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Salter Point

LAGOON STUDY

July 2018

For City of South Perth

SYRINX ENVIRONMENTAL

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GLOSSARY

The following terms used in the report have the meanings ascribed below:

Word or phrase	*Refers to*
algae	Informal term for a large, diverse group of photosynthetic organisms
algal spore	A cell that germinates without fusing to form a new individual
benthic	Relates to the bottom of a body of water, e.g. a habitat at the lowest level of a body of water
benthos	A community of organisms that lives on, in or near the benthic zone
biofilter	An excavated basin or trench that is filled with a porous filter media and planted with vegetation to remove pollutants from stormwater runoff
bioflocculant	A biological flocculant that promotes the clumping of particles in wastewater treatment
chlorophyll *a*	A specific form of chlorophyll used in oxygenic photosynthesis and is present in all algal and cyanobacterial species
choke	Experience a reduced tidal range due to a narrow entrance
ciliates	A group of protozoans characterized by the presence of hair-like organelles called cilia
circumneutral	Having a pH of between 6.5 and 7.5
cladocerans	An order of small crustaceans commonly called water fleas
coccoid	Shaped like or resembling a coccus/ spherical
cryptic	An organism that is seldom observed and their habitat requirements is not well known
cryptophytes	A taxonomic group of algae belonging to the Cryptophyceae, common in most water bodies
Cyanobacteria	Commonly referred to as blue-green algae. A group of prokaryotes belonging to the Kingdom Monera
cyanophyte	A member of the division Cyanobacteria
depauperate	Lacking in numbers or variety of flora or fauna species (or ecosystem)

Word or phrase	*Refers to*
diatom	A single celled alga, with a siliceous skeleton (frustule), common term for members of the division Bacillariophyta
dieback	A condition in which a tree or shrub begins to die from the tip of its leaves or roots backwards, owing to disease or an unfavourable environment
epiphyte	An organism that grows on the surface of a plant or macroalgae (in water)
estuary	A tidal mouth of a large river, where the tide meets the stream
euryhaline	An aquatic organism able to tolerate a wide range of salinity
eutrophication	A term describing an excessive richness of nutrients in a body of water
filamentous	The growth of single into elongated filaments or threads
first flush	The initial surface runoff of a rainstorm
floating mat	An algal mat that occurs on the surface of a water body comprising of cyanobacteria and other algal groups, mostly filamentous. Usually dislodged from the surface of the sediment
hydraulic conductivity	This describes the ease with which a fluid (usually water) can move through pore spaces or fractures
hydraulic gradient	A vector gradient between two or more hydraulic head measurements over the length of the flow path
hydraulic head	A specific measurement of liquid pressure above a geodetic datum
invertebrate	animals that neither possess nor develop a vertebral column (backbone)
lunar nodal cycle	An 18.6-year cycle in the magnitude of the lunar diurnal tide determined by the relative movement of the plane in which the Moon orbits the Earth
macroaglae	Refers to several species of macroscopic, multicellular, marine algae e.g. seaweed

Word or phrase	*Refers to*
marsh	an area of low-lying land which is flooded in wet seasons or at high tide, and typically remains waterlogged at all times
microenvironment	the immediate small-scale environment of an organism or a part of an organism, especially as a distinct part of a larger environment
microinvertebrate	Invertebrate of microscopic size (< 150 µm)
mucilage	A polysaccharide produced by plants, algae and cyanobacteria/bacteria forming an external layer on the organism
oxidation	A loss of electrons or increase in oxidation state by a molecule or atom
phytoplankton	Microscopic, autotrophic (algae, cyanobacteria) components of the plankton community
redox	A chemical reaction in which the oxidation states of atoms are changed and involves both a reduction and an oxidation process; which allow for electron transfer processes
riparian	Relating to, or situated, on the banks of a river or stream. The riparian zone is the interface between land and a river or stream
rotifer	Are commonly called wheel animals, they make up a phylum of microscopic and near-microscopic aquatic invertebrates (pseudocoelomate)
saltmarsh	a coastal ecosystem in the upper coastal intertidal zone between land and open saltwater or brackish water that is regularly flooded by the tides
salt pan	A flat expanse of ground covered with salt and other minerals
sedgeland	Land where sedge grows in abundance
sill	an underwater ridge or rock ledge extending across the bed of a body of water
spit	an elongated sandy deposit that extends out into open water in the direction of a longshore current
substrate	The surface or material on or from which an organism lives, grows, or obtains its nourishment

Word or phrase	*Refers to*
swale	A water sensitive design feature consisting of a linear channel in the ground lined with grass or other vegetation
total kjeldahl nitrogen	The total concentration of organic nitrogen and ammonia
turbidity	The cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye
weir	A barrier across the horizontal width of a river that alters the flow characteristics of water and usually results in a change in the height of the river level

ABBREVIATIONS

The following terms used in the report.

Abbreviation or acronym	*What it stands for*
ABRS	Australian Biological Resources Systematics
AHD	Australian Height Datum
ANZECC	Australia and New Zealand Environment Conservation Council
ARI	Average Recurrence Interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS/NZS	Australian Standard/New Zealand Standard
BOM	Bureau of Meteorology
CBD	Central Business District
CoSP	City of South Perth
DBCA	Department of Biodiversity, Conservation and Attractions
DWER	Department of Water and Environmental Regulation
DoW	Department of Water
DPAW	Department of Parks and Wildlife
DRP	Dissolved Reactive Phosphorus
EPA	Environmental Protection Authority

Abbreviation or acronym	*What it stands for*
EIA	Environmental Impact Assessment
GW	Ground Water Sample (Syrinx, 2018)
ISQG	Interim Sediment Quality Guide
NEPM	National Environment Protection Measures
NOx	Total oxidised nitrogen (the sum of the nitrate and nitrite)
NRMMC	Natural Resource Management Ministerial Council
OHS	Occupational Health and Safety
ORP	Oxidation Redox Potential
PEU	Phytoplankton Ecology Unit
SD	Stormwater Sample (Syrinx, 2013)
SED	Lagoon Sediment Sample (Syrinx, 2013)
SW	Surface Water Sample (Syrinx, 2018)
TN	Total Nitrogen as N
TP	Total Phosphorus as P
TDS	Total Dissolved Solids
WIR	Water Information Reporting. Refers to a database surface and groundwater information supplied by the Department of Water.

PART 1: INTRODUCTION

1.0 PROJECT BACKGROUND

This comprehensive study of the Salter Point Lagoon (the Lagoon) was commissioned by the City of South Perth to characterise the hydrology, and chemistry of the Lagoon with a purpose of elucidating conditions that favour algal growth and developing appropriate recommendations for the management of this unique ecosystem. The study was triggered by concerns from local residents over extensive coverage across the surface water of the Lagoon of floating algal mats between January 2016 and April 2017. The proliferation of the mats was seen as a bloom with locals fearing the health of the Lagoon was deteriorating. The floating mats were predominantly composed of the filamentous green algae, *Chaetomorpha* and *Cladophora* species. Aerial photography of the extent of the "bloom" is shown on Figure 1.

Since the Lagoon is dynamic in nature, connected hydraulically to the Canning River Estuary (the Estuary), the task of determining the most appropriate management action is complex. A highly considered, and possibly a long term investigation beyond the scope of this study, is therefore required. The situation in the Lagoon is further complicated by the filling of the channel with limestone rocks by members of the public, presumably to gain access across the channel. The result is altered flow and the subsequent build-up of sediment at the mouth of the Lagoon.

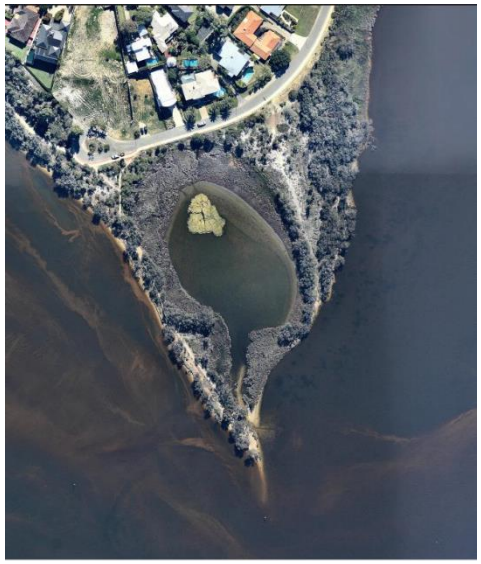
2.0 PROJECT OBJECTIVES AND TASKS

The objective of this study was to develop a sound methodology, within the timeframe for this project (March to June 2018), and a practical, succinct and pragmatic set of recommendations and management actions for both the short term and long term management of the Lagoon.

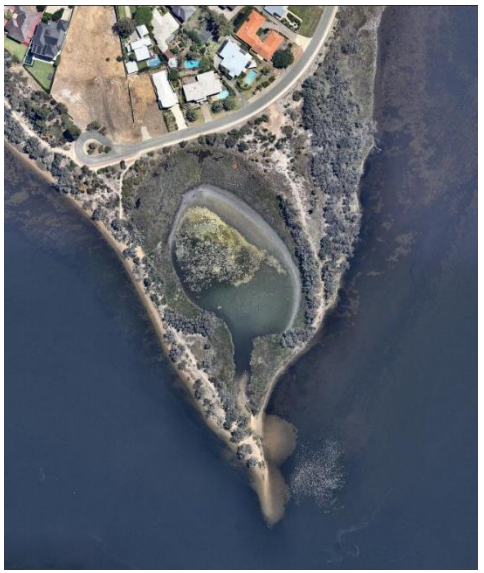
The project tasks were to:

- Describe and measure tidal interactions and groundwater input and output (water flows in and out of the Lagoon);
- Describe the general hydrology of the Lagoon;
- Assess the nutrients levels in the sediment, surface water and groundwater (i.e. assess water and sediment quality);
- Conduct a vegetation condition survey and fauna survey to a level that would enable formulation of management recommendations;
- Provide recommendations for short and long term management of the Lagoon with a focus on water quality improvement, reduction of sedimentation and improvements of flows between the Estuary and the Lagoon via the lagoon inlet/outlet channel;
- Assess the risks / impacts of dredging the Lagoon as a management option.

1. January 2016 – blooms visible



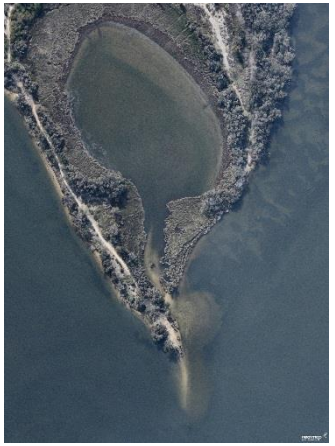
2. May 2016 – peak in bloom



3. November 2016 – peak in bloom

4. January 2017 – just before die-off of blooms

5. April 2017 – end of die-off of blooms



6. April 2018 – middle of study period

Figure 1. Aerial imagery showing the extent of the mat coverage at Salter Point Lagoon from January 2016 to April 2018

3.0 SITE CONTEXT

3.1 LOCATION AND SURROUNDING LAND USE

Salter Point Lagoon is located within the suburb of Salter Point, approximately 8.5 kilometres (km) south of the Perth Central Business District (CBD) Western Australia (Figure 2). The Lagoon is located within ecologically significant native bushland as part of the Canning River Foreshore, Salter Point to Wilson, Bush Forever Site 333 (Dell and Banyard, 2000). The land to the north of the Lagoon is residential housing and the Canning River Estuary surrounds the land to the east, south and west of the Lagoon.

3.2 LOCATION WITHIN SWAN-CANNING ESTUARY

The Lagoon is located within the Swan-Canning Estuary (the Estuary). The Estuary is described as a permanently open valley estuary (Hodgkin and Hesp,1998) receiving flow from two tributaries, the Swan-Avon and Canning Rivers. Valley estuaries are characterised by large flow with extreme changes in salinity. The Canning River dissects through the Bassendean Dune system of the Swan Coastal Plain and is estuarine until Kent St Weir. Generally, it is shallow throughout, 4 m to 5 m to Mt Henry, then less than 1 m upstream of Salter Point. The Estuary is a microtidal system, strongly influenced by seasonal variation in rainfall. It has been described as a seasonal estuary, this being the dominant hydrological feature (Hodgkin, 1987). In seasonally dominated estuaries the intensity of river discharge is the major influence on the salinity of the systems (formation of the salt wedge) followed by tidal variations (Hamilton *et al*., 2006). Winds are also a major influence, generating waves that affect circulation of nutrients and sedimentation (Brearley, 2005). Salinity is then one of the major determinants of the ecology of the system.

The community structure (biota) in the Estuary is one of continuous recruitment with a diverse marine-estuarine fauna. Mostly euryhaline biota (organisms able to tolerate a range of salinities from fresh to saline) dominate these systems. More freshwater forms occur near the river entrances and marine species nearer to the coast.

3.3 LAGOON MORPHOLOGY

The Lagoon is hydraulically connected to the Canning Estuary through a narrow tidal channel located at its southern end. The Lagoon also has a sandy spit at the southern end. A sediment sill is located between the spit and the sedgeland foreshore on the east side of the Lagoon (Figure 3).

3.4 GEOLOGY AND SOILS

Regional geology mapping (Gozzard, 1983) indicates the following soil is expected around the Lagoon:

S14 SAND - white to pale grey, subangular to subrounded, medium to coarse-grained quartz sand, abundant shells and shell fragments of alluvial origin.

The Lagoon area is mapped as "*high to moderate risk of ASS occurring with 3 m of the natural soil surface*" on DER (2014) Acid Sulfate Soil (ASS) risk mapping.

3.5 WATER FLOWS

The three water flows influencing the Lagoon are tidal flows, groundwater flows and a small volume of stormwater inflow as detailed in the sections below.

3.5.1 Tidal Flows

Changes in water levels in the Estuary are influenced by the daily tidal range (0.1 m to 0.6 m), being an open system with no barrier to the ocean, and river discharge (rainfall) (Hodgkin, 1987). When the Estuary levels rise and fall, exchange occurs between the Estuary and the Lagoon via the tidal channel.

3.5.2 Groundwater Flows

Groundwater contours from the Perth Groundwater Atlas (DoE, 2004) indicate groundwater flow in the area is from north-northeast to south-southwest towards the Canning River Estuary (Figure 4).

It is likely groundwater flows into the Lagoon from the north and radially out of the Lagoon towards the east, west and south into the Estuary. However, changes in the water of the Lagoon due to tidal fluctuations, storm surge and stormwater inflows could change the groundwater flow into and out of the Lagoon. For example, if the water level of the Lagoon rises sufficiently during a storm and/or high tide event this would slow down the seepage inflow from the north.

3.5.3 Stormwater Flows

A stormwater pit drain is located to the north of the Lagoon on Salter Point Parade (Figure 3). Stormwater runoff is channelled from the road directly into the northern vegetated area surrounding the Lagoon, potentially entering the Lagoon as well.

