2*day)	9.8		12.8		
			Soluble N Out (g-N/day)	25.872		33.792		
		11/24/2015	Productivity (g/m^2*day)	8.6		10.7		
			Soluble N Out (g-N/day)	22.704		28.248		
		12/3/2015	Productivity (g/m^2*day)	4.4		4.4		
			Soluble N Out (g-N/day)	11.616		11.616		
			Productivity (g/m^2*day)					
			Soluble N Out (g-N/day)	0		0		
			Productivity (g/m^2*day)					
			Soluble N Out (g-N/day)	0		0		

Recorded Values																	
Sample Date	Soluble N in Ponds (mg-N/L)				Soluble N in Recycle Influent (mg-N/L)				Soluble N Out Calculated (mg-N/L)				Fertilizer Added each day for the week (mg-N/L)				Comments
	Pond 4	Pond 5	Pond 6	Pond 8	Pond 4 + 5		Pond 6 + 8		Pond 4	Pond 5	Pond 6	Pond 8	Pond 4	Pond 5	Pond 6	Pond 8	
8/20/2015	0.66	0.89	0.54	0.3	2.91	2.91	0.52	0.52	55.308		61.69		0	0	50	50	New Experimental Plan additions began on Tuesday 9/1/15
8/27/2015	0.4	0.29	0.15	0.11	0.28	0.28	0.13	0.13	49.896		51.48		120	120	181	181	
9/3/2015	2.92	3.55	0.28	2.78	2.53	2.53	1.87	1.87									
9/10/2015	3.65	3.71	0.49	3.17	4.02	4.02	1.7	1.7	68.112		59.664						
9/17/2015																	
9/24/2015																	
10/1/2015	15.8	31.6	8.6	17.2	14.86	14.86	16.33	16.33									
10/8/2015					8.72	8.72	17.19	17.19									
10/15/2015																	
10/22/2015	9.01	3.21	8.64	7.65	7.21	7.21	7.85	7.85	19.8		34.584		0	0	27	27	
10/29/2015	14.25	12.48	8.74	3.31	7.2	7.2	4.44	4.44	17.16		30.88		0	0	27	27	The calculator put out 53 grams for P6+8 but I choose to keep it the same to adjust for deficit and to account for decreasing solar radiation.
11/5/2015	12.32	9.6	3.53	2.27	5.45	5.45	2.46	2.46	26.66		29.83		0	0	56	56	
11/12/2015	15.62	9.24	2.69	1.54	5.13	5.13	2.06	2.06	33.26		52.72		0	0	125	125	
11/19/2015	19.66	9.73	2.16	2.61	5.31	5.31	2.22	2.22	25.872		33.792		0	0	125	125	Calc says 95g for P6+8 but with a very sunny week we are keeping at 125g a day.
11/24/2015	14.72	8.95	2.48	2.7	4.79	4.79	3.35	3.35	22.704		28.248		0	0	100	100	calc says 69 but it still seems to be undershooting
12/3/2015	6.7	6.87	2.73	2.92	7.17	7.17	3.47	3.47	11.6		11.6		0	0	50	50	calc says 0 for all but productivity threw off calcs since recycle influent was very poor on that day. Adding 50 for now.
Notes:																	

Appendix B. Fertilizer Product Data

Water Soluble Fertilizer used for the FRT Integrated Recycling Ponds (Azalea, Camellia, Rhododendron Plant Food, Miracle-Gro Fertilizer)

Appendix C. Coagulant Product Data Sheet

WWT 6100S

SAFETY DATA SHEET

Preparation Date: 19-Dec-2007

Revision Date: 27-May-2015

Revision Number: 2

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name WWT 6100S

Other means of identification

Item#: 1777

Synonyms None

Recommended use of the chemical and restrictions on use

Recommended use Water Treatment - Coagulant, Restricted to professional users

Uses advised against No information available

Details of the supplier of the safety data sheet

Supplier DeLaval Cleaning Solutions
11100 N. Congress Ave.
Kansas City, MO 64153

Tel: 816-891-7700, 8am – 5pm M-F

Emergency Telephone Number

Chemtrec 1-800-424-9300

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status

This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.122)

Label Elements

Emergency Overview

Appearance Brown

Physical state Liquid

Odor No information available

Hazards not otherwise classified (HNOC)

Other Information

Unknown Acute Toxicity 100% of the mixture consists of ingredient(s) of unknown toxicity

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Weight %	Trade Secret
Aluminum salts, soluble	Not specified	10 - 20%	*

* The exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST AID MEASURES

FIRST AID MEASURES

Eye contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. If eye irritation persists, get medical advice/attention.
Skin contact	Wash off immediately with plenty of water. If skin irritation persists, call a physician.
Inhalation	Move to fresh air.
Ingestion	Do not induce vomiting. Drink 1 or 2 glasses of water. Call a physician or Poison Control Centre immediately. Never give anything by mouth to an unconscious person.

Most important symptoms and effects, both acute and delayed

Most Important Symptoms and Effects	According to our experience and to the information provided to us, the product does not have any harmful effects if it is used and handled as specified.
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Indication of any immediate medical attention and special treatment needed

Notes to Physician	Treat symptomatically.
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5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media

Water, Foam, Carbon dioxide (CO₂), Dry chemical

Unsuitable Extinguishing Media

No information available.

Specific hazards arising from the chemical

No information available.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Avoid contact with the skin and the eyes.

Environmental Precautions

Prevent further leakage or spillage if safe to do so.

Methods and material for containment and cleaning up

Soak up with inert absorbent material.

7. HANDLING AND STORAGE

Precautions for Safe Handling

Handling	Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin and eyes.
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Conditions for safe storage, including any incompatibilities

Storage	Keep containers tightly closed in a dry, cool and well-ventilated place.
Incompatible Materials	strong oxidizing agents

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Keep out of the reach of children

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Aluminum salts, soluble Not specified	TWA: 2mg/m ³		

Appropriate engineering controls

Engineering Controls Ensure adequate ventilation, especially in confined areas.

Individual protection measures, such as personal protective equipment

Eye/face Protection	Goggles.
Skin and body protection	Wear protective gloves and protective clothing.
Respiratory Protection	If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

General Hygiene Considerations Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Liquid	Odor	No information available
Appearance	Brown	Odor Threshold	No information available
Color	No information available		

<u>Property</u>	<u>Values</u>	<u>Remarks/ Method</u>
pH	4	
Melting point/freezing point	No information available	
Boiling Point/Range	No information available	
Flash Point	No information available	
Evaporation rate	No information available	
Flammability (solid, gas)	No information available	
Flammability Limit in Air		
Upper flammability limit	No information available	
Lower flammability limit	No information available	
Vapor Pressure	No information available	
Vapor Density	No information available	
Specific Gravity	1.21	
Water Solubility	soluble	
Solubility in other solvents	No information available	
Partition coefficient: n-octanol/water	No information available	
Autoignition Temperature	No information available	
Decomposition temperature	No information available	
Viscosity of Product	No information available	
Dynamic viscosity	No information available	
Explosive Properties	No information available	
Oxidizing Properties	No information available	

Other information

Softening Point	No information available
Molecular Weight	No information available

VOC Content	No information available
Density	10.0 lb/gal
Bulk Density	No information available

10. STABILITY AND REACTIVITY

Reactivity

No data available

Chemical Stability

Stable under normal conditions.

Possibility of hazardous reactions

None known.

Conditions to Avoid

Extremes of temperature and direct sunlight.

Incompatible Materials

strong oxidizing agents

Hazardous decomposition products

Carbon oxides. Sulphur oxides.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation	No data available.
Eye contact	No data available.
Skin contact	No data available.
Ingestion	No data available.

Information on toxicological effects

Symptoms	No information available.
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Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization	No information available.
Mutagenic effects	No information available.
Carcinogenicity	No information available.

Reproductive Effects	No information available.
STOT - single exposure	No information available.
STOT-repeated exposure	No information available.
Aspiration Hazard	No information available.

Numerical measures of toxicity - Product Information

Unknown Acute Toxicity	100% of the mixture consists of ingredient(s) of unknown toxicity
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12. ECOLOGICAL INFORMATION

Ecotoxicity

100% of the mixture consists of components(s) of unknown hazards to the aquatic environment

Persistence and degradability

No information available.

Bioaccumulation/Accumulation

No information available.

Other adverse effects

No information available

13. DISPOSAL CONSIDERATIONS**Waste treatment methods****Waste Disposal Method**

Dispose of in accordance with local regulations.

Contaminated Packaging

Empty containers should be taken for local recycling, recovery or waste disposal.

14. TRANSPORT INFORMATION**DOT**

Not regulated

15. REGULATORY INFORMATION**International Inventories**

TSCA	TSCA
DSL/NDSL	DSL/NDSL
EINECS/ELINCS	Does not Comply
ENCS	Does not Comply
CHINA	Does not Comply
KECL	Does not Comply
PICCS	Does not Comply
AICS	Does not Comply

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory**DSL/NDSL** - Canadian Domestic Substances List/Non-Domestic Substances List**ENCS** - Japan Existing and New Chemical Substances**IECSC** - China Inventory of Existing Chemical Substances**KECL** - Korean Existing and Evaluated Chemical Substances**PICCS** - Philippines Inventory of Chemicals and Chemical Substances**AICS** - Australian Inventory of Chemical Substances**State Regulations****California Proposition 65**

This product does not contain any Proposition 65 chemicals.

U.S. EPA Label information**EPA Pesticide registration number** Not applicable**16. OTHER INFORMATION**

NFPA**Health 1****Flammability 0****Instability 0****Physical Hazard -****Preparation Date:** 19-Dec-2007**Revision Date:** 27-May-2015**Revision Note**

No information available

Disclaimer

The information provided on this MSDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of SDS

Appendix D. Total Suspended Solids (mg/L)

	Alpha					Delta					Zeta					Omega					Comments
Date	WW Influent	Pond 1	Pond 2	Average	Std. Dev.	Δ Influent	Pond 4	Pond 5	Average	Std. Dev.	Z Influent	Pond 6	Pond 8	Average	Std. Dev.	RW Influent	Pond 3	Pond 9	Average	Std. Dev.	
4/20/2015																					
4/27/2015	60.60	368.40	309.20	338.8	29.6	48.3	432.30	420.10	426.2	6.1	78.9	333.30	335.6	334.5	1.2	7.70	449.6	412.9	431.3	18.4	
5/4/2015	50	334.27	321.07	327.7	6.6	63.0	312.93	341.33	327.1	14.2	30.4	267.87		267.9	0.0	6.13	299.2		299.2	0.0	WW INF
5/11/2015	50.27	316.00	387.73	351.9	35.9		335.87	400.67	368.3	32.4		286.67	258.9	272.8	13.9		370.4	194.4	282.4	88.0	
5/18/2015	57.60	380.93	401.60	391.3	10.3	22.5	356.53	420.40	388.5	31.9	71.1	336.13	273.9	305.0	31.1	16.40	443.2	257.3	350.3	92.9	
5/25/2015	47.53	394.67	405.07	399.9	5.2	39.4	416.27	453.47	434.9	18.6	22.5	359.87	308.3	334.1	25.8	13.20	559.2	286.3	422.8	136.4	
6/1/2015	56.60	377.20	437.73	407.5	30.3	95.9	461.20	519.60	490.4	29.2	28.0	408.13	442.1	425.1	17.0	7.33	507.9	362.9	435.4	72.5	
6/8/2015																					bad solids sample day lot of triplicates failed and VSS was higher than TSS in some cases
6/18/2015	52.00	445.33	392.00	418.7	26.7	52.7	585.3	608.00	596.7	11.3	48.7	418.66	400.0	409.3	9.3	4.00	250.7	240.0	245.3	5.3	bad INF, VSS higher than TSS in INF, RW and Pond 3
6/25/2015	133.00	334.00	234.00	284.0	50.0	30.00	469.33	402.66	436.0	33.3	42.66	356.00	506.66	431.3	75.3	10.00	364.00	278.66	321.3	42.7	
7/2/2015	64.00	289.33	240.00	264.7	24.7	59.33	358.67	282.67	320.7	38.0	42.67	266.67	314.67	290.7	24.0	18.67	397.33	276.00	336.7	60.7	
7/9/2015	58.67	266.67	140.00	203.3	63.3	35.33	297.33	296.00	296.7	0.7	22.67	233.33	220.00	226.7	6.7	29.33	382.67	309.33	346.0	36.7	
7/16/2015	64.67	102.67	162.67	132.7	30.0	4.67	253.33	372.00	312.7	59.3	24.87	224.00	228.00	226.0	2.0	12.00	518.67	249.33	384.0	134.7	
7/23/2015	45.30	188.00	212.00	200.0	12.0	70.00	276.00	322.70	299.4	23.4	24.00	190.70	53.30	122.0	68.7		462.70	81.30	272.0	190.7	RW was a negative value for TSS
7/30/2015	50.00	281.33	208.00	244.7	36.7	-477.33	342.67	252.00	297.3	45.3	17.33	252.00	221.33	236.7	15.3	2.00	438.67	212.00	325.3	113.3	VSS is larger than TSS
8/6/2015	82.67	196.00	241.33	218.7	22.7	165.33	588.00	510.00	549.0	39.0	26.00	285.33	289.33	287.3	2.0	4.67	472.00	212.00	342.0	130.0	
8/13/2015	50.00	322.70	414.40	368.6	45.9	200.00	486.70	403.30	445.0	41.7	29.70	214.40	306.70	260.6	46.1	5.30	308.90	286.70	297.8	11.1	
8/20/2015	73.00	350.00	495.56	422.8	72.8	90.67	436.67	490.00	463.3	26.7	44.00	351.67	414.67	383.2	31.5	9.00	277.33	258.67	268.0	9.3	
8/27/2015	62.70	84.00	365.30	224.7	140.7	45.30	420.00	393.30	406.7	13.4	52.00	341.30	386.00	363.7	22.4	12.00	185.30	318.70	252.0	66.7	samples may have been fried because of broken muffle furnace
9/3/2015	61.20	245.20	277.60	261.4	16.2	31.20	374.50	428.00	401.3	26.8	32.80	221.50	355.10	288.3	66.8	4.70	251.00	195.70	223.4	27.7	
9/10/2015																					Solids Fail, Tare Weights MUCH greater than TSS values
9/17/2015	39.60	159.22	170.40	164.8	5.6	199.33	412.80	457.33	435.1	22.3	18.43	413.53	312.60	363.1	50.5	7.77	346.13	236.93	291.5	54.6	DINF is SLIGHTLY QUESTIONABLE
9/24/2015	49.62	268.40	265.33	266.9	1.5	56.70	413.07	265.60	339.3	73.7	12.17	235.20	502.53	368.9	133.7	5.00	247.47	140.40	193.9	53.5	
10/1/2015	63.53	338.80	215.80	277.3	61.5	76.71	371.87	409.60	390.7	18.9	16.16	392.80	490.00	441.4	48.6	7.27	177.27	167.60	172.4	4.8	
10/8/2015	56.16	297.73	288.66	293.2	4.5	12.00	405.33	367.60	386.5	18.9	212.28	578.00	649.11	613.6	35.6	3.23	154.80	183.46	169.1	14.3	
10/15/2015	55.40	271.60	229.40	250.5	21.1	72.33	434.66	393.33	414.0	20.7	327.37	486.53	583.86	535.2	48.7	3.27	191.13	143.33	167.2	23.9	
10/22/2015	69.57	225.46	198.00	211.7	13.7	99.50	253.47	185.00	219.2	34.2	39.97	249.33	250.67	250.0	0.7	4.68	157.80	166.80	162.3	4.5	
10/29/2015	63.73	194.60	266.00	230.3	35.7	110.49	216.27	224.66	220.5	4.2	65.83	250.13	226.66	238.4	11.7	4.38	204.00	135.47	169.7	34.3	
11/5/2015	60.66	210.13	215.20	212.7	2.5	93.47	263.33		263.3	0.0	338.80	400.93	185.27	293.1	107.8	3.55	316.53	62.80	189.7	126.9	FRT pump was probably plugged and Reclaimed pond9 crashed
11/12/2015	60.58	258.67	262.80	260.7	2.1	21.73	277.60	349.07	313.3	35.7	84.07	515.20	443.60	479.4	35.8	3.90	245.20	93.53	169.4	75.8	
11/19/2015	63.57	193.20	211.20	202.2	9.0	44.84	216.27	179.33	197.8	18.5	57.80	304.00	245.87	274.9	29.1	3.80	60.66	94.80	77.7	17.1	
11/24/2015	65.23	211.73	264.93	238.3	26.6	43.73	197.60	186.40	192.0	5.6	77.47	280.53	254.00	267.3	13.3	4.60	133.87	177.07	155.5	21.6	
12/3/2015	56.50	205.60	193.20	199.4	6.2	90.93	170.00	162.80	166.4	3.6	307.20	351.87	351.87	351.9	0.0	5.90	183.60	194.80	189.2	5.6	

Appendix E. Volatile Suspended Solids (mg/L)

	Alpha					Delta					Zeta					Omega					Comments
Date	WW Influent	Pond 1	Pond 2	Average	Std. Dev.	Δ Influent	Pond 4	Pond 5	Average	Std. Dev.	Z Influent	Pond 6	Pond 8	Average	Std. Dev.	RW Influent	Pond 3	Pond 9	Average	Std. Dev.	
4/20/2015																					
4/27/2015	54.67	294.67	272.00	283.3	11.3	42.0	432.27	420.13	426.2	6.1	72.7	333.33	335.6	334.5	1.1	10.00	385.3	412.9	399.1	13.8	RW solids failure so assuming average ~ 10
5/4/2015	50.00	294.67	290.67	292.7	2.0	62.7	288.00	317.33	302.7	14.7	32.7	249.33		249.3	0.0	10.00	249.3		249.3	0.0	WW INF had problems so assuming average value of ~50
5/11/2015	46.00	282.67	346.67	314.7	32.0	37.2	306.67	382.67	344.7	38.0	24.8	276.00	242.7	259.3	16.7	7.33	337.3	181.3	259.3	78.0	
5/18/2015	54.00	338.66	354.66	346.7	8.0	23.3	333.33	385.33	359.3	26.0	64.0	320.00	368.0	344.0	24.0	16.00	405.3	245.3	325.3	80.0	
5/25/2015	43.33333	356	365.3333	360.7	4.7	34.66667	366.6667	388	377.3	10.7	20.66667	337.3333	285.3333	311.3	26.0	13.33333	506.6667	256.6667	381.7	125.0	
6/1/2015	52.00	333.30	380.30	356.8	23.5	85.3	396.00	442.00	419.0	23.0	26.7	380.00	410.7	395.4	15.4	6.00	448.0	317.3	382.7	65.4	
6/8/2015						28.0	329.33	423.11	376.2	46.9	49.3	366.66	374.7	370.7	4.0	24.00	260.0	216.0	238.0	22.0	bad solids sample day lot of triplicates failed and VSS was higher than TSS in some cases. VSS is so low in Alpha so it seems like false data
6/18/2015	56.00	418.66	362.66	390.66	28.00	39.33	492.00	517.33	504.67	12.67	46.67	388.00	366.66	377.33	10.67	8.00	252.00	216.00	234.00	18.00	bad INF, VSS higher than TSS in INF, RW and Pond 3
6/25/2015	113.00	292.00	204.00	248.00	44.00	23.33	364.00	320.00	342.00	22.00	32.66	281.33	401.33	341.33	60.00	7.33	290.67	224.00	257.34	33.33	
7/2/2015	56.00	258.67	216.00	237.34	21.34	50.00	294.67	238.67	266.67	28.00	29.33	245.33	274.67	260.00	14.67	16.00	357.33	233.33	295.33	62.00	
7/9/2015	58.66	266.66	140.00	203.33	63.33	35.33	297.33	296.00	296.67	0.66	22.66	233.33	220.00	226.67	6.67	29.33	382.66	282.66	332.66	50.00	INF VSS was higher than TSS so went with TSS
7/16/2015	66.00	105.33	174.67	140.00	34.67	11.33	218.67	310.67	264.67	46.00	24.53	233.33	197.33	215.33	18.00	15.33	469.33	241.33	355.33	114.00	
7/23/2015	42.00	196.00	188.00	192.00	4.00	71.30	237.30	281.30	259.30	22.00	52.00	177.30	96.00	136.65	40.65	5.30	404.00	104.00	254.00	150.00	Might be a FAIL since VSS was higher than TSS in Pond 1, 8, 9 and RW
7/30/2015	64.00	298.67	221.33	260.00	38.67		325.33	254.67	290.00	35.33	32.67	262.67	232.00	247.33	15.33	23.33	416.00	185.33	300.67	115.33	
8/6/2015	70.00	184.00	226.67	205.33	21.33	150.67	521.33	480.00	500.67	20.67	26.00	261.33	265.33	263.33	2.00	12.67	417.33	200.00	308.67	108.67	
8/13/2015	46.00	298.70	367.80	333.25	34.55	180.00	406.70	386.70	396.70	10.00	22.00	197.80	300.00	248.90	51.10	5.30	267.80	254.70	261.25	6.55	data from diel 445 AM set
8/20/2015	67.00	310.00	440.00	375.00	65.00	94.67	350.00	390.00	370.00	20.00	42.00	321.67	385.33	353.50	31.83	18.00	264.00	240.00	252.00	12.00	
8/27/2015	45.30	74.00	266.00	170.00	96.00	18.00	275.00	265.00	270.00	5.00	25.30	282.70	288.00	285.35	2.65	12.00	118.00	264.00	191.00	73.00	
9/3/2015	58.20	203.90	238.10	221.00	17.10	21.40	339.80	301.60	320.70	19.10	29.10	162.90	289.80	226.35	63.45	4.40	219.60	155.30	187.45	32.15	
9/10/2015	70.00	188.80	134.00	161.40	27.40	75.30	419.80	418.40	419.10	0.70	21.91	381.70	264.87	323.28	58.42	6.78	263.10	218.93	241.02	22.08	
9/17/2015	42.90	133.70	139.30	136.50	2.80	166.10	323.10	364.30	343.70	20.60	10.70	357.50	259.10	308.30	49.20	6.90	269.30	190.90	230.10	39.20	
9/24/2015	44.52	243.07	241.47	242.27	0.80	41.90	325.60	262.13	293.87	31.73	6.43	197.60	432.00	314.80	117.20	5.80	217.10	127.50	172.30	44.80	
10/1/2015	55.50	310.30	192.90	251.60	58.70	57.50	293.60	332.90	313.25	19.65	11.00	339.10	438.10	388.60	49.50	7.50	147.70	135.60	141.65	6.05	
10/8/2015	50.20	260.70	254.20	257.45	3.25	7.70	343.20	292.90	318.05	25.15	84.50	397.90	458.30	428.10	30.20	3.30	115.40	145.30	130.35	14.95	
10/15/2015	47.20	236.80	199.90	218.4	18.5	50.2	344.00	315.30	329.7	14.4	212.0	343.60	347.5	345.6	1.9	1.00	152.0	114.7	133.4	18.7	
10/22/2015	60.10	193.90	171.00	182.5	11.5	85.9	214.40	157.50	186.0	28.5	28.0	205.60	198.9	202.3	3.3	3.70	122.4	131.9	127.2	4.8	
10/29/2015	55.80	170.10	230.90	200.5	30.4	102.1	185.30	193.50	189.4	4.1	49.0	208.50	200.3	204.4	4.1	2.90	166.1	109.9	138.0	28.1	
11/5/2015	51.20	180.00	175.00	177.5	2.5	51.3	171.50		171.5	0.0	151.6	273.30	126.8	200.1	73.3	1.90	242.9	46.1	144.5	98.4	
11/12/2015	52.30	221.50	228.80	225.2	3.7	11.7	155.30	203.30	179.3	24.0	33.4	298.10	298.0	298.1	0.1	3.00	199.6	67.7	133.7	66.0	
11/19/2015	61.10	186.50	203.90	195.2	8.7	28.7	172.50	144.90	158.7	13.8	41.4	234.50	190.5	212.5	22.0	5.80	67.5	91.5	79.5	12.0	
11/24/2015	55.50	177.30	213.10	195.2	17.9	24.3	141.10	137.70	139.4	1.7	60.8	215.90	190.4	203.2	12.8	3.45	100.9	138.0	119.5	18.6	
12/3/2015	49.57	169.73	157.87	163.8	5.9	64.2	129.60	115.87	122.7	6.9	189.1	255.20	240.7	247.9	7.3	3.85	145.1	149.9	147.5	2.4	

Appendix F. Total Ammonium Nitrogen (mg-N/L)

	Alpha					Delta					Zeta					Omega					Comments
Date	WW Influent	Pond 1	Pond 2	Average	Std. Dev.	Δ Influent	Pond 4	Pond 5	Average	Std. Dev.	Z Influent	Pond 6	Pond 8	Average	Std. Dev.	RW Influent	Pond 3	Pond 9	Average	Std. Dev.	
4/20/2015																					
4/27/2015	39.17	4.25	8.08	6.2	1.9	13.3	11.67	13.60	12.6	1.0	4.3	8.57	9.8	9.2	0.6	0.00	3.82	13.6	8.7	4.9	
5/4/2015	19.68	3.88	3.71	3.8	0.1	4.9	4.18	4.19	4.2	0.0	4.5	2.08		2.1	0.0	1.65	3.85		3.9	0.0	
5/11/2015	41.82	5.33	5.01	5.2	0.2	0.2	0.65	-0.02	0.3	0.3	2.4	0.41	0.0	0.2	0.2	0.14	-0.04	0.0	0.0	0.0	45Gal. Were added on 5/9/15 to each of delta
5/18/2015	35.78	6.01	5.87	5.9	0.1	0.5	0.54	0.43	0.5	0.1	0.5	0.49	0.5	0.5	0.0	0.60	0.66	0.6	0.6	0.0	
5/25/2015	40.40	0.38	1.56	1.0	0.6	0.3	0.27	0.35	0.3	0.0	0.3	0.35	0.6	0.5	0.1	0.59	0.32	0.3	0.3	0.0	
6/1/2015	32.90	6.68	5.74	6.2	0.5	0.4	0.42	0.38	0.4	0.0	0.8	0.44	0.5	0.5	0.0	0.58	0.33	0.3	0.3	0.0	
6/8/2015	34.90	4.70	4.85	4.8	0.1	1.1	0.23	0.30	0.3	0.0	2.2	0.70	0.5	0.6	0.1	0.21	0.27	0.4	0.3	0.0	
6/18/2015	30.13	9.54	9.02	9.28	0.26	0.74	0.71	0.79	0.75	0.04	0.80	0.75	0.84	0.80	0.05	0.78	0.81	0.81	0.8	0.0	
6/25/2015	25.36	4.38	5.31	4.85	0.47	0.01	0.06	0.01	0.04	0.03	0.13	0.08	0.10	0.09	0.01	0.03	0.07	0.09	0.1	0.0	
7/2/2015	29.40	7.01	7.08	7.05	0.04	1.20	0.43	0.41	0.42	0.01	3.17	0.45	0.45	0.45	0.00	6.01	0.35	0.42	0.4	0.0	
7/9/2015	27.78	4.93	5.28	5.11	0.18	1.47	0.79	0.77	0.78	0.01	1.09	0.94	0.78	0.86	0.08	0.91	0.84	0.80	0.8	0.0	
7/16/2015	35.37	6.92	10.83	8.88	1.96	2.18	1.63	1.65	1.64	0.01	1.69	1.66	1.60	1.63	0.03	1.69	1.75	1.61	1.7	0.1	
7/23/2015	33.50	10.49	8.88	9.69	0.81	0.41	0.05	0.12	0.09	0.04	0.19	0.00	0.00	0.00	0.00	0.62	0.23	0.04	0.1	0.1	
7/30/2015	33.09	2.08	4.11	3.10	1.02	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	
8/6/2015	29.22	2.85	4.06	3.46	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	
8/13/2015	33.99	2.12	2.13	2.13	0.00	0.17	0.16	0.20	0.18	0.02	0.13	0.15	0.15	0.15	0.00	0.15	0.11	0.18	0.1	0.0	counts as 4:45 AM sample of diel study need to confirm that spike and INF were switched.
8/20/2015	32.60	3.46	4.83	4.15	0.69	2.18	0.24	0.53	0.39	0.15	0.22	0.31	0.22	0.27	0.05	0.49	0.20	0.49	0.3	0.1	
8/27/2015	35.56	5.59	3.65	4.62	0.97	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.0	0.0	
9/3/2015	34.55	4.35	3.69	4.02	0.33	1.62	1.68	2.01	1.85	0.17	0.10	0.06	0.06	0.06	0.00	0.09	0.11	0.04	0.1	0.0	
9/10/2015	28.54	4.00	3.49	3.75	0.26	0.40	0.00	0.00	0.00	0.00	0.18	0.00	0.42	0.21	0.21	0.06	0.00	0.00	0.0	0.0	
9/17/2015	38.26	7.70	6.98	7.34	0.36	0.30	0.13	0.25	0.19	0.06	0.57	0.17	0.42	0.30	0.13	0.47	0.30	0.21	0.3	0.0	
9/24/2015	35.14	4.14	3.89	4.02	0.13	0.58	0.05	0.00	0.03	0.03	3.98	3.18	6.62	4.90	1.72	0.13	0.00	0.04	0.0	0.0	
10/1/2015	41.63	7.44	5.78	6.6	0.8	2.3	0.13	0.18	0.2	0.0	11.0	3.94	8.4	6.2	2.2	0.53	0.14	0.1	0.1	0.0	
10/8/2015	12.31	1.42	1.29	1.4	0.1	0.4	0.00	0.00	0.0	0.0	0.5	0.11	0.1	0.1	0.0	0.03	0.00	0.0	0.0	0.0	low ammonia levels are accurate. Confirmed with Ryan Stumpp 10/22/15
10/15/2015	11.21	1.46	2.07	1.8	0.3	0.0	0.02	0.03	0.0	0.0	0.1	0.03	0.0	0.0	0.0	0.05	0.02	0.1	0.0	0.0	
10/22/2015	10.27	1.71	2.53	2.1	0.4	0.0	0.03	0.02	0.0	0.0	0.0	0.04	0.0	0.0	0.0	0.06	0.00	0.0	0.0	0.0	
10/29/2015	14.23	3.92	3.71	3.8	0.1	0.1	0.08	0.02	0.1	0.0	0.1	0.03	0.0	0.0	0.0	0.08	0.06	0.1	0.1	0.0	
11/5/2015	13.71	4.35	3.77	4.1	0.3	0.2	0.06	0.20	0.1	0.1	0.1	0.99	0.1	0.6	0.4	0.12	0.13	0.1	0.1	0.0	data most likely failed. Need to review. Current input is for reference.
11/12/2015	14.81	4.19	4.86	4.5	0.3	0.0	0.00	0.04	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.06	0.00	0.0	0.0	0.0	
11/19/2015	14.20	5.54	6.36	6.0	0.4	0.0	0.15	0.18	0.2	0.0	0.0	0.04	0.0	0.0	0.0	0.02	0.00	0.0	0.0	0.0	
11/24/2015	31.08	9.66	14.81	12.2	2.6	0.1	0.08	0.28	0.2	0.1	0.5	0.18	0.2	0.2	0.0	0.23	0.26	0.1	0.2	0.1	
12/3/2015	8.21	8.20	15.45	11.8	3.6	2.8	0.30	0.10	0.2	0.1	0.6	0.11	0.3	0.2	0.1	8.09	0.10	0.1	0.1	0.0	

Appendix G. Nitrate (mg-N/L)

	Alpha					Delta					Zeta					Omega					Comments
Date	WW Influent	Pond 1	Pond 2	Average	Std. Dev.	Δ Influent	Pond 4	Pond 5	Average	Std. Dev.	Z Influent	Pond 6	Pond 8	Average	Std. Dev.	RW Influent	Pond 3	Pond 9	Average	Std. Dev.	
4/20/2015																					
4/27/2015																					FAIL
5/4/2015																					FAIL
5/11/2015	0.38	16.61	9.73	13.17	3.44	0.41	0.71	0.15	0.43	0.28	7.20	5.85	6.03	5.94	0.09	35.45	21.19	27.27	24.23	3.04	
5/18/2015	0.16	16.65	11.86	14.26	2.40	0.12	-0.01	0.01	0.01	0.00	0.00	0.15	0.08	0.12	0.04	37.20	14.49	21.90	18.20	3.71	
5/25/2015	0.34	24.91	20.69	22.80	2.11	0.86	0.42	2.83	1.63	1.21	0.87	0.79	5.24	3.02	2.22	39.47	11.66	20.08	15.87	4.21	Split Fail See notes in original Data
6/1/2015	0.79	17.08	15.18	16.13	0.95	10.58	9.02	8.46	8.74	0.28	8.20	8.38	9.52	8.95	0.57	39.91	20.76	27.38	24.07	3.31	
6/8/2015	0.34	24.91	20.69	22.80	2.11	0.86	0.42	2.83	1.63	1.21	0.87	0.79	5.24	3.02	2.22	39.47	11.66	20.08	15.87	4.21	
6/18/2015	0.21	7.17	5.34	6.25	0.92	9.84	8.51	12.23	10.37	1.86	7.12	7.33	7.66	7.49	0.17	36.57	24.35	25.77	25.06	0.71	
6/25/2015	0.00	9.58	7.81	8.69	0.89	9.46	10.43	11.19	10.81	0.38	2.48	3.47	3.28	3.37	0.10	30.85	24.12	25.40	24.76	0.64	
7/2/2015	0.37	6.69	5.67	6.18	0.51	1.50	1.39	5.12	3.26	1.87	0.30	0.32	0.30	0.31	0.01	21.53	13.00	12.90	12.95	0.05	
7/9/2015	0.26	5.25	2.63	3.94	1.31	2.20	2.21	3.13	2.67	0.46	0.43	0.30	0.32	0.31	0.01	30.12	10.69	11.40	11.05	0.36	
7/16/2015	0.31	3.69	0.84	2.27	1.43	1.25	1.66	1.67	1.67	0.01	0.38	0.33	0.32	0.33	0.01	34.01	11.53	15.30	13.42	1.89	
7/23/2015	0.33	2.92	1.61	2.27	0.65	1.35	1.84	0.56	1.20	0.64	7.13	0.37	19.46	9.92	9.55	29.60	14.85	11.55	13.20	1.65	assed but Nitrate looks really weird for Zeta
7/30/2015	0.19	8.71	6.12	7.42	1.30	0.38	0.23	0.20	0.22	0.02	0.12	0.29	0.16	0.23	0.07	26.97	15.27	13.39	14.33	0.94	
8/6/2015	0.26	6.45	4.88	5.67	0.79	0.35	0.48	0.41	0.45	0.04	0.25	0.21	0.19	0.20	0.01	30.76	13.43	16.07	14.75	1.32	
8/13/2015	0.26	10.86	9.72	10.29	0.57	0.46	0.45	0.60	0.53	0.07	0.19	0.22	0.19	0.21	0.02	28.97	16.70	15.62	16.16	0.54	diel 4:45AM data
8/20/2015	0.19	14.77	7.81	11.29	3.48	0.72	0.42	0.36	0.39	0.03	0.30	0.23	0.08	0.16	0.08	29.51	17.24	17.87	17.56	0.32	
8/27/2015	0.19	10.31	9.02	9.67	0.65	0.27	0.40	0.29	0.35	0.06	0.13	0.15	0.11	0.13	0.02	23.62	12.96	13.26	13.11	0.15	
9/3/2015	0.26	13.59	13.74	13.67	0.08	0.80	1.09	1.37	1.23	0.14	1.63	0.22	2.64	1.43	1.21	30.00	19.35	19.69	19.52	0.17	
9/10/2015	0.31	13.66	8.51	11.09	2.57	2.74	2.86	3.00	2.93	0.07	1.33	0.44	2.48	1.46	1.02		15.42	10.36	12.89	2.53	EXTREMELY HIGH RW
9/17/2015	0.27	14.44	12.19	13.32	1.13	6.32	6.36	6.76	6.56	0.20	1.69	1.41	2.23	1.82	0.41	31.77	18.51	19.45	18.98	0.47	
9/24/2015	0.23	17.09	13.59	15.34	1.75	8.25	11.15	9.32	10.24	0.92	2.33	2.45	2.98	2.72	0.27	36.04	23.08	22.15	22.62	0.47	
10/1/2015	0.44	20.11	16.61	18.36	1.75	10.61	15.06	31.37	23.22	8.16	4.38	4.14	6.05	5.10	0.96	40.41	26.96	27.74	27.35	0.39	
10/8/2015	0.20	24.01	19.30	21.66	2.36	7.93	17.80	17.85	17.83	0.03	6.55	5.84	7.27	6.56	0.71	38.05	28.04	28.58	28.31	0.27	
10/15/2015	0.24	20.77	15.10	17.94	2.84	11.18	19.18	19.46	19.32	0.14	6.04	6.72	5.88	6.30	0.42	36.87	26.96	26.91	26.94	0.03	
10/22/2015	0.27	20.14	15.84	17.99	2.15	7.02	8.89	9.10	9.00	0.11	4.68	4.69	4.75	4.72	0.03	30.93	26.47	25.68	26.08	0.40	
10/29/2015	0.33	14.99	13.55	14.27	0.72	6.93	14.03	12.32	13.18	0.86	3.23	6.93	3.14	5.04	1.90	25.39	25.24	26.76	26.00	0.76	
11/5/2015	0.27	13.41	12.96	13.19	0.23	5.21	12.23	9.37	10.80	1.43	1.64	1.56	1.68	1.62	0.06	34.57	26.93	29.36	28.15	1.22	
11/12/2015	0.30	14.11	12.78	13.45	0.67	5.05	15.61	9.19	12.40	3.21	1.60	2.00	1.26	1.63	0.37	39.62	31.42	32.60	32.01	0.59	review data, problems with spike
11/19/2015	0.27	11.42	9.17	10.30	1.13	5.13	19.35	9.39	14.37	4.98	2.03	1.74	2.49	2.12	0.37	36.68	33.09	32.55	32.82	0.27	review data, problems with spike
11/24/2015	0.25	12.04	7.55	9.80	2.25	4.53	14.49	8.56	11.53	2.97	2.64	2.04	2.44	2.24	0.20	30.05	27.55	27.79	27.67	0.12	
12/3/2015	0.54	14.11	8.47	11.29	2.82	4.15	6.22	6.49	6.36	0.14	2.82	2.50	2.61	2.56	0.05	28.38	22.19	15.32	18.76	3.43	

