Design performance evaluation of Oaklands Park wetland through water quality analysis

By

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Water Resources Management

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List of Acronyms

ASR	Aquifer Storage and Recovery
BOM	Bureau of Meteorology
CW	Constructed Wetland
FWS	Free Water Surface
EMC	Event Mean Concentrations
HF	Horizontal Flow
HSSF	Horizontal subsurface flow
MAR	Managed Aquifer Recharge
SA/CA	Surface Area/Catchment Area
TN	Total Nitrogen
TOC	Total organic carbon
TSS	Total Suspended Solids
VF	Vertical Flow

Summary

In order to overcome the water insecurity issues, managed aquifer recharge schemes (MAR) have been gaining interests of Australian States and Territories. South Australia has implemented such schemes after going through severe water crises during the Millennium drought. There were several MAR schemes constructed after 2010 to secure and reuse stormwater which was previously discharged to sea. The MAR schemes in South Australia, are recharging aquifers by intercepting stormwater in to wetlands to be treated and then recharged into the aquifer for later use when needed. In order to reduce and prevent the risks associated with water recycling, Australian guidelines For Managed Aquifer Recharge have been developed (NRMMC-EPHC-NHMRC 2009), which are part of National Water Quality Management Strategy. These guidelines provide guidance for practitioners in order to reduce the environmental and public health risks associated with water recycling.

There are several schemes established in South Australia. Oaklands Park wetland and MAR scheme was established in 2014. The water injected into the ASR wells has been used for irrigation of North and South public reserves by Marion City council. The scheme has been functioning for past four years. Although these schemes have been implemented there are few evaluation studies conducted to determine the performance of these systems. This project is the first to evaluate the performance of the Oaklands Park wetland.

This study was conducted between May and August, 2018 and determined the performance of this wetland in terms of water quality and treatment. The impact of rainfall on water quality of the wetland was evaluated by monitoring performance over 3 storm events. Microbiological, physical and chemical analysis were conducted. Online water quality monitoring data and climate was collected and analysed. These parameters were analysed at inlet and outlet pond as well as through the whole wetland system. Increases in concentrations of nutrients and *E.coli* were recorded from in outlet pond, Pond 2 and 3, Pond 5 than the inlet pond following passage through the wetland. Wetlands systems are complex and each pond behaviour in treating water quality was not consistent during the whole study period. There are some linkages of these contaminations with wetlands internal bio geophysical activities inside the wetland. The increased concentrations of Total Suspended Solids (TSS) were observed in the outlet pond as compare to the inlet pond where the average concentrations of TSS suggests that water is of low quality as per guideline value of Australian Guidelines for Managed Aquifer Recharge.

The numbers of *E.coli* observed in the outlet pond and 2/3 was higher than those of the inlet pond and faeces of ducks/birds (present in wetland) are the likely cause of this contamination. The number of *E.coli* further increased during rainfall events in all ponds of the wetland. The increase in number of *E.coli* have shown clear linkage with rainfall events. The cause of the increase in concentration of TSS and TOC concentrations in Ponds 2, 3, 5, and outlet pond is due to the movement of ducks, birds, and fish present inside these ponds which causes the resuspension of particulate pollutants through their movement. The nitrate concentration was less in outlet pond as compare to inlet pond whereas ammonia concentration was more in the outlet pond. The increase in ammonia concentrations could be resulted through denitrification process as nitrates concentrations decreased in the outlet pond or due to ducks/birds feaces which contain high concentrations of ammonia. Further research is required to analyse the impacts of rainfall on water quality improvement by considering different parameters like rainfall duration and intensity, volume of inflow into the wetland. It has been recommended to increase the residence time of the wetland and conduct research to analyse the impacts of increased residence time on water quality improvement.

Declaration

In submitting this dissertation, I certify that I understand the rules and regulations of Flinders University regarding integrity and assessment procedures and I declare that all work contained within this document is my own work apart from properly referenced quotations. This research is the result of an independent investigation. Where my work is indebted to others, I have made acknowledgments. I declare that this work has not been accepted in any form for any other degree, nor is it currently being submitted in candidature for any other degree.

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Dedication

I dedicate this work to my beloved mother (my best friend, my motivator and my courage)

1. Introduction

1.1 Managed aquifer recharge

Water resources all around the world including in Australia, are stressed by increased demand due to climate change impacts and increasing populations. In Australia, managed aquifer recharge has been contributing to the irrigation supplies in urban areas (Dillon, PJ et al. 2009). The purposeful recharge of water to aquifers for the subsequent recovery or environmental benefit is called managed aquifer recharge (MAR) (Dillon, PJ et al. 2009). The economic and cost effectiveness of managed aquifer recharge schemes are well established however, these schemes have not been promoted and adopted in large scale. Managed aquifer recharge systems have been used to store water from different sources such as storm water and rain water. MAR schemes have been used to improve and secure water supplies, ground water quality improvement and maintenance of environmental flows(Dillon, PJ et al. 2009). It also helps in maintaining the ecosystems dependent on ground water. The stored water has been treated before recharge into the aquifer and sometimes treated after recovery (depending on the purpose of reuse of recovered water) (Kazner, Wintgens & Dillon 2012). There are several methods used for managed aquifer recharge, where Aquifer storage and recovery (ASR) is one of those methods used in Australia. In ASR method, water has been injected into wells for storage and recovered from same wells when needed (Dillon, PJ et al. 2009). There are seven elements which constitutes managed aquifer recharge system, water capturing, pre-treatment, recharge storage, post treatment and end use (Dillon, P et al. 2010), however, the post treatment after recovery depends on the type of end use of water, for example, water need to be treated after recovery if the intended use is for drinking(NRMMC-EPHC-NHMRC 2009).

Availability of a suitable aquifer is a prerequisite of MAR, in order to store water. Consolidated sediment aquifers are preferable over unconsolidated aquifers for storage of water in ASR wells as the construction and maintenance is easy. There are several benefits of storing water below the ground which is preventing evaporation of water and use of land above the storage areas for other purposes. However, if the aquifer is brackish, the same amount of water might be lost by mixing it with brackish aquifer as it may loss through evaporation (Dillon, P et al. 2010). In order to limit the risks of water contamination and reuse of recycled water, Australia Guidelines for Managed Aquifer Recharge (NRMMC-EPHC-NHMRC 2009) has been developed to provide guidance on how to identify hazards and adopt risk management strategies in order to protect public health from the risks associated with reuse of recycled water (Dillon, P et al. 2010). These guidelines provide nationally consistent guidance on risk assessment and management associated with water recycling. These guidelines do not have legal status for application and are flexible for adoption as per context and needs of the respective States/Territories.

MAR systems can also play an important role in role in water treatment in addition to water storage (Li, D et al. 2013). However, scientific research is required to evaluate the MAR's system performance in eliminating those public health risks. The risk management plan of the managed aquifer recharge has 12 fundamental elements which aim to prevent hazardous effects through application of multi-barrier approach(Natural Resources Management Ministerial Council 2009). All these 12 elements have been recommended to be followed as a part of risk management plan of managed aquifer recharge. The guidelines suggest more repeated validation of managed aquifer recharged systems is required as compare to other forms of systems used for water recycling. These guidelines serve as a key document for the regulators in South Australia for approval and inspection of scheme.

The Millennium drought in South-east Australia from 2001 to 2009 had an enormous impact on national as well as South Australian water policies. Several MARs projects have been initiated and implemented in South Australia where Oaklands Park Wetland is one of those schemes, used for irrigation of Marion City council reserves. These council reserves have been badly affected during the Millennium drought (Kretschmer 2017). Oaklands Park wetland is a landscaped wetland which helps to treat the stormwater before injecting into wells and it also provides a space for recreation to the surrounding communities. Besides providing recreational space and stormwater treatment, it helps in detention of stormwater runoff volumes.

1.2 Wetlands

Wetlands acts as a buffer zones, which might assimilate nutrients and ultimately reduced the load of pollutants to the rivers and lakes (Ramsar, 1998; Kandasamy, et al. 2008). When water flows through these wetlands, they become 'sponges', which store and soak excess water as it performs the function of filtration and cleaning respectively (Melbourne Water 2005; Kandasamy, *et al.* 2008). There are two types of wetlands, natural and constructed wetlands. Natural wetland are ecological systems, complex in nature which performs different process e.g. physical, chemical and biological. However, these natural wetlands have been degraded and reduced due to increasing urbanization and agricultural expansion, though these wetlands have been protected by international convention (Ramsar Convention) (Metcalfe, Nagabhatla & Fitzgerald 2018). Constructed wetlands are ecologically engineered systems which are built to restore the ecosystem services, improve water quality and minimise the impacts of the natural disasters e.g. flooding etc. The ecological functions of both natural and constructed wetlands are the same (Hsu et al. 2011). Therefore, constructed wetlands have been used as an option to treat urban stormwater, improving the downstream water quality and also reducing urban heat impacts (Wong et al. 2011).

1.3 Wetlands and Sustainable development goals

Wetlands are important not only as a source of surface water treatment but they also provide environmental benefits valued by the community. They act as a source of recreation, temporary safe storage of water and improved landscape (Bawden 2009). The Sustainable Development Agenda of 2030 has been adopted by UN which comprises of 17 goals, the Sustainable Development Goal 6 (SDG6) is entirely focused on ensuring access to safe water and sanitation (UN Water 2016). Water security has been the priority agenda of every developed and developing country after adopting the UN agenda of Sustainable Development Goals 2030. Wetlands contribute to all targets of SDG6 both directly and indirectly to ensure the safe reuse of recycled storm- and wastewater. All other targets have some linkages with wetlands but target 6.3 is more relevant particularly in this project as it is focusing on treatment urban wastewater and reuse of stormwater through technological solutions; constructed wetlands have been considered as one technological solution (Metcalfe, Nagabhatla & Fitzgerald 2018). Therefore, sustainable development goals program can be used as an incentive to promote use of natural and constructed wetlands for waste and stormwater reuse. There are scientifically proven abilities of wetlands in pollutant removal, disaster risk reduction in terms of minimising floods in tropical and sub-tropical areas and protecting community's livelihood (Metcalfe, Nagabhatla & Fitzgerald 2018).

1.4 Impacts of wetlands on human health

The linkages between human health and wetlands have been well established. Wetlands have direct and indirect impacts on human health in terms of ecosystems provision, livelihood and lifestyles (social determinant of health) and safe ground water recharge (Horwitz et al. 2012). Wetlands improves the ecosystem services and provide good quality of water which have ultimate impacts on human health. Natural wetlands have been adversely affected due to anthropological changes and environmental modifications as a result of development projects.

The provision of ecosystem services, which have been supporting human health and wellbeing, have been reduced. Wetlands have been considered as the source of livelihood as globally these have been used to support agriculture in some form. In the past, wetlands had been considered in Europe as unproductive and source of diseases. However, those wetlands were later on converted into highly productive farmlands and now the efforts have been extended beyond conservation to restoration of wetlands in order to enlarge it due its positive impacts on improvement livelihoods (Finlayson, 2015).

The contribution of wetlands in people's choice of lifestyle cannot be ignored as they play an important role in maintaining healthy lifestyle of the community living in the proximity of the wetlands. Social determinants of health are the factors having an impact on the status of human health. Whereas livelihood improvement and choice of limfestyle are important components of social determinants of health. The lifestyle and mental health of the people are affected by the surrounding. (Horwitz, Finlayson & Weinstein 2012). There is also possibility that wetlands bring an adverse effect by exposing the communities to vector borne diseases (in endemic areas) and other risks causing diseases, however these risks can be controlled through proper management of wetlands (Finlayson, Horwitz & Weinstein 2015).

1.5 Constructed Wetlands

Constructed wetlands are constructed with natural materials for example soil, water and biota which helps to perform the hydrological, physical, chemical and biological processes of natural wetland in a controlled manner (Kandasamy, et al. 2008). These wetlands have been considered as an alternate technology for treating wastewater other than adopting conventional treatment method with high maintenance costs (Merlin, Pajean & Lissolo 2002). Constructed wetlands are classified based on the type of macrophyte's form dominated in the designed system, for example, free floating, submerged, deep rooted and floating leaves. Further classification is

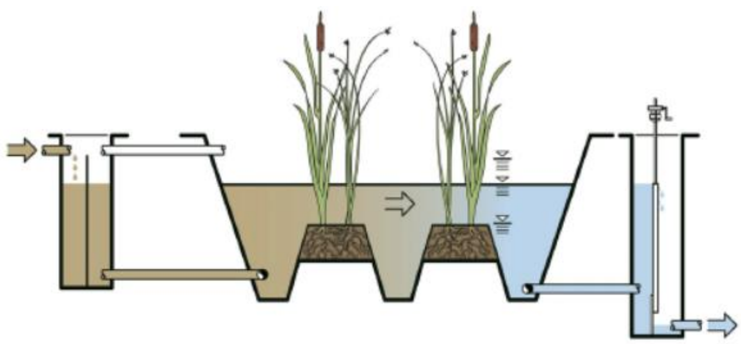

Figure 1. 1 Free water surface horizontal flow constructed wetland schematic diagram (source: (Kadlec, RH & Wallace 2008)

based on the type of hydrological flow inside the system i.e. free water surface and subsurface flow.

1.5.1 Free Water Surface Constructed Wetlands

Free water surface constructed wetlands (also known called surface flow wetlands) comprised of larger areas with open water, floating vegetation and emerging plants, which makes their resemblance to natural wetlands. Some of these wetlands serve as primary, secondary or tertiary treatment systems for waste water, depending on the required water quality of the outflow (Kadlec, R 2009). The water flows above the media bed in free water surface constructed wetlands which is heavily vegetated area (Kadlec, R 2009).

1.5.2 Subsurface Constructed Wetlands

The Subsurface Constructed wetlands with subsurface flow are further classified into

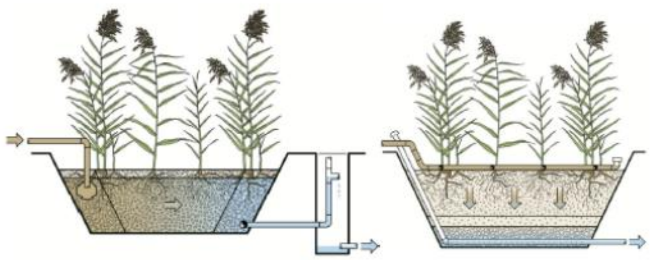

Figure 1. 2 Schematic diagrams of horizontal and vertical flow treatment wetlands (left side image shows HF constructed wetland and right image shows vertical flow constructed wetland system

Source: (Kadlec, RH & Wallace 2008)

horizontal and vertical flow constructed wetlands. (Kadlec, R 2009; Vymazal 2010a). Horizontal flow and vertical flow constructed wetlands have been used as secondary or tertiary treatment systems in order to prevent clogging of the treatment system. The water level has been kept below the porous medium in subsurface constructed wetlands, where the porous medium is usually made of gravels or sand (Kadlec, RH & Wallace 2008)

1.5.3 Horizontal and vertical flow constructed wetlands

Horizontal flow constructed wetland were developed in 1950 in Germany by Kathe Seidel where coarse material has been used as the medium for roots. The soil medium with high clay content was suggested later on by Reinhold Kickuth in 1960 (Vymazal 2010a). However, the design has been evolved from the initial design, as the medium used in this type of treatment system is coarse sand or gravel instead of using clay (Kadlec, RH & Wallace 2008). Horizontal flow constructed wetlands (also called Horizontal subsurface flow- HSSF) are composed of inlet zone from where the water flows into the main area of the wetland which is a macrophytic area and finally into the outlet zone as shown in Figure 1.2 (Kröpfelová 2008). The inlet zone is generally at higher level than the other ponds to allow water flow under gravity. The inlet zone has been considered as the sedimentation pond which is deep and is usually composed of submerged vegetation (Kadlec, RH & Wallace 2008). The macrophyte area is a heavily vegetated area which serves as the main treatment system of the wetland (Kadlec, RH & Wallace 2008; Kröpfelová 2008). The bed of the horizontal subsurface flow (HSSF) constructed wetland is separated by impermeable material (plastic and clay liner) from the surrounding land (Kadlec, RH & Wallace 2008). Different ponds in the wetlands have different water depths depends on the type of treatment, for example in UK, 1 % longitudinal slope base has been used in constructing horizontal flow treatment systems to facilitate the drainage (Kadlec, RH & Wallace 2008) and water flow. The beds are usually called reed beds due to plantation of *Phragmites* spp. in some countries for example in Europe and UK, however different plants are used in different countries as per local habitat (Kadlec, RH & Wallace 2008; Vymazal 2010a). The flow of water inside the wetland needs to be controlled in order to increase the retention time of water. There are some open areas which are free from vegetation in order to treat water by ultraviolet rays (solar treatment). The runoff flow has been controlled by the wetland in terms of providing residence time and volume of water stored in wetland (Mangangka et al. 2016). The concentration of dissolved oxygen in the filtration beds is limited therefore the organic compounds have been effectively degraded by microbial degradation (Kadlec, RH & Wallace 2008). The removal efficiency of horizontal flow constructed wetland for suspended solids by filtration and sedimentation is very high (Vymazal 2010a). Denitrification is the main removal mechanism for nitrogen (Kadlec, RH et al. 2017). Due to lack of oxygen in the filtration bed as a result of permanent waterlogged conditions, there is limited removal of ammonia (Vymazal 2007). Provision of substrate (e.g. roots and rhizomes of plants) for the growth of attached bacteria, nutrient uptake and insulation of the bed surface are important roles of plants in horizontal flow constructed wetlands (Brix 1994). The removal of phosphorus is limited and requires special medium material for increasing the removal efficiency in this type of wetland (Albalawneh et al. 2016).

Vertical flow (VF)wetlands have been used to treat municipal and domestic wastewater specifically when effluents limits have been set to remove ammonia-nitrogen (Vymazal 2010a). However, vertical flow constructed wetlands have been used for different types of wastewaters. The vertical flow constructed wetlands have not been adopted as quickly as horizontal flow wetlands due to its higher operational and maintenance costs requirement as well as energy to pump the wastewater on the surface of the wetland intermittently (Luederitz et al. 2001; Vymazal 2010a).

Table 1. 1 Different types of wetlands having typical removal efficiencies (Kadlec, RH & Wallace 2008)

Parameters	HF	VF [a]	French VF	FWS
Treatment step (main application)	Secondary	Secondary	Combined primary and secondary	Tertiary
Total Suspended Solids	> 80%	> 90%	> 90%	> 80%
Organic matter (measured as oxygen demand)	> 80%	> 90%	> 90%	> 80%
Ammonia nitrogen	20 – 30%	> 90%	> 90%	> 80%
Total nitrogen	30 – 50%	< 20%	< 20%	30 – 50%
Total phosphorus (long term)	10 – 20%	10 – 20%	10 – 20%	10 – 20%
Coliforms	2 $\log_{10}$	2 – 4 $\log_{10}$	1 – 3 $\log_{10}$	1 $\log_{10}$

[a] Single-stage VF bed, main layer of sand (grain size 0.06 – 4 mm)

The area required for a vertical flow constructed wetland is less than that for horizontal flow wetlands (Kadlec, RH & Wallace 2008; Kröpfelová 2008).

Water is introduced into the designed system in large amount which percolates down the medium made of sand. Once the bed is free of water then the new batch of wastewater is fed into the system (Kadlec, RH & Wallace 2008; Vymazal 2010a). The oxygen from the air will be diffused into the bed as the water percolates down the system (Vymazal 2007, 2010a). Suitable aerobic conditions are provided for nitrification process in this type of wetland as compare to horizontal flow constructed wetlands. The removal efficiency of vertical flow constructed wetlands in organic and suspended solids is also good. The phosphorus removal of horizontal flow constructed wetlands is less than vertical flow constructed wetlands and the phosphorus removal efficiency of VF constructed wetlands can be further improved if better sorption medium is used (Albalawneh et al. 2016; Kadlec, RH et al. 2017; Kröpfelová 2008; Vymazal 2007). In order to achieve higher removal efficiencies, combined vertical and horizontal flow constructed wetlands have been used in many countries in order to remove ammonia and total nitrogen(Vymazal 2007, 2010a). Due to higher inflow concentrations in vertical flow constructed wetlands, its removal efficiency is higher than horizontal flow and free water surface flow(Kadlec, RH & Wallace 2008; Kröpfelová 2008). Horizontal flow constructed wetlands are used for stormwater treatment or wastewater diluted by stormwater and vertical flow constructed wetlands are used for primary or secondary wastewater treatment (Vymazal 2010a).

1.6 Performance evaluation of Constructed Wetlands

In Australia, horizontal flow constructed wetlands have been used to treat storm water to reuse it for irrigation purposes (Mangangka et al. 2016; Vymazal 2010a). It has been observed that both in developed and developing countries, the use constructed wetlands have been promoted in the past three decades due to their higher efficiency in pollutants removal, cost effective sustainable option and easy operation and maintenance (Kadlec, RH & Wallace 2008). Constructed wetlands are important components of stormwater management strategies to serve as an option of integrated stormwater treatment (Malaviya & Singh 2012). However, the effectiveness of wetland's design has rarely been evaluated against the desired water quality improvement targets. The studies conducted on the performance evaluation of the wetlands are limited. There are few studies conducted to evaluate the long-term performance of the constructed wetlands (Arroyo et al. 2013).

Water quality improvement involves complex physical, biological and chemical processes in the wetland systems(Li, YC, Zhang & Wang 2017).The environmental conditions also have an impact on the wetland's systems operational efficiency. Variations in water temperature and

Table 1. 2 HSSF constructed wetland performance efficiencies of outlet calculated from 6 years of data (source: (Merlin, Pajean & Lissolo 2002)

Table 1. Average pollutants removal at the different stages in percent of inflow loads

Outlets	TSS	BOD	COD	TKN	TP
Stage 1	82.5	56.1	59.2	15.8	30.3
±SD	11.8	18.6	14.3	24.7	28.9
Stage 2	96.0	89.4	89.6	38.5	47.8
±SD	3.5	9.0	7.4	32.3	30.1
Stage 3	95.6	93.6	93.6	57.3	69.4
±SD	3.6	5.2	4.4	21.2	27.1

SD: Standard deviation.

daylight, vegetation growth inside wetland, depth of water, chemical and microbial activities are the conditions which have an impact on the wetlands performance. The treatment efficiency of wetland varies in different times and season of the year for a particular contaminant (Government 2010). In order to determine the efficiency and effectiveness of constructed wetlands, it is important to evaluate performance of wetlands based on scientific evidence. Studies have been conducted in France to evaluate the performance of Horizontal subsurface flow (HSSF) constructed wetland built for experimental study in 1994 and continuously monitored over the period of six years (Merlin, Pajean & Lissolo 2002). The pollutants removal efficiencies recorded for total suspended solids (TSS) were 95.6 % during the whole year, 90% of biochemical oxygen demand (BOD_5) with little variations during different times of the year as shown in Table 1.2.

There were no significant variations in pollutants removal efficiency of the wetland when compared between warm and cold weather conditions therefore the impact of temperature on wetland's performance was considered weak (Merlin, Pajean & Lissolo 2002). However, the observed phosphorus removal was higher in summers than in winter season. The study observed the bacterial (total coliforms and *E.coli*) removal proportional to the residence time during the respective stages of the wetlands (Merlin, Pajean & Lissolo 2002). It was recommended that by adding absorbing media into the wetland material will help in the phosphorus removal. The bacterial removal was found as 98-99.99 % however the study could not establish impact of seasonal variation in removal efficiency(Merlin, Pajean & Lissolo 2002).

Several pilot studies and field studies have been conducted to identify the suitable design of constructed wetlands suitable for the removal of nutrients from wastewater and stormwater. However, evaluating the design of the system has been done rarely to overview the performance of the wetland's system once it has been constructed. Constructed wetlands performance was evaluated for the period of 12 years by Arroyo et al. (2013), which were

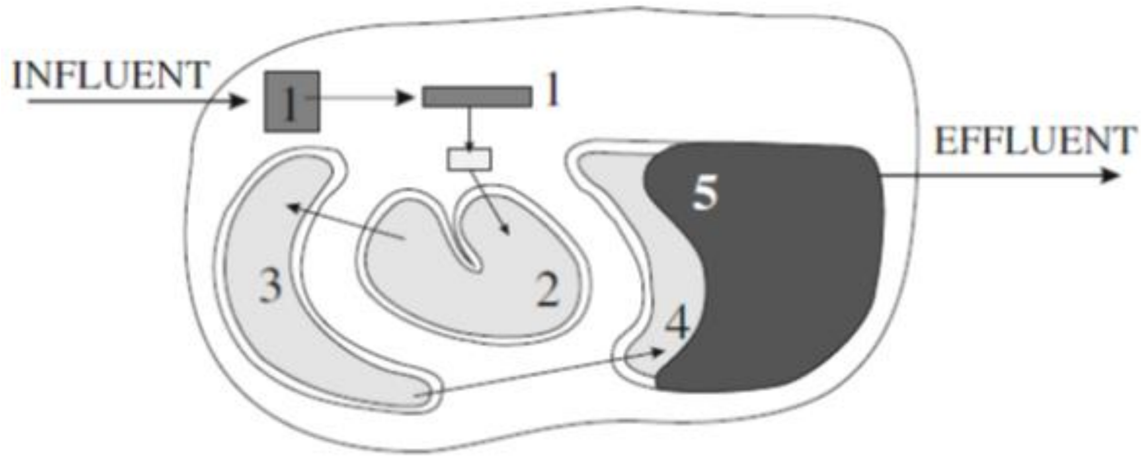

Figure 1. 3 Diagram of a treatment plant using combination of different types of constructed wetland types (1) stabilization pond (2) FWS flow CW (Typha Latifolia) (3) further divided into two areas FW flow CW (iris pseudocorus) and HSSF gravel bed system (Salix atrocinerea)

Mainly designed to treat municipal wastewater in Bustillo de Cea, a rural area located in north-western Spain. This Hierarchical Mosaic of Artificial Ecosystem (HMAE) was built in 1999. The area has Mediterranean climate with 546.7 mm mean annual rainfall and mean annual temperature of 10.2°C. This constructed wetland's design comprised of pre-treatment system which discharged water into three cells. The first cell was a stabilisation pond followed by free water flow constructed wetland cell. The third cell was further divided into free water flow constructed wetland cell and horizontal subsurface flow. The residence time for this wetland system was 10.5 days. The treated water from this wetland has been used for agricultural irrigation. Samples for water analysis in this study were collected from inlet and outlet only. Kadlec (2009) discussed that suspended solids can be generated by resuspension processes within the system. There was no statistically significant difference found in removal efficiencies when annual results were compared (Arroyo et al. 2013). The inlet organic concentrations were found less when compared with the data of other studies where the inlet organic concentrations were higher at inlet. The percentage removal efficiency of the wetland increases when the inlet concentrations were increasing(Arroyo et al. 2013; Vymazal 2002). The study concluded from the results of the 12 years data analysis that system had been effectively performing in removing organics, suspended solids, indicator bacteria and nutrients as well as the removal efficiency was steady in all those years.

This study is conducted to evaluate the performance of HF constructed wetland which was built in 1991 in Ondřejov, Czech Republic and this one of the oldest operational HF wetland (Kadlec, RH et al. 2017; Vymazal 2009). The study evaluated its performance until 2015. The wetland was planted with *Phragmites australis,* treating sewage coming from households of 360 persons in a single bed horizontal flow wetland. The treatment performance is shown in Table 1.2 (Kadlec, RH et al. 2017) . The performance removal efficiency shows 93 % for BOD_5, 95 % TSS, 41 % NH_4, TP 46 % and TN 37 % (until reported year 2004) (Kadlec, RH et al. 2017)

Table 1. 3 Table consisting of data to evaluate the performance of HF wetland in Ondřejov from 1991 to 2015 (data from 1991 to 2004 has been represented from study conducted by (Vymazal 2009) the empty spaces indicated that parameter has not been measure in that year) (Kadlec, RH et al. 2017)

Year	BOD_5		COD		TSS		NH_4-N		TN		TP	
	In (mg/L)	Out (mg/L)	In (mg/L)	Out (mg/L)	In (mg/L)	Out (mg/L)	In (mg/L)	Out (mg/L)	In (mg/L)	Out (mg/L)	In (mg/L)	Out (mg/L)
1991	168	16	660	62	108	5	56.5	2.5	-	-	14.2	2.5
1992	161	38	254	74	44	10	19.6	17.8	-	-	17.7	21.1
1993	152	28	445	88	257	18	29.8	22.6	41.8	28.8	6.4	5.8
1994	330	16	719	57	304	3	39.1	21.6	49.8	28.0	12.6	6.8
1995	83	13	188	35	67	5	17.7	17.0	34.6	21.1	4.2	4.8
1996	106	13	207	44	36	9	-	10.7	26.1	15.4	-	1.9
1997	112	13	-	45	-	23	-	23.0	57.2	27.0	-	6.0
1998	137	12	-	33	-	4	-	25.5	36.3	28.8	-	5.4
1999	493	27	-	79	-	7	-	40.0	86.9	49.0	-	8.1
2000	571	30	-	68	-	8	-	41.6	81.5	44.1	-	10.1
2002	169	15	190	36	66	2	40.3	33.1	57.1	34.1	8.3	7.0
2003	408	11	1,047	40	463	9	39.6	20.8	58.2	28.5	24.0	7.7
2004	187	16	458	81	148	6	33.0	17.0	20.6	21.6	34.0	4.5
2005	204	16	558	51	515	20	33.6	23.1	-	-	6.0	3.4
2006	340	3	540	33	290	11	33.5	7.9	-	-	11.0	4.7
2007	360	8	580	53	310	13	13.7	8.5	-	-	5.8	1.6
2008	195	9	370	35	190	8	29.0	10.0	-	-	6.0	1.3
2009	220	12	450	58	200	10	54.0	10.0	-	-	7.0	3.0
2010	421	14	1,032	64	710	6	17.0	15.5	-	-	7.1	3.2
2011	257	7	1,060	41	355	8	50.0	28.0	-	-	7.2	3.2
2012	355	4	1,210	29	596	3	38.3	24.0	-	-	6.5	3.5
2013	255	6	984	33	417	3	25.5	14.4	-	-	6.6	2.4
2014	305	11	974	26	818	6	33.1	23.5	-	-	5.0	3.9
2015	395	15	695	78	458	8	47.7	30.8	-	-	7.7	3.5
Average	**266**	**15**	**631**	**52**	**318**	**8**	**34.3**	**20.4**	**50.0**	**29.7**	**10.4**	**5.2**

Performance of horizontal subsurface flow constructed wetlands in Czech Republic has been done through analysing the water quality data of inflow and outflow for the period of 20 years from 1989 to 2008(Vymazal 2010b). The survey conducted in 2008 found that 250 wetland systems have been operational since 1989 in Czech Republic (Vymazal 2010b). All these wetland systems are horizontal subsurface flow constructed wetlands which are designed to treat mostly domestic or municipal wastewater. Only one wetland was designed to treat stormwater runoff and was later on converted to treat domestic waste water as the stormwater runoff was not enough due to lack of rainfall (Vymazal 2010b). The treatment performance of these constructed wetlands was good and is shown in Table 1.3. The median outflow concentrations were 9.6 mg/L for BOD_5, 42 mg/L for COD and 8.8 mg/L for total suspended solids, which are under the discharge limits as set for small sources of pollution. The variation in inflow concentrations of the CWS as shown in Table 1.3 and is due to dilution of wastewater by stormwater and drainage waters. When organics and suspended solids are the treatment targets of the wetland, then HF CWs are an excellent treatment alternatives due to their higher removal of organics and suspended solids from diluted wastewater (Vymazal 2010b).

Table 1. 4 20 years treatment performance of constructed wetlands in Czech Republic from 1989 to 2008 (inflow and outflow concentrations are expressed in mg/L, treatment efficiency in %, n is number of annual means and CWs is the number of CW wetlands)(Vymazal 2010b)

	BOD_5			COD			TSS		
	In	Out	Eff.	In	Out	Eff.	In	Out	Eff.
Mean	171	14.4	85.3	372	52	75.6	189	12.0	82.7
Median	106	9.6	90.0	232	42	80.7	87.3	8.8	89.3
Min	3.0	1.0	6.7	9.2	2.6	−18.3	5.0	0.9	−113
Max	2540	114	99.7	8500	238	99.4	4230	262	99.8
n	423	423		396	396		410	410	
CWs	70			65			66		

10 years of data collected from different sites of Czech Republic had been analysed and then compared with results from different countries as shown in Table 1.5 (Vymazal 2002).

Table 1. 5 HSSF CWs inflow and outflow concentrations BOD5 and COD in mg/L and removal efficiencies in % in Czech Republic and other countries (Vymazal 2002)

BOD_5	In	SD	Out	SD	Eff	*n*
Czech Republic	87.2	63.1	10.5	9.9	88.0	55
Denmark and UK[a]	97.0	81.0	13.1	12.6	86.5	80
North America[b]	27.5		8.6		68.5	34
Germany-L. Saxony[c,d]	248	233	42.0		83.0	39
Germany-Bavaria[c]	106	62.1	21.6	16.4	79.6	7
Poland[e]	110	87.8	18.1	14.3	83.5	6
Slovenia[f]	107	30.2	11.3	2.5	89.0	3
Sweden[g]	80.5	55.0	5.9	4.5	92.7	3
COD						
Czech Republic	211	160	53.0	48.3	75.0	53
Denmark[a]	264	192	64.7	27.9	75.0	59
Germany-L.Saxony[c,d]	430	348	133		69.0	47
Germany-Bavaria[c]	234	124	69.4	39.1	70.3	7
Poland[e]	283	170	101	23.6	64.3	6
Slovenia[f]	200	41.5	35.7	3.1	82.0	3

As observed in the study conducted by Vymazal (2002), the Czech legislation has set effluent limits only therefore discharge data has been monitored. The influent data for this study was derived from other research studies projects or local authorities. The results were focused on vegetated beds only. The study found those constructed wetlands were mainly effective in suspended solids, BOD_5 and COD removal i.e 84.3 %, 88.0 % and 75 % respectively, which were comparable with results of other countries as shown in Table 1.5 (Vymazal 2002). The percentage removal efficiency of wetlands increases with the increase in inflow concentrations therefore to express the treatment efficiency of constructed wetlands in percentage removal could be misleading (Vymazal 2002). The wetland sites selected for performance evaluation were treating domestic and municipal wastewater as the data of other horizontal flow constructed wetlands for stormwater was not available in the literature for comparison. (Vymazal 2002). It is evident from the literature that horizontal flow constructed wetlands have been used for storm water treatment and for tertiary treatment of wastewater.

Choi et al. (2015) conducted study to compare the treatment efficiency of two hybrid constructed wetlands systems to treat stormwater runoff in two different cities in Chungnam Province of Korea. These two cities were selected as they have similar climatic conditions for comparing their results. The Type 1 was receiving storm water runoff from an impervious two lane road and the Type 2 was also receiving drainage from impervious road inside Kongjo National University. These hybrid CW treatment systems were designed as a combination of free water surface and horizontal subsurface flow constructed wetlands designs as shown in Figure 1.3.

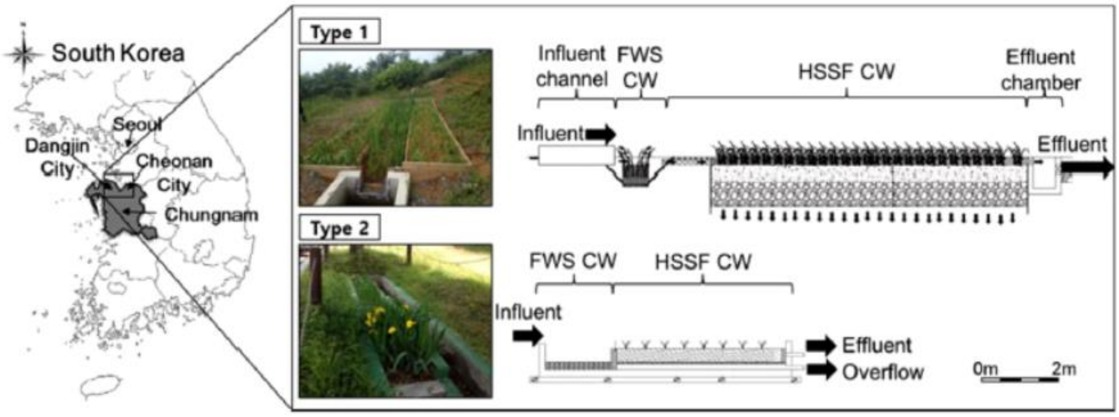

Figure 1. 4 Schematic diagram of the Type 1 and Type 2 Hybrids systems (Choi et al. 2015)

The size of CW Type 1 was bigger than Type 2. In Type 1 system, iris and reed was planted and Type 2 was planted with iris only. The data for storm events was monitored through manual grab sampling. Weather forecasts from a nearby station were used to analyse the stormwater impacts. The Type 1 received more runoff than Type 2 CW, however, the pollutant concentrations in Type 2 were higher than Type 1. The removal efficiency of Type 2 was found lower as compared to Type 1 as shown in Table 1.6, however Type 2 showed a similar trend

Table 1. 6 Comparison of influents and effluents concentrations of this study as well as with other studies (Choi et al. 2015)

				Average volume	Influent EMC (mg/L)					Removal efficiency (%)				
References	CW Type	Land Use	SA/CA (%)	reduction (%)	TSS	TN	TP	Zn	Pb	TSS	TN	TP	Zn	Pb
Hathaway & Hunt (2010)	FWS	Urban runoff	2.5	–	77	1.74	0.31	–	–	84	62	52	–	–
Lenhart & Hunt (2011)	FWS	Urban runoff	0.3	54	31	0.73	0.23	–	–	49	47	36	–	–
Line *et al.* (2008)	FWS	Urban runoff	4.7	–	100	0.66	0.27	–	–	83	42	52	–	–
Korea Institute of Construction Technology (2013)	FWS	Road runoff	1.6	49	62	3.20	0.50	0.30	0.15	92	74	88	70	65
Korea Institute of Construction Technology (2013)	HSSF	Road runoff	2.5	94	19	4.70	0.25	0.35	0.18	83	85	83	79	78
Korea Institute of Construction Technology (2013)	FWS + HSSF	Road runoff	2.7	93	36	7.18	1.45	0.33	0.18	93	97	91	89	89
This study (Type 1)	FWS + HSSF	Road runoff	2.5	88	48	2.11	0.15	0.25	0.04	95	97	96	84	88
This study (Type 2)	FWS + HSSF	Road runoff	1.1	30	220	5.80	0.50	0.42	0.15	71	49	42	58	52

EMC: Event mean concentration.
FWS: Free water surface flow.
HSSF: Horizontal subsurface flow.
SA/CA: Surface area to catchment area ratio.

in removal efficiency to the influent Event Mean Concentration (EMC). The study showed the correlation of surface area/catchment area and removal efficiency of wetlands. The study results showed that it would be difficult to achieve higher pollutant removal efficiency for smaller size constructed wetlands with more highly polluted influents (Choi et al. 2015). The strong correlation was found between rainfall duration, antecedent dry days, pollutant influent

EMC, runoff and other parameters. The runoff and discharge for Type 1 and Type 2 was highly affected by rainfall. There was high correlation between runoff and discharge for both Type 1 and Type 2. The negative and high correlation was found between rainfall duration and influent event mean concentration (EMC) in Type 1, which showed that influent concentration of pollutants will be lower when the rainfall duration and antecedent dry days are longer. However, this correlation was not evident in Type 2 CW due to high variability in collected data and smaller Surface Area/Catchment Area (SA/CA). The first flush has increased the TSS during first 30 mins of runoff in both types of CWs(Choi et al. 2015).

Li et. al. (2017) evaluated the performance of constructed, horizontal sub surface flow wetland for stormwater treatment in HangZhou China, and its correlation with stormwater events. Higher removal efficiencies for TSS (84.3 %) were recorded despite highly variable inflow concentrations. The TSS removal efficiencies were significantly lower during higher rainfall events as shown in Table 1.7 (Li, YC, Zhang & Wang 2017). The effluent concentrations of TSS, TN, TP and PO_4^{3-} have significant positive correlation with flow intensity. The inflow

Table 1. 7 Correlation Analysis through Pearson correlation coefficient ® between pollutant concentrations and Stormwater variables, (DUR= indicates duration (h) , INT =intensity cm/h, PRE= precipitation (cm)

	Stormwater influent			Pond effluent	CW effluent
	PRE[c)]	DUR[a)]	INT[b)]	[b)]INT	INT[b)]
TSS	0.49	0.12	0.56	0.50	0.41
COD	0.55	0.01	0.32	0.32	0.46
TN	0.41	0.22	0.44	0.36	0.49
NH_4-N	0.34	0.24	0.11	0.38	0.48
NO_3-N	0.16	0.08	0.02	0.22	0.15
TP	0.48	0.16	0.54	0.38	0.46
PO_4-P	0.27	0.23	0.42	0.43	0.51

concentrations of TSS, TN and TN were moderately correlated with inflow intensity (Li, YC, Zhang & Wang 2017). The negative correlation of reactive phosphorus and lead (Pb) with rainfall suggested that more diluted runoff was generated by the long storm events(Malaviya & Singh 2012).

Historically drainage infrastructure was used in Australia to minimise flooding. (Metcalfe, Nagabhatla & Fitzgerald 2018). The stormwater reuse treated through constructed wetlands has been the prevailing practice and treated water has been used in Australia for irrigation purposes. Each stormwater treatment wetland behaves differently due to the variation in quality and quantity of pollutants present in stormwater (Malaviya & Singh 2012). There are also other factors like drainage, catchment area, land use, geographic and geological characteristics and the nature and frequency of storm events, which influences the treatment efficiency of constructed wetland (Malaviya & Singh 2012). It is quite evident from the literature that the performance of stormwater treatment wetlands is not consistent in treating stormwater as the removal efficiencies are dependent on aforementioned factors. Technologies have been adopted in Australia for managing stormwater as most of the stormwater has been discharged directly into the waterways without treatment which resulted in erosion and pollution in rivers and urban creeks (Vymazal 2010a). However, limited studies are available to evaluate the performance of these wetlands to see how these adopted systems are performing in respective environmental conditions. Malaviya et. al (2012) discussed that CWs in context of stormwater treatment, have been looked at as a 'black box', as only influent and effluent concentrations have been measured without conducting any further investigation. However, in most cases, only effluent pollutants are measured to comply with legislation requirements.

1.7 Legislation and guidelines for stormwater reuse in Australia

Wetlands have been used as an option to recycle and reuse stormwater and waste water for irrigation purposes in Australia. The need for stormwater reuse in Australia has been felt after the decade of drought and climate impacts on changing weather patterns. There is significant potential in using wetlands for water quality management. In order to make better use of storm and waste water, 'Australian Guidelines for Managed Aquifer Recharge' (NRMMC-EPHC-NHMRC 2009) were developed. These guidelines further helped to address the environmental health risks linked with water recycling. These national water recycling guidelines have been developed in two phases and Phase 2 guidelines focuses on managed aquifer recharge(NRMMC-EPHC-NHMRC 2009). These guidelines contribute to the 'National Water Quality Management Strategy' and help manage the environmental health risks associated with waste- and stormwater recycling uses. (NRMMC-EPHC-NHMRC 2009)

In South Australia, water quality monitoring has been conducted under the Environmental Protection act 1993 and the Environmental Protection (Water Quality) Policy 2003. These guidelines have been used to address the environmental health risks by mainly focusing on water quality of water treated through wetlands and managed aquifer recharge (Natural Resources Management Ministerial Council 2009).

1.8 Catchment area of Sturt River

The Sturt River has a catchment of 120 square km and is drained into the Patawalonga Basin (Fig 1.5). The western slopes of the Adelaide Hills to the south east of the City comprises the upper part of the catchment. It comprises of large and expanding areas of urban development

downstream, is steep and includes significant areas of native vegetation (Teoh 2006). There is concrete lined river channel downstream of Sturt Road, and runoff has been discharged through council drainage systems from the urban catchment directly into this channel. Treated water from Heathfield Waste Water Treatment Plant is also been discharged into this river (Government 2010; Teoh 2006). The Sturt river has large urban and rural catchment, which helps to maintain a reasonable baseflow. However the water quality of the river is dependent on the water source contributing into the river flow and therefore water quality of the river can be variable (Kretschmer 2017).

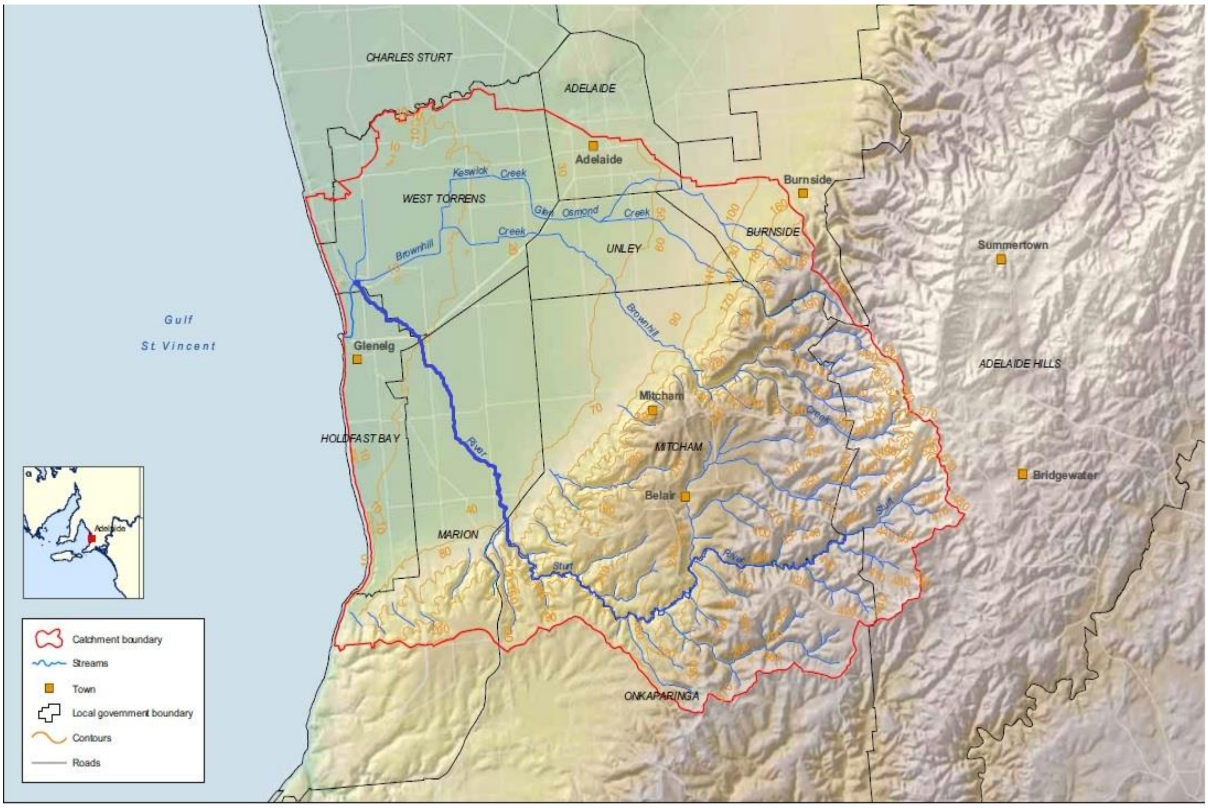

Figure 1. 5 Sturt River Catchment

Source: Department of Water, Land and Biodiversity

An off stream Warriparinga Wetland, has been located adjacently to the Sturt River between Main South Road and Marion Road in Bedford Park. This wetland is located upstream of the Oakland's park wetland. Annually 8400 ML of water eneters this wetland from the Sturt River. The water has been drawn from the upstream of oxbow bend of Sturt River. The outlet is located upstream of the river channel which is concrete lined. Silt, nutrients, bacteria, heavy metals, oils and suspended organic material and contaminants have been removed through wetland traps. 100 tonnes of sediments and 50 kg of phosphorus has been removed annually from water (Government 2010).

1.9 Background

Oaklands Park wetland was constructed in 2014, on an area of 2.3 hectares adjacent to the Sturt River on Oaklands Road, in City of Marion. This site had been used by Department of Transport before construction of this wetland. It was built to cater the needs of irrigation of public reserves in the north and south of the Marion City Council. The construction of this wetland has been under consideration by Patawalonga Catchment Management Board since 1990 but was decided later on when the council was unable to fulfil the irrigation requirement of the public reserves during the millennium drought. Oakland's park wetland is an example of horizontal subsurface flow constructed wetland where the stormwater from Sturt River has been recycled and treated through wetland and injected into the aquifer (ASR well) for recovery for irrigation purposes in summer season (dry season)(Kretschmer 2017). To meet the initial forecast demand, the wetland has been completed with four ASR wells instead of six wells (initially proposed in the designed report). The location of the wetland is in the south-eastern extent of the Munno Para Clay forming the aquitard where the T1 and T2 aquifers have been separated by this aquitard over most of the Adelaide Plains (Kretschmer 2017). It has been considered as T1 aquifer scheme instead of T2 aquifer scheme even one of the wetland's well has been penetrating in Munno Para Clay (Kretschmer 2017). The depth of the wells varies between 97 to 108 metres with open-hole completions. The yielding capacity of wells varies from 3 L/s (one well) to 12 L/s (two wells). The scheme has been in the commissioning phase and has been planning to extend the distribution of its supply. 15 ML and 80 ML of treated water has been injected into wells in 2014 and 2015 respectively (Kretschmer 2017). 30 ML was injected in 2016 when the wetland was inspected (Kretschmer 2017).

This site has been used for educational and scientific studies besides recreational purposes. Marion City Council in collaboration with Flinders University has been conducted scientific studies and has been used for educational learning and research. Flinders University has installed two probes inside the wetland to monitor water quality (conductivity, turbidity, temperature, salinity) of the wetland's system.

1.10 Aims and Objectives

Oaklands park wetland system has been selected to evaluate and assess the treatment performance through targetted water quality parameters including microbiological, physical and checimcal parameters i.e. phosphorus, nitrate, nitrite, ammonia, total suspendid solids conductvitiy, temperature, pH, *E.coli* , F-RNA Bacteriophage, BOD_5 , TOC and Total nitrogen as per MAR guidelines. The parameters selection was based on the water quality requirements of the managed acquifer recharge and their proven correlation with wetlands water treatment performance. The impacts of storm events on performance of wetland has been assessed by comparing the rainfall data with influent and effluent pollutants concentrations as well as the real time water quality monitoring data. The treatment performance of this wetland has not been evaluated since its construction, therefore this site has been selected to conduct this study.

The aim of this project was to identification of environmental health risks of water treated by wetland.The objectives of this research project were

1. To determine water quality in the throughout wetland treatment system
2. To determine the impacts of weather (storms) on water quality improvement of wetland through analysis of different water quality parameters

2. Material and Methods

2.1 Site location and functioning description as per designed report

2.1.1 Wetland design

The Oaklands Park Wetland is located adjacent to Oaklands Estate Reserve in the city of Marion, South Australia. This site has been considered as major recreational park and is playing an important role contributing to the wellbeing of the communities by providing ambient and relaxing environment. This project has been developed in consultation with respective stakeholders including community. The main objectives for the wetlands were to enhance the biodiversity of the area, provision of safe recreational environment and to improve the water quality of stormwater before injection into the 4 ASR wells installed at the wetland.

The approximate size of the wetland is 2.3 hectares. This wetland was designed to operate as a constant flow wetland and the flow has only been diverted into the wetland at a rate i.e. 50 L/s maximum inflow rate, which can be treated by the wetland. The primary objective of this wetland was to supply 172 ML of water for irrigation purposes annually up to 30 council reserves. The design yielding capacity of ASR wells in wetland is 450/500 ML per year whereas the initial anticipated demand was 140-170 ML/year.

Figure 2. 1 Oaklands Park wetland map

Stormwater from Sturt River is treated by this wetland. The water from the river is collected by a harvesting pump installed to provide a flow rate of 50L/s into the wetland. Water flow from the river into the wetland is controlled by conductivity probes to prevent flow of lesser quality water into the wetland. The stormwater is pumped from the river into the inlet pond after passing through the gross pollutant trap in order to remove the debris and prevent the accumulation of debris in inlet pond. The gross pollutant trap also prevents malodours developing within the wetlands, potentially making them aesthetically attractive to the public. The inlet pond (1) has been constructed up-slope to other ponds as shown in Figure 2.1. The inlet pond has also been designed to regulate gravity flow of water into other ponds through two weirs. The water flow from inlet pond (1) is equally divided to flow into Pond 2 and 3 as shown in Figure 2.1. The other weir has been installed between the two macrophyte areas i.e. Ponds 2, 3 and Pond 4 as shown in Figure 2.1. The flow of water is controlled by these two weirs and the theoretical hydraulic retention time of water in this wetland is 3 days. The residence time influences the water treatment as it passes through these ponds. The outlet Pond (6) overflows into a sump where water is pumped into the ASR wells through a main injection ring. The inlet pond is built at higher level to the wetland and sediments (if any left after passing through GPT), are collected in the inlet pond. The inlet pond regulates flows of storm water into the wetland's macrophyte area comprised of Ponds 2, 3, 4 and 5. The macrophyte area has been vegetated with a mixture of plants mostly native plants, based on their suitability to different depths in wetland as ponds are situated at different levels and depths to maintain the constant flow. The water flows into the outlet pond after passing through the macrophyte area and is finally collected in the outlet pit (sump). A review by Soil and Groundwater Consulting (2011) determined the suitability of this site for wetland and ASR purposes based on the available information the proposed use do not pose any unacceptable risk to human or ecological health (Robin Allison 2012)

The wetland has been designed to maintain plug flow where the incoming water replaces the old water in order to provide equal residence time. The inlet pond is 2 m deep for sedimentation process. The remaining ponds of the wetland are a combination of shallow marsh areas (depth of 100 or 350 mm) with dispersed pockets of deep ponds (depth of 1m or 1.5)

2.1.2 Wetlands operation

Stormwater flows from the adjacent Sturt river channel are collected in a sump constructed under the Sturt River channel and deliver flows to a pump chamber. The flows entering into the inlet sump has been screened with a trash grate to prevent large amount of debris entering into the pump chamber. The inlet pump sump is connected to the pump chamber through pipe and a harvesting pump transfers the flows from the pump chamber into the GPT as shown in Figure 2.3.

There are two conductivity probes installed in the inlet sump of the wetland. First conductivity probe has been installed under the trash grate which prevents the harvesting pump from starting when water flow in the Sturt River is saline. The second probe in the pump sump starts monitoring of the conductivity level of water flows 3 minutes after the harvesting pump begins running. The harvesting pump stops when the conductivity increases above the set threshold point. The cycle resets after 15 min automatically and first probe starts its operation. The conductivity has been measured to estimate the salinity level. The harvesting pump does not start when the water level in the sump is above a set threshold even if the conductivity to estimate salinity in Sturt River is below the set threshold point. The variable drive increases or decreases the pump speed dependent on the water level and flow set point in the sump respectively. The flow between the pump and GPT is measured by an electromagnetic flow meter. The flow set point is less than 50 L/s. The harvesting pump pushed water into the wetland by passing it through GPT, at the required flow rate when the harvesting pump is enabled and suitable quality and quantity of water is available.