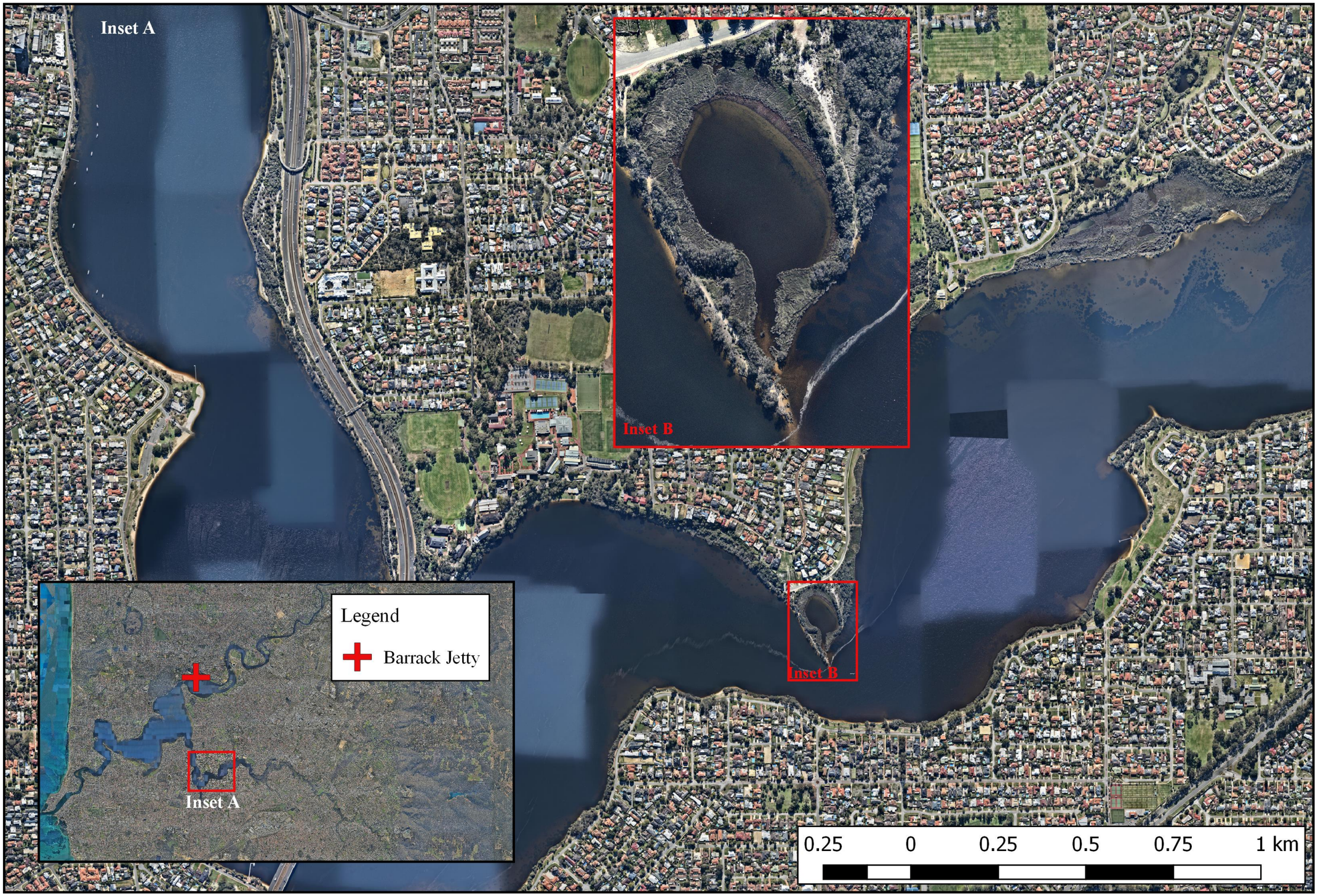


Figure 2. Location of Salter Point Lagoon. Insert A shows the location of the Lagoon within the Swan-Canning Estuary.

Figure 3. Morphology of Salter Point Lagoon

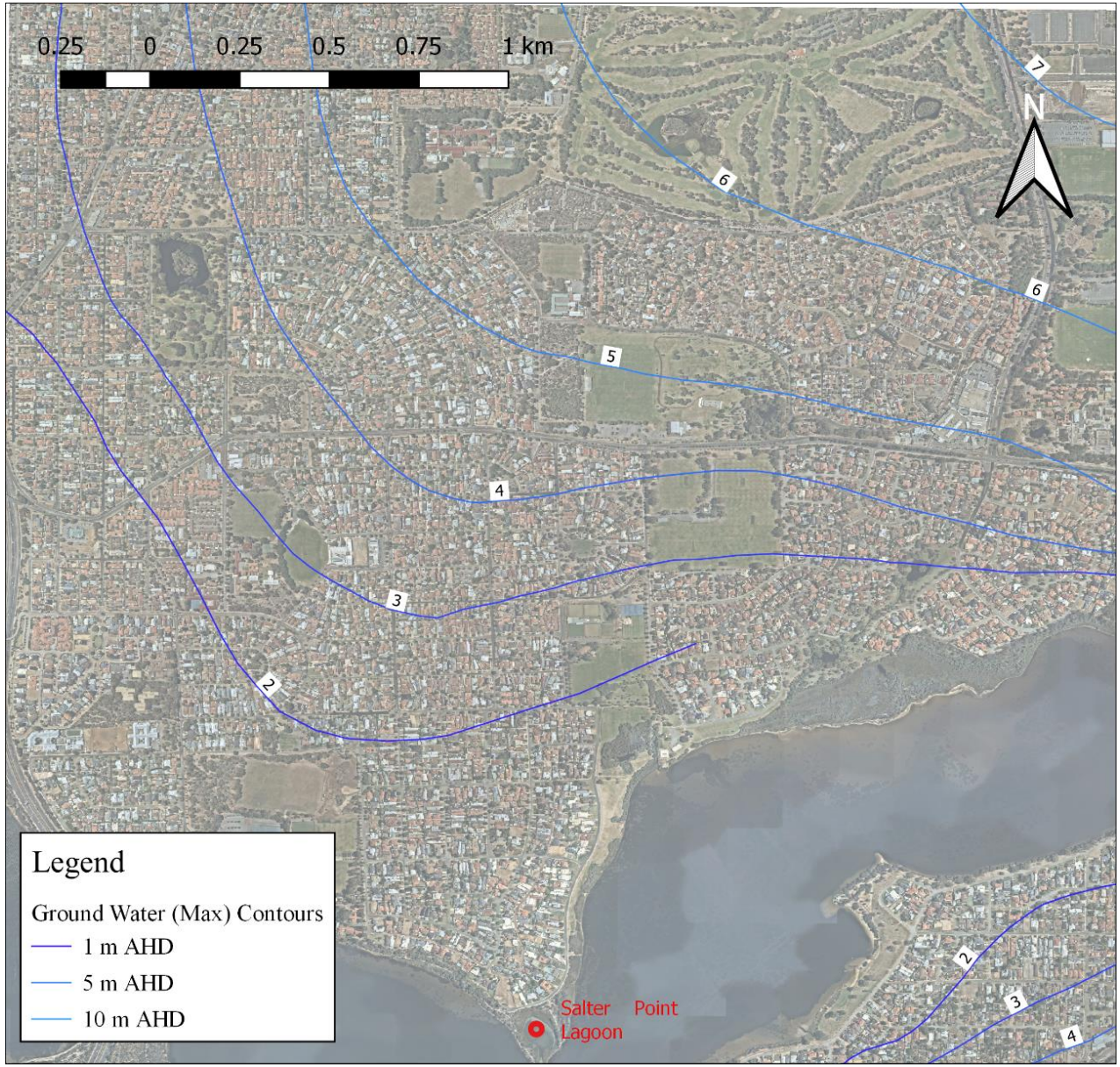


Figure 4. Regional groundwater elevation contours

3.6 PHYTOPLANKTON AND MACROALGAL BLOOMS

Estuaries are dynamic systems with cycles and processes operating at a range of spatial and temporal scales resulting in a variety of biotic communities. The phytoplankton and macroalgae present in the Estuary are controlled by the physical and chemical processes that are seasonally driven and more variable in estuaries than in the marine environment (Deeley and Paling, 1999). Changes in the Estuary, such as an increase in available nutrients following a flush of fresh water, can trigger the rapid growth of particular algae and form a bloom. The Estuary typically undergoes seasonal succession of phytoplankton. Diatom blooms are typical every Autumn and late Spring with dinoflagellate abundances increasing in early Autumn (Brearley, 2005; DoW, 2016).

The Estuary has a much higher diversity of macroalgae, such as *Chaetomorpha* and *Cladophora* species, than other estuaries in the south-west of Australia. This can be attributable to the high habitat diversity in the system with the green filamentous algae dominating in the upper Canning River Estuary (Brearley, 2005). In the 1990s high number of the filamentous green alga, *Rhizoclonium* sp., was present at Riverton Bridge and extended down to Mt Henry Bridge in 1996 (Brearely, 2005). Historically, there appears to have been problems with the growth and decomposition of filamentous algae in the Swan River estuary since settlement. However, the exact causes of the appearance and disappearance were unknown (Hodgkin and Vicker, 1987). Like phytoplankton, the distribution and abundance of macroalgae is seasonally driven. Certain years may be more favourable to their growth than at other times. And, like phytoplankton, macroalgae are controlled by physical factors such as wave action, tidal movement, and changes in salinity, nutrients and light (Deeley and Paling, 1999).

3.7 COMMUNITY AND ENVIRONMENTAL VALUES

The Lagoon is the last remaining natural lagoon of this type within the Swan - Canning River System (SRT, 2009). The Swan-Canning Estuary is listed as a nationally important wetland in the Directory of Important Wetlands (Environment Australia, 2001) and this includes the tidal and inter-tidal lagoons and marshes located along the estuary. As such, Salter Point Lagoon is identified as an Environmentally Sensitive Area (under the *Environmental Protection Act 1986*) within a high conservation area requiring protection. The foreshores of the Swan and Canning Rivers and the Estuary are also protected under the *Swan and Canning Rivers Management Act 2006* which created the Swan Canning Riverpark managed by the DBCA.

The environmental values, as per Environment Australia (2001), for the Lagoon fall into the following categories:

- Aquatic ecosystems,
- Recreational and aesthetic, and
- Cultural.

The Canning River is a registered Aboriginal site (ID 3538) under Section 5 of the *Aboriginal Heritage Act 1972*. It has mythological significance to the Noongar people from its association with the Waugal. The path of the river across the Swan Coastal Plain was formed by the Waugal and follows the pattern of the Waugal's movements. The Canning River and its surrounding wetlands were also a source for ochre, food and water for the Noongar people (Australian Interaction Consultants, 2010).

The community response to the aesthetics of the Lagoon is an indication of the importance of the Lagoon to the public. It is therefore considered important to provide information to educate all stakeholders on the status and processes that drive the Lagoon, and how these influence the management of the area.

PART 2: METHODOLOGY

4.0 DESKTOP REVIEW

A desktop review was undertaken to distil available information on the Lagoon and its dynamics. The following data was reviewed for the past five years:

- Estuary water levels at the nearest level monitoring station (Barrack Street Jetty) by the Department of Transport.
- Canning River Estuary water quality data collected near Salter Point by the DBCA.
- Rainfall and air temperature data from the nearest BOM station (Jandakot Aerodrome).

Data was compared for the following periods to determine changes in properties that may be driving the phytoplankton blooms:

- Bloom period: September 2015 and May 2017.
- Non-bloom period: September 2013 and May 2015.

Groundwater data within the Salter Point area and freely available flora and fauna database searches were also reviewed to provide a wider context for analysing and interpreting the field data collected during this study.

5.0 SURVEY OF THE LAGOON BATHYMETRY AND SURROUNDS

The field study of the Lagoon commenced with a survey of the Lagoon bathymetry and surrounds on 16 March 2018. A map showing the survey area and results of the survey are included in Appendix 1. The survey was undertaken to record the volume and area of the Lagoon for water balance calculations and to identify drainage pathways for surface water runoff around the Lagoon.

5.1 LEVEL AND FEATURE SURVEY

The level and feature survey of the area outlined in red in Appendix 1 included:

- Ground and lagoon bed level with contours at 0.2 m intervals;
- Estimated depth and extent of sludge or soft sediment within the Lagoon;
- Details of any pipes e.g. invert and obvert levels of stormwater inlet to the north of the Lagoon.

The Lagoon channel inlet/outlet area (area outlined in yellow shown with in Appendix 1) was surveyed at a finer level of detail to determine if flow is being restricted through the channel:

- Channel bed level contours at 0.1 m intervals;

- Channel bed levels at 0.05 m changes in height along the three profile lines (blue lines shown within Appendix 1).

The profile lines were surveyed approximately at monthly intervals during the study (27 March 2018, 10 April 2018, 2 May 2018, and 6 June 2018) to provide information on changes to surface elevation of the channel over time. Seven channel elevation monitoring stakes were installed by the surveyors to allow for measurements of surface elevation in the channel to be taken in between the surveys.

5.2 SURVEY OF MONITORING POINTS AFTER INSTALLATION

The location and elevation of seven channel elevation monitoring stakes were surveyed at the start of the survey on the 16 March 2018 and the location and elevation of the top of casing of the groundwater monitoring wells and housing for surface water level loggers were surveyed at the end of the survey on the 28 March 2018. The x and y locations of all monitoring points were connected to MGA94 Zone 50 coordinate datum the elevation (z) was spirit levelled with an estimated accuracy of +/-2 mm and connected to Australian Height Datum (AHD).

6.0 LAGOON HYDROLOGY ASSESSMENT

6.1 TIDAL INTERACTIONS ASSESSMENT

Tidal interactions between the Lagoon and the adjacent Estuary were assessed through high temporal resolution measurements of water levels and the measurement of the surface elevation along the inlet/outlet channel. Tidal flushing of the Lagoon was assessed by calculating the tidal prism as described in more detail below.

6.1.1 Surface Water Levels

Continuous water level recorders (Heron Nanologgers) were installed at the following locations:

1. Middle of the Lagoon; and
2. Estuary adjacent to the Lagoon.

The locations are shown in Figure 5. The location of the Estuary monitoring point was selected so as to not be in the path of boat traffic, yet still far enough from the shore to be inaccessible to passers-by (reduce the risk of vandalism or theft). The surface water level loggers were installed within slotted pipes secured to the Lagoon/Estuary bed by stakes. The loggers measured water levels at high at a high temporal resolution (5 minute intervals).

Data from the water level loggers was downloaded approximately every month, typically corresponding with each water sampling round. At the same time, measurements of the water level using an electronic water level meter were taken to assess the accuracy of the water level record.

Figure 5. Salter Point Lagoon monitoring locations. Points 01, 02 and 03 are surface water (SW) sampling points for phytoplankton, physico-chemical and nutrients.

6.1.2 Surface Elevation Changes Along the Channel

As discussed in Section 5.1 changes in surface elevation along the tidal channel were monitored via monthly level surveys of profile lines across the channel. Seven survey stakes were also installed at approximate 5 m to 10 m intervals along the channel. Measurements of the distance from the top of the stake to the channel bottom were taken approximately every month during each sampling event and subtracted from the surveyed elevation of the top of the stake to calculate the channel elevation at each stake. The difference in surveyed and measured channel levels between each observation indicates the average surface elevation changes over the observation period.

The method described above does not distinguish between surface (e.g. erosion) and subsurface (e.g. compaction) processes behind the surface elevation changes but it is able to provide relatively robust data of surface elevation changes in intertidal zones (Thomas and Ridd, 2004). This is provided the stakes do not interfere with accretion patterns by disturbing wave and current patterns (Bird, 1986). Observations of flow through the channel were also recorded during each site visit.

6.1.3 Calculation of Tidal Prism

In addition to water level and channel elevation measurements, tidal interactions in the Lagoon were also assessed by calculating the tidal prism using the following equation:

$$\mathbf{T = HA} \text{ (Equation 1)}$$

Where:

T – tidal prism (m^3)

H – tidal range (m)

A – surface area of the Lagoon (m^2)

The tidal prism is the change in volume of the Lagoon between high and low tide or the volume of the incoming or outgoing tide plus any other net flows such as the groundwater flows.

Measurements of tidal flow through the channel from the installation of a weir or a stage discharge relationship were considered. However, as these techniques are designed to measure streamflow in one direction and flow through the channel is tidal and will change directions, it was not used. The channel is also several metres wide and the flow divides into two branches which further complicates measurements of the flow. Installation of monitoring equipment in the channel was considered too risky as it could be easily accessed and therefore not secure. A weir structure would also require regular maintenance to remove silt/sediment build up.

6.2 GROUNDWATER INPUT AND OUTPUT ASSESSMENT

To analyse groundwater (GW) inputs and outputs, three groundwater monitoring wells were installed at the GW locations shown in Figure 5. The coordinates for each of the wells are included in Table 1.