Appendix H. Nitrite (mg-N/L)

Date	Alpha					Delta					Zeta					Omega					Comments
	WW Influent	Pond 1	Pond 2	Average	Std. Dev.	Δ Influent	Pond 4	Pond 5	Average	Std. Dev.	Z Influent	Pond 6	Pond 8	Average	Std. Dev.	RW Influent	Pond 3	Pond 9	Average	Std. Dev.	
4/20/2015																					
4/27/2015	0.03	1.96	2.79	2.4	0.4	3.3	4.77	3.21	4.0	0.8	4.7	11.09	1.7	6.4	4.7	0.01	1.3	3.5	2.4	1.1	
5/4/2015	0.00	1.07	2.04	1.6	0.5	0.1	2.22	2.17	2.2	0.0	0.0	2.54		2.5	0.0	4.41	0.1		0.1	0.0	
5/11/2015	0.00	1.50	1.38	1.4	0.1	0.0	0.06	0.00	0.0	0.0	1.2	0.79	1.2	1.0	0.2	0.01	0.0	0.5	0.3	0.2	
5/18/2015	0.01	1.56	1.45	1.5	0.1	0.0	0.00	0.00	0.0	0.0	0.0	0.00	0.0	0.0	0.0	0.02	0.1	0.7	0.4	0.3	
5/25/2015	0.00	0.17	0.28	0.2	0.1	0.5	0.09	0.87	0.5	0.4	0.3	0.38	0.1	0.3	0.1	0.02	0.0	1.0	0.5	0.5	
6/1/2015	0.01	2.68	0.93	1.8	0.9	2.6	2.76	2.60	2.7	0.1	1.4	1.42	0.8	1.1	0.3	0.01	0.1	0.9	0.5	0.4	
6/8/2015	0.01	1.80	0.94	1.37	0.43	1.32	0.39	0.22	0.31	0.09	2.30	2.31	0.87	1.59	0.72	0.01	0.08	0.81	0.4	0.4	
6/18/2015	0.03	3.62	1.45	2.54	1.08	0.14	0.20	0.20	0.20	0.00	1.00	0.51	0.72	0.61	0.10	0.01	0.09	0.67	0.4	0.3	
6/25/2015	0.00	2.44	2.15	2.29	0.14	0.13	0.06	0.04	0.05	0.01	0.36	0.25	0.38	0.32	0.06	0.00	0.11	0.67	0.4	0.3	
7/2/2015	0.00	1.64	0.97	1.31	0.34	0.00	0.05	0.10	0.08	0.03	0.00	0.00	0.00	0.00	0.00	0.40	0.09	0.76	0.4	0.3	
7/9/2015	0.00	0.91	0.57	0.74	0.17	0.13	0.04	0.02	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.18	0.09	0.99	0.5	0.5	
7/16/2015	0.01	1.15	0.31	0.73	0.42	0.14	0.03	0.09	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.03	0.12	0.62	0.4	0.3	
7/23/2015	0.01	1.25	0.74	1.00	0.26	0.04	0.04	0.01	0.03	0.02	0.09	0.00	0.08	0.04	0.04	0.03	0.11	0.61	0.4	0.3	
7/30/2015	0.01	1.05	1.01	1.03	0.02	0.03	0.00	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.09	2.62	1.4	1.3	
8/6/2015	0.01	1.12	0.73	0.93	0.20	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.48	0.3	0.2	
8/13/2015	0.00	0.55	0.59	0.57	0.02	0.07	0.00	0.09	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.27	0.2	0.1	data from diel 445AM
8/20/2015	0.01	0.66	0.48	0.57	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.18	0.1	0.1	
8/27/2015	0.00	1.88	0.89	1.39	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.29	0.2	0.1	
9/3/2015	0.01	0.99	0.95	0.97	0.02	0.11	0.15	0.17	0.16	0.01	0.14	0.00	0.08	0.04	0.04	0.01	0.04	0.05	0.0	0.0	
9/10/2015	0.07	0.72	0.62	0.67	0.05	0.88	0.79	0.71	0.75	0.04	0.19	0.05	0.27	0.16	0.11	0.04	0.05	0.05	0.1	0.0	
9/17/2015				#DIV/0!	#DIV/0!				#DIV/0!	#DIV/0!				#DIV/0!	#DIV/0!				#DIV/0!	#DIV/0!	FAIL
9/24/2015	0.00	1.32	0.70	1.01	0.31	0.94	1.35	0.11	0.73	0.62	0.49	0.38	2.46	1.42	1.04	0.01	0.03	0.07	0.1	0.0	
10/1/2015	0.01	2.59	0.80	1.70	0.90	2.00	0.58	0.09	0.34	0.25	0.99	0.48	2.70	1.59	1.11	0.01	0.03	0.08	0.1	0.0	
10/8/2015	0.00	1.61	1.39	1.50	0.11	0.43	0.03	0.04	0.04	0.01	10.18	6.30	11.07	8.69	2.39	0.42	0.03	0.07	0.1	0.0	
10/15/2015	0.01	2.22	2.77	2.50	0.28	1.06	0.03	0.03	0.03	0.00	5.73	5.81	5.62	5.72	0.09	0.03	0.04	0.10	0.1	0.0	
10/22/2015	0.11	2.95	3.40	3.18	0.23	0.17	0.09	0.09	0.09	0.00	3.15	3.91	2.90	3.41	0.51	0.12	0.07	0.09	0.1	0.0	
10/29/2015	0.00	3.59	2.57	3.08	0.51	0.13	0.14	0.14	0.14	0.00	1.16	1.78	0.14	0.96	0.82	0.01	0.07	0.08	0.1	0.0	
11/5/2015	0.02	3.72	2.90	3.31	0.41	0.09	0.03	0.03	0.03	0.00	0.73	0.98	0.45	0.72	0.27	0.09	0.04	0.09	0.1	0.0	
11/12/2015	0.02	4.96	2.94	3.95	1.01	0.04	0.01	0.01	0.01	0.00	0.46	0.69	0.28	0.49	0.21	0.02	0.05	0.12	0.1	0.0	
11/19/2015	0.01	4.69	2.93	3.81	0.88	0.18	0.16	0.16	0.16	0.00	0.19	0.38	0.12	0.25	0.13	0.01	0.05	0.12	0.1	0.0	
11/24/2015	0.01	6.66	3.57	5.12	1.55	0.18	0.15	0.11	0.13	0.02	0.17	0.26	0.11	0.19	0.08	0.02	0.05	0.10	0.1	0.0	
12/3/2015	0.01	8.41	4.57	6.49	1.92	0.24	0.18	0.28	0.23	0.05	0.09	0.12	0.04	0.08	0.04	0.09	0.14	0.24	0.2	0.1	

Appendix I. Conductivity ($\mu\text{S}/\text{cm}$)

	Alpha				Delta				Zeta				Omega				Comments
Date	Pond 1	Pond 2	Average	Std. Dev.	Pond 4	Pond 5	Average	Std. Dev.	Pond 6	Pond 8	Average	Std. Dev.	Pond 3	Pond 9	Average	Std. Dev.	
4/27/2015	1150	1135	1142.5	8	1191	1205	1198.0	7	1201.00	1241.0	1221.0	20	1133.0	1322.0	1227.5	95	
4/28/2015	1166	1148	1157.0	9	1157	1170	1163.5	7	1201	1272	1236.5	36	1156	1353	1254.5	99	
4/29/2015																	Measurements were not taken.
4/30/2015	1117	1095	1106.0	11	1130	1136	1133.0	3	1192	1356	1274.0	82	1108	1340	1224.0	116	
5/1/2015	1108	1085	1096.5	12	1144	1156	1150.0	6	1220	1370	1295.0	75	1105	1379	1242.0	137	
5/2/2015	1148	1121	1134.5	14	1233	1237	1235.0	2	1304	1397	1350.5	47	1127	1429	1278.0	151	
5/3/2015	1158	1125	1141.5	17	1253	1251	1252.0	1	1319	1399	1359.0	40	1137	1435	1286.0	149	
5/4/2015	1130	1084	1107.0	23	1278	1273	1275.5	3	1353	1351	1352.0	1	1392	1385	1388.5	4	
5/5/2015	1149	1094	1121.5	28	1297	1300	1298.5	2	1377	1323	1350.0	27	1388	1318	1353.0	35	
5/6/2015																	Measurements were not taken.
5/7/2015	1155	1154	1154.5	1	1278	1280	1279.0	1	1366	1369	1367.5	2	1363	1336	1349.5	14	
5/8/2015	1159	1189	1174.0	15	1304	1317	1310.5	7	1381	1379	1380.0	1	1354	1338	1346.0	8	
5/9/2015	1156	1158	1157.0	1	1375	1346	1360.5	15									Hach probe quit working after measuring pond 5
5/10/2015	1159	1144	1151.5	8	1361	1359	1360.0	1	1433	1441	1437.0	4	1424	1411	1417.5	7	
5/11/2015	1132	1108	1120.0	12	1381	1380	1380.5	1	1448	1457	1452.5	5	1432	1419	1425.5	7	
5/12/2015	1142	1115	1128.5	14	1401	1400	1400.5	1	1458	1474	1466.0	8	1434	1413	1423.5	11	
5/13/2015																	Measurements were not taken.
5/14/2015	1145	1108	1126.5	19	1456	1462	1459.0	3	1518	1523	1520.5	3	1449	1430	1439.5	10	
5/15/2015	1139	1108	1123.5	16	1465	1467	1466.0	1	1501	1509	1505.0	4	1425	1230	1327.5	98	
5/16/2015	1137	1107	1122.0	15	1465	1469	1467.0	2	1521	1522	1521.5	1	1436	1408	1422.0	14	
5/17/2015	1178	1139	1158.5	20	1466	1477	1471.5	6	1532	1556	1544.0	12	1458	1428	1443.0	15	
5/18/2015	1133	1096	1114.5	19	1494	1505	1499.5	6	1556	1565	1560.5	5	1459	1428	1443.5	16	
5/19/2015	1128.00	1098.00	1113.0	15	1442.00	1416.00	1429.0	13	1512.00	1509.0	1510.5	2	1428.0	1394.0	1411.0	17	
5/20/2015	1164	1118	1141.0	23	1498	1473	1485.5	13	1587	1574	1580.5	7	1520	1467	1493.5	27	
5/21/2015	1146	1110	1128.0	18	1496	1474	1485.0	11	1596	1585	1590.5	6	1510	1461	1485.5	25	
5/22/2015	1158	1125	1141.5	17	1511	1494	1502.5	9	1617	1591	1604.0	13	1515	1468	1491.5	24	
5/23/2015	1146	1122	1134.0	12	1538	1505	1521.5	17	1631	1620	1625.5	6	1518	1473	1495.5	23	
5/24/2015	1154	1128	1141.0	13	1557	1558	1557.5	1	1674	1634	1654.0	20	1496	1469	1482.5	14	
5/25/2015	1147	1149	1148.0	1	1580	1574	1577.0	3	1700	1680	1690.0	10	1534	1494	1514.0	20	
5/26/2015	1172	1163	1167.5	5	1577	1571	1574.0	3	1689	1688	1688.5	1	1532	1488	1510.0	22	
5/27/2015	1138	1118	1128.0	10	1560	1594	1577.0	17	1666	1725	1695.5	30	1499	1498	1498.5	1	
5/28/2015	1231	1189	1210.0	21	1651	1649	1650.0	1	1802	1834	1818.0	16	1577	1520	1548.5	29	
5/29/2015	1188	1170	1179.0	9	1675	1678	1676.5	2	1764	1804	1784.0	20	1550	1509	1529.5	21	
5/30/2015	1198	1173	1185.5	13	1693	1702	1697.5	5	1884	1954	1919.0	35	1563	1564	1563.5	1	
5/31/2015	1191	1168	1179.5	12	1781	1797	1789.0	8	1870	1961	1915.5	46	1603	1549	1576.0	27	
6/1/2015	1161	1138	1149.5	12	1750	1767	1758.5	9	1828	1858	1843.0	15	1542	1458	1500.0	42	
6/2/2015	1173	1148	1160.5	13	1798	1822	1810.0	12	1896	1968	1932.0	36	1608	1518	1563.0	45	
6/3/2015	1147.00	1135.00	1141.0	6	1812.00	1854.00	1833.0	21	1485.00	1810.0	1647.5	163	1499.0	1482.0	1490.5	9	
6/4/2015	1190	1164	1177.0	13	1861	1880	1870.5	10	1936	1938	1937.0	1	1593	1539	1566.0	27	
6/5/2015	1199	1178	1188.5	11	1917	1944	1930.5	14	1955	1954	1954.5	1	1554	1527	1540.5	14	
6/6/2015	1192	1148	1170.0	22	1886	1939	1912.5	27	1958	1940	1949.0	9	1463	1467	1465.0	2	
6/7/2015	1209	1183	1196.0	13	2030	2060	2045.0	15	2080	2060	2070.0	10	1542	1548	1545.0	3	
6/8/2015	1195	1174	1184.5	11	2060	2060	2060.0	0	2070	2090	2080.0	10	1556	1542	1549.0	7	
6/9/2015	1242	1215	1228.5	14	2150	2110	2130.0	20	2160	2200	2180.0	20	1566	1582	1574.0	8	
6/10/2015																	Measurements were not taken.
6/11/2015																	bad values
6/12/2015	1116	1088	1102.0	14	2040	2016	2028.0	12	2020	2050	2035.0	15	1386	1417	1401.5	16	
6/13/2015																	Measurements were not taken.
6/14/2015																	Measurements were not taken.
6/15/2015																	Measurements were not taken.
6/16/2015	1183	1173	1178.0	5	2180	2150	2165.0	15	2180	2210	2195.0	15	1461	1543	1502.0	41	
6/17/2015	1206	1224	1215.0	9	2180	2110	2145.0	35	2160	2170	2165.0	5	1502	1509	1505.5	4	
6/18/2015	1181	1170	1175.5	6	2120	2080	2100.0	20	2110	2110	2110.0	0	1458	1464	1461.0	3	
6/19/2015	1168	1174	1171.0	3	2160	2150	2155.0	5	2150	2140	2145.0	5	1477	1486	1481.5	5	
6/20/2015	1178	1183	1180.5	3	2130	2180	2155.0	25	2140	2110	2125.0	15	1497	1510	1503.5	7	
6/21/2015	1156	1157	1156.5	1	2180	2200	2190.0	10	2160	2120	2140.0	20	1493	1497	1495.0	2	
6/22/2015	1147	1153	1150.0	3	2160	2140	2150.0	10	2000	1993	1996.5	4	1460	1463	1461.5	2	
6/23/2015																	Measurements were not taken.
6/24/2015																	Measurements were not taken.
6/25/2015																	Measurements were not taken.
6/26/2015																	Measurements were not taken.
6/27/2015																	Measurements were not taken.
6/28/2015																	Measurements were not taken.
6/29/2015																	No data.
6/30/2015																	No data.
7/1/2015																	No data.
7/2/2015																	No data.
7/3/2015																	Measurements were not taken.
7/4/2015																	
7/5/2015																	Measurements were not taken.
7/6/2015																	No data.
7/7/2015																	Measurements were not taken.
7/8/2015																	Measurements were not taken.
7/9/2015																	Measurements were not taken.
7/10/2015																	
7/11/2015																	
7/12/2015																	
7/13/2015																	
7/14/2015																	
7/15/2015																	
7/16/2015	1112	1117	1114.5	3	2690	2670	2680.0	10	2640	2460	2550.0	90	1573	1445	1509.0	64	
7/17/2015	1113	1105	1109.0	4	2700	2680	2690.0	10	2640	2500	2570.0	70	1618	1472	1545.0	73	
7/18/2015																	
7/19/2015	1059	1050	1054.5	5	2570	2610	2590.0	20	2500	2360	2430.0	70	1470	1357	1413.5	57	
7/20/2015	980	974	977.0	3	2460	2490	2475.0	15	2380	2240	2310.0	70	1373	1259	1316.0	57	
7/21/2015	1000	999	999.5	1	2520	2540	2530.0	10	2430	2320	2375.0	55	1388	1308	1348.0	40	
7/22/2015	1006	1002	1004.0	2	2500	2560	2530.0	30	2450	2360	2405.0						

7/25/2015	983	995	989.0	6	2560	2480	2520.0	40	2260	1794	2027.0	233	1331	1315	1323.0	8	
7/26/2015																	
7/27/2015																	
7/28/2015	1044	1042	1043.0	1	2540	2360	2450.0	90	2120	1825	1972.5	148	1333	1302	1317.5	16	
7/29/2015	1053	1045	1049.0	4	2570	2370	2470.0	100	2110	1809	1959.5	151	1331	1306	1318.5	13	
7/30/2015	1060	1057	1058.5	2	2660	2486	2573.0	87	2210	2030	2120.0	90	1408	1401	1404.5	4	
7/31/2015	1061	1059	1060.0	1	2630	2380	2505.0	125	2160	2020	2090.0	70	1382	1364	1373.0	9	
8/1/2015	1074	1062	1068.0	6	2660	2430	2545.0	115	2210	2080	2145.0	65	1445	1426	1435.5	10	
8/2/2015	1045	1038	1041.5	4	2640	2420	2530.0	110	2210	2080	2145.0	65	1408	1377	1392.5	16	
8/3/2015	1086	1069	1077.5	9	2700	2310	2505.0	195	2240	2100	2170.0	70	1472	1440	1456.0	16	
8/4/2015	1078	1072	1075.0	3	2720	2330	2525.0	195	2250	2130	2190.0	60	1465	1423	1444.0	21	
8/5/2015	1051	1041	1046.0	5	2690	2400	2545.0	145	2210	2090	2150.0	60	1429	1374	1401.5	28	
8/6/2015																	
8/7/2015	1075	1076	1075.5	1	2680	2390	2535.0	145	2210	2090	2150.0	60	1422	1363	1392.5	30	
8/8/2015	1091	1069	1080.0	11	2680	2270	2475.0	205	2280	2190	2235.0	45	1483	1437	1460.0	23	
8/9/2015	1043	1042	1042.5	1	2720	2250	2485.0	235	2250	2160	2205.0	45	1398	1360	1379.0	19	
8/10/2015	1093	1083	1088.0	5	2730	2330	2530.0	200	2330	2260	2295.0	35	1475	1408	1441.5	34	
8/11/2015	1108	1098	1103.0	5	2780	2340	2560.0	220	2330	2300	2315.0	15	1466	1409	1437.5	29	
8/12/2015	1072	1094	1083.0	11	2750	2400	2575.0	175	2340	2270	2305.0	35	1475	1427	1451.0	24	
8/13/2015																	
8/14/2015	1117	1111	1114.0	3	2780	2530	2655.0	125	2410	2380	2395.0	15	1506	1469	1487.5	19	
8/15/2015	1091	1089	1090.0	1	2760	2340	2550.0	210	2350	2160	2255.0	95	1430	1406	1418.0	12	
8/16/2015	1125	1104	1114.5	11	2760	2560	2660.0	100	2410	2116	1813.0	597	1492	1477	1484.5	8	
8/17/2015	1117	1083	1100.0	17	2810	2510	2660.0	150	2420	2430	2425.0	5	1490	1420	1455.0	35	
8/18/2015	1133	1105	1119.0	14	2800	2550	2675.0	125	2440	2450	2445.0	5	1481	1347	1414.0	67	
8/19/2015	1128	1103	1115.5	13	2800	2550	2675.0	125	2440	2410	2425.0	15	1478	1408	1443.0	35	
8/20/2015	1130	1106	1118.0	12	2880	2620	2750.0	130	2500	2460	2480.0	20	1470	1426	1448.0	22	
8/21/2015	1131	1110	1120.5	11	2850	2650	2750.0	100	2520	2500	2510.0	10	1484	1452	1468.0	16	
8/22/2015	1128	1115	1121.5	7	2780	2730	2755.0	25	2480	2500	2490.0	10	1484	1449	1466.5	18	
8/23/2015	1118	1106	1112.0	6	2740	2730	2735.0	5	2530	2460	2495.0	35	1438	1452	1445.0	7	
8/24/2015	1116	1107	1111.5	5	2770	2760	2765.0	5	2550	2430	2490.0	60	1474	1456	1465.0	9	
8/25/2015	1117	1098	1107.5	10	2800	2800	2800.0	0	2570	2440	2505.0	65	1466	1449	1457.5	9	
8/26/2015	1118	1093	1105.5	13	2860	2770	2815.0	45	2600	2350	2475.0	125	1437	1439	1438.0	1	
8/27/2015	1119	1096	1107.5	12	2910	2820	2865.0	45	2630	2420	2525.0	105	1448	1439	1443.5	5	
8/28/2015	1133	1105	1119.0	14	2970	3490	3230.0	260	2690	2490	2590.0	100	1449	1451	1450.0	1	
8/29/2015	1133	1109	1121.0	12	2960	2890	2925.0	35	2730	2510	2620.0	110	1449	1449	1449.0	0	
8/30/2015	1115	1101	1108.0	7	2900	2900	2900.0	0	2750	2540	2645.0	105	1460	1448	1454.0	6	
8/31/2015	1101	1099	1100.0	1	2960	2840	2900.0	60	2750	2450	2600.0	150	1417	1425	1421.0	4	
9/1/2015	1112	1110	1111.0	1	2910	2900	2905.0	5	2720	2540	2630.0	90	1432	1424	1428.0	4	
9/2/2015	1118	1122	1120.0	2	2930	2920	2925.0	5	2740	2560	2650.0	90	1426	1424	1425.0	1	
9/3/2015	1113	1113	1113.0	0	2900	2950	2925.0	25	2700	2320	2510.0	190	1427	1425	1426.0	1	
9/4/2015	1084	1095	1089.5	6	2760	2940	2850.0	90	2650	2350	2500.0	150	1382	1384	1383.0	1	
9/5/2015	1077	1102	1089.5	13	2085	3020	2552.5	468	2680	2440	2560.0	120	1446	1455	1450.5	5	
9/6/2015	1075	1038	1056.5	19	2840	2850	2845.0	5	2730	2390	2560.0	170	1404	1401	1402.5	2	
9/7/2015	1096	1106	1101.0	5	2930	2930	2930.0	0	2790	2440	2615.0	175	1437	1429	1433.0	4	
9/8/2015	1085	1096	1090.5	6	2990	2980	2985.0	5	2710	2460	2585.0	125	1455	1449	1452.0	3	
9/9/2015	1106	1113	1109.5	4	3040	3020	3030.0	10	2700	2330	2515.0	185	1450	1448	1449.0	1	
9/10/2015																	
9/11/2015	1355	1355	1355.0	0	2669	2770	2719.5	51	2627	1519	2073.0	554	1518	1073	1295.5	223	
9/12/2015	1350	1395	1372.5	23	3408	3433	3420.5	13	3223	1806	2514.5	709	1715	1146	1430.5	285	
9/13/2015	1025	898	961.5	64	1423	2900	2161.5	739	2976	2677	2826.5	150	650	1716	1183.0	533	
9/14/2015	1292	1294	1293.0	1	3066	2311	2688.5	378	2982	2652	2817.0	165	1601	1629	1615.0	14	
9/15/2015	1259	1245	1252.0	7	3010	3227	3118.5	109	2865	2618	2741.5	124	1568	1530	1549.0	19	
9/16/2015	1260	1250	1255.0	5	3010	3260	3135.0	125	2901	2669	2785.0	116	1590	1549	1569.5	21	
9/17/2015	1191	1163	1177.0	14	2851	3098	2974.5	124	2781	2576	2678.5	103	1500	1444	1472.0	28	
9/18/2015	1200	1179	1189.5	11	3000	3261	3130.5	131	2940	2746	2843.0	97	1527	1518	1522.5	5	
9/19/2015	1282	1272	1277.0	5	3291	3564	3427.5	137	3062	2947	3004.5	58	1631	1613	1622.0	9	
9/20/2015	1284	1297	1290.5	7	3513	3784	3648.5	136	3269	3149	3209.0	60	1700	1648	1674.0	26	
9/21/2015	1184	1163	1173.5	11	3049	3380	3214.5	166	2912	2759	2835.5	77	1541	1497	1519.0	22	
9/22/2015	1224	1198	1211.0	13	3227	3586	3406.5	180	3075	2955	3015.0	60	1613	1578	1595.5	18	
9/23/2015	1181	1163	1172.0	9	3094	3443	3268.5	175	2794	2898	2846.0	52	1552	1516	1534.0	18	
9/24/2015	1171	1237	1204.0	33	3452	3656	3554.0	102	2966	3111	3038.5	73	1673	1633	1653.0	20	
9/25/2015																	
9/26/2015	1211	1186	1198.5	13	3379	3527	3453.0	74	2910	3049	2979.5	70	1597	1564	1580.5	17	
9/27/2015	1176	1170	1173.0	3	3424	3322	3373.0	51	2896	3095	2995.5	100	1593	1567	1580.0	13	
9/28/2015																	batteries out
9/29/2015																	missing
9/30/2015	1124	1109	1116.5	8	3073	3077	3075.0	2	2742	2534	2638.0	104	1459	1435	1447.0	12	
10/1/2015	1150	1138	1144.0	6	3077	3175	3126.0	49	2788	1938	2363.0	425	1485	1473	1479.0	6	
10/2/2015	1154	1138	1146.0	8	3147	3242	3194.5	48	2858	2986	2922.0	64	1497	1480	1488.5	9	
10/3/2015	1133	1127	1130.0	3	3120	3090	3105.0	15	2854	2862	2858.0	4	1474	1466	1470.0	4	
10/4/2015	950	810	880.0	70	3124	3156	3140.0	16	2888	2080	2484.0	404	1398	1506	1452.0	54	
10/5/2015	1087	1080	1083.5	4	3036	2943	2989.5	47	2726	2732	2729.0	3	1397	1391	1394.0	3	
10/6/2015	1092	1086	1089.0	3	3061	2961	3011.0	50	2760	2757	2758.5	2	1372	1369	1370.5	2	
10/7/2015	1105	1097	1101.0	4	3099	2945	3022.0	77	2768	2812	2790.0	22	1395	1421	1408.0	13	
10/8/2015	1120	882	1001.0	119	3050	2190	2620.0	430	2752	2690	2721.0	31	1401	1385	1393.0	8	
10/9/2015	1171	1125	1148.0	23	3132	3097	3114.5	18	2977	3034	3005.5	29	3034	1525	2279.5	755	
10/10/2015	1128	1128	1128.0	0	3198	2914	3056.0	142	2857	2898	2877.5	21	1148	1443	1295.5	148	
10/11																	

10/24/2015	1136	1148	1142.0	6	2979	2957	2968.0	11	2461	2635	2548.0	87	1380	1500	1440.0	60	
10/25/2015	1105	1120	1112.5	8	2760	2720	2740.0	20	2468	2570	2519.0	51	1340	1320	1330.0	10	
10/26/2015	1069	1075	1072.0	3	2761	2818	2789.5	29	2503	2667	2585.0	82	1316	1314	1315.0	1	
10/27/2015	1098	1100	1099.0	1	2859	2721	2790.0	69	2613	2745	2679.0	66	1341	1332	1336.5	5	
10/28/2015	1161	1162	1161.5	1	3038	3063	3050.5	13	2803	2880	2841.5	39	1419	1399	1409.0	10	
10/29/2015	1085	1074	1079.5	6	2823	2836	2829.5	7	2602	2664	2633.0	31	1305	1299	1302.0	3	
10/30/2015	1032	1046	1039.0	7	2677	2711	2694.0	17	2548	2536	2542.0	6	1269	1262	1265.5	4	
10/31/2015																	data not taken
11/1/2015	1067	1090	1078.5	12	2898	2917	2907.5	10	2758	2774	2766.0	8	1363	1372	1367.5	5	
11/2/2015	1075	1060	1067.5	8		2816	2816.0	0	2698	2623	2660.5	38	1324	1304	1314.0	10	data point missing
11/3/2015	995	991	993.0	2	2575	2563	2569.0	6	2408	2388	2398.0	10	1201	1196	1198.5	3	
11/4/2015	971	965	968.0	3	2483	2473	2478.0	5	2314	2309	2311.5	3	1155	1152	1153.5	2	
11/5/2015	994	984	989.0	5	2464	2455	2459.5	5	2295	2349	2322.0	27	1173	1166	1169.5	4	
11/6/2015	1010	1003	1006.5	4	2492	2478	2485.0	7	2270	2402	2336.0	66	1192	1184	1188.0	4	
11/7/2015	967	977	972.0	5	2404	2403	2403.5	1	2200	2336	2268.0	68	1160	1159	1159.5	1	
11/8/2015	979	992	985.5	7	2413	2410	2411.5	2	2193	2354	2273.5	81	1169	1172	1170.5	2	
11/9/2015	1029	1044	1036.5	8	2514	2520	2517.0	3	2281	2479	2380.0	99	1238	1227	1232.5	6	
11/10/2015	980	987	983.5	4	2351	2344	2347.5	4	2139	2315	2227.0	88	1154	1141	1147.5	7	
11/11/2015	1016	1027	1021.5	6	2421	2431	2426.0	5	2209	2341	2275.0	66	1195	1155	1175.0	20	
11/12/2015	938	955	946.5	9	2265	1895	2080.0	185	1835	2171	2003.0	168	1106	1080	1093.0	13	
11/13/2015	976	980	978.0	2	2319	2259	2289.0	30	2119	2125	2122.0	3	1098	1097	1097.5	1	
11/14/2015	982	987	984.5	3	2350	2301	2325.5	25	2156	2144	2150.0	6	1106	1112	1109.0	3	
11/15/2015	957	975	966.0	9	2345	2292	2318.5	27	2141	2183	2162.0	21	1185	1173	1179.0	6	
11/16/2015	928	937	932.5	5	2238	2193	2215.5	23	2081	2060	2070.5	11	1130	1105	1117.5	13	
11/17/2015	922	931	926.5	5	2188	2154	2171.0	17	2038	2029	2033.5	5	1055	1076	1065.5	11	
11/18/2015	985	992	988.5	4	2316	2284	2300.0	16	2188	2090	2139.0	49	1127	1150	1138.5	12	
11/19/2015	1025	1029	1027.0	2	2387	2351	2369.0	18	2288	2130	2209.0	79	1177	1190	1183.5	7	
11/20/2015	1056	1060	1058.0	2	2461	2423	2442.0	19	2380	2238	2309.0	71	1222	1230	1226.0	4	
11/21/2015	1033	1075	1054.0	21	2494	2466	2480.0	14	2409	2284	2346.5	63	1230	1252	1241.0	11	
11/22/2015	1037	1060	1048.5	12	2483	2457	2470.0	13	2388	2298	2343.0	45	1219	1235	1227.0	8	
11/23/2015	1034	1055	1044.5	11	2498	2479	2488.5	10	2403	2331	2367.0	36	1215	1229	1222.0	7	
11/24/2015	1032	1060	1046.0	14	2403	2441	2422.0	19	2406	2347	2376.5	30	1190	1227	1208.5	19	
11/25/2015	1026	1057	1041.5	16	2421	2420	2420.5	1	2392	2344	2368.0	24	1199	1219	1209.0	10	
11/26/2015	940	970	955.0	15	2220	2238	2229.0	9	2171	2136	2153.5	18	1070	1107	1088.5	19	
11/27/2015	1006	1038	1022.0	16	2410	2432	2421.0	11	2356	2333	2344.5	12	1189	1215	1202.0	13	
11/28/2015																	No data.
11/29/2015	900	937	918.5	19	1964	2107	2035.5	72	2047	2015	2031.0	16	1048	1111	1079.5	32	
11/30/2015	910	932	921.0	11	2086	2074	2080.0	6	2014	2074	2044.0	30	1050	1100	1075.0	25	
12/1/2015	967	985	976.0	9	2189	2189	2189.0	0	2116	2132	2124.0	8	1113	1148	1130.5	18	
12/2/2015	963	988	975.5	13	2191	2126	2158.5	33	2127	2135	2131.0	4	1120	1151	1135.5	16	
12/3/2015	978	1004	991.0	13	2206	2137	2171.5	35	2150	2105	2127.5	23	1136	1160	1148.0	12	

Appendix J. Soluble Chemical Oxygen Demand (mg/L)

	Alpha						Delta					Zeta					Omega					
Date	Influent	Pond 1	Pond 2		Average	Std. Dev.	Delta INF	Pond 4	Pond 5	Average	Std. Dev.	Zeta INF	Pond 6	Pond 8	Average	Std. Dev.	RW INF	Pond 3	Pond 9	Average	Std. Dev.	
9/17/2015	216.16	101.2386	84.33815		92.8	8.5	130.0	114.8	138.42	126.6	11.8	130.0	89.4	77.58	83.5	5.9	21.8	21.8	42.09	31.9	10.1	
9/24/2015	178.69	56.58891	53.62879		55.1	1.5	90.6	96.6	98.77	97.7	1.1	126.9	72.1	71.39	71.8	0.4	60.3	57.3	67.69	62.5	5.2	
10/1/2015	219.69	73.34254	69.31476		71.3	2.0	94.2	84.1	90.12	87.1	3.0	86.8	92.1	98.18	95.2	3.0	21.0	33.1	50.52	41.8	8.7	
10/8/2015																						
10/15/2015	212.49	75.86809	71.57191		73.7	2.1	100.8	88.8	90.48	89.6	0.9	91.3	92.2	98.21	95.2	3.0	26.0	71.6	56.96	64.3	7.3	
10/22/2015	172.84	69.99355	46.58677		58.3	11.7	76.4	79.2	87.73	83.5	4.3	72.1	62.9	67.87	65.4	2.5	34.5	27.4	26.73	27.1	0.4	
10/29/2015	217.81	74.93051	61.0591		68.0	6.9	108.9	130.4	122.79	126.6	3.8	78.4	78.4	88.11	83.3	4.9	33.3	29.8	33.32	31.6	1.7	
11/5/2015	207.56	56.6606	31.76142		44.2	12.4	59.7	43.8	49.12	46.5	2.6	86.1	52.9	57.42	55.2	2.3						
11/12/2015	237.6427	86.54179	80.5245		80.5	0.0	237.6	91.2	85.87	88.5	2.7	118.0	118.6	128.66	123.6	5.0	44.4	46.4	48.43	47.4	1.0	
11/19/2015	181.48	77.18156	63.8098		70.5	6.7	77.2	82.5	91.22	86.9	4.3	113.3	127.3	98.58	113.0	14.4	42.4	49.1	28.37	38.7	10.4	
11/26/2015	199.91	127.8449	98.88528		113.4	14.5	123.8	164.2	106.97	135.6	28.6	107.6	86.1	150.74	118.4	32.3	49.0	92.8	93.50	93.2	0.3	