A gross pollutant trap (GPT) has been installed in upstream of the inlet pond which removes the majority of the debris from stormwater extracted from Sturt River. This gross pollutant trap is cleaned after every two months during harvesting (winter season). The water from GPT is delivered by gravity to the inlet pond of the wetland.

The outflow from the outlet pond wetland is collected in the outlet pit. The wetland outlet pit is located near the northern part of the wetland near outlet pond as shown in Figure 2.1.The outlet pit (outlet pump sump) is the pump station to transfer flows to the ASR wells. The pumping is controlled by the water level in the outlet pit and suitability of wells to accept water. The water quality station has been installed in the outlet pit to monitor water quality to ensure the suitability of the water for injection into the aquifer. The outlet pit is located separately to the wetland and has been connected through 450 mm of pipe to the wetland. This pit also contains an overflow structure which transfer flows from the wetland when the water level rises above the set limits. A connection pipe has been installed from the outlet pit to transfer flows from outlet pit into the local drainage along Oaklands Road into a pit. The water flows have been delivered by the injection pump from the outlet pump sump to the ASR wells through ring. The injection pump operates only when the water quality parameters are acceptable for aquifer injection and the level of water in the outlet sump is above threshold set point. When the water level continues to rise and overflow in the pit, then the water level probes triggers the harvesting pump to stop pumping water from the Sturt River into the wetland. The variable drive of the injection operates in two modes which are injection and recirculation, each mode has been interlocked with the corresponding valve on the pump discharge as shown in below Figures 2.2 and 2.3. The injection pump delivers water through dedicated injection ring main to four ASR wells at suitable flow and pressure in order to ensure sufficient injection.

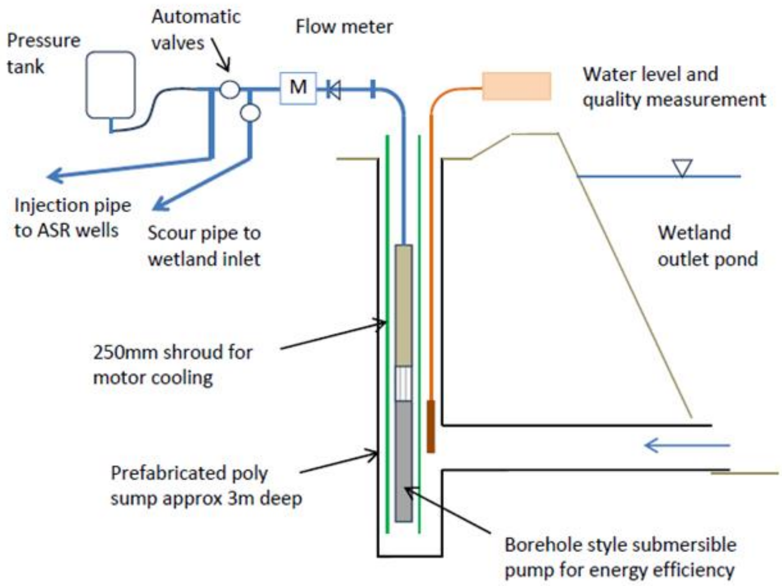

Figure 2. 2 Image taken from Design Report of Oaklands Park

The recirculation mode operates when the water quality is not up to the set threshold point and water from the outlet pit (outlet sump) is pumped back through scour pipes into the inlet of the wetland without injecting into the ASR wells. The river return mode is activated to remove excess water through drainage pipes and introduce fresh through water from the river. When the water level decreases in wetland due to evaporation in the summer then water has been extracted through extraction pumps from the ASR wells through scour pipes to top up the wetland with the stored water (see Fig 2.3). An extraction pump has been installed in each well in order to recover and transfer the injected stored water through dedicated extraction main ring to a buffer tank which is located in the north west of the wetland. The buffer tank is connected to the distribution pump station within a shed located in the north-west corner of the wetland. The water from the buffer tank is distributed by distribution pump through a network of reticulation pipes to north and south of the council for irrigation purposes. The distribution pump is configured at two pressures for outflows, the north part which is downhill requires lower pressure and the south part (uphill) requires higher pressure for water supply to the respective areas.

The design report lacks the information on the water quality parameters associated with this wetland.

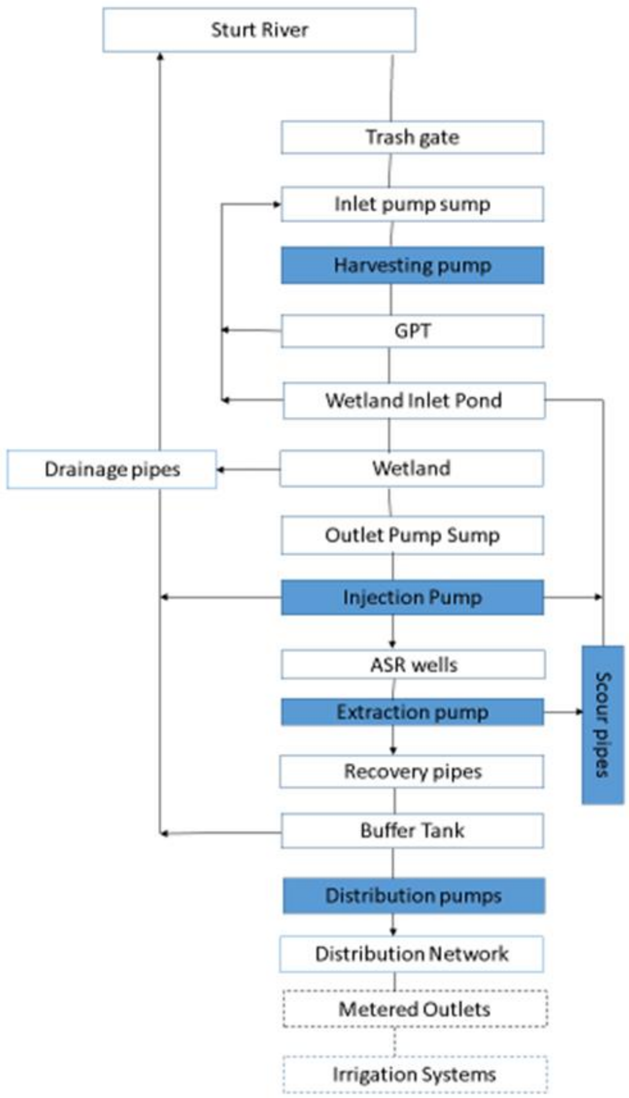

Figure 2. 3 source: adopted from wetland's design report of Marion city council

The design report has used the available water quality reports and studies conducted regarding the water quality of the Sturt River. It was decided based on the available literature that wetland would not require screening and further treatment as the water quality would be acceptable as per Australian Guidelines for Managed Aquifer Recharge(NRMMC-EPHC-NHMRC 2009).

2.1.3 In-Situ Online water quality monitoring

The online control system inside the wetlands provides several functions such as controlling harvesting and injection pumps, ASR wells management, operational data provision for use by the onsite personnel, alarms for notifying operating personnel of problem conditions, water quality and operational logs data of site for analysis later on as a licence condition of reporting. The control system has been operational with complete automatic mode with minimal interaction by the council staff. The operational problems (higher water level, turbidity level, conductivity, pH, overflow or no flow, failure of control valve to stay in the required status) etc. have been notified through text to the operational staff. Online monitoring data of pH, temperature, conductivity and turbidity are monitored after every 15 minutes. The following sites within the wetland are monitored and the functions have been managed automatically.

- First Conductivity probe in the trash grate
- Water level probe and second conductivity probe in the inlet sump
- Flow meter between the harvesting pump and GPT
- Flow meter for recirculated or scoured/back flushed water at the inlet of the wetland
- Flow meter at the injection pump
- Conductivity Probes inside Pond 2 and Pond 5 (installed by Flinders university)

2.2 Climate Data

The climate data comprised of daily rainfall, daily minimum and maximum air temperature and daily solar exposure was obtained from Bureau of Meteorology. The weather station used in this study was Adelaide Airport weather station (23034), Adelaide, South Australia located at Latitude -34.95 and Longitude 138.52. The weather station has been monitoring data for more than 50 years.

2.3 Water samples collection from Wetland

Sampling Site: The sampling protocol has been identified for the selected analysis such as the number of ponds in wetland, bridge and weir locations and sites for sampling collection. The layout for sampling collection has been determined before starting the sampling collection sample collection has been avoided from recirculation eddy, area having backwater as recommended in guidelines (Duncan et al. 2007). The sampling location points have been marked in numbers on each pond as shown in Figure 2.4.

Figure 2. 4 Location of sampling points for water samples collection in Oaklands Park Wetland

2.4.1 Sampling Methodology

The sampling collection methodology has been used as explained in 1060 B Collection of samples by Greenberg et al. (1992). Samples were collected by using two approaches i.e. grab sampling and auto sampler.

2.4.1.1 Grab sampling

Grab sampler was used for weekly manual sampling in order to collect samples from inlet during storm events as there was no auto sampler installed at inlet. From Inlet Pond and Outlet Pond as well as from the whole system (Pond 2, Pond 3, Pond 5) as marked in Figure 2. 4. 50 Samples from the whole wetland system were collected fortnightly for 4 months consecutive starting from May 8, 2018 to Aug 31, 2018. Manually collected samples for storm events were collected over 3 days after rain events as recorded by Bureau of Meteorology (BOM) at

Adelaide airport weather station. Grab sampling used sterilised glass bottles to collect weekly samples. 5 litre containers were used for samples for physical and chemical parameters analysis. Sterile, plastic containers were used separately for microbiological parameters analysis. The samples collected through auto sampler were acid stabilised therefore separate samples from inlet and outlet were collected through grab sampler for microbiological analysis in sampling campaigns during storm events.

2.4.1.2 Automatic sampling

To collect samples for chemical analysis, a programmed auto sampler (Teledyne ISCO Lincoln, NE) was installed in the outlet sump to collect 3 composite water samples each day at 8 hourly intervals starting at 10:15 am, from Oakland's Park Wetland for 22 days consecutive as shown in Figure 2.4.

Figure 2. 5 Auto Sampler installed in Outlet pit of Oaklands Park wetland to collect composite samples to capture storm events from July 20 2018 to Sep 3, 2018

The first cycle of the sampling campaign was comprised of 22 days and the second cycle of campaign collected 24 composite samples. The pH of each sample was adjusted to < pH 2 by (10mL of 1 M H_2SO_4 /600 mL of water sample) to biologically stabilise the samples. After retrieving the acid stabilised samples from the auto sampler, these were transported in sealed containers to Flinders University for analysis of the predetermined water quality parameters.

Though, the auto-samples stopped functioning automatically for the remaining 20 days of the second cycle. 3 storm events have been captured over this period. Samples for microbiological analysis have been collected through grab sampler from inlet and outlet for storm events as acid stabilised samples cannot be used for microbiological analysis.

2. 5 Analysis of water for Microbiological parameters

Samples collected for microbiological analysis were analysed within 24 hours of sample collection. *E.coli,* total coliforms (MPN/100 mL). *E.coli* removal rates were reported as $\log_{10}$ reduction values (LRV). The *E.coli* ($\log_{10}$ MPN /100 mL) concentration in the outlet water samples were subtracted from the respective *E.coli* ($\log_{10}$ MPN/100 mL) concentration in the inlet water samples.

2.5.1 *E.coli*

IDEXX Colilert Test Kit was used to enumerate *E.coli* in water samples as per the manufacturer's instructions (IDEXX Ltd). The samples collected from Pond 3 and Pond 4 were diluted by 10^{-1} (10 mL of sample in 90 mL of sterile distilled water). The single test for *E.coli* enumeration has been used due to limited amount of resources available.

2.5.2 F-RNA bacteriophage (MS2) Quantification by double Agar Layer method

F-RNA bacteriophage was enumerated using the modified double layer agar plaque assay method from Nobel et al. (2004) and Debartolomeis and Cabelli (1991). The results were expressed as plaque forming units per 100 (PFU/100 mL).

2.6 Analysis of physical water quality parameters

2.6.1 Turbidity

The method adopted to measure turbidity was 2130 B Nephelometric method as described by Greenberg et al., (1992). Turbidity was analysed using a HACH spectrophotometer (DR/2000) on the same day of sample collection and reported as Nephelometric turbidity units (NTU).

2.6.2 Conductivity

Conductivity (µs/cm) was measured using a JENWAY 470 271 conductivity meter

2.6.3 pH and Temperature

pH and temperature of samples were recorded using a EUTECH pH 700.

2.6.4 Total Suspended Solids

Total suspended solids (mg/L) for all samples were determined using Test 2540 D (Total Suspended Solids Dried at 103-105°C; Greenberg et al., 1992). 250 mL of water sample was filtered through pre-dried (105°C 24h) and weighed GF/C filter pads. The pads were dried (105 °C 24h)), re-weighed and the suspended solids calculated by difference (Equation 1). The filtrate was retained for subsequent analysis of NH_4-N, NO_3-N, NO_2-N and (soluble) PO_4-P analysis.

$$\text{Suspended Solids (mg/L)} = \frac{(\text{wt. of filter and residue (g) - wt. of filter (g)}) \times 1000}{\text{sample vol (ml)}} \quad \text{Eq.1}$$

2.7 Analysis of chemical water quality parameters

2.7.1 Biological oxygen demand

The analysis was performed within 24 h of sample collection using method number 5210 B 5-Day BOD test Greenberg et al. (1992) using the OxiTop® (OxiTop® OC100) according to the manufacturer's instructions.

2.7.2 Total organic carbon and total nitrogen

The total organic carbon (mg C/L), and total nitrogen (mgN/L) content of raw water and filtered stormwater samples (GF/C, 1.6 µm; Whatman Ltd) was determined using Shimadzu TOC-LSCH analyser.

2.7.3 Ammonium (NH_4-N), nitrite (NO_2-N), nitrate (NO_3-N) and orthophosphate (PO_4-P)

The analysis of ammonium (mg NH_4-N mg/L), nitrite/nitrate (mg NOx-N mg/L) and orthophosphate (mgPO_4-P mg/L) was performed using a Foss Fiastar 5000 Analysis System (Foss Pacific Pty Ltd, North Ryde, NSW) in triplicate, using filtered (GF/C, 1.6 µm; Whatman Ltd) water samples.

2.7.4 Nitrate (NO_3-N)

Initially for NO_3-N analysis, the Automated Cadmium Reduction Method described in Test 4500-NO_3 F was used (Greenberg et al., 1992). However, due to limited ranges i.e. from 0.5 to 10 mg/L of this procedure, NO_3-N was subsequently analysed using a HACH test kit (method 8192) using their respective procedure. One analysis has been performed for each sample while analysing through HACH test kit due to limited amount of reagents availability.

2.7.5 Nitrite (NO_2-N)

NO_2-N was initially analysed in water samples by using Foss Fiastar 5000 Analysis System (Foss Pacific Pty Ltd, North Ryde, NSW). Subsequently, the 4500-NO2-B Colorimetric method (HACH) was used for the analysis. One analysis has been performed for each sample while analysing through HACH test kit due to limited amount of reagents availability.

2.7.6 Ammonium NH_4-N

For ammonium analysis, Automated Phenate Method described in Test 4500-NH3 H was used (Greenberg et al., 1992). Subsequently, an alternate method 8155 (HACH) was also used to detect ammonia in water samples. One analysis has been performed for each sample while analysing through HACH test kit due to limited amount of reagents availability.

2.7.7 Phosphates (PO_4-P)

The Stannous Chloride Method described in Test 4500-P D has been used for orthophosphate analysis. The alternate method used to detect phosphates was 4500-P E Ascorbic Acid method (HACH) as described in 'Standard Methods for the Examination of Water and Wastewater' by Greenberg et al. (1992). HACH spectrophotometer method 8048 was used which has the detection limit of 0 to 2.60 mg/L PO_4^{3-}. One analysis has been performed for each sample while analysing through HACH test kit due to limited amount of reagents availability.

3. Results

3.1 Analysis of Climatic conditions from Bureau of Meteorology

Daily rainfall, minimum and maximum air temperature, and daily global solar exposure were obtained for the study period from May to August 2018. The daily global solar exposure (Fig. 3.1) was maximum in August. The maximum rainfall (21 mm) was also recorded in August (Fig.3.2), however, the rainfall this winter in the study area (monitored through weather station of Adelaide airport) was below average. The maximum day time temperature recorded was in May and August where maximum day time temperature was more than 25 °C as shown in Fig 3.3. The minimum temperature was recorded in July (Fig.3.3).

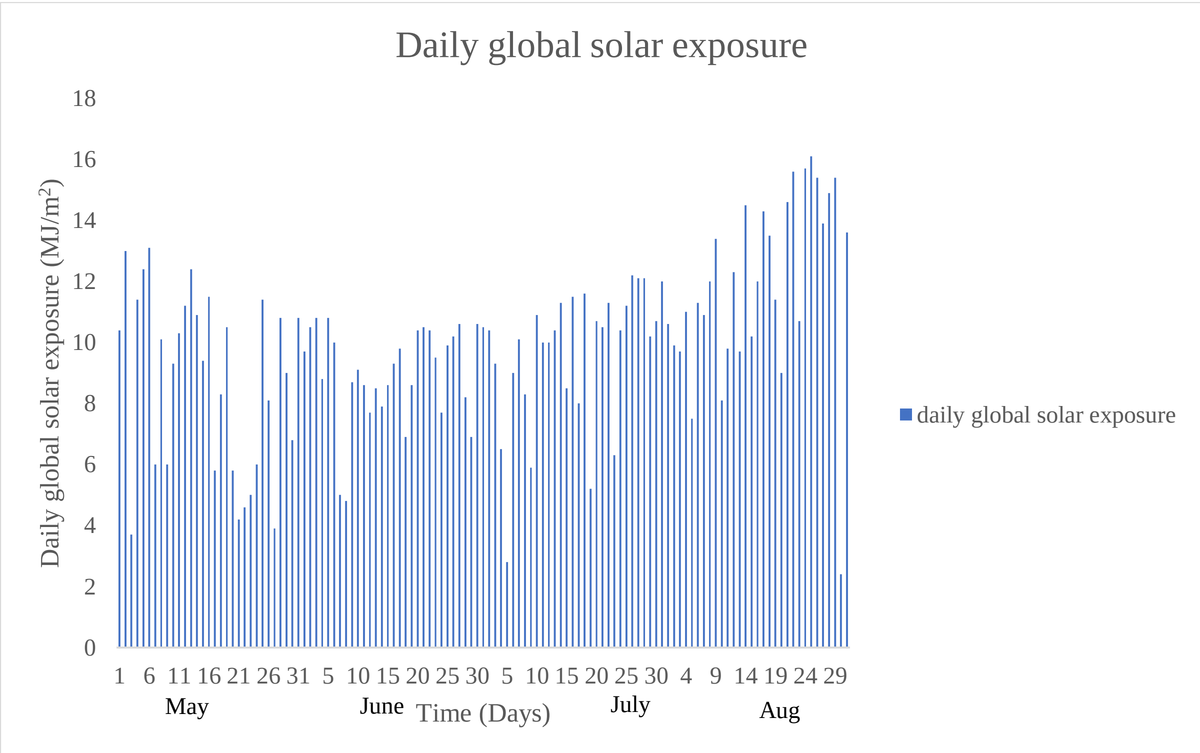

Figure 3. 1 Daily global solar exposure data (MJ/m^2), derived from weather Station of Adelaide Airport (source: Bureau of Meteorology)

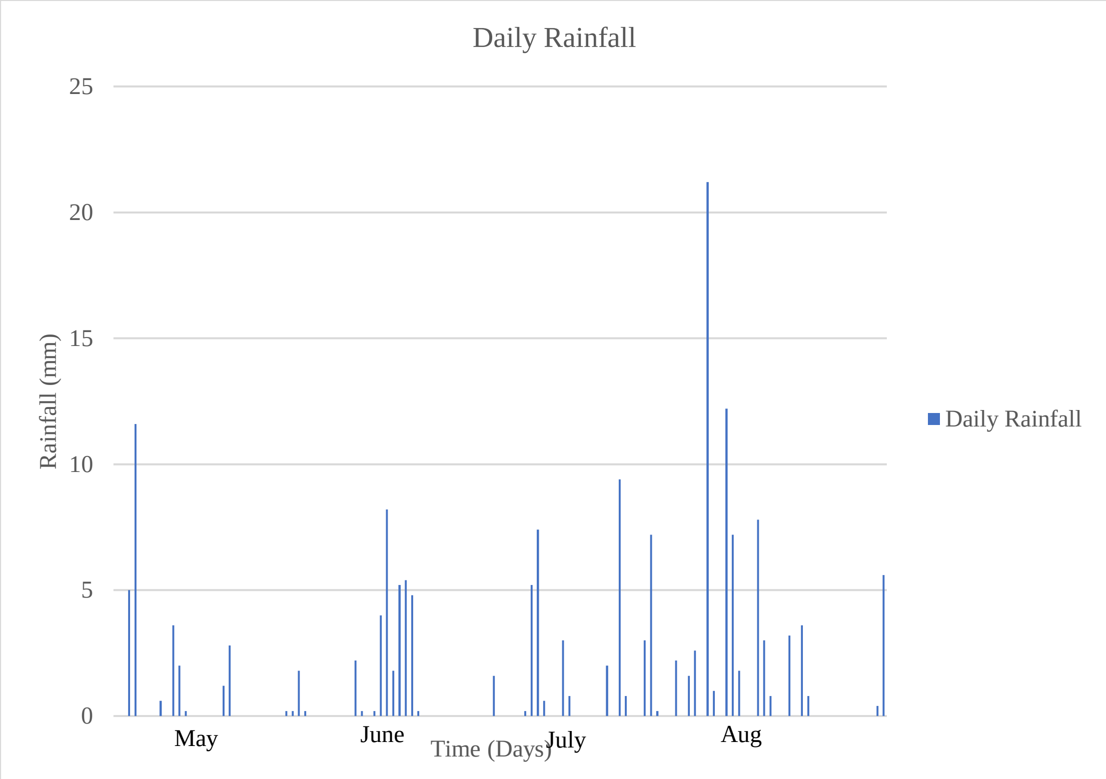

Figure 3. 2 Daily rainfall data, derived from weather Station of Adelaide Airport (source: Bureau of Meteorology)

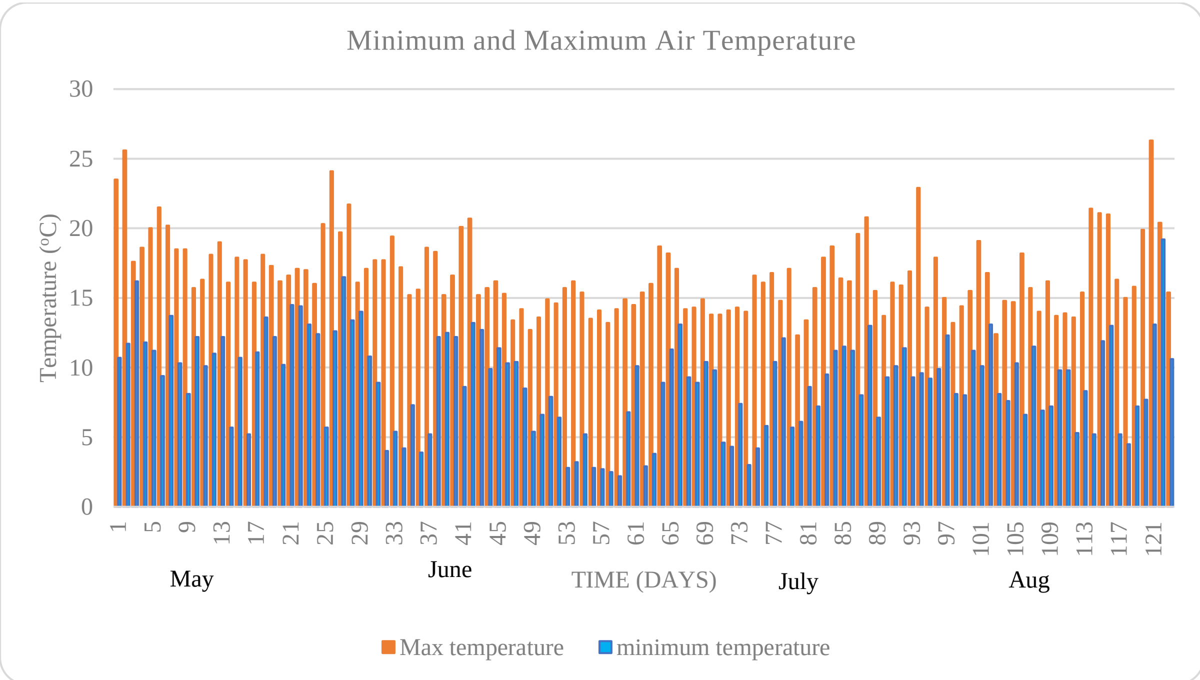

Figure 3. 3 Daily maximum and minimum air temperature recorded at weather station Adelaide Airport (source: Bureau of Meteorology)

3.2 Real time monitoring of water quality data

Water quality parameters conductivity, pH, turbidity and temperature were monitored online as described in detail Section 2.1.3. The conductivity (Fig.3.4) in the Sturt River before harvesting was high in May and decreased in the following months. Data from the probe installed in the outlet sump, which monitors the water quality before injection into the wells, indicates that water was injected into the aquifer in July and August. The zero or negative values indicate that the outlet sump was dry during those periods.

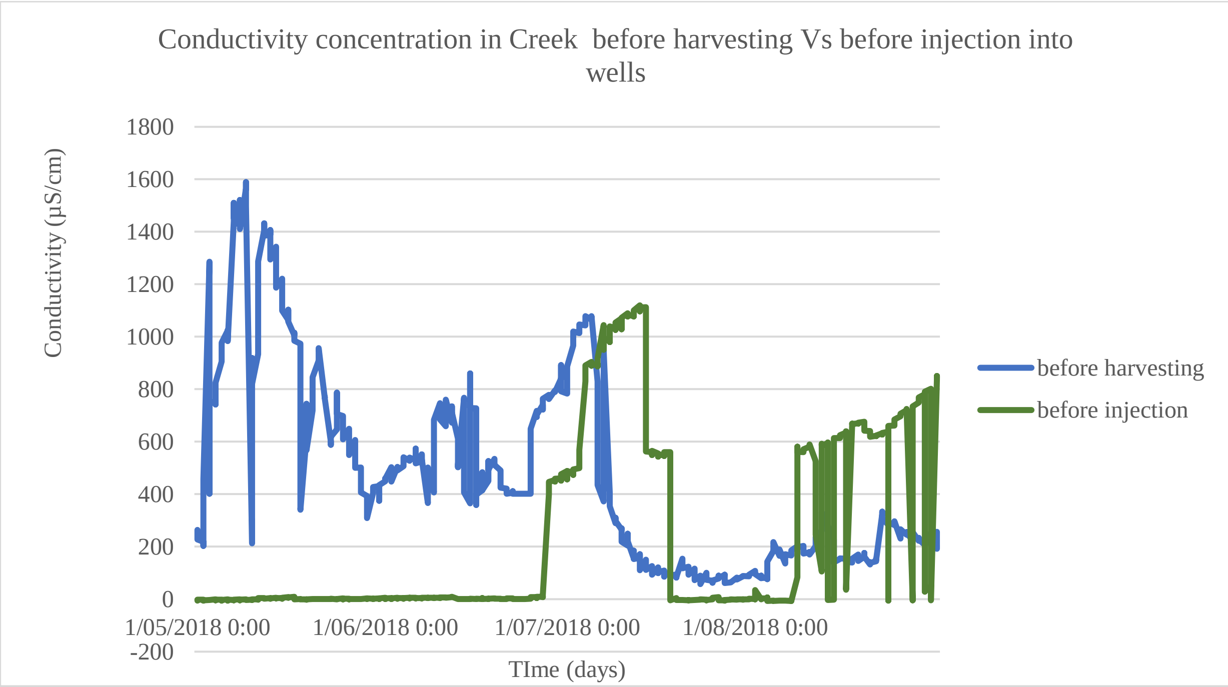

Figure 3. 4 Conductivity recorded in Sturt River before harvesting water and in the outlet sump after passage through the wetland

The conductivity (Fig. 3.5), increased as the water moved from Pond 2 to Pond 5. The probe in Pond 2 was not functional until mid of July.

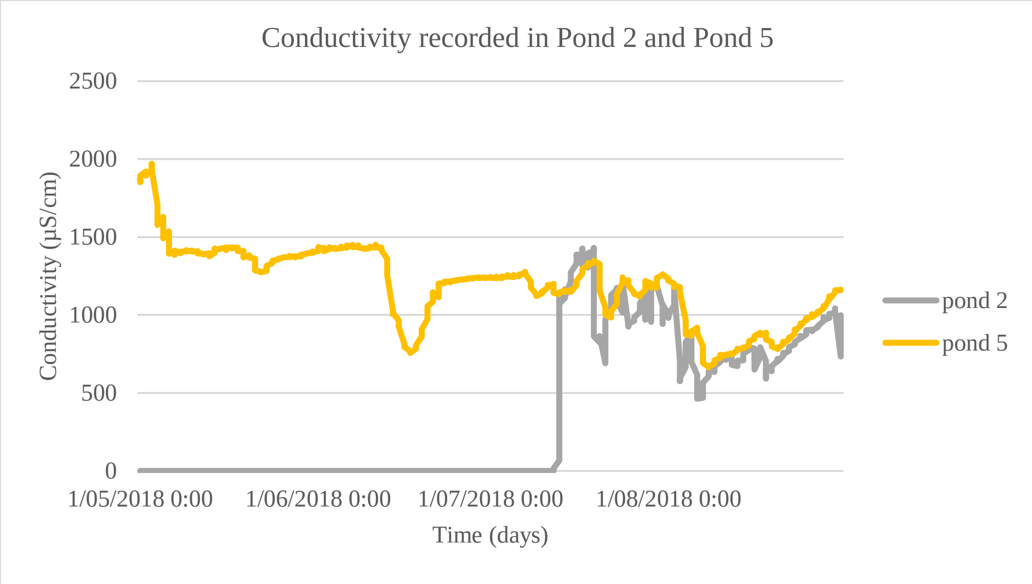

Figure 3. 5 Conductivity recorded by probes installed in Pond 2 and Pond 5 of the wetland by Flinders University

Figure 3.6 and 3.7 shows turbidity and pH respectively in three sites of the wetland system Pond 2, Pond 5 and outlet sump (before injection monitoring). The results clearly indicate that turbidity and pH decreased as water flows from Pond 2 to outlet sump.

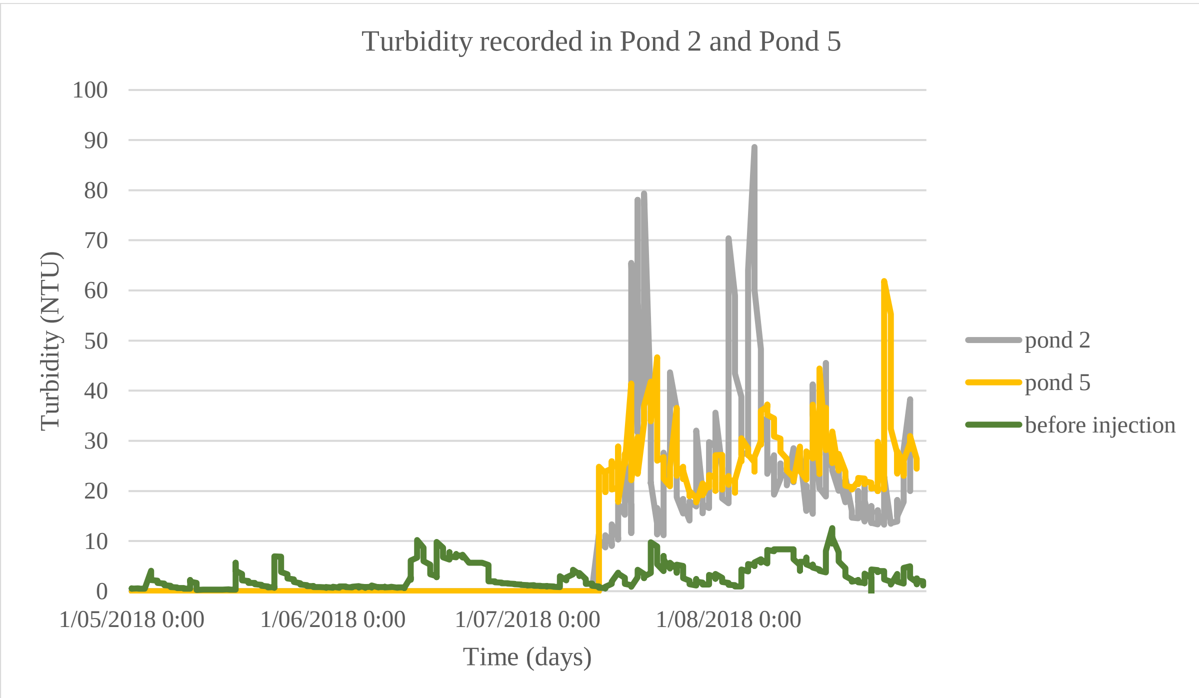

Figure 3. 6 Online monitoring data for turbidity monitored through probes installed in Pond 2, Pond 5 and in the outlet sump (to monitor water quality before injection into the well) of the wetland

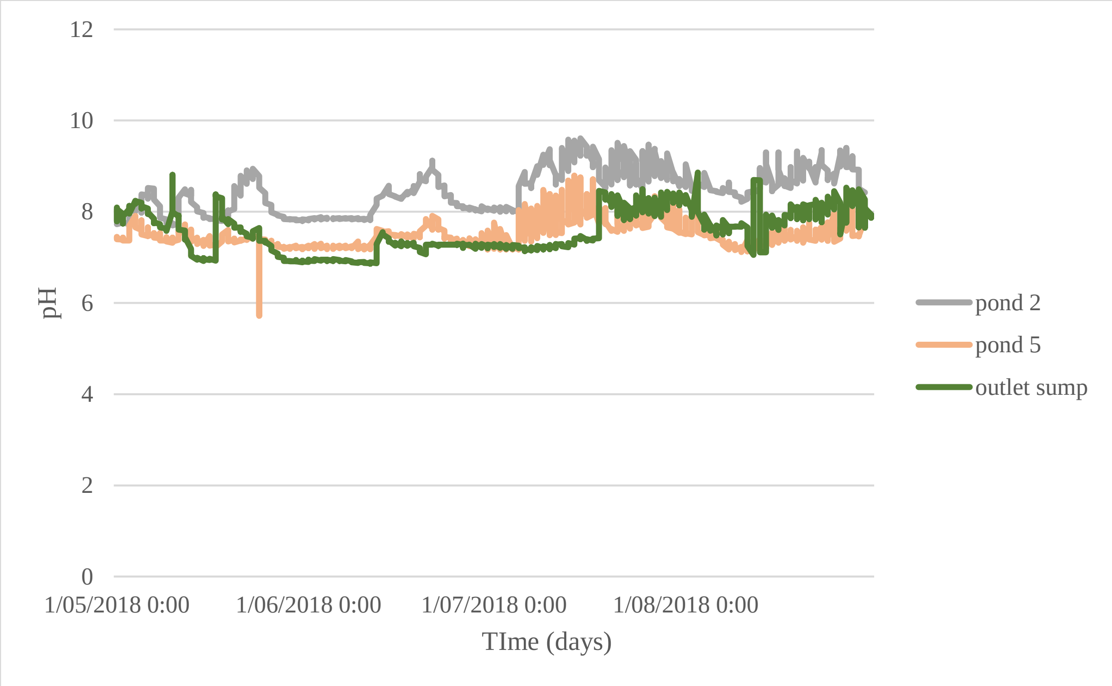

Figure 3. 7 Online monitoring data of pH monitored through probes installed in Pond 2, Pond 5 and probe installed in outlet sump (to monitor water quality before injection into the well) of the wetland

There was little difference in water temperature between ponds, which showed diurnal and daily variations (Fig.3.8) The rates of key biological processes are modified by the water temperatures (Kadlec, R 2009).

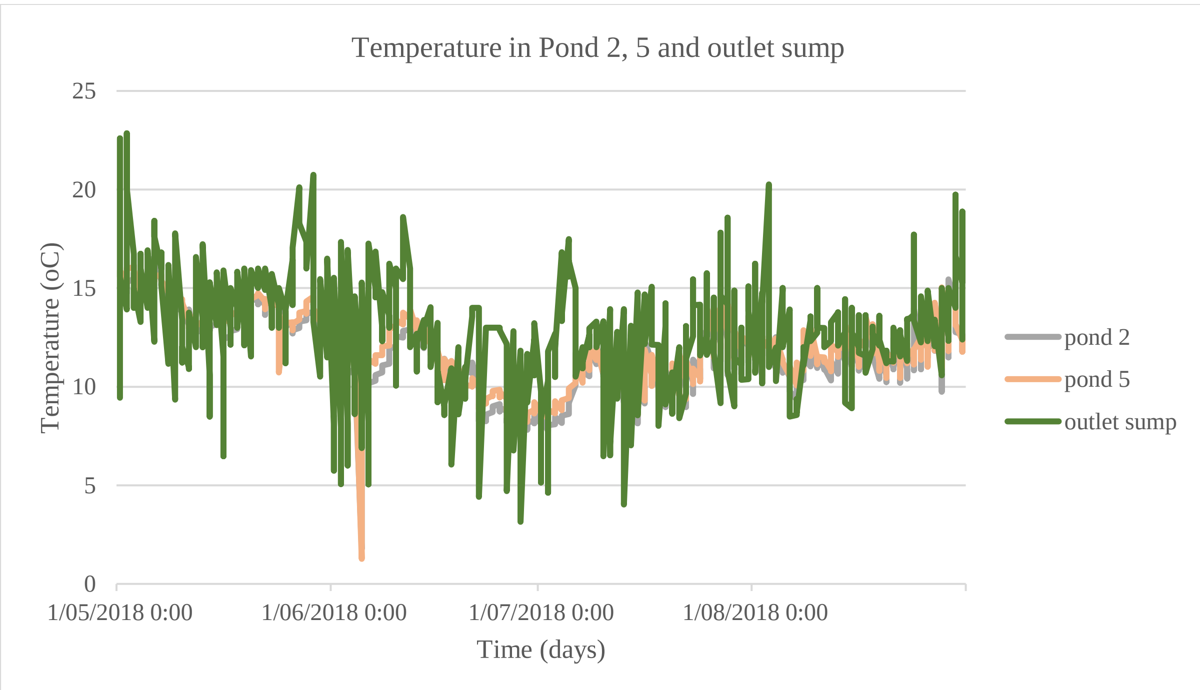

Figure 3. 8 Online monitoring data of temperature monitored through probes installed in Pond 2, Pond 5 and probe installed in outlet sump (to monitor water quality before injection into the well) of the wetland

3.3 Wetland Performance

The performance of the wetland was assessed by comparing the quality of; 1) the inlet and outlet water; 2) the water throughout the wetlands and 3) the water during storm events.

3.3.1 Comparison of inlet and outlet water quality

3.3.1.1 *E.coli*

The results for *E.coli* in Inlet pond and the outlet pond before the outlet are shown in Figure 3.9. The number of *E.coli* increased slightly from inlet to outlet. The number of *E.coli* significantly increased in both inlet and outlet during the first storm event in June recorded during the study period.

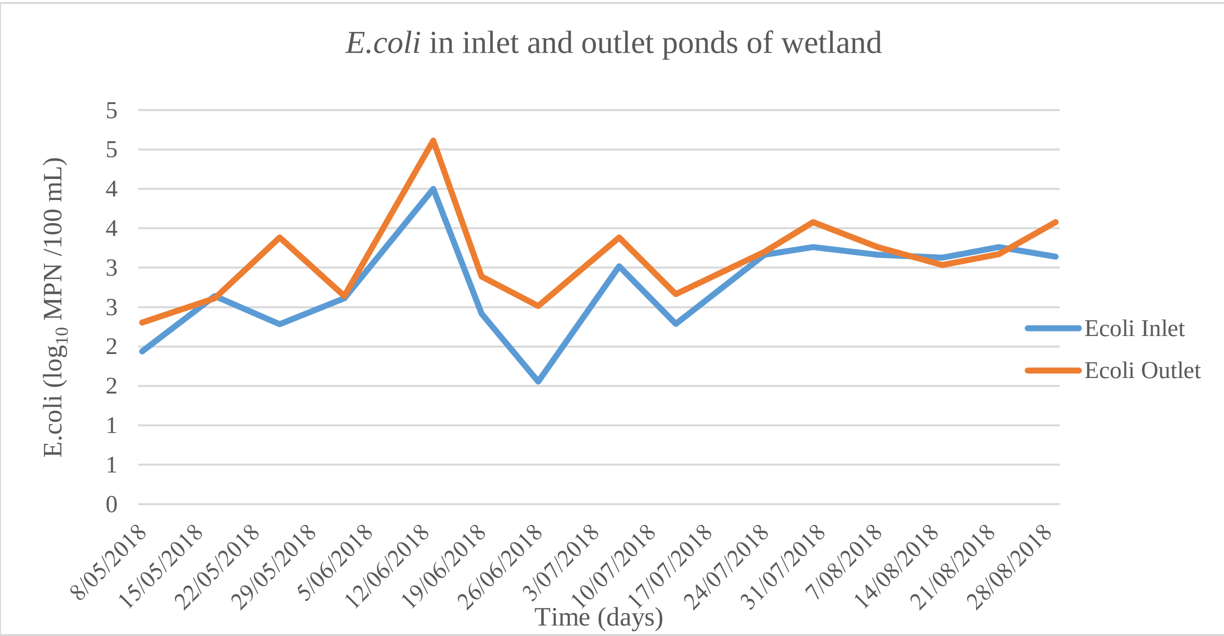

Figure 3. 9 *E.coli* (log_{10} MPN/100 ml) enumeration in samples collected weekly from inlet and outlet Ponds of the wetland system

3.3.1.2 F-RNA coliphage

F-RNA bacteriophage enumerated using the modified double layer agar plaque assay method from (Noble, Lee & Schiff 2004) and (Debartolomeis & Cabelli 1991) was below the detection level (xx PFU/100mL) as shown in Appendix 7.1.

3.3.1.3 Biological oxygen demand (BOD_5)

Figure 3.10 shows that although generally low in the inlet, peaks in biological oxygen demand (BOD_5) associated with storm events were reduced at the outlet following passage through the wetland system.

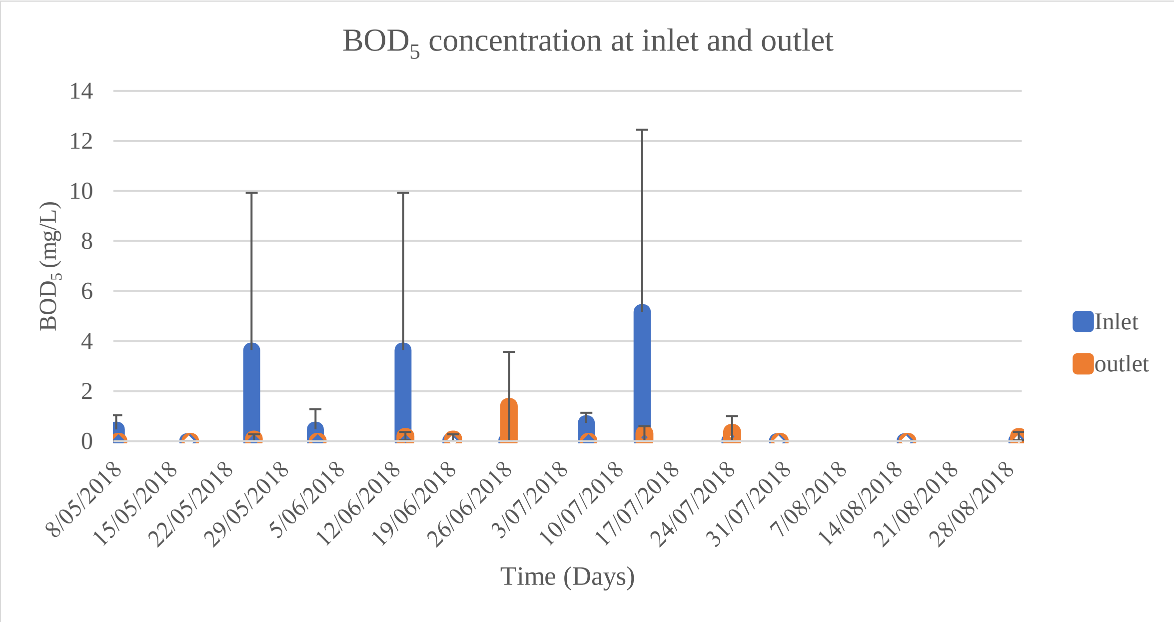

Figure 3. 10 BOD_5 (mg/L) in samples collected weekly from inlet Pond 1 and outlet Pond of the wetland system

3.3.4 Total Nitrogen removal

The concentrations of total nitrogen (TN) in the inlet Pond were generally low. Comparison of total nitrogen concentrations between inlet and outlet in some weeks showed little improvement following passage through the wetlands, and on occasion the TN concentration was higher at the outlet than the inlet (Fig. 3.11). The removal efficiency of TN from Inlet was 16.5 % in June and 42.2 % in July.

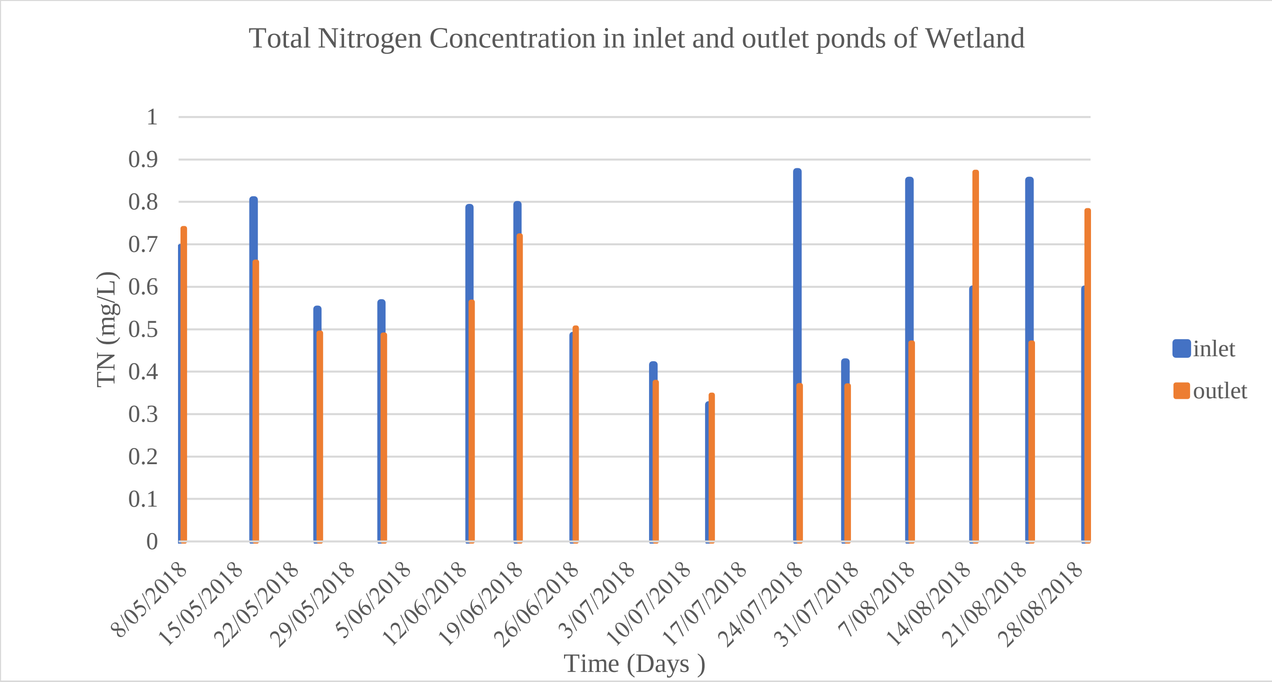

Figure 3. 11 Total nitrogen concentrations at inlet Pond and outlet Pond

3.3.1.5 Removal of Nitrite (NO_2-N), Nitrate (NO_3-N), Ammonium (NH_4-N) and Phosphorus (PO_4-P)

Nitrite, nitrate, ammonium and phosphorus analysis was conducted on water samples collected from the wetland system. The concentrations were below the limit of detection of the Foss FIA Star analyser (Appendix 7.1). Subsequently, water analysis was conducted using the HACH test kit system which detected lower ranges of these four parameters. The results have been compared with previous year's laboratory analysis of water samples collected before injection into the well provided by the Marion City Council (Appendix 7.5). The inlet water quality results for phosphorus have been compared with the historical water quality data of the Sturt River (Appendices 7.5), which confirmed the results of samples tested from the inlet Pond 1 that the level of concentration of phosphorus was low in Sturt River. The PO_4-P concentration was higher in the inlet in May and June and on one occasion in August, however, generally the concentration was higher at the in the outlet Pond 5 then the inlet Pond 1 (Figure 3.12).

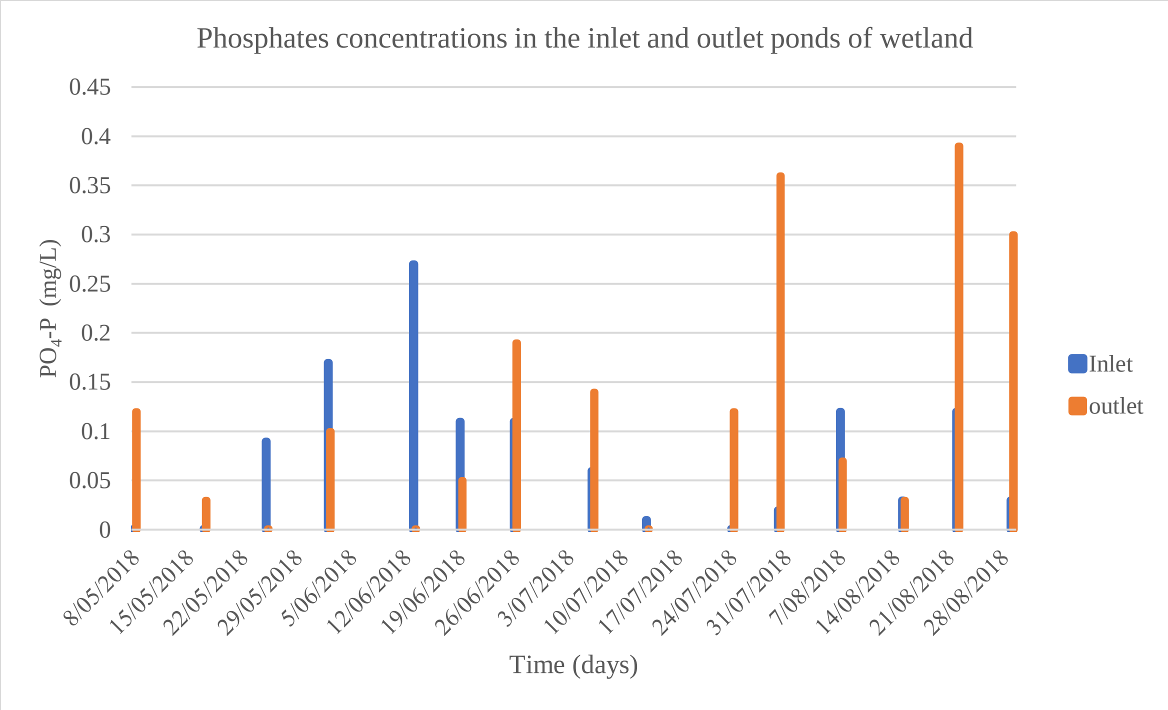

Figure 3. 12 Phosphorus concentrations (PO_4-P mg/L) in samples collected from inlet Pond 1 and outlet Pond of the wetland system

There was no consistent trend of reduction in NH_4-N concentration from inlet Pond 1 to outlet Pond (Figure 3.13; generally the outlet NH_4-N concentration was higher than those at the inlet Pond 1.

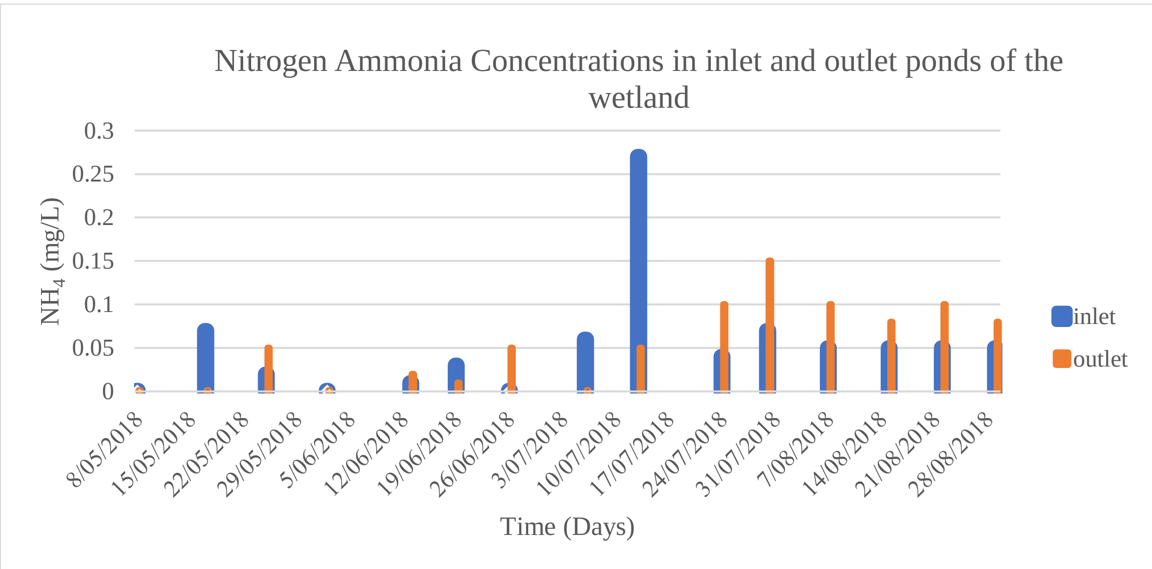

Figure 3. 13 NH_4-N (mg/L) concentration in samples collected from inlet Pond 1 and outlet Pond of the wetland system

The results of nitrite concentrations from inlet and outlet Ponds are shown in Figure 3.14. Although the nitrite concentration of influent is very low it increased slightly in the outlet Pond.