Table 1. Groundwater Well Coordinates

Groundwater Well ID	Easting	Northing
GW01	393657.506	6455800.141
GW02	393549.467	6455755.032
GW03	393626.110	6455833.007

The locations for the groundwater wells were selected based on likely groundwater contours as per the Perth Groundwater Atlas discussed in Section 3.5.2. GW03 was chosen as an upgradient bore to characterise groundwater potentially flowing in the Lagoon and GW01 and GW02 were chosen to characterise groundwater potentially flowing in out or out of the Lagoon, depending on the difference between Lagoon and Estuary levels and to allow for triangulation to calculate groundwater flow direction.

All groundwater monitoring wells were installed in accordance with the Department of Water (2006) *Water Quality Protection Note – Groundwater Monitoring Bores and the Australian Government – National Water Quality Management Strategy Minimum Construction Requirements for Water Bores in Australia*. Well construction logs are contained in Appendix 2.

Continuous water level recorders (Heron Nanologgers) were installed in the three groundwater bores. The data was downloaded and the levels checked using an electronic water level meter dipper approximately monthly, at the same time as the data download of the surface water loggers.

Groundwater levels and the relative hydraulic head of the Lagoon were compared to understand the movement of groundwater and therefore potential direction of any nutrients associated with that groundwater.

Groundwater flows in and out of the Lagoon were estimated using Darcy's Law:

$$\mathbf{G = -K\ I\ A} \text{ (Equation 2)}$$

Where:

G – estimated net groundwater flow (m^3s^{-1})

K – hydraulic conductivity (ms^{-1})

I – hydraulic gradient (m)

A – cross-sectional area through which flow occurs (m^2)

6.3 STORMWATER FLOWS MEASUREMENT

The volume of stormwater inflow into the lagoon from the drain SD1 was estimated based on its catchment size. The stormwater drain was submerged at the time of sampling so bucket measurements of flow were not possible.

6.4 WATER BALANCE AND FLUSHING TIME ASSESSMENT

The assessment of the Lagoon hydrology was not intended to complete a precise water balance of the Lagoon. Collection of the data required to accurately evaluate all the terms in the water balance of a tidal lagoon is expensive and time consuming. Because of this, few detailed scientific studies have been documented (Kjerfve, 1994). Instead, the flushing time of the Lagoon was estimated from the tidal range using the following equation:

Flushing Time = Depth of Lagoon (m) x Tidal Period (days) / Tidal Range (m) (Equation 3)

The tidal prism was also compared the estimated volumes of groundwater inputs and outputs and stormwater flows to assess the relative importance of each of these components of the water balance and estimate the volume of tidal flushing.

7.0 WATER QUALITY SAMPLING METHODOLOGY

Water quality sampling of the Lagoon, the adjacent Estuary, surrounding groundwater and stormwater inflows was undertaken according to the schedule in Table 2.

Table 2. Water quality sampling schedule

Site	Frequency	Date
Surface Water Quality (lagoon and river)	Monthly	28th March 24th April 30th May
Groundwater Quality	Bi-monthly	28th March 30th May
Stormwater Quality	One-off (first major rain event during study)	25th May

All sample collection was conducted by qualified Syrinx Environmental staff in line with the methodology outlined in Australian/New Zealand Standards for Water Quality Sampling Series AS/NZS 5667:1998. Sample sites for water quality testing were proposed based on our understanding of the site, the hydrology of groundwater flows, tidal interactions and the location of stormwater inlets (Figure 5).

Water quality data was compared to relevant standards and guidelines (i.e. ANZECC 2000 for estuarine water and sediments) and relevant research literature.

7.1 SURFACE WATER SAMPLING METHODOLOGY

Surface water sampling was undertaken at three locations using a canoe to access the locations marked as SW in Figure 5. The SW02 and SW03 sampling locations were placed within the Lagoon, whilst SW01 was located adjacent to the outlet of the Lagoon within the Estuary.

At each surface water location, the following parameters were measured in the field:

- pH, conductivity, total dissolved solids, dissolved oxygen and redox potential;
- Secchi depth, as a measure of the transparency of the water; and
- The indicative algal coverage of the Lagoon surface water and Lagoon bed.

Water samples were collected and analysed in the laboratory for the following parameters:

- pH, nutrients suite including ammonia, nitrite, nitrate, total Kjeldahl nitrogen, total nitrogen, total phosphorus, dissolved reactive phosphorus and reactive phosphorus;
- Total and dissolved metals suite including arsenic, cadmium, chromium, copper, lead, nickel, zinc aluminium, iron, selenium and mercury;
- Phytoplankton identification and enumeration and cyanophyte biovolume measurements; and
- Examination under the microscope of one sample of a benthic algal/cyanobacterial mat in the Lagoon and one sample of floating material that became detached from the mat to identify the main species forming the mat.

7.2 GROUNDWATER SAMPLING METHODOLOGY

Groundwater samples were collected at the three groundwater monitoring wells marked as GW locations in Figure 5 to gather data on nutrient and metal concentrations entrained in groundwater which could impact on the Lagoon. Purging and sampling of groundwater bores was consistent with AS/NZS 5667.1:1998 and AS/NZS 5667.11:1998. The groundwater was field tested and analysed for the same parameters as the surface water (excluding Secchi depth and phytoplankton/cyanobacteria analysis).

7.3 STORMWATER SAMPLING METHODOLOGY

The stormwater from drain SD1 marked on Figure 5 was sampled and analysed for nutrients and metals to understand what contribution these contaminants entrained in stormwater might have on algal blooms and the impact to Lagoon water quality. The sampling was also undertaken to identify whether a potential source of metal contamination from stormwater may be loading Lagoon sediments which has potential implications for certain management options i.e. dredging. The stormwater was field tested and analysed for the same parameters as the groundwater.

8.0 SEDIMENT QUALITY SAMPLING

Sediment samples were taken from both the Estuary and the Lagoon near the water sample locations (at the sediment (SED) locations in Figure 5) 28 March 2018. Samples were taken in accordance with the AS:NZ 5667.12:1999 for sampling bottom sediments. A Petite Ponar sampling device was used to ensure that discrete sediment samples are obtained while minimising oxidation of sediments. Lab analysis was conducted to characterise the potential impacts and risk to the Lagoon and other receptors should sediments be dredged and exposed to oxygenated conditions. The samples were analysed for:

- pH_F and pH_{FOX} to provide an indication if the sediments are acid sulfate soils and their reaction to exposure to oxygen;
- Total organic carbon;
- Nutrients suite including ammonia, nitrite, nitrate, total Kjeldahl nitrogen, total nitrogen and total phosphorus; and
- Total metals suite including arsenic, cadmium, chromium, copper, lead, nickel, zinc aluminium, iron, selenium and mercury.

9.0 LAGOON VEGETATION CONDITION ASSESSMENT

Vegetation condition assessment of the Lagoon and the immediate surrounding areas (upland) was conducted using the vegetation condition scale by Keighery (1994). Because the vegetation within the Lagoon is in Very Good to Excellent condition overall, the mapping was conducted at a much smaller scale so that it could be meaningfully used for data interpretation and management planning and recommendations. For example, existing methodologies average the condition across areas, such that an area of 1 ha may be rated as Very Good or Excellent, even though it may contain smaller patches 5 m^2 or similar of native vegetation that are of degraded condition due to weed invasion or poor plant health. We endeavoured to identify those patches (where present) to assist with data interpretation.

In addition to vegetation condition assessment the species recorded during traverses of the site were recorded and presented in a tabular form so that any impacts to those species can be examined.

10.0 FAUNA ASSESSMENT

A Level 1 fauna assessment of the site was undertaken to assist with management recommendations for the Lagoon. The Level 1 fauna assessment included a desktop review and site inspection undertaken in accordance with EPA *Guidance Statement No. 56* (EPA, 2004). The desktop review provides an inventory of the fauna species recorded in the general area of a site, while the site inspection provides information on the sorts of environments present that provide habitat for fauna, which allows for some contextual interpretation of the species list generated by the desktop search. The site inspection also provides the opportunity for some fauna observations to be made.

The desktop review involved accessing databases and reports from the general area and was conducted by Syrinx Environmental. Sources of information included:

- ATA Environmental (2001); report on East Clontarf (included multiple fauna surveys carried out by Bamford Consulting).
- Siemon (2000); surveys in the Salter Point/Waterford area in the 1970s and 1980s.
- April 2016 surveys at Cygnia Cove
- Naturemap incorporating DBCA and WA Museum fauna records (within 2 km).
- EPBC Protected Matters search tool (within 2 km).
- Birdlife Australia Birdata records (within 2 km).

The site visit was carried out on 23 February 2018 by Dr Mike Bamford, in conjunction with staff from Syrinx Environmental. Dr Bamford was familiar with the site, having undertaken studies at nearby Cygnia Cove and Riverton Traffic Bridge.

11.0 DIEBACK MANAGEMENT

Personnel involved in the study were made aware of dieback control methods and application of these protocols on site according to Syrinx's Standard Operating Procedure for dieback management (Syrinx, 2012). Particular care was taken during rainfall events as these are the times when transfer of disease is most likely. Personnel utilised strict dieback hygiene protocols each time when accessing or leaving the site (e.g. cleaning and sanitising boots with methanol spray) and used designated pathways.

12.0 OPERATIONAL HEALTH & SAFETY (OHS)

For the duration of the project Syrinx strictly adhered to the City's OHS requirements in addition to the Syrinx OHS procedures and policies. Safety risks and management actions for the field assessment were outlined in a Job Safety Analysis sheet prior to start of works which was submitted to the City for review and approval. All personnel involved in the monitoring activities underwent inductions required by the City of South Perth OHS protocols.

13.0 STAKEHOLDER CONSULTATION

Prior to the installation of any monitoring equipment at the Lagoon the Syrinx via the City of South Perth provided the DBCA with a description of the proposed scientific study and applied for approval to commence the study through the permit process, as required by regulation 16C of The *Swan and Canning Rivers Management Amendment Regulations 2012*. A permit authorising the scientific study was granted on the 13 March 2018 (Appendix 3).

PART 3: RESULTS AND DISCUSSION

14.0 REVIEW OF HISTORICAL WATER LEVEL, WATER QUALITY AND METEOROLOGICAL DATA

The desktop study highlighted a number of changes to water levels, rainfall levels and other climatic factors between historic average data and data collected in the spring of 2015 preceding the first major algae blooms. The main differences in the conditions this spring compared to the spring of 2013, when algal blooms were not a problem, were:

- Water levels at the Barrack St Jetty were up to 0.32 m lower (Figure 6),
- The monthly precipitation for September was 137.6 mm lower (Figure 7),
- The mean monthly maximum air temperature for September and October were 2.5°C and 2.7°C warmer than average, respectively (Figure 8).

Water levels at the Barrack St Jetty continued to be low compared to the non-bloom period until October 2016. After this time water levels in the Estuary were similar to water levels during the non-bloom period. The low water levels were likely related to declining tidal peaks between 2007 and 2017 associated with the 18.6-year lunar nodal cycle (Eliot, 2010). Four months after the water levels returned to pre-bloom levels the bloom began to die-off in February 2017. The mean monthly maximum temperature this month was more than 2°C cooler than in 2015 and 2016.

There was less difference in the plots of Total Nitrogen, Total Phosphorus and chlorophyll *a* for between the bloom and non-bloom periods (Appendix 4).

The review of the historical water levels and water quality data indicates the algal blooms in the Lagoon between January 2016 and May 2017 were caused by low water levels in the estuary, associated with the lunar nodal cycle, which is likely to have prevented flushing of the Lagoon. Low spring rainfall in 2015, would have contributed to low levels in the estuary and the reduced flushing of the Lagoon. High spring air temperatures in 2015 are also likely to have been a factor triggering the formation of the blooms, the shallow water temperature reflecting ambient air temperature.

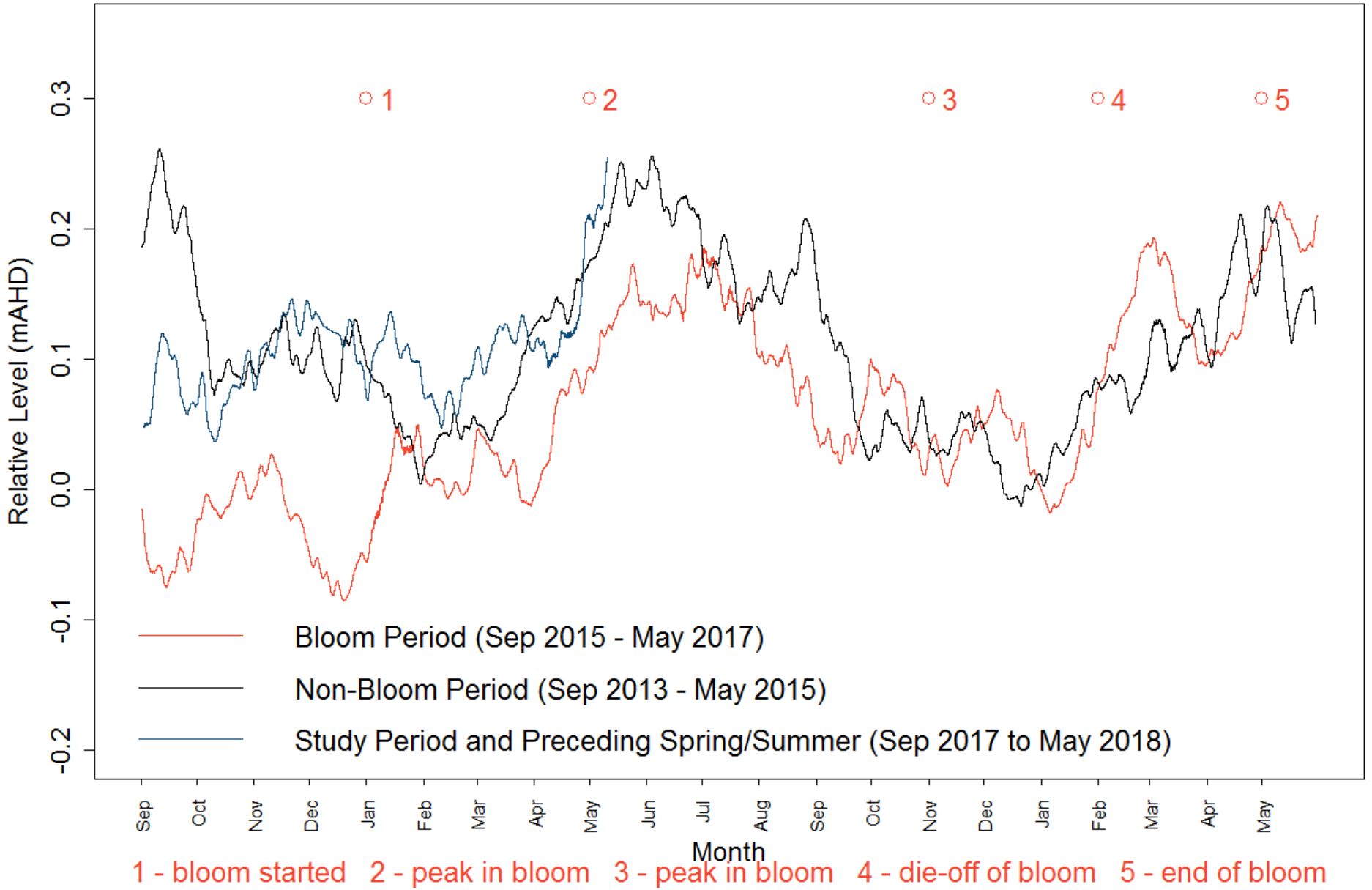


Figure 6. Water levels at Barrack St Jetty (four week moving average)