Appendix K. Wavelength Spectrum Absorbance

Wavelength (Absorbance @240nm)																					
Date	INF	Alpha (Primary Effluent)				D INF	Delta (Algae Digestate)				Z INF	Zeta (Fertilizer)				RW	Omega (Reclaimed Water)				Comments
		Pond 1	Pond 2	Average	Std. Dev.		Pond 4	Pond 5	Average	Std. Dev.		Pond 6	Pond 8	Average	Std. Dev.		Pond 3	Pond 9	Average	Std. Dev.	
6/18/2015							0.69	0.72	0.70	0.02		0.56	0.54	0.55	0.01						
6/25/2015	0.42	0.45	0.45	0.45	0.00	0.64	0.67	0.70	0.69	0.01	0.50	0.53	0.53	0.53	0.00	0.44	0.38	0.40	0.39	0.01	
7/2/2015	0.51	0.45	0.41	0.43	0.02	0.71	0.63	0.69	0.66	0.03	0.66	0.50	0.54	0.52	0.02	0.53	0.36	0.38	0.37	0.01	
7/9/2015	0.48	0.42	0.46	0.44	0.02	0.74	0.77	0.76	0.76	0.01	0.51	0.52	0.54	0.53	0.01	0.45	0.37	0.34	0.36	0.02	
7/16/2015	0.49	0.42	0.38	0.40	0.02	0.72	0.79	0.78	0.78	0.00	0.46	0.52	0.47	0.49	0.02	0.42	0.39	0.34	0.36	0.03	
7/23/2015	0.52	0.43	0.43	0.43	0.00	0.76	0.78	0.78	0.78	0.00	0.46	0.46	0.39	0.42	0.03	0.42	0.36	0.30	0.33	0.03	
7/30/2015	0.53	0.44	0.62	0.53	0.09	0.72	0.84	0.72	0.78	0.06	0.37	0.40	0.39	0.40	0.00	0.40	0.36	0.37	0.37	0.01	
8/6/2015	0.49	0.43	0.43	0.43	0.00	0.72	0.84	0.66	0.75	0.09	0.36	0.38	0.38	0.38	0.00	0.38	0.33	0.37	0.35	0.02	
8/13/2015	0.52	0.40	0.41	0.40	0.00	0.58	0.74	0.57	0.65	0.08	0.35	0.38	0.38	0.38	0.00	0.34	0.32	0.30	0.31	0.01	Diel Study 4:30am sample
8/20/2015	0.57	0.44	0.41	0.43	0.01	0.58	0.74	0.63	0.68	0.05	0.36	0.39	0.22	0.30	0.09	0.52	0.32	0.32	0.32	0.00	
8/27/2015	0.52	0.66	0.46	0.56	0.10	0.61	0.72	0.70	0.71	0.01	0.37	0.40	0.37	0.39	0.01	0.41	0.29	0.33	0.31	0.02	
9/3/2015	0.53	0.47	0.46	0.47	0.00	0.67	0.75	0.76	0.76	0.01	0.41	0.42	0.40	0.41	0.01	0.38	0.32	0.33	0.33	0.00	

	Round 13 - 6/23/2015								Round 29 - 9/3/2015							
	DIG Recycle Ponds			FRT Recycle Ponds					DIG Recycle Ponds			FRT Recycle Ponds				
Wavelength	Pond 4	Pond 5	Set Average	Pond 6	Pond 8	Set Average	DI Scan		Pond 4	Pond 5	Set Average	Pond 6	Pond 8	Set Average	DI Scan	
190	1.8833333	1.9226667	1.903	1.762333	1.8936667	1.828	-0.01167		2.126	1.987667	2.056833	1.908667	1.808333	1.8585	-0.011	
190.5	1.9566667	1.966	1.961333	1.861	1.9483333	1.904667	-0.012		2.119	2.058667	2.088833	1.968	1.872333	1.920167	-0.01267	
191	2.145	2.0856667	2.115333	2.045333	2.0516667	2.0485	-0.01333		2.201333	2.197	2.199167	2.068333	2.043	2.055667	-0.015	
191.5	2.266	2.182	2.224	2.152	2.1776667	2.164833	-0.01167		2.369	2.380667	2.374833	2.207667	2.184	2.195833	-0.01367	
192	2.2683333	2.2513333	2.259833	2.215	2.236	2.2255	-0.00833		2.380667	2.431667	2.406167	2.294	2.216667	2.255333	-0.00933	
192.5	2.2646667	2.302	2.283333	2.284667	2.2463333	2.2655	-0.008		2.414667	2.406667	2.410667	2.318333	2.253	2.285667	-0.00867	
193	2.3473333	2.351	2.349167	2.359	2.2916667	2.325333	-0.00967		2.526333	2.488667	2.5075	2.388	2.31	2.349	-0.00967	
193.5	2.4603333	2.4826667	2.4715	2.409333	2.3866667	2.398	-0.006		2.596667	2.548	2.572333	2.432333	2.349	2.390667	-0.00633	
194	2.4786667	2.5826667	2.530667	2.465333	2.479	2.472167	-0.003		2.631667	2.558	2.594833	2.492	2.419	2.4555	-0.00333	
194.5	2.4936667	2.55	2.521833	2.495667	2.4986667	2.497167	-0.002		2.627667	2.565333	2.5965	2.552667	2.489	2.520833	-0.00267	
195	2.5626667	2.573	2.567833	2.545333	2.5233333	2.534333	-0.002		2.700667	2.659333	2.68	2.571	2.52	2.5455	-0.00233	
195.5	2.6063333	2.678	2.642167	2.600333	2.5813333	2.590833	-0.00233		2.735333	2.707667	2.7215	2.594333	2.557	2.575667	-0.00233	
196	2.6376667	2.7076667	2.672667	2.593	2.64	2.6165	-0.00333		2.725	2.699	2.712	2.582667	2.575333	2.579	-0.00267	
196.5	2.671	2.7056667	2.688333	2.601333	2.6326667	2.617	-0.004		2.764	2.827333	2.795667	2.529333	2.630333	2.579833	-0.00333	
197	2.6523333	2.7086667	2.6805	2.618333	2.6113333	2.614833	-0.00233		2.770333	2.826	2.798167	2.463667	2.674667	2.569167	-0.002	
197.5	2.6993333	2.7273333	2.713333	2.635667	2.6233333	2.6295	0		2.801333	2.785667	2.7935	2.377	2.685	2.531	-0.00033	
198	2.7633333	2.746	2.754667	2.641333	2.6426667	2.642	0		2.86	2.849	2.8545	2.282667	2.710667	2.496667	-0.00033	
198.5	2.78	2.79	2.785	2.687	2.6656667	2.676333	0		2.861667	2.883	2.872333	2.171333	2.703	2.437167	-0.00033	
199	2.8253333	2.8613333	2.843333	2.773333	2.661	2.717167	0		2.894333	2.916	2.905167	2.047667	2.698333	2.373	-0.00033	
199.5	2.843	2.8343333	2.838667	2.810333	2.6576667	2.734	-0.00133		2.932333	2.88	2.906167	1.929	2.709667	2.319333	-0.00133	
200	2.878	2.8213333	2.849667	2.812667	2.682	2.747333	-0.003		2.983333	2.905	2.944167	1.826667	2.769333	2.298	-0.00267	
200.5	2.878	2.8453333	2.861667	2.785333	2.695	2.740167	-0.00233		2.997333	2.883	2.940167	1.741	2.808333	2.274667	-0.00167	
201	2.8373333	2.8696667	2.8535	2.792	2.698	2.745	0		2.998667	2.785667	2.892167	1.663667	2.779	2.221333	0.000333	
201.5	2.8436667	2.9063333	2.875	2.807	2.7103333	2.758667	0.001		3.015	2.789333	2.902167	1.592667	2.774333	2.1835	0.001	
202	2.8753333	2.9133333	2.894333	2.795333	2.702	2.748667	0		2.981333	2.794333	2.887833	1.527333	2.785667	2.1565	-0.00033	
202.5	2.9196667	2.9606667	2.940167	2.812667	2.6756667	2.744167	-0.001		3.031333	2.779333	2.905333	1.469333	2.826333	2.147833	-0.00067	
203	2.9236667	2.951	2.937333	2.837333	2.6553333	2.746333	-0.001		3.065	2.754	2.9095	1.419667	2.848667	2.134167	-0.001	
203.5	2.9456667	2.904	2.924833	2.849333	2.6286667	2.739	-0.00167		3.032	2.686667	2.859333	1.373667	2.829	2.101333	-0.001	
204	2.9653333	2.9576667	2.9615	2.808	2.5926667	2.700333	-0.002		3.040333	2.636333	2.838333	1.329333	2.840333	2.084833	-0.00133	
204.5	2.9766667	2.9963333	2.9865	2.797	2.569	2.683	-0.001		3.033667	2.596333	2.815	1.29	2.847333	2.068667	-0.00067	
205	2.968	3.0853333	3.026667	2.81	2.5723333	2.691167	0		2.997667	2.571667	2.784667	1.255	2.912333	2.083667	0.000333	
205.5	2.9596667	3.0853333	3.0225	2.835	2.5586667	2.696833	0		2.985	2.565	2.775	1.222333	2.955667	2.089	-0.00033	
206	2.9913333	2.991	2.991167	2.85	2.5306667	2.690333	-0.001		2.976667	2.522667	2.749667	1.189333	2.932667	2.061	-0.001	
206.5	3.0143333	3.035	3.024667	2.829	2.51	2.6695	-0.00133		2.953667	2.49	2.721833	1.160333	2.918	2.039167	-0.00133	
207	3.0433333	3.0496667	3.0465	2.83	2.4723333	2.651167	-0.002		2.946	2.469333	2.707667	1.134	2.925667	2.029833	-0.00167	
207.5	3.065	3.0693333	3.067167	2.793333	2.4276667	2.6105	-0.002		2.952333	2.425333	2.688833	1.107667	2.969667	2.038667	-0.002	
208	3.107	3.0776667	3.092333	2.749667	2.404	2.576833	-0.00233		2.944667	2.382333	2.6635	1.083667	2.985667	2.034667	-0.002	
208.5	3.083	3.0596667	3.071333	2.739333	2.3826667	2.561	-0.001		2.914667	2.346667	2.630667	1.062333	3.008333	2.035333	-0.001	
209	3.054	3.061	3.0575	2.724	2.348	2.536	-0.00067		2.907	2.310667	2.608833	1.040667	3.009667	2.025167	-0.00033	
209.5	3.072	3.1336667	3.102833	2.706	2.3066667	2.506333	-0.001		2.887667	2.278667	2.583167	1.019	2.998667	2.008833	-0.001	
210	3.101	3.1763333	3.138667	2.688667	2.2656667	2.477167	-0.001		2.855	2.231667	2.543333	0.999	3.002	2.0005	-0.00133	
210.5	3.1323333	3.1503333	3.141333	2.667667	2.2263333	2.447	-0.00133		2.842333	2.186333	2.514333	0.979667	3.009667	1.994667	-0.00133	
211	3.092	3.1256667	3.108833	2.632	2.1786667	2.405333	-0.00167		2.797	2.155	2.476	0.962667	3.014	1.988333	-0.00133	
211.5	3.0966667	3.1516667	3.124167	2.589	2.132	2.3605	-0.00167		2.752333	2.122667	2.4375	0.946	2.996667	1.971333	-0.00167	
212	3.1393333	3.226	3.182667	2.54	2.0873333	2.313667	-0.00133		2.711333	2.086	2.398667	0.928333	3.007	1.967667	-0.00167	
212.5	3.139	3.23	3.1845	2.498333	2.043	2.270667	-0.001		2.648	2.046	2.347	0.911667	2.981333	1.9465	-0.00133	
213	3.126	3.246	3.186	2.449667	2.0013333	2.2255	-0.001		2.602667	2.009333	2.306	0.897	2.981333	1.939167	-0.00133	
213.5	3.1123333	3.2326667	3.1725	2.404333	1.9576667	2.181	-0.001		2.568333	1.972667	2.2705	0.883	3	1.9415	-0.00133	
214	3.153	3.2233333	3.188167	2.370333	1.9143333	2.142333	-0.001		2.533	1.936667	2.234833	0.869667	2.988333	1.929	-0.00133	
214.5	3.2116667	3.244	3.227833	2.323667	1.8713333	2.0975	-0.001		2.478333	1.899333	2.188833	0.855667	2.947333	1.9015	-0.00067	
215	3.1823333	3.2353333	3.208833	2.269333	1.827	2.048167	-0.001		2.407333	1.861	2.134167	0.842	2.915333	1.878667	-0.00133	
215.5	3.1643333	3.244	3.204167	2.209667	1.78	1.994833	-0.001		2.348667	1.824667	2.086667	0.829333	2.875667	1.8525	-0.00133	
216	3.1553333	3.262	3.208667	2.157333	1.7333333	1.945333	-0.001		2.295	1.788667	2.041833	0.816333	2.805333	1.810833	-0.00133	
216.5	3.1413333	3.28	3.210667	2.105	1.6856667	1.895333	-0.001		2.242	1.751333	1.996667	0.803	2.762667	1.782833	-0.00133	
217	3.2593333	3.264	3.261667	2.042667	1.638	1.840333	-0.001		2.182	1.713667	1.947833	0.791	2.678667	1.734833	-0.00133	
217.5	3.2496667	3.2186667	3.234167	1.983333	1.5923333	1.787833	-0.001		2.118667	1.676333	1.8975	0.779	2.589	1.684	-0.00133	
218	3.088	3.1723333	3.130167	1.922667	1.548	1.735333	-0.001		2.064333	1.639667	1.852	0.767667	2.512	1.639833	-0.001	
218.5	3.0403333	3.197	3.118667	1.864333	1.504	1.684167	-0.001		2.009	1.606	1.8075	0.756333	2.422333	1.589333	-0.001	
219	3.073	3.2336667	3.153333	1.810667	1.4616667	1.636167	-0.00067		1.952333	1.573333	1.762833	0.746333	2.339667	1.543	-0.00067	

219.5	3.0643333	3.2043333	3.134333	1.753667	1.4193333	1.5865	-0.00033	1.897667	1.540667	1.719167	0.735333	2.250667	1.493	-0.001
220	3.006	3.2176667	3.111833	1.698	1.377	1.5375	-0.001	1.844	1.509333	1.676667	0.725	2.156	1.4405	-0.001
220.5	2.9383333	3.2176667	3.078	1.643	1.335	1.489	-0.001	1.791333	1.478333	1.634833	0.715	2.067667	1.391333	-0.00067
221	2.8613333	3.175	3.018167	1.587	1.2933333	1.440167	-0.00067	1.738667	1.447	1.592833	0.705	1.976667	1.340833	-0.00067
221.5	2.8113333	3.1616667	2.9865	1.534667	1.2546667	1.394667	-0.00033	1.688	1.417	1.5525	0.695	1.884667	1.289833	-0.00067
222	2.7333333	3.1636667	2.9485	1.485333	1.2183333	1.351833	-0.00033	1.640333	1.387667	1.514	0.685667	1.798333	1.242	-0.00067
222.5	2.619	3.11	2.8645	1.436333	1.1826667	1.3095	0	1.592333	1.358333	1.475333	0.676	1.713667	1.194833	-0.00033
223	2.5233333	2.9993333	2.761333	1.391	1.1493333	1.270167	0	1.548333	1.331333	1.439833	0.667667	1.633333	1.1505	-0.00033
223.5	2.44	2.93	2.685	1.349333	1.119	1.234167	0	1.509667	1.307	1.408333	0.659	1.560667	1.109833	-0.00033
224	2.3436667	2.852	2.597833	1.307667	1.0883333	1.198	0	1.471	1.282667	1.376833	0.651	1.489	1.07	-0.00033
224.5	2.231	2.737	2.484	1.266333	1.057	1.161667	0	1.430333	1.258	1.344167	0.642667	1.416667	1.029667	-0.00033
225	2.1306667	2.618	2.374333	1.223667	1.0256667	1.124667	0	1.39	1.233	1.3115	0.634	1.345333	0.989667	-0.00033
225.5	2.033	2.492	2.2625	1.182	0.9956667	1.088833	0	1.351	1.208333	1.279667	0.625333	1.277	0.951167	-0.00033
226	1.9366667	2.3736667	2.155167	1.142333	0.9666667	1.0545	0	1.314333	1.186	1.250167	0.617	1.214	0.9155	-0.00033
226.5	1.8456667	2.259	2.052333	1.105333	0.9403333	1.022833	0	1.279667	1.163667	1.221667	0.609	1.154333	0.881667	-0.00033
227	1.759	2.1486667	1.953833	1.069667	0.915	0.992333	0	1.246	1.142	1.194	0.601	1.097333	0.849167	0
227.5	1.6773333	2.0426667	1.86	1.036333	0.8906667	0.9635	0	1.215	1.121333	1.168167	0.593	1.043333	0.818167	0.000333
228	1.5986667	1.94	1.769333	1.004333	0.8686667	0.9365	0	1.185	1.101	1.143	0.585	0.993333	0.789167	0
228.5	1.525	1.8433333	1.684167	0.973	0.8463333	0.909667	0	1.156333	1.081	1.118667	0.577	0.946	0.7615	-0.00033
229	1.4573333	1.752	1.604667	0.944	0.8253333	0.884667	0	1.128	1.061333	1.094667	0.569	0.901333	0.735167	0
229.5	1.3923333	1.663	1.527667	0.916	0.8043333	0.860167	0	1.101	1.042667	1.071833	0.561333	0.858667	0.71	0
230	1.329	1.5773333	1.453167	0.889333	0.7843333	0.836833	0	1.074333	1.024333	1.049333	0.553	0.818	0.6855	0
230.5	1.2706667	1.499	1.384833	0.863667	0.7653333	0.8145	0	1.048667	1.006667	1.027667	0.545333	0.780333	0.662833	0
231	1.218	1.428	1.323	0.84	0.7476667	0.793833	0	1.025667	0.99	1.007833	0.538	0.745333	0.641667	0.000333
231.5	1.1686667	1.3596667	1.264167	0.816667	0.731	0.773833	0	1.003667	0.973667	0.988667	0.530667	0.713667	0.622167	0.000333
232	1.1223333	1.2956667	1.209	0.794333	0.7143333	0.754333	0	0.982333	0.958	0.970167	0.523	0.683	0.603	0.000333
232.5	1.0776667	1.2376667	1.157667	0.773333	0.6983333	0.735833	0	0.962	0.942667	0.952333	0.516	0.655	0.5855	0.000333
233	1.0363333	1.1823333	1.109333	0.752667	0.6833333	0.718	0	0.942	0.927667	0.934833	0.508333	0.628667	0.5685	0.000333
233.5	0.9973333	1.1306667	1.064	0.733333	0.6683333	0.700833	0	0.923667	0.913	0.918333	0.501	0.604333	0.552667	0.000333
234	0.961	1.082	1.0215	0.715333	0.655	0.685167	0	0.905667	0.899	0.902333	0.494	0.581333	0.537667	0.000333
234.5	0.9273333	1.0363333	0.981833	0.697333	0.6413333	0.669333	0	0.888333	0.885333	0.886833	0.486667	0.559667	0.523167	0.000333
235	0.8966667	0.996	0.946333	0.681333	0.629	0.655167	0	0.872	0.872333	0.872167	0.479667	0.539667	0.509667	0.000333
235.5	0.869	0.9576667	0.913333	0.666333	0.618	0.642167	0	0.857	0.860667	0.858833	0.473333	0.521	0.497167	0.000333
236	0.8433333	0.9243333	0.883833	0.652	0.6076667	0.629833	0	0.843	0.848667	0.845833	0.467	0.504	0.4855	0.000333
236.5	0.8196667	0.894	0.856833	0.638667	0.5976667	0.618167	0	0.83	0.837667	0.833833	0.460667	0.488333	0.4745	0.000333
237	0.7963333	0.865	0.830667	0.626333	0.5876667	0.607	0	0.817	0.826	0.8215	0.454333	0.473667	0.464	0.000333
237.5	0.775	0.837	0.806	0.613667	0.578	0.595833	0	0.804333	0.815	0.809667	0.448333	0.459333	0.453833	0.000333
238	0.7546667	0.8106667	0.782667	0.602	0.5686667	0.585333	0	0.792333	0.804	0.798167	0.443	0.446333	0.444667	0.000333
238.5	0.7353333	0.786	0.760667	0.590667	0.5596667	0.575167	0	0.780333	0.794	0.787167	0.437	0.434	0.4355	0.000333
239	0.7176667	0.763	0.740333	0.580333	0.5516667	0.566	0	0.769	0.783333	0.776167	0.431667	0.422	0.426833	0.000333
239.5	0.7016667	0.7423333	0.722	0.570333	0.5436667	0.557	0	0.758	0.774	0.766	0.426333	0.411667	0.419	0.000333
240	0.6863333	0.723	0.704667	0.561	0.536	0.5485	0	0.747	0.764667	0.755833	0.421	0.401333	0.411167	0.000333
240.5	0.673	0.7056667	0.689333	0.552333	0.529	0.540667	0	0.738	0.755333	0.746667	0.416	0.392333	0.404167	0.000333
241	0.661	0.6903333	0.675667	0.544333	0.5223333	0.533333	0	0.729	0.747333	0.738167	0.411333	0.384667	0.398	0.000333
241.5	0.649	0.6753333	0.662167	0.536667	0.5163333	0.5265	0	0.72	0.739333	0.729667	0.407	0.376667	0.391833	0.000333
242	0.6383333	0.662	0.650167	0.529333	0.51	0.519667	0	0.712	0.731	0.7215	0.402333	0.369667	0.386	0.000333
242.5	0.6283333	0.65	0.639167	0.522333	0.505	0.513667	0	0.703333	0.724	0.713667	0.398	0.363	0.3805	0.000333
243	0.619	0.638	0.6285	0.516	0.499	0.5075	0	0.695667	0.716333	0.706	0.394	0.356667	0.375333	0
243.5	0.61	0.6273333	0.618667	0.51	0.494	0.502	0	0.688	0.708667	0.698333	0.39	0.350667	0.370333	-0.00033
244	0.602	0.618	0.61	0.504	0.489	0.4965	0	0.681333	0.702	0.691667	0.386	0.345333	0.365667	-0.00033
244.5	0.5946667	0.609	0.601833	0.498	0.4846667	0.491333	0	0.674667	0.695333	0.685	0.382333	0.340333	0.361333	-0.00033
245	0.5876667	0.6	0.593833	0.493	0.48	0.4865	0	0.667667	0.689	0.678333	0.379	0.336	0.3575	0
245.5	0.581	0.593	0.587	0.488	0.476	0.482	0	0.661667	0.683	0.672333	0.375667	0.331667	0.353667	-0.00033
246	0.5746667	0.585	0.579833	0.483333	0.4716667	0.4775	0	0.656	0.677	0.6665	0.372667	0.327667	0.350167	-0.00033
246.5	0.5683333	0.5783333	0.573333	0.478667	0.4673333	0.473	-0.00033	0.650333	0.671	0.660667	0.369333	0.323	0.346167	-0.00033
247	0.563	0.572	0.5675	0.474	0.4636667	0.468833	-0.00033	0.644333	0.665333	0.654833	0.366	0.319333	0.342667	-0.00033
247.5	0.5573333	0.565	0.561167	0.47	0.46	0.465	-0.00033	0.639	0.659667	0.649333	0.363	0.316	0.3395	-0.00033
248	0.552	0.5593333	0.555667	0.466	0.456	0.461	0	0.634	0.654667	0.644333	0.36	0.312667	0.336333	-0.00033
248.5	0.547	0.554	0.5505	0.462333	0.453	0.457667	0	0.628667	0.649333	0.639	0.357333	0.309	0.333167	-0.00033
249	0.5423333	0.549	0.545667	0.458667	0.45	0.454333	0	0.623667	0.644	0.633833	0.355	0.306667	0.330833	-0.00033
249.5	0.538	0.544	0.541	0.455333	0.447	0.451167	-0.00033	0.619	0.639333	0.629167	0.352	0.303667	0.327833	-0.00033
250	0.5336667	0.5396667	0.536667	0.452	0.4433333	0.447667	0	0.614333	0.634	0.624167	0.349	0.301	0.325	-0.00033
250.5	0.5296667	0.535	0.532333	0.449	0.4406667	0.444833	0	0.61	0.63	0.62	0.346667	0.298	0.322333	-0.00033
251	0.5256667	0.531	0.528333	0.446	0.438	0.442	0	0.606	0.625	0.6155	0.344333	0.295333	0.319833	-0.00033

251.5	0.5213333	0.5263333	0.523833	0.443	0.435	0.439	0	0.601	0.620667	0.610833	0.342	0.293	0.3175	-0.00033
252	0.518	0.5223333	0.520167	0.44	0.432	0.436	0	0.596667	0.616	0.606333	0.34	0.290333	0.315167	-0.00033
252.5	0.514	0.5183333	0.516167	0.437	0.429	0.433	-0.001	0.592	0.611667	0.601833	0.337	0.288	0.3125	-0.00033
253	0.5103333	0.515	0.512667	0.434	0.4263333	0.430167	-0.00067	0.588	0.607333	0.597667	0.335	0.286	0.3105	-0.00033
253.5	0.507	0.511	0.509	0.431333	0.424	0.427667	-0.00067	0.584	0.603	0.5935	0.332333	0.283667	0.308	-0.00033
254	0.504	0.507	0.5055	0.429	0.4213333	0.425167	-0.001	0.58	0.599	0.5895	0.33	0.281667	0.305833	-0.00033
254.5	0.5	0.504	0.502	0.426	0.4186667	0.422333	-0.001	0.576	0.594667	0.585333	0.328	0.279667	0.303833	-0.00033
255	0.497	0.501	0.499	0.423333	0.4163333	0.419833	-0.00067	0.572	0.590667	0.581333	0.326	0.277	0.3015	-0.00033
255.5	0.494	0.497	0.4955	0.421	0.414	0.4175	-0.001	0.568	0.587	0.5775	0.323333	0.275	0.299167	-0.00033
256	0.491	0.494	0.4925	0.418667	0.4113333	0.415	-0.001	0.564	0.583	0.5735	0.321333	0.273	0.297167	-0.00033
256.5	0.488	0.491	0.4895	0.416333	0.4093333	0.412833	-0.001	0.560333	0.579	0.569667	0.319333	0.271	0.295167	-0.00033
257	0.485	0.4883333	0.486667	0.414	0.407	0.4105	-0.001	0.557	0.575	0.566	0.317333	0.269333	0.293333	-0.00033
257.5	0.4823333	0.4856667	0.484	0.412	0.405	0.4085	-0.00067	0.553	0.571667	0.562333	0.315	0.267667	0.291333	-0.00033
258	0.479	0.483	0.481	0.41	0.4026667	0.406333	-0.001	0.55	0.568	0.559	0.313	0.266	0.2895	-0.00033
258.5	0.476	0.48	0.478	0.407333	0.4	0.403667	-0.00067	0.546	0.564	0.555	0.311333	0.264	0.287667	-0.00033
259	0.474	0.477	0.4755	0.405333	0.398	0.401667	0	0.543	0.560333	0.551667	0.309333	0.262	0.285667	-0.00033
259.5	0.4716667	0.475	0.473333	0.403333	0.396	0.399667	0	0.539667	0.557	0.548333	0.307333	0.260667	0.284	0.000333
260	0.469	0.472	0.4705	0.401333	0.394	0.397667	0	0.536	0.553667	0.544833	0.305333	0.259	0.282167	-0.00033
260.5	0.466	0.4696667	0.467833	0.399333	0.392	0.395667	-0.00033	0.533	0.55	0.5415	0.303667	0.257	0.280333	-0.00033
261	0.464	0.467	0.4655	0.397	0.39	0.3935	0	0.529333	0.547	0.538167	0.302	0.255667	0.278833	0.000333
261.5	0.461	0.464	0.4625	0.395	0.388	0.3915	0	0.526	0.543	0.5345	0.299667	0.253667	0.276667	0.000333
262	0.458	0.4613333	0.459667	0.393	0.3856667	0.389333	0	0.522	0.539	0.5305	0.297333	0.252	0.274667	0
262.5	0.456	0.459	0.4575	0.391	0.3836667	0.387333	0	0.519	0.535667	0.527333	0.296	0.25	0.273	0.000333
263	0.4533333	0.457	0.455167	0.389	0.3816667	0.385333	0	0.516	0.533	0.5245	0.294	0.248333	0.271167	0.000333
263.5	0.4513333	0.454	0.452667	0.387	0.38	0.3835	0	0.512667	0.529	0.520833	0.292	0.247	0.2695	0
264	0.449	0.452	0.4505	0.385	0.3773333	0.381167	0	0.509	0.525667	0.517333	0.289667	0.245	0.267333	-0.00033
264.5	0.446	0.449	0.4475	0.382667	0.375	0.378833	0	0.506	0.522	0.514	0.288	0.243	0.2655	0.000333
265	0.444	0.447	0.4455	0.380333	0.373	0.376667	0	0.503	0.519	0.511	0.286	0.242	0.264	0.000333
265.5	0.4416667	0.4443333	0.443	0.378333	0.371	0.374667	0	0.499667	0.515333	0.5075	0.284	0.24	0.262	0.000333
266	0.439	0.442	0.4405	0.376	0.369	0.3725	0	0.496	0.512	0.504	0.282	0.238667	0.260333	0.000333
266.5	0.437	0.44	0.4385	0.374667	0.367	0.370833	0	0.493	0.508667	0.500833	0.28	0.237	0.2585	0.000333
267	0.4343333	0.4376667	0.436	0.372333	0.365	0.368667	0	0.489667	0.505	0.497333	0.278	0.235	0.2565	0.000333
267.5	0.432	0.435	0.4335	0.37	0.3626667	0.366333	0	0.486	0.501	0.4935	0.275667	0.233	0.254333	0.000333
268	0.429	0.432	0.4305	0.367333	0.36	0.363667	0	0.482	0.498	0.49	0.273	0.231	0.252	0.000333
268.5	0.427	0.4293333	0.428167	0.365	0.358	0.3615	0	0.479	0.494	0.4865	0.271	0.229	0.25	0.000333
269	0.424	0.427	0.4255	0.362667	0.355	0.358833	0	0.475	0.49	0.4825	0.269	0.227333	0.248167	0.000333
269.5	0.421	0.424	0.4225	0.36	0.353	0.3565	0	0.471333	0.486333	0.478833	0.266333	0.226	0.246167	0.000333
270	0.4183333	0.422	0.420167	0.358	0.351	0.3545	0	0.468	0.483	0.4755	0.264	0.224	0.244	0.000333
270.5	0.4156667	0.419	0.417333	0.355	0.348	0.3515	0	0.464	0.479	0.4715	0.261667	0.222	0.241833	0.000333
271	0.413	0.416	0.4145	0.353	0.346	0.3495	0	0.460333	0.475	0.467667	0.259	0.22	0.2395	0.000333
271.5	0.41	0.414	0.412	0.350333	0.343	0.346667	0	0.457	0.471333	0.464167	0.257	0.218	0.2375	0.000333
272	0.4073333	0.411	0.409167	0.348	0.3406667	0.344333	0	0.453333	0.467333	0.460333	0.254667	0.216	0.235333	0.000333
272.5	0.4046667	0.408	0.406333	0.345	0.338	0.3415	0	0.449333	0.463	0.456167	0.252	0.214	0.233	0.000333
273	0.402	0.405	0.4035	0.343	0.3356667	0.339333	0	0.446	0.459	0.4525	0.249333	0.212	0.230667	0.000333
273.5	0.399	0.403	0.401	0.340667	0.333	0.336833	0	0.442	0.455667	0.448833	0.247333	0.21	0.228667	0.000333
274	0.3963333	0.4	0.398167	0.338	0.3303333	0.334167	0	0.438	0.451667	0.444833	0.245	0.208	0.2265	0.000333
274.5	0.394	0.397	0.3955	0.335333	0.328	0.331667	0	0.435	0.448	0.4415	0.242	0.206	0.224	0.000333
275	0.391	0.395	0.393	0.333	0.326	0.3295	0	0.431	0.444	0.4375	0.24	0.204	0.222	0.000333
275.5	0.388	0.391	0.3895	0.33	0.323	0.3265	0	0.427	0.44	0.4335	0.237	0.202	0.2195	0.000333
276	0.385	0.3883333	0.386667	0.327667	0.32	0.323833	0	0.422333	0.435	0.428667	0.234	0.2	0.217	0.000333
276.5	0.382	0.385	0.3835	0.325	0.317	0.321	0	0.418333	0.431	0.424667	0.232	0.198	0.215	0.000333
277	0.3786667	0.382	0.380333	0.322333	0.314	0.318167	0	0.414667	0.427	0.420833	0.229	0.196	0.2125	0.000333
277.5	0.3756667	0.379	0.377333	0.319333	0.312	0.315667	0	0.410667	0.423	0.416833	0.226667	0.194	0.210333	0.000333
278	0.373	0.376	0.3745	0.317	0.309	0.313	0	0.406333	0.419	0.412667	0.224	0.192	0.208	0.000333
278.5	0.37	0.3733333	0.371667	0.314	0.3063333	0.310167	0	0.402	0.415	0.4085	0.221	0.189333	0.205167	0.000333
279	0.366	0.37	0.368	0.311	0.3033333	0.307167	0	0.398	0.41	0.404	0.218	0.187	0.2025	0.000333
279.5	0.363	0.367	0.365	0.308	0.3006667	0.304333	0	0.394	0.405667	0.399833	0.215	0.185	0.2	0.000333
280	0.36	0.364	0.362	0.305	0.2973333	0.301167	0	0.389	0.401	0.395	0.212333	0.183	0.197667	0.000333
280.5	0.3566667	0.3606667	0.358667	0.302	0.2946667	0.298333	0	0.385	0.396667	0.390833	0.209333	0.18	0.194667	0.000333
281	0.3533333	0.357	0.355167	0.299	0.292	0.2955	0	0.38	0.391667	0.385833	0.206333	0.178	0.192167	0.000333
281.5	0.35	0.354	0.352	0.296	0.289	0.2925	0	0.376	0.387	0.3815	0.203667	0.176	0.189833	0.000333
282	0.347	0.351	0.349	0.293	0.286	0.2895	0	0.371667	0.383	0.377333	0.201	0.173667	0.187333	0.000667
282.5	0.3433333	0.3473333	0.345333	0.29	0.283	0.2865	0	0.367333	0.378	0.372667	0.198	0.171	0.1845	0.000667
283	0.3396667	0.344	0.341833	0.287	0.2796667	0.283333	0	0.362667	0.373333	0.368	0.195	0.168667	0.181833	0.000333