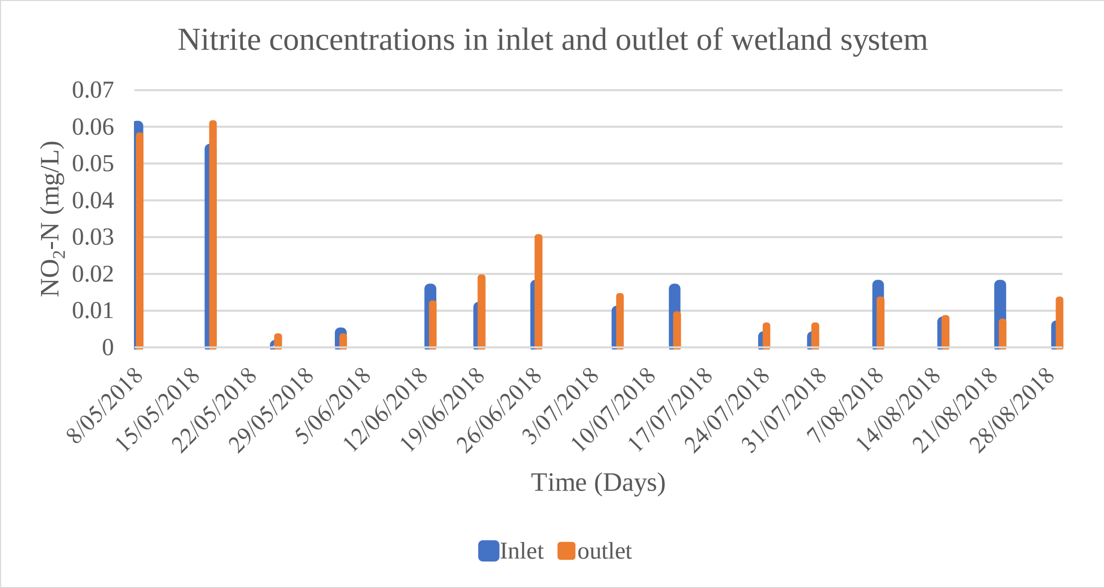

Figure 3. 14 Nitrite concentrations in samples collected from inlet Pond 1 and outlet Pond of the wetland system

Nitrate concentrations although very low were consistently higher in the inlet Pond 1 compared with the outlet Pond 5 (Figure 3.15) and were lowered by passage through the wetland to outlet Pond.

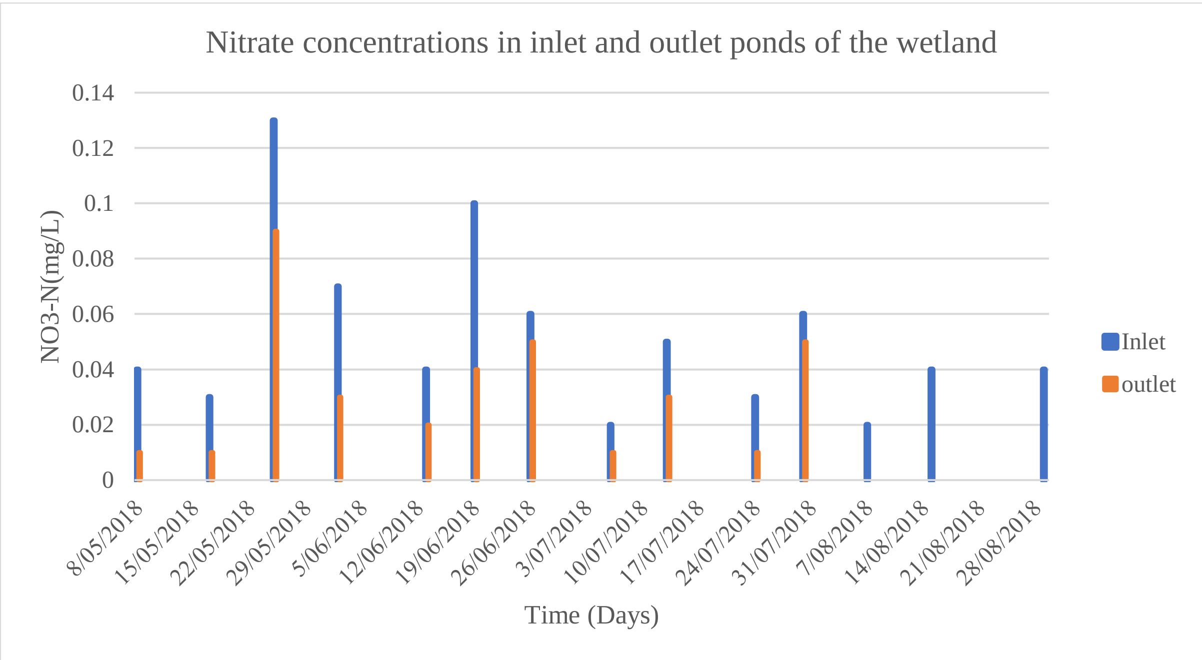

Figure 3. 15 Nitrate concentrations in samples collected from inlet Pond 1 and outlet Pond of the wetland system

3.3.1.6 Total organic carbon

The results of water samples analysed for total organic carbon shows that concentration of total organic were higher in the outlet pond compared to inlet Pond 1except few weeks of May and June as shown in Figure 3.16.

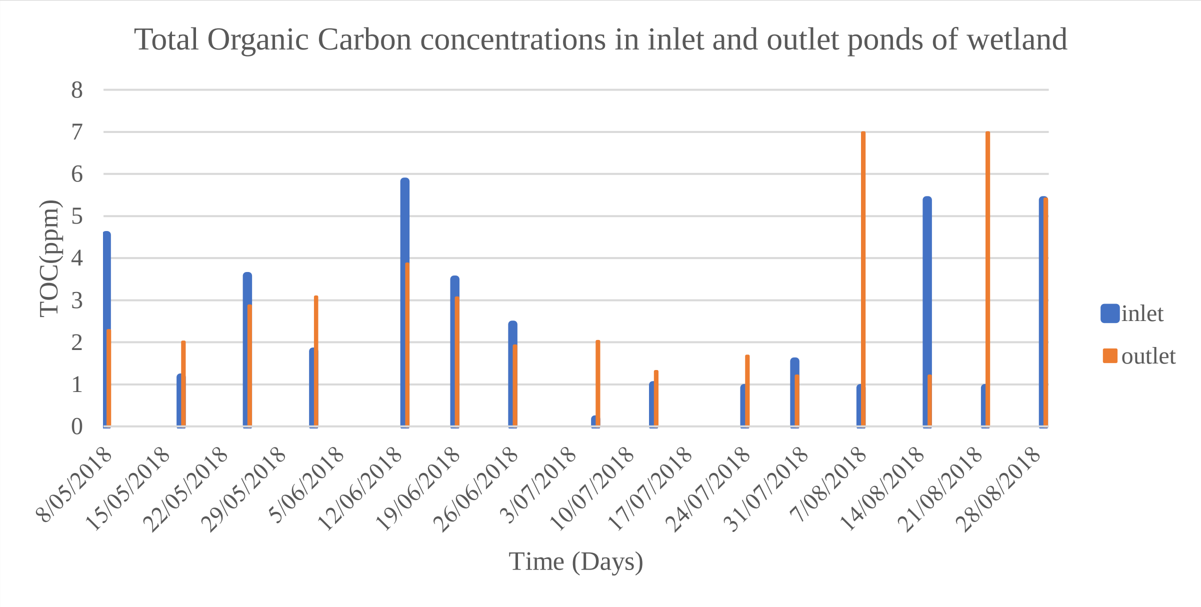

Figure 3. 16 TOC concentrations in samples collected from inlet Pond 1 and outlet Pond of the wetland system

3.3.1.7 Total Suspended solids

It has been observed that the concentration of total suspended solids was generally higher in outlet Pond than the inlet Pond 1 with few exceptions, Figure 3.17

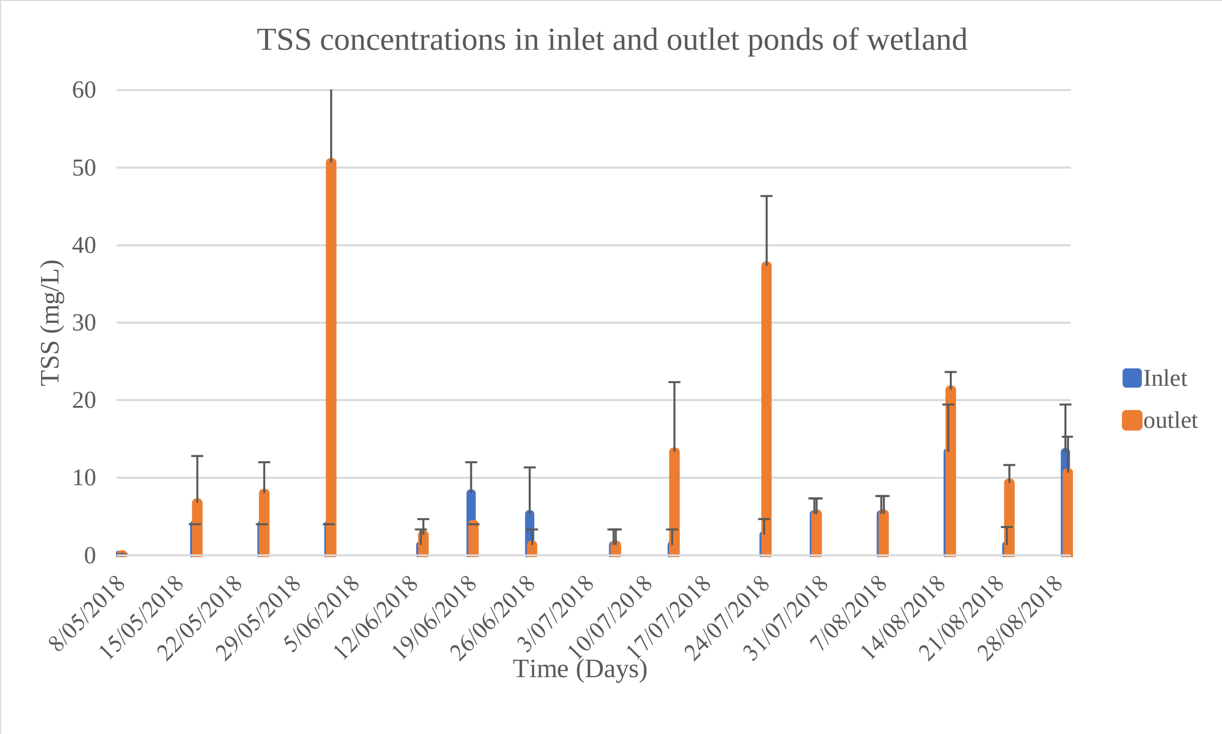

Figure 3. 17 Total suspended solids concentration in inlet Pond and outlet Pond

3.4 Wetlands System Performance Overview

The fortnightly samples collected from the whole system have been analysed to determine the relative performance of different Ponds within the wetlands.

3.4.1 *E.coli*

Samples were collected from Pond 2 and 3 and equal volumes of each mixed in the laboratory to make a composite sample. The numbers of *E.coli* are shown in Fig 3.18 (May), 3.19 (June), 3.20 (July) and 3.21 (August). Except for May the numbers of *E.coli* were higher in Ponds 2/3 than those in the inlet Pond 1. Generally, the number of *E.coli* decreased in Pond 5 before increasing at the outlet pond.

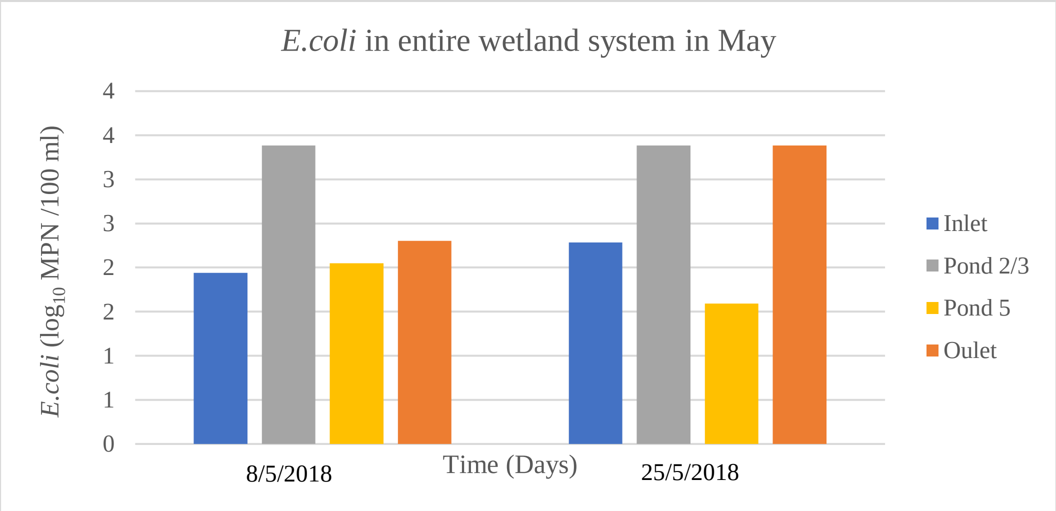

Figure 3. 18 Enumeration of *E.coli* in the samples collected from (inlet Pond, Ponds 2 and 3, Pond 5 and outlet Pond) entire wetlands system of Oakland's park wetland

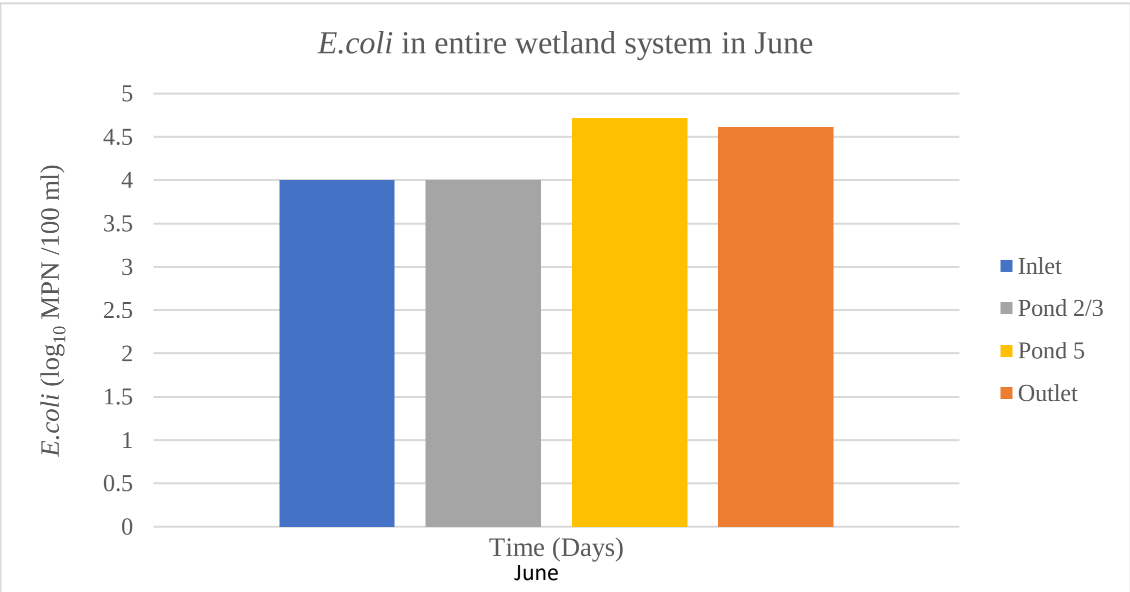

Figure 3. 19 Enumeration of *E.coli* in the samples collected from (inlet Pond, Ponds 2 and 3, Pond 5 and outlet Pond) entire wetlands system of Oakland's park wetland

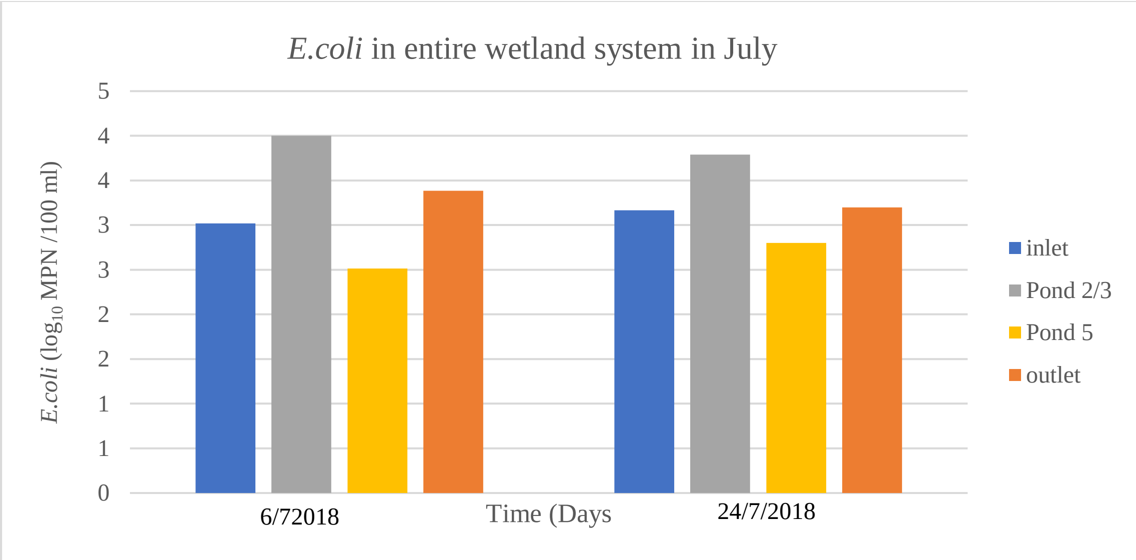

Figure 3. 20 Enumeration of *E.coli* in the samples collected from (inlet Pond, Ponds 2 and 3, Pond 5 and outlet Pond) entire wetlands system of Oakland's park wetland

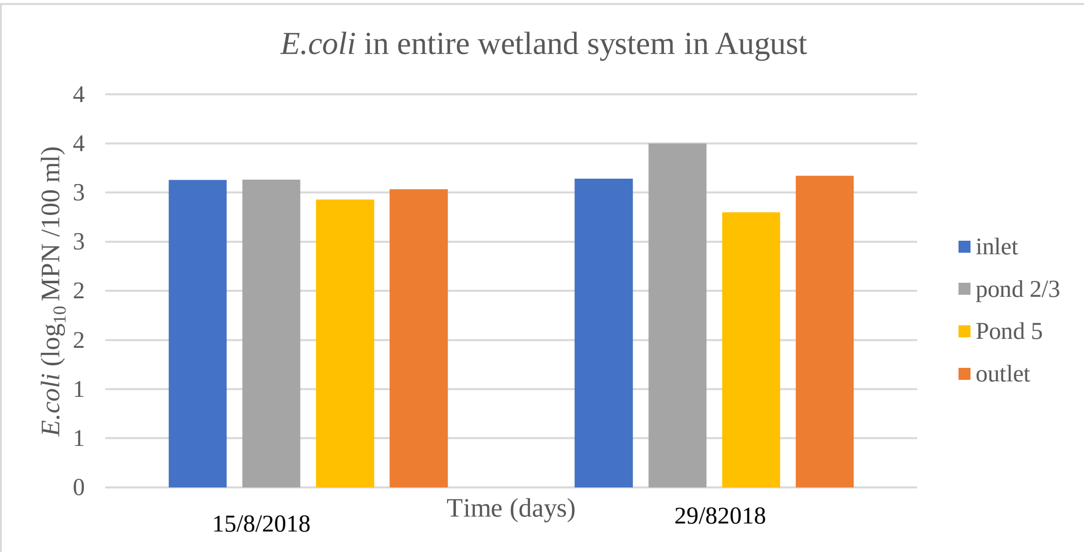

Figure 3. 21 Enumeration of *E.coli* in the samples collected from (inlet Pond, Ponds 2 and 3, Pond 5 and outlet Pond) entire wetlands system of Oakland's park wetland

3.4.2 Biological Oxygen demand (BOD_5)

The results of BOD_5 analysis shows that the concentration of BOD_5 were mostly below the detectable limit of Oxitop equipment. However, were BOD_5 was detected in the inlet it was generally removed following passage through Pond 2 & 3 (Figs 3.22 – 3.25). In July (Fig 3.24) and August (Fig. 3.25) the BOD_5 increased at the outlet.

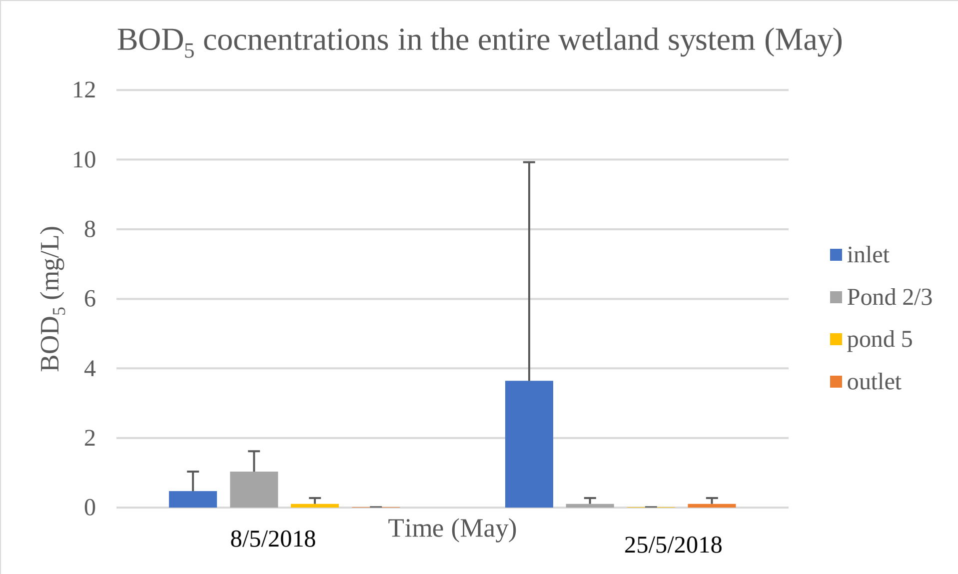

Figure 3. 22 Monthly analysis of BOD5 concentration of all Ponds in the wetland system

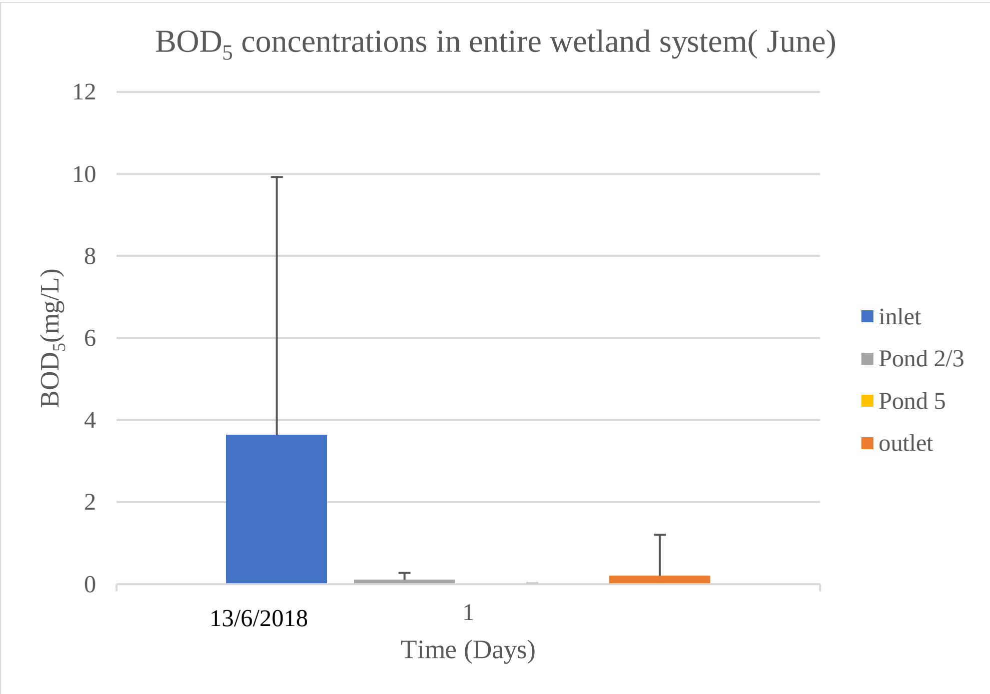

Figure 3. 23 Monthly analysis of BOD_5 concentration of all Ponds in the wetland system

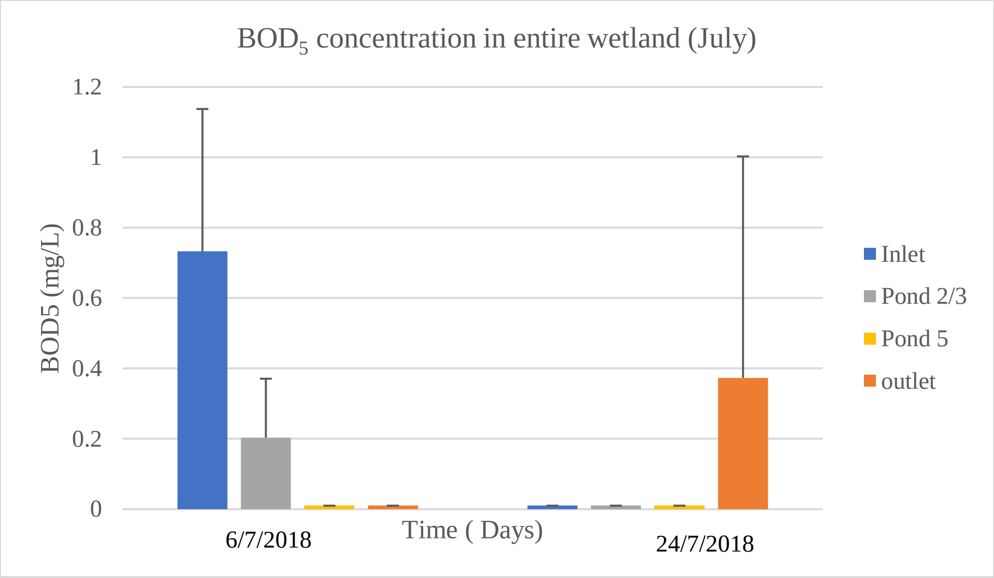

Figure 3. 24 Monthly analysis of BOD_5 concentration of all Ponds in the wetland system

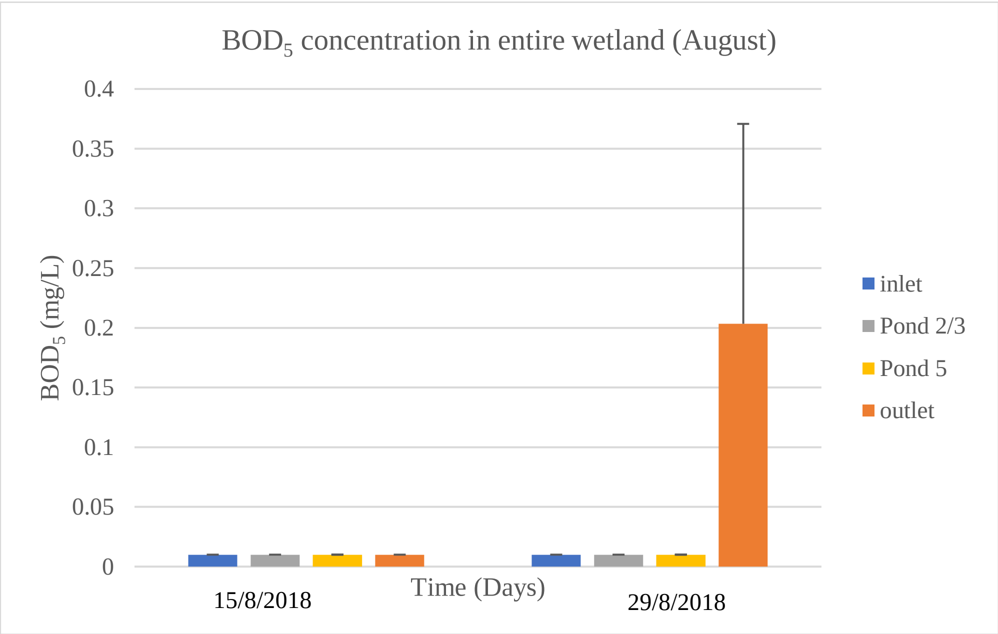

Figure 3. 25 Monthly analysis of BOD_5 concentration of all Ponds in the wetland system

3.4.3 Total Nitrogen removal

The variations in total nitrogen concentrations in all Ponds are shown in Figures 3.26 (May), 3.27 (June), 3.28(July) and 3.29 (August). There was no clear, consistent trend of total nitrogen removal following sequential passage through the wetland system. More frequently the TN concentration was higher in Ponds 2&3 than in the inlet.

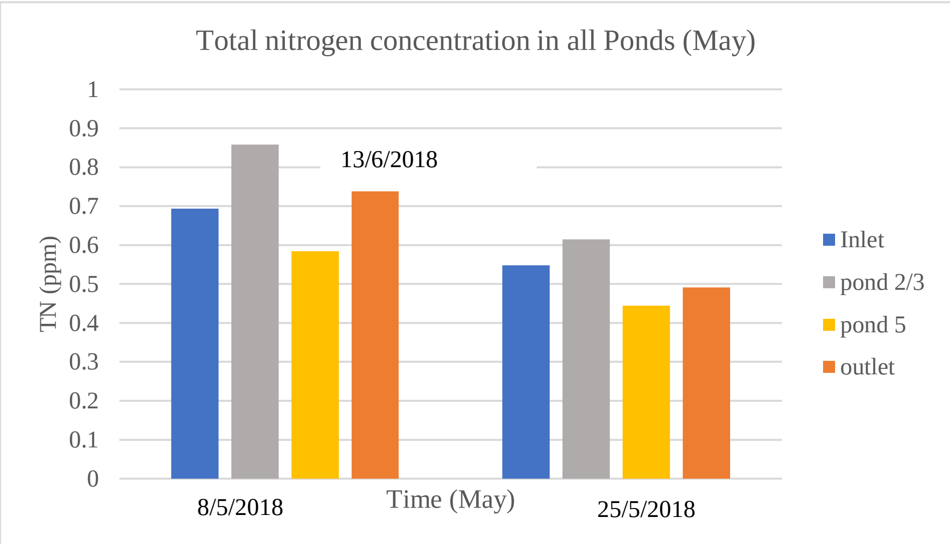

Figure 3. 26 TN concentration in all ponds of wetland system in month of May

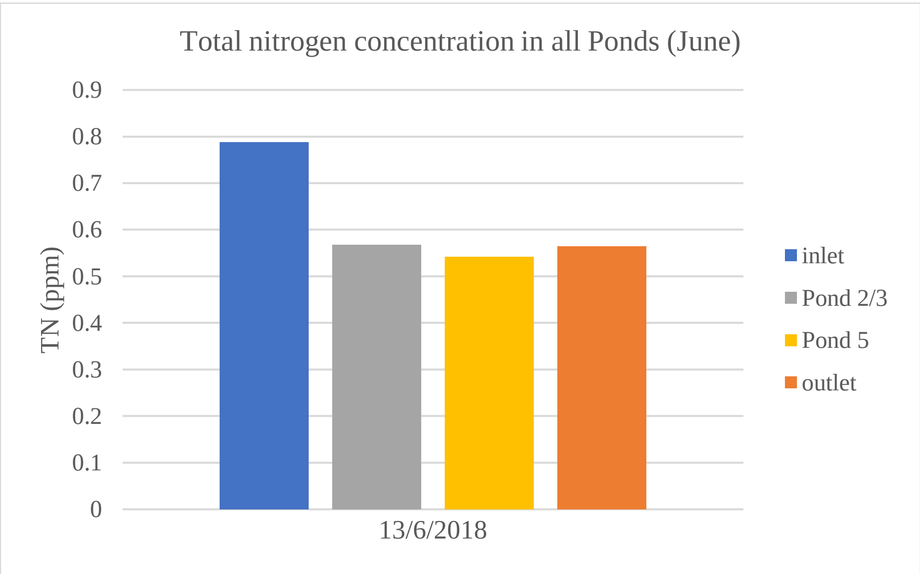

Figure 3. 27 TN concentration in all ponds of wetland system in month of June

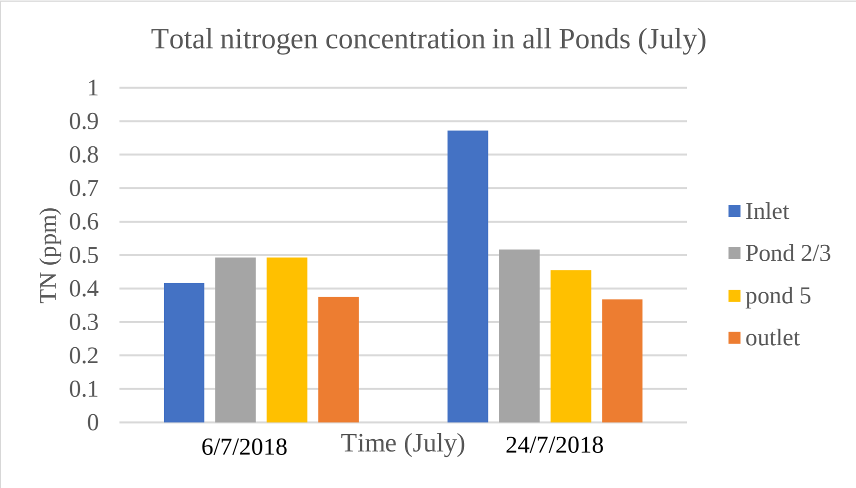

Figure 3. 28 TN concentration in all ponds of wetland system in month of July

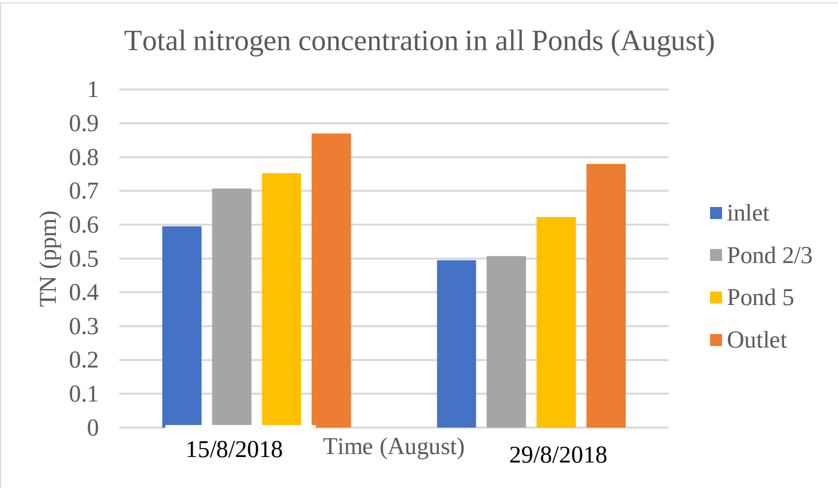

Figure 3. 29 TN concentration in all ponds of wetland system in month of August

3.4.4 Nitrite, Nitrate, Ammonia and Phosphorus

3.4.4.1 Phosphorus

Overall results of phosphorus analysis from the inlet Pond shows low phosphorus concentrations. The inlet concentrations were higher than Pond 2 & 3 concentrations in May (Fig 3.30) and June (Fig 3.31). In contrast in July (Fig 3.32) and August (Fig. 3.33) phosphorus concentrations were the lowest in the inlet samples and generally increased towards the outlet.

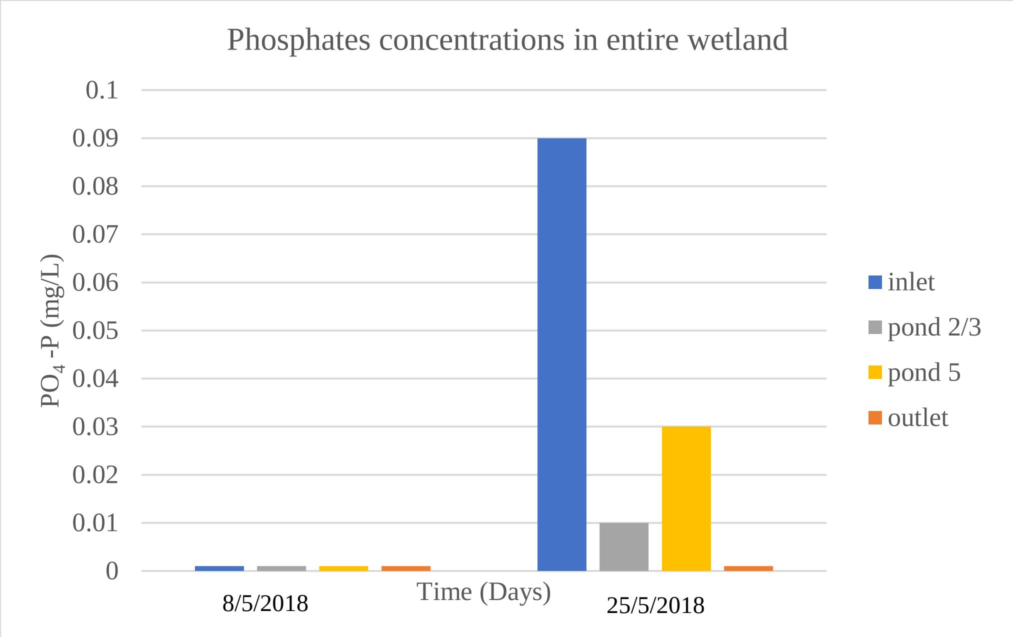

Figure 3. 30 Phosphorus (PO_4-P) concentration in the entire wetland system in month of May

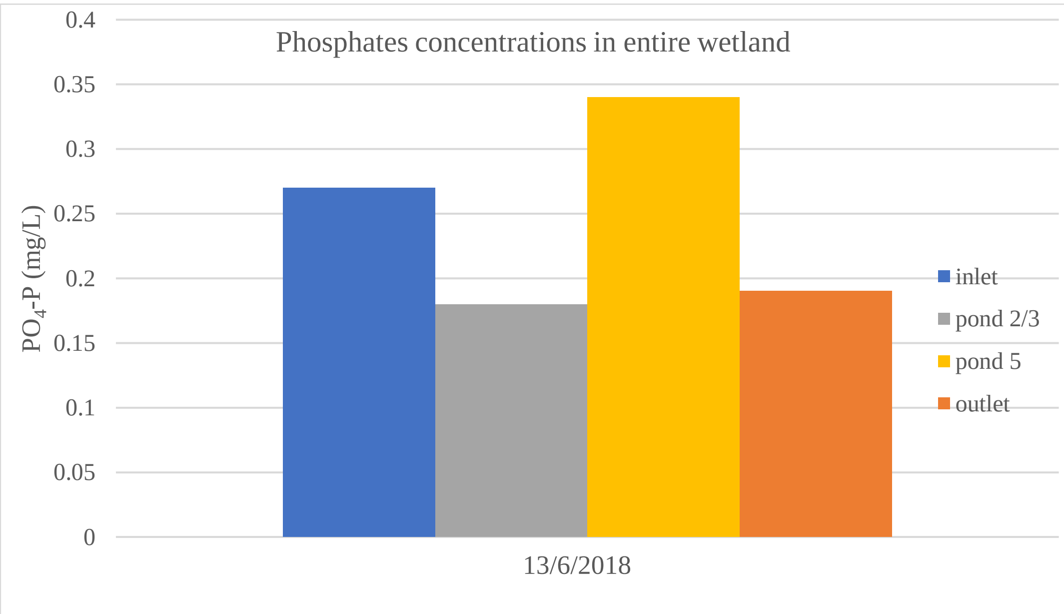

Figure 3. 31 Phosphorus (PO_4-P) concentration in the entire wetland system in month of June

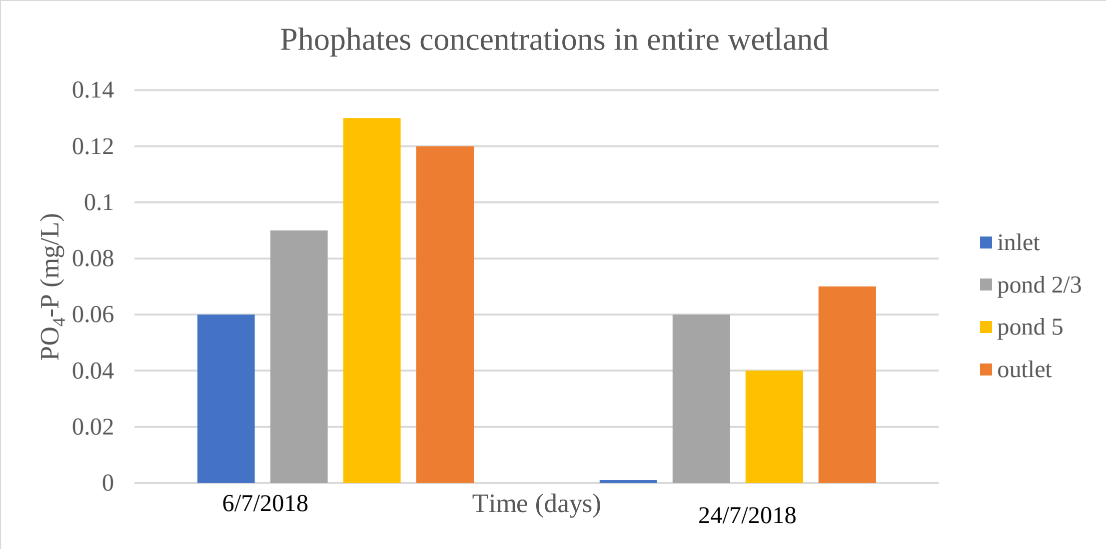

Figure 3. 32 Phosphorus (PO_4-P) concentration in the entire wetland system in month of July

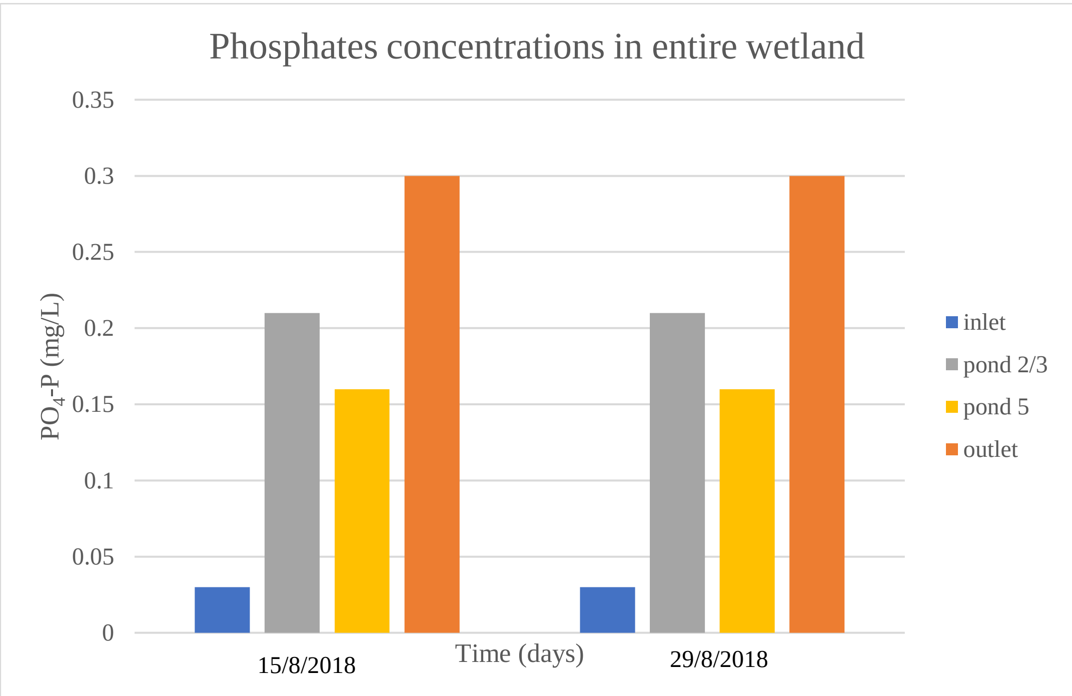

Figure 3. 33 Phosphorus (PO_4-P) concentration in the entire wetland system in month of August

3.4.4.2 Ammonia – nitrogen

In May (Fig 3.34) the concentration of NH_4-N was higher in Ponds 2 & 3 compared to the inlet and increased towards the outlet, whereas in June (Fig 3.35) the concentration was generally low except for a peak in Pond 5. In July (Fig 3.36) and August (Fig 3.37) the outlet had the highest NH_4-N concentration.

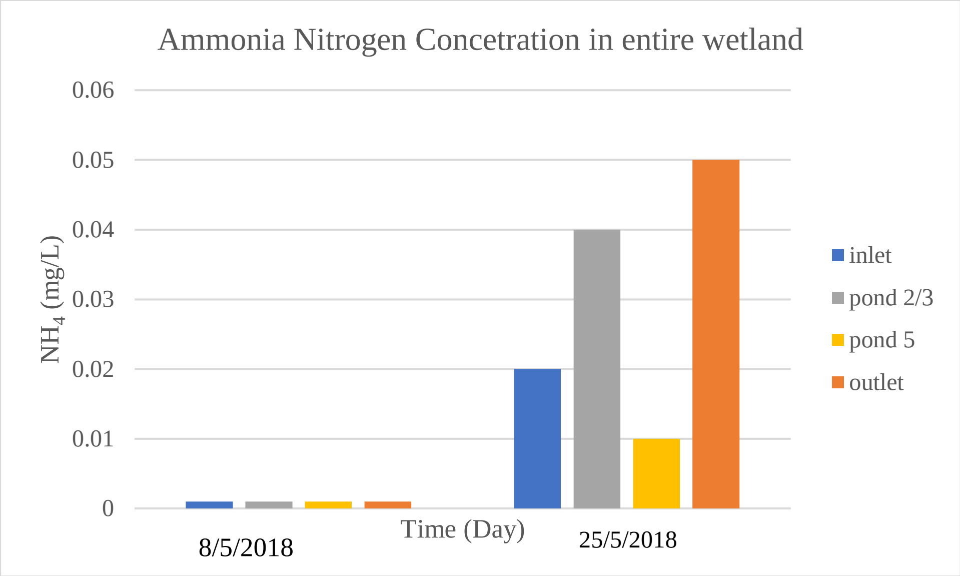

Figure 3. 34 Nitrogen Ammonia Concentration in samples collected from the entire wetland in month of May

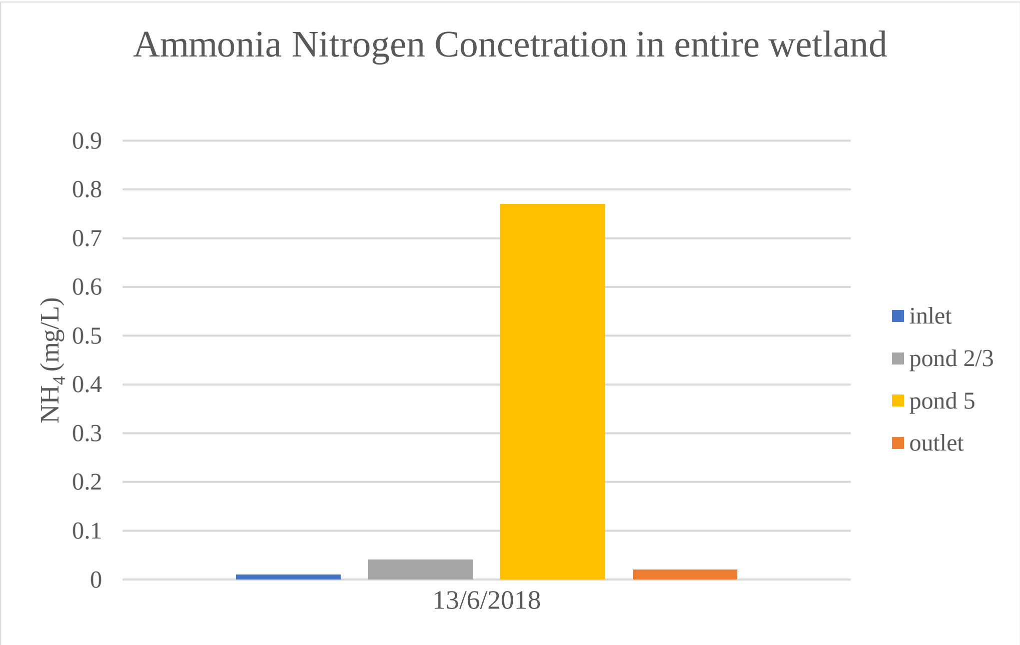

Figure 3. 35 Nitrogen Ammonia Concentration in samples collected from the entire wetland in month of June

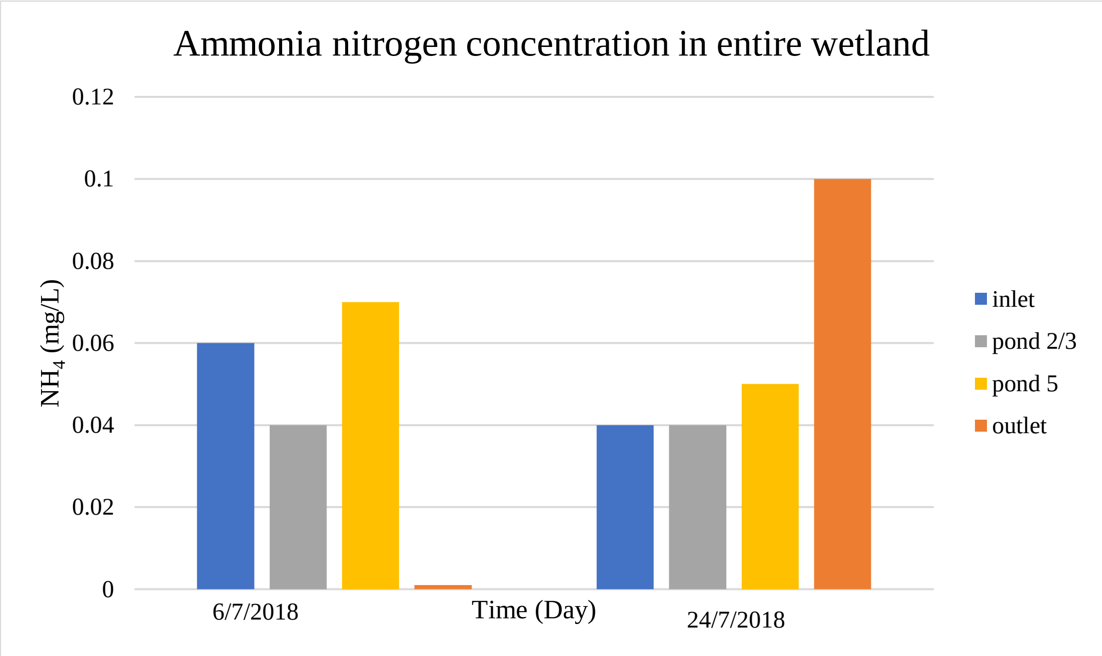

Figure 3. 36 Nitrogen Ammonia Concentration in samples collected from the entire wetland in month of July

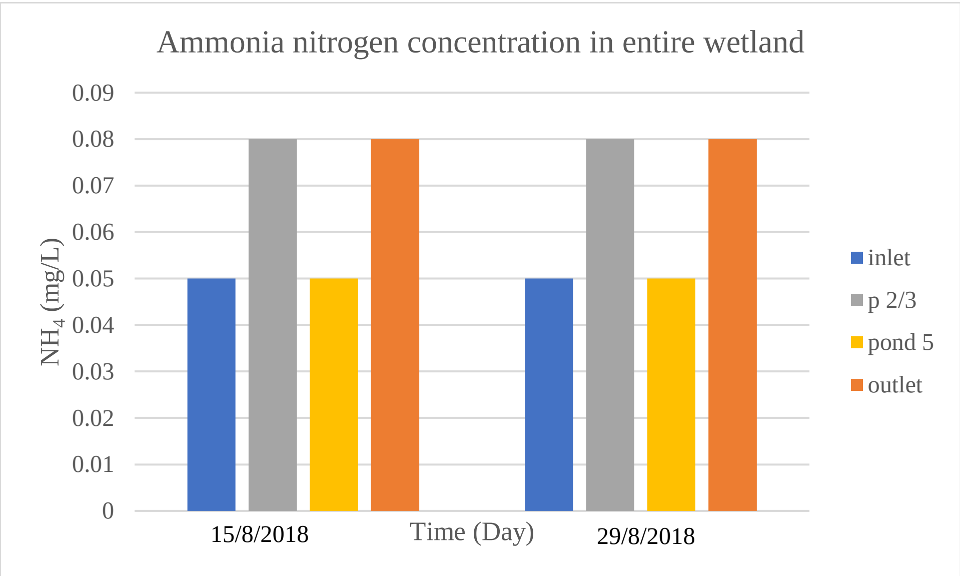

Figure 3. 37 Nitrogen Ammonia Concentration in samples collected from the entire wetland in month of August

2.4.4.3 Nitrite Analysis

The nitrite concentrations in the entire wetland system were (Figures 3.38, to 3.41) were extremely low, at or near the level of detection. The relative changes between ponds was considered inconsequential.