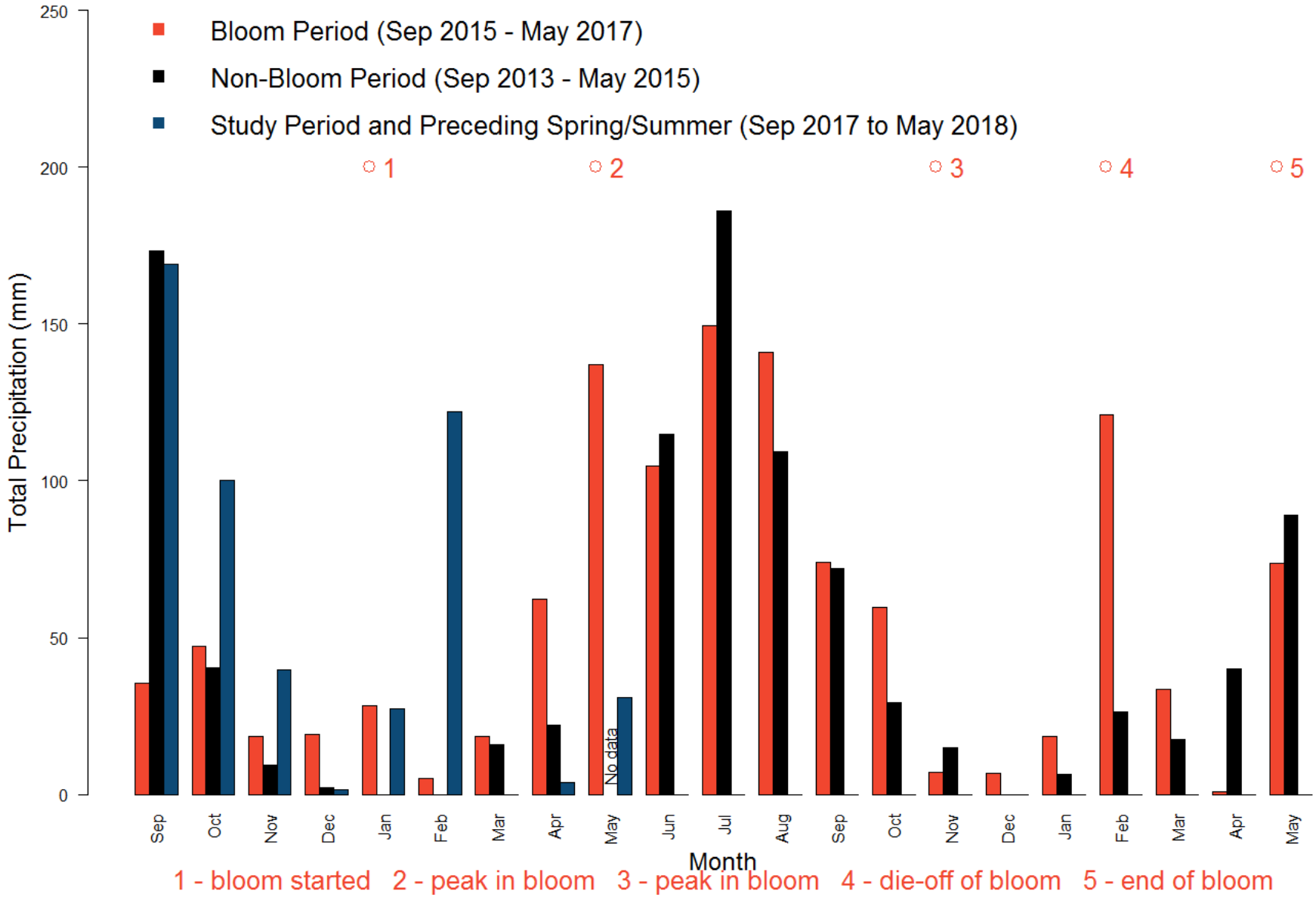


Figure 7. Monthly total precipitation at Jandakot Aerodrome

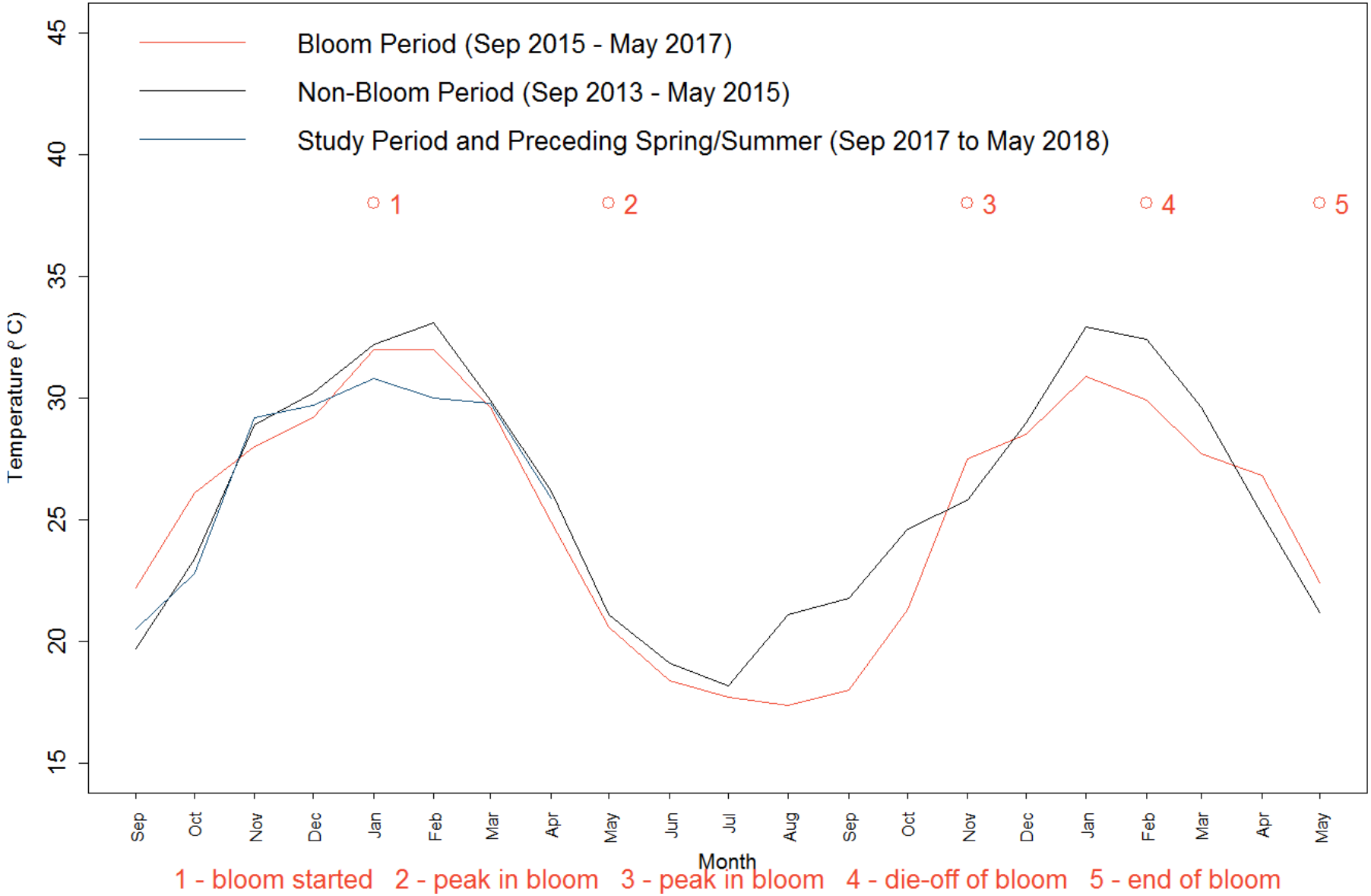


Figure 8. Monthly mean maximum temperature at Jandakot Aerodrome.

15.0 LAGOON FEATURE AND LEVEL SURVEY

The results of the level and feature survey of the Lagoon is included as Appendix 1. The Lagoon bathymetry is shown on Figure 9.

Figure 9. Salter Point Lagoon bathymetry

There was a thick layer of sludge, approximately 1 m to 2 m deep at the bottom of the Lagoon. The elevation of the Lagoon bed at its deepest point was -0.17 mAHD (on top of the sludge). The maximum water depth and estimated area and volume of the Lagoon at a range of water levels observed during the study are summarised in Table 3.

Table 3. Lagoon dimensions

Water Level (m AHD)	Maximum Depth (m)	Estimated Area (m^2)	Estimated Volume (m^3)
0.0	0.17	5,400	-
0.2	0.37	11,780	1,714
0.3	0.47	12,312	2,939
0.4	0.57	12,505	4,113
0.7	0.87	13,149	7,977
0.8	0.97	13,368	9,302
0.9	1.07	13,477	10,642

16.0 LAGOON HYDROLOGY

16.1 TIDAL INTERACTIONS

16.1.1 Surface Elevation Changes Along the Channel

The surface elevation of the channel generally increased during the study period as shown on the surveys of Profile Lines 1 to 3 in Appendix 1 and the channel elevations at the survey stakes shown in Table 4 below.

Table 4. Channel elevation at survey stakes (mAHD).

Stake ID	Survey Stake Elevation (mAHD)		
	16/03/2018	4/04/2018	30/05/2018
1	-0.114	0.035	-0.005
2	-0.091	0	-0.03
3	-0.061	-0.021	-0.06
4	-0.083	0.047	-0.035
5	-0.052	0.006	0.005
6	0.031	-0.004	0.015
7	-0.058	-0.016	-0.015

Profile Line 2 intersects one of the highest sections of the tidal channel. It is expected that water will stop flowing through the channel when water levels drop below the minimum elevation along this profile line. The minimum elevation on this profile line is shown in Table 5.

Table 5. Minimum channel elevation for Profile Line 2

Month Measured	Minimum Channel Elevation (mAHD)
March	-0.15
April	-0.13
May	-0.13
June	-0.12

16.1.2 Surface Water Levels

During the study period water levels recorded in the Lagoon showed similar tidal signal to the water levels in the Estuary. This indicated that the Lagoon was almost always tidally connected to the Estuary over this period (Figure 10). Water levels in the Estuary were mostly identical to the water levels recorded at the Barrack St Jetty.

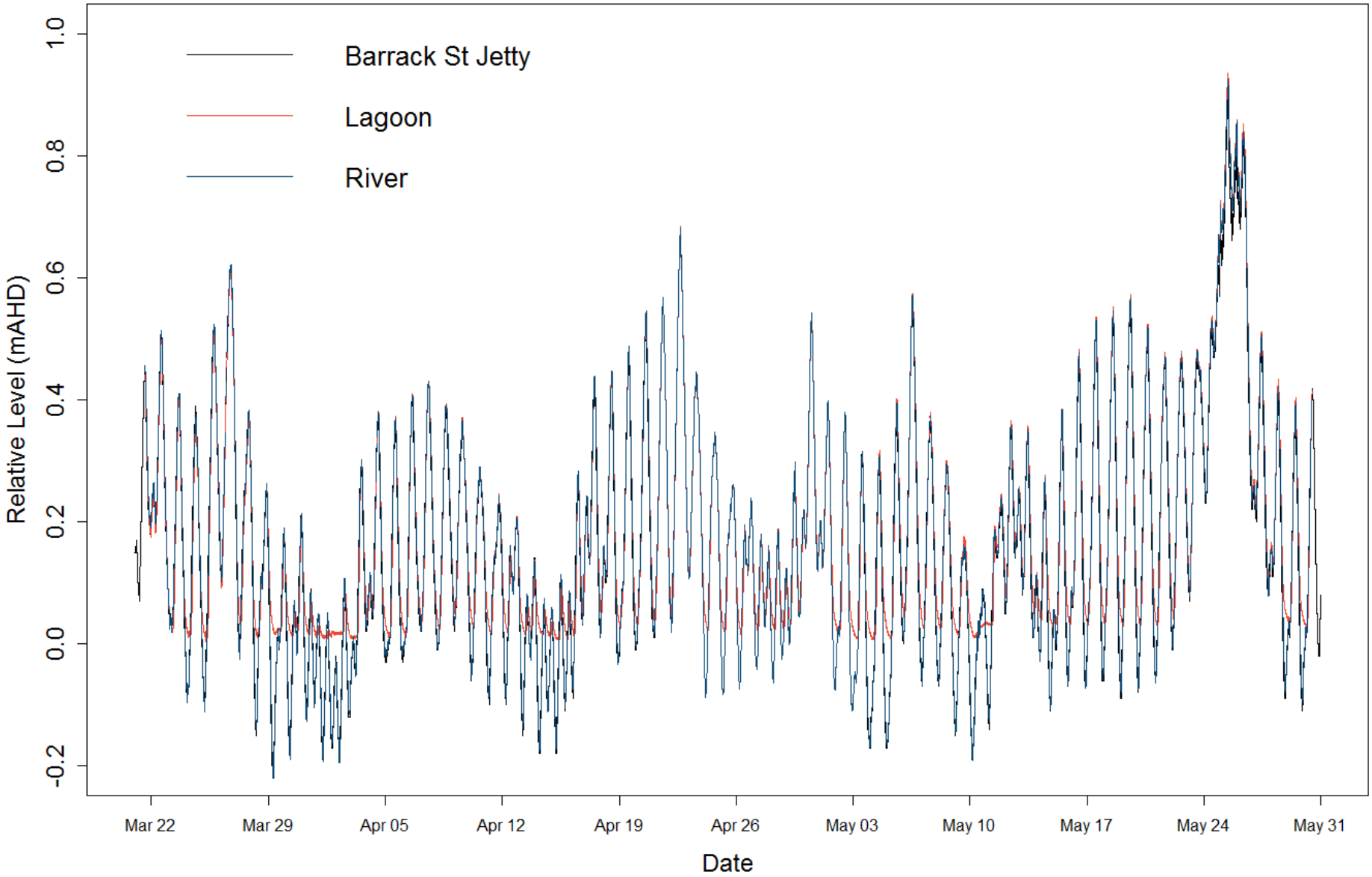


Figure 10. Surface water levels at Barrack St Jetty, the Lagoon and in the Canning River Estuary (22 March 2018 – 31 May 2018).

On many occasions the minimum water level in the Lagoon for each tidal period was not as low as in the Estuary indicating water was not always draining from the Lagoon at low tide. This occurred when the Lagoon level was at approximately 0 m AHD which is just above the minimum elevation along Profile Line 2 shown in Table 5. If water levels fall below 0 m AHD, water will not flow in or out of the Lagoon. However, during the study period the high tide was almost always above these levels so the Lagoon was usually flushed during high tide.

There was one short period (~2.5 days) between 1 April 00:00 and 3 April 12:00 when the tidal range of the Lagoon was zero, indicating there was no tidal flow in or out of the Lagoon during this time. This occurred because water levels in the Estuary were below 0 m AHD even during high tide.

When tidal flow ceased in the Lagoon the water levels at the Barrack Street Jetty were also below 0 m AHD. During the bloom period, more than 38% of the water levels records were below 0 m AHD at the Barrack St Jetty (Figure 6) whereas during the non-bloom period approximately 27% of the water level records were below this level.

16.1.3 Tidal Prism

Water balance calculations, including tidal prism, were calculated for two scenarios:

- **Water Balance Scenario 1**: No Tidal Flushing (2 April 2018)
- **Water Balance Scenario 2**: High Tidal Flushing (6 May 2018)

Scenario 1 represents a period where water levels are very low and there is no tidal range or tidal flushing and Scenario 2 represents a period where water levels are high, there is high tidal range and high tidal flushing.

Calculations of the tidal prism for the two scenarios are shown in Table 6 below.

For Scenario 1 the tidal prism was zero and for Scenario 2 it is 5,031 m^3.