283.5	0.336	0.341	0.3385	0.284	0.276	0.28	0	0.358	0.368667	0.363333	0.192	0.166333	0.179167	0.000333
284	0.333	0.3373333	0.335167	0.281	0.273	0.277	0	0.353667	0.364	0.358833	0.188667	0.164	0.176333	0.000333
284.5	0.33	0.334	0.332	0.278	0.2703333	0.274167	0	0.349	0.359	0.354	0.186	0.162	0.174	0.000333
285	0.327	0.331	0.329	0.275	0.268	0.2715	0	0.345	0.354667	0.349833	0.183	0.16	0.1715	0.000333
285.5	0.323	0.328	0.3255	0.272	0.265	0.2685	0	0.341	0.350333	0.345667	0.18	0.158	0.169	0.000333
286	0.32	0.325	0.3225	0.269	0.262	0.2655	0	0.336667	0.346	0.341333	0.178	0.156	0.167	0.000333
286.5	0.317	0.322	0.3195	0.266	0.259	0.2625	0	0.333	0.342	0.3375	0.175	0.153	0.164	0.000333
287	0.3136667	0.318	0.315833	0.263	0.256	0.2595	0	0.328	0.338	0.333	0.172333	0.151	0.161667	0.000333
287.5	0.3103333	0.315	0.312667	0.26	0.253	0.2565	0	0.324	0.333333	0.328667	0.17	0.149	0.1595	0.000333
288	0.307	0.312	0.3095	0.257333	0.25	0.253667	0	0.32	0.329	0.3245	0.167	0.147	0.157	0.000333
288.5	0.304	0.309	0.3065	0.255	0.247	0.251	0	0.316	0.324667	0.320333	0.164333	0.145	0.154667	0.000333
289	0.301	0.3056667	0.303333	0.252	0.2446667	0.248333	0	0.312	0.321	0.3165	0.161667	0.143	0.152333	0.000333
289.5	0.298	0.3026667	0.300333	0.249	0.242	0.2455	0	0.308	0.317	0.3125	0.159	0.141	0.15	0.000333
290	0.2946667	0.299	0.296833	0.246	0.239	0.2425	0	0.303667	0.312667	0.308167	0.157	0.139333	0.148167	0.000333
290.5	0.291	0.2966667	0.293833	0.243333	0.2363333	0.239833	0	0.299667	0.308	0.303833	0.154	0.137	0.1455	0.000333
291	0.288	0.2936667	0.290833	0.24	0.233	0.2365	0	0.296	0.304	0.3	0.152	0.135	0.1435	0.000333
291.5	0.2856667	0.291	0.288333	0.238	0.231	0.2345	0	0.292	0.3	0.296	0.149	0.133	0.141	0.000333
292	0.2826667	0.288	0.285333	0.235	0.228	0.2315	0	0.288	0.296	0.292	0.147	0.131333	0.139167	0.000667
292.5	0.2796667	0.285	0.282333	0.232	0.225	0.2285	0	0.284	0.292	0.288	0.144667	0.13	0.137333	0.000333
293	0.276	0.282	0.279	0.229667	0.2226667	0.226167	0	0.280667	0.288	0.284333	0.142	0.128	0.135	0.000333
293.5	0.274	0.279	0.2765	0.227	0.22	0.2235	0	0.277	0.284333	0.280667	0.14	0.125667	0.132833	0.000333
294	0.271	0.2763333	0.273667	0.224333	0.2176667	0.221	0	0.273	0.280667	0.276833	0.138	0.124	0.131	0.000333
294.5	0.268	0.2736667	0.270833	0.222	0.215	0.2185	0	0.27	0.277	0.2735	0.135	0.122	0.1285	0.000333
295	0.2656667	0.271	0.268333	0.219667	0.213	0.216333	0	0.266	0.273667	0.269833	0.133	0.120667	0.126833	0.000333
295.5	0.2626667	0.268	0.265333	0.217	0.21	0.2135	0	0.263	0.27	0.2665	0.131	0.119	0.125	0.000333
296	0.26	0.266	0.263	0.214	0.208	0.211	0	0.259	0.266	0.2625	0.129	0.117	0.123	0.000333
296.5	0.257	0.263	0.26	0.212	0.2053333	0.208667	0	0.256	0.263	0.2595	0.127	0.115333	0.121167	0.000333
297	0.2546667	0.26	0.257333	0.209667	0.203	0.206333	0	0.253	0.26	0.2565	0.125	0.114	0.1195	0.000333
297.5	0.252	0.258	0.255	0.207667	0.2006667	0.204167	0	0.25	0.256	0.253	0.123	0.112333	0.117667	0.000333
298	0.2493333	0.255	0.252167	0.205	0.198	0.2015	0	0.247	0.253	0.25	0.121	0.111	0.116	0.000333
298.5	0.247	0.2526667	0.249833	0.203	0.196	0.1995	0	0.244	0.25	0.247	0.119667	0.109667	0.114667	0.000333
299	0.2446667	0.25	0.247333	0.201	0.194	0.1975	0	0.241	0.247	0.244	0.118	0.108	0.113	0.000333
299.5	0.242	0.248	0.245	0.199	0.192	0.1955	0	0.238	0.244	0.241	0.116	0.107	0.1115	0.000333
300	0.2396667	0.245	0.242333	0.196333	0.1896667	0.193	0	0.235	0.240667	0.237833	0.114	0.105	0.1095	0.000333
300.5	0.237	0.243	0.24	0.194	0.1873333	0.190667	0	0.231667	0.237333	0.2345	0.112	0.104	0.108	0.000333
301	0.235	0.2406667	0.237833	0.192	0.185	0.1885	0	0.229	0.235	0.232	0.110333	0.102	0.106167	0.000333
301.5	0.232	0.238	0.235	0.189333	0.183	0.186167	0	0.226	0.232	0.229	0.109	0.101	0.105	0.000333
302	0.23	0.236	0.233	0.187	0.181	0.184	0	0.223	0.229	0.226	0.107333	0.099333	0.103333	0.000333
302.5	0.2276667	0.2336667	0.230667	0.185	0.179	0.182	0	0.22	0.226	0.223	0.105667	0.098	0.101833	0.000333
303	0.225	0.231	0.228	0.183	0.177	0.18	0	0.218	0.223	0.2205	0.104	0.097	0.1005	0.000333
303.5	0.223	0.2283333	0.225667	0.181	0.1746667	0.177833	0	0.215	0.22	0.2175	0.102	0.095	0.0985	0.000333
304	0.22	0.226	0.223	0.179	0.173	0.176	0	0.212	0.217333	0.214667	0.100333	0.094	0.097167	0.000333
304.5	0.218	0.224	0.221	0.177	0.171	0.174	0	0.209667	0.215	0.212333	0.099	0.093	0.096	0.000333
305	0.216	0.222	0.219	0.175	0.169	0.172	0	0.207	0.212	0.2095	0.097667	0.091333	0.0945	0.000333
305.5	0.214	0.22	0.217	0.174	0.167	0.1705	0	0.205	0.21	0.2075	0.096	0.090333	0.093167	0.000333
306	0.212	0.218	0.215	0.172	0.1653333	0.168667	0	0.203	0.208	0.2055	0.095	0.089	0.092	0.000333
306.5	0.209	0.215	0.212	0.169	0.163	0.166	0	0.2	0.205	0.2025	0.093333	0.088	0.090667	0.000333
307	0.2073333	0.213	0.210167	0.167	0.161	0.164	0	0.198	0.203	0.2005	0.092667	0.087	0.089833	0.000333
307.5	0.205	0.211	0.208	0.166	0.1593333	0.162667	0	0.196	0.200333	0.198167	0.091333	0.086	0.088667	0.000333
308	0.203	0.209	0.206	0.164	0.158	0.161	0	0.193333	0.198	0.195667	0.09	0.084667	0.087333	0.000333
308.5	0.201	0.2073333	0.204167	0.162333	0.156	0.159167	0	0.191667	0.196	0.193833	0.089	0.083667	0.086333	0.000333
309	0.1993333	0.205	0.202167	0.161	0.1546667	0.157833	0	0.189	0.194	0.1915	0.087333	0.083	0.085167	0.000333
309.5	0.197	0.203	0.2	0.159	0.153	0.156	0	0.186667	0.191333	0.189	0.086	0.081667	0.083833	0.000333
310	0.195	0.201	0.198	0.157	0.1513333	0.154167	0	0.184667	0.189	0.186833	0.085	0.080333	0.082667	0.000333
310.5	0.193	0.199	0.196	0.155333	0.1493333	0.152333	0	0.182667	0.187	0.184833	0.083333	0.079333	0.081333	0.000333
311	0.191	0.197	0.194	0.153333	0.1476667	0.1505	0	0.180333	0.184333	0.182333	0.082	0.078	0.08	0.000333
311.5	0.189	0.1946667	0.191833	0.152	0.146	0.149	0	0.178	0.182333	0.180167	0.081	0.077	0.079	0.000333
312	0.187	0.1926667	0.189833	0.150333	0.1446667	0.1475	0	0.176	0.180667	0.178333	0.08	0.076	0.078	0.000333
312.5	0.1853333	0.191	0.188167	0.149	0.143	0.146	0	0.174	0.178	0.176	0.079	0.075	0.077	0.000333
313	0.1833333	0.189	0.186167	0.147333	0.141	0.144167	-0.00033	0.172	0.176	0.174	0.078	0.074	0.076	0.000333
313.5	0.1813333	0.1866667	0.184	0.146	0.14	0.143	-0.00033	0.170333	0.174333	0.172333	0.077	0.073333	0.075167	0.000667
314	0.1796667	0.185	0.182333	0.144	0.1383333	0.141167	-0.00033	0.168333	0.172333	0.170333	0.076	0.072333	0.074167	0.000333
314.5	0.178	0.183	0.1805	0.143	0.137	0.14	0	0.166	0.170667	0.168333	0.075	0.071	0.073	0
315	0.176	0.181	0.1785	0.141	0.135	0.138	0	0.164333	0.168667	0.1665	0.073333	0.070333	0.071833	0

315.5	0.174	0.179	0.1765	0.14	0.134	0.137	0	0.162333	0.166333	0.164333	0.072667	0.069333	0.071	0.000333
316	0.172	0.1773333	0.174667	0.138	0.1323333	0.135167	0	0.161	0.165	0.163	0.071667	0.069	0.070333	0.000333
316.5	0.1706667	0.1753333	0.173	0.137	0.131	0.134	0	0.159	0.163	0.161	0.071	0.068	0.0695	0.000667
317	0.169	0.1736667	0.171333	0.135	0.13	0.1325	0	0.157667	0.161	0.159333	0.07	0.067	0.0685	0.000667
317.5	0.167	0.172	0.1695	0.134	0.128	0.131	0	0.156	0.159	0.1575	0.069	0.066	0.0675	0.000667
318	0.165	0.17	0.1675	0.132333	0.127	0.129667	0	0.153667	0.157	0.155333	0.068	0.065	0.0665	0.000333
318.5	0.163	0.168	0.1655	0.131	0.1256667	0.128333	0	0.151667	0.155	0.153333	0.067	0.064	0.0655	0.000333
319	0.161	0.1666667	0.163833	0.13	0.124	0.127	0	0.15	0.153667	0.151833	0.066	0.063333	0.064667	0.000333
319.5	0.16	0.165	0.1625	0.128	0.123	0.1255	0	0.148333	0.152	0.150167	0.065	0.063	0.064	0.000333
320	0.1583333	0.163	0.160667	0.127	0.122	0.1245	0	0.147	0.151	0.149	0.064	0.062	0.063	0.000333
320.5	0.157	0.1616667	0.159333	0.125667	0.1206667	0.123167	0	0.145667	0.149	0.147333	0.063	0.061	0.062	0.000333
321	0.155	0.16	0.1575	0.125	0.119	0.122	0	0.144	0.147	0.1455	0.063	0.06	0.0615	0.000333
321.5	0.154	0.158	0.156	0.124	0.118	0.121	0	0.142333	0.146	0.144167	0.062	0.059333	0.060667	0.000667
322	0.1526667	0.157	0.154833	0.122667	0.1166667	0.119667	0	0.141	0.144333	0.142667	0.061667	0.059	0.060333	0.000667
322.5	0.151	0.1556667	0.153333	0.121	0.1156667	0.118333	0	0.138667	0.143	0.140833	0.061	0.058	0.0595	0.000667
323	0.1493333	0.154	0.151667	0.12	0.1146667	0.117333	0	0.137333	0.141	0.139167	0.06	0.057	0.0585	0.000667
323.5	0.1476667	0.152	0.149833	0.119	0.113	0.116	0	0.136	0.139667	0.137833	0.059	0.056667	0.057833	0.000333
324	0.146	0.15	0.148	0.117333	0.112	0.114667	0	0.134	0.138	0.136	0.058	0.056	0.057	0.000333
324.5	0.1446667	0.1483333	0.1465	0.116	0.111	0.1135	-0.00033	0.132667	0.136	0.134333	0.057	0.055	0.056	0
325	0.143	0.147	0.145	0.114667	0.1093333	0.112	0	0.131	0.134333	0.132667	0.056	0.054	0.055	0.000333
325.5	0.141	0.1453333	0.143167	0.113333	0.108	0.110667	-0.00033	0.129667	0.132667	0.131167	0.055333	0.053333	0.054333	0
326	0.14	0.144	0.142	0.112	0.107	0.1095	-0.00067	0.128	0.131	0.1295	0.055	0.052667	0.053833	0.000333
326.5	0.138	0.142	0.14	0.111	0.106	0.1085	-0.001	0.126	0.13	0.128	0.054	0.052	0.053	-0.00033
327	0.137	0.141	0.139	0.11	0.105	0.1075	-0.00033	0.125	0.128333	0.126667	0.053333	0.051667	0.0525	0
327.5	0.1353333	0.14	0.137667	0.109	0.104	0.1065	-0.00033	0.124	0.127	0.1255	0.053	0.051	0.052	0
328	0.134	0.1383333	0.136167	0.108	0.103	0.1055	-0.00067	0.122333	0.125667	0.124	0.052	0.050333	0.051167	0
328.5	0.133	0.137	0.135	0.107333	0.102	0.104667	-0.00033	0.121	0.124333	0.122667	0.052	0.05	0.051	0.000333
329	0.1316667	0.136	0.133833	0.106	0.101	0.1035	0	0.12	0.123	0.1215	0.051	0.049	0.05	0.000333
329.5	0.1303333	0.1343333	0.132333	0.105	0.1	0.1025	0	0.119	0.122	0.1205	0.050667	0.048333	0.0495	0.000333
330	0.129	0.1333333	0.131167	0.104	0.099	0.1015	0	0.117333	0.120333	0.118833	0.05	0.048	0.049	0.000333
330.5	0.128	0.132	0.13	0.103	0.098	0.1005	0	0.116	0.119	0.1175	0.049	0.047333	0.048167	0.000667
331	0.127	0.1306667	0.128833	0.102	0.097	0.0995	0	0.115	0.118	0.1165	0.048333	0.047	0.047667	0.000333
331.5	0.126	0.1296667	0.127833	0.101	0.096	0.0985	0.000333	0.114	0.116667	0.115333	0.048	0.046333	0.047167	0.000333
332	0.125	0.128	0.1265	0.1	0.095	0.0975	0	0.112	0.115	0.1135	0.047333	0.045667	0.0465	0.000333
332.5	0.1236667	0.127	0.125333	0.099	0.0943333	0.096667	0	0.111	0.114	0.1125	0.047	0.045	0.046	0.000333
333	0.1223333	0.126	0.124167	0.098667	0.0936667	0.096167	0.000333	0.109667	0.112667	0.111167	0.046333	0.044667	0.0455	0.000333
333.5	0.121	0.125	0.123	0.097	0.0923333	0.094667	0	0.108	0.111	0.1095	0.045333	0.044	0.044667	0.000333
334	0.12	0.123	0.1215	0.096333	0.0916667	0.094	0	0.107	0.11	0.1085	0.045	0.043333	0.044167	0.000333
334.5	0.1186667	0.122	0.120333	0.095333	0.091	0.093167	0	0.106	0.109	0.1075	0.044667	0.043	0.043833	0.000333
335	0.117	0.121	0.119	0.094	0.09	0.092	0	0.104333	0.108	0.106167	0.043667	0.042333	0.043	0
335.5	0.1163333	0.1196667	0.118	0.094	0.089	0.0915	0	0.103333	0.106333	0.104833	0.043	0.042	0.0425	0
336	0.115	0.1186667	0.116833	0.093	0.088	0.0905	0	0.102333	0.105	0.103667	0.042667	0.041	0.041833	0
336.5	0.114	0.1173333	0.115667	0.092	0.087	0.0895	0	0.101333	0.104	0.102667	0.042	0.040667	0.041333	-0.00033
337	0.113	0.1166667	0.114833	0.091	0.0863333	0.088667	0	0.1	0.103	0.1015	0.042	0.040333	0.041167	0.000333
337.5	0.112	0.1153333	0.113667	0.09	0.086	0.088	0	0.099333	0.102	0.100667	0.041333	0.04	0.040667	0.000333
338	0.111	0.1146667	0.112833	0.089	0.085	0.087	0	0.098333	0.101	0.099667	0.041	0.039667	0.040333	0.000333
338.5	0.11	0.114	0.112	0.089	0.084	0.0865	0	0.097	0.1	0.0985	0.040667	0.039333	0.04	0.000333
339	0.109	0.113	0.111	0.088	0.083	0.0855	0	0.096	0.099	0.0975	0.04	0.039	0.0395	0.000333
339.5	0.108	0.1113333	0.109667	0.087	0.0823333	0.084667	0	0.095	0.098	0.0965	0.039667	0.038	0.038833	0.000333
340	0.107	0.11	0.1085	0.086333	0.0816667	0.084	0	0.094	0.096333	0.095167	0.039	0.038	0.0385	0.000333
340.5	0.106	0.1093333	0.107667	0.086	0.081	0.0835	0	0.093	0.095667	0.094333	0.038333	0.037333	0.037833	0.000333
341	0.1043333	0.108	0.106167	0.084333	0.079	0.081667	0	0.092	0.094667	0.093333	0.038	0.037	0.0375	0.000667
341.5	0.103	0.106	0.1045	0.082667	0.078	0.080333	-0.00033	0.091	0.093	0.092	0.037	0.036	0.0365	0.000333
342	0.102	0.105	0.1035	0.082	0.077	0.0795	-0.00067	0.089667	0.092	0.090833	0.036333	0.036	0.036167	0.000333
342.5	0.101	0.104	0.1025	0.081	0.076	0.0785	-0.00033	0.089	0.091	0.09	0.036	0.035	0.0355	0.000333
343	0.1	0.103	0.1015	0.080333	0.076	0.078167	-0.00033	0.088	0.09	0.089	0.036	0.035	0.0355	0.000667
343.5	0.099	0.102	0.1005	0.079667	0.075	0.077333	-0.00067	0.087	0.089	0.088	0.035333	0.035	0.035167	0.000667
344	0.098	0.1013333	0.099667	0.079	0.074	0.0765	0	0.086	0.088667	0.087333	0.035	0.034	0.0345	0.000667
344.5	0.097	0.1006667	0.098833	0.078	0.0733333	0.075667	0	0.085	0.087	0.086	0.035	0.034	0.0345	0.000667
345	0.0966667	0.0993333	0.098	0.078	0.073	0.0755	0	0.084	0.086333	0.085167	0.034	0.033333	0.033667	0.000667
345.5	0.0956667	0.099	0.097333	0.077	0.072	0.0745	0	0.083	0.085333	0.084167	0.034	0.033	0.0335	0.000667
346	0.0946667	0.098	0.096333	0.076	0.071	0.0735	-0.00033	0.082	0.084	0.083	0.033	0.032667	0.032833	0.000333
346.5	0.0936667	0.097	0.095333	0.075	0.07	0.0725	-0.00067	0.081	0.083	0.082	0.033	0.032	0.0325	0.000333
347	0.093	0.0956667	0.094333	0.074333	0.07	0.072167	-0.00067	0.08	0.082333	0.081167	0.032	0.032	0.032	0.000667

347.5	0.0916667	0.0946667	0.093167	0.074	0.069	0.0715	-0.00067	0.079	0.082	0.0805	0.032	0.031	0.0315	0.000667
348	0.091	0.094	0.0925	0.073	0.0683333	0.070667	-0.00033	0.079	0.081	0.08	0.032	0.031	0.0315	0.000667
348.5	0.09	0.0936667	0.091833	0.072667	0.068	0.070333	-0.00033	0.078	0.08	0.079	0.031333	0.031	0.031167	0.000667
349	0.0893333	0.0923333	0.090833	0.071667	0.067	0.069333	0	0.077	0.079	0.078	0.031	0.031	0.031	0.000667
349.5	0.089	0.092	0.0905	0.071333	0.067	0.069167	0	0.076	0.078333	0.077167	0.031	0.030667	0.030833	0.001
350	0.088	0.091	0.0895	0.071	0.066	0.0685	0	0.076	0.078	0.077	0.030333	0.03	0.030167	0.001
350.5	0.087	0.09	0.0885	0.07	0.0656667	0.067833	-0.00033	0.075	0.077	0.076	0.03	0.03	0.03	0.001
351	0.086	0.0896667	0.087833	0.069667	0.065	0.067333	0	0.074	0.076	0.075	0.03	0.03	0.03	0.001
351.5	0.085	0.0883333	0.086667	0.068667	0.064	0.066333	0	0.073	0.075	0.074	0.029333	0.029	0.029167	0.000667
352	0.0843333	0.0876667	0.086	0.068	0.063	0.0655	-0.00067	0.072333	0.074	0.073167	0.029	0.029	0.029	0.000667
352.5	0.0836667	0.087	0.085333	0.067333	0.063	0.065167	0	0.072	0.074	0.073	0.029	0.028333	0.028667	0.001
353	0.083	0.086	0.0845	0.067	0.0623333	0.064667	0	0.071	0.073	0.072	0.028	0.028	0.028	0.001
353.5	0.0823333	0.0856667	0.084	0.066333	0.062	0.064167	0	0.07	0.072	0.071	0.028	0.028	0.028	0.001
354	0.082	0.085	0.0835	0.066	0.061	0.0635	0	0.069	0.071	0.07	0.028	0.027333	0.027667	0.000667
354.5	0.081	0.084	0.0825	0.065	0.061	0.063	0	0.068333	0.070333	0.069333	0.027	0.027	0.027	0.000667
355	0.08	0.083	0.0815	0.064333	0.06	0.062167	0	0.068	0.07	0.069	0.027	0.027	0.027	0.000667
355.5	0.0793333	0.0826667	0.081	0.064	0.0593333	0.061667	0	0.067	0.069	0.068	0.026333	0.026667	0.0265	0.000667
356	0.079	0.082	0.0805	0.063	0.059	0.061	0	0.066667	0.068	0.067333	0.026	0.026	0.026	0.000667
356.5	0.078	0.081	0.0795	0.062667	0.058	0.060333	0	0.066	0.067667	0.066833	0.026	0.026	0.026	0.001
357	0.077	0.08	0.0785	0.062	0.058	0.06	-0.00033	0.065	0.067	0.066	0.026	0.026	0.026	0.000667
357.5	0.0763333	0.079	0.077667	0.061	0.057	0.059	0	0.064	0.066	0.065	0.025333	0.025333	0.025333	0.000667
358	0.076	0.079	0.0775	0.061	0.057	0.059	0	0.064	0.065	0.0645	0.025	0.025	0.025	0.000667
358.5	0.0753333	0.078	0.076667	0.060667	0.056	0.058333	0	0.063333	0.065	0.064167	0.025	0.025	0.025	0.001
359	0.0746667	0.0773333	0.076	0.06	0.056	0.058	0	0.062667	0.064	0.063333	0.024667	0.025	0.024833	0.001
359.5	0.074	0.077	0.0755	0.059333	0.0553333	0.057333	0	0.062	0.063667	0.062833	0.024333	0.024667	0.0245	0.001
360	0.0733333	0.0763333	0.074833	0.059	0.055	0.057	0	0.061	0.063	0.062	0.024	0.024	0.024	0.000667
360.5	0.073	0.076	0.0745	0.058333	0.054	0.056167	-0.00033	0.061	0.062	0.0615	0.024	0.024	0.024	0.000667
361	0.072	0.075	0.0735	0.058	0.053	0.0555	-0.00033	0.06	0.061333	0.060667	0.023333	0.023667	0.0235	0.001
361.5	0.071	0.074	0.0725	0.057333	0.053	0.055167	-0.00033	0.059	0.061	0.06	0.023	0.023	0.023	0.000667
362	0.0706667	0.073	0.071833	0.057	0.0526667	0.054833	-0.00067	0.059	0.06	0.0595	0.023	0.023	0.023	0.000667
362.5	0.0703333	0.073	0.071667	0.056	0.052	0.054	-0.00067	0.058	0.06	0.059	0.023	0.023	0.023	0.000667
363	0.0696667	0.073	0.071333	0.056	0.052	0.054	0	0.058	0.059	0.0585	0.022667	0.023	0.022833	0.001
363.5	0.0693333	0.072	0.070667	0.055333	0.0513333	0.053333	0	0.057	0.058	0.0575	0.022	0.022333	0.022167	0.001
364	0.0686667	0.071	0.069833	0.055	0.051	0.053	-0.00033	0.056333	0.058	0.057167	0.022	0.022	0.022	0.000667
364.5	0.068	0.071	0.0695	0.054333	0.0506667	0.0525	0	0.056	0.057	0.0565	0.021333	0.022	0.021667	0.000667
365	0.0676667	0.0703333	0.069	0.054	0.05	0.052	0	0.056	0.057	0.0565	0.021333	0.022	0.021667	0.001
365.5	0.067	0.0696667	0.068333	0.054	0.0496667	0.051833	0	0.055	0.056	0.0555	0.021	0.021333	0.021167	0.001
366	0.066	0.069	0.0675	0.053	0.049	0.051	0	0.054667	0.055	0.054833	0.021	0.021333	0.021167	0.001
366.5	0.066	0.0686667	0.067333	0.052667	0.049	0.050833	0	0.054	0.055	0.0545	0.021	0.021	0.021	0.001
367	0.065	0.068	0.0665	0.052	0.048	0.05	0	0.053	0.054	0.0535	0.020667	0.021	0.020833	0.001
367.5	0.0646667	0.0673333	0.066	0.052	0.048	0.05	-0.00033	0.053	0.054	0.0535	0.02	0.020667	0.020333	0.001
368	0.064	0.0666667	0.065333	0.051	0.0473333	0.049167	-0.00033	0.052	0.053	0.0525	0.02	0.020333	0.020167	0.001
368.5	0.0636667	0.066	0.064833	0.050667	0.047	0.048833	0	0.052	0.052667	0.052333	0.02	0.02	0.02	0.001
369	0.063	0.066	0.0645	0.050333	0.047	0.048667	0	0.051	0.052	0.0515	0.02	0.02	0.02	0.001
369.5	0.063	0.065	0.064	0.05	0.046	0.048	0	0.050667	0.052	0.051333	0.019333	0.02	0.019667	0.001
370	0.062	0.065	0.0635	0.05	0.046	0.048	0	0.05	0.051	0.0505	0.019	0.02	0.0195	0.001
370.5	0.062	0.064	0.063	0.049333	0.0453333	0.047333	0	0.049667	0.05	0.049833	0.019	0.019333	0.019167	0.001
371	0.061	0.0636667	0.062333	0.049	0.045	0.047	0	0.049	0.05	0.0495	0.019	0.019	0.019	0.001
371.5	0.0606667	0.063	0.061833	0.048667	0.0446667	0.046667	0	0.048333	0.049	0.048667	0.018	0.019	0.0185	0.001
372	0.0596667	0.0626667	0.061167	0.048	0.044	0.046	0	0.048	0.049	0.0485	0.018	0.018667	0.018333	0.001
372.5	0.0593333	0.062	0.060667	0.047667	0.044	0.045833	0	0.048	0.048	0.048	0.018	0.018333	0.018167	0.001
373	0.059	0.0613333	0.060167	0.047	0.043	0.045	0	0.047	0.048	0.0475	0.018	0.018333	0.018167	0.001
373.5	0.0583333	0.061	0.059667	0.047	0.043	0.045	0	0.047	0.047	0.047	0.017667	0.018	0.017833	0.001
374	0.058	0.06	0.059	0.046	0.0423333	0.044167	0	0.046	0.047	0.0465	0.017	0.018	0.0175	0.001
374.5	0.0573333	0.06	0.058667	0.046	0.042	0.044	0	0.046	0.046333	0.046167	0.017	0.017667	0.017333	0.001
375	0.057	0.059	0.058	0.045333	0.042	0.043667	0	0.045	0.046	0.0455	0.017	0.017333	0.017167	0.001
375.5	0.0563333	0.059	0.057667	0.045	0.0416667	0.043333	0	0.045	0.045	0.045	0.017	0.017333	0.017167	0.001
376	0.056	0.059	0.0575	0.045	0.041	0.043	0	0.044	0.045	0.0445	0.016333	0.017	0.016667	0.001
376.5	0.056	0.058	0.057	0.044667	0.041	0.042833	0	0.044	0.045	0.0445	0.016	0.017	0.0165	0.001
377	0.055	0.058	0.0565	0.044	0.041	0.0425	0	0.043333	0.044	0.043667	0.016	0.017	0.0165	0.001
377.5	0.055	0.057	0.056	0.044	0.04	0.042	0	0.043	0.044	0.0435	0.016	0.017	0.0165	0.001
378	0.0543333	0.057	0.055667	0.043333	0.04	0.041667	0	0.043	0.043	0.043	0.016	0.016333	0.016167	0.001
378.5	0.0536667	0.056	0.054833	0.043	0.0393333	0.041167	0	0.042	0.043	0.0425	0.015667	0.016	0.015833	0.001
379	0.053	0.0556667	0.054333	0.042	0.039	0.0405	0	0.042	0.042	0.042	0.015	0.016	0.0155	0.001

379.5	0.053	0.055	0.054	0.042	0.0383333	0.040167	0	0.041	0.042	0.0415	0.015	0.016	0.0155	0.001
380	0.0523333	0.055	0.053667	0.042	0.038	0.04	-0.00033	0.041	0.041	0.041	0.015	0.016	0.0155	0.001
380.5	0.052	0.0543333	0.053167	0.041333	0.038	0.039667	-0.00033	0.040333	0.041	0.040667	0.015	0.016	0.0155	0.001
381	0.052	0.054	0.053	0.041	0.038	0.0395	0	0.04	0.041	0.0405	0.015	0.015667	0.015333	0.001
381.5	0.051	0.0536667	0.052333	0.041	0.037	0.039	0	0.04	0.04	0.04	0.015	0.015333	0.015167	0.001
382	0.051	0.053	0.052	0.040333	0.037	0.038667	0	0.039	0.04	0.0395	0.014	0.015	0.0145	0.001
382.5	0.05	0.0526667	0.051333	0.04	0.0363333	0.038167	-0.00033	0.039	0.039	0.039	0.014	0.015	0.0145	0.001
383	0.05	0.052	0.051	0.04	0.036	0.038	0	0.039	0.039	0.039	0.014	0.015	0.0145	0.001
383.5	0.05	0.052	0.051	0.039333	0.036	0.037667	0	0.038	0.039	0.0385	0.014	0.015	0.0145	0.001
384	0.049	0.052	0.0505	0.039	0.036	0.0375	0	0.038	0.038	0.038	0.014	0.015	0.0145	0.001333
384.5	0.049	0.051	0.05	0.039	0.036	0.0375	0	0.037	0.038	0.0375	0.013	0.014333	0.013667	0.001
385	0.0483333	0.051	0.049667	0.038667	0.035	0.036833	0	0.037	0.037	0.037	0.013	0.014	0.0135	0.001
385.5	0.048	0.0503333	0.049167	0.038	0.035	0.0365	0	0.036667	0.037	0.036833	0.013	0.014	0.0135	0.001
386	0.048	0.05	0.049	0.038	0.035	0.0365	0	0.036	0.037	0.0365	0.013	0.014	0.0135	0.001333
386.5	0.047	0.05	0.0485	0.038	0.034	0.036	0	0.036	0.036	0.036	0.013	0.014	0.0135	0.001333
387	0.047	0.049	0.048	0.037	0.034	0.0355	0	0.036	0.036	0.036	0.013	0.014	0.0135	0.001333
387.5	0.047	0.049	0.048	0.037	0.034	0.0355	0	0.035	0.036	0.0355	0.012667	0.014	0.013333	0.001333
388	0.046	0.049	0.0475	0.037	0.0336667	0.035333	0	0.035	0.035	0.035	0.012667	0.013333	0.013	0.001333
388.5	0.046	0.048	0.047	0.037	0.033	0.035	0	0.035	0.035	0.035	0.012333	0.013	0.012667	0.001333
389	0.046	0.048	0.047	0.036	0.033	0.0345	0	0.034	0.034667	0.034333	0.012	0.013	0.0125	0.001333
389.5	0.0453333	0.048	0.046667	0.036	0.033	0.0345	0	0.034	0.034	0.034	0.012	0.013	0.0125	0.001333
390	0.045	0.0473333	0.046167	0.036	0.0326667	0.034333	0	0.034	0.034	0.034	0.012	0.013	0.0125	0.001333
390.5	0.045	0.047	0.046	0.036	0.032	0.034	0	0.033667	0.034	0.033833	0.012	0.013	0.0125	0.001333
391	0.045	0.047	0.046	0.035	0.032	0.0335	0	0.033	0.033	0.033	0.011667	0.013	0.012333	0.001
391.5	0.044	0.046	0.045	0.035	0.032	0.0335	0	0.033	0.033	0.033	0.011333	0.013	0.012167	0.001
392	0.044	0.046	0.045	0.035	0.031	0.033	0	0.032	0.032333	0.032167	0.011	0.013	0.012	0.001333
392.5	0.0433333	0.046	0.044667	0.034333	0.031	0.032667	0	0.032	0.032	0.032	0.011	0.012333	0.011667	0.001333
393	0.043	0.045	0.044	0.034	0.031	0.0325	0	0.032	0.032	0.032	0.011	0.012333	0.011667	0.001333
393.5	0.043	0.045	0.044	0.034	0.031	0.0325	0	0.031333	0.032	0.031667	0.011	0.012	0.0115	0.001333
394	0.043	0.045	0.044	0.034	0.031	0.0325	0	0.031	0.031	0.031	0.011	0.012	0.0115	0.001333
394.5	0.0423333	0.0443333	0.043333	0.034	0.0303333	0.032167	0	0.031	0.031	0.031	0.011	0.012	0.0115	0.001333
395	0.042	0.044	0.043	0.034	0.03	0.032	0	0.031	0.031	0.031	0.011	0.012	0.0115	0.001333
395.5	0.042	0.044	0.043	0.033	0.03	0.0315	0	0.031	0.031	0.031	0.010667	0.012	0.011333	0.001333
396	0.0416667	0.0436667	0.042667	0.033	0.03	0.0315	0	0.03	0.03	0.03	0.010333	0.012	0.011167	0.001333
396.5	0.041	0.043	0.042	0.033	0.0296667	0.031333	0	0.03	0.03	0.03	0.01	0.011667	0.010833	0.001333
397	0.041	0.043	0.042	0.033	0.029	0.031	0	0.03	0.03	0.03	0.01	0.011333	0.010667	0.001333
397.5	0.041	0.043	0.042	0.032333	0.029	0.030667	0	0.029333	0.029667	0.0295	0.01	0.011333	0.010667	0.001333
398	0.0403333	0.043	0.041667	0.032	0.029	0.0305	0	0.029	0.029	0.029	0.01	0.011333	0.010667	0.001333
398.5	0.04	0.042	0.041	0.032	0.029	0.0305	0	0.029	0.029	0.029	0.01	0.011	0.0105	0.001333
399	0.04	0.042	0.041	0.032	0.028	0.03	0	0.029	0.029	0.029	0.01	0.011	0.0105	0.001333
399.5	0.04	0.042	0.041	0.031333	0.028	0.029667	0	0.028333	0.028	0.028167	0.009667	0.011	0.010333	0.001333
400	0.04	0.0416667	0.040833	0.031	0.028	0.0295	0	0.028	0.028	0.028	0.009667	0.011	0.010333	0.001333
400.5	0.039	0.041	0.04	0.031	0.028	0.0295	0	0.028	0.028	0.028	0.009667	0.011	0.010333	0.001333
401	0.039	0.041	0.04	0.031	0.0276667	0.029333	0	0.028	0.028	0.028	0.009667	0.011	0.010333	0.001333
401.5	0.039	0.041	0.04	0.031	0.027	0.029	0	0.027	0.027	0.027	0.009	0.011	0.01	0.001333
402	0.0383333	0.04	0.039167	0.030333	0.027	0.028667	0	0.027	0.027	0.027	0.009	0.011	0.01	0.001333
402.5	0.038	0.04	0.039	0.03	0.027	0.0285	0	0.027	0.027	0.027	0.009	0.010333	0.009667	0.001333
403	0.038	0.04	0.039	0.03	0.027	0.0285	0	0.027	0.026333	0.026667	0.009	0.010333	0.009667	0.001333
403.5	0.038	0.0396667	0.038833	0.03	0.026	0.028	0	0.026333	0.026	0.026167	0.009	0.01	0.0095	0.001333
404	0.0373333	0.0393333	0.038333	0.03	0.026	0.028	0	0.026	0.026	0.026	0.009	0.010333	0.009667	0.001333
404.5	0.037	0.039	0.038	0.03	0.026	0.028	0	0.026	0.026	0.026	0.009	0.010333	0.009667	0.001333
405	0.037	0.039	0.038	0.029333	0.026	0.027667	0	0.026	0.026	0.026	0.008667	0.01	0.009333	0.001333
405.5	0.0366667	0.039	0.037833	0.029	0.026	0.0275	0	0.026	0.026	0.026	0.008667	0.01	0.009333	0.001333
406	0.036	0.0383333	0.037167	0.029	0.026	0.0275	0	0.025333	0.025	0.025167	0.008333	0.01	0.009167	0.001333
406.5	0.036	0.038	0.037	0.029	0.0256667	0.027333	0	0.025	0.025	0.025	0.008	0.01	0.009	0.001333
407	0.036	0.038	0.037	0.028333	0.025	0.026667	0	0.025	0.025	0.025	0.008	0.01	0.009	0.001333
407.5	0.036	0.0373333	0.036667	0.028	0.025	0.0265	0	0.025	0.025	0.025	0.008	0.01	0.009	0.001333
408	0.035	0.037	0.036	0.028	0.025	0.0265	0	0.024667	0.024	0.024333	0.008	0.01	0.009	0.001333
408.5	0.035	0.037	0.036	0.028	0.0246667	0.026333	0	0.024	0.024	0.024	0.008	0.01	0.009	0.001333
409	0.035	0.0366667	0.035833	0.028	0.024	0.026	0	0.024	0.024	0.024	0.008	0.01	0.009	0.001333
409.5	0.034	0.036	0.035	0.027	0.024	0.0255	0	0.024	0.023333	0.023667	0.008	0.01	0.009	0.001333
410	0.034	0.036	0.035	0.027	0.024	0.0255	0	0.023333	0.023	0.023167	0.008	0.01	0.009	0.001333
410.5	0.034	0.036	0.035	0.027	0.024	0.0255	0	0.023	0.023	0.023	0.007667	0.01	0.008833	0.001333
411	0.034	0.0356667	0.034833	0.027	0.0236667	0.025333	0	0.023	0.023	0.023	0.007333	0.009333	0.008333	0.001333