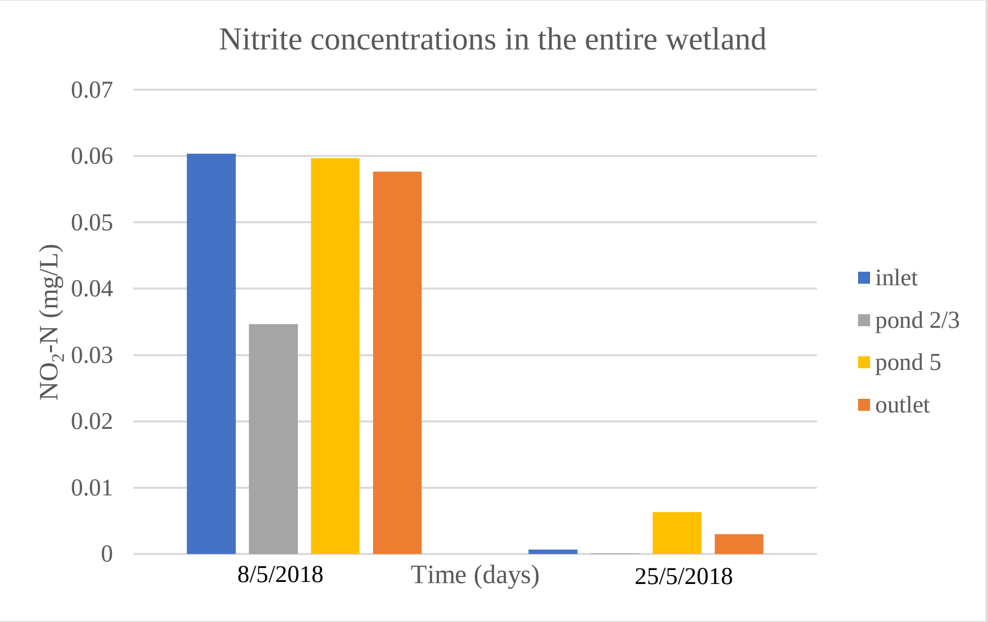

Figure 3. 38 Nitrite concentrations in samples collected from the entire wetland in May

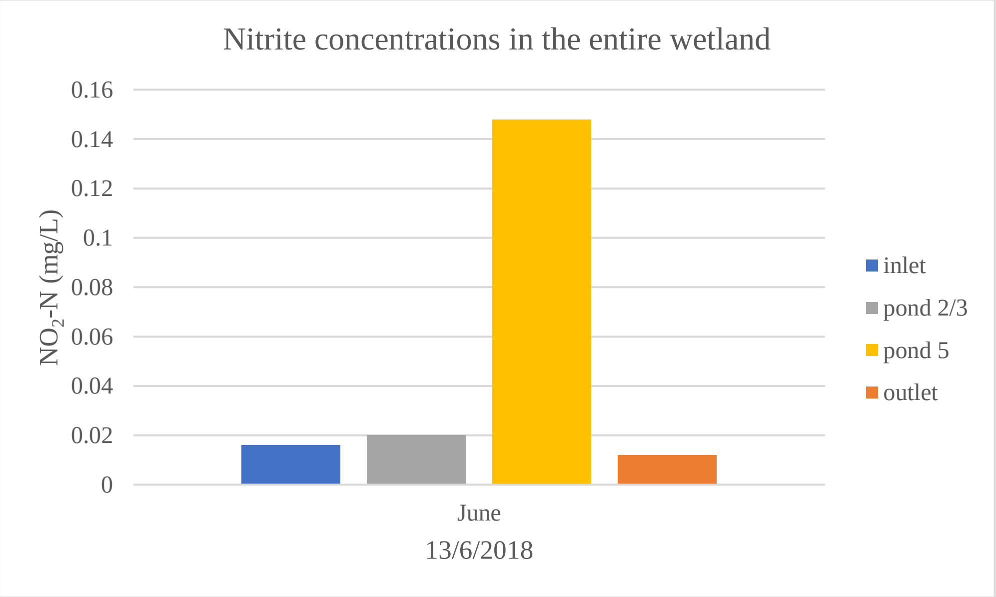

Figure 3. 39 Nitrite concentrations in samples collected from the entire wetland in June

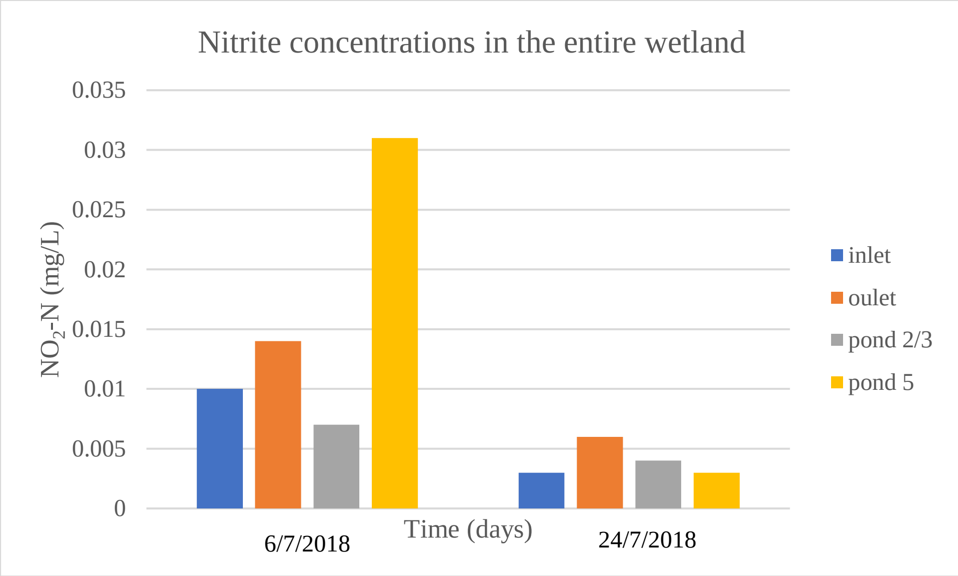

Figure 3. 40 Nitrite concentrations in samples collected from the entire wetland in July

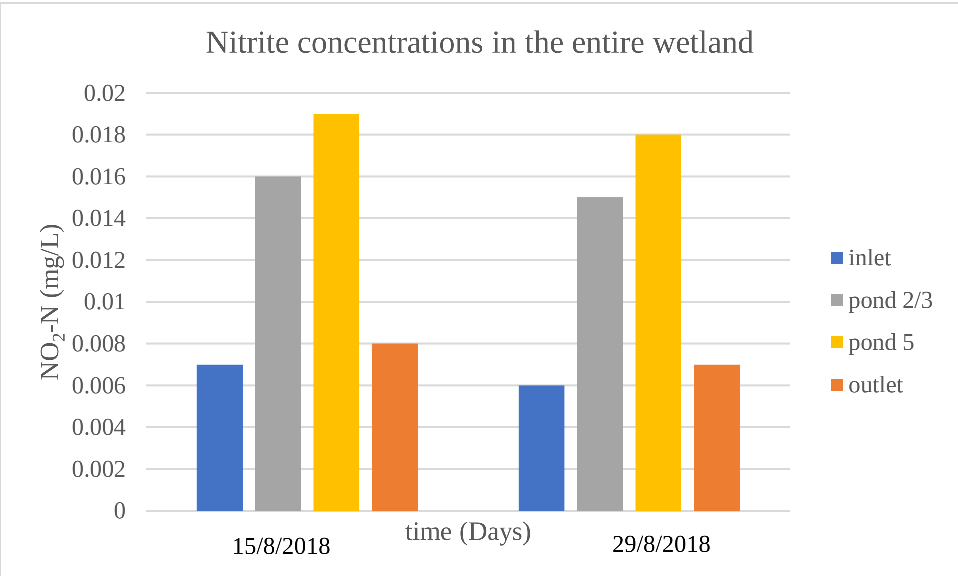

Figure 3. 41 Nitrite concentrations in samples collected from the entire wetland in August

3.4.4.4 Nitrate Analysis

The results in second week of May shows improvement in removing the nitrate concentrations as water flows from Inlet towards outlet Pond. The behaviour of Ponds 2, 3 and Ponds 5 were found different in different months during the study period as shown in Figures 3.42, 3.43, 3.44 and 3.45. The concentrations have been increased in Ponds 2, 3 and Pond 5.

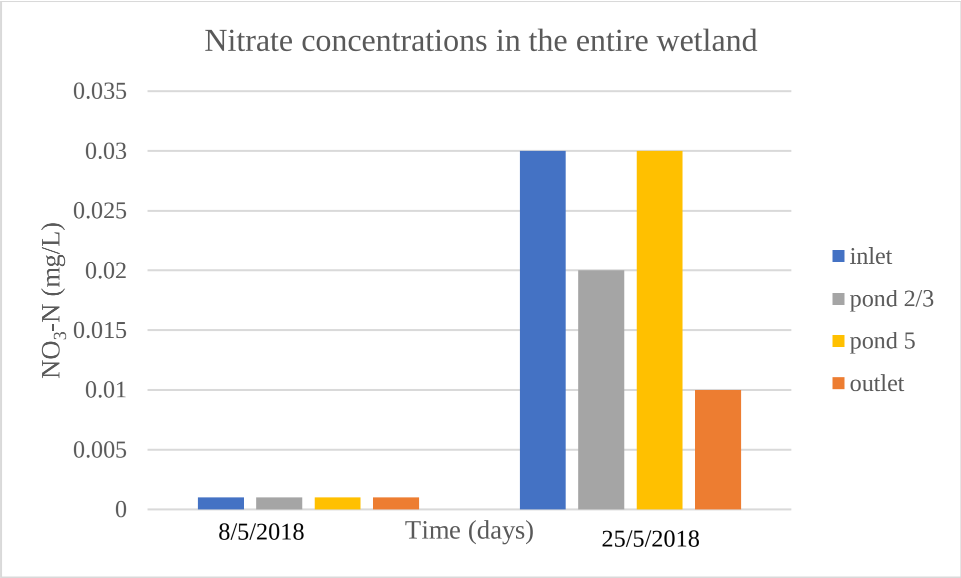

Figure 3. 42 Nitrate concentrations in samples collected from entire wetland system in month of May

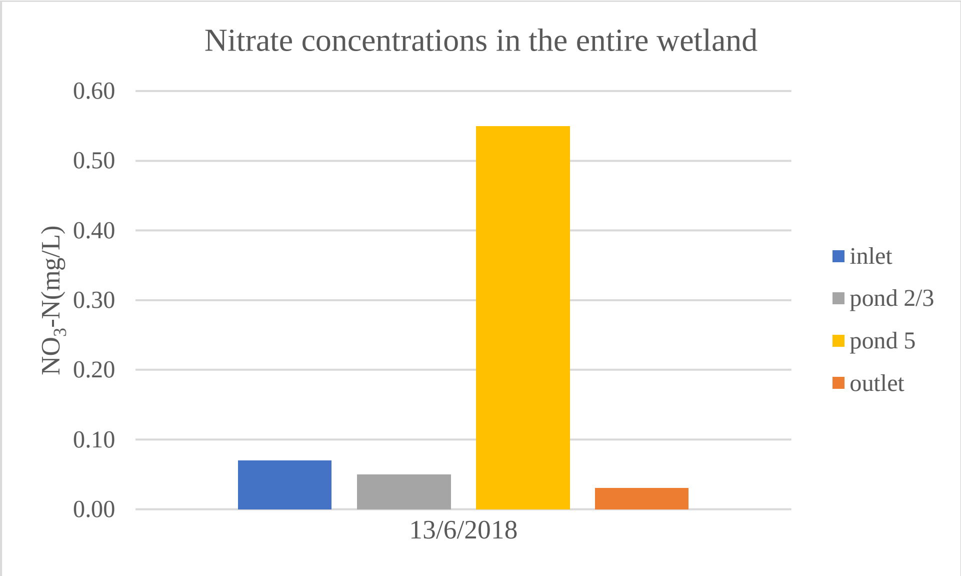

Figure 3. 43 Nitrate concentrations in samples collected from entire wetland system in month of June

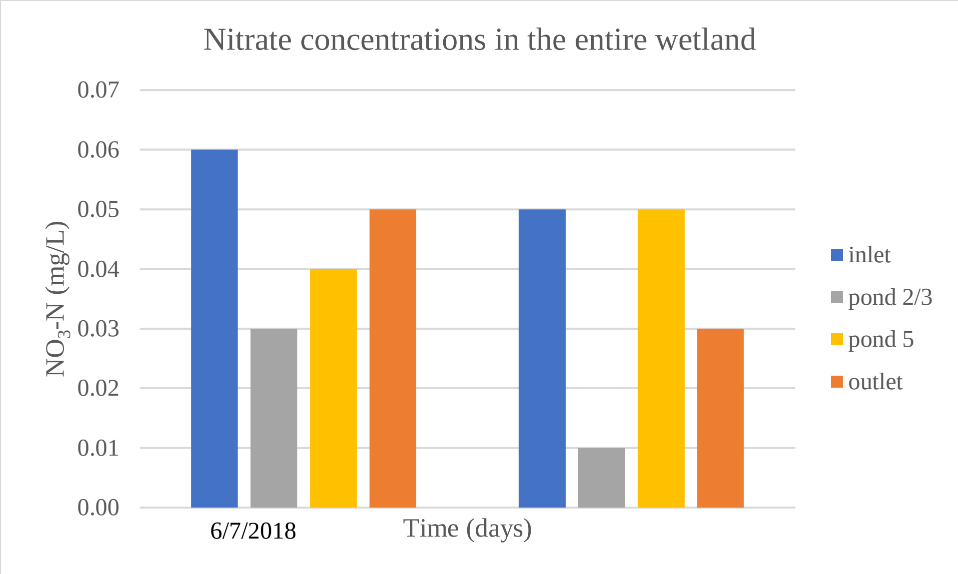

Figure 3. 44 Nitrate concentrations in samples collected from entire wetland system in month July

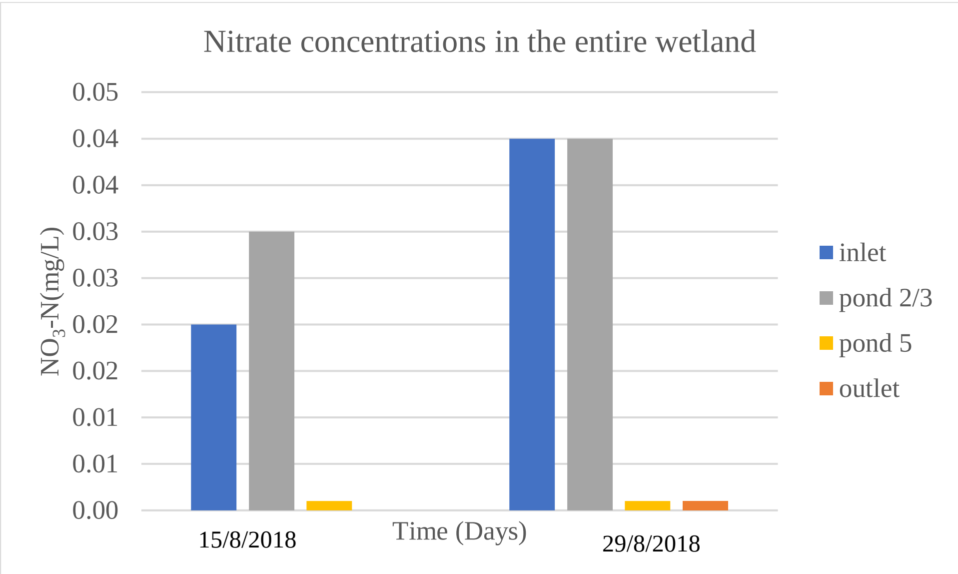

Figure 3. 45 Nitrate concentrations in samples collected from entire wetland system in month of August

3.4.4.5 TOC Analysis

The TOC concentration are Figures 3.46, 3.47, 3.48 and 3.49. There is no consistent discernible pattern in TOC concentration during passage of the water through the wetland. More frequently the outlet TOC concentration is higher than the inlet concentration.

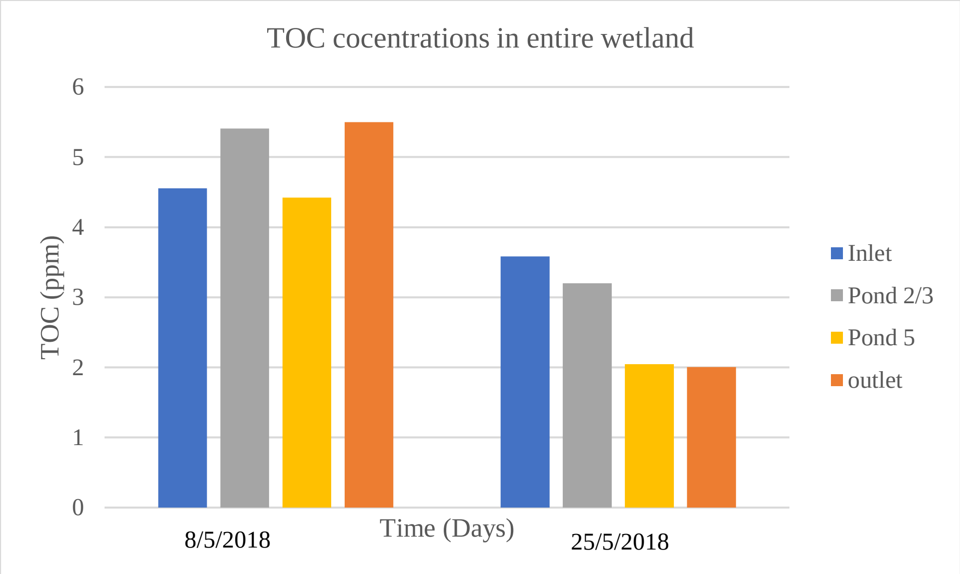

Figure 3. 46 TOC concentrations in samples collected from entire wetland system in month of May

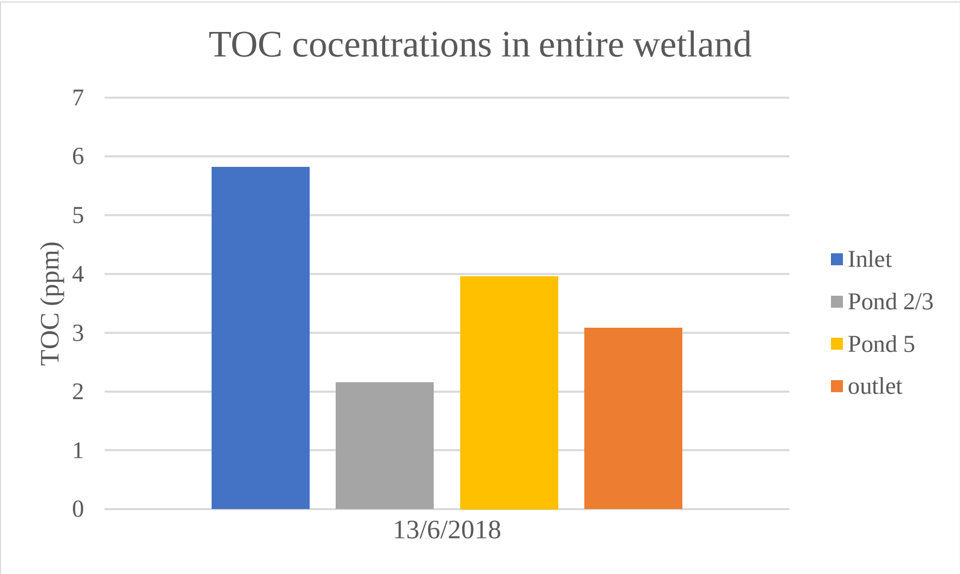

Figure 3. 47 TOC concentrations in samples collected from entire wetland system in month of June

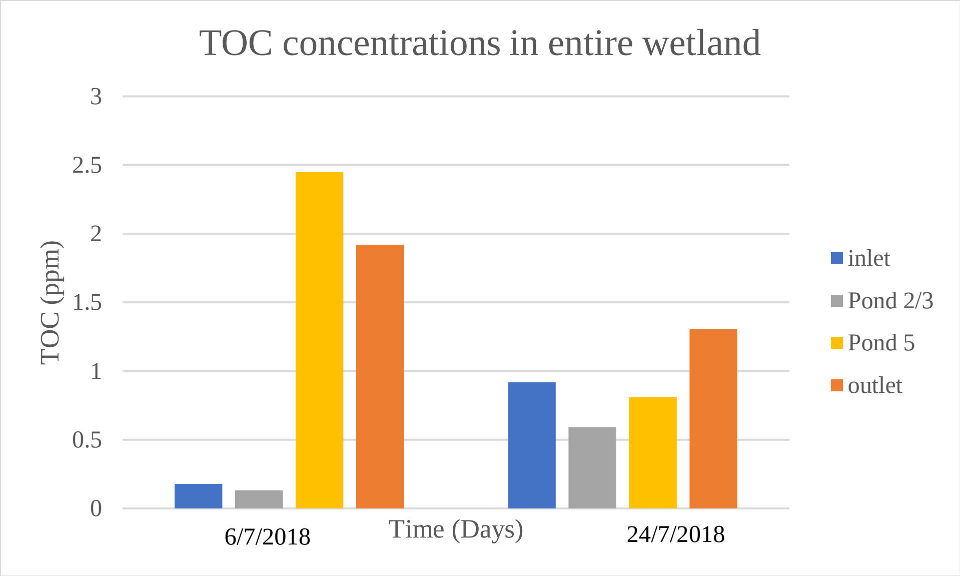

Figure 3. 48 TOC concentrations in samples collected from entire wetland system in month of July

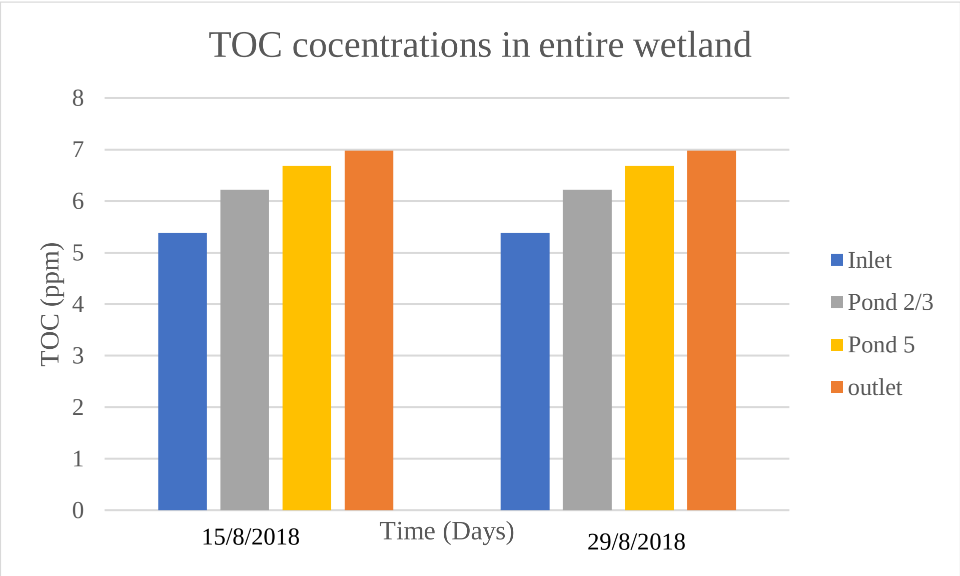

Figure 3. 49 TOC concentrations in samples collected from entire wetland system in month of August

3.4.4.4 Total Suspended Solids Analysis

Total suspended solids concentration (Figures 3.50, 3.51, 3.52 and 3.53) in Ponds 2 & 3 was often equal to or greater than those in the inlet water and further increased towards the outlet.

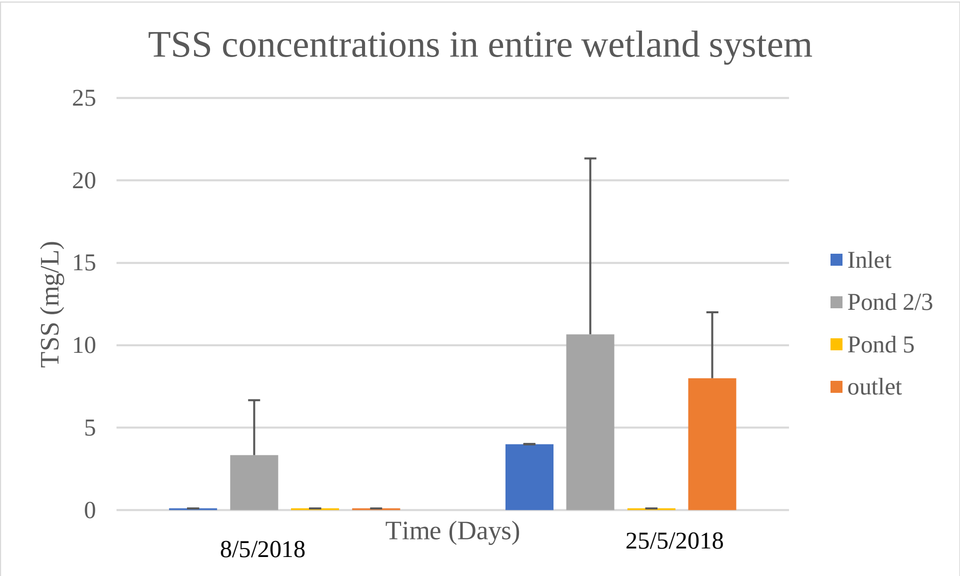

Figure 3. 50 TSS concentration in the entire wetland system in the month of May

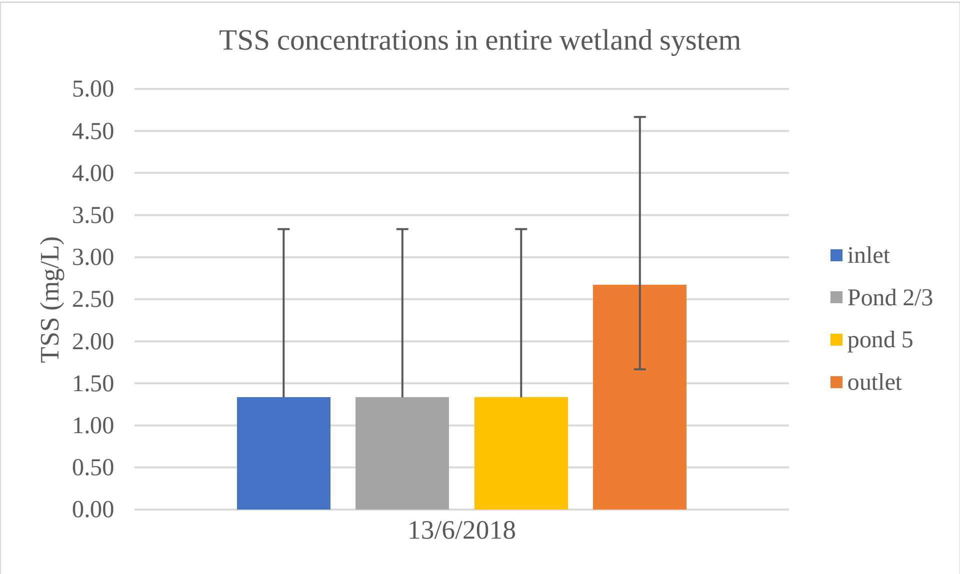

Figure 3. 51 TSS concentrations in the entire wetland system in the month of June

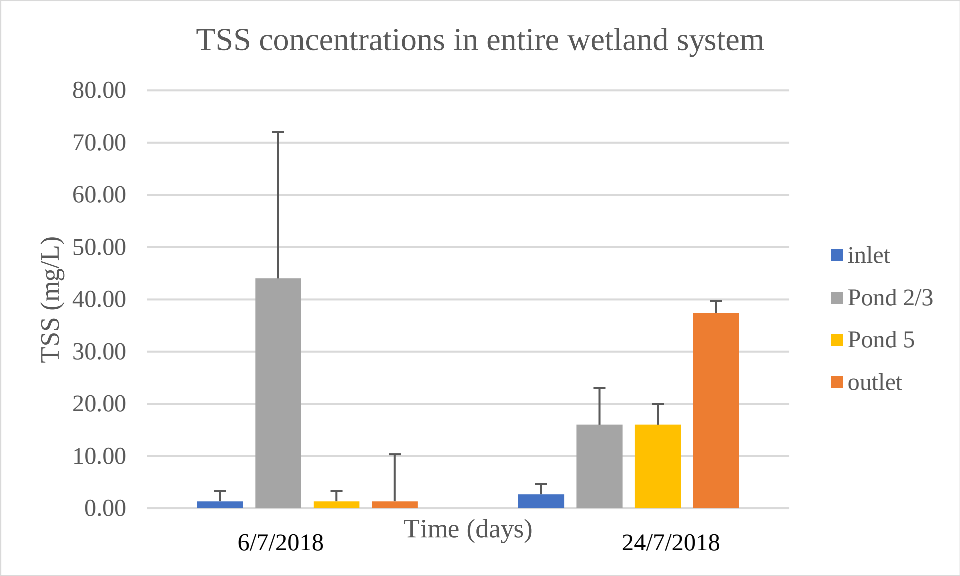

Figure 3. 52 Grab sample analysis for TSS concentration in the entire wetland system in July

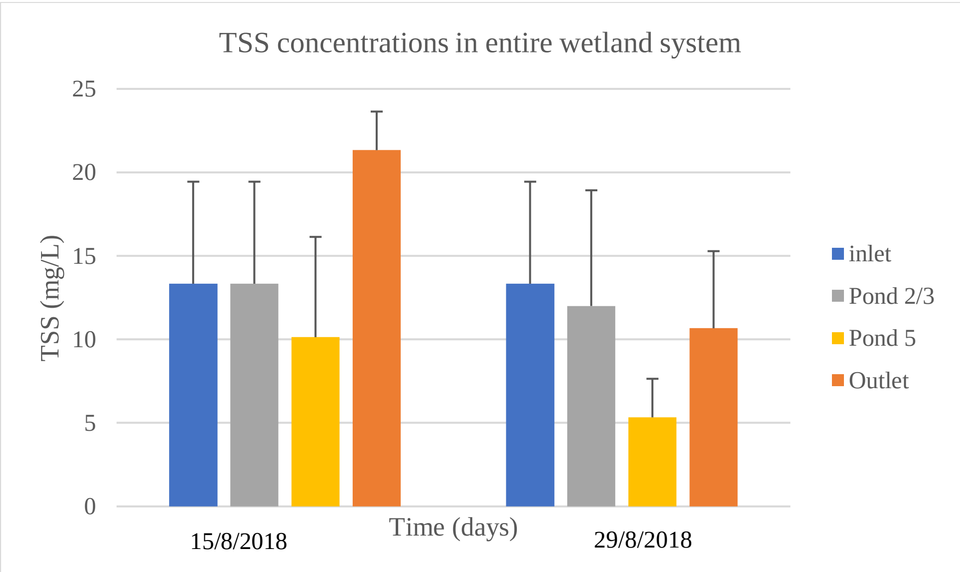

Figure 3. 53 Grab sample analysis for TSS concentration in the entire wetland system in August

3.5 Performance of the wetland during rainfall events

Samples collected through auto sampler (composite samples from outlet sump) and grab sampler from inlet during the rainfall events have been analysed to see the impacts of rainfall on water quality of wetland. Results of rainfall impacts on water quality are shown in Figures 3.54, 3.55, 3.56, 3.57, 3.58, 3.59 and 3.60 for *E.coli*, nitrate, nitrite, ammonium, total nitrogen, phosphorus, TOC and Total suspended solids respectively. The overall water quality of wetlands in terms of *E.coli* has deteriorated after every rainfall event as shown in Figure 3.54. Higher numbers of *E.coli were* observed during the major rainfall event in first week of August, 2018. However, the number of *E.coli* enumerated in the outlet Pond were more than the inlet Pond (collected sample from inlet and outlet Pond at same time). The concentration of NH_4 in inlet and outlet varies in different weeks, there is no direct impact of storm event on the concentration of nitrogen ammonia in inlet Pond and outlet Pond as shown in Figure 3.55. The concentration of TOC has been found to be higher in the outlet Pond as compare to inlet Pond concentrations. The Figure 3.61 shows the total suspended solids concentrations in the inlet and outlet Ponds. The results showed that the concentrations of TSS increased in the outlet as compared to the inlet concentration levels. The only difference was observed on the day of highest rainfall event on August 3, 2018 when the inlet concentrations were found more than the outlet concentrations.

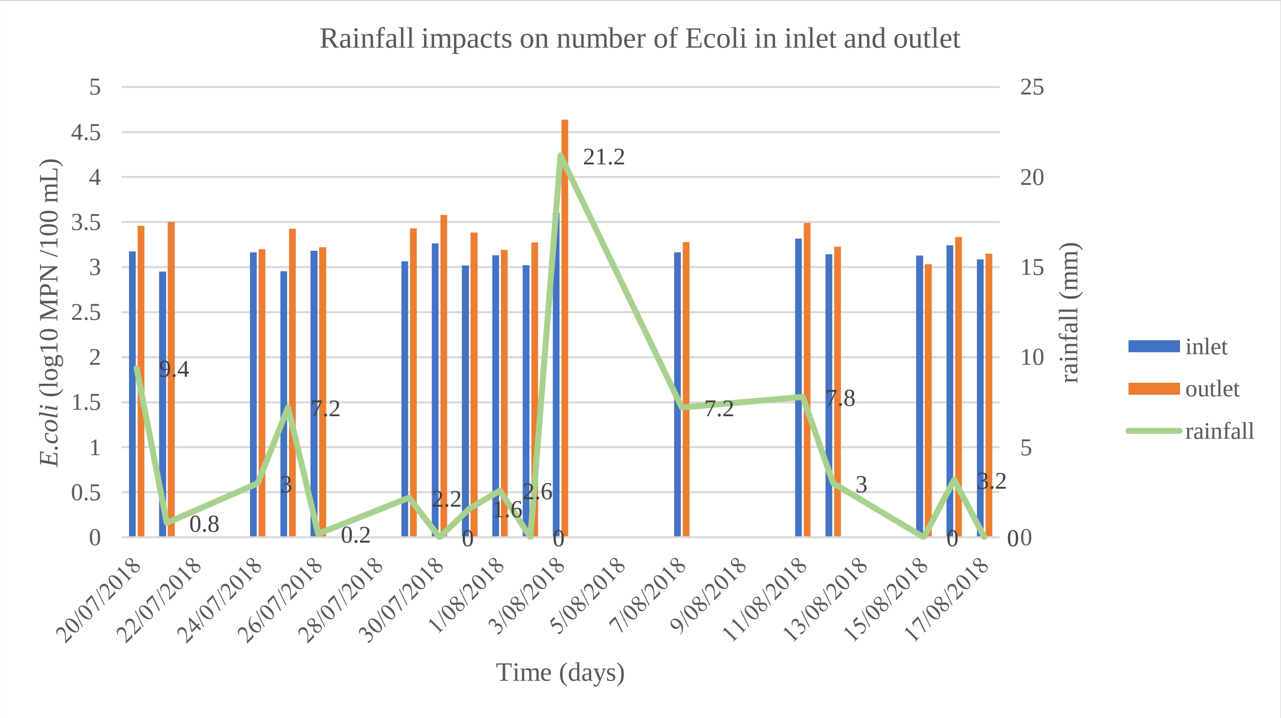

Figure 3. 54 *E.coli* (MPN /100mL) in inlet and outlet during rainfall events collected by grab sampling

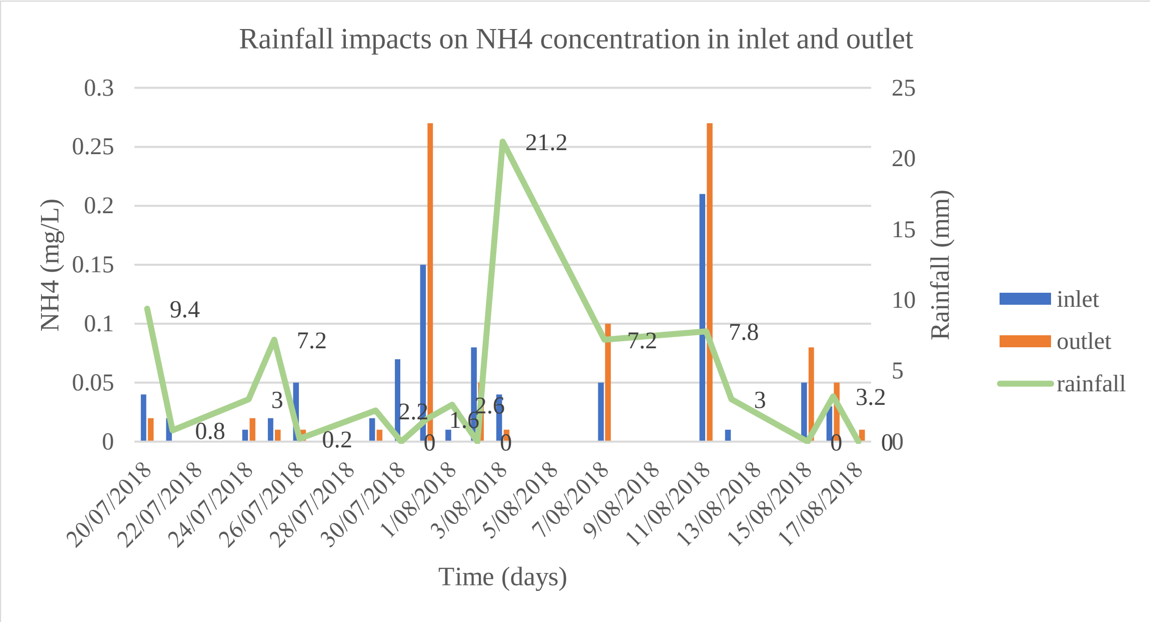

Figure 3. 55 Concentration of NH4 –N (mg/L) at inlet and outlet Ponds in water samples collected during Storm water events through auto-sampler (outlet)

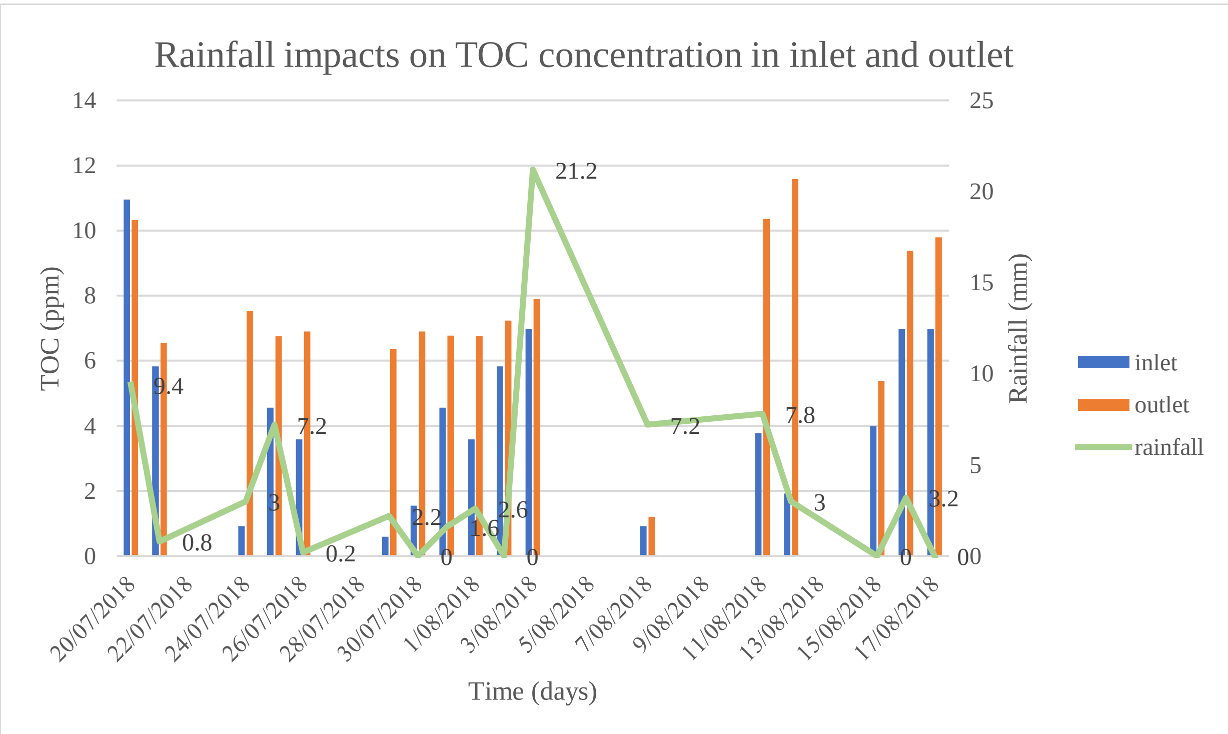

Figure 3. 56 Concentration of TOC (ppm) at inlet and outlet Ponds during rainfall events

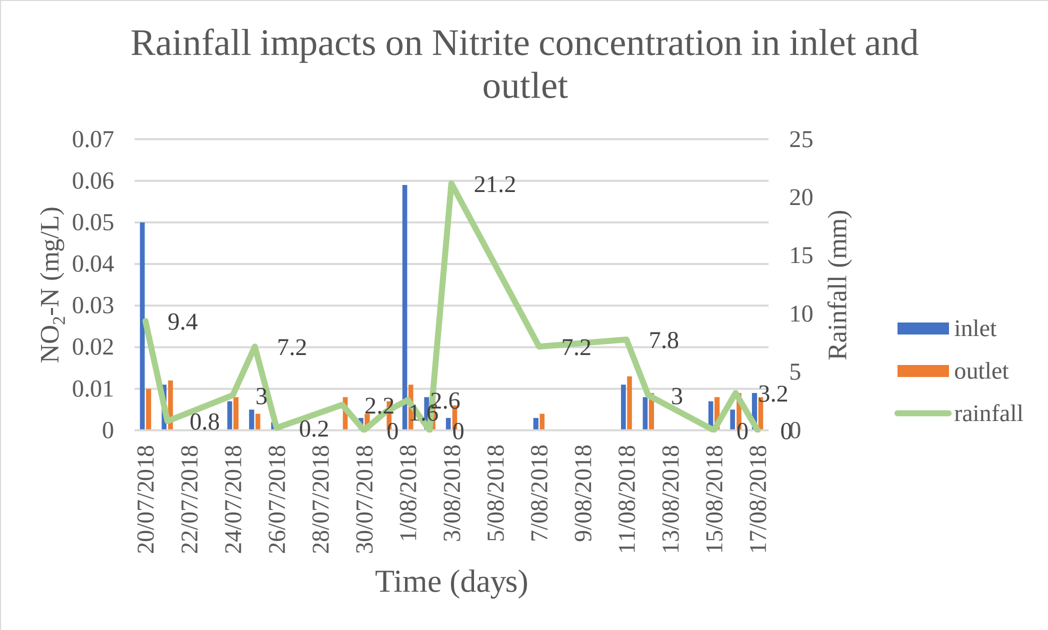

Figure 3. 57 Concentration of Nitrite at inlet and outlet Ponds during rainfall events

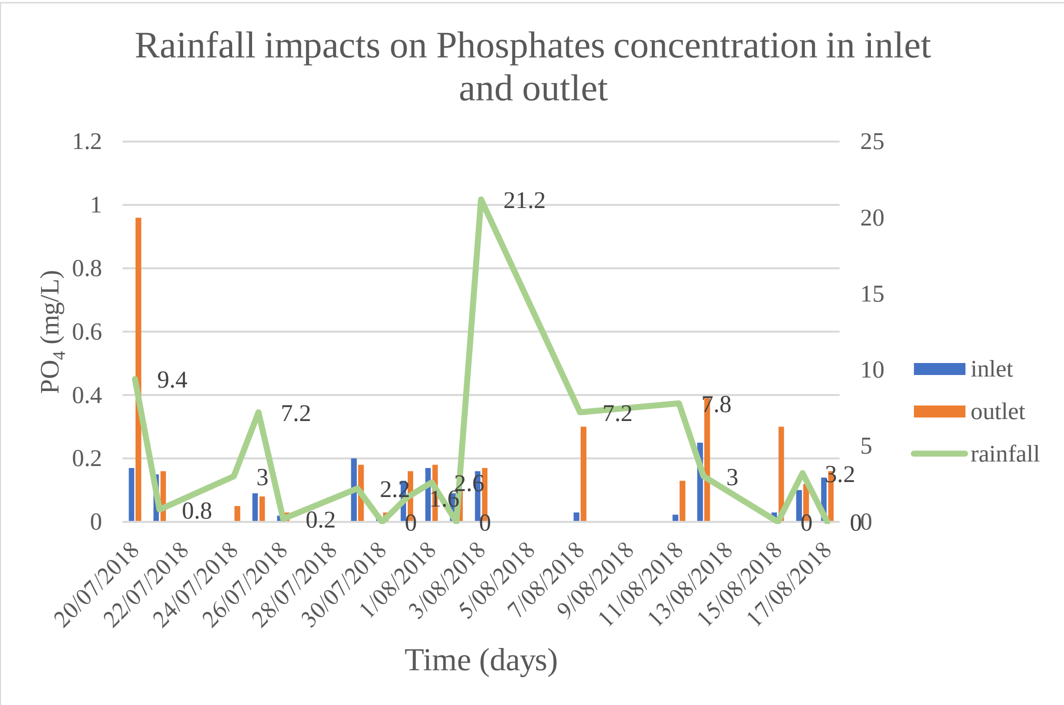

Figure 3. 58 Concentration of Phosphates (mg/L) at inlet and outlet Ponds during rainfall events

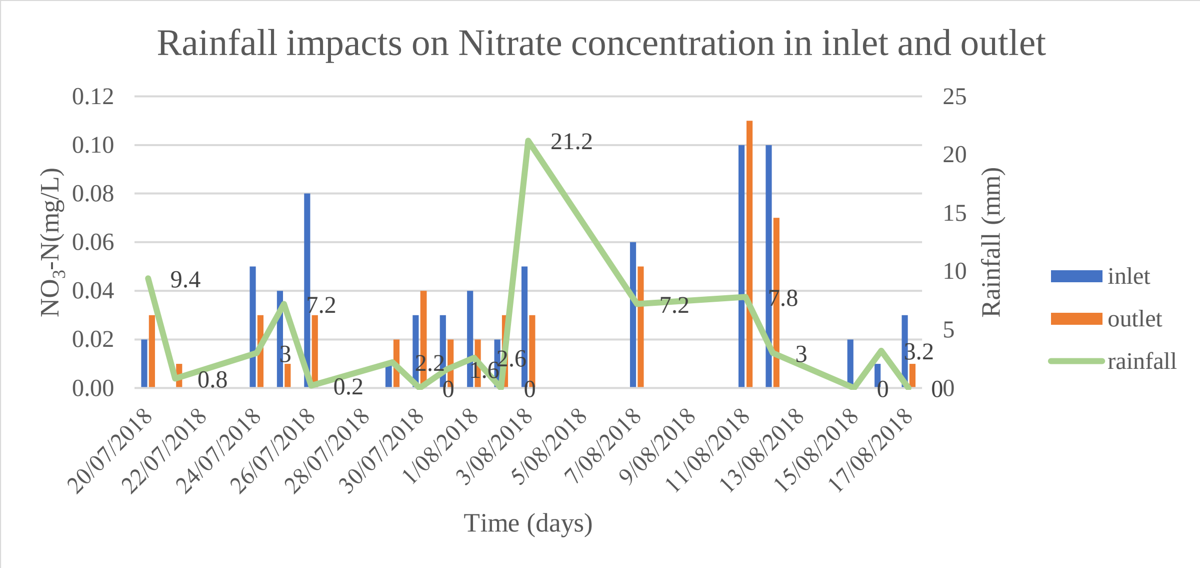

Figure 3. 59 Concentration of Nitrate at inlet and outlet Ponds during rainfall events

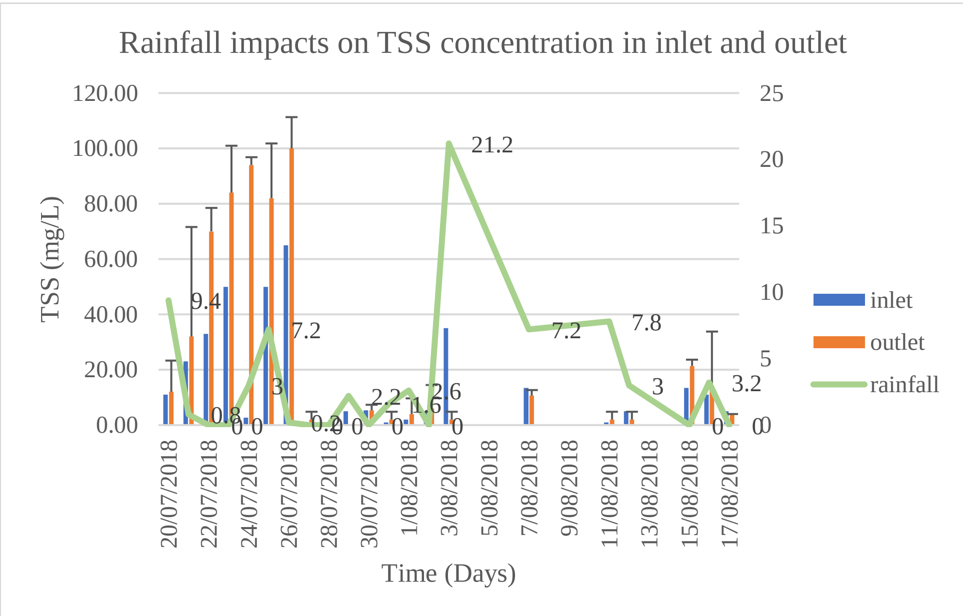

Figure 3. 60 TSS concentration level in inlet and outlet pond during the rainfall events

4. Discussion

4.1 Wetland performance

The Oaklands Park wetland was studied over a period of 4 months during the winter season, 2018. The study was designed to analyse the performance of wetland through weekly water quality analysis of inlet and outlet ponds and fortnightly water quality analysis of all ponds in the wetland system. The other objective of this study was to analyse the impacts of rainfall on performance of wetland through water quality analysis of inlet and outlet in storm events. The online water quality parameters were derived from the *in situ* water quality monitoring system and analysed to see the real time water quality data (pH, Turbidity, conductivity, water temperature) for the study period from May to Aug 2018. Climate data on rainfall, air temperature (maximum and minimum) and daily solar exposure was obtained from Bureau of Meteorology to analyse the impact of weather conditions specifically rainfall impact on performance of wetland.

The climatic conditions in the current year showed that it was comparatively dry year with average and below average rainfall received in this year. The first storm event was observed on June 13 during the study period. The maximum temperature and minimum data showed that days and night were warmer than average in Adelaide region. The maximum recorded temperature was 26.3°C in August which was higher than mean maximum temperature for winters. 2.2°C was the minimum temperature recorded in June. One of the effects of colder temperatures could be the reduction in biological treatment process in wetlands (Metcalfe, Nagabhatla & Fitzgerald 2018). 148.6 mm of rainfall has been received in the winter of 2018 which was below the winter average (past 20 years) of 199mm (Bureau of Meteorology 2018). Intensity, volume and duration of rainfall has direct relationship with runoff. Therefore, more research would be required by considering these factors in order to determine the impacts of rainfall on water quality improvement in wetland system.

The online monitoring data showed an increase in turbidity as water flows from Pond 2 to Pond 5. The probe in pond has been installed close to the macrophyte area as shown in Figure 2.1. After crossing the densely vegetated deep pond, the water further flows into the shallow pond outlet Pond. Whereas the injection data shows that turbidity levels declines as it flows from Pond 5 to outlet pond in the month of July and August.

E.coli was used as an indicator for faecal contamination. *E.coli* and F-RNA parameters have been recommended as validation monitoring parameters in Australian Guidelines on Managed

Aquifer Recharge, for Managing Health and Environmental Risks in Managed Aquifer Recharge System(NRMMC-EPHC-NHMRC 2009). This system has shown an increased number of *E.coli* in the outlet pond as compare to the inlet pond. However, increased numbers of *E.coli* have been observed during the rainfall events, when all the ponds systems including the inlet pond have increased numbers of *E.coli*. There are water birds within the ponds which may be contributing to increased numbers of *E.coli* in wetland, however, the linkage between rainfall events and increased numbers of *E.coli* is also evident from the results. F-RNA ‘phages were below the detectable limit in all samples as shown in Appendices 7.1.

The overall performance of the wetland was assessed by comparing water quality parameters between the inlet ponds with outlet pond. Comparison of the inlet concentrations of TSS, total nitrogen, ammonia, phosphorus and other parameters with 5 years of historical water quality data collected from the Sturt River shows that the concentrations of these nutrients were lower in the inlet water to the wetlands during the study period.

Though the BOD_5 concentrations were very low in the inlet as well as in the outlet ponds, the system showed a reduction in the BOD_5 concentration in the months of May and June.

The removal of nitrogen in constructed wetlands is achieved, mainly through bacterial transformation involving the combination processes of ammonification, nitrification and denitrification process as well as seasonal removal through volatilization and adsorption (Vymzal 2007, IWA 2000), Total nitrogen removal have been observed in this wetland where the outlet concentrations were less than inlet concentrations.

The chemical precipitation, sedimentation, sorption and plant and microbial uptake are the mechanisms through which phosphorus has been removed by the treatment wetlands (Kadlec, RH et al. 2017). The inlet concentration of phosphorus were less but it increased in the outlet pond. The capacity of constructed wetlands is limited for reducing nutrients particularly phosphorus (Vymazal, 2007), however, the efficiency of the wetland can be improved if better sorption medium is introduced (Albalawneh et al. 2016; Kadlec, RH & Wallace 2008; Vymazal 2007). The phosphorus might be released back to the water column due to anaerobic conditions that exists at the soil and water interface (Malaviya & Singh 2012) the increase in phosphorus in the outlet samples is likely due to the presence of water birds although the increase in concentration is very small.

The nitrogen in wetlands has a complex transformation processes as reported in literature(Kadlec, RH & Wallace 2008; Vymazal 2007). Nitrite and ammonium concentrations were higher at the outlet when compared with the inlet concentrations (except few weeks when reduction in concentrations of ammonia and nitrite was observed). The potential for nitrogen removal by constructed wetland has been demonstrated (Lee, Fletcher & Sun 2009; Senzia, Mashauri & Mayo 2003) Adsorbed ammonia can be released easily with changes in water chemistry, as it is bound loosely to the substrate (Kröpfelová 2008). The inlet water entering the wetland with lower ammonium concentration when compared with other ponds within the wetland may cause desorption of the adsorbed ammonium and release into the water resulting in increased concentrations in the macrophyte region of the wetland (Pond 2, 3, 5) and the outlet pond. The increase in ammonium concentrations in the outlet could be the conversion of nitrates into ammonium (Kadlec, RH & Wallace 2008; Lee, Fletcher & Sun 2009; Vymazal 2007) as the concentration of nitrogen ammonia was increased in the outlet pond. The other sources of increase in ammonium concentrations are the faecal matter of ducks/birds in wetland as the bird's faecal matter contained higher ammonium concentration and potential resuspension from the sediment by bird and fish foraging for food in the sediment. However, due to inadequate observation of nitrogen transformation and removal mechanisms, the nitrogen removal efficiency has been inconsistent(Lee, Fletcher & Sun 2009; Senzia, Mashauri & Mayo 2003)

The nitrate concentrations in the outlet were decreased by the wetland system. The nitrate concentrations can be reduced by denitrification i.e. conversion of nitrates to nitrogen gas or nitrates converting into ammonium (Kadlec, RH et al. 2017; Mangangka et al. 2016; NRMMC-EPHC-NHMRC 2009). The biological mediated reduction of nitrate to nitrogen gas through several intermediary steps in the absence of dissolved oxygen (anaerobic conditions) is called denitrification (Kadlec, RH et al. 2017; Mangangka et al. 2016). Denitrification also accounts for the total organic carbon removal in horizontal flow wetland (Kadlec, RH et al. 2017), however, it has been observed in this wetland system that the TOC levels were increased in the outlet pond.

Suspended solids cause the clogging of the ASR systems as mentioned in the guidelines, therefore it should be managed before injection into the system. High concentrations of suspended solids result in significant change in turbidity (Vymazal, 2007). The turbidity and the concentration of the total suspended solids of the wetland was also increased in the outlet pond when compared with the inlet pond. Kadlec (2009) reported the resuspension of the total suspended solids generated due to biogeochemical processes. The TSS in effluent of the wetland might be dominated by internal processes (Kadlec, R 2009) The resuspension of the total suspended solids might be changing the biogeochemical conditions of the ponds system (ducks/birds movement between ponds in the macrophyte area). The Australian Guidelines for Managed Aquifer Recharge (NRMMC-EPHC-NHMRC 2009) suggested that TSS value for high quality the source water for recharge should be less than 10 mg/L and water with more than 10 mg/L is low quality water for recharge as shown in Table 4.1. The average value of outlet pond was 10.5 mg/L which is above the lowest guide value. Therefore, improved management of the outlet pond is recommended.