Table 6 Tidal prism for two scenarios

Scenario	Lagoon Water Level (m AHD)	Tidal Range (m) (H)	Approximate Lagoon Area (m^2) (A)*	Tidal Prism (m^3)* (HxA)
1	0.017	0	5400	0
2 - low tide	0.023	0.552	5400	5031
2 - high tide	0.575		12827	

16.2 GROUNDWATER INPUT AND OUTPUT

As shown on Figure 12 the water level in groundwater bores GW01 and GW02 shows a tidal influence, indicating they are influenced by the estuary levels. The water level is typically higher than the Lagoon in GW03 indicating there is a groundwater inflow into the Lagoon from the north.

Examination of aerial photography of the north eastern side of the Lagoon identified that lines of water flow are visible in the sand and the beach is more developed as a result (Figure 11). It is expected that most of the area inside this zone (outlined in orange) is providing some groundwater inflows through the lagoon during low tides (Mark Musgrave pers. comm. June 2016).

Figure 11. Expected groundwater inflow zone

Estimates of groundwater inputs and outputs into the Lagoon were calculated for the two water balance scenarios (Table 7). Sketches of the groundwater elevation contours for the two Scenarios are included as Appendix 5.

The following assumptions were made in the estimate of groundwater inputs and outputs:

- •The sandy soil surrounding the Lagoon has a hydraulic conductivity of 30 m/d, which is the middle of the range of values given by Davidson (1995) for fine to gravel (poorly sorted) (10 m/d) and medium to very coarse (moderately sorted) sand (50 m/d).

- •Groundwater flows through the full depth of the Lagoon. A Lagoon depth of 0.5 m was used to calculate the area through which flow occurs.

For Scenario 1 the sketch of the groundwater contours confirmed groundwater flowed into the Lagoon from the north at low tide (Appendix 5). The groundwater inflow was estimated to be approximately 2 m^3/day. Slightly higher rates of groundwater inflow would be expected during the wet season. It is also expected that river water would flow through the lagoon from the north east to south west.

The groundwater contours for Scenario 2 were sketched at high tide Appendix 5. The water level in the Lagoon and estuary were approximately equal and were higher than the groundwater to the north. It is expected that the groundwater inflow may be essentially static during high tides, with rising river levels slowing down the seepage inflow to the lagoon to the north, causing it to mound up (Mark Musgrave pers. comm. June 2016). The groundwater elevation contours indicate a mounding effect in the area around the N-E-W sides of the lagoon.

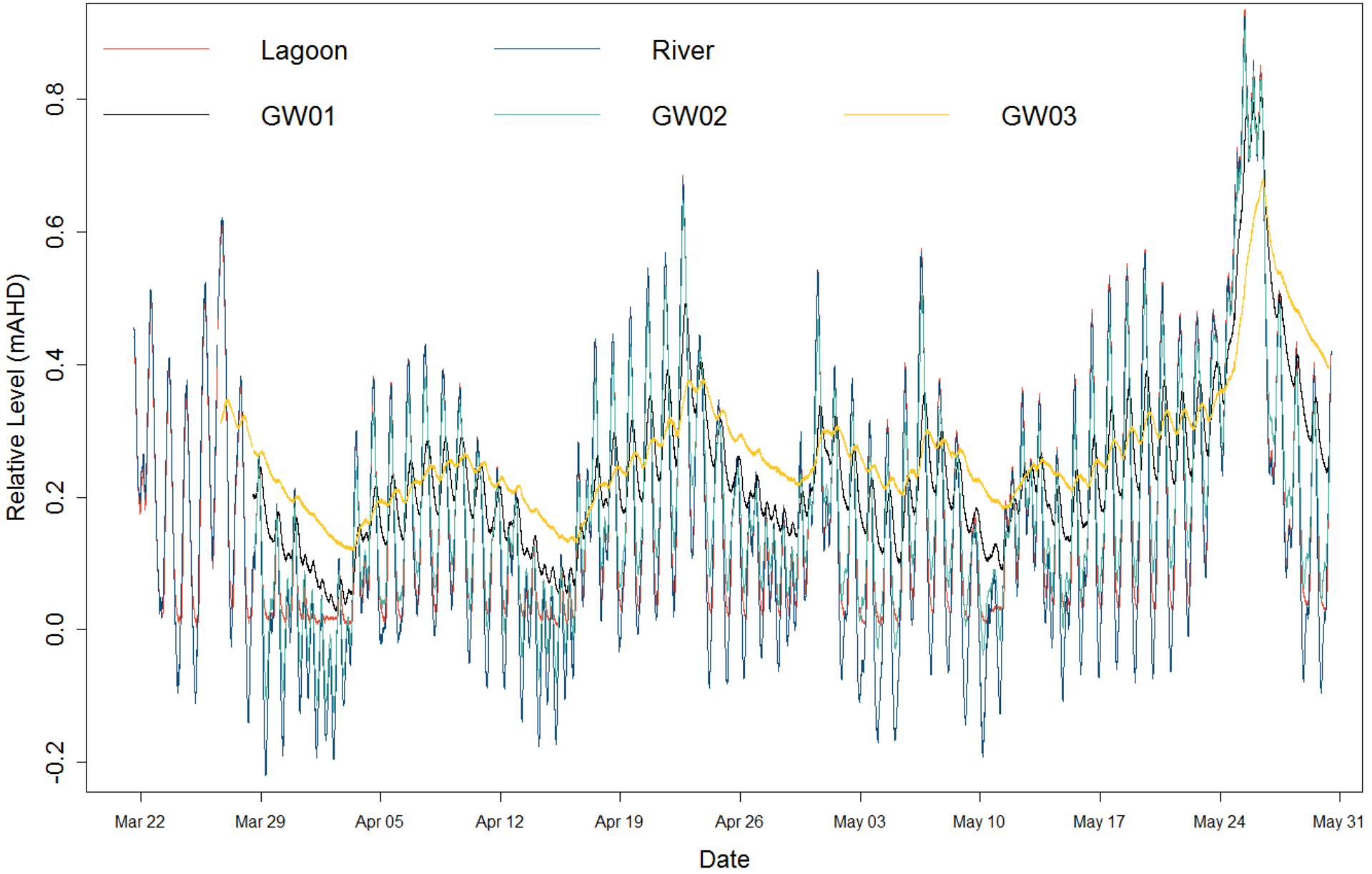


Figure 12. Groundwater levels recorded by groundwater loggers

16.3 STORMWATER FLOWS

The stormwater inlet to the north of the Lagoon collects runoff from Salter Point Parade. The catchment area is small (0.16 ha). The runoff volume associated with a one-hour duration, one-year Average Recurrence Interval (ARI) event is estimated to be 24.91 m^3.

16.4 WATER BALANCE AND FLUSHING TIME

Estimates of the flushing time of the Lagoon were calculated for Scenario 2 from the tidal range. The entire Lagoon was flushing during the tidal cycle (i.e. twice daily). The flushing time of the Lagoon is expected to be much higher if there is no tidal flow. For Scenario 1 an indicative flushing time of 473 days was estimated by dividing the Lagoon volume by the groundwater inflow. This estimate does not include flushing due to the seepage flow of estuary water through the lagoon but this flow is expected to be of a similar order of magnitude of groundwater inflow hence the flushing time would still be greater than one month if there was no tidal flow.

Tidal exchange with the Estuary was the largest component of the Lagoon water balance during the study. Contributions from groundwater and stormwater were small by comparison and only become important when water levels in the Estuary are very low.

The results indicate that for most of the study tidal exchange with the Estuary was the largest component of the Lagoon water balance. Contributions from groundwater and stormwater were small by comparison and only become important when water levels in the Estuary are very low.

Table 7. Estimates of groundwater inputs into the Lagoon

Scenario	Zone	Hydraulic conductivity (K) (md^{-1})	rise (m)	run (m)	Hydraulic gradient (I) (m)	Lagoon depth (m)	Length of Lagoon perimeter through which flow occurs (m)	Cross-sectional area through which flow occurs (A) (m^2)	Estimated groundwater flow (m^3d^{-1})
1	Inflow zone	30	0.123	40	0.0031	0.5	42	21	1.94

Table 8. Estimates of Lagoon flushing time

Scenario	Estimated Volume of Water (m^3)	Estimated groundwater inflow	Flushing Time (days)
1	918	1.94	473.2

Scenario	Lagoon Level (m AHD)	Depth of Lagoon	Approximate Tidal Period (days)	Tidal Range (m)	Flushing Time (days)
2 - low tide	0.023	0.17	0.5	0.552	0.4
2 - high tide	0.575	0.72			

17.0 WATER QUALITY

Water quality data collected as part of this study were assessed against the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines for Fresh and Marine Water Quality (ANZECC, 2000). Salter Point Lagoon and the Canning River Estuary (the Estuary) water samples were assessed against the criteria for South-west estuaries as well as toxicants for slightly to moderately disturbed ecosystems. Trigger values used for toxicants were those for 95% species protection. Trigger values are used to consider the risk of adverse effects due to nutrients, biodegradable organic matter and pH in various ecosystem types.

Full laboratory reports for all water quality sampling are attached as Appendix 6.

17.1 SURFACE WATER QUALITY

The sample locations for surface water are denoted by the SW Sample ID. SW01 refers to the Estuary sample location, SW02 refers to the sample location within the Salter Point Lagoon channel, and SW03 refers to the sample location within the Lagoon itself (Figure 5).

17.1.1 Physico-chemical measurements

The pH recorded across all sample locations was generally within the acceptable range for estuaries of pH 7.5 to 8.5, with exceedances generally within half a pH unit outside this range (Table 9). Dissolved oxygen (%) was generally slightly below the acceptable range of 90% to 110%, except for the April sampling event within SW03, where a high % saturation of dissolved oxygen was recorded at 173%, which may have been indicative of high production of oxygen from algal photosynthesis. Total dissolved solid concentrations were highly saline across all sampling locations in March and April (>20,000 mg/L) but were less saline in May, especially in the lagoon (<10,000 mg/L) (Table 9).

17.1.2 Nutrients

Nitrogen

Total nitrogen (TN) within the surface water locations was generally below the trigger value of 0.75 mg/L, except during the March sampling round at the SW01 and SW02 locations (Table 9, Figure 13), suggesting that the Estuary was a source of TN for the Lagoon during this time. Organic nitrogen within the Estuary (SW01) and the Lagoon (SW03) was generally above 80% as a percentage of TN, except during May, where due to the increase of nitrate, the organic fraction declined to 63% and 67% respectively (Table 9). Nitrate flushing within tributaries to the Estuary (Canning River) as a result of the first large rainfall events of the winter season may have impacted these concentrations.

In terms of mineral nitrogen (more readily available fractions), ammonia-N concentrations exceeded the 0.04 mg/L trigger value at all locations across all sampling events (Table 9, Figure 14). Ammonia-N concentrations were generally higher in the Estuary (SW01) than the Lagoon, except within the

Lagoon channel (SW02) during March (Table 9, Figure 14). This suggests that the Estuary may generally provide ammonia-N to the Lagoon, dependent on the flushing regime at any given time.

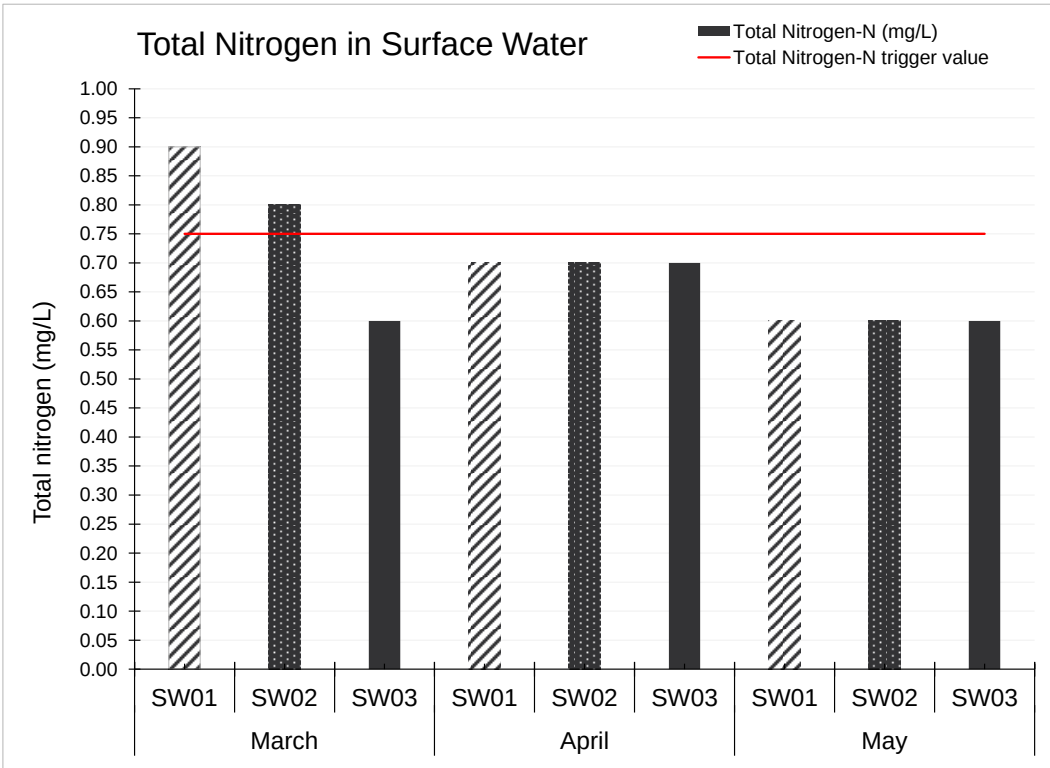


Figure 13. Total nitrogen in surface water. SW01: Estuary, SW02: Lagoon channel, SW03: Lagoon centre

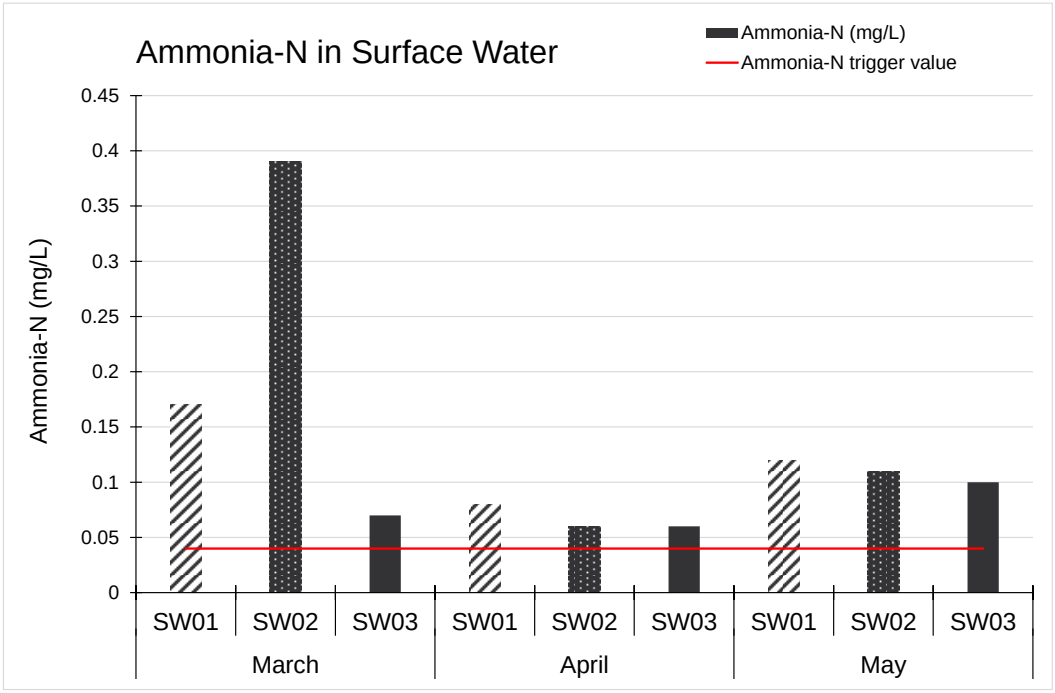


Figure 14. Ammonia-N in surface water. SW01: Estuary, SW02: Lagoon channel, SW03: Lagoon centre