411.5	0.033	0.035	0.034	0.027	0.023	0.025	0	0.023	0.023	0.023	0.007333	0.009	0.008167	0.001333
412	0.033	0.035	0.034	0.026	0.023	0.0245	0	0.023	0.022	0.0225	0.007	0.009	0.008	0.001333
412.5	0.0326667	0.035	0.033833	0.026	0.023	0.0245	0	0.022333	0.022	0.022167	0.007	0.009	0.008	0.001333
413	0.032	0.034	0.033	0.026	0.023	0.0245	0	0.022	0.022	0.022	0.007	0.009	0.008	0.001333
413.5	0.032	0.034	0.033	0.025667	0.023	0.024333	0	0.022	0.022	0.022	0.007	0.009	0.008	0.001333
414	0.032	0.034	0.033	0.025	0.0223333	0.023667	0	0.022	0.021667	0.021833	0.007	0.009	0.008	0.001333
414.5	0.0313333	0.0336667	0.0325	0.025	0.022	0.0235	0	0.022	0.021	0.0215	0.007	0.009	0.008	0.001333
415	0.031	0.033	0.032	0.025	0.022	0.0235	0	0.021333	0.021	0.021167	0.007	0.009	0.008	0.001333
415.5	0.031	0.033	0.032	0.025	0.022	0.0235	0	0.021	0.021	0.021	0.007	0.009	0.008	0.001333
416	0.031	0.033	0.032	0.025	0.022	0.0235	0	0.021	0.021	0.021	0.007	0.009	0.008	0.001333
416.5	0.031	0.032	0.0315	0.024	0.0216667	0.022833	0	0.021	0.021	0.021	0.006667	0.008667	0.007667	0.001333
417	0.03	0.032	0.031	0.024	0.021	0.0225	0	0.021	0.021	0.021	0.006667	0.008667	0.007667	0.001333
417.5	0.03	0.032	0.031	0.024	0.021	0.0225	0	0.021	0.02	0.0205	0.006333	0.008333	0.007333	0.001333
418	0.03	0.032	0.031	0.024	0.021	0.0225	0	0.020333	0.02	0.020167	0.006333	0.008333	0.007333	0.001333
418.5	0.03	0.031	0.0305	0.024	0.021	0.0225	0	0.02	0.02	0.02	0.006333	0.008333	0.007333	0.001333
419	0.029	0.031	0.03	0.023	0.021	0.022	0	0.02	0.02	0.02	0.006333	0.008333	0.007333	0.001667
419.5	0.029	0.031	0.03	0.023	0.021	0.022	0	0.02	0.02	0.02	0.006333	0.008	0.007167	0.001333
420	0.029	0.031	0.03	0.023	0.021	0.022	0	0.02	0.019	0.0195	0.006	0.008	0.007	0.001333
420.5	0.029	0.0303333	0.029667	0.023	0.02	0.0215	0	0.019667	0.019	0.019333	0.006	0.008	0.007	0.001333
421	0.028	0.03	0.029	0.022333	0.02	0.021167	0	0.019333	0.019	0.019167	0.006	0.008	0.007	0.001333
421.5	0.028	0.03	0.029	0.022	0.02	0.021	0	0.019	0.019	0.019	0.006	0.008	0.007	0.001333
422	0.028	0.03	0.029	0.022	0.02	0.021	0	0.019	0.019	0.019	0.006	0.008	0.007	0.001333
422.5	0.028	0.0296667	0.028833	0.022	0.02	0.021	0	0.019	0.018	0.0185	0.006	0.008	0.007	0.001333
423	0.027	0.029	0.028	0.022	0.0196667	0.020833	0	0.019	0.018	0.0185	0.006	0.008	0.007	0.001333
423.5	0.027	0.029	0.028	0.022	0.019	0.0205	0	0.018	0.018	0.018	0.005667	0.008	0.006833	0.001333
424	0.027	0.0286667	0.027833	0.021	0.019	0.02	0	0.018	0.018	0.018	0.005667	0.008	0.006833	0.001333
424.5	0.0266667	0.028	0.027333	0.021	0.019	0.02	0	0.018	0.018	0.018	0.005667	0.008	0.006833	0.001333
425	0.026	0.028	0.027	0.021	0.019	0.02	0	0.018	0.017	0.0175	0.005333	0.008	0.006667	0.001333
425.5	0.026	0.028	0.027	0.021	0.0183333	0.019667	0	0.018	0.017	0.0175	0.005333	0.007667	0.0065	0.001333
426	0.026	0.028	0.027	0.021	0.018	0.0195	0	0.017667	0.017	0.017333	0.005333	0.007667	0.0065	0.001333
426.5	0.026	0.027	0.0265	0.021	0.018	0.0195	0	0.017	0.017	0.017	0.005333	0.007333	0.006333	0.001667
427	0.0256667	0.027	0.026333	0.02	0.018	0.019	0	0.017	0.017	0.017	0.005	0.007333	0.006167	0.001667
427.5	0.0253333	0.027	0.026167	0.02	0.018	0.019	0	0.017	0.017	0.017	0.005	0.007333	0.006167	0.001667
428	0.025	0.0266667	0.025833	0.02	0.018	0.019	0	0.017	0.016	0.0165	0.005	0.007	0.006	0.001333
428.5	0.025	0.026	0.0255	0.02	0.0176667	0.018833	0	0.017	0.016	0.0165	0.005	0.007	0.006	0.001333
429	0.0243333	0.026	0.025167	0.02	0.017	0.0185	0	0.016667	0.016	0.016333	0.005	0.007	0.006	0.001333
429.5	0.024	0.026	0.025	0.019	0.017	0.018	0	0.016333	0.016	0.016167	0.005	0.007	0.006	0.001667
430	0.024	0.026	0.025	0.019	0.017	0.018	0	0.016	0.016	0.016	0.005	0.007	0.006	0.001667
430.5	0.024	0.0253333	0.024667	0.019	0.017	0.018	0	0.016	0.015667	0.015833	0.005	0.007	0.006	0.001333
431	0.0236667	0.025	0.024333	0.019	0.017	0.018	0	0.016	0.015	0.0155	0.005	0.007	0.006	0.001333
431.5	0.0236667	0.025	0.024333	0.019	0.017	0.018	0	0.016	0.015	0.0155	0.005	0.007	0.006	0.001333
432	0.023	0.025	0.024	0.018667	0.017	0.017833	0	0.016	0.015	0.0155	0.005	0.007	0.006	0.001333
432.5	0.023	0.0243333	0.023667	0.018	0.0166667	0.017333	0	0.015	0.015	0.015	0.005	0.007	0.006	0.001333
433	0.023	0.024	0.0235	0.018	0.016	0.017	0	0.015	0.015	0.015	0.004667	0.007	0.005833	0.001333
433.5	0.0223333	0.024	0.023167	0.018	0.016	0.017	0	0.015	0.014333	0.014667	0.004667	0.006333	0.0055	0.001333
434	0.022	0.024	0.023	0.018	0.016	0.017	0	0.015	0.014	0.0145	0.004667	0.006333	0.0055	0.001333
434.5	0.022	0.0236667	0.022833	0.018	0.016	0.017	0	0.015	0.014	0.0145	0.004667	0.006333	0.0055	0.001333
435	0.022	0.023	0.0225	0.017667	0.016	0.016833	0	0.014333	0.014	0.014167	0.004333	0.006333	0.005333	0.001333
435.5	0.022	0.023	0.0225	0.017	0.016	0.0165	0	0.014333	0.014	0.014167	0.004	0.006	0.005	0.001333
436	0.021	0.023	0.022	0.017	0.016	0.0165	0	0.014	0.014	0.014	0.004	0.006	0.005	0.001333
436.5	0.021	0.023	0.022	0.017	0.0156667	0.016333	0	0.014	0.014	0.014	0.004333	0.006333	0.005333	0.001333
437	0.021	0.0223333	0.021667	0.017	0.015	0.016	0	0.014	0.013667	0.013833	0.004	0.006333	0.005167	0.001333
437.5	0.021	0.022	0.0215	0.017	0.015	0.016	0	0.014	0.013	0.0135	0.004	0.006	0.005	0.001333
438	0.021	0.022	0.0215	0.017	0.015	0.016	0	0.014	0.013	0.0135	0.004	0.006	0.005	0.001333
438.5	0.021	0.022	0.0215	0.016	0.015	0.0155	0	0.013333	0.013	0.013167	0.004	0.006	0.005	0.001333
439	0.02	0.022	0.021	0.016	0.015	0.0155	0	0.013	0.013	0.013	0.004	0.006	0.005	0.001333
439.5	0.02	0.0213333	0.020667	0.016	0.015	0.0155	0	0.013	0.013	0.013	0.004	0.006	0.005	0.001333
440	0.02	0.021	0.0205	0.016	0.015	0.0155	0	0.013	0.013	0.013	0.004	0.006	0.005	0.001333
440.5	0.02	0.021	0.0205	0.016	0.0146667	0.015333	0	0.013	0.012333	0.012667	0.004	0.006	0.005	0.001333
441	0.02	0.021	0.0205	0.016	0.0143333	0.015167	0	0.013	0.012	0.0125	0.004	0.006	0.005	0.001333
441.5	0.02	0.021	0.0205	0.016	0.014	0.015	0	0.013	0.012	0.0125	0.004	0.006	0.005	0.001333
442	0.0196667	0.021	0.020333	0.016	0.014	0.015	0	0.013	0.012	0.0125	0.004	0.006	0.005	0.001333
442.5	0.0196667	0.021	0.020333	0.016	0.014	0.015	0	0.013	0.012	0.0125	0.004	0.006	0.005	0.001333
443	0.019	0.021	0.02	0.016	0.014	0.015	0	0.012667	0.012	0.012333	0.004	0.006	0.005	0.001333

443.5	0.019	0.0203333	0.019667	0.015667	0.014	0.014833	0	0.012	0.012	0.012	0.004	0.006	0.005	0.001333
444	0.019	0.02	0.0195	0.015333	0.014	0.014667	0	0.012	0.012	0.012	0.004	0.006	0.005	0.001667
444.5	0.019	0.02	0.0195	0.015	0.014	0.0145	0	0.012	0.012	0.012	0.003667	0.006	0.004833	0.001667
445	0.019	0.02	0.0195	0.015	0.014	0.0145	0	0.012	0.011	0.0115	0.003667	0.006	0.004833	0.001333
445.5	0.019	0.02	0.0195	0.015	0.014	0.0145	0	0.012	0.011	0.0115	0.003333	0.006	0.004667	0.001333
446	0.018	0.02	0.019	0.015	0.0136667	0.014333	0	0.012	0.011	0.0115	0.003333	0.005667	0.0045	0.001333
446.5	0.018	0.0196667	0.018833	0.015	0.0136667	0.014333	0.000333	0.011667	0.011	0.011333	0.003333	0.005667	0.0045	0.001333
447	0.018	0.019	0.0185	0.015	0.0136667	0.014333	0.000333	0.011667	0.011	0.011333	0.003333	0.005667	0.0045	0.001667
447.5	0.018	0.019	0.0185	0.015	0.013	0.014	0	0.011	0.011	0.011	0.003333	0.005333	0.004333	0.001333
448	0.018	0.019	0.0185	0.014667	0.013	0.013833	0	0.011	0.011	0.011	0.003333	0.005	0.004167	0.001333
448.5	0.0176667	0.019	0.018333	0.014	0.013	0.0135	0	0.011	0.01	0.0105	0.003	0.005	0.004	0.001333
449	0.017	0.019	0.018	0.014	0.013	0.0135	0	0.011	0.01	0.0105	0.003	0.005	0.004	0.001333
449.5	0.017	0.0183333	0.017667	0.014	0.013	0.0135	0	0.011	0.01	0.0105	0.003	0.005	0.004	0.001333
450	0.017	0.018	0.0175	0.014	0.013	0.0135	0	0.011	0.01	0.0105	0.003	0.005	0.004	0.001333
450.5	0.017	0.018	0.0175	0.014	0.013	0.0135	0	0.010667	0.01	0.010333	0.003	0.005	0.004	0.001333
451	0.017	0.018	0.0175	0.014	0.013	0.0135	0	0.010333	0.01	0.010167	0.003	0.005	0.004	0.001333
451.5	0.017	0.018	0.0175	0.014	0.013	0.0135	0	0.01	0.01	0.01	0.003	0.005	0.004	0.001333
452	0.017	0.018	0.0175	0.014	0.0123333	0.013167	0	0.01	0.01	0.01	0.003	0.005	0.004	0.001333
452.5	0.017	0.018	0.0175	0.013667	0.012	0.012833	0	0.01	0.01	0.01	0.003	0.005	0.004	0.001333
453	0.0163333	0.0173333	0.016833	0.013	0.012	0.0125	0	0.01	0.01	0.01	0.003	0.005	0.004	0.001333
453.5	0.016	0.0173333	0.016667	0.013	0.012	0.0125	0	0.01	0.01	0.01	0.003	0.005	0.004	0.001333
454	0.016	0.017	0.0165	0.013	0.012	0.0125	0	0.01	0.009	0.0095	0.003	0.005	0.004	0.001333
454.5	0.016	0.017	0.0165	0.013	0.012	0.0125	0	0.01	0.009	0.0095	0.003	0.005	0.004	0.001333
455	0.016	0.017	0.0165	0.013	0.012	0.0125	0	0.01	0.009	0.0095	0.003	0.005	0.004	0.001333
455.5	0.016	0.017	0.0165	0.013	0.012	0.0125	0	0.009667	0.009	0.009333	0.003	0.005	0.004	0.001333
456	0.016	0.017	0.0165	0.013	0.012	0.0125	0	0.009667	0.009	0.009333	0.003	0.005	0.004	0.001333
456.5	0.016	0.017	0.0165	0.013	0.012	0.0125	0	0.009333	0.009	0.009167	0.003	0.005	0.004	0.001333
457	0.016	0.0166667	0.016333	0.013	0.012	0.0125	0	0.009	0.009	0.009	0.002667	0.004333	0.0035	0.001333
457.5	0.0153333	0.016	0.015667	0.013	0.012	0.0125	0	0.009	0.009	0.009	0.002667	0.004333	0.0035	0.001333
458	0.015	0.016	0.0155	0.013	0.0116667	0.012333	0	0.009	0.009	0.009	0.002667	0.004333	0.0035	0.001333
458.5	0.015	0.016	0.0155	0.012	0.011	0.0115	0	0.009	0.008	0.0085	0.002333	0.004	0.003167	0.001333
459	0.015	0.016	0.0155	0.012	0.011	0.0115	0	0.009	0.008	0.0085	0.002333	0.004	0.003167	0.001333
459.5	0.015	0.016	0.0155	0.012	0.011	0.0115	0	0.009	0.008	0.0085	0.002667	0.004	0.003333	0.001333
460	0.015	0.016	0.0155	0.012	0.011	0.0115	0	0.009	0.008	0.0085	0.002667	0.004333	0.0035	0.001667
460.5	0.015	0.016	0.0155	0.012	0.011	0.0115	0	0.008667	0.008	0.008333	0.002667	0.004	0.003333	0.001333
461	0.015	0.016	0.0155	0.012	0.011	0.0115	0	0.008333	0.008	0.008167	0.002667	0.004	0.003333	0.001333
461.5	0.015	0.016	0.0155	0.012	0.011	0.0115	0	0.008	0.008	0.008	0.002333	0.004	0.003167	0.001667
462	0.015	0.016	0.0155	0.012	0.011	0.0115	0	0.008	0.008	0.008	0.002333	0.004	0.003167	0.001667
462.5	0.014	0.015	0.0145	0.012	0.011	0.0115	0	0.008	0.008	0.008	0.002333	0.004	0.003167	0.001667
463	0.014	0.015	0.0145	0.012	0.011	0.0115	0	0.008	0.008	0.008	0.002333	0.004	0.003167	0.001333
463.5	0.014	0.015	0.0145	0.012	0.011	0.0115	0	0.008	0.008	0.008	0.002	0.004	0.003	0.001333
464	0.014	0.015	0.0145	0.012	0.011	0.0115	0	0.008	0.008	0.008	0.002	0.004	0.003	0.001667
464.5	0.014	0.015	0.0145	0.012	0.0106667	0.011333	0.000333	0.008	0.008	0.008	0.002	0.004	0.003	0.001333
465	0.014	0.015	0.0145	0.012	0.0103333	0.011167	0	0.008	0.008	0.008	0.002	0.004	0.003	0.001333
465.5	0.014	0.015	0.0145	0.011	0.01	0.0105	0	0.008	0.008	0.008	0.002	0.004	0.003	0.001667
466	0.014	0.015	0.0145	0.011	0.01	0.0105	0	0.008	0.007	0.0075	0.002	0.004	0.003	0.001667
466.5	0.014	0.015	0.0145	0.011	0.01	0.0105	0.000333	0.007667	0.007	0.007333	0.002	0.004	0.003	0.001667
467	0.014	0.0146667	0.014333	0.011	0.01	0.0105	0.000333	0.007667	0.007	0.007333	0.002	0.004	0.003	0.001667
467.5	0.0133333	0.014	0.013667	0.011	0.01	0.0105	0.000333	0.007333	0.007	0.007167	0.002	0.003667	0.002833	0.001667
468	0.013	0.014	0.0135	0.011	0.01	0.0105	0	0.007	0.007	0.007	0.002	0.003667	0.002833	0.001667
468.5	0.013	0.014	0.0135	0.011	0.01	0.0105	0	0.007	0.007	0.007	0.002	0.003333	0.002667	0.001667
469	0.013	0.014	0.0135	0.011	0.01	0.0105	0	0.007	0.007	0.007	0.002	0.003333	0.002667	0.001667
469.5	0.013	0.014	0.0135	0.011	0.01	0.0105	0	0.007	0.007	0.007	0.002	0.003	0.0025	0.001667
470	0.013	0.014	0.0135	0.011	0.01	0.0105	0	0.007	0.007	0.007	0.002	0.003	0.0025	0.001667
470.5	0.013	0.014	0.0135	0.011	0.01	0.0105	0	0.007	0.007	0.007	0.002	0.003	0.0025	0.001667
471	0.013	0.014	0.0135	0.011	0.01	0.0105	0.000333	0.007	0.007	0.007	0.002	0.003	0.0025	0.001667
471.5	0.013	0.014	0.0135	0.011	0.01	0.0105	0.000333	0.007	0.007	0.007	0.002	0.003	0.0025	0.001667
472	0.013	0.013	0.013	0.010667	0.01	0.010333	0	0.006667	0.007	0.006833	0.002	0.003	0.0025	0.001667
472.5	0.0126667	0.013	0.012833	0.01	0.01	0.01	0	0.006333	0.006	0.006167	0.002	0.003	0.0025	0.001667
473	0.0123333	0.013	0.012667	0.01	0.01	0.01	0	0.006333	0.006	0.006167	0.002	0.003	0.0025	0.001667
473.5	0.012	0.013	0.0125	0.01	0.01	0.01	0	0.006	0.006	0.006	0.002	0.003	0.0025	0.001667
474	0.012	0.013	0.0125	0.01	0.01	0.01	0	0.006	0.006	0.006	0.002	0.003	0.0025	0.001667
474.5	0.012	0.013	0.0125	0.01	0.01	0.01	0	0.006	0.006	0.006	0.002	0.003	0.0025	0.001667
475	0.012	0.013	0.0125	0.01	0.0096667	0.009833	0	0.006	0.006	0.006	0.002	0.003	0.0025	0.001667

475.5	0.012	0.013	0.0125	0.01	0.0093333	0.009667	0	0.006	0.006	0.006	0.002	0.003	0.0025	0.001667
476	0.012	0.013	0.0125	0.01	0.009	0.0095	0	0.006	0.006	0.006	0.002	0.003	0.0025	0.001667
476.5	0.012	0.013	0.0125	0.01	0.009	0.0095	0	0.006	0.006	0.006	0.002	0.003	0.0025	0.001667
477	0.012	0.013	0.0125	0.01	0.009	0.0095	0	0.006	0.006	0.006	0.001667	0.003	0.002333	0.001667
477.5	0.012	0.012	0.012	0.01	0.009	0.0095	0	0.006	0.006	0.006	0.001667	0.003	0.002333	0.001667
478	0.0116667	0.012	0.011833	0.01	0.009	0.0095	0	0.005667	0.005667	0.005667	0.001333	0.003	0.002167	0.001667
478.5	0.0116667	0.012	0.011833	0.01	0.009	0.0095	0	0.005667	0.005667	0.005667	0.001333	0.003	0.002167	0.001667
479	0.0113333	0.012	0.011667	0.01	0.009	0.0095	0	0.005667	0.005667	0.005667	0.001667	0.003	0.002333	0.001667
479.5	0.0113333	0.012	0.011667	0.01	0.009	0.0095	0	0.005667	0.005667	0.005667	0.001667	0.003	0.002333	0.001667
480	0.011	0.012	0.0115	0.01	0.009	0.0095	0	0.005	0.005	0.005	0.001667	0.003	0.002333	0.001667
480.5	0.011	0.012	0.0115	0.009667	0.009	0.009333	0	0.005	0.005	0.005	0.001333	0.003	0.002167	0.001667
481	0.011	0.012	0.0115	0.009667	0.009	0.009333	0.000333	0.005	0.005	0.005	0.001333	0.003	0.002167	0.001667
481.5	0.011	0.012	0.0115	0.009	0.009	0.009	0.000333	0.005	0.005	0.005	0.001333	0.003	0.002167	0.001667
482	0.011	0.012	0.0115	0.009	0.0083333	0.008667	0	0.005	0.005	0.005	0.001333	0.003	0.002167	0.001667
482.5	0.011	0.012	0.0115	0.009	0.0086667	0.008833	0	0.005	0.005	0.005	0.001333	0.003	0.002167	0.001667
483	0.011	0.0116667	0.011333	0.009	0.008	0.0085	0	0.005	0.005	0.005	0.001333	0.002667	0.002	0.001667
483.5	0.011	0.011	0.011	0.009	0.008	0.0085	0	0.005	0.005	0.005	0.001333	0.002667	0.002	0.001667
484	0.011	0.011	0.011	0.009	0.008	0.0085	0	0.005	0.005	0.005	0.001333	0.003	0.002167	0.001667
484.5	0.0106667	0.011	0.010833	0.009	0.008	0.0085	0	0.005	0.005	0.005	0.001333	0.002667	0.002	0.001667
485	0.0103333	0.011	0.010667	0.009	0.008	0.0085	0	0.005	0.005	0.005	0.001333	0.002667	0.002	0.001667
485.5	0.0103333	0.011	0.010667	0.009	0.008	0.0085	0	0.005	0.005	0.005	0.001333	0.002667	0.002	0.001667
486	0.01	0.011	0.0105	0.009	0.008	0.0085	0	0.005	0.005	0.005	0.001333	0.002667	0.002	0.001667
486.5	0.01	0.011	0.0105	0.009	0.008	0.0085	0	0.005	0.005	0.005	0.001333	0.002667	0.002	0.001667
487	0.01	0.011	0.0105	0.009	0.008	0.0085	0	0.005	0.005	0.005	0.001333	0.002	0.001667	0.001667
487.5	0.01	0.011	0.0105	0.009	0.008	0.0085	0.000333	0.005	0.005	0.005	0.001333	0.002	0.001667	0.0016

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539.5	0.006	0.007	0.0065	0.006	0.005	0.0055	0	0.002	0.002	0.002	0.000667	0.001333	0.001	0.001667
540	0.006	0.007	0.0065	0.005667	0.005	0.005333	0	0.002	0.002	0.002	0.000667	0.001333	0.001	0.001667
540.5	0.006	0.007	0.0065	0.005667	0.005	0.005333	0	0.002	0.002	0.002	0.000667	0.002	0.001333	0.001667
541	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
541.5	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
542	0.006	0.006	0.006	0.005333	0.005	0.005167	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
542.5	0.006	0.0063333	0.006167	0.005667	0.005	0.005333	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
543	0.006	0.0063333	0.006167	0.005333	0.005	0.005167	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
543.5	0.006	0.006	0.006	0.005667	0.005	0.005333	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
544	0.006	0.0063333	0.006167	0.006	0.005	0.0055	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
544.5	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
545	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
545.5	0.006	0.0063333	0.006167	0.005667	0.005	0.005333	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
546	0.006	0.006	0.006	0.005333	0.005	0.005167	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
546.5	0.006	0.006	0.006	0.005333	0.005	0.005167	0.000333	0.002	0.002	0.002	0.001	0.001667	0.001333	0.001667
547	0.006	0.006	0.006	0.005	0.005	0.005	0.000333	0.002	0.002	0.002	0.001	0.001667	0.001333	0.001667
547.5	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.001	0.002	0.0015	0.001667
548	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.001	0.001667	0.001333	0.001667
548.5	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.000667	0.001667	0.001167	0.001667
549	0.006	0.006	0.006	0.005	0.005	0.005	0.000333	0.002	0.002	0.002	0.000667	0.001667	0.001167	0.001667
549.5	0.006	0.006	0.006	0.005	0.005	0.005	0.000667	0.002	0.002	0.002	0.001	0.001667	0.001333	0.001667
550	0.006	0.006	0.006	0.005	0.005	0.005	0.000333	0.002	0.002	0.002	0.001	0.001667	0.001333	0.001667
550.5	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.001	0.001667	0.001333	0.001667
551	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.001	0.001667	0.001333	0.001667
551.5	0.006	0.006	0.006	0.005	0.005	0.005	0	0.002	0.002	0.002	0.001	0.001667	0.001333	0.001667
552	0.006	0.006	0.006	0.005	0.005	0.005	0							

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603.5	0.003	0.003	0.003	0.005	0.004	0.0045	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001667
604	0.003	0.003	0.003	0.005	0.004	0.0045	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001667
604.5	0.003	0.003	0.003	0.005	0.004	0.0045	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001667
605	0.003	0.003	0.003	0.005	0.004	0.0045	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001667
605.5	0.003	0.003	0.003	0.005	0.004	0.0045	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001333
606	0.003	0.003	0.003	0.004667	0.004	0.004333	0	0.000333	0.000667	0.0005	0.001	0.001	0.001	0.001333
606.5	0.003	0.003	0.003	0.004333	0.004	0.004167	0	0.000333	0.000667	0.0005	0.001	0.001	0.001	0.001333
607	0.003	0.003	0.003	0.004333	0.004	0.004167	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001333
607.5	0.003	0.003	0.003	0.004333	0.004	0.004167	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001333
608	0.003	0.003	0.003	0.004333	0.004	0.004167	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001333
608.5	0.003	0.003	0.003	0.004667	0.004	0.004333	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001667
609	0.003	0.003	0.003	0.004333	0.004	0.004167	0	0.000333	0.000333	0.000333	0.001	0.001	0.001	0.001333
609.5	0.003	0.003	0.003	0.004333	0.004	0.004167	0	0.000333	0.000333	0.000333	0.001	0.001	0.001	0.001333
610	0.003	0.003	0.003	0.004333	0.004	0.004167	0	0.000333	0.001	0.000667	0.001	0.001	0.001	0.001667
610.5	0.003	0.003	0.003	0.004	0.004	0.004	0	0.000333	0.000667	0.0005	0.001	0.001	0.001	0.001333
611	0.003	0.003	0.003	0.004	0.004	0.004	0	0.000333	0.000667	0.0005	0.001	0.001	0.001	0.001333
611.5	0.003	0.003	0.003	0.004	0.004	0.004	0	0.000333	0.000667	0.0005	0.001	0.001	0.001	0.001333
612	0.003	0.003	0.003	0.004	0.004	0.004	0	0	0	0	0.001	0.001	0.001	0.001333
612.5	0.003	0.003	0.003	0.004	0.004	0.004	0	0	0	0	0.001	0.001	0.001	0.001333
613	0.003	0.003	0.003	0.004	0.004	0.004	0	0.000333	0.000333	0.000333	0.001	0.001	0.001	0.001333
613.5	0.003	0.003	0.003	0.004	0.004	0.004	0	0.000333	0.000667	0.0005	0.001333	0.001	0.001167	0.001667
614	0.003	0.003	0.003	0.004	0.004	0.004	0	0.000333	0.000667	0.0005	0.001333	0.001	0.001167	0.001333
614.5	0.003	0.003	0.003	0.004	0.004	0.004	0	0.000333	0.000667	0.0005	0.001333	0.001	0.001167	0.001333
615	0.003	0.003	0.003	0.005	0.004	0.0045	0	0.000333	0.000667	0.0005	0.001333	0.001	0.001167	0.001667
615.5	0.003	0.003	0.003	0.004667	0.004	0.004333	0	0.000333	0.000333	0.000333	0.001333	0.001	0.001167	0.001333
616	0.003	0.003	0.003	0.004667	0.004									

635.5	0.003	0.003	0.003	0.004	0.004	0.004	0	0	0	0	0.000333	0	0.000167	0.001333
636	0.003	0.003	0.003	0.004	0.004	0.004	0	0	0	0	0.000333	0	0.000167	0.001333
636.5	0.003	0.003	0.003	0.004	0.004	0.004	0	0	0	0	0.000333	0	0.000167	0.001333
637	0.003	0.003	0.003	0.004	0.004	0.004	0	0	0	0	0.000667	0.000667	0.000667	0.002
637.5	0.003	0.003	0.003	0.004	0.004	0.004	0.001	0	0	0	0.001	0.001	0.001	0.002
638	0.003	0.003	0.003	0.004	0.004	0.004	0	0	0	0	0.000333	0	0.000167	0.001667
638.5	0.003	0.003	0.003	0.004	0.004	0.004	0	0	0	0	0	0	0	0.001333
639	0.003	0.003	0.003	0.004	0.004	0.004	0	-0.00067	0	-0.00033	0	0	0	0.001333
639.5	0.003	0.003	0.003	0.004	0.004	0.004	0	-0.00067	0	-0.00033	0	0	0	0.001333
640	0.003	0.003	0.003	0.004	0.0033333	0.003667	0	-0.00067	0	-0.00033	0	0	0	0.001333
640.5	0.003	0.003	0.003	0.004	0.0033333	0.003667	0	-0.00067	0	-0.00033	0	0	0	0.001333
641	0.003	0.003	0.003	0.004	0.003	0.0035	0	-0.00067	0	-0.00033	0	0	0	0.001333
641.5	0.003	0.003	0.003	0.004	0.003	0.0035	0	-0.00067	-0.00067	-0.00067	0	0	0	0.001333
642	0.003	0.003	0.003	0.004	0.003	0.0035	0	-0.00067	-0.001	-0.00083	0	0	0	0.001333
642.5	0.003	0.003	0.003	0.004	0.003	0.0035	0	-0.001	-0.001	-0.001	0	0	0	0.001333
643	0.003	0.003	0.003	0.004	0.003	0.0035	0	-0.00067	-0.001	-0.00083	0	0	0	0.001333
643.5	0.003	0.003	0.003	0.004	0.003	0.0035	0	-0.00067	-0.001	-0.00083	0	0	0	0.001333
644	0.003	0.003	0.003	0.003667	0.003	0.003333	0	-0.001	-0.001	-0.001	-0.00033	0	-0.00017	0.001333
644.5	0.003	0.003	0.003	0.003667	0.003	0.003333	0	-0.001	-0.001	-0.001	-0.00033	0	-0.00017	0.001333
645	0.003	0.003	0.003	0.003	0.003	0.003	0	-0.001	-0.001	-0.001	-0.00033	0	-0.00017	0.001333
645.5	0.003	0.003	0.003	0.003	0.003	0.003	0	-0.001	-0.001	-0.001	-0.00067	-0.00033	-0.0005	0.001333
646	0.003	0.003	0.003	0.003	0.003	0.003	0	-0.001	-0.001	-0.001	-0.00067	-0.00033	-0.0005	0.001333
646.5	0.003	0.003	0.003	0.003	0.003	0.003	0	-0.001	-0.001	-0.001	-0.00067	-0.001	-0.00083	0.001333
647	0.003	0.003	0.003	0.003	0.003	0.003	0	-0.001	-0.001	-0.001	-0.00067	-0.001	-0.00083	0.001333
647.5	0.003	0.003	0.003	0.003	0.003	0.003	0	-0.001	-0.001	-0.001	-0.00067	-0.001	-0.00083	0.001333
648	0.003	0.003	0.003	0.003	0.003	0.003	0	-0.001	-0.001	-0.001	-0.00067	-0.001	-0.00083	0.001333
648.5	0.003	0.003	0.003	0.003	0.003	0.003	0	-0.001	-0.001	-0.001	-0.00067	-0.001	-0.00083	0.001333
649	0.003	0.003	0.003	0.003	0.003	0.003	0	-0.001	-0.001	-0.001	-0.			