Table 4. 1 Clogging rates of 14 ASR sites based on aquifer type and source water quality (source: NRMMC-EPHC-NHMRC 2009)

	Source-water quality		
	Low (TSS >10 mg/L, TOC >10 mg/L)	Moderate (TSS 1–10 mg/L, TOC 1–10 mg/L)	High (TSS <1 mg/L, TOC <1 mg/L)
Aquifer type	**Rate of clogging**		
Limestone	Low–moderate	Low–moderate	No data available
Sand and gravel	Moderate–severe	Low–moderate	Low–moderate
Fractured rock	Severe	No data available	No data available

TSS = total suspended solids; TOC = total organic carbon.

Table 4. 2 Comparison of mean outlet concentration with MAR guide value (NRMMC-EPHC-NHMRC 2009)

Date	Site	TSS (mg/L) mean	MAR Guide Value
8/05/2018	outlet point	0.1	High Quality
7/08/2018	outlet point	5.333333	Moderate Quality
17/05/2018	outlet point	6.8	Moderate Quality
25/05/2018	outlet point	8	Moderate Quality
2/06/2018	outlet point	50.7	Low Quality
13/06/2018	outlet point	2.67	Moderate Quality
19/06/2018	outlet point	4	Moderate Quality
26/06/2018	outlet point	1.33	Moderate Quality
6/07/2018	outlet point	1.33	Moderate Quality
13/07/2018	outlet point	13.33	Moderate Quality
24/07/2018	outlet point	37	Low Quality
30/07/2018	outlet point	5.33	Moderate Quality
15/08/2018	outlet point	21.33333	Low Quality
29/08/2018	outlet point	10.66667	Low Quality
22/08/2018	outlet point	9.333333	Moderate Quality

The water quality of sequential ponds within the wetlands was also assessed. The numbers of *E.coli* were different in all ponds. The results for Ponds 2 and 3 showed consistently higher values than the inlet pond. These ponds include a shallow macrophyte area and open space for water birds. Pond 5 showed a reduction in the number of *E.coli*. The sampling location for Pond 5 was the deep pool side of the pond with excessive vegetation. The turbidity results from the same location were also less compared to other ponds. However, the number of *E.coli* again increased in the outlet pond. However, it is worth noting that during the first storm event the number of *E.coli* increased in all ponds, more specifically the results were higher in Pond 5. The presence of water birds and the rainfall events both have impacts on the number of *E.coli* in these ponds.

The performance wetlands regarding BOD_5 removal depends on the influent concentrations (Kadlec, RH et al. 2017). BOD_5 reduction can occur through both aerobic and anaerobic decomposition processes, furthermore, BOD_5 can be generated internally in the wetland (Kadlec, R 2009). The overall BOD_5 concentration remained very low or below the detection limit in all ponds except few weeks in July and August. BOD_5 removal was observed from inflow to outflow during passage through the wetlands. However, the increases in BOD_5 concentration in the outlet pond compared to the inlet pond were also recorded. This increase may be due to the influence of water birds or fish (defaecation and foraging) and degradation of plant organic matter.

The total nitrogen concentrations were highly variable in each pond in different weeks. In the first week of May, the total nitrogen concentration was increased in Pond 2/3 compared with the influent concentration and again decreased in Pond 5 followed by further increases in the outlet. The second week in May had similar results when the total nitrogen concentrations in Ponds 2&3 were again more than in the inlet pond, however, in contrast to the first week a decrease was observed in Pond 5; the outlet concentrations were lower than inlet concentrations. In June, the inlet concentrations were more than Pond 2 and 3, pond 5 and outlet. In July, the concentrations at inlet were less than Pond 2, 3 and pond 5, however the concentrations decreased as water flew towards the outlet pond. During August, the outlet concentrations were higher than the inlet ponds system. It has been reported by Vymazal (1999) that nitrogen removal in two horizontal flow constructed wetlands in Czech Republic, were affected by temperature only slightly and the difference between removal rates of nitrogen in winter and summer were not significantly different in some cases (Kröpfelová 2008; Vymazal 2009).

The NH_4-N concentrations were highly variable in all ponds in each week during the study period. Ponds 2, 3 and outlet concentrations of NH_4-N are higher than the inlet concentrations in the month of July and August. The increase in concentration of NH_4-N in ponds other than inlet pond, may be due to the presence the ducks/birds. The NO_2-N concentrations were low in inlet pond also variable in each week. The inflow concentrations remained low, however, the concentration of NO_2-N and NO_3-N was higher in Pond 5 in all weeks. The NO_3-N concentrations in the inlet were slightly higher than outlet and the other ponds. The Pond 5 NO_3-N concentrations were higher than other ponds.

In May and June, the inlet PO_4-P concentrations were high and the concentrations decreased in Ponds 2 and 3 and outlet pond. However, the concentrations were increased in Pond 5 in all weekly samples. In July and August, the concentrations of outlet pond were higher than those of the inlet pond, whereas the inlet concentrations were less than other ponds (2, 3, 5 and outlet pond). Mostly the birds and ducks are in the macrophyte area i.e. Ponds 2/3, 4, 5 and also in the shallow outlet pond. This is the likely cause of the increased PO_4-P concentrations in the outlet and the other ponds.

The TOC concentrations were increased in the outlet and Ponds 2,3 as compare to the inlet pond concentrations within the wetland system in first week of May. In second week of May, the concentrations of inlet were high as compare to outlet and Ponds 2,3 and 5. the first week samples were collected after the first storm event of the season which might have caused turbulence in the wetland system and caused the resuspension of the particulate pollutants(Mangangka et al. 2016). The increase in TOC concentrations were observed in Pond 5 and outlet as compare to inlet pond and Pond 2/3 in first week of July. In second week of July, the concentrations in outlet were more than inlet pond, Pond 2/3 and Pond 5. However, the concentrations of TOC were increased in outlet, Ponds 2 and 3, Pond 5 than the inlet concentrations in month of August. The average concentration of the outlet pond is 3 mgC/L which suggests that the water quality is of moderate quality as per guide values of 'Australian Guidelines for Managed Aquifer Recharge'(NRMMC-EPHC-NHMRC 2009).

It has been reported by Vymazal 2012 that (Schierup *et al.* 1990) established that the percentage efficiency increases with increasing influent concentrations, therefore to evaluate the performance of CW wetlands according to the treatment efficient expressed as percentage removal, could be misleading. Mangangka reported that Carltton *et al*. 2000 found the water quality improvement provided by wetland is inconsistent and high variable. System design, rainfall characteristics and hydraulic parameters are the factors on which removal efficiencies are dependent (Mangangka et al. 2015) Choi *et al.* (2010) reported that TSS removal efficiency of wetlands increases with the increase in influents TSS concentrations. The concentrations of TSS in Pond 2 and 3 remain high as well as in the outlet pond as compared to the inlet pond, likely due to the presence of water birds and fish defecating and disturbing sediment.

The performance of the wetland during rainfall events was also assessed. An impact of rainfall impact on the *E.coli* concentrations was observed, the highest number of *E.coli* were observed when the highest peak rainfall occurred. There was no clear relationship found between NH_4-

N and rainfall as the influent concentrations remain lower than effluent concentrations. There was no impact observed on the influent concentrations of nitrate, nitrite and phosphates. The other upstream constructed wetland which has been treating water and discharging it back to the Sturt River, was also contributing in reducing pollutants in the Sturt River. The water quality results of Sturt River (source of water for Oaklands Park wetland) have shown that the concentrations of phosphates, total nitrogen and total suspended solids are less. The overall total suspended solids outlet concentrations remained high during the rainfall events in the outlet sump. The influent concentrations of TSS were less as compare to the outlet sump. The only influent concentration of TSS which was observed higher, was during the highest rainfall event where the effluent concentrations were less than influent.

The study found that Oaklands park wetland in terms of treating water quality parameters *E.coli*, TSS and TOC is not performing well. The weather (storm) impacts on water quality status in terms of *E.coli* is well established as the number of E.coli increased during rainfall events. The internal biogeochemical processes were found contributing in changing the water quality treatment processes of the wetland.

5. Conclusion

This research project has been conducted to evaluate the performance of Oaklands Park wetland, which has been established as a part of managed aquifer recharge scheme to cater for the irrigation needs of the Marion City council public reserves. The wetland has been functioning for past five years but the performance of the design has never been evaluated. The following are the main conclusions and recommendations based on water quality results and data analysis.

1. Based on climatic conditions analysis, below average rainfall was recorded during the study period - the winter season of 2018. Only 3 major rainfall events (rainfall event of more than 7 mm) were closely monitored during the study period. The temperature data shows that this year was a comparatively warmer winter season, which also might impact on the performance of the wetland system via an impact on the biological processes. To better establish the correlation between rainfall and wetland's treatment performance, more parameters like rainfall intensity, volume and duration require investigation. It is recommended that monitoring of the influent and effluent water quality over a longer period would give a clearer indication of the wetland system performance.
2. In this study, composite samples only from the outlet has been analysed due to the lack of a secure space to install an auto-sampler at the inlet pond site, which could have provided composite samples for water quality analysis and enabled a better comparison between influent and effluent water quality. The samples for monitoring the impacts of rainfall on inlet pond were collected through individual grab sampling and only at one time during the day. This wetland is contributing to MAR system, therefore, the focus is more on the effluent water quality for regulatory purposes. Since this wetland has been collaborating with Flinders University, the influent water quality needs to be studied more regularly as recommended by 'Australian guidelines for Managed Aquifer Recharge'. This will further enhance the current knowledge of wetlands system performance as there are limited studies available on evaluation of the wetland system performance particularly stormwater treatment wetlands performance evaluation. There is a need to provide a safe place for autosampler installation near the inlet pond to permit comparison with outlet pond data collected using an autosampler.

3. Based on rainfall event monitoring data, the impact of rainfall on treatment performance of wetland was correlated with increases in numbers of *E.coli* and TOC concentration. Water quality generally deteriorated following passage through the wetland, for example, TSS, phosphates, ammonia nitrogen, total nitrogen increase in concentrations in the outlet samples compared to the inlet values. As this increase has been observed during the entire period of the study so the direct impact of rainfall on these parameters could not be established. However, there are other factors, which need to be considered in order to establish correlation between rainfall impacts on water quality of the wetland, for example volume and duration of stormwater from Sturt River is harvested into the wetland during this season.
4. The TOC and TSS causes clogging of the MAR systems therefore preventive measurements need be taken to avoid the clogging of the MAR systems as recommended in Australian guidelines of managed aquifer recharge.
5. Based on the online data analysis of the online water quality data, the increase in turbidity was recorded in Pond 5, which is a deep macrophyte area in the wetland. More detailed analysis of other factors need to be studied to identify those which are influencing turbidity when water flows from Pond 2 to Pond 5 and also what factors assist in decreasing the turbidity from Pond 5 to outlet sump.
6. There is a need to identify proper management practices of ponds through research to control the increased number of *E.coli* .
7. Based on literature review, it is recommended to increase the residence time from 3 days to 5 or more days and further analyse the impacts of increasing residence time on water quality improvement through research.
8. Before storm events, the level of contaminants (*E.coli*, TSS, and turbidity) were less in May and early June before the rainfall events. The comparison between the dry season and wet season events would give better understanding of the wetland system performance.

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7. Appendices

7.1 Weekly and fortnightly Water Quality Data analysed from May to August 2018

Date	Location	Ecoli (MPN/100ml)	Ecoli log10 MPN 100 m/L	pH (log [H+])	Temp (degree Celcius)	conductivity (us/cm)	MS2 (PFU m/L)	turbidity (NTU)	TSS (mg/L)	TSS (filtration) mg/L	SD (TSS)	NO3-N (mg/L)	NO3-N (mg/L)	NO2-N (mg/L)hacc	NO2-N (mg/L)	NH4 (mg/L)	NH4-N (mg/L)	PO4-P (mg/L)	PO4-P (mg/l)	TOC (ppm)	BOD5 (mg/l)	TN (ppm)
8/05/2018	Inlet	87	2	7.95	10.5	1341	0.005	15	*	0.1	0	*	-0.125	0.060	0.060	*	0.0	-0.10	3.02	4.556	0.47	0.6933
8/05/2018	Pond 2	125	2	8.03	10.2	1245	0.005	33	*	6.667	6	*	0.130	0.048	0.048	*	0.0	-0.12	-0.27	8.819	0.01	0.5636
8/05/2018	Pond 3	1203.3	3	7.89	11.4	1254	0.005	16	*	0.1	0	*	-0.120	0.061	0.061	*	0.0	-0.36	-0.28	4.755	1.03	0.5076
8/05/2018	Pond 4	2419.6	3	7.68	11.3	1173	0.005	33	*	3.333	6	*	-0.144	0.035	0.035	*	-0.2	-0.12	-0.28	5.406	0.01	0.8583
8/05/2018	Pond 5	111.9	2	7.75	7.5	1257	0.005	7	*	0.1	0	*	-0.109	0.060	0.060	*	-1.6	-0.12	-0.26	4.422	0.01	0.5841
8/05/2018	outlet	201.4	2	7.86	7.3	1660	0.005	4	*	0.1	0	*	-0.141	0.058	0.058	*	-1.7	-0.09		5.5	0.01	0.7379
17/05/2018	inlet poin	435.2	3	7.95	12.1	1490	0.005	7	0.01	4	0	0.04	-0.134	0.054	0.054	0.07	-1.4	0.38	0.00	1.17	0.01	0.8053
17/05/2018	outlet poi	410.6	3	8.03	9.9	1408	0.005	8	0.01	6.8	6	0.01	-0.140	0.061	0.061	0	-1.3	0.22	0.10	2.278	0.01	0.6589
25/05/2018	inlet poin	191.8	2	7.89	10.5	1303	0.005	9	0.01	4	0	0.03	-0.093	0.001	0.001	0.02	-1.0	-0.11	0.09	3.583	0.01	0.5477
25/05/2018	pond 2/3	2419.6	3	7.68	10.2	1218	0.005	28	1	10.67	5	0.02	-0.105	0.000	0.000	0.04	-1.3	-0.11	0.01	3.198	0.30	0.6145
25/05/2018	pond 5	38.9	2	7.75	11.4	1208	0.005	7	0.01	0.1	0	0.03	0.208	0.006	0.006	0.01	-2.0	-0.04	0.03	2.046	0.01	0.4445
25/05/2018	outlet poi	2419.6	3	7.95	11.3	1166	0.005	11	0.01	8	4	0.01	-0.103	0.003	0.003	0.05	-1.2	-0.11	0	2.005	0.30	0.4914
2/06/2018	inlet poin	410.6	3	7.36	7.5	1568	0.005	8	5	4	0	0.13	-0.067	0.004	0.004	0.001	-1.1	-0.12	0.17	1.788	0.01	0.563
2/06/2018	outlet poi	435.2	3	7.86	7.3	1389	0.005	19	6	50.7	74	0.09	-0.044	0.003	0.003	0	-0.9	0.31	0.05	2.87	0.01	0.4872
13/06/2018	inlet poin	10000	4	7.96	13.2	664	0.005	52	37	1.33	2	0.07	0.510	0.016	-0.014	0.01	-1.0	-0.11	0.27	5.824	0.01	0.7875
13/06/2018	pond 2/3	10000	4	7.83	13.4	783	0.005	45	30	1.33	2	0.05	0.114	0.02	-0.021	0.04	-2.3	-0.11	0.18	2.156	0.30	0.5683
13/06/2018	pond 5	52000	5	7.88	11.6	988	0.005	26	17	1.33	2	0.55	0.005	0.148	-0.004	0.77	-1.8	-0.12	0.34	3.961	0.01	0.5421
13/06/2018	outlet poi	41000	5	7.98	10.5	1195	0.005	21	12	2.67	2	0.03	9.007	0.012	-0.008	0.02	-1.1	0.45	0.19	3.08	0.30	0.5643
19/06/2018	inlet poin	261	2	8.85	18.3	1174	0.005	15	4	8	4	0.04	-0.087	0.011	-0.014	0.03	-1.7	-0.12	0.11	3.5	0.01	0.794

Date	Location	Ecoli (MPN/100ml)	Ecoli log10 MPN 100 m/L	pH (log [H+])	Temp (degree Celcius)	conductivity (us/cm)	MS2 (PFU m/L)	turbidity (NTU)	TSS (mg/L)	TSS (filtration) mg/L	SD (TSS)	NO3-N (mg/L)	NO3-N (mg/L)	NO2-N (mg/L)hacc	NO2-N (mg/L)	NH4 (mg/L)	NH4-N (mg/L)	PO4-P (mg/L)	PO4-P (mg/l)	TOC (ppm)	BOD5 (mg/l)	TN (ppm)
19/06/2018	outlet poi	770.1	3	8.07	18.3	846	0.005	25	12	4	0	0.02	0.123	0.019	-0.021	0.01	-1.1	-0.12	0.14	3.862	0.30	0.7208
26/06/2018	inlet poin	35.9	2	8.01	14.7	1316	0.005	13	5	5.33	6	0.10	0.268	0.017	-0.008	0	-0.7	-0.12	0.11	2.427	0.01	0.4858
26/06/2018	outlet poi	325.5	3	8.38	14.5	1075	0.005	23	15	1.33	2	0.04	8.942	0.03	-0.019	0.05	-0.6	**	0	3.054	1.40	0.5036
6/07/2018	inlet poin	1046	3	8.91	9.4	1070	0.005	14	5	1.33	2	0.06	-0.094	0.01	-0.016	0.06	-0.5	**	0.06	0.1786	0.73	0.4165
6/07/2018	pond 2/3	10000	4	7.96	8.4	1125	0.005	11	3	44	28	0.03	-0.142	0.007	-0.008	0.04	-1.9	**	0.09	0.1317	0.20	0.4931
6/07/2018	pond 5	325.5	3	7.84	9.2	1120	0.005	8	0	1.33	2	0.04	-0.168	0.031	-0.021	0.07	-0.5	**	0.13	2.449	0.01	0.4931
6/07/2018	outlet poi	2419.6	3	8.14	8	1068	0.005	12	4	1.33	2	0.05	8.843	0.014	-0.016	0	-0.7	**	0.12	1.919	0.01	0.3756
13/07/2018	inlet poin	193.5	2	9.14	7.5	1091	0.005	9	3	1.33	2	0.02	-0.143	0.016	-0.004	0.27	**	**	0.01	0.987	5.17	0.3226
13/07/2018	outlet poi	461.1	3	8.69	7.3	1065	0.005	14	13	13.33	9	0.01	**	0.009	-0.008	0.05	**	**	0.36	2.025	0.30	0.3449
24/07/2018	inlet poin	1460	3	9.21	16.5	1234	0.005	9	3	2.67	2	0.05	**	0.003	-0.008	0.04	**	**	0	0.9188	0.01	0.8717
24/07/2018	pond 2/3	6170	4	8.28	16.4	1184	0.005	17	14	16	7	0.01	**	0.004	-0.019	0.04	**	**	0.06	0.5913	0.01	0.5165
24/07/2018	pond 5	630	3	8.24	17	1174	0.005	6	14	16	4	0.05	**	0.003	-0.016	0.05	**	**	0.04	0.8125	0.01	0.4544
24/07/2018	outlet poi	1580	3	8.59	17.1	1186	0.005	12	28	37	9	0.03	**	0.006	-0.008	0.1	**	**	0.07	1.307	0.01	0.3679
30/07/2018	inlet poin	1830	3	8.71	18.4	1315	0.005	8	5	5.33	2	0.03	**	0.003	-0.021	0.07	**	**	0.02	1.551	0.01	0.4239
30/07/2018	outlet poi	3790	4	8.28	18.5	1170	0.005	10	4	5.33	2	0.01	**	0.006	-0.016	0.15	**	**	0.03	1.672	0.01	0.3673
7/08/2018	inlet poin	1460	3	8.1	17.5	1140	0.005	15	9	5.33	2.31	0.06	**	0.017	**	0.05	**	**	0.12	0.917	0.01	0.8518
7/08/2018	outlet	1830	3	8.48	17	1075	0.005	13	6	5.33	2.31	0.05	**	0.013	**	0.1	**	**	0.39	1.201	0.01	0.4679
15/08/2018	inlet poin	1340	3	8.9	10.6	824	0.005	16	3	13.33	6.11	0.02	**	0.007	**	0.05	**	**	0.03	5.383	0.01	0.595
15/08/2018	pond 2/3	1350	3	8.51	10.7	776	0.005	22	13	13.33	6.11	0.03	**	0.016	**	0.07	**	**	0.21	6.223	1.10	0.7069
15/08/2018	pond 5	850	3	8.1	10.6	734	0.005	21	4	10.13	6.00	0.00	**	0.019	**	0.05	**	**	0.16	6.68	0.01	0.7525
15/08/2018	outlet poi	1080	3	8.79	12.6	687	0.005	23	7	21.33	2.31	0.00	**	0.008	**	0.08	**	**	0.3	6.982	0.01	0.8701
22/08/2018	inlet poin	1830	3	8.1	17.5	1140	0.005	**	**	1.33	2.31	0.04	**	0.017	**	0.05	**	**	0.12	0.917	0.01	0.8518
22/08/2018	pond 2/3	3790	4	8.48	17	1075	0.005	**	**	9.33	2.31	0.03	**	0.013	**	0.1	**	**	0.39	1.201	0.01	0.4679
29/08/2018	inlet poin	1380	3	8.9	10.6	824	0.005	**	**	13.33	6.11	0.04	**	0.006	**	0.05	**	**	0.03	5.383	0.01	0.595
29/08/2018	pond 2/3	3170	4	8.51	10.7	776	0.005	**	**	12.00	6.93	0.04	**	0.015	**	0.07	**	**	0.21	6.223	0.30	0.7069
29/08/2018	pond 5	630	3	8.1	10.6	734	0.005	**	**	5.33	2.31	0	**	0.018	**	0.05	**	**	0.16	6.68	0.01	0.7525
29/08/2018	outlet poi	1480	3	8.79	12.6	687	0.005	**	**	10.67	4.62	0	**	0.007	**	0.08	**	**	0.3	6.982	0.01	0.8701

[1]

[1] ** No analysis done for these parameter in those days due to change of analysis methods

7.2 Water quality data of samples collected from inlet and outlet during rainfall events

Date	rainfall (mm)	NH4-N (mg/L)		NO3-N (mg/L)		NO2-N (mg/L)		PO4-P (mg/L)		TOC (ppm)		TN (ppm)		E.coli (MPN /100 mL)	Ecoli (log10 MPN 100 m/L)	.coli (MPN /100 ml		TSS(mg/L)		TSS (SD)
		Inlet	outlet	Inlet	outlet	Inlet	outlet	Inlet	outlet	Inlet	outlet	Inlet	outlet	Inlet	outlet	Inlet	outlet	Inlet	outlet	outlet
20/07/2018	9.4	0.04	0.02	0.02	0.03	0.05	0.01	0.17	0.96	10.949	10.32	0.4402	0.3771	2490	3.396199347	2880	3.45939	11.00	0.00	0.00
21/07/2018	0.8	0.02	0	0.00	0.01	0.011	0.012	0.15	0.16	5.824	6.543	0.5477	0.3215	2440	3.387389826	3160	3.49969	23.00	0.00	0.00
22/07/2018	0		0.01		0.03		0.024		0.15		6.509		0.2566						0	0
23/07/2018	0		0.01		0.01		0.011		0.11		1.564		0.3056						0.00	0
24/07/2018	3	0.01	0.02	0.05	0.03	0.007	0.008	0	0.05	0.9188	7.525	0.8717	0.3051	1460	3.164352856	1580	3.19866	2.70	0.00	0.00
25/07/2018	7.2	0.02	0.01	0.04	0.01	0.005	0.004	0.09	0.08	4.556	6.756	0.3656	0.2608	2180	3.338456494	2660	3.42488	50.00	0.00	0.00
26/07/2018	0.2	0.05	0.01	0.08	0.03	0.002	0.001	0.02	0.03	3.583	6.899	0.4156	0.2617	1520	3.181843588	1660	3.22011	65.00	0.00	0.00
27/07/2018	0		0.07		0.01		0		0.08		6.913		0.2594						2.00	0
28/07/2018	0		0		0.02		0.002		0.1		6.548		0.2321						0.00	0.00
29/07/2018	2.2	0.02	0.01	0.01	0.02		0.008	0.2	0.18	0.5913	6.36	0.5631	0.2591	1190	3.075546961	2690	3.42975	5.00	0.00	0.00
30/07/2018	0	0.07	0	0.03	0.04	0.003	0.004	0.02	0.03	1.551	6.9	0.8518	0.3098	1830	3.26245109	3790	3.57864	5.34	5.34	2.00
31/07/2018	1.6	0.15	0.27	0.03	0.02		0.007	0.13	0.16	4.556	6.773	0.4675	0.2326	1046	3.019531685	2419.6	3.38374	1.00	2.00	0.00
1/08/2018	2.6	0.01	0	0.04	0.02	0.059	0.011	0.17	0.18	3.583	6.76	0.3546	0.2853	1350	3.130333768	1560	3.19312	2.00	4.00	0.00
2/08/2018	0	0.08	0.05	0.02	0.03	0.224	0.009	0.09	0.1	5.824	7.237	0.5676	0.3606	10.5	1.021189299	1880	3.27416	5.00	6.00	0.00
3/08/2018	21.2	0.04	0.01	0.05	0.03	0.103	0.006	0.16	0.17	6.982	7.908	0.4292	0.3254	41060	4.613418945	43520	4.63869	35.00	2.00	0.00
7/08/2018	7.2	0.05	0.1	0.06	0.05	0.003	0.004	0.03	0.3	0.917	1.201	0.8518	0.3673	1460	3.164352856	1890	3.27646	13.40	10.66	2.00
11/08/2018	7.8	0.21	0.27	0.1	0.11	0.11	0.013	0.023	0.13	3.775	10.35	0.4800	0.6369	2990	3.475671188	3090	3.48996	1.00	2.00	0.00
12/08/2018	3	0.01	0	0.1	0.07	0.008	0.009	0.25	0.39	1.919	11.58	1.715	2.504	1390	3.1430148	1690	3.22789	5.00	2.00	0.00
15/08/2018	0	0.05	0.08	0.02	0.00	0.007	0.008	0.03	0.3	3.983	5.383	0.595	8701	1340	3.127104798	1080	3.03342	13.40	21.33	2.3094
16/08/2018	3.2	0.03	0.05	0.01	0	0.005	0.009	0.1	0.12	6.982	9.379	0.723	0.5822	1750	3.243038049	2160	3.33445	11.00	14.00	0.00
17/08/2018	0	0	0.01	0.03	0.01	0.009	0.008	0.14	0.16	6.982	9.794	0.651	0.5838	1220	3.086359831	1410	3.14922	5.00	4.00	4.00

[2]

[2] Empty spaces indicates no samples have been collected from inlet pond during these days

7.3 Online monitoring Data from May to Aug 2018

pH					
Pond 2		**Pond 5**		**injection sump**	
1/05/2018 7:01	7.73	1/05/2018 7:01	7.41	1/05/2018 6:52	8.09
1/05/2018 14:56	7.73	1/05/2018 14:56	7.45	1/05/2018 14:42	7.79
1/05/2018 22:51	7.73	1/05/2018 22:51	7.4	1/05/2018 22:31	8.06
2/05/2018 6:46	7.76	2/05/2018 6:46	7.39	2/05/2018 6:20	7.95
2/05/2018 14:41	7.76	2/05/2018 14:41	7.43	2/05/2018 14:09	7.74
2/05/2018 22:36	7.76	2/05/2018 22:36	7.37	2/05/2018 21:58	7.9
3/05/2018 6:31	7.73	3/05/2018 6:31	7.37	3/05/2018 5:47	8.06
3/05/2018 14:26	7.76	3/05/2018 14:26	7.4	3/05/2018 13:37	8.13
3/05/2018 22:21	8.05	3/05/2018 22:21	7.69	3/05/2018 21:26	7.96
4/05/2018 6:17	8.01	4/05/2018 6:17	7.91	4/05/2018 5:15	8.24
4/05/2018 14:12	8.05	4/05/2018 14:12	7.83	4/05/2018 13:04	8.18
4/05/2018 22:07	8.16	4/05/2018 22:07	7.66	4/05/2018 20:53	8.23
5/05/2018 6:02	8.1	5/05/2018 6:02	7.6	5/05/2018 4:43	8.2
5/05/2018 13:57	7.98	5/05/2018 13:57	7.81	5/05/2018 12:32	8.07
5/05/2018 21:52	8.38	5/05/2018 21:52	7.5	5/05/2018 20:21	8.12
6/05/2018 5:47	8.36	6/05/2018 5:47	7.47	6/05/2018 4:10	8.07
6/05/2018 13:42	8.29	6/05/2018 13:42	7.66	6/05/2018 11:59	7.95
6/05/2018 21:37	8.52	6/05/2018 21:37	7.47	6/05/2018 19:48	7.99
7/05/2018 5:32	8.51	7/05/2018 5:32	7.51	7/05/2018 3:38	7.85
7/05/2018 13:27	8.4	7/05/2018 13:27	7.53	7/05/2018 11:27	7.75
7/05/2018 21:22	8.27	7/05/2018 21:22	7.43	7/05/2018 19:16	7.77
8/05/2018 5:17	8.12	8/05/2018 5:17	7.42	8/05/2018 3:05	7.73
8/05/2018 13:12	7.91	8/05/2018 13:12	7.53	8/05/2018 10:54	7.68
8/05/2018 21:07	7.87	8/05/2018 21:07	7.37	8/05/2018 18:44	7.66
9/05/2018 5:02	7.83	9/05/2018 5:02	7.37	9/05/2018 2:33	7.63
9/05/2018 12:57	7.77	9/05/2018 12:57	7.44	9/05/2018 10:22	7.59
9/05/2018 20:52	7.75	9/05/2018 20:52	7.35	9/05/2018 18:11	7.58
10/05/2018 4:47	7.75	10/05/2018 4:47	7.32	10/05/2018 2:00	8.01
10/05/2018 12:42	7.73	10/05/2018 12:42	7.43	10/05/2018 9:49	8.81
10/05/2018 20:38	7.7	10/05/2018 20:38	7.35	10/05/2018 17:39	7.99
11/05/2018 4:33	7.74	11/05/2018 4:33	7.38	11/05/2018 1:28	7.9
11/05/2018 12:28	7.82	11/05/2018 12:28	7.57	11/05/2018 9:17	7.92
11/05/2018 20:23	8.31	11/05/2018 20:23	7.56	11/05/2018 17:06	7.61
12/05/2018 4:18	8.49	12/05/2018 4:18	7.54	12/05/2018 0:55	7.59
12/05/2018 12:13	8.48	12/05/2018 12:13	7.72	12/05/2018 8:44	7.39
12/05/2018 20:08	8.4	12/05/2018 20:08	7.48	12/05/2018 16:34	7.44
13/05/2018 4:03	8.35	13/05/2018 4:03	7.4	13/05/2018 0:23	7.19
13/05/2018 11:58	8.48	13/05/2018 11:58	7.61	13/05/2018 8:12	7.12
13/05/2018 19:53	8.4	13/05/2018 19:53	7.41	13/05/2018 16:01	7.12
14/05/2018 3:48	8.21	14/05/2018 3:48	7.34	13/05/2018 23:50	7.03

pH					
Pond 2		**Pond 5**		**injection sump**	
14/05/2018 11:43	8.1	14/05/2018 11:43	7.43	14/05/2018 7:40	6.95
14/05/2018 19:38	8.01	14/05/2018 19:38	7.31	14/05/2018 15:29	6.99
15/05/2018 3:33	8.01	15/05/2018 3:33	7.29	14/05/2018 23:18	6.99
15/05/2018 11:28	7.97	15/05/2018 11:28	7.38	15/05/2018 7:07	6.92
15/05/2018 19:23	7.87	15/05/2018 19:23	7.26	15/05/2018 14:56	6.98
16/05/2018 3:18	7.89	16/05/2018 3:18	7.25	15/05/2018 22:45	6.96
16/05/2018 11:13	7.86	16/05/2018 11:13	7.47	16/05/2018 6:35	6.94
16/05/2018 19:08	7.84	16/05/2018 19:08	7.28	16/05/2018 14:24	6.94
17/05/2018 3:04	7.84	17/05/2018 3:04	7.26	16/05/2018 22:13	6.97
17/05/2018 10:59	7.85	17/05/2018 10:59	7.28	17/05/2018 6:02	6.93
17/05/2018 18:54	7.84	17/05/2018 18:54	7.25	17/05/2018 13:51	8.38
18/05/2018 2:49	7.81	18/05/2018 2:49	7.23	17/05/2018 21:40	8.34
18/05/2018 10:44	7.8	18/05/2018 10:44	7.35	18/05/2018 5:30	8.3
18/05/2018 18:39	7.81	18/05/2018 18:39	7.35	18/05/2018 13:19	7.83
19/05/2018 2:34	8.01	19/05/2018 2:34	7.5	18/05/2018 21:08	7.89
19/05/2018 10:29	7.9	19/05/2018 10:29	7.6	19/05/2018 4:57	7.73
19/05/2018 18:24	8.03	19/05/2018 18:24	7.43	19/05/2018 12:46	7.76
20/05/2018 2:19	8.01	20/05/2018 2:19	7.35	19/05/2018 20:36	7.84
20/05/2018 10:14	8.06	20/05/2018 10:14	7.39	20/05/2018 4:25	7.74
20/05/2018 18:09	8.49	20/05/2018 18:09	7.41	20/05/2018 12:14	7.72
21/05/2018 2:04	8.56	21/05/2018 2:04	7.33	20/05/2018 20:03	7.65
21/05/2018 9:59	8.35	21/05/2018 9:59	7.37	21/05/2018 3:52	7.66
21/05/2018 17:54	8.76	21/05/2018 17:54	7.39	21/05/2018 11:41	7.56
22/05/2018 1:49	8.79	22/05/2018 1:49	7.36	21/05/2018 19:31	7.59
22/05/2018 9:44	8.61	22/05/2018 9:44	7.42	22/05/2018 3:20	7.52
22/05/2018 17:39	8.88	22/05/2018 17:39	7.38	22/05/2018 11:09	7.49
23/05/2018 1:34	8.91	23/05/2018 1:34	7.42	22/05/2018 18:58	7.46
23/05/2018 9:29	8.72	23/05/2018 9:29	7.42	23/05/2018 2:47	7.43
23/05/2018 17:25	8.83	23/05/2018 17:25	7.42	23/05/2018 10:37	7.41
24/05/2018 1:20	8.94	24/05/2018 1:20	7.47	23/05/2018 18:26	7.57
24/05/2018 9:15	8.78	24/05/2018 9:15	7.44	24/05/2018 2:15	7.64
24/05/2018 17:10	8.66	24/05/2018 17:10	5.72	24/05/2018 10:04	7.4
25/05/2018 1:05	8.53	25/05/2018 1:05	7.4	24/05/2018 17:53	7.36
25/05/2018 9:00	8.41	25/05/2018 9:00	7.39	25/05/2018 1:42	7.36
25/05/2018 16:55	8.3	25/05/2018 16:55	7.37	25/05/2018 9:32	7.33
26/05/2018 0:50	8.19	26/05/2018 0:50	7.33	25/05/2018 17:21	7.34
26/05/2018 8:45	8.15	26/05/2018 8:45	7.31	26/05/2018 1:10	7.25
26/05/2018 16:40	8.06	26/05/2018 16:40	7.36	26/05/2018 8:59	7.21
27/05/2018 0:35	7.99	27/05/2018 0:35	7.28	26/05/2018 16:48	7.15
27/05/2018 8:30	7.93	27/05/2018 8:30	7.26	27/05/2018 0:37	7.08
27/05/2018 16:25	7.93	27/05/2018 16:25	7.29	27/05/2018 8:27	7.05
28/05/2018 0:20	7.92	28/05/2018 0:20	7.23	27/05/2018 16:16	7.01
28/05/2018 8:15	7.89	28/05/2018 8:15	7.22	28/05/2018 0:05	6.99

pH					
Pond 2		**Pond 5**		**injection sump**	
28/05/2018 16:10	7.87	28/05/2018 16:10	7.23	28/05/2018 7:54	6.94
29/05/2018 0:05	7.85	29/05/2018 0:05	7.2	28/05/2018 15:43	6.94
29/05/2018 8:00	7.84	29/05/2018 8:00	7.19	28/05/2018 23:33	6.92
29/05/2018 15:55	7.83	29/05/2018 15:55	7.23	29/05/2018 7:22	6.92
29/05/2018 23:51	7.84	29/05/2018 23:51	7.19	29/05/2018 15:11	6.92
30/05/2018 7:46	7.83	30/05/2018 7:46	7.21	29/05/2018 23:00	6.91
30/05/2018 15:41	7.83	30/05/2018 15:41	7.26	30/05/2018 6:49	6.91
30/05/2018 23:36	7.81	30/05/2018 23:36	7.2	30/05/2018 14:38	6.94
31/05/2018 7:31	7.81	31/05/2018 7:31	7.21	30/05/2018 22:28	6.91
31/05/2018 15:26	7.82	31/05/2018 15:26	7.23	31/05/2018 6:17	6.89
31/05/2018 23:21	7.8	31/05/2018 23:21	7.18	31/05/2018 14:06	6.93
1/06/2018 7:16	7.83	1/06/2018 7:16	7.19	31/05/2018 21:55	6.91
1/06/2018 15:11	7.82	1/06/2018 15:11	7.26	1/06/2018 5:44	6.9
1/06/2018 23:06	7.81	1/06/2018 23:06	7.2	1/06/2018 13:34	6.95
2/06/2018 7:01	7.84	2/06/2018 7:01	7.21	1/06/2018 21:23	6.93
2/06/2018 14:56	7.86	2/06/2018 14:56	7.29	2/06/2018 5:12	6.92
2/06/2018 22:51	7.83	2/06/2018 22:51	7.19	2/06/2018 13:01	6.96
3/06/2018 6:46	7.84	3/06/2018 6:46	7.21	2/06/2018 20:50	6.96
3/06/2018 14:41	7.88	3/06/2018 14:41	7.3	3/06/2018 4:39	6.93
3/06/2018 22:36	7.83	3/06/2018 22:36	7.2	3/06/2018 12:29	6.95
4/06/2018 6:31	7.84	4/06/2018 6:31	7.2	3/06/2018 20:18	6.95
4/06/2018 14:26	7.87	4/06/2018 14:26	7.26	4/06/2018 4:07	6.95
4/06/2018 22:21	7.84	4/06/2018 22:21	7.18	4/06/2018 11:56	6.92
5/06/2018 6:17		5/06/2018 6:17		4/06/2018 19:45	6.95
5/06/2018 14:12	7.86	5/06/2018 14:12	7.26	5/06/2018 3:34	6.93
5/06/2018 22:07	7.84	5/06/2018 22:07	7.19	5/06/2018 11:24	6.92
6/06/2018 6:02	7.85	6/06/2018 6:02	7.2	5/06/2018 19:13	6.96
6/06/2018 13:57	7.86	6/06/2018 13:57	7.26	6/06/2018 3:02	6.94
6/06/2018 21:52	7.85	6/06/2018 21:52	7.21	6/06/2018 10:51	6.92
7/06/2018 5:47	7.84	7/06/2018 5:47	7.2	6/06/2018 18:40	6.93
7/06/2018 13:42	7.86	7/06/2018 13:42	7.26	7/06/2018 2:30	6.91
7/06/2018 21:37	7.86	7/06/2018 21:37	7.23	7/06/2018 10:19	6.91
8/06/2018 5:32	7.85	8/06/2018 5:32	7.2	7/06/2018 18:08	6.94
8/06/2018 13:27	7.86	8/06/2018 13:27	7.24	8/06/2018 1:57	6.91
8/06/2018 21:22	7.84	8/06/2018 21:22	7.2	8/06/2018 9:46	6.9
9/06/2018 5:17	7.83	9/06/2018 5:17	7.2	8/06/2018 17:35	6.89
9/06/2018 13:12	7.86	9/06/2018 13:12	7.35	9/06/2018 1:25	6.88
9/06/2018 21:07	7.84	9/06/2018 21:07	7.18	9/06/2018 9:14	6.89
10/06/2018 5:02	7.83	10/06/2018 5:02	7.18	9/06/2018 17:03	6.89
10/06/2018 12:57	7.85	10/06/2018 12:57	7.26	10/06/2018 0:52	6.9
10/06/2018 20:52	7.82	10/06/2018 20:52	7.18	10/06/2018 8:41	6.9
11/06/2018 4:47	7.82	11/06/2018 4:47	7.17	10/06/2018 16:31	6.88
11/06/2018 12:42	7.87	11/06/2018 12:42	7.27	11/06/2018 0:20	6.87

pH					
Pond 2		**Pond 5**		**injection sump**	
11/06/2018 20:38	7.84	11/06/2018 20:38	7.18	11/06/2018 8:09	6.86
12/06/2018 4:33	7.82	12/06/2018 4:33	7.18	11/06/2018 15:58	6.87
12/06/2018 12:28	7.93	12/06/2018 12:28	7.27	11/06/2018 23:47	6.89
12/06/2018 20:23	8.15	12/06/2018 20:23	7.46	12/06/2018 7:36	6.87
13/06/2018 4:18	8.27	13/06/2018 4:18	7.61	12/06/2018 15:26	6.87
13/06/2018 12:13	8.29	13/06/2018 12:13	7.62	12/06/2018 23:15	7.29
13/06/2018 20:08	8.35	13/06/2018 20:08	7.58	13/06/2018 7:04	7.55
14/06/2018 4:03	8.35	14/06/2018 4:03	7.55	13/06/2018 14:53	7.5
14/06/2018 11:58	8.36	14/06/2018 11:58	7.56	13/06/2018 22:42	7.5
14/06/2018 19:53	8.57	14/06/2018 19:53	7.57	14/06/2018 6:31	7.42
15/06/2018 3:48	8.42	15/06/2018 3:48	7.51	14/06/2018 14:21	7.34
15/06/2018 11:43	8.39	15/06/2018 11:43	7.5	14/06/2018 22:10	7.37
15/06/2018 19:38	8.34	15/06/2018 19:38	7.49	15/06/2018 5:59	7.26
16/06/2018 3:33	8.33	16/06/2018 3:33	7.47	15/06/2018 13:48	7.26
16/06/2018 11:28	8.33	16/06/2018 11:28	7.49	15/06/2018 21:37	7.32
16/06/2018 19:23	8.28	16/06/2018 19:23	7.46	16/06/2018 5:27	7.24
17/06/2018 3:18	8.31	17/06/2018 3:18	7.46	16/06/2018 13:16	7.35
17/06/2018 11:13	8.29	17/06/2018 11:13	7.51	16/06/2018 21:05	7.33
17/06/2018 19:08	8.44	17/06/2018 19:08	7.43	17/06/2018 4:54	7.26
18/06/2018 3:04	8.43	18/06/2018 3:04	7.45	17/06/2018 12:43	7.31
18/06/2018 10:59	8.38	18/06/2018 10:59	7.5	17/06/2018 20:32	7.26
18/06/2018 18:54	8.5	18/06/2018 18:54	7.41	18/06/2018 4:22	7.32
19/06/2018 2:49	8.56	19/06/2018 2:49	7.42	18/06/2018 12:11	7.26
19/06/2018 10:44	8.41	19/06/2018 10:44	7.52	18/06/2018 20:00	7.24
19/06/2018 18:39	8.66	19/06/2018 18:39	7.49	19/06/2018 3:49	7.21
20/06/2018 2:34	8.82	20/06/2018 2:34	7.44	19/06/2018 11:38	7.18
20/06/2018 10:29	8.72	20/06/2018 10:29	7.57	19/06/2018 19:27	7.12
20/06/2018 18:24	8.67	20/06/2018 18:24	7.69	20/06/2018 3:17	7.07
21/06/2018 2:19	8.72	21/06/2018 2:19	7.77	20/06/2018 11:06	7.2
21/06/2018 10:14	8.77	21/06/2018 10:14	7.84	20/06/2018 18:55	7.28
21/06/2018 18:09	8.98	21/06/2018 18:09	7.63	21/06/2018 2:44	7.28
22/06/2018 2:04	9.12	22/06/2018 2:04	7.61	21/06/2018 10:33	7.28
22/06/2018 9:59	8.92	22/06/2018 9:59	7.91	21/06/2018 18:23	7.3
22/06/2018 17:54	8.81	22/06/2018 17:54	7.83	22/06/2018 2:12	7.26
23/06/2018 1:49	8.65	23/06/2018 1:49	7.61	22/06/2018 10:01	7.25
23/06/2018 9:44	8.54	23/06/2018 9:44	7.64	22/06/2018 17:50	7.28
23/06/2018 17:39	8.58	23/06/2018 17:39	7.59	23/06/2018 1:39	7.28
24/06/2018 1:34	8.44	24/06/2018 1:34	7.41	23/06/2018 9:28	7.28
24/06/2018 9:29	8.34	24/06/2018 9:29	7.45	23/06/2018 17:18	7.28
24/06/2018 17:25	8.37	24/06/2018 17:25	7.43	24/06/2018 1:07	7.28
25/06/2018 1:20	8.28	25/06/2018 1:20	7.35	24/06/2018 8:56	7.28
25/06/2018 9:15	8.2	25/06/2018 9:15	7.36	24/06/2018 16:45	7.28
25/06/2018 17:10	8.19	25/06/2018 17:10	7.41	25/06/2018 0:34	7.28

pH					
Pond 2		**Pond 5**		**injection sump**	
26/06/2018 1:05	8.15	26/06/2018 1:05	7.31	25/06/2018 8:24	7.27
26/06/2018 9:00	8.12	26/06/2018 9:00	7.31	25/06/2018 16:13	7.3
26/06/2018 16:55	8.12	26/06/2018 16:55	7.37	26/06/2018 0:02	7.27
27/06/2018 0:50	8.1	27/06/2018 0:50	7.28	26/06/2018 7:51	7.21
27/06/2018 8:45	8.08	27/06/2018 8:45	7.27	26/06/2018 15:40	7.3
27/06/2018 16:40	8.09	27/06/2018 16:40	7.38	26/06/2018 23:29	7.27
28/06/2018 0:35	8.07	28/06/2018 0:35	7.24	27/06/2018 7:19	7.27
28/06/2018 8:30	8.05	28/06/2018 8:30	7.26	27/06/2018 15:08	7.28
28/06/2018 16:25	8.09	28/06/2018 16:25	7.42	27/06/2018 22:57	7.28
29/06/2018 0:20	8.05	29/06/2018 0:20	7.25	28/06/2018 6:46	7.19
29/06/2018 8:15	8.03	29/06/2018 8:15	7.24	28/06/2018 14:35	7.23
29/06/2018 16:10	8.05	29/06/2018 16:10	7.4	28/06/2018 22:24	7.3
30/06/2018 0:05	8.01	30/06/2018 0:05	7.22	29/06/2018 6:14	7.21
30/06/2018 8:00	8.03	30/06/2018 8:00	7.22	29/06/2018 14:03	7.28
30/06/2018 15:55	8.12	30/06/2018 15:55	7.53	29/06/2018 21:52	7.29
30/06/2018 23:51	8.04	30/06/2018 23:51	7.19	30/06/2018 5:41	7.23
1/07/2018 7:46	8.04	1/07/2018 7:46	7.17	30/06/2018 13:30	7.2
1/07/2018 15:41	8.07	1/07/2018 15:41	7.59	30/06/2018 21:20	7.28
1/07/2018 23:36	8.02	1/07/2018 23:36	7.19	1/07/2018 5:09	7.25
2/07/2018 7:31	8.03	2/07/2018 7:31	7.19	1/07/2018 12:58	7.23
2/07/2018 15:26	8.09	2/07/2018 15:26	7.76	1/07/2018 20:47	7.29
2/07/2018 23:21	8.02	2/07/2018 23:21	7.18	2/07/2018 4:36	7.21
3/07/2018 7:16	8	3/07/2018 7:16	7.17	2/07/2018 12:25	7.23
3/07/2018 15:11	8.1	3/07/2018 15:11	7.62	2/07/2018 20:15	7.29
3/07/2018 23:06	8.01	3/07/2018 23:06	7.19	3/07/2018 4:04	7.19
4/07/2018 7:01	8.03	4/07/2018 7:01	7.17	3/07/2018 11:53	7.21
4/07/2018 14:56	8.11	4/07/2018 14:56	7.49	3/07/2018 19:42	7.27
4/07/2018 22:51	8.04	4/07/2018 22:51	7.2	4/07/2018 3:31	7.19
5/07/2018 6:46	8	5/07/2018 6:46	7.17	4/07/2018 11:21	7.2
5/07/2018 14:41	8.03	5/07/2018 14:41	7.22	4/07/2018 19:10	7.27
5/07/2018 22:36	8	5/07/2018 22:36	7.18	5/07/2018 2:59	7.26
6/07/2018 6:31	8.25	6/07/2018 6:31	7.17	5/07/2018 10:48	7.24
6/07/2018 14:26	8.56	6/07/2018 14:26	8.04	5/07/2018 18:37	7.2
6/07/2018 22:21	8.87	6/07/2018 22:21	7.36	6/07/2018 2:26	7.22
7/07/2018 6:17	8.73	7/07/2018 6:17	7.46	6/07/2018 10:16	7.14
7/07/2018 14:12	8.61	7/07/2018 14:12	8.17	6/07/2018 18:05	7.15
7/07/2018 22:07	8.63	7/07/2018 22:07	7.45	7/07/2018 1:54	7.19
8/07/2018 6:02	8.52	8/07/2018 6:02	7.35	7/07/2018 9:43	7.15
8/07/2018 13:57	8.61	8/07/2018 13:57	8.07	7/07/2018 17:32	7.22
8/07/2018 21:52	9	8/07/2018 21:52	7.42	8/07/2018 1:21	7.16
9/07/2018 5:47	8.81	9/07/2018 5:47	7.45	8/07/2018 9:11	7.16
9/07/2018 13:42	8.81	9/07/2018 13:42	8.13	8/07/2018 17:00	7.25
9/07/2018 21:37	9.25	9/07/2018 21:37	7.56	9/07/2018 0:49	7.2

pH					
Pond 2		**Pond 5**		**injection sump**	
10/07/2018 5:32	9.06	10/07/2018 5:32	7.54	9/07/2018 8:38	7.17
10/07/2018 13:27	9.03	10/07/2018 13:27	8.48	9/07/2018 16:27	7.24
10/07/2018 21:22	9.37	10/07/2018 21:22	7.53	10/07/2018 0:17	7.21
11/07/2018 5:17	9.22	11/07/2018 5:17	7.49	10/07/2018 8:06	7.18
11/07/2018 13:12	9.02	11/07/2018 13:12	8.39	10/07/2018 15:55	7.27
11/07/2018 21:07	9.13	11/07/2018 21:07	7.64	10/07/2018 23:44	7.26
12/07/2018 5:02	8.8	12/07/2018 5:02	7.49	11/07/2018 7:33	7.2
12/07/2018 12:57	8.6	12/07/2018 12:57	8.35	11/07/2018 15:22	7.29
12/07/2018 20:52	8.81	12/07/2018 20:52	7.55	11/07/2018 23:12	7.28
13/07/2018 4:47	8.7	13/07/2018 4:47	7.53	12/07/2018 7:01	7.29
13/07/2018 12:42	9	13/07/2018 12:42	8.48	12/07/2018 14:50	7.29
13/07/2018 20:38	9.4	13/07/2018 20:38	7.81	12/07/2018 22:39	7.24
14/07/2018 4:33	8.89	14/07/2018 4:33	7.75	13/07/2018 6:28	7.22
14/07/2018 12:28	9.09	14/07/2018 12:28	8.68	13/07/2018 14:17	7.24
14/07/2018 20:23	9.58	14/07/2018 20:23	7.72	13/07/2018 22:07	7.31
15/07/2018 4:18	9.08	15/07/2018 4:18	7.76	14/07/2018 5:56	7.28
15/07/2018 12:13	9.14	15/07/2018 12:13	8.79	14/07/2018 13:45	7.29
15/07/2018 20:08	9.56	15/07/2018 20:08	8.02	14/07/2018 21:34	7.41
16/07/2018 4:03	9.25	16/07/2018 4:03	7.72	15/07/2018 5:23	7.42
16/07/2018 11:58	9.23	16/07/2018 11:58	8.75	15/07/2018 13:13	7.4
16/07/2018 19:53	9.61	16/07/2018 19:53	8.04	15/07/2018 21:02	7.47
17/07/2018 3:48	9.43	17/07/2018 3:48	7.92	16/07/2018 4:51	7.38
17/07/2018 11:43	9.23	17/07/2018 11:43	8.39	16/07/2018 12:40	7.36
17/07/2018 19:38	9.35	17/07/2018 19:38	7.87	16/07/2018 20:29	7.4
18/07/2018 3:33	9.1	18/07/2018 3:33	7.94	17/07/2018 4:18	7.37
18/07/2018 11:28	8.98	18/07/2018 11:28	8.71	17/07/2018 12:08	7.39
18/07/2018 19:23	9.43	18/07/2018 19:23	8.12	17/07/2018 19:57	7.41
19/07/2018 3:18	9.15	19/07/2018 3:18	7.74	18/07/2018 3:46	7.42
19/07/2018 11:13	8.9	19/07/2018 11:13	8.11	18/07/2018 11:35	8.33
19/07/2018 19:08	8.69	19/07/2018 19:08	8.08	18/07/2018 19:24	8.46
20/07/2018 3:04	8.54	20/07/2018 3:04	7.73	19/07/2018 3:14	8.42
20/07/2018 10:59	8.52	20/07/2018 10:59	8.08	19/07/2018 11:03	8.27
20/07/2018 18:54	8.97	20/07/2018 18:54	7.78	19/07/2018 18:52	8.34
21/07/2018 2:49	8.6	21/07/2018 2:49	7.58	20/07/2018 2:41	8.19
21/07/2018 10:44	8.6	21/07/2018 10:44	7.61	20/07/2018 10:30	8.11
21/07/2018 18:39	9.35	21/07/2018 18:39	7.62	20/07/2018 18:19	8.39
22/07/2018 2:34	8.9	22/07/2018 2:34	7.56	21/07/2018 2:09	8.15
22/07/2018 10:29	8.7	22/07/2018 10:29	8.03	21/07/2018 9:58	7.91
22/07/2018 18:24	9.51	22/07/2018 18:24	7.73	21/07/2018 17:47	8.36
23/07/2018 2:19	9.08	23/07/2018 2:19	7.58	22/07/2018 1:36	8.03
23/07/2018 10:14	8.76	23/07/2018 10:14	7.79	22/07/2018 9:25	7.82
23/07/2018 18:09	9.44	23/07/2018 18:09	7.91	22/07/2018 17:14	8.2
24/07/2018 2:04	8.95	24/07/2018 2:04	7.63	23/07/2018 1:04	8.07