Table 9. Surface water quality data. Orange highlights relate to exceedances of ANZECC (2000) trigger values

Surface water parameter	Unit	SW01 (Canning River)			SW02 (Lagoon near tidal channel)			SW03 (Lagoon open water)			ANZECC (2000) South-west Estuaries
		28/03/2018	24/04/2018	30/05/2018	28/03/2018	24/04/2018	30/05/2018	28/03/2018	24/04/2018	30/05/2018	
Physico-chemical											
Temperature	°C	28.0	19.3	16.4	27.6	19.8	16.4	22.7	20.3	16.1	
pH (Field)	pH unit	8.35	7.03	7.80	8.00	7.24	7.68	7.19	7.57	7.76	7.5 - 8.5
pH (Lab)	pH unit	8.79	7.85	7.47	8.34	7.83	7.45	7.93	7.82	7.42	7.5 - 8.5
Dissolved oxygen	mg/L	-	8.32	-	-	9.00	-	-	11.70	-	
Dissolved oxygen %	%	-	97.1	83.3	-	99.2	86.2	-	173.0	69.9	90 - 110
Salinity	ppt	-	25.7	-	-	21.0	-	-	20.6	-	
Electrical conductivity	mS/cm	51.7	39.5	21.4	51.3	31.7	11.29	51.2	34.3	11.54	
TDS	mg/L	33,100.0	25,730.0	13,663.0	32,800.0	21,020.0	7,338.5	32,700.0	20,620.0	7,371.0	
ORP	mV	37.00	187.00	60.50	-54.00	149.00		96.00	149.00	-	
Secchi Depth	cm	>40	>40	>50	>3	>3	>20	>10	>10	>30	
Nutrients											
Total Nitrogen-N	mg/L	0.90	0.70	0.60	0.80	0.70	0.60	0.60	0.70	0.60	0.75
Ammonia-N	mg/L	0.17	0.08	0.12	0.39	0.06	0.11	0.07	0.06	0.10	0.04
Nitrite-N	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Nitrate-N	mg/L	<0.01	0.04	0.06	0.01	0.03	0.08	<0.01	0.03	0.07	
NOx-N	mg/L	<0.01	0.040	0.060	0.010	0.030	0.080	<0.01	0.030	0.070	0.045
Total Kjeldahl Nitrogen-N	mg/L	0.9	0.7	0.5	0.8	0.7	0.5	0.6	0.7	0.5	
Organic Nitrogen (calculation)	mg/L	0.73	0.62	0.38	0.41	0.64	0.39	0.53	0.64	0.4	
Organic Nitrogen % (calculation)	%	81%	89%	63%	51%	91%	65%	88%	91%	67%	
Total Phosphorus	mg/L	0.10	0.08	0.07	0.09	0.09	0.09	0.08	0.09	0.07	0.03
Dissolved Reactive Phosphorus	mg/L	<0.01	0.020	0.020	0.020	0.030	0.030	0.010	0.020	0.030	0.005
Particulate P (calculation)	mg/L	0.1	0.06	0.05	0.07	0.06	0.06	0.07	0.07	0.04	
Particulate P % (calculation)	%	100%	75%	71%	78%	67%	67%	88%	78%	57%	
Dissolved metal and metalloids											
Aluminium	mg/L	<0.05	-	<0.01	<0.05	-	<0.01	<0.05	-	<0.01	0.055
Arsenic	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.013
Cadmium	mg/L	<0.0005	-	<0.0001	<0.0005	-	<0.0001	<0.0005	-	<0.0001	0.0002
Chromium	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.001 (CrVI)
Copper	mg/L	<0.005	-	0.005	<0.005	-	0.002	<0.005	-	0.002	0.0014
Lead	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.0034
Nickel	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.011
Selenium	mg/L	<0.05	-	<0.01	<0.05	-	<0.01	<0.05	-	<0.01	0.011
Zinc	mg/L	<0.025	-	0.013	<0.025	-	0.020	<0.025	-	0.016	0.008
Iron	mg/L	<0.25	-	0.07	<0.25	-	0.09	<0.25	-	0.09	10
Mercury	mg/L	<0.0001	-	<0.0001	<0.0001	-	<0.0001	<0.0001	-	<0.0001	0.0006
Total metal and metalloids											
Aluminium	mg/L	0.100	-	0.090	0.110	-	0.100	0.140	-	0.120	0.055
Arsenic	mg/L	<0.005	-	0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.013
Cadmium	mg/L	<0.0005	-	<0.0001	<0.0005	-	<0.0001	<0.0005	-	<0.0001	0.0002
Chromium	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.001 (CrVI)
Copper	mg/L	<0.005	-	0.004	<0.005	-	0.002	<0.005	-	0.005	0.0014
Lead	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.0034
Nickel	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	0.001	0.011
Selenium	mg/L	<0.05	-	<0.01	<0.05	-	<0.01	<0.05	-	<0.01	0.011
Zinc	mg/L	<0.025	-	0.015	<0.025	-	0.018	<0.025	-	0.021	0.008
Iron	mg/L	<0.25	-	0.28	<0.25	-	0.33	0.32	-	0.34	
Mercury	mg/L	<0.0001	-	<0.0001	<0.0001	-	<0.0001	<0.0001	-	<0.0001	0.0006

Nitrate and nitrite concentrations (NO_X) did not exceed the 0.045 mg/L trigger value at any location during the March and April sampling rounds, but exceeded the trigger value at all locations during the May sampling round (Table 9, Figure 13). This may have coincided with the first rainfall event of winter which could have flushed NOx from catchments and tributaries into the Canning River Estuary which then passed into the Lagoon.

Phosphorus

Total phosphorus (TP) in surface waters exceeded the 0.03 mg/L trigger value during all sampling events, with a TP range of 0.07 mg/L to 0.10 mg/L (Table 9,). TP concentrations during March were greater in the Estuary (SW01) than the Lagoon (SW02, SW03) however, during April 2018 this trend was reversed, and during May TP concentrations were equivalent in the Estuary and centre of the Lagoon (SW03) but were elevated in the Lagoon channel (SW02).

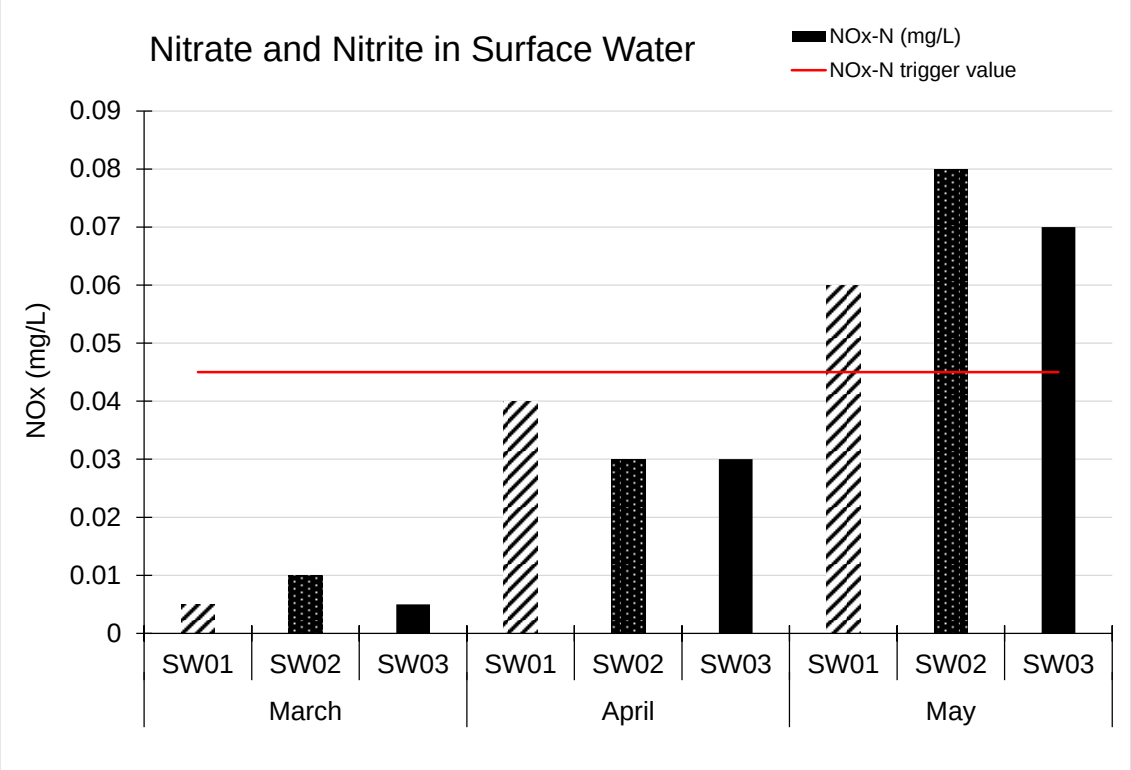


Figure 15. NOx-N in surface water. SW01: Canning River Estuary, SW02: Lagoon channel, SW03: Lagoon centre

Dissolved reactive phosphorus (DRP) exceeded the 0.005 mg/L trigger value at all location during all sampling events (data range of 0.01 mg/L to 0.03 mg/L), except at SW01 during the March sampling round where DRP was not detected (Table 9, Figure 17). Particulate phosphorus (calculated from the TP concentration minus the DRP concentration) ranged between 57% and 100% of TP, with a greater percentage of particulate phosphorus observed in the March and April sampling events, compared to the May sampling events (Table 9). Whilst the majority of TP was in particulate form, DRP still generally exceeded the trigger value of 0.005 mg/L (Figure 17).

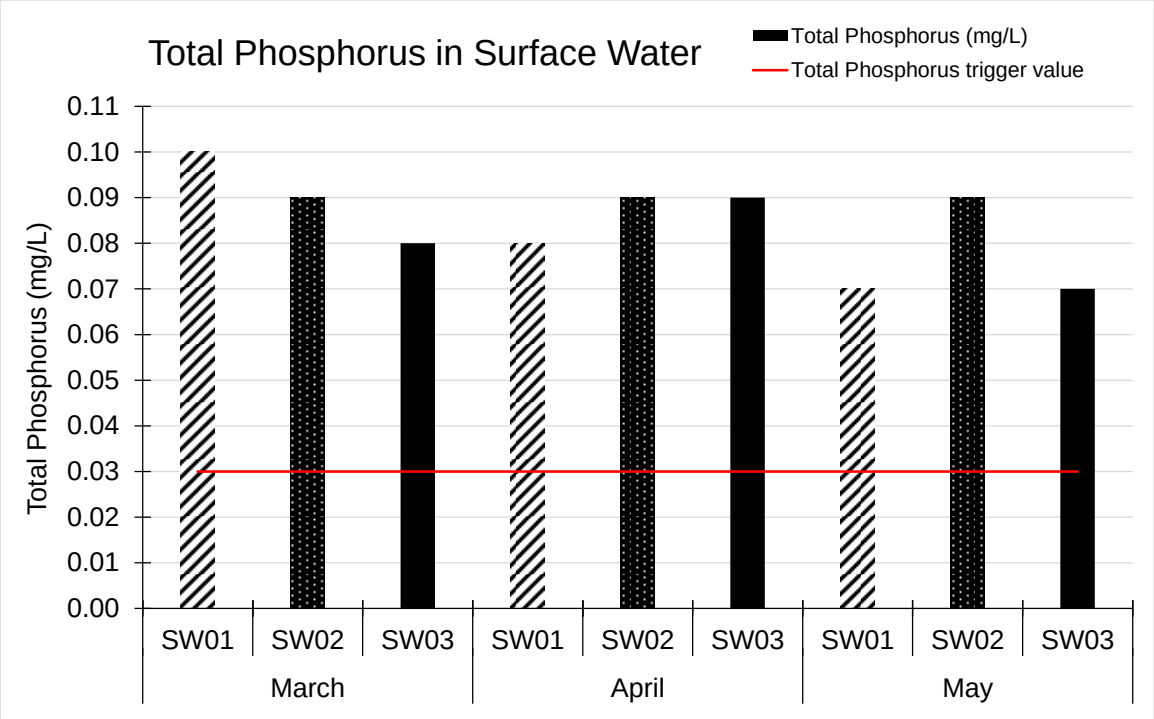


Figure 16. TP in surface water. SW01: Canning River Estuary, SW02: Lagoon channel, SW03: Lagoon centre

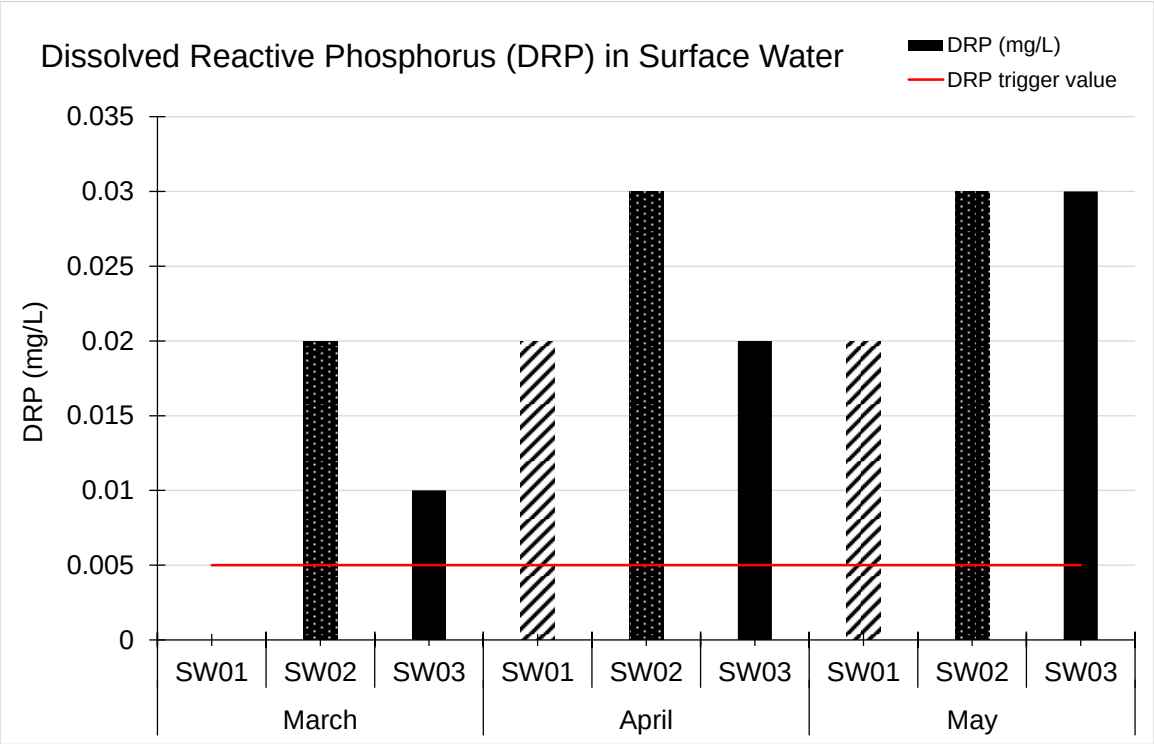


Figure 17. DRP in surface water. SW01: Canning River Estuary, SW02: Lagoon channel, SW03: Lagoon centre

17.1.3 Metals and metalloids

Metals that exceeded their respective trigger values included aluminium (total only), copper (total and dissolved) and zinc (total and dissolved) (Table 9). The majority of exceedances occurred mostly in the May 2018 sampling round, except for total aluminium which also exceeded at all sample locations in the March 2018 sampling (Table 9). The exceedances in May are likely due to the "first flush" effect caused by the heavy rainfall during the end of May.