667.5	0.002	0.002	0.002	0.002	0.002	0.002	0	-0.00133	-0.001	-0.00117	-0.00167	-0.002	-0.00183	0.001333
668	0.002	0.002	0.002	0.002	0.0016667	0.001833	0	-0.00133	-0.001	-0.00117	-0.002	-0.002	-0.002	0.001333
668.5	0.002	0.002	0.002	0.002	0.0013333	0.001667	0	-0.00167	-0.00167	-0.00167	-0.002	-0.002	-0.002	0.001333
669	0.002	0.002	0.002	0.002	0.001	0.0015	0	-0.00167	-0.00167	-0.00167	-0.002	-0.002	-0.002	0.001333
669.5	0.002	0.002	0.002	0.002	0.001	0.0015	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
670	0.002	0.002	0.002	0.002	0.001	0.0015	0	-0.00167	-0.00167	-0.00167	-0.002	-0.002	-0.002	0.001333
670.5	0.002	0.002	0.002	0.002	0.001	0.0015	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
671	0.002	0.002	0.002	0.001667	0.001	0.001333	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
671.5	0.002	0.002	0.002	0.001667	0.001	0.001333	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
672	0.002	0.002	0.002	0.002	0.001	0.0015	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
672.5	0.002	0.002	0.002	0.002	0.001	0.0015	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
673	0.002	0.002	0.002	0.002	0.001	0.0015	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
673.5	0.002	0.002	0.002	0.001333	0.001	0.001167	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
674	0.002	0.002	0.002	0.001333	0.001	0.001167	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
674.5	0.002	0.002	0.002	0.001667	0.001	0.001333	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
675	0.002	0.002	0.002	0.001667	0.001	0.001333	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
675.5	0.002	0.002	0.002	0.001333	0.001	0.001167	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
676	0.002	0.002	0.002	0.001	0.001	0.001	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
676.5	0.002	0.002	0.002	0.001	0.001	0.001	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
677	0.002	0.002	0.002	0.001333	0.001	0.001167	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
677.5	0.002	0.002	0.002	0.001333	0.001	0.001167	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
678	0.002	0.002	0.002	0.001333	0.001	0.001167	0	-0.00167	-0.002	-0.00183	-0.002	-0.002	-0.002	0.001333
678.5	0.0016667	0.0016667	0.001667	0.001	0.001	0.001	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001333
679	0.0016667	0.0013333	0.0015	0.001	0.001	0.001	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001333
679.5	0.0013333	0.0013333	0.001333	0.001	0.001	0.001	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001333
680	0.0016667	0.001	0.001333	0.001	0.001	0.001	0							

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827.5	0.001	0.001	0.001	0.001	0.001	0.001	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001667
828	0.001	0.001	0.001	0.001	0.001	0.001	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001667
828.5	0.001	0.001	0.001	0.001	0.001	0.001	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001667
829	0.001	0.001	0.001	0.001	0.001	0.001	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001667
829.5	0.001	0.001	0.001	0.001	0.001	0.001	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001667
830	0.001	0.001	0.001	0.001	0.0006667	0.000833	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001667
830.5	0.001	0.001	0.001	0.000667	0.0006667	0.000667	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001667
831	0.001	0.001	0.001	0.000667	0.001	0.000833	0	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	0.001667
831.5	0.001	0.001	0.001	0.001	0.001	0.001	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001667
832	0.001	0.001	0.001	0.001	0.001	0.001	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001667
832.5	0.001	0.001	0.001	0.000667	0.001	0.000833	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001667
833	0.001	0.001	0.001	0.000667	0.001	0.000833	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001667
833.5	0.001	0.001	0.001	0.000667	0.001	0.000833	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001667
834	0.001	0.001	0.001	0.000667	0.0006667	0.000667	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001667
834.5	0.001	0.0006667	0.000833	0.000667	0.001	0.000833	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001667
835	0.001	0.0006667	0.000833	0.000333	0.001	0.000667	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001667
835.5	0.0003333	0.0006667	0.0005	0.000333	0.001	0.000667	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001667
836	0.0006667	0.0006667	0.000667	0.000667	0.0006667	0.000667	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.002
836.5	0.0006667	0.0006667	0.000667	0.000333	0.0006667	0.0005	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.002
837	0.0006667	0.0006667	0.000667	0.000333	0.0006667	0.0005	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.002
837.5	0.0006667	0	0.000333	0	0.0006667	0.000333	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.002
838	0.0006667	0	0.000333	0	0.0006667	0.000333	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.002
838.5	0	0	0	0	0.0003333	0.000167	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.002
839	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.002
839.5	0.0003333	0.0003333	0.000333	0	0	0	0	-0.00167	-0.00167	-0.00167	-0.00167	-0.002	-0.00183	0.002
840	0.0003333	0.0003333	0.000333	0	0.0003333	0.000167	0	-0.00133	-0.00167	-0.0015	-0.00167	-0.002	-0.00183	0.002
840.5	0	0	0	0	0	0	0	-0.00133	-0.00167	-0.0015	-0.00167	-0.002	-0.00183	0.002
841	0	0	0	0	0	0	0	-0.00133	-0.00167	-0.0015	-0.00167	-0.002	-0.00183	0.002
841.5	0.0003333	0	0.000167	0	0	0	0	-0.00133	-0.00167	-0.0015	-0.00167	-0.002	-0.00183	0.002
842	0	0	0	0	0	0	0	-0.00133	-0.00167	-0.0015	-0.00167	-0.002	-0.00183	0.002
842.5	0	0	0	0	0	0	0	-0.00133	-0.00167	-0.0015	-0.00167	-0.002	-0.00183	0.002
843	0	0	0	0	0	0	0	-0.00133	-0.00167	-0.0015	-0.00167	-0.002	-0.00183	0.002
843.5	0	0	0	0	0	0	0	-0.00133	-0.00133	-0.00133	-0.00167	-0.002	-0.00183	0.002
844	0	0	0	0	0	0	0	-0.00133	-0.00133	-0.00133	-0.00167	-0.002	-0.00183	0.002
844.5	0	0	0	0	0	0	0	-0.00133	-0.001	-0.00117	-0.00167	-0.002	-0.00183	0.002
845	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.002	-0.00183	0.002
845.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.002	-0.00183	0.002
846	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.002	-0.00183	0.002333
846.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.002	-0.00183	0.002
847	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.002	-0.00183	0.002
847.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.002	-0.00183	0.002
848	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.002	-0.00183	0.002333
848.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.001	-0.00133	-0.00117	0.002333
849	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00133	-0.00133	-0.00133	0.002
849.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00133	-0.00167	-0.0015	0.002
850	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00133	-0.002	-0.00167	0.002
850.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00133	-0.00167	-0.0015	0.002
851	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00133	-0.00167	-0.0015	0.002
851.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00133	-0.00167	-0.0015	0.002
852	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.00167	-0.00167	0.002
852.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.00167	-0.00167	0.002
853	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00133	-0.00167	-0.0015	0.002
853.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00133	-0.00167	-0.0015	0.002
854	0	0	0	0	0	0	0	-0.00133	-0.00067	-0.001	-0.00167	-0.00167	-0.00167	0.002
854.5	0	0	0	0	0	0	0	-0.00133	-0.00067	-0.001	-0.00167	-0.00167	-0.00167	0.002
855	0	0	0	0	0	0	0	-0.00133	-0.00067	-0.001	-0.00167	-0.002	-0.00183	0.002
855.5	0	0	0	0	0	0	0	-0.00133	-0.00067	-0.001	-0.00167	-0.002	-0.00183	0.002
856	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.00133	-0.0015	0.002
856.5	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.001	-0.001	-0.001	0.002333
857	0	0	0	0	0	0	0	-0.001	-0.00067	-0.00083	-0.00167	-0.001	-0.00133	0.002333
857.5	0	0	0	0	0	0	0	-0.00133	-0.00067	-0.001	-0.00167	-0.00133	-0.0015	0.002
858	0	0	0	0	0	0	0	-0.00133	-0.00067	-0.001	-0.00167	-0.00133	-0.0015	0.002
858.5	0	0	0	0	0	0	0	-0.00133	-0.00067	-0.001	-0.00133	-0.001	-0.00117	0.002
859	0	0	0	0	0	0	0	-0.00133	-0.00067	-0.001	-0.00133	-0.001	-0.00117	0.002

859.5	0	0	0	0	0	0	0	0	-0.00167	-0.00133	-0.0015	-0.00167	-0.00167	-0.00167	0.002
860	0	0	0	0	0	0	0	0	-0.00167	-0.00133	-0.0015	-0.00167	-0.00167	-0.00167	0.002
860.5	0	0	0	0	0	0	0	0	-0.00167	-0.00067	-0.00117	-0.00167	-0.001	-0.00133	0.002
861	0	0	0	0	0	0	0	0	-0.00167	-0.00133	-0.0015	-0.00167	-0.00167	-0.00167	0.002
861.5	0	0	0	0	0	0	0	0	-0.00167	-0.00133	-0.0015	-0.00167	-0.00167	-0.00167	0.002
862	0	0	0	0	0	0	0	0	-0.00167	-0.00133	-0.0015	-0.00167	-0.001	-0.00133	0.002333
862.5	0	0	0	0	0	0	0	0	-0.00167	-0.00133	-0.0015	-0.00167	-0.00133	-0.0015	0.002333
863	0	0	0	0	0	0	0	0	-0.00167	-0.00133	-0.0015	-0.00167	-0.00167	-0.00167	0.002
863.5	0	0	0	0	0	0	0	0	-0.00167	-0.00133	-0.0015	-0.00167	-0.00167	-0.00167	0.002
864	0	0	0	0	0	0	0	0	-0.00167	-0.00133	-0.0015	-0.00167	-0.002	-0.00183	0.001667
864.5	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.00167	-0.002	-0.00183	0.001667
865	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.00167	-0.002	-0.00183	0.001667
865.5	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.00167	-0.002	-0.00183	0.001667
866	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.00167	-0.002	-0.00183	0.001667
866.5	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
867	0	0	0	-0.00033	0	-0.00017	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
867.5	0	0	0	-0.00033	0	-0.00017	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
868	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
868.5	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
869	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
869.5	0	0	0	-0.00033	0	-0.00017	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
870	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
870.5	0	-0.0003333	-0.00017	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
871	0	0	0	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
871.5	0	0	0	-0.00067	0	-0.00033	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
872	0	-0.0003333	-0.00017	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
872.5	0	-0.0003333	-0.00017	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
873	0	0	0	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
873.5	0	-0.0003333	-0.00017	0	-0.0003333	-0.00017	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001667
874	0	-0.0003333	-0.00017	0	0	0	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
874.5	0	-0.0003333	-0.00017	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
875	0	-0.0003333	-0.00017	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
875.5	0	-0.0003333	-0.00017	0	-0.0003333	-0.00017	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
876	0	0	0	0	-0.0003333	-0.00017	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
876.5	0	0	0	0	-0.0003333	-0.00017	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
877	0	-0.0006667	-0.00033	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
877.5	0	0	0	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
878	0	0	0	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
878.5	0	-0.0006667	-0.00033	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
879	0	-0.001	-0.0005	-0.00067	-0.0006667	-0.00067	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
879.5	0	-0.001	-0.0005	-0.00067	-0.001	-0.00083	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
880	0	-0.001	-0.0005	-0.001	-0.001	-0.001	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
880.5	0	-0.001	-0.0005	-0.001	-0.001	-0.001	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
881	0	-0.001	-0.0005	-0.00033	-0.001	-0.00067	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
881.5	0	-0.0003333	-0.00017	-0.00033	-0.001	-0.00067	0	0	-0.002	-0.00133	-0.00167	-0.002	-0.002	-0.002	0.001333
882	0	-0.0003333	-0.00017	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
882.5	0	-0.0003333	-0.00017	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
883	0	-0.0006667	-0.00033	-0.00067	-0.0003333	-0.0005	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
883.5	0	-0.0006667	-0.00033	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
884	0	-0.0006667	-0.00033	-0.00033	-0.0006667	-0.0005	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
884.5	0	-0.0003333	-0.00017	-0.00033	-0.0006667	-0.0005	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
885	0	-0.0003333	-0.00017	-0.00033	-0.0003333	-0.00033	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001
885.5	0	-0.0003333	-0.00017	0	0	0	0	0	-0.00233	-0.00167	-0.002	-0.002	-0.002	-0.002	0.001
886	0	0	0	0	0	0	0	0	-0.00233	-0.00167	-0.002	-0.002	-0.002	-0.002	0.001
886.5	0	0	0	0	0	0	0	0	-0.00233	-0.00167	-0.002	-0.002	-0.002	-0.002	0.001333
887	0	0	0	0	0	0	0	0	-0.00233	-0.00167	-0.002	-0.002	-0.002	-0.002	0.001333
887.5	0	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
888	0	-0.0003333	-0.00017	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
888.5	0	-0.0003333	-0.00017	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
889	0	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
889.5	0	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
890	0	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
890.5	0	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
891	0	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333

891.5	0	-0.0003333	-0.00017	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
892	0	-0.0003333	-0.00017	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
892.5	0	0	0	0	-0.0003333	-0.00017	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
893	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
893.5	0	-0.0006667	-0.00033	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
894	0	-0.0003333	-0.00017	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
894.5	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
895	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
895.5	0	-0.0003333	-0.00017	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
896	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
896.5	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001
897	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001
897.5	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001
898	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
898.5	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001333
899	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001
899.5	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001
900	0	0	0	0	0	0	0	-0.002	-0.00167	-0.00183	-0.002	-0.002	-0.002	0.001

Appendix L. Reclaimed Water Topoff Quantities for Experimental Recycling
Raceway Ponds

		Reclaimed Water Added in Recycle Pond Sets (INCHES)												Reclaimed Water Added (CUBIC METERS)							
		Date	Digestate Ponds Initial Height		Fertilizer Ponds Initial Height		Digestate Ponds Final Height		Fertilizer Ponds Final Height		Digestate Ponds Depth Added		Fertilizer Ponds Depth Added		Digestate Ponds Volume Added		Fertilizer Ponds Volume Added		Comments		
			Pond 4	Pond 5	Pond 6	Pond 8	Pond 4	Pond 5	Pond 6	Pond 8	Pond 4	Pond 5	Pond 6	Pond 8	Pond 4	Pond 5	Pond 6	Pond 8			
Monday		4/27/2015	10.75	12.00	11.75	12.25	11.00	12.25	12.00	12.25	0.250	0.250	0.250	0.000	0.210	0.210	0.210	0.000			
Tuesday		4/28/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		Pond Surface Area (m2)	
Wednesday		4/29/2015	11.00	12.25			11.75	13.00			0.750	0.750	0.000	0.000	0.629	0.629	0.000	0.000		33.0	
Thursday		4/30/2015	11.25	11.5	11.75	11	11.75	12	12.25	11.25	0.500	0.500	0.500	0.250	0.419	0.419	0.419	0.210			
Friday		5/1/2015	11.25	12	12.125	11	11.5	12.5	12.75	11	0.250	0.500	0.625	0.000	0.210	0.419	0.524	0.000		Unit conversion (m/in)	
Saturday		5/2/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.0254	
Sunday		5/3/2015	11.125	12	11.375	11.75	11.75	12.625	12.5	11.75	0.625	0.625	1.125	0.000	0.524	0.524	0.943	0.000		1mg/L = 1g/m^3	
Monday		5/4/2015			11.5				11.875		0.000	0.000	0.375	0.000	0.000	0.000	0.314	0.000			
Tuesday		5/5/2015	11.5	12.25	11.75	12.5	12	12.25	12.25	13	0.500	0.000	0.500	0.500	0.419	0.000	0.419	0.419		For 4/27/15 to 6/23/15	
Wednesday		5/6/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		HRT Calculation	
Thursday		5/7/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		Avg daily addn (m3)	0.19
Friday		5/8/2015	11	12.25	11.375	11.25	12.25	13.25	11.75	11.25	1.250	1.000	0.375	0.000	1.048	0.838	0.314	0.000		Pond Volume (m3)	9.90
Saturday		5/9/2015	10.75	12	11.5	11	11.5	12.25	11.75	12.5	0.750	0.250	0.250	1.500	0.629	0.210	0.210	1.257		HRT (d)	51.15
Sunday		5/10/2015	11	13	11.375	11.5	11.5	13	11.625	11.625	0.500	0.000	0.250	0.125	0.419	0.000	0.210	0.105		Days	56.00
Monday		5/11/2015		12.25	11.5			12.75	12		0.000	0.500	0.500	0.000	0.000	0.419	0.419	0.000		Influent HRT (d)	4.00
Tuesday		5/12/2015			11.25				11.75		0.000	0.000	0.500	0.000	0.000	0.000	0.419	0.000		Recycled effluent (m3/d)	2.28
Wednesday		5/13/2015	10.75			11	11.25			11.5	0.500	0.000	0.000	0.500	0.419	0.000	0.000	0.419		Corrected HRT (d)	4.34
Thursday		5/14/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		# of cycles	14
Friday		5/15/2015	11.5	13.25	12.125	11.125	12	13.25	12.5	11.5	0.500	0.000	0.375	0.375	0.419	0.000	0.314	0.314		corrected # of cycles	12.91
Saturday		5/16/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Sunday		5/17/2015	11.25	13	11.875	11.375	11.5	13	12.125	11.5	0.250	0.000	0.250	0.125	0.210	0.000	0.210	0.105			
Monday		5/18/2015	12.125	11.875	11.875	11.25	12.125	12.5	12.25	11.25	0.000	0.625	0.375	0.000	0.000	0.524	0.314	0.000			
Tuesday		5/19/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Maybe missing data		
Wednesday		5/20/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		For 4/27/15 to 9/3/15	
Thursday		5/21/2015				11.125				12.25	0.000	0.000	0.000	1.125	0.000	0.000	0.000	0.943		HRT Calculation	
Friday		5/22/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		Avg daily addn (m3)	0.23
Saturday		5/23/2015	12	12	11.75	11	12	13.25	11.75	12.5	0.000	1.250	0.000	1.500	0.000	1.048	0.000	1.257		Pond Volume (m3)	9.90
Sunday		5/24/2015	11.5	13.25	12	11	11.5	13.25	12	12	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.838		HRT (d)	43.27
Monday		5/25/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		Days	129.00
Tuesday		5/26/2015				11				11.75	0.000	0.000	0.000	0.750	0.000	0.000	0.000	0.629		Influent HRT (d)	4.00
Wednesday		5/27/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		Recycled effluent (m3/d)	2.25
Thursday		5/28/2015			11.25				12		0.000	0.000	0.750	0.000	0.000	0.000	0.629	0.000		Corrected HRT (d)	4.41
Friday		5/29/2015	11.5	12	11.75	11.125	11.75	12.25	12	12.5	0.250	0.250	0.250	1.375	0.210	0.210	0.210	1.153		# of cycles	32.25
Saturday		5/30/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		corrected # of cycles	29.27
Sunday		5/31/2015	11.5	12	12	11	12	12.5	12.75	11.25	0.500	0.500	0.750	0.250	0.419	0.419	0.629	0.210			
Monday		6/1/2015	11.25	12.25	12.375	11	12	12.5	12.75	11	0.750	0.250	0.375	0.000	0.629	0.210	0.314	0.000			
Tuesday		6/2/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		For 4/27/15 to 9/3/15	
Wednesday		6/3/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		HRT Calculation	
Thursday		6/4/2015	11	12	11.5	10.75	12.2	13	12.5	11.5	1.200	1.000	1.000	0.750	1.006	0.838	0.838	0.629		Avg daily addn (m3)	0.20
Friday		6/5/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		Pond Volume (m3)	9.90

Saturday	6/6/2015				11				11.5	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.419		HRT (d)	48.32
Sunday	6/7/2015		12.125	12.25			13	13		0.000	0.875	0.750	0.000	0.000	0.733	0.629	0.000		Days	220.00
Monday	6/8/2015	12.25	12.25	12.5	11		13			0.000	0.750	0.000	0.000	0.000	0.629	0.000	0.000	**Final Heights Interpolated data from previous day pond height readings**	Influent HRT (d)	4.00
Tuesday	6/9/2015	11	13	12	11		13.5			0.000	0.500	0.000	0.000	0.000	0.419	0.000	0.000		Recycled effluent (m3/d)	2.27
Wednesday	6/10/2015	11	13.5	12	11	11.25				0.250	0.000	0.000	0.000	0.210	0.000	0.000	0.000		Corrected HRT (d)	4.36
Thursday	6/11/2015	11	13	12	11	11.25	11.25			0.250	0.000	0.000	0.000	0.210	0.000	0.000	0.000		# of cycles	55
Friday	6/12/2015	11.38	12.75	11.75	10.88				12.00	0.000	0.000	0.000	1.125	0.000	0.000	0.000	0.943		corrected # of cycles	50.45
Saturday	6/13/2015	11	12.25	11.5	12		13.5	12		0.000	1.250	0.500	0.000	0.000	1.048	0.419	0.000			
Sunday	6/14/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	no daily sheet		
Monday	6/15/2015	11	13.25	12	11.25					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Tuesday	6/16/2015	11.5	12	11.875	10.875	12.25	12.75	12.625	11.25	0.750	0.750	0.750	0.375	0.629	0.629	0.629	0.314			
Wednesday	6/17/2015	12.125	11.75	12.75	11		12.5			0.000	0.750	0.000	0.000	0.000	0.629	0.000	0.000			
Thursday	6/18/2015	11	13	12	11.25	11.5	13	12	11.5	0.500	0.000	0.000	0.250	0.419	0.000	0.000	0.210			
Friday	6/19/2015	11	12.75	12	11					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Saturday	6/20/2015	10.75	12.5	11.25	11	11.5	12.5	12	11.5	0.750	0.000	0.750	0.500	0.629	0.000	0.629	0.419			
Sunday	6/21/2015		12.00	11.80	11.25		12.50	12.00	11.50	0.000	0.500	0.200	0.250	0.000	0.419	0.168	0.210			
Monday	6/22/2015		12	11.5	11		12.75	12	11.5	0.000	0.750	0.500	0.500	0.000	0.629	0.419	0.419			
Tuesday	6/23/2015	11.5	12	12	11.25	11.75	12.75	12	11.5	0.250	0.750	0.000	0.250	0.210	0.629	0.000	0.210			
Wednesday	6/24/2015	10.9	13	11.5	11.6	11.5	13	12	11.6	0.600	0.000	0.500	0.000	0.503	0.000	0.419	0.000			
Thursday	6/25/2015				11.375				11.5	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.105			
Friday	6/26/2015	11.125	12.25	11.5	11.25	11.5	12.75	12.125	11.5	0.375	0.500	0.625	0.250	0.314	0.419	0.524	0.210			
Saturday	6/27/2015	10.75	13	11.75	11.5	11.4	13	12	11.5	0.650	0.000	0.250	0.000	0.545	0.000	0.210	0.000			
Sunday	6/28/2015	10.75				11.35				0.600	0.000	0.000	0.000	0.503	0.000	0.000	0.000			
Monday	6/29/2015	11.5	12.8	12	11					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Tuesday	6/30/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	no daily sheet		
Wednesday	7/1/2015	10.7	12	11.5		11.3	12.7	12		0.600	0.700	0.500	0.000	0.503	0.587	0.419	0.000			
Thursday	7/2/2015	11.75	12	12.25	10.75		12.5	12.5	11.75	0.000	0.500	0.250	1.000	0.000	0.419	0.210	0.838			
Friday	7/3/2015				11				12.25	0.000	0.000	0.000	1.250	0.000	0.000	0.000	1.048			
Saturday	7/4/2015		12				12.5			0.000	0.500	0.000	0.000	0.000	0.419	0.000	0.000			
Sunday	7/5/2015	11	12.5	11.5	12	11.25	12.75	12	12	0.250	0.250	0.500	0.000	0.210	0.210	0.419	0.000			
Monday	7/6/2015	10.8	12.5	11.4	12					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Tuesday	7/7/2015	11	12	11	12			12		0.000	0.000	1.000	0.000	0.000	0.000	0.838	0.000			
Wednesday	7/8/2015	10.4	12			11.5	12.5			1.100	0.500	0.000	0.000	0.922	0.419	0.000	0.000			
Thursday	7/9/2015	11.00	12.00	12.25	10.75	11.50	12.75		11.50	0.500	0.750	0.000	0.750	0.419	0.629	0.000	0.629			
Friday	7/10/2015		12				12.6			0.000	0.600	0.000	0.000	0.000	0.503	0.000	0.000			
Saturday	7/11/2015	11.5	12.25	11.65	10.5		12.75		11	0.000	0.500	0.000	0.500	0.000	0.419	0.000	0.419			
Sunday	7/12/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Monday	7/13/2015	10.8	12	11.7	10	11.2	13	12.1	11.5	0.400	1.000	0.400	1.500	0.335	0.838	0.335	1.257			
Tuesday	7/14/2015	11.2				11.38				0.180	0.000	0.000	0.000	0.151	0.000	0.000	0.000	40 gallons addede to pond due to draining tube settler. (created a		
Wednesday	7/15/2015				10.25				11	0.000	0.000	0.000	0.750	0.000	0.000	0.000	0.629			
Thursday	7/16/2015	11.125	12.25	12	1.75	11.5	12.75	12.25	11	0.375	0.500	0.250	9.250	0.314	0.419	0.210	7.753			
Friday	7/17/2015	11.25	12.375	12.5	10.25	11.25	12.375	12.5	10.25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Saturday	7/18/2015	11.10	12.20	11.90	10.50				11.00	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.419			
Sunday	7/19/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Monday	7/20/2015	11.5	14.1	13.75	10.6					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Tuesday	7/21/2015				10.5				11	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.419			
Wednesday	7/22/2015	10.75				11.4				0.650	0.000	0.000	0.000	0.545	0.000	0.000	0.000			
Thursday	7/23/2015		12.125				12.75			0.000	0.625	0.000	0.000	0.000	0.524	0.000	0.000			
Friday	7/24/2015	11.6	11.8	12.3	11.125					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Saturday	7/25/2015		11.8	11.5			12.4	11.9		0.000	0.600	0.400	0.000	0.000	0.503	0.335	0.000			

Sunday	7/26/2015	11.8	12	11.8	11.5					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Monday	7/27/2015		10.00		10.50		11.60		11.00	0.000	1.600	0.000	0.500	0.000	1.341	0.000	0.419	
Tuesday	7/28/2015			11.25				12		0.000	0.000	0.750	0.000	0.000	0.000	0.629	0.000	
Wednesday	7/29/2015		12	10.5			12.5	11		0.000	0.500	0.500	0.000	0.000	0.419	0.419	0.000	
Thursday	7/30/2015	11.128	12	11	10.875	11.375	13	11.375	11.25	0.247	1.000	0.375	0.375	0.207	0.838	0.314	0.314	
Friday	7/31/2015	11				11.25				0.250	0.000	0.000	0.000	0.210	0.000	0.000	0.000	
Saturday	8/1/2015		12	11.25	10.5	12.375	12.375	11.5	10.875	12.375	0.375	0.250	0.375	10.373	0.314	0.210	0.314	
Sunday	8/2/2015		10.75	11	10.5		12	11.5	11	0.000	1.250	0.500	0.500	0.000	1.048	0.419	0.419	
Monday	8/3/2015	11.8			10.4	12.5			10.8	0.700	0.000	0.000	0.400	0.587	0.000	0.000	0.335	
Tuesday	8/4/2015	11.5	12.5	11.5	11					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Wednesday	8/5/2015	10.60		11.00	10.50	11.00		11.20	11.50	0.400	0.000	0.200	1.000	0.335	0.000	0.168	0.838	
Thursday	8/6/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	no daily sheet
Friday	8/7/2015		10.8				12.5			0.000	1.700	0.000	0.000	0.000	1.425	0.000	0.000	
Saturday	8/8/2015		11.875				12.5			0.000	0.625	0.000	0.000	0.000	0.524	0.000	0.000	
Sunday	8/9/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Monday	8/10/2015	11.5	12	11	11					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Tuesday	8/11/2015	10.8			10.5	11.5			11	0.700	0.000	0.000	0.500	0.587	0.000	0.000	0.419	
Wednesday	8/12/2015	11	12.1	11.5	11	11.5	13	12.25	12	0.500	0.900	0.750	1.000	0.419	0.754	0.629	0.838	
Thursday	8/13/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	no daily sheet
Friday	8/14/2015		12.00	11.50			12.20	12.30		0.000	0.200	0.800	0.000	0.000	0.168	0.671	0.000	
Saturday	8/15/2015	11.2	12.2		10.5	11.4	12.5		11.4	0.200	0.300	0.000	0.900	0.168	0.251	0.000	0.754	
Sunday	8/16/2015		12	11.6	11.6		12.4	12	11.8	0.000	0.400	0.400	0.200	0.000	0.335	0.335	0.168	
Monday	8/17/2015		11.8	11.6			12.5	11.8		0.000	0.700	0.200	0.000	0.000	0.587	0.168	0.000	
Tuesday	8/18/2015			11				11.3		0.000	0.000	0.300	0.000	0.000	0.000	0.251	0.000	
Wednesday	8/19/2015	10.75	12	11.5	10.6	11.15	12.7	11.9	11.5	0.400	0.700	0.400	0.900	0.335	0.587	0.335	0.754	
Thursday	8/20/2015	10.5	12.75	11.75	11.5	11.25	12.75	12	11.5	0.750	0.000	0.250	0.000	0.629	0.000	0.210	0.000	
Friday	8/21/2015	11	12.25	12	11					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Saturday	8/22/2015	10.5	12.5	10.3		11.5	12.7	11.8		1.000	0.200	1.500	0.000	0.838	0.168	1.257	0.000	
Sunday	8/23/2015	10.9			10.5	11.4			11.5	0.500	0.000	0.000	1.000	0.419	0.000	0.000	0.838	
Monday	8/24/2015				10.8				11.5	0.000	0.000	0.000	0.700	0.000	0.000	0.000	0.587	
Tuesday	8/25/2015				10.8				11.2	0.000	0.000	0.000	0.400	0.000	0.000	0.000	0.335	
Wednesday	8/26/2015		12		10.7		12.65		11.85	0.000	0.650	0.000	1.150	0.000	0.545	0.000	0.964	
Thursday	8/27/2015	11	12.25	12	11.25					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Friday	8/28/2015	10.6	12	12.4	10.85	11.25	12.75	12.4	11.25	0.650	0.750	0.000	0.400	0.545	0.629	0.000	0.335	
Saturday	8/29/2015	10.5				11.1				0.600	0.000	0.000	0.000	0.503	0.000	0.000	0.000	
Sunday	8/30/2015		11.8		10.7		12.6		11.6	0.000	0.800	0.000	0.900	0.000	0.671	0.000	0.754	
Monday	8/31/2015	10.7				11.25				0.550	0.000	0.000	0.000	0.461	0.000	0.000	0.000	
Tuesday	9/1/2015			11.7	10.8			12	11.2	0.000	0.000	0.300	0.400	0.000	0.000	0.251	0.335	
Wednesday	9/2/2015	10.75				11.3				0.550	0.000	0.000	0.000	0.461	0.000	0.000	0.000	
Thursday	9/3/2015	10.75			12	12.375			12.25	1.625	0.000	0.000	0.250	1.362	0.000	0.000	0.210	
Friday	9/4/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Saturday	9/5/2015	11.6	12.1	11.6	11.5	11.8	12.6	11.9	12.2	0.200	0.500	0.300	0.700	0.168	0.419	0.251	0.587	
Sunday	9/6/2015		12.125	11.75	12		12.75	12.25	12.375	0.000	0.625	0.500	0.375	0.000	0.524	0.419	0.314	
Monday	9/7/2015				11.75				12.25	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.419	
Tuesday	9/8/2015				11.75				13	0.000	0.000	0.000	1.250	0.000	0.000	0.000	1.048	
Wednesday	9/9/2015		12.1		11.8		12.5		12.5	0.000	0.400	0.000	0.700	0.000	0.335	0.000	0.587	
Thursday	9/10/2015	10.75	12.25	12.25	12.125	11.75	13.25	12.25	12.625	1.000	1.000	0.000	0.500	0.838	0.838	0.000	0.419	
Friday	9/11/2015	13.375	13	12.25	12.125					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Saturday	9/12/2015	10.7		11.5		11.5		12		0.800	0.000	0.500	0.000	0.671	0.000	0.419	0.000	
Sunday	9/13/2015	10.6		11.7	12.1	11.5		12	13	0.900	0.000	0.300	0.900	0.754	0.000	0.251	0.754	

Monday	9/14/2015	10.6			12.1	11.1			12.5	0.500	0.000	0.000	0.400	0.419	0.000	0.000	0.335	
Tuesday	9/15/2015	10.75	13	12.25	12	11.6	13	12.25	12	0.850	0.000	0.000	0.000	0.712	0.000	0.000	0.000	
Wednesday	9/16/2015	10.5				11.25				0.750	0.000	0.000	0.000	0.629	0.000	0.000	0.000	
Thursday	9/17/2015	11.125	12.5	11.25	12.25					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Friday	9/18/2015	11	12.5	11.25	12	11.625	12.75	11.875	12.25	0.625	0.250	0.625	0.250	0.524	0.210	0.524	0.210	
Saturday	9/19/2015	11		11.2		11.3		12		0.300	0.000	0.800	0.000	0.251	0.000	0.671	0.000	
Sunday	9/20/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Monday	9/21/2015	10.9			11.5	11.6			12.5	0.700	0.000	0.000	1.000	0.587	0.000	0.000	0.838	
Tuesday	9/22/2015		12	11.3			12.2	11.6		0.000	0.200	0.300	0.000	0.000	0.168	0.251	0.000	
Wednesday	9/23/2015	10.7		11.4		11.1		11.9		0.400	0.000	0.500	0.000	0.335	0.000	0.419	0.000	
Thursday	9/24/2015		12.2	11.6			12.8	12		0.000	0.600	0.400	0.000	0.000	0.503	0.335	0.000	
Friday	9/25/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Saturday	9/26/2015		12.25	11.5			14	12.25		0.000	1.750	0.750	0.000	0.000	1.467	0.629	0.000	
Sunday	9/27/2015	10.5			11.8	11.75			12.3	1.250	0.000	0.000	0.500	1.048	0.000	0.000	0.419	
Monday	9/28/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	no daily sheet
Tuesday	9/29/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	No Daily Sheet
Wednesday	9/30/2015	11.6	12.3	11.7	11.9					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Thursday	10/1/2015	10.8	12.6	11.5	11.8	11.5	12.6	12	12.6	0.700	0.000	0.500	0.800	0.587	0.000	0.419	0.671	
Friday	10/2/2015	11.25	12.25	12	12	11.5	12.625	12	12.5	0.250	0.375	0.000	0.500	0.210	0.314	0.000	0.419	
Saturday	10/3/2015	11.5	11.5	12	11.8	11.5	12.6	12	12.4	0.000	1.100	0.000	0.600	0.000	0.922	0.000	0.503	
Sunday	10/4/2015	10.9	13	11.5	12.5	10.6	13	12	12.5	0.000	0.000	0.500	0.000	0.000	0.000	0.419	0.000	
Monday	10/5/2015	11.4	12.1	12	12	11.4	12.5	12	12.6	0.000	0.400	0.000	0.600	0.000	0.335	0.000	0.503	
Tuesday	10/6/2015	11.25	11.75	11.5	12.25	11.25	12.6	12	12.25	0.000	0.850	0.500	0.000	0.000	0.712	0.419	0.000	
Wednesday	10/7/2015	11.4	12.1	12.2	12	11.4	12.1	12.2	12.6	0.000	0.000	0.000	0.600	0.000	0.000	0.000	0.503	
Thursday	10/8/2015	10.8	12.4	12	12	11.4	12.7	12	12.6	0.600	0.300	0.000	0.600	0.503	0.251	0.000	0.503	
Friday	10/9/2015		11.8	12			12.8	12.4		0.000	1.000	0.400	0.000	0.000	0.838	0.335	0.000	
Saturday	10/10/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Sunday	10/11/2015	10	13	12	11.5	11	13	12	12	1.000	0.000	0.000	0.500	0.838	0.000	0.000	0.419	
Monday	10/12/2015	10.75	12.9	11.3	12.3	11.4	12.9	12	12.3	0.650	0.000	0.700	0.000	0.545	0.000	0.587	0.000	
Tuesday	10/13/2015	10.8	12.2	11.5	12.4	11.3	12.7	12.1	12.4	0.500	0.500	0.600	0.000	0.419	0.419	0.503	0.000	
Wednesday	10/14/2015	11.2	12.3	11.5	12.4	11.2	12.3	12	12.4	0.000	0.000	0.500	0.000	0.000	0.000	0.419	0.000	
Thursday	10/15/2015	11.1	12	11.5	12.5	11.1	12	12	12.5	0.000	0.000	0.500	0.000	0.000	0.000	0.419	0.000	
Friday	10/16/2015		10.5	11.5			12.7	12.1		0.000	2.200	0.600	0.000	0.000	1.844	0.503	0.000	
Saturday	10/17/2015	11.25	12.375	11.875	12.125	11.25	12.875	12.125	12.5	0.000	0.500	0.250	0.375	0.000	0.419	0.210	0.314	
Sunday	10/18/2015	11	13	12	12.5	11	13	12	12.75	0.000	0.000	0.000	0.250	0.000	0.000	0.000	0.210	
Monday	10/19/2015	10.9	12.7	12	12	11.2	12.7	12	12.6	0.300	0.000	0.000	0.600	0.251	0.000	0.000	0.503	
Tuesday	10/20/2015	11.2	12.7	12	12	11.2	12.7	12	12.6	0.000	0.000	0.000	0.600	0.000	0.000	0.000	0.503	
Wednesday	10/21/2015	11.8	12.6	11.9	12.1	11.8	12.6	11.9	12.5	0.000	0.000	0.000	0.400	0.000	0.000	0.000	0.335	
Thursday	10/22/2015	10.9	12	11.75	12	11.3	12.5	11.75	12.3	0.400	0.500	0.000	0.300	0.335	0.419	0.000	0.251	
Friday	10/23/2015	11.25	12.3	11.4	12.25	11.25	12.7	12.3	12.25	0.000	0.400	0.900	0.000	0.000	0.335	0.754	0.000	
Saturday	10/24/2015	11	12.1	11.5	12.3	11	12.1	12.2	12.3	0.000	0.000	0.700	0.000	0.000	0.000	0.587	0.000	
Sunday	10/25/2015	11	12	12	12.5	11	12	12	12.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Monday	10/26/2015	10.7	12.2	11.5	12.3	11.4	12.2	12.2	12.3	0.700	0.000	0.700	0.000	0.587	0.000	0.587	0.000	
Tuesday	10/27/2015	11.2	12.1	12.3	12	11.2	12.1	12.3	12.5	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.419	
Wednesday	10/28/2015	10.9	12.1	12.2	12.1	11.1	12.5	12.2	12.1	0.200	0.400	0.000	0.000	0.168	0.335	0.000	0.000	
Thursday	10/29/2015	11.25	12.3	11.8	12.25	11.25	12.3	11.8	12.25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Friday	10/30/2015	10.75	12.25	12.25	11.5	11.5	12.75	12.25	12.4	0.750	0.500	0.000	0.900	0.629	0.419	0.000	0.754	
Saturday	10/31/2015	11.3	12.6	11.9	12.2	11.3	12.6	11.9	12.2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Sunday	11/1/2015	11.25	12.5	11.75	12.25	11.25	12.5	12.25	12.25	0.000	0.000	0.500	0.000	0.000	0.000	0.419	0.000	
Monday	11/2/2015	11.4	12.6	12.6	11.3	11.4	12.6	12.6	12	0.000	0.000	0.000	0.700	0.000	0.000	0.000	0.587	