pH					
Pond 2		**Pond 5**		**injection sump**	
24/07/2018 9:59	8.58	24/07/2018 9:59	7.88	23/07/2018 8:53	7.84
24/07/2018 17:54	9.33	24/07/2018 17:54	7.99	23/07/2018 16:42	8.06
25/07/2018 1:49	9.14	25/07/2018 1:49	7.7	24/07/2018 0:31	8.09
25/07/2018 9:44	8.6	25/07/2018 9:44	7.81	24/07/2018 8:20	7.92
25/07/2018 17:39	9.05	25/07/2018 17:39	7.96	24/07/2018 16:10	8.35
26/07/2018 1:34	8.74	26/07/2018 1:34	7.72	24/07/2018 23:59	8.36
26/07/2018 9:29	8.51	26/07/2018 9:29	7.72	25/07/2018 7:48	7.99
26/07/2018 17:25	9.33	26/07/2018 17:25	7.98	25/07/2018 15:37	8.49
27/07/2018 1:20	9.11	27/07/2018 1:20	7.64	25/07/2018 23:26	8.37
27/07/2018 9:15	8.66	27/07/2018 9:15	7.67	26/07/2018 7:15	7.96
27/07/2018 17:10	9.47	27/07/2018 17:10	8.04	26/07/2018 15:05	8.3
28/07/2018 1:05	9.29	28/07/2018 1:05	7.76	26/07/2018 22:54	8.25
28/07/2018 9:00	8.78	28/07/2018 9:00	7.95	27/07/2018 6:43	7.9
28/07/2018 16:55	9.38	28/07/2018 16:55	8.34	27/07/2018 14:32	8.22
29/07/2018 0:50	9.32	29/07/2018 0:50	8.01	27/07/2018 22:21	8.31
29/07/2018 8:45	8.74	29/07/2018 8:45	7.99	28/07/2018 6:11	7.89
29/07/2018 16:40	9.07	29/07/2018 16:40	8.24	28/07/2018 14:00	8.19
30/07/2018 0:35	9.11	30/07/2018 0:35	7.87	28/07/2018 21:49	8.42
30/07/2018 8:30	8.7	30/07/2018 8:30	7.74	29/07/2018 5:38	8.04
30/07/2018 16:25	8.91	30/07/2018 16:25	8.11	29/07/2018 13:27	8.16
31/07/2018 0:20	9.28	31/07/2018 0:20	7.66	29/07/2018 21:16	8.44
31/07/2018 8:15	8.84	31/07/2018 8:15	7.63	30/07/2018 5:06	8.27
31/07/2018 16:10	8.67	31/07/2018 16:10	8.26	30/07/2018 12:55	8.2
1/08/2018 0:05	8.86	1/08/2018 0:05	7.63	30/07/2018 20:44	8.4
1/08/2018 8:00	8.57	1/08/2018 8:00	7.54	31/07/2018 4:33	8.19
1/08/2018 15:55	8.56	1/08/2018 15:55	8.05	31/07/2018 12:22	8.14
1/08/2018 23:51	8.72	1/08/2018 23:51	7.56	31/07/2018 20:11	8.42
2/08/2018 7:46	8.54	2/08/2018 7:46	7.51	1/08/2018 4:01	8.18
2/08/2018 15:41	9.02	2/08/2018 15:41	7.87	1/08/2018 11:50	8.35
2/08/2018 23:36	9.04	2/08/2018 23:36	7.53	1/08/2018 19:39	8.37
3/08/2018 7:31	8.53	3/08/2018 7:31	7.5	2/08/2018 3:28	8.03
3/08/2018 15:26	8.46	3/08/2018 15:26	7.99	2/08/2018 11:17	7.89
3/08/2018 23:21	8.45	3/08/2018 23:21	7.45		
4/08/2018 7:16	8.47	4/08/2018 7:16	7.51		
4/08/2018 15:11	8.65	4/08/2018 15:11	8.02	3/08/2018 10:45	8.86
4/08/2018 23:06	8.62	4/08/2018 23:06	7.55	3/08/2018 18:34	7.99
5/08/2018 7:01	8.54	5/08/2018 7:01	7.49	4/08/2018 2:23	7.72
5/08/2018 14:56	8.85	5/08/2018 14:56	7.56	4/08/2018 10:12	7.61
5/08/2018 22:51	8.85	5/08/2018 22:51	7.48	4/08/2018 18:02	7.94
6/08/2018 6:46	8.49	6/08/2018 6:46	7.5	5/08/2018 1:51	7.7
6/08/2018 14:41	8.48	6/08/2018 14:41	7.64	5/08/2018 9:40	7.59
6/08/2018 22:36	8.47	6/08/2018 22:36	7.42	5/08/2018 17:29	7.7
7/08/2018 6:31	8.45	7/08/2018 6:31	7.44	6/08/2018 1:18	7.54

pH					
Pond 2		**Pond 5**		**injection sump**	
7/08/2018 14:26	8.45	7/08/2018 14:26	7.59	6/08/2018 9:08	7.48
7/08/2018 22:21	8.44	7/08/2018 22:21	7.42	6/08/2018 16:57	7.7
8/08/2018 6:17	8.41	8/08/2018 6:17	7.34	7/08/2018 0:46	7.62
8/08/2018 14:12	8.44	8/08/2018 14:12	7.38	7/08/2018 8:35	7.5
8/08/2018 22:07	8.52	8/08/2018 22:07	7.28	7/08/2018 16:24	7.82
9/08/2018 6:02	8.44	9/08/2018 6:02	7.17	8/08/2018 0:13	7.65
9/08/2018 13:57	8.55	9/08/2018 13:57	7.34	8/08/2018 8:03	7.53
9/08/2018 21:52	8.64	9/08/2018 21:52	7.21	8/08/2018 15:52	7.67
10/08/2018 5:47	8.44	10/08/2018 5:47	7.19	8/08/2018 23:41	7.67
10/08/2018 13:42	8.42	10/08/2018 13:42	7.29	9/08/2018 7:30	7.67
10/08/2018 21:37	8.39	10/08/2018 21:37	7.18	9/08/2018 15:19	7.68
11/08/2018 5:32	8.35	11/08/2018 5:32	7.16	9/08/2018 23:08	7.68
11/08/2018 13:27	8.31	11/08/2018 13:27	7.23	10/08/2018 6:58	7.67
11/08/2018 21:22	8.25	11/08/2018 21:22	7.15	10/08/2018 14:47	7.75
12/08/2018 5:17	8.22	12/08/2018 5:17	7.12	10/08/2018 22:36	7.75
12/08/2018 13:12	8.28	12/08/2018 13:12	7.38	11/08/2018 6:25	7.66
12/08/2018 21:07	8.42	12/08/2018 21:07	7.13	11/08/2018 14:14	7.46
13/08/2018 5:02	8.42	13/08/2018 5:02	7.18	11/08/2018 22:04	7.25
13/08/2018 12:57	8.45	13/08/2018 12:57	7.28	12/08/2018 5:53	7.05
13/08/2018 20:52	8.48	13/08/2018 20:52	7.16	12/08/2018 13:42	8.7
14/08/2018 4:47	8.42	14/08/2018 4:47	7.14	12/08/2018 21:31	8.7
14/08/2018 12:42	8.5	14/08/2018 12:42	7.41	13/08/2018 5:20	8.69
14/08/2018 20:38	8.96	14/08/2018 20:38	7.16	13/08/2018 13:09	7.47
15/08/2018 4:33	8.69	15/08/2018 4:33	7.23	13/08/2018 20:59	7.11
15/08/2018 12:28	8.64	15/08/2018 12:28	7.26	14/08/2018 4:48	7.11
15/08/2018 20:23	9.3	15/08/2018 20:23	7.2	14/08/2018 12:37	7.6
16/08/2018 4:18	9.05	16/08/2018 4:18	7.24	14/08/2018 20:26	7.94
16/08/2018 12:13	8.64	16/08/2018 12:13	7.56	15/08/2018 4:15	7.73
16/08/2018 20:08	8.45	16/08/2018 20:08	7.28	15/08/2018 12:04	7.65
17/08/2018 4:03	8.47	17/08/2018 4:03	7.27	15/08/2018 19:54	7.92
17/08/2018 11:58	8.59	17/08/2018 11:58	7.62	16/08/2018 3:43	7.6
17/08/2018 19:53	9.3	17/08/2018 19:53	7.39	16/08/2018 11:32	7.61
18/08/2018 3:48	8.92	18/08/2018 3:48	7.32	16/08/2018 19:21	7.82
18/08/2018 11:43	8.56	18/08/2018 11:43	7.74	17/08/2018 3:10	7.7
18/08/2018 19:38	8.73	18/08/2018 19:38	7.51	17/08/2018 11:00	7.76
19/08/2018 3:33	8.57	19/08/2018 3:33	7.36	17/08/2018 18:49	7.93
19/08/2018 11:28	8.52	19/08/2018 11:28	7.53	18/08/2018 2:38	7.91
19/08/2018 19:23	8.98	19/08/2018 19:23	7.6	18/08/2018 10:27	7.86
20/08/2018 3:18	8.69	20/08/2018 3:18	7.39	18/08/2018 18:16	8.16
20/08/2018 11:13	8.62	20/08/2018 11:13	7.47	19/08/2018 2:05	8
20/08/2018 19:08	9.32	20/08/2018 19:08	7.58	19/08/2018 9:55	7.84
21/08/2018 3:04	9.03	21/08/2018 3:04	7.36	19/08/2018 17:44	8.11
21/08/2018 10:59	8.68	21/08/2018 10:59	7.55	20/08/2018 1:33	8.07

pH					
Pond 2		**Pond 5**		**injection sump**	
21/08/2018 18:54	9.14	21/08/2018 18:54	7.66	20/08/2018 9:22	7.81
22/08/2018 2:49	9.18	22/08/2018 2:49	7.32	20/08/2018 17:11	8.16
22/08/2018 10:44	8.95	22/08/2018 10:44	7.62	21/08/2018 1:01	8.11
22/08/2018 18:39	9.1	22/08/2018 18:39	7.75	21/08/2018 8:50	7.84
23/08/2018 2:34	8.99	23/08/2018 2:34	7.39	21/08/2018 16:39	8.14
23/08/2018 10:29	8.64	23/08/2018 10:29	7.36	22/08/2018 0:28	8.17
23/08/2018 18:24	8.98	23/08/2018 18:24	7.61	22/08/2018 8:17	7.83
24/08/2018 2:19	8.97	24/08/2018 2:19	7.38	22/08/2018 16:06	8.16
24/08/2018 10:14	8.68	24/08/2018 10:14	7.51	22/08/2018 23:56	8.26
24/08/2018 18:09	9.3	24/08/2018 18:09	7.67	23/08/2018 7:45	7.98
25/08/2018 2:04	9.35	25/08/2018 2:04	7.39	23/08/2018 15:34	7.77
25/08/2018 9:59	9.03	25/08/2018 9:59	7.49	23/08/2018 23:23	8.2
25/08/2018 17:54	8.91	25/08/2018 17:54	7.77	24/08/2018 7:12	7.94
26/08/2018 1:49	8.7	26/08/2018 1:49	7.36	24/08/2018 15:01	8.14
26/08/2018 9:44	8.73	26/08/2018 9:44	7.43	24/08/2018 22:51	8.33
26/08/2018 17:39	8.84	26/08/2018 17:39	7.98	25/08/2018 6:40	8.05
27/08/2018 1:34	8.63	27/08/2018 1:34	7.36	25/08/2018 14:29	8.15
27/08/2018 9:29	8.62	27/08/2018 9:29	7.34	25/08/2018 22:18	8.45
27/08/2018 17:25	9.25	27/08/2018 17:25	7.41	26/08/2018 6:07	8.2
28/08/2018 1:20	9.34	28/08/2018 1:20	7.45	26/08/2018 13:57	7.9
28/08/2018 9:15	8.99	28/08/2018 9:15	7.65	26/08/2018 21:46	7.5
28/08/2018 17:10	9.26	28/08/2018 17:10	8.03	27/08/2018 5:35	8.15
29/08/2018 1:05	9.4	29/08/2018 1:05	7.59	27/08/2018 13:24	7.76
29/08/2018 9:00	8.98	29/08/2018 9:00	7.68	27/08/2018 21:13	8.53
29/08/2018 16:55	8.99	29/08/2018 16:55	8.07	28/08/2018 5:02	8.25
30/08/2018 0:50	9.22	30/08/2018 0:50	7.62	28/08/2018 12:52	8.13
30/08/2018 8:45	8.93	30/08/2018 8:45	7.47	28/08/2018 20:41	8.47
30/08/2018 16:40	8.92	30/08/2018 16:40	7.49	29/08/2018 4:30	8.23
31/08/2018 0:35	8.65	31/08/2018 0:35	7.46	29/08/2018 12:19	7.66
31/08/2018 8:30	8.51	31/08/2018 8:30	7.47	29/08/2018 20:08	8.49
31/08/2018 16:25	8.42	31/08/2018 16:25	7.85	30/08/2018 3:58	8.27
				30/08/2018 11:47	7.65
				30/08/2018 19:36	8.08
				31/08/2018 3:25	7.94
				31/08/2018 11:14	7.87
				31/08/2018 19:03	7.94

turbidity					
Pond 2		**Pond 5**		**injection sump**	
43221.24	0	43221.1	0	43221.17	0.53
43221.57	-0.01	43221.43	0	43221.5	0.58
43221.9	-0.01	43221.76	0	43221.83	0.52
43222.24	-0.01	43222.09	0	43222.16	0.54

turbidity					
Pond 2		**Pond 5**		**injection sump**	
43222.57	-0.01	43222.43	0	43222.48	0.51
43222.9	-0.01	43222.76	0	43222.81	0.53
43223.23	-0.01	43223.09	0	43223.14	0.51
43223.57	-0.01	43223.42	0	43223.47	0.52
43223.9	-0.01	43223.75	0	43223.79	0.51
43224.23	-0.01	43224.08	0	43224.12	4.08
43224.57	-0.01	43224.41	0	43224.45	2.81
43224.9	-0.01	43224.74	0	43224.78	2.25
43225.23	-0.01	43225.08	0	43225.1	2.12
43225.56	-0.01	43225.41	0	43225.43	1.96
43225.9	-0.01	43225.74	0	43225.76	1.64
43226.23	-0.01	43226.07	0	43226.09	1.55
43226.56	-0.01	43226.4	0	43226.41	1.41
43226.9	0	43226.73	0	43226.74	1.19
43227.23	-0.01	43227.06	0	43227.07	1.06
43227.56	-0.01	43227.4	0	43227.4	0.9
43227.89	-0.01	43227.73	0	43227.72	0.8
43228.23	-0.01	43228.06	0	43228.05	0.75
43228.56	-0.01	43228.39	0	43228.38	0.7
43228.89	-0.01	43228.72	0	43228.71	0.61
43229.23	0	43229.05	0	43229.03	0.63
43229.56	-0.01	43229.38	0	43229.36	0.63
43229.89	-0.01	43229.72	0	43229.69	0.53
43230.22	-0.01	43230.05	0	43230.02	0.52
43230.56	-0.01	43230.38	0	43230.34	0.52
43230.89	-0.01	43230.71	0	43230.67	2.22
43231.22	-0.01	43231.04	0	43231	1.89
43231.56	-0.01	43231.37	0	43231.33	1.63
43231.89	-0.01	43231.7	0	43231.65	0.25
43232.22	-0.01	43232.03	0	43231.98	0.27
43232.55	-0.01	43232.37	0	43232.31	0.28
43232.89	-0.01	43232.7	0	43232.64	0.29
43233.22	-0.01	43233.03	0	43232.96	0.29
43233.55	-0.01	43233.36	0	43233.29	0.3
43233.89	-0.01	43233.69	0	43233.62	0.3
43234.22	-0.01	43234.02	0	43233.95	0.32
43234.55	-0.01	43234.35	0	43234.27	0.32
43234.88	-0.01	43234.69	0	43234.6	0.3
43235.22	-0.01	43235.02	0	43234.93	0.31
43235.55	-0.01	43235.35	0	43235.25	0.32
43235.88	-0.01	43235.68	0	43235.58	0.3
43236.22	-0.01	43236.01	0	43235.91	0.33
43236.55	-0.01	43236.34	0	43236.24	0.35

turbidity					
Pond 2		**Pond 5**		**injection sump**	
43236.88	-0.01	43236.67	0	43236.57	0.33
43237.21	-0.01	43237	0	43236.89	0.33
43237.55	-0.01	43237.34	0	43237.22	0.32
43237.88	-0.01	43237.67	0	43237.55	5.65
43238.21	-0.01	43238	0	43237.88	4.09
43238.55	-0.01	43238.33	0	43238.2	3.46
43238.88	-0.01	43238.66	0	43238.53	2.7
43239.21	-0.01	43238.99	0	43238.86	2.16
43239.54	-0.01	43239.32	0	43239.18	2.01
43239.88	-0.01	43239.66	0	43239.51	1.82
43240.21	-0.01	43239.99	0	43239.84	1.66
43240.54	-0.01	43240.32	0	43240.17	1.65
43240.88	-0.01	43240.65	0	43240.5	1.54
43241.21	-0.01	43240.98	0	43240.82	1.4
43241.54	-0.01	43241.31	0	43241.15	1.24
43241.87	-0.01	43241.64	0	43241.48	1.13
43242.21	-0.01	43241.98	0	43241.8	1.06
43242.54	-0.01	43242.31	0	43242.13	0.92
43242.87	-0.01	43242.64	0	43242.46	0.9
43243.21	-0.01	43242.97	0	43242.79	0.78
43243.54	-0.01	43243.3	0	43243.11	0.82
43243.87	-0.01	43243.63	0	43243.44	0.72
43244.2	0	43243.96	0	43243.77	6.97
43244.54	-0.01	43244.3	0	43244.1	6.87
43244.87	-0.01	43244.63	0	43244.43	4.38
43245.2	-0.01	43244.96	0	43244.75	3.85
43245.54	-0.01	43245.29	0	43245.08	3.4
43245.87	-0.01	43245.62	0	43245.41	2.92
43246.2	-0.01	43245.95	0	43245.73	2.56
43246.53	-0.01	43246.28	0	43246.06	2.34
43246.87	-0.01	43246.61	0	43246.39	2.09
43247.2	-0.01	43246.95	0	43246.72	1.82
43247.53	-0.01	43247.28	0	43247.04	1.6
43247.87	-0.01	43247.61	0	43247.37	1.47
43248.2	-0.01	43247.94	0	43247.7	1.33
43248.53	-0.01	43248.27	0	43248.03	1.21
43248.86	-0.01	43248.6	0	43248.35	1.13
43249.2	-0.01	43248.93	0	43248.68	1.04
43249.53	-0.01	43249.27	0	43249.01	0.98
43249.86	-0.01	43249.6	0	43249.34	0.95
43250.2	-0.01	43249.93	0	43249.66	0.99
43250.53	-0.01	43250.26	0	43249.99	0.85
43250.86	-0.01	43250.59	0	43250.32	0.82

turbidity					
Pond 2		Pond 5		injection sump	
43251.19	-0.01	43250.92	0	43250.65	0.83
43251.53	-0.01	43251.25	0	43250.97	0.84
43251.86	-0.01	43251.58	0	43251.3	0.75
43252.19	-0.01	43251.92	0	43251.63	0.67
43252.53	-0.01	43252.25	0	43251.96	0.82
43252.86	-0.01	43252.58	0	43252.28	0.72
43253.19	-0.01	43252.91	0	43252.61	0.74
43253.52	0	43253.24	0	43252.94	0.87
43253.86	-0.01	43253.57	0	43253.27	0.7
43254.19	-0.01	43253.9	0	43253.59	0.69
43254.52	-0.01	43254.24	0	43253.92	0.92
43254.85	0	43254.57	0	43254.25	0.92
43255.19	-0.01	43254.9	0	43254.58	0.93
43255.52	-0.01	43255.23	0	43254.9	0.8
43255.85	-0.01	43255.56	0	43255.23	0.75
43256.19	-0.01	43255.89	0	43255.56	0.77
43256.52	-0.01	43256.22	0	43255.89	0.87
43256.85	-0.01	43256.56	0	43256.21	1.03
43257.18	-0.01	43256.89	0	43256.54	0.76
43257.52	-0.01	43257.22	0	43256.87	0.95
43257.85	-0.01	43257.55	0	43257.2	0.81
43258.18	-0.01	43257.88	0	43257.52	0.69
43258.52	-0.01	43258.21	0	43257.85	0.84
43258.85	-0.01	43258.54	0	43258.18	0.88
43259.18	-0.01	43258.88	0	43258.51	0.74
43259.51	-0.01	43259.21	0	43258.83	1.11
43259.85	-0.01	43259.54	0	43259.16	0.75
43260.18	-0.01	43259.87	0	43259.49	0.8
43260.51	-0.01	43260.2	0	43259.82	0.8
43260.85	-0.01	43260.53	0	43260.14	0.84
43261.18	-0.01	43260.86	0	43260.47	0.89
43261.51	-0.01	43261.19	0	43260.8	0.76
43261.84	-0.01	43261.53	0	43261.13	0.81
43262.18	-0.01	43261.86	0	43261.45	0.89
43262.51	-0.01	43262.19	0	43261.78	0.9
43262.84	-0.01	43262.52	0	43262.11	0.69
43263.18	-0.01	43262.85	0	43262.44	0.74
43263.51	-0.01	43263.18	0	43262.76	0.74
43263.84	-0.01	43263.51	0	43263.09	0.77
43264.17	-0.01	43263.85	0	43263.42	0.62
43264.51	-0.01	43264.18	0	43263.75	0.68
43264.84	-0.01	43264.51	0	43264.07	2.83
43265.17	-0.01	43264.84	0	43264.4	2.28

turbidity					
Pond 2		**Pond 5**		**injection sump**	
43265.51	-0.01	43265.17	0	43264.73	6.1
43265.84	-0.01	43265.5	0	43265.06	6.67
43266.17	-0.01	43265.83	0	43265.38	7.58
43266.5	-0.01	43266.16	0	43265.71	10.22
43266.84	-0.01	43266.5	0	43266.04	8.7
43267.17	-0.01	43266.83	0	43266.37	7.71
43267.5	-0.01	43267.16	0	43266.69	6
43267.84	-0.01	43267.49	0	43267.02	5.32
43268.17	-0.01	43267.82	0	43267.35	4.06
43268.5	-0.01	43268.15	0	43267.68	3.38
43268.83	-0.01	43268.48	0	43268	3.01
43269.17	-0.01	43268.82	0	43268.33	2.77
43269.5	-0.01	43269.15	0	43268.66	9.84
43269.83	-0.01	43269.48	0	43268.99	9.82
43270.17	-0.01	43269.81	0	43269.31	8.69
43270.5	-0.01	43270.14	0	43269.64	7.59
43270.83	-0.01	43270.47	0	43269.97	6.73
43271.16	-0.01	43270.8	0	43270.3	6.31
43271.5	-0.01	43271.14	0	43270.62	7.78
43271.83	-0.01	43271.47	0	43270.95	6.94
43272.16	-0.01	43271.8	0	43271.28	6.78
43272.5	-0.01	43272.13	0	43271.61	7.37
43272.83	-0.01	43272.46	0	43271.93	7.23
43273.16	-0.01	43272.79	0	43272.26	7
43273.49	-0.01	43273.12	0	43272.59	6.77
43273.83	-0.01	43273.45	0	43272.92	7.26
43274.16	-0.01	43273.79	0	43273.24	5.66
43274.49	-0.01	43274.12	0	43273.57	5.69
43274.83	-0.01	43274.45	0	43273.9	5.69
43275.16	-0.01	43274.78	0	43274.23	5.69
43275.49	-0.01	43275.11	0	43274.55	5.69
43275.82	-0.01	43275.44	0	43274.88	5.69
43276.16	-0.01	43275.77	0	43275.21	5.69
43276.49	-0.01	43276.11	0	43275.54	5.69
43276.82	-0.01	43276.44	0	43275.86	5.69
43277.15	-0.01	43276.77	0	43276.19	5.23
43277.49	-0.01	43277.1	0	43276.52	2.63
43277.82	-0.01	43277.43	0	43276.85	2
43278.15	-0.01	43277.76	0	43277.17	1.94
43278.49	-0.01	43278.09	0	43277.5	1.83
43278.82	-0.01	43278.43	0	43277.83	1.75
43279.15	-0.01	43278.76	0	43278.16	1.71
43279.48	-0.01	43279.09	0	43278.48	1.64

turbidity					
Pond 2		**Pond 5**		**injection sump**	
43279.82	-0.01	43279.42	0	43278.81	1.58
43280.15	-0.01	43279.75	0	43279.14	1.57
43280.48	-0.01	43280.08	0	43279.47	1.52
43280.82	-0.01	43280.41	0	43279.79	1.49
43281.15	0	43280.74	0	43280.12	1.47
43281.48	0	43281.08	0	43280.45	1.42
43281.81	0	43281.41	0	43280.78	1.38
43282.15	0	43281.74	0	43281.1	1.32
43282.48	0	43282.07	0	43281.43	1.32
43282.81	0	43282.4	0	43281.76	1.27
43283.15	0	43282.73	0	43282.09	1.22
43283.48	0	43283.06	0	43282.41	1.21
43283.81	0	43283.4	0	43282.74	1.15
43284.14	0	43283.73	0	43283.07	1.19
43284.48	0	43284.06	0	43283.4	1.09
43284.81	0	43284.39	0	43283.72	1.06
43285.14	0	43284.72	0	43284.05	1.05
43285.48	0	43285.05	0	43284.38	1.02
43285.81	0	43285.38	0	43284.71	1.02
43286.14	0	43285.72	0	43285.03	0.98
43286.47	0	43286.05	0	43285.36	0.96
43286.81	0	43286.38	0	43285.69	0.99
43287.14	0	43286.71	0	43286.02	0.96
43287.47	0	43287.04	0	43286.34	0.9
43287.81	0	43287.37	0	43286.67	0.87
43288.14	0	43287.7	0	43287	0.9
43288.47	0	43288.03	0	43287.33	0.85
43288.8	0	43288.37	0	43287.65	1.18
43289.14	0	43288.7	0	43287.98	2.96
43289.47	0	43289.03	0	43288.31	2.13
43289.8	0	43289.36	0	43288.64	2.53
43290.14	0	43289.69	0	43288.96	2.71
43290.47	0	43290.02	0	43289.29	3.38
43290.8	0	43290.35	0	43289.62	3.96
43291.13	0	43290.69	0	43289.95	4.25
43291.47	0	43291.02	0	43290.27	3.4
43291.8	0	43291.35	0	43290.6	3.04
43292.13	0	43291.68	0	43290.93	3.6
43292.47	0	43292.01	0	43291.25	2.43
43292.8	0	43292.34	0	43291.58	1.77
43293.13	0	43292.67	0	43291.91	1.47
43293.46	0	43293	0	43292.24	1.55
43293.8	0	43293.34	0	43292.57	1.31

turbidity					
Pond 2		**Pond 5**		**injection sump**	
43294.13	0	43293.67	0	43292.89	1.09
43294.46	0	43294	0	43293.22	0.96
43294.8	0	43294.33	0	43293.55	0.83
43295.13	0	43294.66	24.83	43293.88	0.69
43295.46	0	43294.99	23.55	43294.2	0.62
43295.79	0	43295.32	19.8	43294.53	0.58
43296.13	0	43295.66	23.89	43294.86	0.89
43296.46	0	43295.99	24.43	43295.18	1.43
43296.79	0	43296.32	25.93	43295.51	1.55
43297.13	0	43296.65	20.31	43295.84	1.88
43297.46	0	43296.98	20.67	43296.17	3.7
43297.79	0	43297.31	28.85	43296.5	3.68
43298.12	0	43297.64	17.78	43296.82	3.52
43298.46	0	43297.98	26.52	43297.15	2.64
43298.79	0	43298.31	27.36	43297.48	1.82
43299.12	0	43298.64	25.31	43297.8	1.45
43299.45	0	43298.97	41.4	43298.13	1.23
43299.79	0	43299.3	25.35	43298.46	1.1
43300.12	0	43299.63	22.16	43298.79	0.91
43300.45	0	43299.96	30.77	43299.11	2.78
43300.79	0	43300.3	25.71	43299.44	4.26
43301.12	0	43300.63	23.39	43299.77	4.29
43301.45	0	43300.96	33.5	43300.1	3.45
43301.78	0	43301.29	36.88	43300.43	2.6
43302.12	0	43301.62	36.98	43300.75	2.92
43302.45	0	43301.95	41.82	43301.08	3.63
43302.78	0	43302.28	36.54	43301.41	4.2
43303.12	0	43302.61	33.87	43301.73	9.77
43303.45	0	43302.95	46.65	43302.06	8.95
43303.78	0	43303.28	29.6	43302.39	7
43304.11	0	43303.61	26.01	43302.72	5.34
43304.45	0	43303.94	26.77	43303.04	3.98
43304.78	0	43304.27	23.61	43303.37	7.01
43305.11	0	43304.6	22.49	43303.7	6.32
43305.45	0	43304.93	20.94	43304.03	4.51
43305.78	0	43305.27	22.12	43304.35	5.5
43306.11	0	43305.6	24.75	43304.68	5.67
43306.44	0	43305.93	36.6	43305.01	4.45
43306.78	0	43306.26	29.64	43305.34	4.11
43307.11	0	43306.59	23.04	43305.66	3.7
43307.44	0	43306.92	23.17	43305.99	5.29
43307.78	0	43307.25	24.82	43306.32	5.05
43308.11	0	43307.58	22.38	43306.65	3.6

turbidity					
Pond 2		**Pond 5**		**injection sump**	
43308.44	0	43307.92	24.09	43306.97	2.61
43308.77	0	43308.25	19.72	43307.3	2.08
43309.11	0	43308.58	18.95	43307.63	1.59
43309.44	0	43308.91	20	43307.96	1.37
43309.77	0	43309.24	18.58	43308.28	1.17
43310.11	0	43309.57	18.3	43308.61	2.4
43310.44	0	43309.9	17.75	43308.94	1.91
43310.77	0	43310.24	21.49	43309.27	1.72
43311.1	0	43310.57	20.4	43309.59	1.49
43311.44	0	43310.9	19.15	43309.92	1.34
43311.77	0	43311.23	21.67	43310.25	1.3
43312.1	0	43311.56	20.73	43310.58	2.86
43312.44	0	43311.89	23.19	43310.9	3.27
43312.77	0	43312.22	22.71	43311.23	2.82
43313.1	0	43312.56	20.06	43311.56	2.46
43313.43	0	43312.89	27.12	43311.89	3.41
43313.77	0	43313.22	27.22	43312.21	2.69
43314.1	0	43313.55	20.3	43312.54	2.29
43314.43	0	43313.88	21.51	43312.87	1.81
43314.77	0	43314.21	23	43313.2	1.68
43315.1	0	43314.54	21.23	43313.52	1.49
43315.43	0	43314.88	22.08	43313.85	1.28
43315.76	0	43315.21	22.06	43314.18	1.21
43316.1	0	43315.54	19.66	43314.51	1.1
43316.43	0	43315.87	22.12	43314.83	0.96
43316.76	0	43316.2	26.65	43315.16	0.94
43317.1	0	43316.53	25.94	43315.49	3.53
43317.43	0	43316.86	30.49	43315.82	4.31
43317.76	0	43317.19	28.49	43316.14	3.93
43318.09	0	43317.53	27.13	43316.47	3.98
43318.43	0	43317.86	27.27	43316.8	5.43
43318.76	0	43318.19	25.73	43317.13	5.19
43319.09	0	43318.52	23.89	43317.45	5.01
43319.43	0	43318.85	26.76	43317.78	5.74
43319.76	0	43319.18	29.94	43318.11	6.35
43320.09	0	43319.51	29.26	43318.44	5.75
43320.42	0	43319.85	35.99	43318.76	6.28
43320.76	0	43320.18	36.85	43319.09	5.57
43321.09	0	43320.51	37.21	43319.42	5.8
43321.42	0	43320.84	35.15	43319.75	8.24
43321.75	0	43321.17	34.47	43320.07	7.99
43322.09	0	43321.5	31.6	43320.4	8.07
43322.42	0	43321.83	30.92	43320.73	8.35

turbidity					
Pond 2		**Pond 5**		**injection sump**	
43322.75	0	43322.16	30.45	43321.06	8.35
43323.09	0	43322.5	28.49	43321.38	8.33
43323.42	0	43322.83	27.82	43321.71	8.33
43323.75	0	43323.16	26.4	43322.04	8.34
43324.08	0	43323.49	25.06	43322.37	8.33
43324.42	0	43323.82	24.06	43322.69	8.33
43324.75	0	43324.15	22.7	43323.02	8.33
43325.08	0	43324.48	22.06	43323.35	7.56
43325.42	0	43324.82	21.93	43323.68	6.39
43325.75	0	43325.15	28.83	43324	5.22
43326.08	0	43325.48	26.68	43324.33	4.05
43326.41	0	43325.81	26.92	43324.66	5.86
43326.75	0	43326.14	23.97	43324.99	5.86
43327.08	0	43326.47	22.26	43325.31	5.87
43327.41	0	43326.8	26.7	43325.64	6.68
43327.75	0	43327.14	27.91	43325.97	5.36
43328.08	0	43327.47	26.49	43326.3	4.83
43328.41	0	43327.8	26.75	43326.62	5.3
43328.74	0	43328.13	37.23	43326.95	4.74
43329.08	0	43328.46	24.1	43327.28	4.35
43329.41	0	43328.79	23.42	43327.61	4.31
43329.74	0	43329.12	44.41	43327.93	4.06
43330.08	0	43329.45	28.12	43328.26	3.78
43330.41	0	43329.79	36.55	43328.59	7.78
43330.74	0	43330.12	31.63	43328.92	8.05
43331.07	0	43330.45	27.08	43329.24	12.59
43331.41	0	43330.78	25.6	43329.57	9.5
43331.74	0	43331.11	31.87	43329.9	10.69
43332.07	0	43331.44	24.07	43330.23	7.78
43332.41	0	43331.77	26.05	43330.55	7.75
43332.74	0	43332.11	27.35	43330.88	5.92
43333.07	0	43332.44	23.85	43331.21	4.6
43333.4	0	43332.77	22.6	43331.54	3.63
43333.74	0	43333.1	21.05	43331.86	2.97
43334.07	0	43333.43	20.72	43332.19	2.3
43334.4	0	43333.76	20.8	43332.52	2.14
43334.74	0	43334.09	20.27	43332.85	1.89
43335.07	0	43334.43	21.94	43333.17	2.16
43335.4	0	43334.76	21.35	43333.5	2.21
43335.73	0	43335.09	22.56	43333.83	1.79
43336.07	0	43335.42	22.47	43334.16	1.63
43336.4	0	43335.75	21.37	43334.48	1.58
43336.73	0	43336.08	21.93	43334.81	3.49

turbidity					
Pond 2		**Pond 5**		**injection sump**	
43337.07	0	43336.41	21.65	43335.14	2.69
43337.4	0	43336.74	21.24	43335.47	-5.43
43337.73	0	43337.08	20.5	43335.79	4.35
43338.06	0	43337.41	20.71	43336.12	4.19
43338.4	0	43337.74	19.99	43336.45	3.84
43338.73	0	43338.07	29.82	43336.78	4.02
43339.06	0	43338.4	21.23	43337.1	4
43339.4	0	43338.73	20.36	43337.43	3.06
43339.73	0	43339.06	61.88	43337.76	2.37
43340.06	0	43339.4	55.29	43338.09	1.9
43340.39	0	43339.73	35.91	43338.41	1.53
43340.73	0	43340.06	32.33	43338.74	1.35
43341.06	0	43340.39	27.48	43339.07	3.43
43341.39	0	43340.72	23.5	43339.4	2.39
43341.73	0	43341.05	27.97	43339.72	1.88
43342.06	0	43341.38	25.62	43340.05	1.53
43342.39	0	43341.72	23.04	43340.38	4.23
43342.72	0	43342.05	26.07	43340.71	4.63
43343.06	0	43342.38	29.63	43341.03	4.96
43343.39	0	43342.71	28.4	43341.36	3.5
43343.72	0	43343.04	30.95	43341.69	2.75
		43343.37	26.43	43342.02	1.8
		43343.7	24.45	43342.34	1.38
				43342.67	2.57
				43343	2.16
				43343.33	1.95
				43343.65	1.5
				43343.98	1.13

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
		1/05/2018 2:50	0	1/05/2018 2:50	1881.1	1/05/2018 15:21	-5.55
Time/Date	Value	1/05/2018 10:46	0	1/05/2018 10:46	1852.03	1/05/2018 23:14	-2.39
17/02/2018 7:55	1098.9	1/05/2018 18:42	0	1/05/2018 18:42	1893.75	2/05/2018 7:08	-2.04
17/02/2018 15:49	1097.82	2/05/2018 2:37	0	2/05/2018 2:37	1920.83	2/05/2018 15:01	-5.18
17/02/2018 23:42	1111.51	2/05/2018 10:33	0	2/05/2018 10:33	1918.95	2/05/2018 22:55	-4.24
18/02/2018 7:36	1126.71	2/05/2018 18:29	0	2/05/2018 18:29	1892.88	3/05/2018 6:49	-3.04
18/02/2018 15:30	1130.03	3/05/2018 2:25	0	3/05/2018 2:25	1931.98	3/05/2018 14:42	-3.54
18/02/2018 23:23	641.71	3/05/2018 10:20	0	3/05/2018 10:20	1970.04	3/05/2018 22:36	-2.5
19/02/2018 7:17	671.33	3/05/2018 18:16	0	3/05/2018 18:16	1933.02	4/05/2018 6:30	-1.17

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
19/02/2018 15:11	679.94	4/05/2018 2:12	0	4/05/2018 2:12	1708.8	4/05/2018 14:23	-3.83
19/02/2018 23:04	687.15	4/05/2018 10:08	0	4/05/2018 10:08	1644.71	4/05/2018 22:17	-2.22
20/02/2018 6:58	708.81	4/05/2018 18:03	0	4/05/2018 18:03	1578.04	5/05/2018 6:11	-1.67
20/02/2018 14:52	1251.78	5/05/2018 1:59	0	5/05/2018 1:59	1628.47	5/05/2018 14:04	-5.37
20/02/2018 22:45	1261.25	5/05/2018 9:55	0	5/05/2018 9:55	1568.2	5/05/2018 21:58	-2.71
21/02/2018 6:39	1268.57	5/05/2018 17:51	0	5/05/2018 17:51	1491.68	6/05/2018 5:52	-0.96
21/02/2018 14:33	1265.54	6/05/2018 1:46	0	6/05/2018 1:46	1535.9	6/05/2018 13:45	-5.37
21/02/2018 22:26	1271.14	6/05/2018 9:42	0	6/05/2018 9:42	1491.73	6/05/2018 21:39	-2.13
22/02/2018 6:20	1274.19	6/05/2018 17:38	0	6/05/2018 17:38	1393.6	7/05/2018 5:33	-2.85
22/02/2018 14:14	1274.15	7/05/2018 1:34	0	7/05/2018 1:34	1403.32	7/05/2018 13:26	-4.39
22/02/2018 22:07	1283.97	7/05/2018 9:29	0	7/05/2018 9:29	1387.56	7/05/2018 21:20	-2.19
23/02/2018 6:01	1285.87	7/05/2018 17:25	0	7/05/2018 17:25	1412.85	8/05/2018 5:14	-0.9
23/02/2018 13:55	1286.67	8/05/2018 1:21	0	8/05/2018 1:21	1395.99	8/05/2018 13:07	-4.34
23/02/2018 21:48	1305.42	8/05/2018 9:17	0	8/05/2018 9:17	1404.06	8/05/2018 21:01	-1.59
24/02/2018 5:42	259.16	8/05/2018 17:13	0	8/05/2018 17:13	1403.51	9/05/2018 4:55	-0.36
24/02/2018 13:36	345.89	9/05/2018 1:08	0	9/05/2018 1:08	1411.4	9/05/2018 12:48	-3
24/02/2018 21:29	401.27	9/05/2018 9:04	0	9/05/2018 9:04	1414.71	9/05/2018 20:42	-2.81
25/02/2018 5:23	449.15	9/05/2018 17:00	0	9/05/2018 17:00	1407.99	10/05/2018 4:36	-1.46
25/02/2018 13:17	469.07	10/05/2018 0:56	0	10/05/2018 0:56	1413.63	10/05/2018 12:29	-2.88
25/02/2018 21:10	498.03	10/05/2018 8:51	0	10/05/2018 8:51	1409.9	10/05/2018 20:23	-0.69
26/02/2018 5:04	540.62	10/05/2018 16:47	0	10/05/2018 16:47	1406.9	11/05/2018 4:17	-0.46
26/02/2018 12:58	576.31	11/05/2018 0:43	0	11/05/2018 0:43	1407.36	11/05/2018 12:10	-2.44
26/02/2018 20:51	620.19	11/05/2018 8:39	0	11/05/2018 8:39	1409.42	11/05/2018 20:04	4.76
27/02/2018 4:45	635	11/05/2018 16:34	0	11/05/2018 16:34	1393.97	12/05/2018 3:58	4
27/02/2018 12:38	647.98	12/05/2018 0:30	0	12/05/2018 0:30	1392.94	12/05/2018 11:51	2
27/02/2018 20:32	684.22	12/05/2018 8:26	0	12/05/2018 8:26	1387.87	12/05/2018 19:45	2.33
28/02/2018 4:26	709.4	12/05/2018 16:22	0	12/05/2018 16:22	1389.01	13/05/2018 3:38	3.76
28/02/2018 12:19	121.68	13/05/2018 0:17	0	13/05/2018 0:17	1396.91	13/05/2018 11:32	2.33
28/02/2018 20:13	24.31	13/05/2018 8:13	0	13/05/2018 8:13	1396.07	13/05/2018 19:26	3.61
1/03/2018 4:07	4.26	13/05/2018 16:09	0	13/05/2018 16:09	1377.05	14/05/2018 3:19	5.67
1/03/2018 12:00	-5.29	14/05/2018 0:05	0	14/05/2018 0:05	1397.9	14/05/2018 11:13	3.25
1/03/2018 19:54	649.58	14/05/2018 8:00	0	14/05/2018 8:00	1412.33	14/05/2018 19:07	4.14

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
2/03/2018 3:48	664.32	14/05/2018 15:56	0	14/05/2018 15:56	1425.43	15/05/2018 3:00	4.67
2/03/2018 11:41	670	14/05/2018 23:52	0	14/05/2018 23:52	1418.99	15/05/2018 10:54	2.05
2/03/2018 19:35	668.76	15/05/2018 7:48	0	15/05/2018 7:48	1424.01	15/05/2018 18:48	5.97
3/03/2018 3:29	679.49	15/05/2018 15:43	0	15/05/2018 15:43	1425.93	16/05/2018 2:41	8.31
3/03/2018 11:22	678.75	15/05/2018 23:39	0	15/05/2018 23:39	1424.74	16/05/2018 10:35	6
3/03/2018 19:16	677.81	16/05/2018 7:35	0	16/05/2018 7:35	1431.04	16/05/2018 18:29	6.99
4/03/2018 3:10	684.26	16/05/2018 15:31	0	16/05/2018 15:31	1418.4	17/05/2018 2:22	8.58
4/03/2018 11:03	692.84	16/05/2018 23:26	0	16/05/2018 23:26	1432.68	17/05/2018 10:16	0
4/03/2018 18:57	700.08	17/05/2018 7:22	0	17/05/2018 7:22	1433.85	17/05/2018 18:10	-0.74
5/03/2018 2:51	721.81	17/05/2018 15:18	0	17/05/2018 15:18	1427.02	18/05/2018 2:03	0
5/03/2018 10:44	726.45	17/05/2018 23:14	0	17/05/2018 23:14	1431.17	18/05/2018 9:57	0
5/03/2018 18:38	726.22	18/05/2018 7:09	0	18/05/2018 7:09	1431.44	18/05/2018 17:51	-0.26
6/03/2018 2:32	726.44	18/05/2018 15:05	0	18/05/2018 15:05	1427.68	19/05/2018 1:44	-0.17
6/03/2018 10:25	732.33	18/05/2018 23:01	0	18/05/2018 23:01	1408.75	19/05/2018 9:38	-2.36
6/03/2018 18:19	80	19/05/2018 6:57	0	19/05/2018 6:57	1411.33	19/05/2018 17:32	-0.88
7/03/2018 2:13	89.29	19/05/2018 14:52	0	19/05/2018 14:52	1369.83	20/05/2018 1:25	0.28
7/03/2018 10:06	37.72	19/05/2018 22:48	0	19/05/2018 22:48	1373.95	20/05/2018 9:19	-0.02
7/03/2018 18:00	-10.04	20/05/2018 6:44	0	20/05/2018 6:44	1376.46	20/05/2018 17:13	0
8/03/2018 1:54	-2.76	20/05/2018 14:40	0	20/05/2018 14:40	1382.65	21/05/2018 1:06	0
8/03/2018 9:47	-3.73	20/05/2018 22:35	0	20/05/2018 22:35	1367.82	21/05/2018 9:00	0
8/03/2018 17:41	-11	21/05/2018 6:31	0	21/05/2018 6:31	1361.35	21/05/2018 16:54	0
9/03/2018 1:35	-2.2	21/05/2018 14:27	0	21/05/2018 14:27	1355.56	22/05/2018 0:47	0
9/03/2018 9:28	-3.27	21/05/2018 22:23	0	21/05/2018 22:23	1286.92	22/05/2018 8:41	0
9/03/2018 17:22	-12	22/05/2018 6:18	0	22/05/2018 6:18	1278.45	22/05/2018 16:35	0.72
10/03/2018 1:15	-2	22/05/2018 14:14	0	22/05/2018 14:14	1273.8	23/05/2018 0:28	0.86
10/03/2018 9:09	-2	22/05/2018 22:10	0	22/05/2018 22:10	1274.65	23/05/2018 8:22	0.38
10/03/2018 17:03	-14	23/05/2018 6:06	0	23/05/2018 6:06	1283.09	23/05/2018 16:15	1.25
11/03/2018 0:56	0	23/05/2018 14:01	0	23/05/2018 14:01	1282.56	24/05/2018 0:09	-0.19
11/03/2018 8:50	-0.85	23/05/2018 21:57	0	23/05/2018 21:57	1313.94	24/05/2018 8:03	-1.17
11/03/2018 16:44	-9	24/05/2018 5:53	0	24/05/2018 5:53	1332.54	24/05/2018 15:56	0.56
12/03/2018 0:37	-0.24	24/05/2018 13:49	0	24/05/2018 13:49	1346.87	24/05/2018 23:50	1.16
12/03/2018 8:31	0.03	24/05/2018 21:44	0	24/05/2018 21:44	1347.4	25/05/2018 7:44	2.86

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
12/03/2018 16:25	-7.8	25/05/2018 5:40	0	25/05/2018 5:40	1356.04	25/05/2018 15:37	-0.83
13/03/2018 0:18	0	25/05/2018 13:36	0	25/05/2018 13:36	1357.24	25/05/2018 23:31	2.16
13/03/2018 8:12	0	25/05/2018 21:32	0	25/05/2018 21:32	1360.25	26/05/2018 7:25	1.3
13/03/2018 16:06	-7.17	26/05/2018 5:27	0	26/05/2018 5:27	1370.46	26/05/2018 15:18	-1
13/03/2018 23:59	0	26/05/2018 13:23	0	26/05/2018 13:23	1370	26/05/2018 23:12	0
14/03/2018 7:53	0.99	26/05/2018 21:19	0	26/05/2018 21:19	1369.35	27/05/2018 7:06	0
14/03/2018 15:47	-8.46	27/05/2018 5:15	0	27/05/2018 5:15	1373.08	27/05/2018 14:59	0.66
14/03/2018 23:40	-0.63	27/05/2018 13:10	0	27/05/2018 13:10	1378.52	27/05/2018 22:53	0.66
15/03/2018 7:34	0.11	27/05/2018 21:06	0	27/05/2018 21:06	1371.41	28/05/2018 6:47	1
15/03/2018 15:28	-6.42	28/05/2018 5:02	0	28/05/2018 5:02	1375.68	28/05/2018 14:40	0
15/03/2018 23:21	0	28/05/2018 12:58	0	28/05/2018 12:58	1369.61	28/05/2018 22:34	1.1
16/03/2018 7:15	0.74	28/05/2018 20:53	0	28/05/2018 20:53	1375.34	29/05/2018 6:28	2.8
16/03/2018 15:09	-2.81	29/05/2018 4:49	0	29/05/2018 4:49	1376.83	29/05/2018 14:21	0.51
16/03/2018 23:02	0	29/05/2018 12:45	0	29/05/2018 12:45	1382.17	29/05/2018 22:15	2.87
17/03/2018 6:56	0	29/05/2018 20:41	0	29/05/2018 20:41	1387.32	30/05/2018 6:09	2.14
17/03/2018 14:50	-2.44	30/05/2018 4:36	0	30/05/2018 4:36	1393	30/05/2018 14:02	0.9
17/03/2018 22:43	0	30/05/2018 12:32	0	30/05/2018 12:32	1395.35	30/05/2018 21:56	2.13
18/03/2018 6:37	204.01	30/05/2018 20:28	0	30/05/2018 20:28	1395.98	31/05/2018 5:50	3.2
18/03/2018 14:31	257.92	31/05/2018 4:24	0	31/05/2018 4:24	1399.74	31/05/2018 13:43	0.52
18/03/2018 22:24	268.26	31/05/2018 12:19	0	31/05/2018 12:19	1407.46	31/05/2018 21:37	3.5
19/03/2018 6:18	289.28	31/05/2018 20:15	0	31/05/2018 20:15	1400.94	1/06/2018 5:31	4.98
19/03/2018 14:12	300.7	1/06/2018 4:11	0	1/06/2018 4:11	1412.06	1/06/2018 13:24	0.31
19/03/2018 22:05	311.98	1/06/2018 12:07	0	1/06/2018 12:07	1411.82	1/06/2018 21:18	3
20/03/2018 5:59	311.56	1/06/2018 20:02	0	1/06/2018 20:02	1434.92	2/06/2018 5:12	4.5
20/03/2018 13:52	327.64	2/06/2018 3:58	0	2/06/2018 3:58	1425.15	2/06/2018 13:05	0.73
20/03/2018 21:46	336.21	2/06/2018 11:54	0	2/06/2018 11:54	1430.6	2/06/2018 20:59	3.57
21/03/2018 5:40	340.18	2/06/2018 19:50	0	2/06/2018 19:50	1408.53	3/06/2018 4:52	5.06
21/03/2018 13:33	338.04	3/06/2018 3:45	0	3/06/2018 3:45	1423.48	3/06/2018 12:46	1.57
21/03/2018 21:27	356.97	3/06/2018 11:41	0	3/06/2018 11:41	1434.59	3/06/2018 20:40	3.65
22/03/2018 5:21	369.67	3/06/2018 19:37	0	3/06/2018 19:37	1425.96	4/06/2018 4:33	4.69
22/03/2018 13:14	369.09	4/06/2018 3:33	0	4/06/2018 3:33	1429.77	4/06/2018 12:27	1.84
22/03/2018 21:08	382	4/06/2018 11:28	0	4/06/2018 11:28	1427.14	4/06/2018 20:21	4.17

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
23/03/2018 5:02	385	4/06/2018 19:24	0	4/06/2018 19:24	1423.43	5/06/2018 4:14	5.15
23/03/2018 12:55	378	5/06/2018 3:20	0	5/06/2018 3:20	1429.67	5/06/2018 12:08	3
23/03/2018 20:49	349.95	5/06/2018 11:16	0	5/06/2018 11:16	1438.13	5/06/2018 20:02	5.46
24/03/2018 4:43	106.47	5/06/2018 19:11	0	5/06/2018 19:11	1426.77	6/06/2018 3:55	5.45
24/03/2018 12:36	118	6/06/2018 3:07	0	6/06/2018 3:07	1438.56	6/06/2018 11:49	2.88
24/03/2018 20:30	82.43	6/06/2018 11:03	0	6/06/2018 11:03	1446.37	6/06/2018 19:43	4
25/03/2018 4:24	50.04	6/06/2018 18:59	0	6/06/2018 18:59	1432.11	7/06/2018 3:36	4.66
25/03/2018 12:17	8.12	7/06/2018 2:54	0	7/06/2018 2:54	1450.18	7/06/2018 11:30	3.58
25/03/2018 20:11	559.9	7/06/2018 10:50	0	7/06/2018 10:50	1449.58	7/06/2018 19:24	5
26/03/2018 4:05	564.81	7/06/2018 18:46	0	7/06/2018 18:46	1435.71	8/06/2018 3:17	5.46
26/03/2018 11:58	589.77	8/06/2018 2:42	0	8/06/2018 2:42	1440.46	8/06/2018 11:11	4.39
26/03/2018 19:52	598.67	8/06/2018 10:37	0	8/06/2018 10:37	1447.14	8/06/2018 19:05	5.05
27/03/2018 3:46	610.9	8/06/2018 18:33	0	8/06/2018 18:33	1432.44	9/06/2018 2:58	5.17
27/03/2018 11:39	605.33	9/06/2018 2:29	0	9/06/2018 2:29	1427.75	9/06/2018 10:52	4.64
27/03/2018 19:33	625.62	9/06/2018 10:25	0	9/06/2018 10:25	1422.84	9/06/2018 18:46	5.24
28/03/2018 3:27	649.37	9/06/2018 18:20	0	9/06/2018 18:20	1423.86	10/06/2018 2:39	6
28/03/2018 11:20	670.57	10/06/2018 2:16	0	10/06/2018 2:16	1430.28	10/06/2018 10:33	4.81
28/03/2018 19:14	702.97	10/06/2018 10:12	0	10/06/2018 10:12	1437.8	10/06/2018 18:27	6.24
29/03/2018 3:08	715.06	10/06/2018 18:08	0	10/06/2018 18:08	1431.89	11/06/2018 2:20	6.13
29/03/2018 11:01	720.65	11/06/2018 2:03	0	11/06/2018 2:03	1433.55	11/06/2018 10:14	5.9
29/03/2018 18:55	723.1	11/06/2018 9:59	0	11/06/2018 9:59	1450.06	11/06/2018 18:08	6.03
30/03/2018 2:49	748.45	11/06/2018 17:55	0	11/06/2018 17:55	1432.8	12/06/2018 2:01	7.67
30/03/2018 10:42	767	12/06/2018 1:51	0	12/06/2018 1:51	1431.95	12/06/2018 9:55	9.08
30/03/2018 18:36	771.37	12/06/2018 9:46	0	12/06/2018 9:46	1430.82	12/06/2018 17:49	9.02
31/03/2018 2:29	798.5	12/06/2018 17:42	0	12/06/2018 17:42	1416.08	13/06/2018 1:42	0.97
31/03/2018 10:23	734.46	13/06/2018 1:38	0	13/06/2018 1:38	1362.81	13/06/2018 9:36	0.82
31/03/2018 18:17	741	13/06/2018 9:34	0	13/06/2018 9:34	1296.39	13/06/2018 17:29	0
1/04/2018 2:10	770.49	13/06/2018 17:29	0	13/06/2018 17:29	1254.35	14/06/2018 1:23	0.7
1/04/2018 9:04	796	14/06/2018 1:25	0	14/06/2018 1:25	1029.75	14/06/2018 9:17	0
1/04/2018 16:58	800	14/06/2018 9:21	0	14/06/2018 9:21	1004.5	14/06/2018 17:10	0.52
2/04/2018 0:51	818.53	14/06/2018 17:17	0	14/06/2018 17:17	1014.03	15/06/2018 1:04	0.61
2/04/2018 8:45	828.55	15/06/2018 1:13	0	15/06/2018 1:13	966.04	15/06/2018 8:58	0.52