17.1.4 Surface water summary

Water quality within the Lagoon was dynamic across the study period. It was likely to be affected by water quality from the Canning River Estuary, stormwater flows after the first flush event, and groundwater charging from the north. TN was below trigger values during all sampling events for locations within the Lagoon, except one event in March 2018 in the Lagoon channel. This was likely due to the Estuary location exceeding the TN trigger value and providing the Lagoon with TN. Ammonia-N exceeded the trigger value at all locations, and was generally always greater in the Estuary than the Lagoon, suggesting the Estuary was a source of ammonia-N for the Lagoon system during that sampling event. NOx was variable across the sampling events, but was greatest after the first flush in May, and may have been impacted by both stormwater concentrations and the concentrations within the Estuary NOx. TP exceeded the trigger values at all locations, and relative concentrations between the Estuary and Lagoon suggest that the Estuary may be a source of TP for the Lagoon.

17.2 GROUNDWATER QUALITY

The sample locations for ground water are denoted by the GW Sample ID. GW01 refers to the eastern bore, GW02 refers to the western bore, and GW03 refers to the north-east bore (Figure 5). Groundwater data was compared to the ANZECC (2000) trigger values for estuaries to analyse the nutrient and metal/metalloid concentrations within groundwater that could migrate into the estuary and increase the risk of adverse impacts (such as algal blooms and toxicity respectively).

17.2.1 Physico-chemical measurements

Groundwater pH was below the lower range of the trigger value at all locations across both sampling events indicating circumneutral to slightly acidic groundwater (Table 10). Dissolved oxygen was well below the acceptable range for estuaries but typical of groundwater systems separated from the atmosphere (Table 10). Total dissolved solids (TDS) were in the "brackish" salinity range (1000 to 2000 mg/L TDS) for all sampling events in GW01 and GW03. TDS concentrations were highly saline (>30,000 mg/L) for GW02 (the western bore close to the Estuary) (Table 10).

17.2.2 Nutrients

Nitrogen

TN generally exceeded the trigger values for estuaries except during May at the GW01 and GW02 locations, however the north-east bore (GW03) still exceeded (Table 10, Figure 18).

Table 10. Groundwater quality data. Orange highlights relate to exceedances of ANZECC (2000) trigger values

Surface water parameter	Unit	SW01 (Canning River)			SW02 (Lagoon near tidal channel)			SW03 (Lagoon open water)			ANZECC (2000) South-west Estuaries
		28/03/2018	24/04/2018	30/05/2018	28/03/2018	24/04/2018	30/05/2018	28/03/2018	24/04/2018	30/05/2018	
Physico-chemical											
Temperature	°C	28.0	19.3	16.4	27.6	19.8	16.4	22.7	20.3	16.1	
pH (Field)	pH unit	8.35	7.03	7.80	8.00	7.24	7.68	7.19	7.57	7.76	7.5 - 8.5
pH (Lab)	pH unit	8.79	7.85	7.47	8.34	7.83	7.45	7.93	7.82	7.42	7.5 - 8.5
Dissolved oxygen	mg/L	-	8.32	-	-	9.00	-	-	11.70	-	
Dissolved oxygen %	%	-	97.1	83.3	-	99.2	86.2	-	173.0	69.9	90 - 110
Salinity	ppt	-	25.7	-	-	21.0	-	-	20.6	-	
Electrical conductivity	mS/cm	51.7	39.5	21.4	51.3	31.7	11.29	51.2	34.3	11.54	
TDS	mg/L	33,100.0	25,730.0	13,663.0	32,800.0	21,020.0	7,338.5	32,700.0	20,620.0	7,371.0	
ORP	mV	37.00	187.00	60.50	-54.00	149.00		96.00	149.00	-	
Secchi Depth	cm	>40	>40	>50	>3	>3	>20	>10	>10	>30	
Nutrients											
Total Nitrogen-N	mg/L	0.90	0.70	0.60	0.80	0.70	0.60	0.60	0.70	0.60	0.75
Ammonia-N	mg/L	0.17	0.08	0.12	0.39	0.06	0.11	0.07	0.06	0.10	0.04
Nitrite-N	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Nitrate-N	mg/L	<0.01	0.04	0.06	0.01	0.03	0.08	<0.01	0.03	0.07	
NOx-N	mg/L	<0.01	0.040	0.060	0.010	0.030	0.080	<0.01	0.030	0.070	0.045
Total Kjeldahl Nitrogen-N	mg/L	0.9	0.7	0.5	0.8	0.7	0.5	0.6	0.7	0.5	
Organic Nitrogen (calculation)	mg/L	0.73	0.62	0.38	0.41	0.64	0.39	0.53	0.64	0.4	
Organic Nitrogen % (calculation)	%	81%	89%	63%	51%	91%	65%	88%	91%	67%	
Total Phosphorus	mg/L	0.10	0.08	0.07	0.09	0.09	0.09	0.08	0.09	0.07	0.03
Dissolved Reactive Phosphorus	mg/L	<0.01	0.020	0.020	0.020	0.030	0.030	0.010	0.020	0.030	0.005
Particulate P (calculation)	mg/L	0.1	0.06	0.05	0.07	0.06	0.06	0.07	0.07	0.04	
Particulate P % (calculation)	%	100%	75%	71%	78%	67%	67%	88%	78%	57%	
Dissolved metal and metalloids											
Aluminium	mg/L	<0.05	-	<0.01	<0.05	-	<0.01	<0.05	-	<0.01	0.055
Arsenic	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.013
Cadmium	mg/L	<0.0005	-	<0.0001	<0.0005	-	<0.0001	<0.0005	-	<0.0001	0.0002
Chromium	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.001 (CrVI)
Copper	mg/L	<0.005	-	0.005	<0.005	-	0.002	<0.005	-	0.002	0.0014
Lead	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.0034
Nickel	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.011
Selenium	mg/L	<0.05	-	<0.01	<0.05	-	<0.01	<0.05	-	<0.01	0.011
Zinc	mg/L	<0.025	-	0.013	<0.025	-	0.020	<0.025	-	0.016	0.008
Iron	mg/L	<0.25	-	0.07	<0.25	-	0.09	<0.25	-	0.09	10
Mercury	mg/L	<0.0001	-	<0.0001	<0.0001	-	<0.0001	<0.0001	-	<0.0001	0.0006
Total metal and metalloids											
Aluminium	mg/L	0.100	-	0.090	0.110	-	0.100	0.140	-	0.120	0.055
Arsenic	mg/L	<0.005	-	0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.013
Cadmium	mg/L	<0.0005	-	<0.0001	<0.0005	-	<0.0001	<0.0005	-	<0.0001	0.0002
Chromium	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.001 (CrVI)
Copper	mg/L	<0.005	-	0.004	<0.005	-	0.002	<0.005	-	0.005	0.0014
Lead	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	<0.001	0.0034
Nickel	mg/L	<0.005	-	<0.001	<0.005	-	<0.001	<0.005	-	0.001	0.011
Selenium	mg/L	<0.05	-	<0.01	<0.05	-	<0.01	<0.05	-	<0.01	0.011
Zinc	mg/L	<0.025	-	0.015	<0.025	-	0.018	<0.025	-	0.021	0.008
Iron	mg/L	<0.25	-	0.28	<0.25	-	0.33	0.32	-	0.34	
Mercury	mg/L	<0.0001	-	<0.0001	<0.0001	-	<0.0001	<0.0001	-	<0.0001	0.0006

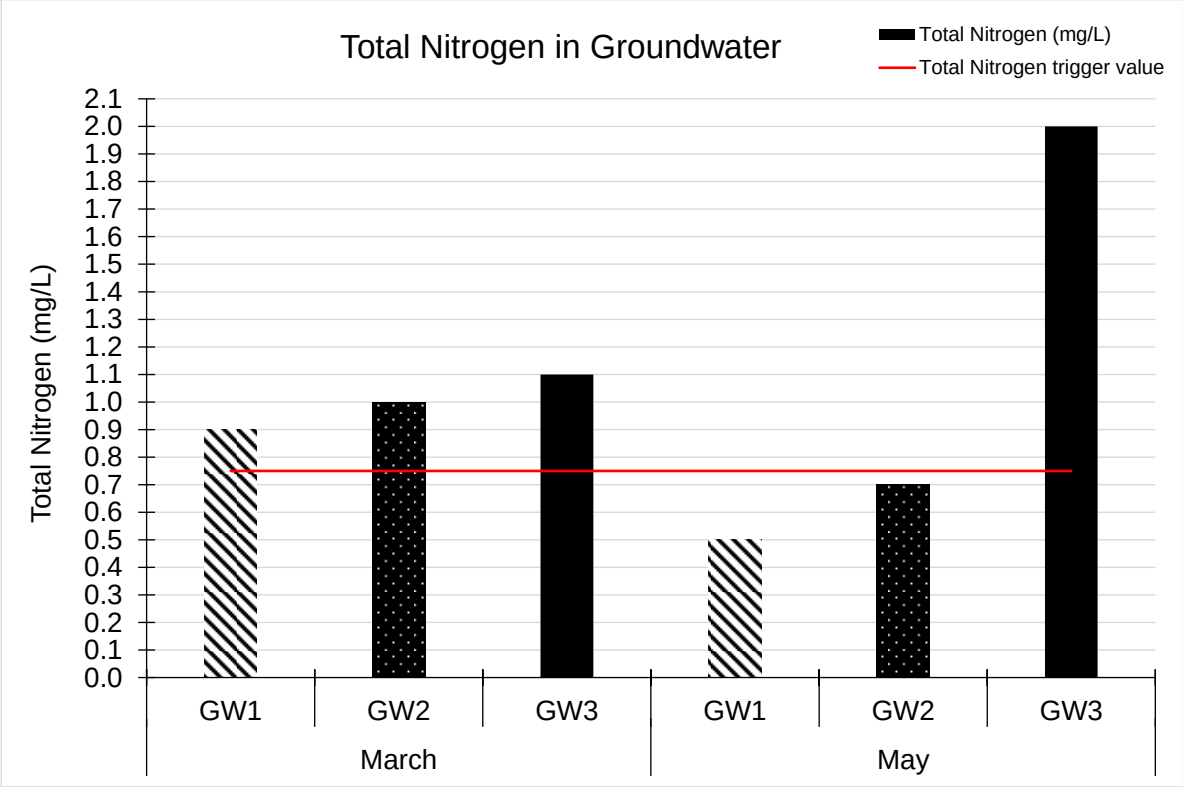


Figure 18. Total nitrogen concentrations in groundwater

Ammonia-N concentrations exceeded the trigger values at all locations in both sampling events, suggesting that groundwater is a potential source of ammonia-N for the Lagoon when groundwater is moving into the Lagoon (Table 10, Figure 19). NOx concentrations only exceeded the trigger values in GW03, which could be due to nitrate-based fertiliser use and subsequent runoff into groundwater in the up gradient urban catchment (Table 10, Figure 20).

Phosphorus

TP concentrations exceeded trigger values at all locations across the two events, and was greatest in the most up gradient bore GW03 (Table 10, Figure 21). DRP concentrations only exceeded trigger values in the western bore GW02, and was not detected in either GW01 or GW03 in either event (Table 10, Figure 22).

17.2.3 Metals and metalloids

Several metal/metalloids exceeded the trigger values in groundwater which included aluminium, arsenic, cadmium, chromium, copper, lead, nickel, zinc and iron (Table 10). GW01 (eastern bore) and GW03 (north-east bore) held the highest metal concentrations, likely affected from the up gradient catchment and impacted groundwater from suburban areas (Table 10). GW02 (western bore) is located close to the Estuary and the Lagoon, and is likely affected by the water quality in either location, and as such had a lower metal loading (Table 10).