Tuesday	11/3/2015	11.75	13	12.5	12.5	11.75	13	12.5	12.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Wednesday	11/4/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Thursday	11/5/2015	11.6	12.7	11.8	12.1	11.6	12.7	11.8	12.1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Friday	11/6/2015	11.3	12.5	11.6	11.75	11.3	12.5	12.2	11.75	0.000	0.000	0.600	0.000	0.000	0.000	0.503	0.000	
Saturday	11/7/2015	11.25	12.25	12.375	11.75					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Sunday	11/8/2015	11	12.25	11.5	12	11.5	12.675	12.125	12	0.500	0.425	0.625	0.000	0.419	0.356	0.524	0.000	
Monday	11/9/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Tuesday	11/10/2015				11.6				12.1	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.419	
Wednesday	11/11/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Thursday	11/12/2015	11.2	12.8	12.6	11.6	11.2	12.8	12.6	12	0.000	0.000	0.000	0.400	0.000	0.000	0.000	0.335	
Friday	11/13/2015	11.8	12	12.5	11.75	12.8	12.75	13.5	12.25	1.000	0.750	1.000	0.500	0.838	0.629	0.838	0.419	
Saturday	11/14/2015	11.5	12.5	12.5	12					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Sunday	11/15/2015	12	13	12.5	12.5	12	13	12.5	12.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Monday	11/16/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Tuesday	11/17/2015	10.75	13	12.5	11.75	11	13	12.5	12	0.250	0.000	0.000	0.250	0.210	0.000	0.000	0.210	
Wednesday	11/18/2015	11.7	12	12.6	11.5	11.7	12.6	12.6	12	0.000	0.600	0.000	0.500	0.000	0.503	0.000	0.419	
Thursday	11/19/2015	10.9	12	12.6	11.65	11.5	12.6	12.6	11.9	0.600	0.600	0.000	0.250	0.503	0.503	0.000	0.210	
Friday	11/20/2015	11.5	12.25	12.4	11.6	12.75	12.75	12.65	12.4	1.250	0.500	0.250	0.800	1.048	0.419	0.210	0.671	
Saturday	11/21/2015	11.5	12.5	12	12.25					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Sunday	11/22/2015	11.5	12	12	12	11.5	12	12	12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Monday	11/23/2015										0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Tuesday	11/24/2015	10.8	12.9	11.8	11.75	11.25	12.9	11.8	11.75	0.450	0.000	0.000	0.000	0.377	0.000	0.000	0.000	
Wednesday	11/25/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Thursday	11/26/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Friday	11/27/2015									0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Saturday	11/28/2015	11	12.5	11.5	11.625	11.75	13	12	12.5	0.750	0.500	0.500	0.875	0.629	0.419	0.419	0.733	
Sunday	11/29/2015	11.75	12.5	12	12	11.75	12.5	12	12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Monday	11/30/2015	11.5	12	11.4	12.4	11.5	12.5	12	12.4	0.000	0.500	0.600	0.000	0.000	0.419	0.503	0.000	
Tuesday	12/1/2015	11.8	12.1	12.1	12	11.8	13	12.1	12	0.000	0.900	0.000	0.000	0.000	0.754	0.000	0.000	
Wednesday	12/2/2015	11.7	12.6	12.4	11.6	11.7	12.6	12.4	12.1	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.419	
Thursday	12/3/2015	11.7	12.4	12.7	11.7	11.7	12.6	12.7	12	0.000	0.200	0.000	0.300	0.000	0.168	0.000	0.251	

Digestate Ponds Volume Added		Fertilizer Ponds Volume Added	
Pond 4	Pond 5	Pond 6	Pond 8

		Reclaimed Water Nitrogen Calculations																															
	Date	Reclaimed Influent (g/m3)				Comments	Pond 4 N Added (g)					Pond 5 N Added (g)					Pond 6 N Added (g)					Pond 8 N Added (g)					Comments						
		TAN	NO3	NO2	Soluble N		Volume Added (m3)	TAN	NO3	NO2	Soluble N	Weekly Soluble N Total	Volume Added (m3)	TAN	NO3	NO2	Soluble N	Weekly Soluble N Total	Volume Added (m3)	TAN	NO3	NO2	Soluble N	Weekly Soluble N Total	Volume Added (m3)	TAN		NO3	NO2	Soluble N	Weekly Soluble N Total		
Monday	4/27/2015	0.20	39.00	0.01	39.21		0.21	0.04	8.17	0.00	8.22	78.06	0.21	0.04	8.17	0.00	8.22	86.27	0.21	0.04	8.17	0.00	8.22	82.16	0.00	0.00	0.00	0.00	0.00	8.22			
Tuesday	4/28/2015	0.20	39.00	0.01	39.21		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00		
Wednesday	4/29/2015	0.20	39.00	0.01	39.21		0.63	0.13	24.52	0.01	24.65		0.63	0.13	24.52	0.01	24.65		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Thursday	4/30/2015	0.20	39.00	0.01	39.21		0.42	0.08	16.34	0.00	16.43		0.42	0.08	16.34	0.00	16.43		0.42	0.08	16.34	0.00	16.43		0.21	0.04	8.17	0.00	8.22				
Friday	5/1/2015	0.20	39.00	0.01	39.21		0.21	0.04	8.17	0.00	8.22		0.42	0.08	16.34	0.00	16.43		0.52	0.10	20.43	0.01	20.54		0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Saturday	5/2/2015	0.20	39.00	0.01	39.21		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Sunday	5/3/2015	0.20	39.00	0.01	39.21		0.52	0.10	20.43	0.01	20.54		0.52	0.10	20.43	0.01	20.54		0.94	0.19	36.78	0.01	36.97		0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Monday	5/4/2015	1.65	0.00	4.41	6.06		0.00	0.00	0.00	0.00	0.00	15.24	0.00	0.00	0.00	0.00	0.00	6.35	0.31	0.52	0.00	1.39	1.90	8.89	0.00	0.00	0.00	0.00	0.00	10.79			
Tuesday	5/5/2015	1.65	0.00	4.41	6.06		0.42	0.69	0.00	1.85	2.54		0.00	0.00	0.00	0.00	0.00		0.42	0.69	0.00	1.85	2.54		0.42	0.69	0.00	1.85	2.54				
Wednesday	5/6/2015	1.65	0.00	4.41	6.06		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00		
Thursday	5/7/2015	1.65	0.00	4.41	6.06		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00		
Friday	5/8/2015	1.65	0.00	4.41	6.06		1.05	1.73	0.00	4.62	6.35		0.84	1.38	0.00	3.70	5.08		0.31	0.52	0.00	1.39	1.90		0.00	0.00	0.00	0.00	0.00		0.00	0.00	
Saturday	5/9/2015	1.65	0.00	4.41	6.06		0.63	1.04	0.00	2.77	3.81		0.21	0.35	0.00	0.92	1.27		0.21	0.35	0.00	0.92	1.27		1.26	2.07	0.00	5.54	7.62				
Sunday	5/10/2015	1.65	0.00	4.41	6.06		0.42	0.69	0.00	1.85	2.54		0.00	0.00	0.00	0.00	0.00		0.21	0.35	0.00	0.92	1.27		0.10	0.17	0.00	0.46	0.63				
Monday	5/11/2015	0.14	35.45	0.01	35.60		0.00	0.00	0.00	0.00	0.00	37.30	0.42	0.06	14.86	0.00	14.92	14.92	0.42	0.06	14.86	0.00	14.92	48.49	0.00	0.00	0.00	0.00	0.00	29.84			
Tuesday	5/12/2015	0.14	35.45	0.01	35.60		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.42	0.06	14.86	0.00	14.92		0.00	0.00	0.00	0.00	0.00		0.00		
Wednesday	5/13/2015	0.14	35.45	0.01	35.60		0.42	0.06	14.86	0.00	14.92		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.42	0.06	14.86	0.00	14.92				
Thursday	5/14/2015	0.14	35.45	0.01	35.60		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00		
Friday	5/15/2015	0.14	35.45	0.01	35.60		0.42	0.06	14.86	0.00	14.92		0.00	0.00	0.00	0.00	0.00		0.31	0.05	11.14	0.00	11.19		0.00	0.00	0.00	0.00	0.00		0.00		
Saturday	5/16/2015	0.14	35.45	0.01	35.60		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00		
Sunday	5/17/2015	0.14	35.45	0.01	35.60		0.21	0.03	7.43	0.00	7.46		0.00	0.00	0.00	0.00	0.00		0.21	0.03	7.43	0.00	7.46		0.10	0.02	3.71	0.00	3.73				
Monday	5/18/2015	0.60	37.20	0.02	37.82		0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.31	19.49	0.01	19.81	59.43	0.31	0.19	11.69	0.00	11.89	11.89	0.00	0.00	0.00	0.00	0.00	114.90			
Tuesday	5/19/2015	0.60	37.20	0.02	37.82		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00		
Wednesday	5/20/2015	0.60	37.20	0.02	37.82		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00		
Thursday	5/21/2015	0.60	37.20	0.02	37.82		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.94	0.57	35.08	0.01	35.66				
Friday	5/22/2015	0.60	37.20	0.02	37.82		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00		
Saturday	5/23/2015	0.60	37.20	0.02	37.82		0.00	0.00	0.00	0.00	0.00		1.05	0.63	38.98	0.02	39.62		0.00	0.00	0.00	0.00	0.00		1.26	0.75	46.77	0.02	47.55				
Sunday	5/24/2015	0.60	37.20	0.02	37.82		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.84	0.50	31.18	0.01	31.70				
Monday	5/25/2015	0.59	39.47	0.02	40.08		0.00	0.00	0.00	0.00	0.00	25.20	0.00	0.00	0.00	0.00	0.00	25.20	0.00	0.00	0.00	0.00	0.00	58.80	0.00	0.00	0.00	0.00	0.00	79.79			
Tuesday	5/26/2015	0.59	39.47	0.02	40.08		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.63	0.37	24.82	0.01	25.20				
Wednesday	5/27/2015	0.59	39.47	0.02	40.08		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00		
Thursday	5/28/2015	0.59	39.47	0.02	40.08		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.63	0.37	24.												

Monday	7/13/2015	0.91	30.12	0.18	31.21		0.34	0.31	10.10	0.06	10.46		0.84	0.76	25.25	0.15	26.16		0.34	0.31	10.10	0.06	10.46		1.26	1.14	37.87	0.22	39.23		
Tuesday	7/14/2015	0.91	30.12	0.18	31.21		0.15	0.14	4.54	0.03	4.71		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Wednesday	7/15/2015	0.91	30.12	0.18	31.21		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.63	0.57	18.93	0.11	19.62		
Thursday	7/16/2015	1.69	34.01	0.03	35.73		0.31	0.53	10.69	0.01	11.23		0.42	0.71	14.25	0.01	14.97		0.21	0.35	7.13	0.01	7.49		7.75	13.10	263.69	0.23	277.03		
Friday	7/17/2015	1.69	34.01	0.03	35.73		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Saturday	7/18/2015	1.69	34.01	0.03	35.73		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.42	0.71	14.25	0.01	14.97		
Sunday	7/19/2015	1.69	34.01	0.03	35.73		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Monday	7/20/2015	1.69	34.01	0.03	35.73		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Tuesday	7/21/2015	1.69	34.01	0.03	35.73		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.42	0.71	14.25	0.01	14.97		
Wednesday	7/22/2015	1.69	34.01	0.03	35.73		0.54	0.92	18.53	0.02	19.47		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Thursday	7/23/2015	0.62	29.60	0.03	30.25		0.00	0.00	0.00	0.00	0.00		0.52	0.32	15.51	0.02	15.85		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Friday	7/24/2015	0.62	29.60	0.03	30.25		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Saturday	7/25/2015	0.62	29.60	0.03	30.25		0.00	0.00	0.00	0.00	0.00		0.50	0.31	14.89	0.02	15.21		0.34	0.21	9.92	0.01	10.14		0.00	0.00	0.00	0.00	0.00		
Sunday	7/26/2015	0.62	29.60	0.03	30.25		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Monday	7/27/2015	0.62	29.60	0.03	30.25		0.00	0.00	0.00	0.00	0.00		1.34	0.83	39.70	0.04	40.57		0.00	0.00	0.00	0.00	0.00		0.42	0.26	12.41	0.01	12.68		
Tuesday	7/28/2015	0.62	29.60	0.03	30.25		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.63	0.39	18.61	0.02	19.02		0.00	0.00	0.00	0.00	0.00		
Wednesday	7/29/2015	0.62	29.60	0.03	30.25		0.00	0.00	0.00	0.00	0.00		0.42	0.26	12.41	0.01	12.68		0.42	0.26	12.41	0.01	12.68		0.00	0.00	0.00	0.00	0.00		
Thursday	7/30/2015	0.00	26.97	0.02	26.99		0.21	0.00	5.58	0.00	5.59		0.84	0.00	22.61	0.02	22.62		0.31	0.00	8.48	0.01	8.48		0.31	0.00	8.48	0.01	8.48		
Friday	7/31/2015	0.00	26.97	0.02	26.99		0.21	0.00	5.65	0.00	5.66		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Saturday	8/1/2015	0.00	26.97	0.02	26.99		10.37	0.00	279.75	0.21	279.96		0.31	0.00	8.48	0.01	8.48		0.21	0.00	5.65	0.00	5.66		0.31	0.00	8.48	0.01	8.48		
Sunday	8/2/2015	0.00	26.97	0.02	26.99		0.00	0.00	0.00	0.00	0.00		1.05	0.00	28.26	0.02	28.28		0.42	0.00	11.30	0.01	11.31		0.42	0.00	11.30	0.01	11.31		
Monday	8/3/2015	0.00	26.97	0.02	26.99		0.59	0.00	15.82	0.01	15.84		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.34	0.00	9.04	0.01	9.05		
Tuesday	8/4/2015	0.00	26.97	0.02	26.99		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Wednesday	8/5/2015	0.00	26.97	0.02	26.99		0.34	0.00	9.04	0.01	9.05		0.00	0.00	0.00	0.00	0.00		0.17	0.00	4.52	0.00	4.52		0.84	0.00	22.61	0.02	22.62		
Thursday	8/6/2015	0.00	30.76	0.02	30.78		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Friday	8/7/2015	0.00	30.76	0.02	30.78		0.00	0.00	0.00	0.00	0.00		1.42	0.00	43.83	0.03	43.86		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Saturday	8/8/2015	0.00	30.76	0.02	30.78		0.00	0.00	0.00	0.00	0.00		0.52	0.00	16.11	0.01	16.12		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Sunday	8/9/2015	0.00	30.76	0.02	30.78		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Monday	8/10/2015	0.00	30.76	0.02	30.78		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Tuesday	8/11/2015	0.00	30.76	0.02	30.78		0.59	0.00	18.05	0.01	18.06		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.42	0.00	12.89	0.01	12.90		
Wednesday	8/12/2015	0.00	30.76	0.02	30.78		0.42	0.00	12.89	0.01	12.90		0.75	0.00	23.20	0.02	23.22		0.63	0.00	19.34	0.01	19.35		0.84	0.00	25.78	0.02	25.80		
Thursday	8/13/2015	0.15	28.97	0.01	29.13		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Friday	8/14/2015	0.15	28.97	0.01	29.13		0.00	0.00	0.00	0.00	0.00		0.17	0.03	4.86	0.00	4.88		0.67	0.10	19.43	0.01	19.53		0.00	0.00	0.00	0.00	0.00		
Saturday	8/15/2015	0.15	28.97	0.01	29.13		0.17	0.03	4.86	0.00	4.88		0.25	0.04	7.28	0.00	7.33		0.00	0.00	0.00	0.00	0.00		0.75	0.11	21.85	0.01	21.98		
Sunday	8/16/2015	0.15	28.97	0.01	29.13		0.00	0.00	0.00	0.00	0.00		0.34	0.05	9.71	0.00	9.77		0.34	0.05	9.71	0.00	9.77		0.17	0.03	4.86	0.00	4.88		
Monday	8/17/2015	0.15	28.97	0.01	29.13		0.00	0.00	0.00	0.00	0.00		0.59	0.09	17.00	0.01	17.09		0.17	0.03	4.86	0.00	4.88		0.00	0.00	0.00	0.00	0.00		
Tuesday	8/18/2015	0.15	28.97	0.01	29.13		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.25	0.04	7.28	0.00	7.33		0.00	0.00	0.00	0.00	0.00		
Wednesday	8/19/2015	0.15	28.97	0.01	29.13		0.34	0.05	9.71	0.00	9.77		0.59	0.09	17.00	0.01	17.09		0.34	0.05	9.71	0.00	9.77		0.75	0.11	21.85	0.01	21.98		
Thursday	8/20/2015	0.49	29.51	0.01	30.01		0.63	0.31	18.55	0.01	18.87		0.00	0.00	0.00	0.00	0.00		0.21	0.10	6.18	0.00	6.29		0.00	0.00	0.00	0.00	0.00		
Friday	8/21/2015	0.49	29.51	0.01	30.01		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Saturday	8/22/2015	0.49	29.51	0.01	30.01		0.84	0.41	24.74	0.01	25.15		0.17	0.08	4.95	0.00	5.03		1.26	0.62	37.10	0.01	37.73		0.00	0.00	0.00	0.00	0.00		
Sunday	8/23/2015	0.49	29.51	0.01	30.01		0.42	0.21	12.37	0.00	12.58		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.84	0.41	24.74	0.01	25.15		
Monday	8/24/2015	0.49	29.51	0.01	30.01		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.59	0.29	17.31	0.01	17.61		
Tuesday	8/25/2015	0.49	29.51	0.01	30.01		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.34	0.16	9.89	0.00	10.06		
Wednesday	8/26/2015	0.49	29.51	0.01	30.01		0.00	0.00	0.00	0.00	0.00		0.54	0.27	16.08	0.01	16.35		0.00	0.00	0.00	0.00	0.00		0.96	0.47	28.45	0.01	28.93		
Thursday	8/27/2015	0.00	23.62	0.01	23.63		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		
Friday	8/28/2015	0.00																													

Friday	10/8/2015	0.03	38.05	0.42	38.50		0.50	0.02	19.14	0.21	19.36	88.74	0.25	0.01	9.57	0.11	9.68	58.09	0.00	0.00	0.00	0.00	0.00	71.00	0.50	0.02	19.14	0.21	19.36	35.50		
Friday	10/9/2015	0.03	38.05	0.42	38.50		0.00	0.00	0.00	0.00	0.00		0.84	0.03	31.89	0.35	32.27		0.34	0.01	12.76	0.14	12.91		0.00	0.00	0.00	0.00	0.00			
Saturday	10/10/2015	0.03	38.05	0.42	38.50		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			
Sunday	10/11/2015	0.03	38.05	0.42	38.50		0.84	0.03	31.89	0.35	32.27		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.42	0.01	15.95	0.18	16.14			
Monday	10/12/2015	0.03	38.05	0.42	38.50		0.54	0.02	20.73	0.23	20.98		0.00	0.00	0.00	0.00	0.00		0.00	0.59	0.02	22.33	0.25		22.59	0.00	0.00	0.00	0.00		0.00	
Tuesday	10/13/2015	0.03	38.05	0.42	38.50		0.42	0.01	15.95	0.18	16.14		0.42	0.01	15.95	0.18	16.14		0.50	0.02	19.14	0.21	19.36		0.00	0.00	0.00	0.00	0.00		0.00	
Wednesday	10/14/2015	0.03	38.05	0.42	38.50		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.42	0.01	15.95	0.18		16.14	0.00	0.00	0.00	0.00		0.00	
Thursday	10/15/2015	0.05	36.87	0.03	36.95		0.00	0.00	0.00	0.00	0.00	9.29	0.00	0.00	0.00	0.00	0.00	83.62	0.42	0.02	15.45	0.01	15.49	41.81	0.00	0.00	0.00	0.00	0.00	68.91		
Friday	10/16/2015	0.05	36.87	0.03	36.95		0.00	0.00	0.00	0.00	0.00		1.84	0.09	67.99	0.06	68.14		0.50	0.03	18.54	0.02	18.58		0.00	0.00	0.00	0.00	0.00			
Saturday	10/17/2015	0.05	36.87	0.03	36.95		0.00	0.00	0.00	0.00	0.00		0.42	0.02	15.45	0.01	15.49		0.21	0.01	7.73	0.01	7.74		0.31	0.02	11.59	0.01	11.61			
Sunday	10/18/2015	0.05	36.87	0.03	36.95		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.21	0.01	7.73	0.01	7.74			
Monday	10/19/2015	0.05	36.87	0.03	36.95		0.25	0.01	9.27	0.01	9.29		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.50	0.03	18.54	0.02	18.58			
Tuesday	10/20/2015	0.05	36.87	0.03	36.95		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.50	0.03	18.54	0.02	18.58			
Wednesday	10/21/2015	0.05	36.87	0.03	36.95		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.34	0.02	12.36	0.01	12.39			
Thursday	10/22/2015	0.06	30.93	0.12	31.11		0.34	0.02	10.37	0.04	10.43	33.90	0.42	0.03	12.96	0.05	13.04	33.90	0.00	0.00	0.00	0.00	0.00	59.98	0.25	0.02	7.78	0.03	7.82	20.86		
Friday	10/23/2015	0.06	30.93	0.12	31.11		0.00	0.00	0.00	0.00	0.00		0.34	0.02	10.37	0.04	10.43		0.75	0.05	23.33	0.09	23.47		0.00	0.00	0.00	0.00	0.00			
Saturday	10/24/2015	0.06	30.93	0.12	31.11		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.59	0.04	18.15	0.07	18.25		0.00	0.00	0.00	0.00	0.00			
Sunday	10/25/2015	0.06	30.93	0.12	31.11		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			
Monday	10/26/2015	0.06	30.93	0.12	31.11		0.59	0.04	18.15	0.07	18.25		0.00	0.00	0.00	0.00	0.00		0.59	0.04	18.15	0.07	18.25		0.00	0.00	0.00	0.00	0.00			
Tuesday	10/27/2015	0.06	30.93	0.12	31.11		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.42	0.03	12.96	0.05	13.04			
Wednesday	10/28/2015	0.06	30.93	0.12	31.11		0.17	0.01	5.19	0.02	5.22		0.34	0.02	10.37	0.04	10.43		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			
Thursday	10/29/2015	0.08	25.39	0.01	25.48		0.00	0.00	0.00	0.00	0.00	16.02	0.00	0.00	0.00	0.00	0.00	10.68	0.00	0.00	0.00	0.00	0.00	10.68	0.00	0.00	0.00	0.00	0.00	34.17		
Friday	10/30/2015	0.08	25.39	0.01	25.48		0.63	0.05	15.96	0.01	16.02		0.42	0.03	10.64	0.00	10.68		0.00	0.00	0.00	0.00	0.00		0.75	0.06	19.15	0.01	19.22			
Saturday	10/31/2015	0.08	25.39	0.01	25.48		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			
Sunday	11/1/2015	0.08	25.39	0.01	25.48		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.42	0.03	10.64	0.00	10.68		0.00	0.00	0.00	0.00	0.00			
Monday	11/2/2015	0.08	25.39	0.01	25.48		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.59	0.05	14.90	0.01	14.95			
Tuesday	11/3/2015	0.08	25.39	0.01	25.48		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			
Wednesday	11/4/2015	0.08	25.39	0.01	25.48		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			
Thursday	11/5/2015	0.12	34.57	0.09	34.78		0.00	0.00	0.00	0.00	0.00	14.58	0.00	0.00	0.00	0.00	0.00	12.39	0.00	0.00	0.00	0.00	0.00	35.71	0.00	0.00	0.00	0.00	0.00	14.58		
Friday	11/6/2015	0.12	34.57	0.09	34.78		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.50	0.06	17.39	0.05	17.49		0.00	0.00	0.00	0.00	0.00			
Saturday	11/7/2015	0.12	34.57	0.09	34.78		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			
Sunday	11/8/2015	0.12	34.57	0.09	34.78		0.42	0.05	14.49	0.04	14.58		0.36	0.04	12.32	0.03	12.39		0.52	0.06	18.11	0.05	18.22		0.00	0.00	0.00	0.00	0.00		0.00	
Monday	11/9/2015	0.12	34.57	0.09	34.78		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			
Tuesday	11/10/2015	0.12	34.57	0.09	34.78		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.42	0.05	14.49	0.04	14.58			
Wednesday	11/11/2015	0.12	34.57	0.09	34.78		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00			
Thursday	11/12/2015	0.06	39.62	0.02	39.70		0.00	0.00	0.00	0.00	0.00	41.60	0.00	0.00	0.00	0.00	0.00	44.92	0.00	0.00	0.00	0.00	0.00	33.28	0.34	0.02	13.28	0.01	13.31	54.91		
Friday	11/13/2015	0.06	39.62	0.02	39.70		0.84	0.05	33.21	0.02	33.28		0.63	0.04	24.91	0.01	24.96		0.84	0.05	33.21	0.02	33.28		0.42	0.03	16.60	0.01	16.64			
Saturday	11/14/2015	0.06	39.62	0.02	39.70		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00										

Pond 4 & 5 Digestate Nitrogen vs. Total Nitrogen Feed Ratio

Pond 6 & 8 Fertilizer Nitrogen vs. Total Nitrogen Feed Ratio

Appendix M. Fertilizer Additions

		Fertilizer Ponds (Pond 6 + Pond 8)								Digestate Ponds (Pond 4 + Pond 5)								
	Date	Fertilizer Mass (g) to P6	Fertilizer Mass (g) to P8	Fertilizer Nitrogen Mass (g) to P6	Fertilizer Nitrogen Mass (g) to P8	Weekly Sum of Nitrogen Mass (g) P6	Weekly Sum of Nitrogen Mass (g) P8	Pond 6 Fertilizer N (g) Added Over Time	Pond 8 Fertilizer N (g) Added Over Time	Fertilizer Mass (g) to P4	Fertilizer Mass (g) to P5	Fertilizer Nitrogen Mass (g) to P4	Fertilizer Nitrogen Mass (g) to P5	Weekly Sum of Nitrogen Mass (g) P4	Weekly Sum of Nitrogen Mass (g) P5	Pond 4 Fertilizer N (g) Added Over Time	Pond 5 Fertilizer N (g) Added Over Time	Comments
Tuesday	5/5/2015	33.33	33.33	9.999	9.999	50.00	50.00	10.00	10.00									
Wednesday	5/6/2015			0.00	0.00			10.00	10.00									
Thursday	5/7/2015	33.33	33.33	10.00	10.00			20.00	20.00									
Friday	5/8/2015			0.00	0.00			20.00	20.00									
Saturday	5/9/2015	100.00	100.00	30.00	30.00			50.00	50.00									
Sunday	5/10/2015			0.00	0.00			50.00	50.00									
Monday	5/11/2015			0.00	0.00	120.00	120.00	50.00	50.00									
Tuesday	5/12/2015	250.00	250.00	75.00	75.00			125.00	125.00									
Wednesday	5/13/2015			0.00	0.00			125.00	125.00									
Thursday	5/14/2015	150.00	150.00	45.00	45.00			170.00	170.00									
Friday	5/15/2015			0.00	0.00			170.00	170.00									
Saturday	5/16/2015			0.00	0.00			170.00	170.00									
Sunday	5/17/2015			0.00	0.00	170.00	170.00											
Monday	5/18/2015			0.00	0.00	264.00	240.00	170.00	170.00									
Tuesday	5/19/2015	400.00	400.00	120.00	120.00			290.00	290.00									*if memory serves
Wednesday	5/20/2015			0.00	0.00			290.00	290.00									
Thursday	5/21/2015	380.00	300.00	114.00	90.00			404.00	380.00									
Friday	5/22/2015			0.00	0.00			404.00	380.00									
Saturday	5/23/2015	100.00	100.00	30.00	30.00			434.00	410.00									
Sunday	5/24/2015			0.00	0.00	434.00	410.00											
Monday	5/25/2015			0.00	0.00	282.00	237.00	434.00	410.00									
Tuesday	5/26/2015	340.00	340.00	102.00	102.00			536.00	512.00									
Wednesday	5/27/2015			0.00	0.00			536.00	512.00									
Thursday	5/28/2015	300.00	200.00	90.00	60.00			626.00	572.00									
Friday	5/29/2015			0.00	0.00			626.00	572.00									
Saturday	5/30/2015	300.00	250.00	90.00	75.00			716.00	647.00									*memory + Daily addition history
Sunday	5/31/2015			0.00	0.00	716.00	647.00											
Monday	6/1/2015			0.00	0.00	171.00	219.00	716.00	647.00									
Tuesday	6/2/2015	120.00	100.00	36.00	30.00			752.00	677.00									
Wednesday	6/3/2015			0.00	0.00			752.00	677.00									
Thursday	6/4/2015	250.00	250.00	75.00	75.00			827.00	752.00									
Friday	6/5/2015			0.00	0.00			827.00	752.00									
Saturday	6/6/2015	200.00	380.00	60.00	114.00			887.00	866.00									
Sunday	6/7/2015			0.00	0.00	887.00	866.00											
Monday	6/8/2015			0.00	0.00	225.00	210.00	887.00	866.00									
Tuesday	6/9/2015	350.00	250.00	105.00	75.00			992.00	941.00									
Wednesday	6/10/2015			0.00	0.00			992.00	941.00									
Thursday	6/11/2015			0.00	0.00			992.00	941.00									
Friday	6/12/2015			0.00	0.00			992.00	941.00									
Saturday	6/13/2015	200.00	250.00	60.00	75.00			1052.00	1016.00									
Sunday	6/14/2015			0.00	0.00			1052.00	1016.00	no daily sheet								
Monday	6/15/2015			0.00	0.00			1052.00	1016.00									
Tuesday	6/16/2015	200.00	200.00	60.00	60.00	1112.00	1076.00											
Wednesday	6/17/2015			0.00	0.00	1112.00	1076.00											
Thursday	6/18/2015	0.00	0.00	0.00	0.00	70.50	70.50	1112.00	1076.00									
Friday	6/19/2015	0.00	0.00	0.00	0.00			1112.00	1076.00									
Saturday	6/20/2015	0.00	0.00	0.00	0.00			1112.00	1076.00									
Sunday	6/21/2015	0.00	0.00	0.00	0.00			1112.00	1076.00									
Monday	6/22/2015	165.00	165.00	49.50	49.50			1161.50	1125.50									

Tuesday	6/23/2015	35.00	35.00	10.50	10.50			1172.00	1136.00		
Wednesday	6/24/2015	35.00	35.00	10.50	10.50			1182.50	1146.50		
Thursday	6/25/2015	35.00	35.00	10.50	10.50	73.50	73.50	1193.00	1157.00		
Friday	6/26/2015	35.00	35.00	10.50	10.50			1203.50	1167.50		
Saturday	6/27/2015	35.00	35.00	10.50	10.50			1214.00	1178.00		
Sunday	6/28/2015	35.00	35.00	10.50	10.50			1224.50	1188.50		
Monday	6/29/2015	35.00	35.00	10.50	10.50			1235.00	1199.00		
Tuesday	6/30/2015	35.00	35.00	10.50	10.50			1245.50	1209.50		no daily sheet
Wednesday	7/1/2015	35.00	35.00	10.50	10.50			1256.00	1220.00		
Thursday	7/2/2015	35.00	35.00	10.50	10.50	73.50	73.50	1266.50	1230.50		
Friday	7/3/2015	35.00	35.00	10.50	10.50			1277.00	1241.00		
Saturday	7/4/2015	35.00	35.00	10.50	10.50			1287.50	1251.50		
Sunday	7/5/2015	35.00	35.00	10.50	10.50			1298.00	1262.00		
Monday	7/6/2015	35.00	35.00	10.50	10.50			1308.50	1272.50		
Tuesday	7/7/2015	35.00	35.00	10.50	10.50			1319.00	1283.00		
Wednesday	7/8/2015	35.00	35.00	10.50	10.50			1329.50	1293.50		
Thursday	7/9/2015	35.00	35.00	10.50	10.50	63.00	63.00	1340.00	1304.00		
Friday	7/10/2015	35.00	35.00	10.50	10.50			1350.50	1314.50		
Saturday	7/11/2015			0.00	0.00			1350.50	1314.50		
Sunday	7/12/2015	35.00	35.00	10.50	10.50			1361.00	1325.00		no daily sheet
Monday	7/13/2015	35.00	35.00	10.50	10.50			1371.50	1335.50		
Tuesday	7/14/2015	35.00	35.00	10.50	10.50			1382.00	1346.00		
Wednesday	7/15/2015	35.00	35.00	10.50	10.50			1392.50	1356.50		
Thursday	7/16/2015	35.00	35.00	10.50	10.50	73.50	73.50	1403.00	1367.00		
Friday	7/17/2015	35.00	35.00	10.50	10.50			1413.50	1377.50		
Saturday	7/18/2015	35.00	35.00	10.50	10.50			1424.00	1388.00		
Sunday	7/19/2015	35.00	35.00	10.50	10.50			1434.50	1398.50		
Monday	7/20/2015	35.00	35.00	10.50	10.50			1445.00	1409.00		
Tuesday	7/21/2015	35.00	35.00	10.50	10.50			1455.50	1419.50		
Wednesday	7/22/2015	35.00	35.00	10.50	10.50			1466.00	1430.00		
Thursday	7/23/2015	35.00	35.00	10.50	10.50	78.00	78.00	1476.50	1440.50		
Friday	7/24/2015	35.00	35.00	10.50	10.50			1487.00	1451.00		
Saturday	7/25/2015	35.00	35.00	10.50	10.50			1497.50	1461.50		
Sunday	7/26/2015	35.00	35.00	10.50	10.50			1508.00	1472.00		
Monday	7/27/2015	35.00	35.00	10.50	10.50			1518.50	1482.50		
Tuesday	7/28/2015	35.00	35.00	10.50	10.50			1529.00	1493.00		
Wednesday	7/29/2015	50.00	50.00	15.00	15.00			1544.00	1508.00		
Thursday	7/30/2015			0.00	0.00	105.00	105.00	1544.00	1508.00		
Friday	7/31/2015	100.00	100.00	30.00	30.00			1574.00	1538.00		
Saturday	8/1/2015	50.00	50.00	15.00	15.00			1589.00	1553.00		
Sunday	8/2/2015	50.00	50.00	15.00	15.00			1604.00	1568.00		
Monday	8/3/2015	50.00	50.00	15.00	15.00			1619.00	1583.00		
Tuesday	8/4/2015	50.00	50.00	15.00	15.00			1634.00	1598.00		
Wednesday	8/5/2015	50.00	50.00	15.00	15.00			1649.00	1613.00		
Thursday	8/6/2015	50.00	50.00	15.00	15.00	105.00	105.00	1664.00	1628.00		no daily sheet
Friday	8/7/2015	50.00	50.00	15.00	15.00			1679.00	1643.00		
Saturday	8/8/2015	50.00	50.00	15.00	15.00			1694.00	1658.00		
Sunday	8/9/2015	50.00	50.00	15.00	15.00			1709.00	1673.00		
Monday	8/10/2015	50.00	50.00	15.00	15.00			1724.00	1688.00		
Tuesday	8/11/2015	50.00	50.00	15.00	15.00			1739.00	1703.00		
Wednesday	8/12/2015	50.00	50.00	15.00	15.00			1754.00	1718.00		
Thursday	8/13/2015	50.00	50.00	15.00	15.00	105.00	105.00	1769.00	1733.00		no daily sheet
Friday	8/14/2015	50.00	50.00	15.00	15.00			1784.00	1748.00		
Saturday	8/15/2015	50.00	50.00	15.00	15.00			1799.00	1763.00		
Sunday	8/16/2015	50.00	50.00	15.00	15.00			1814.00	1778.00		
Monday	8/17/2015	50.00	50.00	15.00	15.00			1829.00	1793.00		