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
2/04/2018 16:39	824.59	15/06/2018 9:08	0	15/06/2018 9:08	938.38	15/06/2018 16:51	1.47
3/04/2018 0:32	842.13	15/06/2018 17:04	0	15/06/2018 17:04	926.79	16/06/2018 0:45	0.11
3/04/2018 8:26	846.62	16/06/2018 1:00	0	16/06/2018 1:00	811.91	16/06/2018 8:39	0.41
3/04/2018 16:20	665.9	16/06/2018 8:56	0	16/06/2018 8:56	793.27	16/06/2018 16:32	1.78
4/04/2018 0:13	155.13	16/06/2018 16:51	0	16/06/2018 16:51	797.82	17/06/2018 0:26	0.63
4/04/2018 8:07	182.47	17/06/2018 0:47	0	17/06/2018 0:47	766.45	17/06/2018 8:20	4.62
4/04/2018 16:01	177.27	17/06/2018 8:43	0	17/06/2018 8:43	756.52	17/06/2018 16:13	1.06
4/04/2018 23:54	162.32	17/06/2018 16:39	0	17/06/2018 16:39	757.46	18/06/2018 0:07	1.56
5/04/2018 7:48	159.42	18/06/2018 0:34	0	18/06/2018 0:34	782.38	18/06/2018 8:01	1.79
5/04/2018 15:42	60.1	18/06/2018 8:30	0	18/06/2018 8:30	798.79	18/06/2018 15:54	0.03
5/04/2018 23:35	15.2	18/06/2018 16:26	0	18/06/2018 16:26	804.99	18/06/2018 23:48	1.7
6/04/2018 7:29	5.82	19/06/2018 0:22	0	19/06/2018 0:22	860.69	19/06/2018 7:42	2.68
6/04/2018 15:23	-5.63	19/06/2018 8:17	0	19/06/2018 8:17	888.52	19/06/2018 15:35	2
6/04/2018 23:16	0.92	19/06/2018 16:13	0	19/06/2018 16:13	908.18	19/06/2018 23:29	2
7/04/2018 7:10	2.87	20/06/2018 0:09	0	20/06/2018 0:09	971.18	20/06/2018 7:23	2
7/04/2018 15:04	-8.41	20/06/2018 8:05	0	20/06/2018 8:05	1002.24	20/06/2018 15:16	2
7/04/2018 22:57	0.68	20/06/2018 16:00	0	20/06/2018 16:00	1027.69	20/06/2018 23:10	1
8/04/2018 6:51	0.29	20/06/2018 23:56	0	20/06/2018 23:56	1056.63	21/06/2018 7:04	1
8/04/2018 14:45	-13.37	21/06/2018 7:52	0	21/06/2018 7:52	1085.57	21/06/2018 14:57	1
8/04/2018 22:38	-2.55	21/06/2018 15:48	0	21/06/2018 15:48	1111.24	21/06/2018 22:51	3.27
9/04/2018 6:32	0	21/06/2018 23:43	0	21/06/2018 23:43	1146.88	22/06/2018 6:45	3.16
9/04/2018 14:26	-10	22/06/2018 7:39	0	22/06/2018 7:39	1114.26	22/06/2018 14:38	1
9/04/2018 22:19	-1	22/06/2018 15:35	0	22/06/2018 15:35	1191.58	22/06/2018 22:32	1
10/04/2018 6:13	-1.53	22/06/2018 23:31	0	22/06/2018 23:31	1202.62	23/06/2018 6:26	1
10/04/2018 14:07	-10	23/06/2018 7:26	0	23/06/2018 7:26	1203.25	23/06/2018 14:19	1
10/04/2018 22:00	0	23/06/2018 15:22	0	23/06/2018 15:22	1204.07	23/06/2018 22:13	1
11/04/2018 5:54	0	23/06/2018 23:18	0	23/06/2018 23:18	1214.1	24/06/2018 6:07	1
11/04/2018 13:47	-9	24/06/2018 7:14	0	24/06/2018 7:14	1213.87	24/06/2018 14:00	1
11/04/2018 21:41	-3	24/06/2018 15:09	0	24/06/2018 15:09	1209.51	24/06/2018 21:54	1
12/04/2018 5:35	0	24/06/2018 23:05	0	24/06/2018 23:05	1217.11	25/06/2018 5:47	2.2
12/04/2018 13:28	-5	25/06/2018 7:01	0	25/06/2018 7:01	1220.56	25/06/2018 13:41	5.82
12/04/2018 21:22	0	25/06/2018 14:57	0	25/06/2018 14:57	1219.76	25/06/2018 21:35	7.31
13/04/2018 5:16	0	25/06/2018 22:52	0	25/06/2018 22:52	1223.33	26/06/2018 5:28	7.87
13/04/2018 13:09	-3	26/06/2018 6:48	0	26/06/2018 6:48	1229.31	26/06/2018 13:22	4.08
13/04/2018 21:03	256.44	26/06/2018 14:44	0	26/06/2018 14:44	1227.83	26/06/2018 21:16	8.88

Conductivity							
Creek		Pond 2		Pond 5		injection sump	
14/04/2018 4:57	401.88	26/06/2018 22:40	0	26/06/2018 22:40	1226.95	27/06/2018 5:09	9.25
14/04/2018 12:50	418.08	27/06/2018 6:35	0	27/06/2018 6:35	1231.04	27/06/2018 13:03	8.48
14/04/2018 20:44	352.12	27/06/2018 14:31	0	27/06/2018 14:31	1229.69	27/06/2018 20:57	16.35
15/04/2018 4:38	462.45	27/06/2018 22:27	0	27/06/2018 22:27	1233.71	28/06/2018 4:50	400.87
15/04/2018 12:31	491.45	28/06/2018 6:23	0	28/06/2018 6:23	1237.31	28/06/2018 12:44	412.93
15/04/2018 20:25	520.56	28/06/2018 14:18	0	28/06/2018 14:18	1235.53	28/06/2018 20:38	446.9
16/04/2018 4:19	475.52	28/06/2018 22:14	0	28/06/2018 22:14	1236.5	29/06/2018 4:31	454.66
16/04/2018 12:12	496.11	29/06/2018 6:10	0	29/06/2018 6:10	1240.36	29/06/2018 12:25	447.93
16/04/2018 20:06	527.3	29/06/2018 14:06	0	29/06/2018 14:06	1236.7	29/06/2018 20:19	459.62
17/04/2018 4:00	566.74	29/06/2018 22:01	0	29/06/2018 22:01	1236.79	30/06/2018 4:12	459.96
17/04/2018 11:53	570.23	30/06/2018 5:57	0	30/06/2018 5:57	1240.33	30/06/2018 12:06	452.32
17/04/2018 19:47	571.17	30/06/2018 13:53	0	30/06/2018 13:53	1239.55	30/06/2018 20:00	476.45
18/04/2018 3:41	566.41	30/06/2018 21:49	0	30/06/2018 21:49	1237.74	1/07/2018 3:53	488.08
18/04/2018 11:34	555.16	1/07/2018 5:44	0	1/07/2018 5:44	1239.94	1/07/2018 11:47	457.21
18/04/2018 19:28	551.73	1/07/2018 13:40	0	1/07/2018 13:40	1243.37	1/07/2018 19:41	488.15
19/04/2018 3:22	569.06	1/07/2018 21:36	0	1/07/2018 21:36	1239.64	2/07/2018 3:34	481.49
19/04/2018 11:15	571	2/07/2018 5:32	0	2/07/2018 5:32	1237.59	2/07/2018 11:28	473.21
19/04/2018 19:09	580.37	2/07/2018 13:27	0	2/07/2018 13:27	1244.87	2/07/2018 19:22	494.25
20/04/2018 3:03	607.74	2/07/2018 21:23	0	2/07/2018 21:23	1240.08	3/07/2018 3:15	499.32
20/04/2018 10:56	651.35	3/07/2018 5:19	0	3/07/2018 5:19	1237.8	3/07/2018 11:09	513.94
20/04/2018 18:50	660.83	3/07/2018 13:15	0	3/07/2018 13:15	1247.1	3/07/2018 19:03	569.01
21/04/2018 2:44	671.43	3/07/2018 21:10	0	3/07/2018 21:10	1243.06	4/07/2018 2:56	829.96
21/04/2018 10:37	663.44	4/07/2018 5:06	0	4/07/2018 5:06	1246.32	4/07/2018 10:50	861.69
21/04/2018 18:31	686.98	4/07/2018 13:02	0	4/07/2018 13:02	1255.99	4/07/2018 18:44	891.36
22/04/2018 2:24	709.14	4/07/2018 20:58	0	4/07/2018 20:58	1248.89	5/07/2018 2:37	904.01
22/04/2018 10:18	726.9	5/07/2018 4:53	0	5/07/2018 4:53	1243.02	5/07/2018 10:31	889
22/04/2018 18:12	735.1	5/07/2018 12:49	0	5/07/2018 12:49	1254.66	5/07/2018 18:24	891.58
23/04/2018 2:05	731	5/07/2018 20:45	0	5/07/2018 20:45	1251.52	6/07/2018 2:18	895.79
23/04/2018 9:59	753.41	6/07/2018 4:41	0	6/07/2018 4:41	1249.66	6/07/2018 10:12	887.27
23/04/2018 17:53	759.39	6/07/2018 12:36	0	6/07/2018 12:36	1258.71	6/07/2018 18:05	917.98
24/04/2018 1:46	789.63	6/07/2018 20:32	0	6/07/2018 20:32	1253.87	7/07/2018 1:59	1044.74
24/04/2018 9:40	862.22	7/07/2018 4:28	0	7/07/2018 4:28	1273.77	7/07/2018 9:53	951.05

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
24/04/2018 17:34	761.92	7/07/2018 12:24	0	7/07/2018 12:24	1276.32	7/07/2018 17:46	984.79
25/04/2018 1:27	774.4	7/07/2018 20:19	0	7/07/2018 20:19	1268.33	8/07/2018 1:40	995.82
25/04/2018 9:21	765	8/07/2018 4:15	0	8/07/2018 4:15	1214	8/07/2018 9:34	979.39
25/04/2018 17:15	762.81	8/07/2018 12:11	0	8/07/2018 12:11	1192.76	8/07/2018 17:27	1040.01
26/04/2018 1:08	774.44	8/07/2018 20:07	0	8/07/2018 20:07	1176.11	9/07/2018 1:21	1032.78
26/04/2018 9:02	761.67	9/07/2018 4:02	0	9/07/2018 4:02	1133.78	9/07/2018 9:15	1026.32
26/04/2018 16:56	764	9/07/2018 11:58	0	9/07/2018 11:58	1124.53	9/07/2018 17:08	1054.62
27/04/2018 0:49	764	9/07/2018 19:54	0	9/07/2018 19:54	1121.31	10/07/2018 1:02	1069.51
27/04/2018 8:43	776.36	10/07/2018 3:50	0	10/07/2018 3:50	1139.24	10/07/2018 8:56	1028.06
27/04/2018 16:37	756.74	10/07/2018 11:45	0	10/07/2018 11:45	1150.39	10/07/2018 16:49	1072.15
28/04/2018 0:30	780.21	10/07/2018 19:41	0	10/07/2018 19:41	1146.34	11/07/2018 0:43	1089.65
28/04/2018 8:24	774.58	11/07/2018 3:37	0	11/07/2018 3:37	1176.69	11/07/2018 8:37	1077.13
28/04/2018 16:18	766.71	11/07/2018 11:33	0	11/07/2018 11:33	1192.49	11/07/2018 16:30	1083.03
29/04/2018 0:11	766.01	11/07/2018 19:28	0	11/07/2018 19:28	1185.31	12/07/2018 0:24	1078.02
29/04/2018 8:05	782.72	12/07/2018 3:24	0	12/07/2018 3:24	1199.16	12/07/2018 8:18	1077.05
29/04/2018 15:59	769.24	12/07/2018 11:20	0	12/07/2018 11:20	1172.75	12/07/2018 16:11	1100.49
29/04/2018 23:52	770.89	12/07/2018 19:16	15.5	12/07/2018 19:16	1142.33	13/07/2018 0:05	1119.7
30/04/2018 7:46	773.7	13/07/2018 3:11	67.53	13/07/2018 3:11	1134.11	13/07/2018 7:59	1113.73
30/04/2018 15:40	393.42	13/07/2018 11:07	1114.69	13/07/2018 11:07	1140.38	13/07/2018 15:52	1096.55
30/04/2018 23:33	277.48	13/07/2018 19:03	1071.94	13/07/2018 19:03	1144.91	13/07/2018 23:46	1110.88
1/05/2018 7:27	264	14/07/2018 2:59	1109.4	14/07/2018 2:59	1157.81	14/07/2018 7:40	1112.9
1/05/2018 15:21	227.95	14/07/2018 10:54	1165.37	14/07/2018 10:54	1159.28	14/07/2018 15:33	1092.55
1/05/2018 23:14	218.69	14/07/2018 18:50	1120.16	14/07/2018 18:50	1147.72	14/07/2018 23:27	562.39
2/05/2018 7:08	202.81	15/07/2018 2:46	1213.76	15/07/2018 2:46	1159.21	15/07/2018 7:21	560.18
2/05/2018 15:01	458.04	15/07/2018 10:42	1248.29	15/07/2018 10:42	1160.32	15/07/2018 15:14	549.03
2/05/2018 22:55	1285.76	15/07/2018 18:37	1274.33	15/07/2018 18:37	1149.01	15/07/2018 23:08	565.24
3/05/2018 6:49	401.41	16/07/2018 2:33	1329.59	16/07/2018 2:33	1192.38	16/07/2018 7:01	555.86
3/05/2018 14:42	748.9	16/07/2018 10:29	1387.17	16/07/2018 10:29	1216.53	16/07/2018 14:55	543.61
3/05/2018 22:36	753	16/07/2018 18:25	1377.67	16/07/2018 18:25	1217.78	16/07/2018 22:49	551.57
4/05/2018 6:30	741.6	17/07/2018 2:20	1396.23	17/07/2018 2:20	1268.14	17/07/2018 6:42	547.77
4/05/2018 14:23	824.99	17/07/2018 10:16	1425.29	17/07/2018 10:16	1293.04	17/07/2018 14:36	545.93

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
4/05/2018 22:17	905.22	17/07/2018 18:12	1318.04	17/07/2018 18:12	1293.92	17/07/2018 22:30	559.7
5/05/2018 6:11	966.2	18/07/2018 2:08	1305.34	18/07/2018 2:08	1319.18	18/07/2018 6:23	560.14
5/05/2018 14:04	976.89	18/07/2018 10:03	1369.76	18/07/2018 10:03	1334.04	18/07/2018 14:17	-3.91
5/05/2018 21:58	1023.95	18/07/2018 17:59	1395.92	18/07/2018 17:59	1317.4	18/07/2018 22:11	-4.59
6/05/2018 5:52	1025.23	19/07/2018 1:55	1408.9	19/07/2018 1:55	1337.29	19/07/2018 6:04	3.78
6/05/2018 13:45	983.23	19/07/2018 9:51	1429.48	19/07/2018 9:51	1346.96	19/07/2018 13:58	-2.04
6/05/2018 21:39	1440.91	19/07/2018 17:46	863.56	19/07/2018 17:46	1347.51	19/07/2018 21:52	-2.77
7/05/2018 5:33	1510.64	20/07/2018 1:42	823.23	20/07/2018 1:42	1326.55	20/07/2018 5:45	-2.96
7/05/2018 13:26	1451.62	20/07/2018 9:38	859.47	20/07/2018 9:38	1235.39	20/07/2018 13:39	-3
7/05/2018 21:20	1423.35	20/07/2018 17:34	866.32	20/07/2018 17:34	1155.83	20/07/2018 21:33	-3.69
8/05/2018 5:14	1521.77	21/07/2018 1:29	691.15	21/07/2018 1:29	1047.21	21/07/2018 5:26	-4.17
8/05/2018 13:07	1410.67	21/07/2018 9:25	896.51	21/07/2018 9:25	1042.59	21/07/2018 13:20	-3.58
8/05/2018 21:01	1565.33	21/07/2018 17:21	971.29	21/07/2018 17:21	1001.39	21/07/2018 21:14	-3.9
9/05/2018 4:55	1589.34	22/07/2018 1:17	1036.65	22/07/2018 1:17	983.94	22/07/2018 5:07	-3.18
9/05/2018 12:48	1498	22/07/2018 9:13	1091.55	22/07/2018 9:13	1006.61	22/07/2018 13:01	-3.36
9/05/2018 20:42	213.18	22/07/2018 17:08	1128.37	22/07/2018 17:08	1023.04	22/07/2018 20:55	-2.56
10/05/2018 4:36	918.54	23/07/2018 1:04	1161.92	23/07/2018 1:04	1072.95	23/07/2018 4:48	-2.39
10/05/2018 12:29	820.06	23/07/2018 9:00	1172.82	23/07/2018 9:00	1100.22	23/07/2018 12:42	-2.31
10/05/2018 20:23	933.39	23/07/2018 16:56	1098.06	23/07/2018 16:56	1133.14	23/07/2018 20:36	-1.02
11/05/2018 4:17	1111.73	24/07/2018 0:51	1016.11	24/07/2018 0:51	1207.15	24/07/2018 4:29	-2.46
11/05/2018 12:10	1287.13	24/07/2018 8:47	1185.1	24/07/2018 8:47	1240.08	24/07/2018 12:23	-3.76
11/05/2018 20:04	1407.06	24/07/2018 16:43	1205.28	24/07/2018 16:43	1221.75	24/07/2018 20:17	-2.59
12/05/2018 3:58	1432.18	25/07/2018 0:39	929.98	25/07/2018 0:39	1215.91	25/07/2018 4:10	-0.17
12/05/2018 11:51	1384.64	25/07/2018 8:34	927.58	25/07/2018 8:34	1221.87	25/07/2018 12:04	-0.54
12/05/2018 19:45	1389.94	25/07/2018 16:30	945.9	25/07/2018 16:30	1190.02	25/07/2018 19:58	5.87
13/05/2018 3:38	1407.02	26/07/2018 0:26	960.96	26/07/2018 0:26	1142.62	26/07/2018 3:51	7.94
13/05/2018 11:32	1293.94	26/07/2018 8:22	984.18	26/07/2018 8:22	1137.1	26/07/2018 11:45	-0.85
13/05/2018 19:26	1343.15	26/07/2018 16:17	984.65	26/07/2018 16:17	1140.7	26/07/2018 19:38	-3.97
14/05/2018 3:19	1329.02	27/07/2018 0:13	1021.32	27/07/2018 0:13	1118.05	27/07/2018 3:32	-4
14/05/2018 11:13	1187.12	27/07/2018 8:09	1059.01	27/07/2018 8:09	1130.82	27/07/2018 11:26	-5.55
14/05/2018 19:07	1220.73	27/07/2018 16:05	1077.69	27/07/2018 16:05	1128.91	27/07/2018 19:19	-2.73

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
15/05/2018 3:00	1203.86	28/07/2018 0:00	1123.64	28/07/2018 0:00	1161.75	28/07/2018 3:13	-1.3
15/05/2018 10:54	1099.64	28/07/2018 7:56	1149.05	28/07/2018 7:56	1174.99	28/07/2018 11:07	-2.29
15/05/2018 18:48	1063.99	28/07/2018 15:52	970.74	28/07/2018 15:52	1173.01	28/07/2018 19:00	-0.4
16/05/2018 2:41	1103.06	28/07/2018 23:48	1074.95	28/07/2018 23:48	1219.22	29/07/2018 2:54	-1.97
16/05/2018 10:35	1058.31	29/07/2018 7:43	955	29/07/2018 7:43	1202.03	29/07/2018 10:48	-0.73
16/05/2018 18:29	1005.51	29/07/2018 15:39	1001.69	29/07/2018 15:39	1192.38	29/07/2018 18:41	-0.98
17/05/2018 2:22	1015.54	29/07/2018 23:35	1159.94	29/07/2018 23:35	1175.4	30/07/2018 2:35	-0.11
17/05/2018 10:16	984.44	30/07/2018 7:31	1196.83	30/07/2018 7:31	1179.68	30/07/2018 10:29	-1.63
17/05/2018 18:10	973.99	30/07/2018 15:26	1187.41	30/07/2018 15:26	1176.48	30/07/2018 18:22	-0.63
18/05/2018 2:03	956.12	30/07/2018 23:22	1185.44	30/07/2018 23:22	1238.58	31/07/2018 2:16	-0.26
18/05/2018 9:57	340.81	31/07/2018 7:18	1060.36	31/07/2018 7:18	1256.59	31/07/2018 10:10	0
18/05/2018 17:51	617.36	31/07/2018 15:14	942.87	31/07/2018 15:14	1259.43	31/07/2018 18:03	1.29
19/05/2018 1:44	744.01	31/07/2018 23:09	1066.45	31/07/2018 23:09	1262.28	1/08/2018 1:57	0
19/05/2018 9:38	567.82	1/08/2018 7:05	1004.71	1/08/2018 7:05	1233.22	1/08/2018 9:51	-0.85
19/05/2018 17:32	718.64	1/08/2018 15:01	982.77	1/08/2018 15:01	1220.21	1/08/2018 17:44	35.08
20/05/2018 1:25	773.58	1/08/2018 22:57	999.89	1/08/2018 22:57	1223.22	2/08/2018 1:38	-0.1
20/05/2018 9:19	845.08	2/08/2018 6:52	1062.37	2/08/2018 6:52	1200.82	2/08/2018 9:32	-1.18
20/05/2018 17:13	908.86	2/08/2018 14:48	1178.37	2/08/2018 14:48	1180.04	2/08/2018 17:25	3.09
21/05/2018 1:06	954.97	2/08/2018 22:44	1161.93	2/08/2018 22:44	1189.03	3/08/2018 1:19	3
21/05/2018 9:00	956.44	3/08/2018 6:40	707.9	3/08/2018 6:40	1179.17	3/08/2018 9:13	6.08
21/05/2018 16:54	767	3/08/2018 14:35	574.96	3/08/2018 14:35	1172.12	3/08/2018 17:06	-6.4
22/05/2018 0:47	771.23	3/08/2018 22:31	595.15	3/08/2018 22:31	1145.29	4/08/2018 1:00	-6.13
22/05/2018 8:41	764.77	4/08/2018 6:27	666.92	4/08/2018 6:27	966.96	4/08/2018 8:54	-6.56
22/05/2018 16:35	600.74	4/08/2018 14:23	752.16	4/08/2018 14:23	951.79	4/08/2018 16:47	-6.17
23/05/2018 0:28	588.27	4/08/2018 22:18	825.37	4/08/2018 22:18	875.48	5/08/2018 0:41	-5.54
23/05/2018 8:22	619.27	5/08/2018 6:14	877	5/08/2018 6:14	867.24	5/08/2018 8:35	-5.92
23/05/2018 16:15	647.34	5/08/2018 14:10	894	5/08/2018 14:10	878.1	5/08/2018 16:28	-6.03
24/05/2018 0:09	786.62	5/08/2018 22:06	698.67	5/08/2018 22:06	894.13	6/08/2018 0:22	-6.08
24/05/2018 8:03	744.4	6/08/2018 6:01	617.67	6/08/2018 6:01	919.48	6/08/2018 8:15	-5.41
24/05/2018 15:56	705.58	6/08/2018 13:57	506.65	6/08/2018 13:57	910.81	6/08/2018 16:09	-5.71
24/05/2018 23:50	697.71	6/08/2018 21:53	463.65	6/08/2018 21:53	885.79	7/08/2018 0:03	-6.88
25/05/2018 7:44	687.81	7/08/2018 5:49	468.62	7/08/2018 5:49	800.39	7/08/2018 7:56	-6.55
25/05/2018 15:37	608.98	7/08/2018 13:44	508.38	7/08/2018 13:44	772.45	7/08/2018 15:50	-5.18
25/05/2018 23:31	649.41	7/08/2018 21:40	565.92	7/08/2018 21:40	693.29	7/08/2018 23:44	-6.37

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
26/05/2018 7:25	605.1	8/08/2018 5:36	606.36	8/08/2018 5:36	667.15	8/08/2018 7:37	83.36
26/05/2018 15:18	549.33	8/08/2018 13:32	632.58	8/08/2018 13:32	665	8/08/2018 15:31	581.45
26/05/2018 23:12	606.04	8/08/2018 21:27	640.34	8/08/2018 21:27	672.59	8/08/2018 23:25	562.02
27/05/2018 7:06	545.53	9/08/2018 5:23	634.89	9/08/2018 5:23	687.02	9/08/2018 7:18	559.8
27/05/2018 14:59	500.6	9/08/2018 13:19	644.3	9/08/2018 13:19	702.11	9/08/2018 15:12	565.13
27/05/2018 22:53	501.74	9/08/2018 21:15	673.18	9/08/2018 21:15	710.09	9/08/2018 23:06	570.7
28/05/2018 6:47	456.04	10/08/2018 5:10	699.35	10/08/2018 5:10	725.86	10/08/2018 6:59	581.07
28/05/2018 14:40	406.12	10/08/2018 13:06	708.99	10/08/2018 13:06	744.11	10/08/2018 14:53	589
28/05/2018 22:34	393.43	10/08/2018 21:02	714.26	10/08/2018 21:02	742.13	10/08/2018 22:47	589
29/05/2018 6:28	369.4	11/08/2018 4:58	714.58	11/08/2018 4:58	743.12	11/08/2018 6:40	526.7
29/05/2018 14:21	309.33	11/08/2018 12:53	714.31	11/08/2018 12:53	745.79	11/08/2018 14:34	386.19
29/05/2018 22:15	404.47	11/08/2018 20:49	719.84	11/08/2018 20:49	746.18	11/08/2018 22:28	245.67
30/05/2018 6:09	424.74	12/08/2018 4:45	725.59	12/08/2018 4:45	751.99	12/08/2018 6:21	105.16
30/05/2018 14:02	427.68	12/08/2018 12:41	726.23	12/08/2018 12:41	750.67	12/08/2018 14:15	591.52
30/05/2018 21:56	430.75	12/08/2018 20:36	680.47	12/08/2018 20:36	747.26	12/08/2018 22:09	586.47
31/05/2018 5:50	374.36	13/08/2018 4:32	673.33	13/08/2018 4:32	775.95	13/08/2018 6:02	594.4
31/05/2018 13:43	434.76	13/08/2018 12:28	688.36	13/08/2018 12:28	783.19	13/08/2018 13:56	596.63
31/05/2018 21:37	448.87	13/08/2018 20:24	706.44	13/08/2018 20:24	776.41	13/08/2018 21:50	-2.87
1/06/2018 5:31	460.78	14/08/2018 4:19	709.6	14/08/2018 4:19	789.69	14/08/2018 5:43	-1.84
1/06/2018 13:24	458.64	14/08/2018 12:15	713.47	14/08/2018 12:15	791.98	14/08/2018 13:37	602.72
1/06/2018 21:18	503	14/08/2018 20:11	752.92	14/08/2018 20:11	787	14/08/2018 21:31	613.39
2/06/2018 5:12	469.77	15/08/2018 4:07	775.81	15/08/2018 4:07	805.41	15/08/2018 5:24	614.53
2/06/2018 13:05	447.77	15/08/2018 12:02	789.22	15/08/2018 12:02	820.26	15/08/2018 13:18	616.89
2/06/2018 20:59	504.32	15/08/2018 19:58	792.68	15/08/2018 19:58	832.93	15/08/2018 21:12	624.44
3/06/2018 4:52	497.52	16/08/2018 3:54	786.11	16/08/2018 3:54	847.48	16/08/2018 5:05	634.68
3/06/2018 12:46	490.18	16/08/2018 11:50	650.62	16/08/2018 11:50	864.93	16/08/2018 12:59	639
3/06/2018 20:40	507.17	16/08/2018 19:45	649.57	16/08/2018 19:45	864.83	16/08/2018 20:52	36.11
4/06/2018 4:33	530.13	17/08/2018 3:41	729.73	17/08/2018 3:41	886.28	17/08/2018 4:46	664.13
4/06/2018 12:27	541.05	17/08/2018 11:37	784.84	17/08/2018 11:37	881.37	17/08/2018 12:40	669
4/06/2018 20:21	527.62	17/08/2018 19:33	793.96	17/08/2018 19:33	872.05	17/08/2018 20:33	668
5/06/2018 4:14	531.46	18/08/2018 3:28	704.53	18/08/2018 3:28	884.47	18/08/2018 4:27	670
5/06/2018 12:08	539	18/08/2018 11:24	591.78	18/08/2018 11:24	885.32	18/08/2018 12:21	669.25
5/06/2018 20:02	529.87	18/08/2018 19:20	657.97	18/08/2018 19:20	842.04	18/08/2018 20:14	672.53
6/06/2018 3:55	573.98	19/08/2018 3:16	640.04	19/08/2018 3:16	827.84	19/08/2018 4:08	676
6/06/2018 11:49	517.46	19/08/2018 11:11	647.09	19/08/2018 11:11	828.29	19/08/2018 12:02	665.78
6/06/2018 19:43	524.65	19/08/2018 19:07	673.13	19/08/2018 19:07	796.76	19/08/2018 19:55	642.41
7/06/2018 3:36	551.34	20/08/2018 3:03	705.96	20/08/2018 3:03	782.95	20/08/2018 3:49	641.26
7/06/2018 11:30	534.24	20/08/2018 10:59	717.67	20/08/2018 10:59	791.3	20/08/2018 11:43	638.84
7/06/2018 19:24	366.5	20/08/2018 18:54	700.47	20/08/2018 18:54	783.52	20/08/2018 19:36	618.96
8/06/2018 3:17	447.95	21/08/2018 2:50	737.61	21/08/2018 2:50	814.21	21/08/2018 3:30	622.57
8/06/2018 11:11	501.76	21/08/2018 10:46	757.1	21/08/2018 10:46	828.71	21/08/2018 11:24	621.08
8/06/2018 19:05	406.05	21/08/2018 18:42	749.97	21/08/2018 18:42	817.27	21/08/2018 19:17	623.73
9/06/2018 2:58	643.64	22/08/2018 2:37	769.12	22/08/2018 2:37	842.17	22/08/2018 3:11	632.3

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
9/06/2018 10:52	683.66	22/08/2018 10:33	790.49	22/08/2018 10:33	855.03	22/08/2018 11:05	626.82
9/06/2018 18:46	746.78	22/08/2018 18:29	793.02	22/08/2018 18:29	847.46	22/08/2018 18:58	634.07
10/06/2018 2:39	701.73	23/08/2018 2:25	811.93	23/08/2018 2:25	880.87	23/08/2018 2:52	638.16
10/06/2018 10:33	685.05	23/08/2018 10:20	825.62	23/08/2018 10:20	907.22	23/08/2018 10:46	-5.82
10/06/2018 18:27	659.14	23/08/2018 18:16	826.15	23/08/2018 18:16	898.23	23/08/2018 18:39	659.84
11/06/2018 2:20	735.51	24/08/2018 2:12	853.66	24/08/2018 2:12	931.78	24/08/2018 2:33	661.48
11/06/2018 10:14	760.44	24/08/2018 10:08	865.33	24/08/2018 10:08	945.25	24/08/2018 10:27	665.95
11/06/2018 18:08	672.24	24/08/2018 18:03	850.35	24/08/2018 18:03	931.13	24/08/2018 18:20	685.19
12/06/2018 2:01	734.36	25/08/2018 1:59	876.51	25/08/2018 1:59	972.96	25/08/2018 2:14	697.28
12/06/2018 9:55	711.09	25/08/2018 9:55	892.6	25/08/2018 9:55	979.96	25/08/2018 10:08	697.06
12/06/2018 17:49	611.77	25/08/2018 17:51	902.07	25/08/2018 17:51	968.92	25/08/2018 18:01	706.51
13/06/2018 1:42	502.99	26/08/2018 1:46	906.51	26/08/2018 1:46	997.18	26/08/2018 1:55	720.35
13/06/2018 9:36	512.4	26/08/2018 9:42	896.49	26/08/2018 9:42	1003.98	26/08/2018 9:49	720.29
13/06/2018 17:29	767	26/08/2018 17:38	900.63	26/08/2018 17:38	986.51	26/08/2018 17:42	724.5
14/06/2018 1:23	452.89	27/08/2018 1:34	923.08	27/08/2018 1:34	1013.33	27/08/2018 1:36	-2.47
14/06/2018 9:17	406.85	27/08/2018 9:29	923.6	27/08/2018 9:29	1021.65	27/08/2018 9:29	-4.31
14/06/2018 17:10	364.73	27/08/2018 17:25	928.82	27/08/2018 17:25	1011.47	27/08/2018 17:23	735.01
15/06/2018 1:04	860.64	28/08/2018 1:21	961.87	28/08/2018 1:21	1046.09	28/08/2018 1:17	749.63
15/06/2018 8:58	728.1	28/08/2018 9:17	987.19	28/08/2018 9:17	1055.33	28/08/2018 9:10	758.09
15/06/2018 16:51	727.25	28/08/2018 17:13	967.11	28/08/2018 17:13	1042.07	28/08/2018 17:04	768.9
16/06/2018 0:45	359.68	29/08/2018 1:08	979.61	29/08/2018 1:08	1101.46	29/08/2018 0:58	780.69
16/06/2018 8:39	398.64	29/08/2018 9:04	1006.13	29/08/2018 9:04	1118.96	29/08/2018 8:51	28.14
16/06/2018 16:32	415.57	29/08/2018 17:00	1003.22	29/08/2018 17:00	1100.36	29/08/2018 16:45	790.55
17/06/2018 0:26	483.88	30/08/2018 0:56	1019.89	30/08/2018 0:56	1144.92	30/08/2018 0:39	801.95
17/06/2018 8:20	414.77	30/08/2018 8:51	1042.03	30/08/2018 8:51	1157.43	30/08/2018 8:32	656.2
17/06/2018 16:13	451.11	30/08/2018 16:47	1023.26	30/08/2018 16:47	1158.44	30/08/2018 16:26	-4.24
18/06/2018 0:07	489.36	31/08/2018 0:43	732.94	31/08/2018 0:43	1159.73	31/08/2018 0:20	836.98
18/06/2018 8:01	526.05	31/08/2018 8:39	966.6	31/08/2018 8:39	1163.39	31/08/2018 8:13	850.25
18/06/2018 15:54	492.97	31/08/2018 16:34	999.05			31/08/2018 16:07	842.39
18/06/2018 23:48	535.16						
19/06/2018 7:42	532						
19/06/2018 15:35	511.41						
19/06/2018 23:29	490.96						
20/06/2018 7:23	459.16						
20/06/2018 15:16	425.45						
20/06/2018 23:10	420.96						
21/06/2018 7:04	411.51						

Conductivity							
Creek		Pond 2		Pond 5		injection sump	
21/06/2018 14:57	402.05						
21/06/2018 22:51	406.02						
22/06/2018 6:45	411.78						
22/06/2018 14:38	402						
22/06/2018 22:32	402						
23/06/2018 6:26	402						
23/06/2018 14:19	402						
23/06/2018 22:13	402						
24/06/2018 6:07	402						
24/06/2018 14:00	402						
24/06/2018 21:54	402						
25/06/2018 5:47	463.63						
25/06/2018 13:41	649.02						
25/06/2018 21:35	717.56						
26/06/2018 5:28	694.73						
26/06/2018 13:22	702.46						
26/06/2018 21:16	741.34						
27/06/2018 5:09	722.47						
27/06/2018 13:03	763.85						
27/06/2018 20:57	777.99						
28/06/2018 4:50	766.86						
28/06/2018 12:44	762.14						
28/06/2018 20:38	795.8						
29/06/2018 4:31	790.77						
29/06/2018 12:25	789						
29/06/2018 20:19	840.54						
30/06/2018 4:12	891.92						
30/06/2018 12:06	791.59						
30/06/2018 20:00	783.49						
1/07/2018 3:53	830.57						
1/07/2018 11:47	887.52						
1/07/2018 19:41	966.95						
2/07/2018 3:34	984.47						
2/07/2018 11:28	1020.15						
2/07/2018 19:22	1013.76						
3/07/2018 3:15	1024.21						
3/07/2018 11:09	1047.07						
3/07/2018 19:03	1043.19						
4/07/2018 2:56	1062.74						
4/07/2018 10:50	1079.08						

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
4/07/2018 18:44	1065						
5/07/2018 2:37	1071.05						
5/07/2018 10:31	1078						
5/07/2018 18:24	830.26						
6/07/2018 2:18	456.56						
6/07/2018 10:12	434.44						
6/07/2018 18:05	373.04						
7/07/2018 1:59	415.56						
7/07/2018 9:53	947.32						
7/07/2018 17:46	406.3						
8/07/2018 1:40	376.54						
8/07/2018 9:34	353.64						
8/07/2018 17:27	289.97						
9/07/2018 1:21	310.04						
9/07/2018 9:15	298.31						
9/07/2018 17:08	265.79						
10/07/2018 1:02	269.6						
10/07/2018 8:56	218.34						
10/07/2018 16:49	204.11						
11/07/2018 0:43	248.95						
11/07/2018 8:37	221.72						
11/07/2018 16:30	155.01						
12/07/2018 0:24	185.09						
12/07/2018 8:18	152.84						
12/07/2018 16:11	157.5						
13/07/2018 0:05	171.8						
13/07/2018 7:59	169.46						
13/07/2018 15:52	109.77						
13/07/2018 23:46	151.05						
14/07/2018 7:40	141.83						
14/07/2018 15:33	111.45						
14/07/2018 23:27	125.58						
15/07/2018 7:21	100.25						
15/07/2018 15:14	93.06						
15/07/2018 23:08	121.34						
16/07/2018 7:01	98.98						
16/07/2018 14:55	103.07						
16/07/2018 22:49	108.87						
17/07/2018 6:42	86.47						
17/07/2018 14:36	92.65						
17/07/2018 22:30	101.87						
18/07/2018 6:23	96.78						

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
18/07/2018 14:17	90.08						
18/07/2018 22:11	93.9						
19/07/2018 6:04	81.87						
19/07/2018 13:58	85.05						
19/07/2018 21:52	154.33						
20/07/2018 5:45	151.29						
20/07/2018 13:39	117.18						
20/07/2018 21:33	123.79						
21/07/2018 5:26	106.25						
21/07/2018 13:20	93.82						
21/07/2018 21:14	116.46						
22/07/2018 5:07	88.6						
22/07/2018 13:01	72.57						
22/07/2018 20:55	89.01						
23/07/2018 4:48	74.68						
23/07/2018 12:42	57.52						
23/07/2018 20:36	101.15						
24/07/2018 4:29	76.7						
24/07/2018 12:23	73.76						
24/07/2018 20:17	70.61						
25/07/2018 4:10	63.37						
25/07/2018 12:04	71.76						
25/07/2018 19:58	78.44						
26/07/2018 3:51	89.76						
26/07/2018 11:45	81.79						
26/07/2018 19:38	91.95						
27/07/2018 3:32	93.64						
27/07/2018 11:26	61.11						
27/07/2018 19:19	63.46						
28/07/2018 3:13	64.31						
28/07/2018 11:07	63.47						
28/07/2018 19:00	82.22						
29/07/2018 2:54	81.06						
29/07/2018 10:48	75.53						
29/07/2018 18:41	87.23						
30/07/2018 2:35	88.19						
30/07/2018 10:29	88.61						
30/07/2018 18:22	86.6						
31/07/2018 2:16	89.79						
31/07/2018 10:10	93.57						
31/07/2018 18:03	108.2						
1/08/2018 1:57	100.55						
1/08/2018 9:51	95.6						

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
1/08/2018 17:44	80.18						
2/08/2018 1:38	89.55						
2/08/2018 9:32	80.99						
2/08/2018 17:25	80.54						
3/08/2018 1:19	75.75						
3/08/2018 9:13	143.04						
3/08/2018 17:06	183.25						
4/08/2018 1:00	212.64						
4/08/2018 8:54	217.92						
4/08/2018 16:47	164.97						
5/08/2018 0:41	186.71						
5/08/2018 8:35	189.63						
5/08/2018 16:28	135.92						
6/08/2018 0:22	136.39						
6/08/2018 8:15	171.73						
6/08/2018 16:09	166.48						
7/08/2018 0:03	170.88						
7/08/2018 7:56	171.33						
7/08/2018 15:50	186.24						
7/08/2018 23:44	201.25						
8/08/2018 7:37	203.64						
8/08/2018 15:31	198.7						
8/08/2018 23:25	202.82						
9/08/2018 7:18	195.53						
9/08/2018 15:12	173.99						
9/08/2018 23:06	178.1						
10/08/2018 6:59	180.05						
10/08/2018 14:53	170.1						
10/08/2018 22:47	202						
11/08/2018 6:40	212.63						
11/08/2018 14:34	236.61						
11/08/2018 22:28	260.59						
12/08/2018 6:21	284.57						
12/08/2018 14:15	330.52						
12/08/2018 22:09	278.17						
13/08/2018 6:02	277.97						
13/08/2018 13:56	279.93						
13/08/2018 21:50	226.95						
14/08/2018 5:43	137.55						
14/08/2018 13:37	141.12						
14/08/2018 21:31	152.77						
15/08/2018 5:24	155.06						
15/08/2018 13:18	155.66						

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
15/08/2018 21:12	153.8						
16/08/2018 5:05	152.56						
16/08/2018 12:59	143						
16/08/2018 20:52	140.11						
17/08/2018 4:46	143.93						
17/08/2018 12:40	154.7						
17/08/2018 20:33	170						
18/08/2018 4:27	163.55						
18/08/2018 12:21	145.88						
18/08/2018 20:14	162.05						
19/08/2018 4:08	175.94						
19/08/2018 12:02	161.7						
19/08/2018 19:55	131.97						
20/08/2018 3:49	140.59						
20/08/2018 11:43	138.25						
20/08/2018 19:36	144.07						
21/08/2018 3:30	154.36						
21/08/2018 11:24	150.47						
21/08/2018 19:17	324.52						
22/08/2018 3:11	333.84						
22/08/2018 11:05	306.81						
22/08/2018 18:58	283.4						
23/08/2018 2:52	278.55						
23/08/2018 10:46	293.55						
23/08/2018 18:39	281.84						
24/08/2018 2:33	288.68						
24/08/2018 10:27	296.65						
24/08/2018 18:20	231.58						
25/08/2018 2:14	255.36						
25/08/2018 10:08	265.88						
25/08/2018 18:01	246.05						
26/08/2018 1:55	255.3						
26/08/2018 9:49	250.19						
26/08/2018 17:42	226.7						
27/08/2018 1:36	238.31						
27/08/2018 9:29	255.96						
27/08/2018 17:23	221.98						
28/08/2018 1:17	233.62						
28/08/2018 9:10	226.9						
28/08/2018 17:04	206.58						
29/08/2018 0:58	217.89						
29/08/2018 8:51	223.58						
29/08/2018 16:45	211.43						

Conductivity							
Creek		**Pond 2**		**Pond 5**		**injection sump**	
30/08/2018 0:39	240.09						
30/08/2018 8:32	254.82						
30/08/2018 16:26	192.53						

Water temperature					
injection sump		**Pond 5**		**Pond 2**	
Time /Date	VAlue	Time/Date	Value	Time/Date	Value
1/05/2018 12:01	22.6	1/05/2018 7:01	15.48	1/05/2018 7:01	14.93
1/05/2018 19:53	15.57	1/05/2018 14:56	15.88	1/05/2018 14:56	15.21
2/05/2018 3:44	13.91	1/05/2018 22:51	15.9	1/05/2018 22:51	15.42
2/05/2018 11:36	22.85	2/05/2018 6:46	15.22	2/05/2018 6:46	14.74
2/05/2018 19:27	20.05	2/05/2018 14:41	15.75	2/05/2018 14:41	15.06
3/05/2018 3:19	16.73	2/05/2018 22:36	16.03	2/05/2018 22:36	15.32
3/05/2018 11:11	14	3/05/2018 6:31	16.03	3/05/2018 6:31	15.46
3/05/2018 19:02	14.95	3/05/2018 14:26	16.14	3/05/2018 14:26	15.77
4/05/2018 2:54	13.29	3/05/2018 22:21	15.93	3/05/2018 22:21	15.46
4/05/2018 10:45	16.74	4/05/2018 6:17	14.8	4/05/2018 6:17	14.48
4/05/2018 18:37	16	4/05/2018 14:12	14.71	4/05/2018 14:12	15.43
5/05/2018 2:28	14	4/05/2018 22:07	15.34	4/05/2018 22:07	15.45
5/05/2018 10:20	16.53	5/05/2018 6:02	15.32	5/05/2018 6:02	14.94
5/05/2018 18:12	16.91	5/05/2018 13:57	15.25	5/05/2018 13:57	15
6/05/2018 2:03	12.28	5/05/2018 21:52	15.56	5/05/2018 21:52	16.67
6/05/2018 9:55	18.41	6/05/2018 5:47	15.76	6/05/2018 5:47	15.83
6/05/2018 17:46	17.62	6/05/2018 13:42	15.34	6/05/2018 13:42	15.47
7/05/2018 1:38	16	6/05/2018 21:37	15.61	6/05/2018 21:37	16.25
7/05/2018 9:29	16.81	7/05/2018 5:32	15.67	7/05/2018 5:32	15.41
7/05/2018 17:21	15.11	7/05/2018 13:27	15.4	7/05/2018 13:27	15.14
8/05/2018 1:13	11.16	7/05/2018 21:22	15.38	7/05/2018 21:22	15.21
8/05/2018 9:04	13.98	8/05/2018 5:17	14.8	8/05/2018 5:17	14.5
8/05/2018 16:56	16.18	8/05/2018 13:12	14.75	8/05/2018 13:12	14.4
9/05/2018 0:47	9.35	8/05/2018 21:07	14.99	8/05/2018 21:07	14.55
9/05/2018 8:39	12.79	9/05/2018 5:02	14.57	9/05/2018 5:02	14.04
9/05/2018 16:31	17.77	9/05/2018 12:57	14.43	9/05/2018 12:57	13.86
10/05/2018 0:22	13.4	9/05/2018 20:52	14.65	9/05/2018 20:52	13.99
10/05/2018 8:14	11.22	10/05/2018 4:47	14.44	10/05/2018 4:47	13.87
10/05/2018 16:05	12	10/05/2018 12:42	14.2	10/05/2018 12:42	13.64
10/05/2018 23:57	11	10/05/2018 20:38	14.24	10/05/2018 20:38	13.88
11/05/2018 7:48	10.9	11/05/2018 4:33	13.4	11/05/2018 4:33	13.14
11/05/2018 15:40	13.76	11/05/2018 12:28	12.94	11/05/2018 12:28	13.5
11/05/2018 23:32	12	11/05/2018 20:23	13.74	11/05/2018 20:23	13.91
12/05/2018 7:23	12.04	12/05/2018 4:18	12.78	12/05/2018 4:18	12.26
12/05/2018 15:15	16.58	12/05/2018 12:13	12.78	12/05/2018 12:13	12.22

Water temperature					
injection sump		**Pond 5**		**Pond 2**	
12/05/2018 23:06	13.44	12/05/2018 20:08	13.09	12/05/2018 20:08	12.71
13/05/2018 6:58	12	13/05/2018 4:03	13.3	13/05/2018 4:03	13.01
13/05/2018 14:49	17.22	13/05/2018 11:58	13.81	13/05/2018 11:58	13.41
13/05/2018 22:41	10.6	13/05/2018 19:53	14.1	13/05/2018 19:53	13.58
14/05/2018 6:33	8.49	14/05/2018 3:48	13.91	14/05/2018 3:48	13.13
14/05/2018 14:24	15.29	14/05/2018 11:43	13.55	14/05/2018 11:43	12.85
14/05/2018 22:16	13.13	14/05/2018 19:38	13.84	14/05/2018 19:38	13.05
15/05/2018 6:07	13.12	15/05/2018 3:33	13.97	15/05/2018 3:33	13.17
15/05/2018 13:59	15.8	15/05/2018 11:28	14.06	15/05/2018 11:28	13.24
15/05/2018 21:51	11.51	15/05/2018 19:23	14.3	15/05/2018 19:23	13.38
16/05/2018 5:42	6.47	16/05/2018 3:18	13.81	16/05/2018 3:18	12.92
16/05/2018 13:34	15.89	16/05/2018 11:13	13.05	16/05/2018 11:13	12.27
16/05/2018 21:25	13	16/05/2018 19:08	13.28	16/05/2018 19:08	12.41
17/05/2018 5:17	12.14	17/05/2018 3:04	13.41	17/05/2018 3:04	12.58
17/05/2018 13:08	15	17/05/2018 10:59	13.41	17/05/2018 10:59	12.67
17/05/2018 21:00	14	17/05/2018 18:54	13.61	17/05/2018 18:54	12.82
18/05/2018 4:52	13	18/05/2018 2:49	13.8	18/05/2018 2:49	12.92
18/05/2018 12:43	15.83	18/05/2018 10:44	13.91	18/05/2018 10:44	13.06
18/05/2018 20:35	13	18/05/2018 18:39	14.19	18/05/2018 18:39	13.82
19/05/2018 4:26	12.1	19/05/2018 2:34	14.62	19/05/2018 2:34	14.14
19/05/2018 12:18	16	19/05/2018 10:29	14.29	19/05/2018 10:29	13.95
19/05/2018 20:09	11.53	19/05/2018 18:24	15.05	19/05/2018 18:24	14.63
20/05/2018 4:01	12.36	20/05/2018 2:19	14.89	20/05/2018 2:19	13.83
20/05/2018 11:53	15.91	20/05/2018 10:14	14.09	20/05/2018 10:14	13.61
20/05/2018 19:44	15	20/05/2018 18:09	14.45	20/05/2018 18:09	14.51
21/05/2018 3:36	15	21/05/2018 2:04	14.65	21/05/2018 2:04	14.34
21/05/2018 11:27	16	21/05/2018 9:59	14.64	21/05/2018 9:59	14.17
21/05/2018 19:19	14.91	21/05/2018 17:54	14.75	21/05/2018 17:54	14.59
22/05/2018 3:11	15	22/05/2018 1:49	14.32	22/05/2018 1:49	14.14
22/05/2018 11:02	16	22/05/2018 9:44	13.94	22/05/2018 9:44	13.65
22/05/2018 18:54	14	22/05/2018 17:39	14.45	22/05/2018 17:39	14.3
23/05/2018 2:45	13	23/05/2018 1:34	14.18	23/05/2018 1:34	14.17
23/05/2018 10:37	15.72	23/05/2018 9:29	13.9	23/05/2018 9:29	13.79
23/05/2018 18:28	14.13	23/05/2018 17:25	14.38	23/05/2018 17:25	14.5
24/05/2018 2:20	13	24/05/2018 1:20	14.03	24/05/2018 1:20	14.26
24/05/2018 10:12	15	24/05/2018 9:15	13.8	24/05/2018 9:15	13.9
24/05/2018 18:03	13.86	24/05/2018 17:10	10.73	24/05/2018 17:10	14.06
25/05/2018 1:55	11.2	25/05/2018 1:05	13.82	25/05/2018 1:05	13.71
25/05/2018 9:46	13.9	25/05/2018 9:00	12.97	25/05/2018 9:00	12.95
25/05/2018 17:38	16.45	25/05/2018 16:55	13.22	25/05/2018 16:55	13.1
26/05/2018 1:29	14.15	26/05/2018 0:50	13.27	26/05/2018 0:50	13.18
26/05/2018 9:21	17.04	26/05/2018 8:45	12.86	26/05/2018 8:45	12.7
26/05/2018 17:13	20.12	26/05/2018 16:40	13.2	26/05/2018 16:40	12.87

Water temperature					
injection sump		Pond 5		Pond 2	
27/05/2018 1:04	18.87	27/05/2018 0:35	13.4	27/05/2018 0:35	12.97
27/05/2018 8:56	18.28	27/05/2018 8:30	13.47	27/05/2018 8:30	13.09
27/05/2018 16:47	17.36	27/05/2018 16:25	13.75	27/05/2018 16:25	13.3
28/05/2018 0:39	16	28/05/2018 0:20	13.83	28/05/2018 0:20	13.36
28/05/2018 8:31	16	28/05/2018 8:15	13.71	28/05/2018 8:15	13.39
28/05/2018 16:22	20.74	28/05/2018 16:10	14.33	28/05/2018 16:10	13.69
29/05/2018 0:14	15.06	29/05/2018 0:05	14.57	29/05/2018 0:05	13.81
29/05/2018 8:05	14	29/05/2018 8:00	14.14	29/05/2018 8:00	13.6
29/05/2018 15:57	13.29	29/05/2018 15:55	14.47	29/05/2018 15:55	13.73
29/05/2018 23:48	10.51	29/05/2018 23:51	13.96	29/05/2018 23:51	13.38
30/05/2018 7:40	12.76	30/05/2018 7:46	13.29	30/05/2018 7:46	12.85
30/05/2018 15:32	15.46	30/05/2018 15:41	13.63	30/05/2018 15:41	12.95
30/05/2018 23:23	11.49	30/05/2018 23:36	13.53	30/05/2018 23:36	13.07
31/05/2018 7:15	11.59	31/05/2018 7:31	13.22	31/05/2018 7:31	12.81
31/05/2018 15:06	16.49	31/05/2018 15:26	13.83	31/05/2018 15:26	13
31/05/2018 22:58	8.11	31/05/2018 23:21	13.63	31/05/2018 23:21	13.1
1/06/2018 6:49	5.74	1/06/2018 7:16	12.47	1/06/2018 7:16	11.99
1/06/2018 14:41	15.52	1/06/2018 15:11	12.74	1/06/2018 15:11	11.89
1/06/2018 22:33	7.95	1/06/2018 23:06	12.45	1/06/2018 23:06	11.98
2/06/2018 6:24	5.07	2/06/2018 7:01	11.58	2/06/2018 7:01	11.13
2/06/2018 14:16	17.34	2/06/2018 14:56	11.84	2/06/2018 14:56	11.2
2/06/2018 22:07	8.13	2/06/2018 22:51	11.85	2/06/2018 22:51	11.3
3/06/2018 5:59	6	3/06/2018 6:46	11.11	3/06/2018 6:46	10.57
3/06/2018 13:51	16.94	3/06/2018 14:41	11.48	3/06/2018 14:41	10.75
3/06/2018 21:42	10.32	3/06/2018 22:36	11.74	3/06/2018 22:36	10.87
4/06/2018 5:34	8.62	4/06/2018 6:31	11.33	4/06/2018 6:31	10.66
4/06/2018 13:25	14.59	4/06/2018 14:26	11.86	4/06/2018 14:26	10.83
4/06/2018 21:17	10	4/06/2018 22:21	11.85	4/06/2018 22:21	11.05
5/06/2018 5:08	6.9	5/06/2018 6:17	1.27	5/06/2018 6:17	1.77
5/06/2018 13:00	15.28	5/06/2018 14:12	11.65	5/06/2018 14:12	10.47
5/06/2018 20:52	8.25	5/06/2018 22:07	11.67	5/06/2018 22:07	10.62
6/06/2018 4:43	5.05	6/06/2018 6:02	10.92	6/06/2018 6:02	10.03
6/06/2018 12:35	17.26	6/06/2018 13:57	11.22	6/06/2018 13:57	10.01
6/06/2018 20:26	15	6/06/2018 21:52	11.39	6/06/2018 21:52	10.17
7/06/2018 4:18	14.53	7/06/2018 5:47	11.16	7/06/2018 5:47	10.3
7/06/2018 12:09	16.86	7/06/2018 13:42	11.43	7/06/2018 13:42	10.51
7/06/2018 20:01	13	7/06/2018 21:37	11.6	7/06/2018 21:37	10.6
8/06/2018 3:53	12.32	8/06/2018 5:32	11.6	8/06/2018 5:32	10.72
8/06/2018 11:44	14.79	8/06/2018 13:27	11.92	8/06/2018 13:27	10.98
8/06/2018 19:36	13.6	8/06/2018 21:22	12.06	8/06/2018 21:22	11.08
9/06/2018 3:27	13	9/06/2018 5:17	12.09	9/06/2018 5:17	11.16
9/06/2018 11:19	16.23	9/06/2018 13:12	12.79	9/06/2018 13:12	11.87
9/06/2018 19:11	15	9/06/2018 21:07	13.13	9/06/2018 21:07	11.93

Water temperature					
injection sump		**Pond 5**		**Pond 2**	
10/06/2018 3:02	10.06	10/06/2018 5:02	12.91	10/06/2018 5:02	12.05
10/06/2018 10:54	16	10/06/2018 12:57	13.22	10/06/2018 12:57	12.46
10/06/2018 18:45	15.46	10/06/2018 20:52	13.38	10/06/2018 20:52	12.55
11/06/2018 2:37	16	11/06/2018 4:47	13.16	11/06/2018 4:47	12.49
11/06/2018 10:28	18.6	11/06/2018 12:42	13.56	11/06/2018 12:42	12.77
11/06/2018 18:20	16	11/06/2018 20:38	13.76	11/06/2018 20:38	12.83
12/06/2018 2:12	13.72	12/06/2018 4:33	13.45	12/06/2018 4:33	12.89
12/06/2018 10:03	12	12/06/2018 12:28	13.56	12/06/2018 12:28	13.38
12/06/2018 17:55	12.68	12/06/2018 20:23	13.91	12/06/2018 20:23	13.07
13/06/2018 1:46	10.77	13/06/2018 4:18	12.86	13/06/2018 4:18	12.26
13/06/2018 9:38	12.23	13/06/2018 12:13	12.79	13/06/2018 12:13	12.68
13/06/2018 17:29	13.38	13/06/2018 20:08	13.37	13/06/2018 20:08	12.54
14/06/2018 1:21	12	14/06/2018 4:03	12.5	14/06/2018 4:03	11.95
14/06/2018 9:13	13	14/06/2018 11:58	12.3	14/06/2018 11:58	12.23
14/06/2018 17:04	14.03	14/06/2018 19:53	13.06	14/06/2018 19:53	13.13
15/06/2018 0:56	11.45	15/06/2018 3:48	12.13	15/06/2018 3:48	12.18
15/06/2018 8:47	11	15/06/2018 11:43	11.71	15/06/2018 11:43	11.65
15/06/2018 16:39	13.24	15/06/2018 19:38	12.88	15/06/2018 19:38	12.09
16/06/2018 0:31	9.21	16/06/2018 3:33	11.96	16/06/2018 3:33	11.5
16/06/2018 8:22	10.79	16/06/2018 11:28	11.22	16/06/2018 11:28	11.25
16/06/2018 16:14	9	16/06/2018 19:23	11.81	16/06/2018 19:23	11.66
17/06/2018 0:05	8.57	17/06/2018 3:18	10.66	17/06/2018 3:18	10.6
17/06/2018 7:57	9.08	17/06/2018 11:13	10.34	17/06/2018 11:13	10.54
17/06/2018 15:48	10.94	17/06/2018 19:08	11.41	17/06/2018 19:08	11.42
17/06/2018 23:40	9	18/06/2018 3:04	10.89	18/06/2018 3:04	10.72
18/06/2018 7:32	6.06	18/06/2018 10:59	10	18/06/2018 10:59	10.05
18/06/2018 15:23	12	18/06/2018 18:54	11.3	18/06/2018 18:54	11.21
18/06/2018 23:15	10.09	19/06/2018 2:49	10.72	19/06/2018 2:49	10.63
19/06/2018 7:06	8.6	19/06/2018 10:44	9.95	19/06/2018 10:44	9.86
19/06/2018 14:58	11	19/06/2018 18:39	10.95	19/06/2018 18:39	10.92
19/06/2018 22:49	9.39	20/06/2018 2:34	10.14	20/06/2018 2:34	9.9
20/06/2018 6:41	10.35	20/06/2018 10:29	10.08	20/06/2018 10:29	10.36
20/06/2018 14:33	13.56	20/06/2018 18:24	10.08	20/06/2018 18:24	10.76
20/06/2018 22:24	14	21/06/2018 2:19	10.04	21/06/2018 2:19	10.72
21/06/2018 6:16	14	21/06/2018 10:14	10.01	21/06/2018 10:14	10.68
21/06/2018 14:07	14	21/06/2018 18:09	10.43	21/06/2018 18:09	11.22
21/06/2018 21:59	7.5	22/06/2018 2:04	10.05	22/06/2018 2:04	9.88
22/06/2018 5:51	4.41	22/06/2018 9:59	8.86	22/06/2018 9:59	8.24
22/06/2018 13:42	13	22/06/2018 17:54	9.12	22/06/2018 17:54	8.7
22/06/2018 21:34	13	23/06/2018 1:49	9.4	23/06/2018 1:49	8.52
23/06/2018 5:25	13	23/06/2018 9:44	9.15	23/06/2018 9:44	8.26
23/06/2018 13:17	13	23/06/2018 17:39	9.38	23/06/2018 17:39	8.59
23/06/2018 21:08	13	24/06/2018 1:34	9.55	24/06/2018 1:34	8.71

Water temperature					
injection sump		Pond 5		Pond 2	
24/06/2018 5:00	13	24/06/2018 9:29	9.52	24/06/2018 9:29	8.82
24/06/2018 12:52	13	24/06/2018 17:25	9.78	24/06/2018 17:25	9.01
24/06/2018 20:43	13	25/06/2018 1:20	9.85	25/06/2018 1:20	9.12
25/06/2018 4:35	12.87	25/06/2018 9:15	9.46	25/06/2018 9:15	8.75
25/06/2018 12:26	12.17	25/06/2018 17:10	9.71	25/06/2018 17:10	8.93
25/06/2018 20:18	7.62	26/06/2018 1:05	9.41	26/06/2018 1:05	8.77
26/06/2018 4:09	4.71	26/06/2018 9:00	8.77	26/06/2018 9:00	8.17
26/06/2018 12:01	12.81	26/06/2018 16:55	8.96	26/06/2018 16:55	8.38
26/06/2018 19:53	8	27/06/2018 0:50	9.03	27/06/2018 0:50	8.51
27/06/2018 3:44	6.76	27/06/2018 8:45	8.63	27/06/2018 8:45	8.16
27/06/2018 11:36	11.83	27/06/2018 16:40	8.87	27/06/2018 16:40	8.38
27/06/2018 19:27	7.62	28/06/2018 0:35	8.89	28/06/2018 0:35	8.43
28/06/2018 3:19	3.15	28/06/2018 8:30	8.25	28/06/2018 8:30	7.76
28/06/2018 11:11	11.67	28/06/2018 16:25	8.43	28/06/2018 16:25	8
28/06/2018 19:02	10.28	29/06/2018 0:20	8.52	29/06/2018 0:20	8.11
29/06/2018 2:54	9.2	29/06/2018 8:15	8.23	29/06/2018 8:15	7.82
29/06/2018 10:45	12.39	29/06/2018 16:10	8.65	29/06/2018 16:10	8.18
29/06/2018 18:37	10.58	30/06/2018 0:05	8.83	30/06/2018 0:05	8.28
30/06/2018 2:28	11	30/06/2018 8:00	8.65	30/06/2018 8:00	8.15
30/06/2018 10:20	13.22	30/06/2018 15:55	9.08	30/06/2018 15:55	8.5
30/06/2018 18:12	9.75	30/06/2018 23:51	9.21	30/06/2018 23:51	8.66
1/07/2018 2:03	5.14	1/07/2018 7:46	8.69	1/07/2018 7:46	8.12
1/07/2018 9:55	8.39	1/07/2018 15:41	8.9	1/07/2018 15:41	8.32
1/07/2018 17:46	10.3	1/07/2018 23:36	8.94	1/07/2018 23:36	8.44
2/07/2018 1:38	4.63	2/07/2018 7:31	8.35	2/07/2018 7:31	7.75
2/07/2018 9:29	11.79	2/07/2018 15:26	8.66	2/07/2018 15:26	7.95
2/07/2018 17:21	12.69	2/07/2018 23:21	8.83	2/07/2018 23:21	8.05
3/07/2018 1:13	10.49	3/07/2018 7:16	8.65	3/07/2018 7:16	8.09
3/07/2018 9:04	11.96	3/07/2018 15:11	9.08	3/07/2018 15:11	8.34
3/07/2018 16:56	16.82	3/07/2018 23:06	9.26	3/07/2018 23:06	8.47
4/07/2018 0:47	13.34	4/07/2018 7:01	8.81	4/07/2018 7:01	8.16
4/07/2018 8:39	13.66	4/07/2018 14:56	9.17	4/07/2018 14:56	8.42
4/07/2018 16:31	17.49	4/07/2018 22:51	9.31	4/07/2018 22:51	8.53
5/07/2018 0:22	15.59	5/07/2018 6:46	9.43	5/07/2018 6:46	8.62
5/07/2018 8:14	16.37	5/07/2018 14:41	9.67	5/07/2018 14:41	8.81
5/07/2018 16:05	15	5/07/2018 22:36	9.92	5/07/2018 22:36	9.19
5/07/2018 23:57	12	6/07/2018 6:31	10.18	6/07/2018 6:31	10.08
6/07/2018 7:48	10.51	6/07/2018 14:26	10.4	6/07/2018 14:26	11.25
6/07/2018 15:40	12.01	6/07/2018 22:21	11.34	6/07/2018 22:21	11.7
6/07/2018 23:32	10.94	7/07/2018 6:17	10.21	7/07/2018 6:17	10.78
7/07/2018 7:23	11.24	7/07/2018 14:12	10.29	7/07/2018 14:12	11.02
7/07/2018 15:15	12.62	7/07/2018 22:07	11.28	7/07/2018 22:07	10.78
7/07/2018 23:06	12	8/07/2018 6:02	10.83	8/07/2018 6:02	10.53

Water temperature					
injection sump		Pond 5		Pond 2	
8/07/2018 6:58	12.96	8/07/2018 13:57	11.1	8/07/2018 13:57	11.76
8/07/2018 14:49	13.3	8/07/2018 21:52	11.91	8/07/2018 21:52	11.96
8/07/2018 22:41	12	9/07/2018 5:47	11.36	9/07/2018 5:47	11.14
9/07/2018 6:33	12	9/07/2018 13:42	11.47	9/07/2018 13:42	11.68
9/07/2018 14:24	13.32	9/07/2018 21:37	12.01	9/07/2018 21:37	12.1
9/07/2018 22:16	11.15	10/07/2018 5:32	10.68	10/07/2018 5:32	10.61
10/07/2018 6:07	6.47	10/07/2018 13:27	10.69	10/07/2018 13:27	10.49
10/07/2018 13:59	13.93	10/07/2018 21:22	11.55	10/07/2018 21:22	11.18
10/07/2018 21:51	6.52	11/07/2018 5:17	9.99	11/07/2018 5:17	9.08
11/07/2018 5:42	7.06	11/07/2018 13:12	10.24	11/07/2018 13:12	9.81
11/07/2018 13:34	12.78	11/07/2018 21:07	11.06	11/07/2018 21:07	10.94
11/07/2018 21:25	10.61	12/07/2018 5:02	10.57	12/07/2018 5:02	10.31
12/07/2018 5:17	9.4	12/07/2018 12:57	10.6	12/07/2018 12:57	11.13
12/07/2018 13:08	13.94	12/07/2018 20:52	11.69	12/07/2018 20:52	11.17
12/07/2018 21:00	7.98	13/07/2018 4:47	9.81	13/07/2018 4:47	9.22
13/07/2018 4:52	4.02	13/07/2018 12:42	9.83	13/07/2018 12:42	9.19
13/07/2018 12:43	13.09	13/07/2018 20:38	10.71	13/07/2018 20:38	10.25
13/07/2018 20:35	7.15	14/07/2018 4:33	8.96	14/07/2018 4:33	7.9
14/07/2018 4:26	7.03	14/07/2018 12:28	8.6	14/07/2018 12:28	8
14/07/2018 12:18	14.77	14/07/2018 20:23	10.14	14/07/2018 20:23	10.31
14/07/2018 20:09	12.04	15/07/2018 4:18	8.9	15/07/2018 4:18	8.6
15/07/2018 4:01	8.55	15/07/2018 12:13	8.56	15/07/2018 12:13	8.15
15/07/2018 11:53	14.68	15/07/2018 20:08	9.9	15/07/2018 20:08	9.63
15/07/2018 19:44	13.6	16/07/2018 4:03	9.3	16/07/2018 4:03	9.15
16/07/2018 3:36	12.16	16/07/2018 11:58	9.76	16/07/2018 11:58	10.02
16/07/2018 11:27	15.07	16/07/2018 19:53	11.88	16/07/2018 19:53	12.31
16/07/2018 19:19	14.36	17/07/2018 3:48	10.6	17/07/2018 3:48	11.27
17/07/2018 3:11	12.13	17/07/2018 11:43	10.04	17/07/2018 11:43	10.27
17/07/2018 11:02	12.11	17/07/2018 19:38	11.61	17/07/2018 19:38	11.41
17/07/2018 18:54	11.88	18/07/2018 3:33	10.24	18/07/2018 3:33	9.96
18/07/2018 2:45	8.02	18/07/2018 11:28	9.7	18/07/2018 11:28	9.39
18/07/2018 10:37	13.08	18/07/2018 19:23	11.52	18/07/2018 19:23	11.61
18/07/2018 18:28	14.23	19/07/2018 3:18	10.21	19/07/2018 3:18	9.86
19/07/2018 2:20	9.1	19/07/2018 11:13	9.73	19/07/2018 11:13	8.97
19/07/2018 10:12	10.72	19/07/2018 19:08	10.41	19/07/2018 19:08	10.83
19/07/2018 18:03	8.63	20/07/2018 3:04	9.5	20/07/2018 3:04	9.69
20/07/2018 1:55	9.44	20/07/2018 10:59	9.01	20/07/2018 10:59	9.31
20/07/2018 9:46	12	20/07/2018 18:54	11.18	20/07/2018 18:54	10.63
20/07/2018 17:38	10.65	21/07/2018 2:49	9.86	21/07/2018 2:49	9.93
21/07/2018 1:29	8.41	21/07/2018 10:44	9.56	21/07/2018 10:44	9.65
21/07/2018 9:21	9.65	21/07/2018 18:39	11.67	21/07/2018 18:39	11.51
21/07/2018 17:13	13.07	22/07/2018 2:34	10.35	22/07/2018 2:34	9.93
22/07/2018 1:04	11.41	22/07/2018 10:29	9.37	22/07/2018 10:29	8.97

Water temperature					
injection sump		Pond 5		Pond 2	
22/07/2018 8:56	12.55	22/07/2018 18:24	11.33	22/07/2018 18:24	11.39
22/07/2018 16:47	15.44	23/07/2018 2:19	10.44	23/07/2018 2:19	10.24
23/07/2018 0:39	14.13	23/07/2018 10:14	10.14	23/07/2018 10:14	9.63
23/07/2018 8:31	14.16	23/07/2018 18:09	10.91	23/07/2018 18:09	11.37
23/07/2018 16:22	13	24/07/2018 2:04	10.47	24/07/2018 2:04	10.92
24/07/2018 0:14	11.58	24/07/2018 9:59	10.27	24/07/2018 9:59	10.39
24/07/2018 8:05	12.58	24/07/2018 17:54	12.37	24/07/2018 17:54	12.82
24/07/2018 15:57	15.75	25/07/2018 1:49	12.06	25/07/2018 1:49	12.49
24/07/2018 23:48	11.62	25/07/2018 9:44	11.86	25/07/2018 9:44	11.76
25/07/2018 7:40	12.43	25/07/2018 17:39	14.01	25/07/2018 17:39	13.14
25/07/2018 15:32	14.52	26/07/2018 1:34	12.7	26/07/2018 1:34	12.03
25/07/2018 23:23	11.7	26/07/2018 9:29	11.49	26/07/2018 9:29	10.93
26/07/2018 7:15	9.16	26/07/2018 17:25	14.06	26/07/2018 17:25	13.71
26/07/2018 15:06	17.81	27/07/2018 1:20	12.75	27/07/2018 1:20	12.18
26/07/2018 22:58	14.62	27/07/2018 9:15	11.91	27/07/2018 9:15	11.28
27/07/2018 6:49	14.18	27/07/2018 17:10	14.54	27/07/2018 17:10	14.37
27/07/2018 14:41	18.58	28/07/2018 1:05	12.75	28/07/2018 1:05	12.36
27/07/2018 22:33	10.81	28/07/2018 9:00	11.39	28/07/2018 9:00	10.59
28/07/2018 6:24	9	28/07/2018 16:55	14.19	28/07/2018 16:55	13.83
28/07/2018 14:16	14.87	29/07/2018 0:50	12.71	29/07/2018 0:50	12.65
28/07/2018 22:07	11.46	29/07/2018 8:45	11.32	29/07/2018 8:45	10.89
29/07/2018 5:59	11.13	29/07/2018 16:40	12.87	29/07/2018 16:40	12.64
29/07/2018 13:51	13	30/07/2018 0:35	11.86	30/07/2018 0:35	11.33
29/07/2018 21:42	10.35	30/07/2018 8:30	11.32	30/07/2018 8:30	10.63
30/07/2018 5:34	10.39	30/07/2018 16:25	12.58	30/07/2018 16:25	12.48
30/07/2018 13:25	15.09	31/07/2018 0:20	12.16	31/07/2018 0:20	12.07
30/07/2018 21:17	13.84	31/07/2018 8:15	11.48	31/07/2018 8:15	11.21
31/07/2018 5:08	11.39	31/07/2018 16:10	13.58	31/07/2018 16:10	13.61
31/07/2018 13:00	16.23	1/08/2018 0:05	12.87	1/08/2018 0:05	12.47
31/07/2018 20:52	12	1/08/2018 8:00	12.28	1/08/2018 8:00	11.81
1/08/2018 4:43	10.71	1/08/2018 15:55	13.38	1/08/2018 15:55	13.05
1/08/2018 12:35	14.76	1/08/2018 23:51	12.59	1/08/2018 23:51	11.86
1/08/2018 20:26	10.17	2/08/2018 7:46	11.2	2/08/2018 7:46	10.55
2/08/2018 4:18	14.19	2/08/2018 15:41	12.56	2/08/2018 15:41	12.05
2/08/2018 12:09	20.26	2/08/2018 23:36	12.38	2/08/2018 23:36	12.25
2/08/2018 20:01	17.16	3/08/2018 7:31	11.97	3/08/2018 7:31	12.22
3/08/2018 3:53	11	3/08/2018 15:26	12.43	3/08/2018 15:26	12.39
3/08/2018 11:44	11.99	3/08/2018 23:21	12.57	3/08/2018 23:21	11.57
3/08/2018 19:36	11.08	4/08/2018 7:16	11.48	4/08/2018 7:16	10.94
4/08/2018 3:27	10.28	4/08/2018 15:11	11.94	4/08/2018 15:11	12.51
4/08/2018 11:19	14.89	4/08/2018 23:06	12.45	4/08/2018 23:06	11.76
4/08/2018 19:11	15	5/08/2018 7:01	11.37	5/08/2018 7:01	10.7
5/08/2018 3:02	12	5/08/2018 14:56	11.39	5/08/2018 14:56	11.21

Water temperature					
injection sump		Pond 5		Pond 2	
5/08/2018 10:54	13.91	5/08/2018 22:51	11.22	5/08/2018 22:51	11.24
5/08/2018 18:45	9	6/08/2018 6:46	10.56	6/08/2018 6:46	10.5
6/08/2018 2:37	8.48	6/08/2018 14:41	10.71	6/08/2018 14:41	10.42
6/08/2018 10:28	8.57	6/08/2018 22:36	11.04	6/08/2018 22:36	9.76
6/08/2018 18:20	9.37	7/08/2018 6:31	10.06	7/08/2018 6:31	9.35
7/08/2018 2:12	8.7	7/08/2018 14:26	10.32	7/08/2018 14:26	10.43
7/08/2018 10:03	11.44	7/08/2018 22:21	11.23	7/08/2018 22:21	10.31
7/08/2018 17:55	12	8/08/2018 6:17	10.8	8/08/2018 6:17	10.33
8/08/2018 1:46	11.08	8/08/2018 14:12	11.12	8/08/2018 14:12	11.84
8/08/2018 9:38	13.37	8/08/2018 22:07	12.86	8/08/2018 22:07	11.49
8/08/2018 17:29	13.56	9/08/2018 6:02	11.73	9/08/2018 6:02	11.03
9/08/2018 1:21	12.31	9/08/2018 13:57	11.56	9/08/2018 13:57	12.43
9/08/2018 9:13	12.74	9/08/2018 21:52	13.01	9/08/2018 21:52	12.21
9/08/2018 17:04	15	10/08/2018 5:47	11.49	10/08/2018 5:47	10.95
10/08/2018 0:56	13	10/08/2018 13:42	11.15	10/08/2018 13:42	11.25
10/08/2018 8:47	12.97	10/08/2018 21:37	11.52	10/08/2018 21:37	11.38
10/08/2018 16:39	12	11/08/2018 5:32	11.48	11/08/2018 5:32	10.97
11/08/2018 0:31	12	11/08/2018 13:27	11.26	11/08/2018 13:27	10.87
11/08/2018 8:22	12.32	11/08/2018 21:22	11.39	11/08/2018 21:22	10.96
11/08/2018 16:14	12.79	12/08/2018 5:17	10.84	12/08/2018 5:17	10.31
12/08/2018 0:05	13.27	12/08/2018 13:12	10.79	12/08/2018 13:12	10.47
12/08/2018 7:57	13.75	12/08/2018 21:07	12.15	12/08/2018 21:07	11.31
12/08/2018 15:48	13.78	13/08/2018 5:02	11.75	13/08/2018 5:02	10.66
12/08/2018 23:40	12.09	13/08/2018 12:57	11.52	13/08/2018 12:57	11.25
13/08/2018 7:32	12.77	13/08/2018 20:52	11.88	13/08/2018 20:52	12.02
13/08/2018 15:23	14.43	14/08/2018 4:47	12.15	14/08/2018 4:47	11.32
13/08/2018 23:15	9.18	14/08/2018 12:42	11.52	14/08/2018 12:42	11.86
14/08/2018 7:06	8.9	14/08/2018 20:38	13.14	14/08/2018 20:38	12.24
14/08/2018 14:58	14	15/08/2018 4:33	11.86	15/08/2018 4:33	11.01
14/08/2018 22:49	12.75	15/08/2018 12:28	11.81	15/08/2018 12:28	11.4
15/08/2018 6:41	12	15/08/2018 20:23	12.63	15/08/2018 20:23	12.17
15/08/2018 14:33	13.63	16/08/2018 4:18	11.33	16/08/2018 4:18	11.12
15/08/2018 22:24	11.71	16/08/2018 12:13	11.02	16/08/2018 12:13	10.82
16/08/2018 6:16	11.57	16/08/2018 20:08	12.41	16/08/2018 20:08	11.51
16/08/2018 14:07	13.62	17/08/2018 4:03	11.97	17/08/2018 4:03	10.86
16/08/2018 21:59	10.7	17/08/2018 11:58	11.57	17/08/2018 11:58	11.29
17/08/2018 5:51	11.91	17/08/2018 19:53	13.53	17/08/2018 19:53	12.93
17/08/2018 13:42	13.04	18/08/2018 3:48	12.32	18/08/2018 3:48	11.9
17/08/2018 21:34	12.68	18/08/2018 11:43	11.68	18/08/2018 11:43	11.45
18/08/2018 5:25	12.09	18/08/2018 19:38	13.18	18/08/2018 19:38	11.59
18/08/2018 13:17	13.59	19/08/2018 3:33	11.24	19/08/2018 3:33	10.4
18/08/2018 21:08	12.4	19/08/2018 11:28	10.8	19/08/2018 11:28	10.54
19/08/2018 5:00	11.2	19/08/2018 19:23	12.04	19/08/2018 19:23	11.39

Water temperature					
injection sump		**Pond 5**		**Pond 2**	
19/08/2018 12:52	11.83	20/08/2018 3:18	11.03	20/08/2018 3:18	10.62
19/08/2018 20:43	11.31	20/08/2018 11:13	10.44	20/08/2018 11:13	10.24
20/08/2018 4:35	11.27	20/08/2018 19:08	11.57	20/08/2018 19:08	11.81
20/08/2018 12:26	12.1	21/08/2018 3:04	11.61	21/08/2018 3:04	10.96
20/08/2018 20:18	13	21/08/2018 10:59	11.22	21/08/2018 10:59	10.88
21/08/2018 4:09	11.54	21/08/2018 18:54	11.68	21/08/2018 18:54	12.47
21/08/2018 12:01	12.87	22/08/2018 2:49	11.57	22/08/2018 2:49	10.95
21/08/2018 19:53	12.63	22/08/2018 10:44	10.44	22/08/2018 10:44	10.2
22/08/2018 3:44	11.31	22/08/2018 18:39	11.2	22/08/2018 18:39	12.29
22/08/2018 11:36	13.43	23/08/2018 2:34	12.18	23/08/2018 2:34	10.89
22/08/2018 19:27	13.36	23/08/2018 10:29	11.2	23/08/2018 10:29	10.41
23/08/2018 3:19	13.65	23/08/2018 18:24	11.55	23/08/2018 18:24	11.81
23/08/2018 11:11	17.72	24/08/2018 2:19	11.9	24/08/2018 2:19	11.17
23/08/2018 19:02	13.36	24/08/2018 10:14	11.13	24/08/2018 10:14	10.84
24/08/2018 2:54	12.25	24/08/2018 18:09	11.88	24/08/2018 18:09	13.98
24/08/2018 10:45	13.52	25/08/2018 2:04	12.49	25/08/2018 2:04	11.88
24/08/2018 18:37	14.59	25/08/2018 9:59	11.38	25/08/2018 9:59	10.88
25/08/2018 2:28	12.32	25/08/2018 17:54	11.94	25/08/2018 17:54	12.23
25/08/2018 10:20	13.48	26/08/2018 1:49	12.84	26/08/2018 1:49	12.28
25/08/2018 18:12	14.88	26/08/2018 9:44	11.02	26/08/2018 9:44	11.47
26/08/2018 2:03	12.06	26/08/2018 17:39	12.25	26/08/2018 17:39	11.95
26/08/2018 9:55	12.6	27/08/2018 1:34	13.24	27/08/2018 1:34	12.28
26/08/2018 17:46	13.4	27/08/2018 9:29	11.85	27/08/2018 9:29	11.82
27/08/2018 1:38	10.57	27/08/2018 17:25	14.26	27/08/2018 17:25	13.97
27/08/2018 9:29	13.77	28/08/2018 1:20	12.19	28/08/2018 1:20	11.54
27/08/2018 17:21	15	28/08/2018 9:15	10.97	28/08/2018 9:15	9.75
28/08/2018 1:13	12.55	28/08/2018 17:10	15.04	28/08/2018 17:10	13.64
28/08/2018 9:04	12.33	29/08/2018 1:05	13	29/08/2018 1:05	12.56
28/08/2018 16:56	15	29/08/2018 9:00	11.81	29/08/2018 9:00	11.48
29/08/2018 0:47	14	29/08/2018 16:55	14.61	29/08/2018 16:55	15.44
29/08/2018 8:39	19.74	30/08/2018 0:50	14.23	30/08/2018 0:50	14.18
29/08/2018 16:31	16.62	30/08/2018 8:45	13.13	30/08/2018 8:45	12.9
30/08/2018 0:22	15.29	30/08/2018 16:40	13.18	30/08/2018 16:40	12.76
30/08/2018 8:14	18.88	31/08/2018 0:35	12.36	31/08/2018 0:35	12.66
30/08/2018 16:05	12.4	31/08/2018 8:30	11.77	31/08/2018 8:30	11.78
30/08/2018 23:57	12	31/08/2018 16:25	12.58	31/08/2018 16:25	12.3
31/08/2018 7:48	12			1/09/2018 0:20	12.99
31/08/2018 15:40	14.79			1/09/2018 8:15	12.41
31/08/2018 23:32	14			1/09/2018 16:10	15.29

7.4 Sturt River historical water quality data

Date/Time	**EC Corrected (us/cm)**	**SS (mg/L)**	**Water Temp (Deg C)**	**Turbidity (NTU)**	**pH**	**Total P (mg/L)**	**TKN (mg/L)**	**NOx (mg/L)**	**Copper (mg/L)**	**Lead (mg/L)**	**Zinc (mg/L)**
	Point	Point	Point	Point	Point	Point	Point	Point	Point	Point	Point
20/08/2009 11:50	944	48	18.5	35.7	7.98	0.122	0.98	0.343	0.0064	0.0032	0.0461
1/09/2009 11:30	766	5	16.3	9.1001	8	0.084	0.85	0.08	0.0061	0.0017	0.0416
14/09/2009 13:00	571	34	19.2	9.7002	8.0601	0.116	1.43	0.199	0.0094	0.0029	0.051
28/09/2009 11:36	625	85	13.9	7.6001	7.9199	0.165	1.24	0.256	0.0114	0.0087	0.1161
12/10/2009 12:45	613	58	18.7	77	7.9399	0.289	2.5	0.346	0.0175	0.0106	0.1487
26/10/2009 11:12	1010	26	17.7	5.5	7.6201	0.141	1.37	0.342	0.0105	0.0059	0.0914
18/01/2010 11:15	5810	7	19.9	4.8	8.54	0.037	1.17	0.02	0.0099	0.0006	0.015
9/03/2010 15:25	3910	32	22.7	28.5	8.1802	0.228	3.71	0.005	0.0247	0.0049	0.0618
10/03/2010 15:25		32				0.228	3.71	0.005	0.0247	0.0049	0.0618
13/04/2010 12:25	2520	22	17.1	10.5	7.8701	0.076	1.54	0.045	0.0133	0.0014	0.0392
28/04/2010 12:42	2360	19	17.4	11.799	8.3198	0.065	0.68	0.084	0.0065	0.0012	0.0258
11/05/2010 9:24	1960	7	16.9	9	8.02	0.073	0.91	0.052	0.0059	0.0009	0.0373
26/05/2010 16:00	2570	18	18.5	24	8.21	0.102	1.34	1.14	0.0066	0.001	0.0266
9/06/2010 15:27	1410		14	15.7	8.25						
9/06/2010 15:37		33				0.071	0.9	0.263	0.0308	0.002	0.5115
23/06/2010 15:55	1300		16.5	11.5							
23/06/2010 16:15		19			7.5901	0.061	0.65	0.059	0.003	0.001	0.0527
7/07/2010 15:55	999	31	15.3	32.7	7.71	0.072	0.85	0.224	0.0049	0.0012	0.0383
19/07/2010 15:15		50				0.126	1.26	0.333	0.0056	0.0051	0.078
22/07/2010 15:15	935		12.5	61.3	7.6599						
5/08/2010 10:30	981	44	9.1	47.7	7.55	0.159	1.52	0.268	0.0126	0.0045	0.0787
19/08/2010 9:35	798	36	13.3	21	7.54	0.123	1.46	0.279	0.0048	0.0026	0.0503
2/09/2010 9:40	600	76	13.1	44.9	7.3	0.154	1.31	0.388	0.0063	0.0055	0.0773
16/09/2010 10:17	575	37	15.4	50.4	6.8401	0.104	1.03	0.409	0.0049	0.0024	0.0359
29/09/2010 9:40	771	42	12.1	15.799	7.8701	0.065	0.69	0.263	0.0055	0.0024	0.045
14/10/2010 8:25	1130	20	14.5	8.7998	7.6299	0.05	0.74	0.186	0.0025	0.0013	0.0181
28/10/2010 9:10	1190	11	18.4	7.2	7.47	0.068	0.84	0.136	0.003	0.0011	0.0215
14/12/2010 11:45	3470	12	22.4	4.8999	8.0098	0.062	1	0.942	0.0047	0.0012	0.022

Date/Time	EC Corrected (us/cm)	SS (mg/L)	Water Temp (Deg C)	Turbidity (NTU)	pH	Total P (mg/L)	TKN (mg/L)	NOx (mg/L)	Copper (mg/L)	Lead (mg/L)	Zinc (mg/L)
17/01/2011 9:50	5230	8	21.7	3.6	8.3398	0.027	1.04	0.53	0.0046	0.0006	0.0156
24/02/2011 9:30	5070	19	24.1	8.5	8.2598	0.079	1.96	0.39	0.0126	0.0017	0.0474
11/04/2011 10:15	4730	3	15.3	1.9	7.0601	0.058	0.78	0.566	0.0053	0.0002	0.0075
28/04/2011 10:45	4480	28	22.7	19.8	8.23	0.171	1.89	0.498	0.0089	0.0019	0.059
9/05/2011 11:40	380	33		20	8.3599	0.125	2.45	0.887	0.0183	0.0029	0.0413
9/05/2011 11:41			16.9								
27/05/2011 13:20	1169	2	14.4	5.2	8.0498	0.05	0.55	0.251	0.0055	0.0007	0.0236
7/06/2011 10:00		38				0.137	2.17	0.331	0.0165	0.0038	0.0506
7/06/2011 10:05	1546		13.8	115.7	8.2798						
23/06/2011 9:55	1904	32	12.8	72.1	7.9199	0.084	0.94	0.16	0.0064	0.004	0.0599
7/07/2011 10:50	606										
7/07/2011 15:50		43		91.4	8.04	0.161	1.1	0.507	0.0043	0.0038	0.016
20/07/2011 13:05	398	80	12.8	99.7	7.45	0.169	1.47	0.474	0.0108	0.0061	0.0841
4/08/2011 11:10	222	40	13	73.1	7.3999	0.109	0.92	0.388	0.0121	0.0062	0.1815
16/08/2011 12:00	508	38	13.2	52.9	7.7	0.174	1.21	0.382	0.0068	0.0044	0.0824
31/08/2011 14:00		5				0.046	0.59	0.039	0.0014	0.0006	0.0042
14/09/2011 14:55	1300	22	18.5	27	7.8899	0.05	0.94	0.058	0.0369	0.0021	0.0343
10/10/2011 16:00	2180	49	16.9	20.4	7.6899	0.095	1.14	0.172	0.008	0.004	0.0425
8/11/2011 15:30	2470	12	25.3	25	7.8899	0.041	0.9	0.358	0.0053	0.0007	0.0207
7/12/2011 13:00			27.3								
7/12/2011 14:00	3660	11			6.6899	0.078	1.79	0.008	0.0176	0.0035	0.1032
5/01/2012 12:55	9590	10		2.01	9.4102	0.07	2.55	0.003	0.008	0.0005	0.0066
1/02/2012 14:00	1400	37	23.6	32.1	8.3999	0.156	0.91	0.525	0.006	0.0033	0.0285
1/03/2012 16:00		6				0.064	1.11	0.055	0.006	0.0009	0.0242
27/03/2012 9:15	1770	4	19.6	2	7.5801	0.058	0.75	0.317	0.0084	0.0014	0.034
27/04/2012 11:15		9				0.151	0.83	0.08	0.0037	0.0014	0.0136
23/05/2012 9:40	537	2	13.9	1.5	7.98	0.103	0.6	0.166	0.0021	0.0006	0.0091
20/06/2012 11:00		19				0.069	0.62	0.067	0.0021	0.0015	0.0068
20/07/2012 10:00	553	125	11.4	120	8.02	0.113	0.71	0.526	0.0098	0.0051	0.0314
13/08/2012 10:00		3				0.005	0.23	0.082	0.0018	0.0008	0.0031

Date/Time	EC Corrected (us/cm)	SS (mg/L)	Water Temp (Deg C)	Turbidity (NTU)	pH	Total P (mg/L)	TKN (mg/L)	NOx (mg/L)	Copper (mg/L)	Lead (mg/L)	Zinc (mg/L)
13/09/2012 15:45		5				0.023	0.28	0.05	0.0028	0.0011	0.0075
10/10/2012 14:25		119				0.46	2.77	0.292	0.0236	0.0177	0.2935
7/11/2012 8:10	650	63	16.6	43.7	7.78	0.161	0.98	0.396	0.0078	0.0062	0.0978
4/12/2012 9:20	0	7		0		0.104	0.97	0.003	0.0077	0.0025	0.0632
2/01/2013 10:25	1620	106	27.6	114	8.6001	0.414	3.27	0.849	0.0236	0.0099	0.1528
20/01/2013 13:30	1613		24.1		7.98						
30/01/2013 13:30		31				0.329	1.69	0.827	0.0158	0.0052	0.1604
27/02/2013 13:45	494	80	21.9	64.3	7.8101	0.287	1.84	0.679	0.0236	0.014	0.3067
25/03/2013 12:10		14				0.03	2.12	0.003	0.0159	0.0013	0.0185
23/04/2013 10:15		45				0.182	1.34	0.333	0.0106	0.0037	0.066
23/04/2013 14:15	1300		13.8	11.799	7.7						
22/05/2013 9:30	405	47	15.5	42.2	6.54	0.115	0.95	0.169	0.0081	0.0065	0.0911
21/06/2013 12:35	5000	50	7.23	130	7.8999	0.124	0.88	0.17	0.0074	0.0062	0.0734
18/07/2013 16:45	1230	20		9.7002		0.063	0.82	0.243	0.0036	0.0013	0.0395
18/07/2013 16:45				9.7002							
15/08/2013 13:40	692	22	13.51	9.2002	8.2598	0.07	0.8	0.667	0.0043	0.0018	0.0312
12/09/2013 14:10	1320	2	15.98	0	9.5	0.024	0.72	0.106	0.0025	0.0004	0.0039
10/10/2013 15:00		9				0.049	0.76	0.14	0.0028	0.0011	0.0214
8/11/2013 7:00	2680	4	18.6	8.3999	8.3999	0.036	0.95	0.989	0.0034	0.0005	0.02
5/12/2013 13:00		6				0.044	1.61	1.1	0.0055	0.0006	0.0194
2/01/2014 12:55	5880	7	22.3	5.5	8.3999	0.09	2.1801	0.139	0.0098	0.001	0.0275
29/01/2014 8:30		8				0.073	1.72	0.171	0.0097	0.0008	0.0166
29/01/2014 8:50	5310		26.6	10.899	8.2002						
26/02/2014 13:45	5080	20	22	11.6	8.2998	0.113	2.09	0.36	0.0083	0.0009	0.0131
27/03/2014 11:25		6				0.044	1.08	0.449	0.0065	0.0007	0.014
27/03/2014 13:45	4350		23.16	6.6001	8.5						
23/04/2014 13:55		40				0.232	2.16	1.74	0.026	0.0041	0.0842
22/05/2014 14:30		78				0.188	0.75	0.439	0.0092	0.0081	0.1047
19/06/2014 14:50	891		12.35	81.5	8.25						

7.5 Climate data on Temperature, Rainfall, Daily (from May to Aug 2018)

Year	Month	Day	Maximum temperature (Degree C)	Days of accumulation of maximum temperature	Quality	Month	Day	Minimum temperature (Degree C)
2018	5	1	23.5	1	N	5	1	10.7
2018	5	2	25.6	1	N	5	2	11.7
2018	5	3	17.6	1	N	5	3	16.2
2018	5	4	18.6	1	N	5	4	11.8
2018	5	5	20	1	N	5	5	11.2
2018	5	6	21.5	1	N	5	6	9.4
2018	5	7	20.2	1	N	5	7	13.7
2018	5	8	18.5	1	N	5	8	10.3
2018	5	9	18.5	1	N	5	9	8.1
2018	5	10	15.7	1	N	5	10	12.2
2018	5	11	16.3	1	N	5	11	10.1
2018	5	12	18.1	1	N	5	12	11
2018	5	13	19	1	N	5	13	12.2
2018	5	14	16.1	1	N	5	14	5.7
2018	5	15	17.9	1	N	5	15	10.7
2018	5	16	17.7	1	N	5	16	5.2
2018	5	17	16.1	1	N	5	17	11.1
2018	5	18	18.1	1	N	5	18	13.6
2018	5	19	17.3	1	N	5	19	12.2
2018	5	20	16.2	1	N	5	20	10.2
2018	5	21	16.6	1	N	5	21	14.5
2018	5	22	17.1	1	N	5	22	14.4
2018	5	23	17	1	N	5	23	13.1
2018	5	24	16	1	N	5	24	12.4
2018	5	25	20.3	1	N	5	25	5.7
2018	5	26	24.1	1	N	5	26	12.6
2018	5	27	19.7	1	N	5	27	16.5
2018	5	28	21.7	1	N	5	28	13.4
2018	5	29	16.1	1	N	5	29	14
2018	5	30	17.1	1	N	5	30	10.8
2018	5	31	17.7	1	N	5	31	8.9
2018	6	1	17.7	1	N	6	1	4
2018	6	2	19.4	1	N	6	2	5.4
2018	6	3	17.2	1	N	6	3	4.2
2018	6	4	15.2	1	N	6	4	7.3
2018	6	5	15.6	1	N	6	5	3.9
2018	6	6	18.6	1	N	6	6	5.2
2018	6	7	18.3	1	N	6	7	12.2
2018	6	8	15.2	1	N	6	8	12.5
2018	6	9	16.6	1	N	6	9	12.2

Year	Month	Day	Maximum temperature (Degree C)	Days of accumulation of maximum temperature	Quality	Month	Day	Minimum temperature (Degree C)
2018	6	10	20.1	1	N	6	10	8.6
2018	6	11	20.7	1	N	6	11	13.2
2018	6	12	15.2	1	N	6	12	12.7
2018	6	13	15.7	1	N	6	13	9.9
2018	6	14	16.2	1	N	6	14	11.4
2018	6	15	15.3	1	N	6	15	10.3
2018	6	16	13.4	1	N	6	16	10.4
2018	6	17	14.2	1	N	6	17	8.5
2018	6	18	12.7	1	N	6	18	5.4
2018	6	19	13.6	1	N	6	19	6.6
2018	6	20	14.9	1	N	6	20	7.9
2018	6	21	14.6	1	N	6	21	6.4
2018	6	22	15.7	1	N	6	22	2.8
2018	6	23	16.2	1	N	6	23	3.2
2018	6	24	15.4	1	N	6	24	5.2
2018	6	25	13.5	1	N	6	25	2.8
2018	6	26	14.1	1	N	6	26	2.7
2018	6	27	13.2	1	N	6	27	2.5
2018	6	28	14.2	1	N	6	28	2.2
2018	6	29	14.9	1	N	6	29	6.8
2018	6	30	14.5	1	N	6	30	10.1
2018	7	1	15.4	1	N	7	1	2.9
2018	7	2	16	1	N	7	2	3.8
2018	7	3	18.7	1	N	7	3	8.9
2018	7	4	18.2	1	N	7	4	11.3
2018	7	5	17.1	1	N	7	5	13.1
2018	7	6	14.2	1	N	7	6	9.3
2018	7	7	14.3	1	N	7	7	8.9
2018	7	8	14.9	1	N	7	8	10.4
2018	7	9	13.8	1	N	7	9	9.8
2018	7	10	13.8	1	N	7	10	4.6
2018	7	11	14.1	1	N	7	11	4.3
2018	7	12	14.3	1	N	7	12	7.4
2018	7	13	14	1	N	7	13	3
2018	7	14	16.6	1	N	7	14	4.2
2018	7	15	16.1	1	N	7	15	5.8
2018	7	16	16.8	1	N	7	16	10.4
2018	7	17	14.8	1	N	7	17	12.1
2018	7	18	17.1	1	N	7	18	5.7
2018	7	19	12.3	1	N	7	19	6.1
2018	7	20	13.4	1	N	7	20	8.6
2018	7	21	15.7	1	N	7	21	7.2

Year	Month	Day	Maximum temperature (Degree C)	Days of accumulation of maximum temperature	Quality	Month	Day	Minimum temperature (Degree C)
2018	7	22	17.9	1	N	7	22	9.5
2018	7	23	18.7	1	N	7	23	11.2
2018	7	24	16.4	1	N	7	24	11.5
2018	7	25	16.2	1	N	7	25	11.2
2018	7	26	19.6	1	N	7	26	8
2018	7	27	20.8	1	N	7	27	13
2018	7	28	15.5	1	N	7	28	6.4
2018	7	29	13.7	1	N	7	29	9.3
2018	7	30	16.1	1	N	7	30	10.1
2018	7	31	15.9	1	N	7	31	11.4
2018	8	1	16.9	1	N	8	1	9.3
2018	8	2	22.9	1	N	8	2	9.6
2018	8	3	14.3	1	N	8	3	9.2
2018	8	4	17.9	1	N	8	4	9.9
2018	8	5	15	1	N	8	5	12.3
2018	8	6	13.2	1	N	8	6	8.1
2018	8	7	14.4	1	N	8	7	8
2018	8	8	15.5	1	N	8	8	11.2
2018	8	9	19.1	1	N	8	9	10.1
2018	8	10	16.8	1	N	8	10	13.1
2018	8	11	12.4	1	N	8	11	8.1
2018	8	12	14.8	1	N	8	12	7.6
2018	8	13	14.7	1	N	8	13	10.3
2018	8	14	18.2	1	N	8	14	6.6
2018	8	15	15.7	1	N	8	15	11.5
2018	8	16	14	1	N	8	16	6.9
2018	8	17	16.2	1	N	8	17	7.2
2018	8	18	13.7	1	N	8	18	9.8
2018	8	19	13.9	1	N	8	19	9.8
2018	8	20	13.6	1	N	8	20	5.3
2018	8	21	15.4	1	N	8	21	8.3
2018	8	22	21.4	1	N	8	22	5.2
2018	8	23	21.1	1	N	8	23	11.9
2018	8	24	21	1	N	8	24	13
2018	8	25	16.3	1	N	8	25	5.2
2018	8	26	15	1	N	8	26	4.5
2018	8	27	15.8	1	N	8	27	7.2
2018	8	28	19.9	1	N	8	28	7.7
2018	8	29	26.3	1	N	8	29	13.1
2018	8	30	20.4	1	N	8	30	19.2
2018	8	31	15.4	1	N	8	31	10.6

Year	Month	Day	Rainfall amount (millimetres)	Period over which rainfall was measured (days)	Quality
2018	5	1	0	1	N
2018	5	2	0	1	N
2018	5	3	5	1	N
2018	5	4	11.6	1	N
2018	5	5	0	1	N
2018	5	6	0	1	N
2018	5	7	0	1	N
2018	5	8	0.6	1	N
2018	5	9	0	1	N
2018	5	10	3.6	1	N
2018	5	11	2	1	N
2018	5	12	0.2	1	N
2018	5	13	0	1	N
2018	5	14	0	1	N
2018	5	15	0	1	N
2018	5	16	0	1	N
2018	5	17	0	1	N
2018	5	18	1.2	1	N
2018	5	19	2.8	1	N
2018	5	20	0	1	N
2018	5	21	0	1	N
2018	5	22	0	1	N
2018	5	23	0	1	N
2018	5	24	0	1	N
2018	5	25	0	1	N
2018	5	26	0	1	N
2018	5	27	0	1	N
2018	5	28	0.2	1	N
2018	5	29	0.2	1	N
2018	5	30	1.8	1	N
2018	5	31	0.2	1	N
2018	6	1	0	1	N
2018	6	2	0	1	N
2018	6	3	0	1	N
2018	6	4	0	1	N
2018	6	5	0	1	N
2018	6	6	0	1	N
2018	6	7	0	1	N
2018	6	8	2.2	1	N
2018	6	9	0.2	1	N
2018	6	10	0	1	N

Year	Month	Day	Rainfall amount (millimetres)	Period over which rainfall was measured (days)	Quality
2018	6	11	0.2	1	N
2018	6	12	4	1	N
2018	6	13	8.2	1	N
2018	6	14	1.8	1	N
2018	6	15	5.2	1	N
2018	6	16	5.4	1	N
2018	6	17	4.8	1	N
2018	6	18	0.2	1	N
2018	6	19	0	1	N
2018	6	20	0	1	N
2018	6	21	0	1	N
2018	6	22	0	1	N
2018	6	23	0	1	N
2018	6	24	0	1	N
2018	6	25	0	1	N
2018	6	26	0	1	N
2018	6	27	0	1	N
2018	6	28	0	1	N
2018	6	29	0	1	N
2018	6	30	1.6	1	N
2018	7	1	0	1	N
2018	7	2	0	1	N
2018	7	3	0	1	N
2018	7	4	0	1	N
2018	7	5	0.2	1	N
2018	7	6	5.2	1	N
2018	7	7	7.4	1	N
2018	7	8	0.6	1	N
2018	7	9	0	1	N
2018	7	10	0	1	N
2018	7	11	3	1	N
2018	7	12	0.8	1	N
2018	7	13	0	1	N
2018	7	14	0	1	N
2018	7	15	0	1	N
2018	7	16	0	1	N
2018	7	17	0	1	N
2018	7	18	2	1	N
2018	7	19	0	1	N
2018	7	20	9.4	1	N
2018	7	21	0.8	1	N
2018	7	22	0	1	N
2018	7	23	0	1	N

Year	Month	Day	Rainfall amount (millimetres)	Period over which rainfall was measured (days)	Quality
2018	7	24	3	1	N
2018	7	25	7.2	1	N
2018	7	26	0.2	1	N
2018	7	27	0	1	N
2018	7	28	0	1	N
2018	7	29	2.2	1	N
2018	7	30	0	1	N
2018	7	31	1.6	1	N
2018	8	1	2.6	1	N
2018	8	2	0	1	N
2018	8	3	21.2	1	N
2018	8	4	1	1	N
2018	8	5	0	1	N
2018	8	6	12.2	1	N
2018	8	7	7.2	1	N
2018	8	8	1.8	1	N
2018	8	9	0	1	N
2018	8	10	0	1	N
2018	8	11	7.8	1	N
2018	8	12	3	1	N
2018	8	13	0.8	1	N
2018	8	14	0	1	N
2018	8	15	0	1	N
2018	8	16	3.2	1	N
2018	8	17	0	1	N
2018	8	18	3.6	1	N
2018	8	19	0.8	1	N
2018	8	20	0	1	N
2018	8	21	0	1	N
2018	8	22	0	1	N
2018	8	23	0	1	N
2018	8	24	0	1	N
2018	8	25	0	1	N
2018	8	26	0	1	N
2018	8	27	0	1	N
2018	8	28	0	1	N
2018	8	29	0	1	N
2018	8	30	0.4	1	N
2018	8	31	5.6	1	N

Year	Month	Day	Daily global solar exposure (MJ/m*m)
2018	5	1	10.4

Year	Month	Day	Daily global solar exposure (MJ/m*m)
2018	5	2	13
2018	5	3	3.7
2018	5	4	11.4
2018	5	5	12.4
2018	5	6	13.1
2018	5	7	6
2018	5	8	10.1
2018	5	9	6
2018	5	10	9.3
2018	5	11	10.3
2018	5	12	11.2
2018	5	13	12.4
2018	5	14	10.9
2018	5	15	9.4
2018	5	16	11.5
2018	5	17	5.8
2018	5	18	8.3
2018	5	19	10.5
2018	5	20	5.8
2018	5	21	4.2
2018	5	22	4.6
2018	5	23	5
2018	5	24	6
2018	5	25	11.4
2018	5	26	8.1
2018	5	27	3.9
2018	5	28	10.8
2018	5	29	9
2018	5	30	6.8
2018	5	31	10.8
2018	6	1	9.7
2018	6	2	10.5
2018	6	3	10.8
2018	6	4	8.8
2018	6	5	10.8
2018	6	6	10
2018	6	7	5
2018	6	8	4.8
2018	6	9	8.7
2018	6	10	9.1
2018	6	11	8.6
2018	6	12	7.7
2018	6	13	8.5
2018	6	14	7.9

Year	**Month**	**Day**	**Daily global solar exposure (MJ/m*m)**
2018	6	15	8.6
2018	6	16	9.3
2018	6	17	9.8
2018	6	18	6.9
2018	6	19	8.6
2018	6	20	10.4
2018	6	21	10.5
2018	6	22	10.4
2018	6	23	9.5
2018	6	24	7.7
2018	6	25	9.9
2018	6	26	10.2
2018	6	27	10.6
2018	6	28	8.2
2018	6	29	6.9
2018	6	30	10.6
2018	7	1	10.5
2018	7	2	10.4
2018	7	3	9.3
2018	7	4	6.5
2018	7	5	2.8
2018	7	6	9
2018	7	7	10.1
2018	7	8	8.3
2018	7	9	5.9
2018	7	10	10.9
2018	7	11	10
2018	7	12	10
2018	7	13	10.4
2018	7	14	11.3
2018	7	15	8.5
2018	7	16	11.5
2018	7	17	8
2018	7	18	11.6
2018	7	19	5.2
2018	7	20	10.7
2018	7	21	10.5
2018	7	22	11.3
2018	7	23	6.3
2018	7	24	10.4
2018	7	25	11.2
2018	7	26	12.2
2018	7	27	12.1
2018	7	28	12.1

Year	Month	Day	Daily global solar exposure (MJ/m*m)
2018	7	29	10.2
2018	7	30	10.7
2018	7	31	12
2018	8	1	10.6
2018	8	2	9.9
2018	8	3	9.7
2018	8	4	11
2018	8	5	7.5
2018	8	6	11.3
2018	8	7	10.9
2018	8	8	12
2018	8	9	13.4
2018	8	10	8.1
2018	8	11	9.8
2018	8	12	12.3
2018	8	13	9.7
2018	8	14	14.5
2018	8	15	10.2
2018	8	16	12
2018	8	17	14.3
2018	8	18	13.5
2018	8	19	11.4
2018	8	20	9
2018	8	21	14.6
2018	8	22	15.6
2018	8	23	10.7
2018	8	24	15.7
2018	8	25	16.1
2018	8	26	15.4
2018	8	27	13.9
2018	8	28	14.9
2018	8	29	15.4
2018	8	30	2.4
2018	8	31	13.6