Tuesday	8/18/2015	50.00	50.00	15.00	15.00			1844.00	1808.00										
Wednesday	8/19/2015	50.00	50.00	15.00	15.00			1859.00	1823.00										
Thursday	8/20/2015	50.00	50.00	15.00	15.00	105.00	105.00	1874.00	1838.00										
Friday	8/21/2015	50.00	50.00	15.00	15.00			1889.00	1853.00										
Saturday	8/22/2015	50.00	50.00	15.00	15.00			1904.00	1868.00										
Sunday	8/23/2015	50.00	50.00	15.00	15.00			1919.00	1883.00										
Monday	8/24/2015	50.00	50.00	15.00	15.00			1934.00	1898.00										
Tuesday	8/25/2015	50.00	50.00	15.00	15.00			1949.00	1913.00										
Wednesday	8/26/2015	50.00	50.00	15.00	15.00			1964.00	1928.00										
Thursday	8/27/2015	50.00	50.00	15.00	15.00	211.80	211.80	1979.00	1943.00										
Friday	8/28/2015	50.00	50.00	15.00	15.00			1994.00	1958.00										
Saturday	8/29/2015	50.00	50.00	15.00	15.00			2009.00	1973.00										
Sunday	8/30/2015	50.00	50.00	15.00	15.00			2024.00	1988.00										
Monday	8/31/2015	50.00	50.00	15.00	15.00			2039.00	2003.00										
Tuesday	9/1/2015	275.00	275.00	82.50	82.50			2121.50	2085.50	200.00	200.00	60.00	60.00	96.00	96.00	60.00	60.00		
Wednesday	9/2/2015	181.00	181.00	54.30	54.30			2175.80	2139.80	120.00	120.00	36.00	36.00	96.00	96.00	96.00	96.00		
Thursday	9/3/2015	181.00	181.00	54.30	54.30	295.50	295.50	2230.10	2194.10	120.00	120.00	36.00	36.00	248.40	248.40	132.00	132.00	why is there a strikethrough?	
Friday	9/4/2015	134.00	134.00	40.20	40.20			2270.30	2234.30	118.00	118.00	35.40	35.40			167.40	167.40		
Saturday	9/5/2015	134.00	134.00	40.20	40.20			2310.50	2274.50	118.00	118.00	35.40	35.40			202.80	202.80	No Daily Sheet	
Sunday	9/6/2015	134.00	134.00	40.20	40.20			2350.70	2314.70	118.00	118.00	35.40	35.40			238.20	238.20		
Monday	9/7/2015	134.00	134.00	40.20	40.20			2390.90	2354.90	118.00	118.00	35.40	35.40			273.60	273.60		
Tuesday	9/8/2015	134.00	134.00	40.20	40.20			2431.10	2395.10	118.00	118.00	35.40	35.40			309.00	309.00	No Daily Sheet	
Wednesday	9/9/2015	134.00	134.00	40.20	40.20			2471.30	2435.30	118.00	118.00	35.40	35.40			344.40	344.40		
Thursday	9/10/2015	134.00	134.00	40.20	40.20	258.60	264.60	2511.50	2475.50	118.00	118.00	35.40	35.40	212.40	212.40	379.80	379.80		
Friday	9/11/2015	134.00	134.00	40.20	40.20			2551.70	2515.70	118.00	118.00	35.40	35.40			415.20	415.20		
Saturday	9/12/2015	134.00	134.00	40.20	40.20			2591.90	2555.90	118.00	118.00	35.40	35.40			450.60	450.60		
Sunday	9/13/2015	134.00	134.00	40.20	40.20			2632.10	2596.10	118.00	118.00	35.40	35.40			486.00	486.00		
Monday	9/14/2015	134.00	20.00	40.20	6.00			2672.30	2602.10	118.00	118.00	35.40	35.40			521.40	521.40		
Tuesday	9/15/2015	192.00	326.00	57.60	97.80			2729.90	2699.90	118.00	118.00	35.40	35.40			556.80	556.80		
Wednesday	9/16/2015			0.00	0.00			2729.90	2699.90			0.00	0.00			556.80	556.80		
Thursday	9/17/2015	384.00	384.00	115.20	115.20	454.13	403.20	2845.10	2815.10	312.00	312.00	93.60	93.60	374.40	374.40	650.40	650.40		
Friday	9/18/2015	192.00	192.00	57.60	57.60			2902.70	2872.70	156.00	156.00	46.80	46.80			697.20	697.20		
Saturday	9/19/2015	192.00	192.00	57.60	57.60			2960.30	2930.30	156.00	156.00	46.80	46.80			744.00	744.00		
Sunday	9/20/2015	192.00	192.00	57.60	57.60			3017.90	2987.90	156.00	156.00	46.80	46.80			790.80	790.80		
Monday	9/21/2015	192.00	192.00	57.60	57.60			3075.50	3045.50	156.00	156.00	46.80	46.80			837.60	837.60		
Tuesday	9/22/2015	169.75	0.00	50.93	0.00			3126.42	3045.50	156.00	156.00	46.80	46.80			884.40	884.40		
Wednesday	9/23/2015	192.00	192.00	57.60	57.60			3184.02	3103.10	156.00	156.00	46.80	46.80			931.20	931.20		
Thursday	9/24/2015	192.00	192.00	57.60	57.60	349.20	349.20	3241.62	3160.70	156.00	156.00	46.80	46.80	156.60	156.60	978.00	978.00		
Friday	9/25/2015	162.00	162.00	48.60	48.60			3290.22	3209.30	61.00	61.00	18.30	18.30			996.30	996.30		
Saturday	9/26/2015	162.00	162.00	48.60	48.60			3338.82	3257.90	61.00	61.00	18.30	18.30			1014.60	1014.60		
Sunday	9/27/2015	162.00	162.00	48.60	48.60			3387.42	3306.50	61.00	61.00	18.30	18.30			1032.90	1032.90		
Monday	9/28/2015	162.00	162.00	48.60	48.60			3436.02	3355.10	61.00	61.00	18.30	18.30			1051.20	1051.20	No Daily Sheet	
Tuesday	9/29/2015	162.00	162.00	48.60	48.60			3484.62	3403.70	61.00	61.00	18.30	18.30			1069.50	1069.50	No Daily Sheet	
Wednesday	9/30/2015	162.00	162.00	48.60	48.60			3533.22	3452.30	61.00	61.00	18.30	18.30			1087.80	1087.80		
Thursday	10/1/2015	162.00	162.00	48.60	48.60	169.20	169.20	3581.82	3500.90	61.00	61.00	18.30	18.30	18.30	18.30	1106.10	1106.10		
Friday	10/2/2015	67.00	67.00	20.10	20.10			3601.92	3521.00	0.00	0.00	0.00	0.00			1106.10	1106.10		
Saturday	10/3/2015	67.00	67.00	20.10	20.10			3622.02	3541.10	0.00	0.00	0.00	0.00			1106.10	1106.10		
Sunday	10/4/2015	67.00	67.00	20.10	20.10			3642.12	3561.20	0.00	0.00	0.00	0.00			1106.10	1106.10		
Monday	10/5/2015	67.00	67.00	20.10	20.10			3662.22	3581.30	0.00	0.00	0.00	0.00			1106.10	1106.10		
Tuesday	10/6/2015	67.00	67.00	20.10	20.10			3682.32	3601.40	0.00	0.00	0.00	0.00			1106.10	1106.10		
Wednesday	10/7/2015	67.00	67.00	20.10	20.10			3702.42	3621.50	0.00	0.00	0.00	0.00			1106.10	1106.10		
Thursday	10/8/2015	67.00	67.00	20.10	20.10	56.10	56.10	3722.52	3641.60	0.00	0.00	0.00	0.00	0.00	0.00	1106.10	1106.10		
Friday	10/9/2015	20.00	20.00	6.00	6.00			3728.52	3647.60	0.00	0.00	0.00	0.00			1106.10	1106.10		
Saturday	10/10/2015	20.00	20.00	6.00	6.00			3734.52	3653.60	0.00	0.00	0.00	0.00			1106.10	1106.10		
Sunday	10/11/2015	20.00	20.00	6.00	6.00			3740.52	3659.60	0.00	0.00	0.00	0.00			1106.10	1106.10		
Monday	10/12/2015	20.00	20.00	6.00	6.00			3746.52	3665.60	0.00	0.00	0.00	0.00			1106.10	1106.10		
Tuesday	10/13/2015	20.00	20.00	6.00	6.00			3752.52	3671.60	0.00	0.00	0.00	0.00			1106.10	1106.10		

Wednesday	10/14/2015	20.00	20.00	6.00	6.00			3758.52	3677.60	0.00	0.00	0.00	0.00			1106.10	1106.10	
Thursday	10/15/2015	20.00	20.00	6.00	6.00	72.00	72.00	3764.52	3683.60	0.00	0.00	0.00	0.00	60.00	60.00	1106.10	1106.10	
Friday	10/16/2015	20.00	20.00	6.00	6.00			3770.52	3689.60	0.00	0.00	0.00	0.00			1106.10	1106.10	
Saturday	10/17/2015	40.00	40.00	12.00	12.00			3782.52	3701.60	40.00	40.00	12.00	12.00			1118.10	1118.10	
Sunday	10/18/2015	40.00	40.00	12.00	12.00			3794.52	3713.60	40.00	40.00	12.00	12.00			1130.10	1130.10	
Monday	10/19/2015	40.00	40.00	12.00	12.00			3806.52	3725.60	40.00	40.00	12.00	12.00			1142.10	1142.10	
Tuesday	10/20/2015	40.00	40.00	12.00	12.00			3818.52	3737.60	40.00	40.00	12.00	12.00			1154.10	1154.10	
Wednesday	10/21/2015	40.00	40.00	12.00	12.00			3830.52	3749.60	40.00	40.00	12.00	12.00			1166.10	1166.10	
Thursday	10/22/2015	40.00	40.00	12.00	12.00	58.20	58.20	3842.52	3761.60	40.00	40.00	12.00	12.00	24.00	24.00	1178.10	1178.10	
Friday	10/23/2015	40.00	40.00	12.00	12.00			3854.52	3773.60	40.00	40.00	12.00	12.00			1190.10	1190.10	
Saturday	10/24/2015	60.00	60.00	18.00	18.00			3872.52	3791.60	0.00	0.00	0.00	0.00			1190.10	1190.10	
Sunday	10/25/2015	0.00	0.00	0.00	0.00			3872.52	3791.60	0.00	0.00	0.00	0.00			1190.10	1190.10	
Monday	10/26/2015			0.00	0.00			3872.52	3791.60			0.00	0.00			1190.10	1190.10	
Tuesday	10/27/2015	27.00	27.00	8.10	8.10			3880.62	3799.70	0.00	0.00	0.00	0.00			1190.10	1190.10	
Wednesday	10/28/2015	27.00	27.00	8.10	8.10			3888.72	3807.80	0.00	0.00	0.00	0.00			1190.10	1190.10	
Thursday	10/29/2015	27.00	27.00	8.10	8.10	56.70	56.70	3896.82	3815.90	0.00	0.00	0.00	0.00	0.00	0.00	1190.10	1190.10	
Friday	10/30/2015	27.00	27.00	8.10	8.10			3904.92	3824.00	0.00	0.00	0.00	0.00			1190.10	1190.10	
Saturday	10/31/2015	27.00	27.00	8.10	8.10			3913.02	3832.10	0.00	0.00	0.00	0.00			1190.10	1190.10	
Sunday	11/1/2015	27.00	27.00	8.10	8.10			3921.12	3840.20	0.00	0.00	0.00	0.00			1190.10	1190.10	
Monday	11/2/2015	27.00	27.00	8.10	8.10			3929.22	3848.30	0.00	0.00	0.00	0.00			1190.10	1190.10	
Tuesday	11/3/2015	27.00	27.00	8.10	8.10			3937.32	3856.40	0.00	0.00	0.00	0.00			1190.10	1190.10	
Wednesday	11/4/2015	27.00	27.00	8.10	8.10			3945.42	3864.50	0.00	0.00	0.00	0.00			1190.10	1190.10	
Thursday	11/5/2015	27.00	27.00	8.10	8.10	92.70	92.70	3953.52	3872.60	0.00	0.00	0.00	0.00	0.00	0.00	1190.10	1190.10	
Friday	11/6/2015	27.00	27.00	8.10	8.10			3961.62	3880.70	0.00	0.00	0.00	0.00			1190.10	1190.10	
Saturday	11/7/2015	27.00	27.00	8.10	8.10			3969.72	3888.80	0.00	0.00	0.00	0.00			1190.10	1190.10	
Sunday	11/8/2015	27.00	27.00	8.10	8.10			3977.82	3896.90	0.00	0.00	0.00	0.00			1190.10	1190.10	
Monday	11/9/2015	27.00	27.00	8.10	8.10			3985.92	3905.00	0.00	0.00	0.00	0.00			1190.10	1190.10	
Tuesday	11/10/2015	87.00	87.00	26.10	26.10			4012.02	3931.10	0.00	0.00	0.00	0.00			1190.10	1190.10	
Wednesday	11/11/2015	87.00	87.00	26.10	26.10			4038.12	3957.20	0.00	0.00	0.00	0.00			1190.10	1190.10	
Thursday	11/12/2015	87.00	87.00	26.10	26.10	173.10	173.10	4064.22	3983.30	0.00	0.00	0.00	0.00	0.00	0.00	1190.10	1190.10	
Friday	11/13/2015	60.00	60.00	18.00	18.00			4082.22	4001.30	0.00	0.00	0.00	0.00			1190.10	1190.10	
Saturday	11/14/2015	60.00	60.00	18.00	18.00			4100.22	4019.30	0.00	0.00	0.00	0.00			1190.10	1190.10	
Sunday	11/15/2015	60.00	60.00	18.00	18.00			4118.22	4037.30	0.00	0.00	0.00	0.00			1190.10	1190.10	
Monday	11/16/2015	60.00	60.00	18.00	18.00			4136.22	4055.30	0.00	0.00	0.00	0.00			1190.10	1190.10	
Tuesday	11/17/2015	125.00	125.00	37.50	37.50			4173.72	4092.80	0.00	0.00	0.00	0.00			1190.10	1190.10	
Wednesday	11/18/2015	125.00	125.00	37.50	37.50			4211.22	4130.30	0.00	0.00	0.00	0.00			1190.10	1190.10	
Thursday	11/19/2015	125.00	125.00	37.50	37.50	187.50	187.50	4248.72	4167.80	0.00	0.00	0.00	0.00	0.00	0.00	1190.10	1190.10	
Friday	11/20/2015	125.00	125.00	37.50	37.50			4286.22	4205.30	0.00	0.00	0.00	0.00			1190.10	1190.10	
Saturday	11/21/2015	125.00	125.00	37.50	37.50			4323.72	4242.80	0.00	0.00	0.00	0.00			1190.10	1190.10	
Sunday	11/22/2015	125.00	125.00	37.50	37.50			4361.22	4280.30	0.00	0.00	0.00	0.00			1190.10	1190.10	
Monday	11/23/2015	125.00	125.00	37.50	37.50			4398.72	4317.80	0.00	0.00	0.00	0.00			1190.10	1190.10	
Tuesday	11/24/2015	125.00	125.00	37.50	37.50	171.60	171.60	4436.22	4355.30	0.00	0.00	0.00	0.00	0.00	0.00	1190.10	1190.10	
Wednesday	11/25/2015	52.00	52.00	15.60	15.60			4451.82	4370.90	0.00	0.00	0.00	0.00			1190.10	1190.10	
Thursday	11/26/2015	100.00	100.00	30.00	30.00			4481.82	4400.90	0.00	0.00	0.00	0.00			1190.10	1190.10	
Friday	11/27/2015	100.00	100.00	30.00	30.00			4511.82	4430.90	0.00	0.00	0.00	0.00			1190.10	1190.10	
Saturday	11/28/2015	100.00	100.00	30.00	30.00			4541.82	4460.90	0.00	0.00	0.00	0.00			1190.10	1190.10	
Sunday	11/29/2015	100.00	100.00	30.00	30.00			4571.82	4490.90	0.00	0.00	0.00	0.00			1190.10	1190.10	
Monday	11/30/2015	0.00	0.00	0.00	0.00			4571.82	4490.90	0.00	0.00	0.00	0.00			1190.10	1190.10	
Tuesday	12/1/2015	60.00	60.00	18.00	18.00			4589.82	4508.90	0.00	0.00	0.00	0.00			1190.10	1190.10	
Wednesday	12/2/2015	60.00	60.00	18.00	18.00			4607.82	4526.90	0.00	0.00	0.00	0.00			1190.10	1190.10	
Thursday	12/3/2015	100.00	100.00	30.00	30.00			4637.82	4556.90	0.00	0.00	0.00	0.00			1190.10	1190.10	

Appendix N. Algae Digestate Additions

Nitrogen Calculation												Mass Calculations																		Events/Comments																									
	date	Tiff Measured Concentration of Digestate	AFS Measured Nitrogen Concentration of Digestate (mg/L)	Volume of Digestate Added Pond 4 (gal)	Volume of Digestate Added Pond 5 (gal)	Mass of Digestate Nitrogen Pond 4 (g)	Mass of Digestate Nitrogen Pond 5 (g)	Weekly Sum of Nitrogen Mass added into P4 (g)	Weekly Sum of Nitrogen Mass added into P5 (g)	Pond 4 Total Digestate N (g) Added Over Time	Pond 5 Total Digestate N (g) Added Over Time	Digestate TS (mg/L)	Digestate VS (mg/L)	Mass of Total Solids Added to Pond 4	Mass of Total Solids Added to Pond 5	Weekly Sum of Solids, TS added into P4 (g)	Weekly Sum of Solids, TS added into P5 (g)	Average Weekly Sum of Solids, TS	Digestate TS Concentration in Pond 4 (mg/L)	Digestate TS Concentration in Pond 5 (mg/L)	Average Weekly Digestate TS Concentration in DIG Ponds (mg/L)	Mass of Volatile Solids Added to Pond 4 (g)	Mass of Volatile Solids Added to Pond 5 (g)	Weekly Sum of Solids, VS added into P4 (g)	Weekly Sum of Solids, VS added into P5 (g)	Total Pond 4 Digestate Total Solids, VS (g) Added Over Time	Total Pond 5 Digestate Solids, VS (g) Added Over Time	Digestate VS Concentration in Pond 4 (mg/L)	Digestate VS Concentration in Pond 5 (mg/L)																										
Tuesday	5/5/2015	367.66	382.15	5.00	5.00	7.23	7.23	78.88	78.88	7.23	7.23	3777.80	2377.80	214.51	214.51	401.89	401.89	401.89	0.90	0.00	6.70	0.00	0.00	135.01	135.01	186.12	186.12	0.00	0.00	0.00	0.00	Start of Experiment-- AD from 5/11/15. No VS data (Phase 1)																							
Wednesday	5/6/2015									7.23	7.23			0.00	0.00													0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
Thursday	5/7/2015		371.38	15.00	15.00	21.09	21.09			28.32	28.32			0.00	0.00													0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	AD from 5/11/15 Timberline							
Friday	5/8/2015									28.32	28.32			0.00	0.00													0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
Saturday	5/9/2015		296.83	45.00	45.00	50.56	50.56	167.07	167.07	78.88	78.88	1100.00	300.00	187.38	187.38	1772.84	1772.84	1772.84	0.00	0.00	25.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	AD from 5/11/15 Timberline																						
Sunday	5/10/2015									78.88	78.88			0.00	0.00																			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Monday	5/11/2015									78.88	78.88			0.00	0.00																			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Tuesday	5/12/2015	242.25	286.32	100.00	100.00	108.38	108.38			187.27	187.27			113.56	113.56																			3000.00		1135.62	1135.62					113.56	113.56	25.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	On sheet written as 5/11 but is most likely 5/12	
Wednesday	5/13/2015							167.07	167.07	187.27	187.27	3366.70		0.00	0.00	1772.84	1772.84	1772.84	0.00	0.00	25.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00																					
Thursday	5/14/2015		310.06	50.00	50.00	58.69	58.69			245.95	245.95			0.00	0.00																				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Friday	5/15/2015									245.95	245.95			0.00	0.00																						0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Saturday	5/16/2015									245.95	245.95			0.00	0.00																						0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sunday	5/17/2015							193.31	225.13	245.95	245.95	6888.90	4866.70	0.00	0.00	1772.84	1772.84	1772.84	0.00	0.00	25.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00																					
Monday	5/18/2015									245.95	245.95			0.00	0.00																						0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Tuesday	5/19/2015	245.31	283.26	50.00	50.00	53.61	53.61			299.57	299.57			317.56	317.56																				1677.80		317.56	317.56					31.76	31.76	25.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wednesday	5/20/2015									299.57	299.57			0.00	0.00																						0.00	0.00					0.00	0.00	17.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thursday	5/21/2015		280.21	50.00	80.00	53.04	84.86	193.31	225.13	352.60	384.42	2977.80	1766.70	563.61	901.78	881.17	1219.33	1050.25	0.00	0.00	17.50	0.00	0.00	334.38	535.01	334.38	535.01	186.12	186.12	0.00	0.00	volume values pulled from addition log																							
Friday	5/22/2015									352.60	384.42			0.00	0.00															0.00	0.00						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
Saturday	5/23/2015		305.25	75.00	75.00	86.66	86.66			439.26	471.08			0.00	0.00															0.00	0.00						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
Sunday	5/24/2015									439.26	471.08			0.00	0.00															0.00	0.00						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
Monday	5/25/2015							223.54	191.61	439.26	471.08	6455.60	4377.80	1221.85	1221.85	3397.41	2923.19	3160.30	0.00	0.00	45.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00																						
Tuesday	5/26/2015	354.48	330.29	50.00	50.00	62.51	62.51			501.78	533.60			0.00	0.00																					122.19	122.19					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Wednesday	5/27/2015									501.78	533.60			0.00	0.00																					0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Thursday	5/28/2015		337.45	75.00	50.00	95.80	63.87			597.58	597.47			1422.68	948.45																			5011.10	3244.40	1422.68	948.45					142.27	94.85	45.15	921.10	614.07	2020.97	1713.94	2270.19	2163.79	92.11	61.41	AD from 5/11/15 Timberline		
Friday	5/29/2015							597.58	597.47	0.00	0.00	3977.80	1433.30	0.00	0.00	881.17	1219.33	1050.25	0.00	0.00	17.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00																						
Saturday	5/30/2015		344.60	50.00	50.00	65.22	65.22	662.80	662.69	752.88	752.88																							75.29	75.29					75.29	75.29	45.15	921.10	614.07	2020.97	1713.94	2270.19	2163.79	92.11	61.41					
Sunday	5/31/2015							662.80	662.69	0.00	0.00																							0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Monday	6/1/2015							662.80	662.69	0.00	0.00																							0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Tuesday	6/2/2015	404.61	342.00	20.00	20.00	25.89	25.89	126.35	101.82	688.69	688.58	6377.80	3444.40	482.85	482.85	2626.23	2086.18	2356.20	0.00	0.00	33.66	260.77	260.77	1451.92	1150.76	1451.92	1150.76	2541.48	2435.07	0.00	0.00	samples not added due to Gustavo's first day and other finals that day and other crap going on.																							
Wednesday	6/3/2015									688.69	688.58			0.00	0.00															48.29	48.29						48.29	48.29	33.66	260.77	260.77	1451.92	1150.76	2802.24	2695.84	26.08	26.08								
Thursday	6/4/2015		339.40	40.00	40.00	51.39	51.39			740.09	739.97			1063.28	1063.28													7022.20	3888.90	1063.28	1063.28						106.33	106.33	33.66	588.84	588.84	1451.92	1150.76	3391.09	3284.68	58.88	58.88								
Friday	6/5/2015									740.09	739.97			0.00	0.00															0.00	0.00						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
Saturday	6/6/2015		324.07	40.00	20.00	49.07	24.53	126.35	101.82	789.15	764.51	7133.30	3977.80	1080.10	540.05	2626.23	2086.18	2356.20	0.00	0.00	33.66	602.30	301.15	1451.92	1150.76	1451.92	1150.76	3993.39	3585.84	60.23	30.12	no daily sheet																							
Sunday	6/7/2015									789.15	764.51			0.00	0.00															0.00	0.00						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00								
Monday	6/8/2015									789.15	764.51			0.00	0.00															0.00	0.00						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
Tuesday	6/9/2015		352.15	50.00	40.00	66.65	53.32			855.81	817.83			876.95	701.56													4633.30	2555.60	876.95	701.56						87.69	70.16	33.66	483.70	386.96	1451.92	1150.76	4477.09	3972.80	48.37	38.70								
Wednesday	6/10/2015							142.84	150.05	855.81	817.83	4633.30	2555.60	0.00	0.00	2694.57	2905.92	2800.25	0.00	0.00	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00																						
Thursday	6/11/2015					0.00	0.00			855.81	817.83			0.00	0.00																					0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Friday	6/12/2015									855.81	817.83			0.00	0.00																					0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Saturday	6/13/2015		361.65	30.00	45.00	41.07	61.60			896.88	879.43			773.48	1160.23																			6811.10	4188.90	773.48	1160.23					77.35	116.02	28.00	475.70	713.55	1637.62	1778.73	4952.79	4686.35	47.57	71.36			
Sunday																																																							

Sunday	8/1/2015	453.27		7.50	7.50	12.87	12.87	90.08	90.08	1320.24	1302.79		2088.90	1311.10	59.31	59.31	401.88	401.88	401.88	5.93	5.93	5.74	37.22	37.22	199.68	199.68	10172.70	9906.26	3.72	3.72	
Sunday	8/2/2015	453.27		7.50	7.50	12.87	12.87			1333.10	1315.66		1588.90	366.70	45.11	45.11				4.51	4.51		10.41	10.41			10183.11	9916.67	1.04	1.04	
Monday	8/3/2015	453.27		7.50	7.50	12.87	12.87			1345.97	1328.53		1922.20	611.10	54.57	54.57				5.46	5.46		17.35	17.35			10200.46	9934.02	1.73	1.73	
Tuesday	8/4/2015	453.27		7.50	7.50	12.87	12.87	76.10	76.10	1358.84	1341.40		2022.20	988.90	57.41	57.41	359.46	359.46	359.46	5.74	5.74	5.14	28.08	28.08	207.57	207.57	10228.54	9962.09	2.81	2.81	
Wednesday	8/5/2015	453.27		7.50	7.50	12.87	12.87			1371.71	1354.27		2022.20	1155.60	57.41	57.41				5.74	5.74		32.81	32.81			10261.34	9994.90	3.28	3.28	
Thursday	8/6/2015	446.72		7.50	7.50	12.68	12.68			1384.39	1366.95		2522.20	1600.00	71.61	71.61				7.16	7.16		45.42	45.42			10306.77	10040.32	4.54	4.54	no daily sheet
Friday	8/7/2015	446.72		7.50	7.50	12.68	12.68			1397.08	1379.63		1744.40	855.60	49.52	49.52				4.95	4.95		24.29	24.29			10331.06	10064.61	2.43	2.43	
Saturday	8/8/2015	446.72		7.50	7.50	12.68	12.68			1409.76	1392.31		1644.40	788.90	46.69	46.69				4.67	4.67		22.40	22.40			10353.46	10087.01	2.24	2.24	
Sunday	8/9/2015	446.72		7.50	7.50	12.68	12.68			1422.44	1405.00		2966.70	2000.00	84.23	84.23				8.42	8.42		56.78	56.78			10410.24	10143.79	5.68	5.68	
Monday	8/10/2015	446.72		7.50	7.50	12.68	12.68			1435.12	1417.68		1616.70	888.90	45.90	45.90				4.59	4.59		25.24	25.24			10435.48	10169.03	2.52	2.52	
Tuesday	8/11/2015	446.72								1435.12	1417.68				0.00	0.00				0.00	0.00		0.00	0.00			10435.48	10169.03	0.00	0.00	
Wednesday	8/12/2015	446.72		7.50	7.50	12.68	12.68			1447.81	1430.36		2166.70	1177.80	61.51	61.51				6.15	6.15		33.44	33.44			10468.91	10202.47	3.34	3.34	
Thursday	8/13/2015	469.01		7.50	7.50	13.32	13.32	93.21	93.21	1461.12	1443.68		3644.40	2166.70	103.47	103.47	680.43	680.43	680.43	10.35	10.35	9.72	61.51	61.51	444.47	444.47	10530.43	10263.98	6.15	6.15	no daily sheet
Friday	8/14/2015	469.01		7.50	7.50	13.32	13.32			1474.44	1456.99		3777.80	2022.20	107.25	107.25				10.73	10.73		57.41	57.41			10587.84	10321.39	5.74	5.74	
Saturday	8/15/2015	469.01		7.50	7.50	13.32	13.32			1487.75	1470.31		3711.10	2455.60	105.36	105.36				10.54	10.54		69.72	69.72			10657.55	10391.11	6.97	6.97	
Sunday	8/16/2015	469.01		7.50	7.50	13.32	13.32			1501.07	1483.62				0.00	0.00				0.00	0.00		0.00	0.00			10657.55	10391.11	0.00	0.00	
Monday	8/17/2015	469.01		7.50	7.50	13.32	13.32			1514.38	1496.94		4744.40	3288.90	134.70	134.70				13.47	13.47		93.37	93.37			10750.93	10484.48	9.34	9.34	
Tuesday	8/18/2015	469.01		7.50	7.50	13.32	13.32			1527.70	1510.26		3633.30	2577.80	103.15	103.15				10.32	10.32		73.19	73.19			10824.11	10557.67	7.32	7.32	
Wednesday	8/19/2015	469.01		7.50	7.50	13.32	13.32			1541.01	1523.57		4455.60	3144.40	126.50	126.50				12.65	12.65		89.27	89.27			10913.39	10646.94	8.93	8.93	
Thursday	8/20/2015	412.63		7.50	7.50	11.71	11.71			1552.73	1535.29		5466.70	3655.60	155.20	155.20				15.52	15.52		103.78	103.78			11017.17	10750.72	10.38	10.38	
Friday	8/21/2015	412.63		7.50	7.50	11.71	11.71			1564.44	1547.00		4955.60	3543.30	140.69	140.69				14.07	14.07		100.60	100.60			11117.77	10851.32	10.06	10.06	
Saturday	8/22/2015	412.63		7.50	7.50	11.71	11.71			1576.16	1558.72		4444.40	3211.10	126.18	126.18				12.62	12.62		91.16	91.16			11208.93	10942.49	9.12	9.12	
Sunday	8/23/2015	412.63		7.50	7.50	11.71	11.71			1587.87	1570.43		6544.40	4755.60	185.80	185.80				18.58	18.58		135.01	135.01			11343.95	11077.50	13.50	13.50	
Monday	8/24/2015	412.63		7.50	7.50	11.71	11.71			1599.59	1582.15		3433.30	2377.80	97.47	97.47				9.75	9.75		67.51	67.51			11411.45	11145.01	6.75	6.75	
Tuesday	8/25/2015	412.63		7.50	7.50	11.71	11.71			1611.30	1593.86		6216.70	4644.40	176.50	176.50				17.65	17.65		131.86	131.86			11543.31	11276.86	13.19	13.19	
Wednesday	8/26/2015	412.63		7.50	7.50	11.71	11.71			1623.02	1605.58		6722.20	5088.90	190.85	190.85				19.08	19.08		144.48	144.48			11687.79	11421.34	14.45	14.45	
Thursday	8/27/2015	411.79		7.50	7.50	11.69	11.69	46.76	46.76	1634.71	1617.27		3800.00	2700.00	107.88	107.88	414.18	414.18	414.18	10.79	10.79	5.92	76.65	76.65	250.47	250.47	11764.44	11498.00	7.67	7.67	
Friday	8/28/2015	411.79		7.50	7.50	11.69	11.69			1646.40	1628.96				0.00	0.00				0.00	0.00		0.00	0.00			11764.44	11498.00	0.00	0.00	have data but samples were not added
Saturday	8/29/2015	411.79								1646.40	1628.96		6400.00		0.00	0.00				0.00	0.00		0.00	0.00			11764.44	11498.00	0.00	0.00	have data but samples were not added
Sunday	8/30/2015	411.79								1646.40	1628.96		7500.00		0.00	0.00				0.00	0.00		0.00	0.00			11764.44	11498.00	0.00	0.00	have data but samples were not added
Monday	8/31/2015	411.79								1646.40	1628.96		5111.10		0.00	0.00				0.00	0.00		0.00	0.00			11764.44	11498.00	0.00	0.00	have data but samples were not added
Tuesday	9/1/2015	411.79		7.50	7.50	11.69	11.69			1658.09	1640.65		7044.40	3466.70	199.99	199.99				20.00	20.00		98.42	98.42			11862.86	11596.42	9.84	9.84	
Wednesday	9/2/2015	411.79		7.50	7.50	11.69	11.69			1669.78	1652.34		3744.40	2655.60	106.31	106.31				10.63	10.63		75.39	75.39			11938.26	11671.81	7.54	7.54	
Thursday	9/3/2015	341.55		7.50	7.50	9.70	9.70	67.88	67.88	1679.48	1662.04				0.00	0.00	660.86	660.86	660.86	0.00	0.00	9.44	100.60	100.60	677.43	677.43	12038.85	11772.41	10.06	10.06	Start of Phase 3
Friday	9/4/2015	341.55		7.50	7.50	9.70	9.70			1689.18	1671.73		3800.00	2655.60	107.88	107.88				10.79	10.79		75.39	75.39			12114.25	11847.80	7.54	7.54	
Saturday	9/5/2015	341.55		7.50	7.50	9.70	9.70			1698.87	1681.43		3844.00	2622.20	109.13	109.13				10.91	10.91		74.45	74.45			12188.69	11922.25	7.44	7.44	no daily sheet
Sunday	9/6/2015	341.55		7.50	7.50	9.70	9.70			1708.57	1691.13				0.00	0.00				0.00	0.00		94.82	94.82			12283.52	12017.07	9.48	9.48	
Monday	9/7/2015	341.55		7.50	7.50	9.70	9.70			1718.27	1700.82		4144.40	3044.40	117.66	117.66				11.77	11.77		86.43	86.43			12369.95	12103.50	8.64	8.64	
Tuesday	9/8/2015	341.55		7.50	7.50	9.70	9.70			1727.96	1710.52		6755.60	5211.10	191.80	191.80				19.18	19.18		147.95	147.95			12517.90	12251.45	1		

	11/14/2015	301.63		7.50	7.50	8.56	8.56	59.94	59.94	2432.87	2415.42				0.00	0.00	434.05	434.05	434.05	0.00	0.00	6.20	0.00	0.00	282.64	282.64	15696.98	15430.53	0.00	0.00			
Sunday	11/15/2015	301.63		7.50	7.50	8.56	8.56			2441.43	2423.99		5033.00	3522.20	142.89	142.89				14.29	14.29		100.00	100.00			15796.97	15530.53	10.00	10.00			
Monday	11/16/2015	301.63		7.50	7.50	8.56	8.56			2449.99	2432.55		3855.55	2511.10	109.46	109.46				10.95	10.95		71.29	71.29			15868.26	15601.82	7.13	7.13			
Tuesday	11/17/2015	301.63		7.50	7.50	8.56	8.56			2458.56	2441.11		1900.00	1000.00	53.94	53.94				5.39	5.39		28.39	28.39			15896.66	15630.21	2.84	2.84			
Wednesday	11/18/2015	301.63		7.50	7.50	8.56	8.56	39.14	39.14	2467.12	2449.68				0.00	0.00	444.40	444.40	444.40	0.00	0.00	8.89	0.00	0.00	275.33	275.33	15896.66	15630.21	0.00	0.00			
Thursday	11/19/2015	275.70		7.50	7.50	7.83	7.83			2474.95	2457.50		2400.00	1355.60	68.14	68.14				6.81	6.81		38.49	38.49			15935.14	15668.70	3.85	3.85			
Friday	11/20/2015	275.70		7.50	7.50	7.83	7.83			2482.77	2465.33		3158.90	1992.20	89.68	89.68				8.97	8.97		56.56	56.56			15991.70	15725.26	5.66	5.66			
Saturday	11/21/2015	275.70		7.50	7.50	7.83	7.83			2490.60	2473.16		2261.00	1072.20	64.19	64.19				6.42	6.42		30.44	30.44			16022.14	15755.70	3.04	3.04			
Sunday	11/22/2015	275.70		7.50	7.50	7.83	7.83	55.37	55.37	2498.43	2480.99		6055.55	4388.90	171.92	171.92	229.49	229.49	229.49	17.19	17.19	2.55	124.60	124.60	102.68	102.68	16146.74	15880.30	12.46	12.46			
Monday	11/23/2015	275.70		7.50	7.50	7.83	7.83			2506.26	2488.81		1777.80	888.90	50.47	50.47				5.05	5.05		25.24	25.24			16171.98	15905.54	2.52	2.52			
Tuesday	11/24/2015	243.79		7.50	7.50	6.92	6.92			2513.18	2495.74		2261.11	1072.20	64.19	64.19				6.42	6.42		30.44	30.44			16202.42	15935.98	3.04	3.04			
Wednesday	11/25/2015	243.79		7.50	7.50	6.92	6.92			2520.10	2502.66		1700.00	822.20	48.26	48.26				4.83	4.83		23.34	23.34			16225.76	15959.32	2.33	2.33			
Thursday	11/26/2015	243.79		7.50	7.50	6.92	6.92			2527.02	2509.58		2072.22	888.90	58.83	58.83				5.88	5.88		25.24	25.24			16251.00	15984.56	2.52	2.52			
Friday	11/27/2015	243.79		7.50	7.50	6.92	6.92			2533.94	2516.50				0.00	0.00				0.00	0.00		0.00	0.00			16251.00	15984.56	0.00	0.00			
Saturday	11/28/2015	243.79		7.50	7.50	6.92	6.92			2540.86	2523.42		2050.00	833.30	58.20	58.20				5.82	5.82		23.66	23.66			16274.66	16008.21	2.37	2.37			
Sunday	11/29/2015	243.79		7.50	7.50	6.92	6.92			2547.79	2530.34				0.00	0.00				0.00	0.00		0.00	0.00			16274.66	16008.21	0.00	0.00			
Monday	11/30/2015	243.79		7.50	7.50	6.92	6.92					2554.71	2537.26				0.00		0.00							0.00	0.00			16274.66	16008.21	0.00	0.00
Tuesday	12/1/2015	243.79		7.50	7.50	6.92	6.92					2561.63	2544.18				0.00		0.00				0.00	0.00	0.00	0.00			16274.66	16008.21	0.00	0.00	
Wednesday	12/2/2015	243.79		7.50	7.50	6.92	6.92					2568.55	2551.11				0.00		0.00				0.00	0.00	0.00	0.00			16274.66	16008.21	0.00	0.00	
Thursday	12/3/2015	269.9		7.50	7.50	7.66	7.66					2576.21	2558.77				0.00		0.00				0.00	0.00					16274.66	16008.21	0.00	0.00	