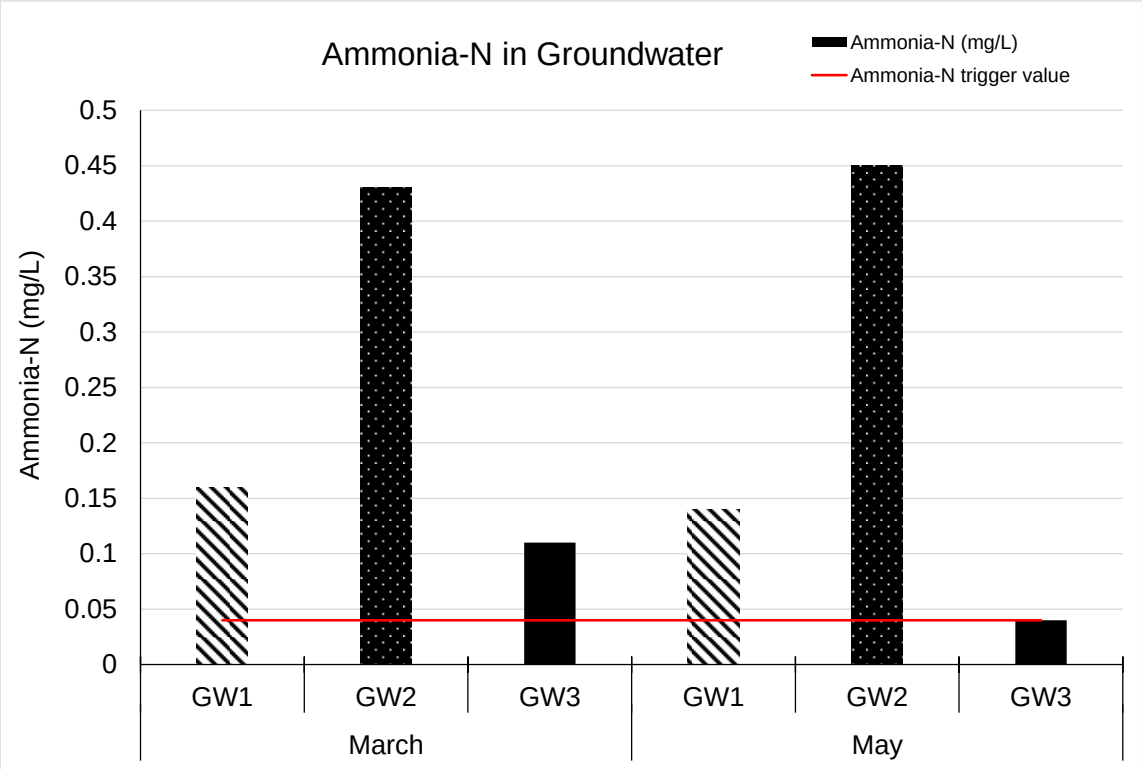


Figure 19. Ammonia-N concentrations in groundwater

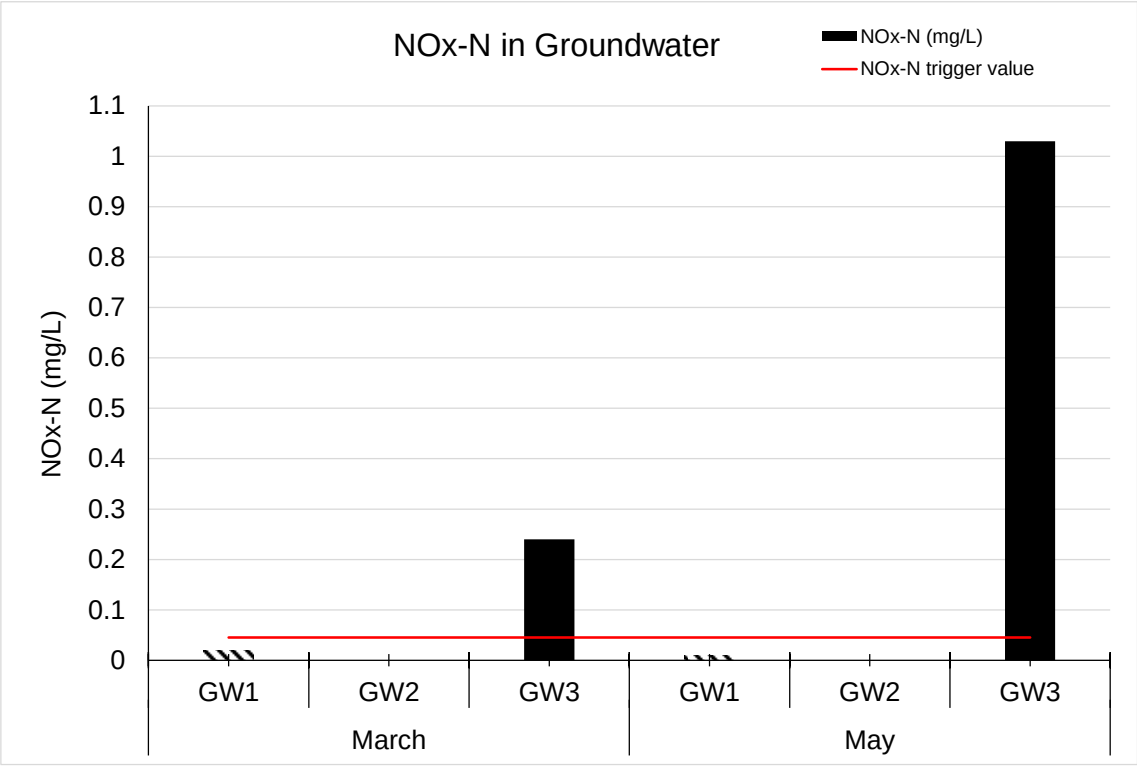


Figure 20. Nitrate/nitrite (NOx) concentrations in groundwater

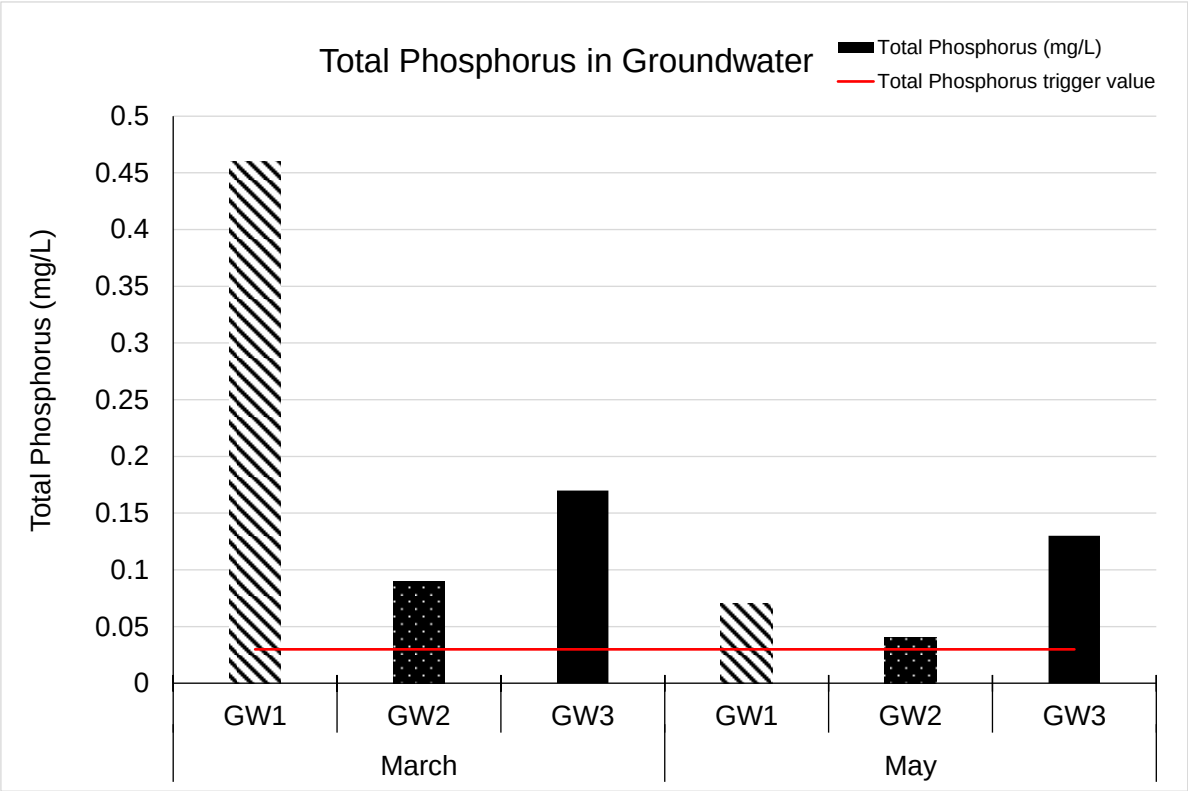


Figure 21. Total phosphorus concentrations in groundwater

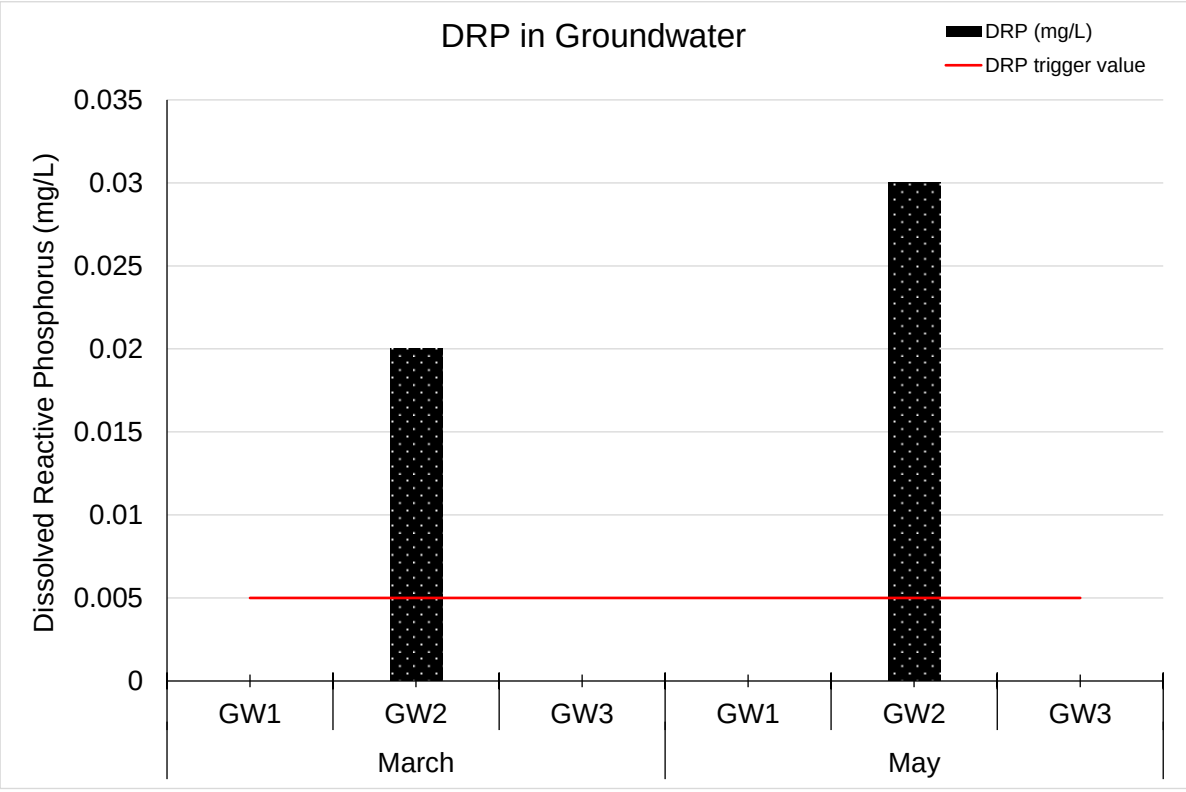


Figure 22. Dissolved reactive phosphorus (DRP) concentrations in groundwater

17.2.4 Groundwater summary

Nutrient concentrations were generally elevated across the groundwater bores compared to the trigger values for estuaries, and indicated that groundwater inputs could enrich the Lagoon if groundwater flows into the Lagoon. Groundwater quality in GW03 and GW01 is likely impacted by the northern catchment and hydraulically up-gradient water quality which then enters the Lagoon from the northern face the groundwater/Lagoon interface. Metal/metalloid concentration were elevated in GW03 and GW01.

17.3 STORMWATER QUALITY

The sample location for stormwater was at the SD sample location shown in Figure 5.

17.3.1 Physico-chemical parameters

Stormwater quality was assessed against the ANZECC (2000) trigger values for south-west estuaries as the stormwater drain sampled directly discharges into Salter Point Lagoon and by extension, the Canning Estuary. The pH measured at SD1 (stormwater drain) were below the minimum pH of 7.5 for estuaries, but remained circumneutral. Stormwater may affect and lower the pH of the Lagoon system when discharging into the Lagoon. Stormwater was considered highly saline, given a TDS of 14,911 mg/L indicating possible mixing with lagoon water which was above the pipe obvert level at the time of sampling. Stormwater had a desirable dissolved oxygen content at 96.2% (Table 11). Stormwater had oxidising conditions with an ORP of 174.2 mV (Table 11).

17.3.2 Nutrients

Nitrogen

The TN concentration in stormwater exceeded the trigger value of 0.75 mg/L at 1.0 mg/L, with the majority of nitrogen made up of organic nitrogen (58%), followed by ammonia-N (32%) and NOx (10%) (Table 11). Ammonia-N and NOx exceeded their respective trigger values of 0.04 mg/L and 0.045 mg/L with concentrations of 0.32 mg/L (eight-fold exceedance) and 0.10 mg/L (two-fold exceedance) respectively. Stormwater was a source of nitrogen that is above the ANZECC (2000) trigger values for estuaries.

Phosphorus

TP concentrations exceeded the 0.03 mg/L trigger value by five-fold at a concentration of 0.15 mg/L, and dissolved reactive phosphorus exceeded the 0.005 mg/L trigger value by ten-fold with a concentration of 0.05 mg/L. Stormwater was a source of phosphorus that was well above the ANZECC (2000) guidelines for estuaries.

17.3.3 Metals and metalloids

Several metal/metalloids were detected in stormwater during the May sampling event, which included aluminium, arsenic, cadmium, chromium, copper, lead, nickel, zinc and iron.

Table 11. Stormwater quality data. Orange highlights relate to exceedances of ANZECC (2000) trigger values

Stormwater parameter	Unit	SD1 (Stormwater drain) 25/05/2018	ANZECC (2000) South-west estuaries
Physico-chemical			
Temp	°C	15.0	
pH (Field)	pH unit	6.51	7.5 - 8.5
pH (Lab)	pH unit	7.02	7.5 - 8.5
DO	%	96.2	90 - 110
Salinity	ppt	13.9	
Electrial conductivity	mS/cm	22.9	
TDS	mg/L	14,911.0	
ORP (mV)	mV	174.2	
Nutrients			
Total Nitrogen-N	mg/L	1.00	0.75
Ammonia-N	mg/L	0.32	0.04
Nitrite-N	mg/L	<0.01	
Nitrate-N	mg/L	0.10	
NOx-N	mg/L	0.10	0.045
Total Kjeldahl Nitrogen-N	mg/L	0.90	
Organic Nitrogen (calculation)	mg/L	0.58	
Organic Nitrogen % (calculation)	%	0.58	
Total Phosphorus	mg/L	0.15	0.03
Dissolved Reactive Phosphorus	mg/L	0.05	0.005
Particulate P (calculation)	mg/L	0.10	
Particulate P % (calculation)	%	0.67	
Dissolved metals and metalloids			
Aluminium	mg/L	<0.01	0.055
Arsenic	mg/L	<0.001	0.013
Cadmium	mg/L	0.0004	0.0002
Chromium	mg/L	<0.001	0.001 (CrVI)
Copper	mg/L	0.0030	0.0014
Lead	mg/L	<0.001	0.0034
Nickel	mg/L	<0.001	0.011
Selenium	mg/L	<0.01	0.011
Zinc	mg/L	0.079	0.008
Iron	mg/L	<0.05	10
Mercury	mg/L	<0.0001	0.0006
Total metals and metalloids			
Aluminium	mg/L	0.160	0.055
Arsenic	mg/L	0.001	0.013
Cadmium	mg/L	0.0004	0.0002
Chromium	mg/L	<0.001	0.001 (CrVI)
Copper	mg/L	0.0050	0.0014
Lead	mg/L	0.003	0.0034
Nickel	mg/L	0.001	0.011
Selenium	mg/L	<0.01	0.011
Zinc	mg/L	0.092	0.008
Iron	mg/L	0.16	
Mercury	mg/L	<0.0001	0.0006

Of these common stormwater contaminants, aluminium (total only), cadmium (total and dissolved), copper (total and dissolved) and zinc (total and dissolved) exceeded their respective trigger values (Table 11). Stormwater was a source of metal contamination, and over time may load the Lagoon sediments and potentially the water column with metal contaminants.

17.3.4 Stormwater summary

Stormwater was a source of nitrogen and phosphorus with levels well above the ANZECC (2000) guidelines for estuaries. Stormwater was also a source of metal contamination with aluminium, cadmium, copper and zinc concentrations greater than toxicant trigger values. It should be noted that the stormwater sampling event was one of the first rainfall events for the winter season (undertaken in late May 2018), and may have contained an elevated "first flush" level of nutrients and metals. Over time, stormwater may load the Lagoon sediments and water column with nutrients and metal contaminants.

18.0 SEDIMENT QUALITY

18.1 PHYSICO-CHEMICAL PARAMETERS

The pH(Field) measurements of the Estuary and Lagoon Channel sediments were circumneutral at 7.8 and 7.5 respectively (Table 12). The sediment within the Lagoon centre was slightly alkaline at pH(Field) 8.4 (Table 12). When all sediments were rapidly oxidised during the pH (Fox) test, the resultant pH(Fox) values were highly acidic, (pH < 3) and evoked moderate to strong reactions (Table 12). The results of the pH(Fox) tests were highly suggestive of potential acid sulfate material as described in the *Identification and investigation of acid sulfate soils and acidic landscapes* by DER (2015). As such, disturbance of Lagoon sediments, such as by dredging or any form of aeration of the sediments, would result in a dramatic pH shift towards an acidic environment. This in turn would rapidly mobilise toxic metal and metalloids from sediment, likely impacting on flora and fauna.

18.2 METAL AND METALLOIDS

No metal or metalloid parameter at any sample location exceeded the ANZECC (2000) ISQG-Low trigger values for sediments (Table 12), and as such current concentrations are unlikely to result in adverse effects on sediment ecological health, should the sediments remain undisturbed. Metal and metalloid concentrations in the Estuary sediment sample were the lowest in comparison to the Lagoon channel (second highest) and the centre of the Lagoon (greatest concentration of metal and metalloids). Given the relatively elevated aluminium, iron, arsenic, copper, lead and zinc concentrations within the centre Lagoon sediment (SED3, Table 12) compared to the channel and Canning Estuary, disturbance of this sediment (and subsequent change to acidic pH) would mobilise these metals and metalloids. These contaminants may then mobilise to the channel (SED2) and Canning Estuary (SED1), where concentrations are above the existing levels, and create further contamination of these areas. This is not withstanding the direct effect of metal and metalloid toxicity on the flora and fauna within the Lagoon which may be significant and irreversible.

Table 12. Sediment quality data. Orange and red highlights relate to exceedances of ANZECC (2000) and DER (2015) trigger values respectively

Sediment Parameter	Unit	SED1 (Canning River)	SED2 (Lagoon channel)	SED3 (Lagoon Centre)	ANZECC (2000) Sediment ISQG-Low	Acid Sulfate Soil Guidelines (DER, 2015)
		28/03/2018	28/03/2018	28/03/2018		
Physico-chemical						
pH (Field)	pH unit	7.8	7.5	8.4		≤ 4
pH (Fox)	pH unit	2.6	2.7	2.4		< 3
Reaction Rate	Reaction Unit	2 - Moderate	2 - Moderate	3 - Strong		
Moisture Content	%	94.6	92.8	48.5		
Metal and metalloids						
Aluminium	mg/kg	160	590	2860		
Iron	mg/kg	410	1580	8250		
Arsenic	mg/kg	<1.00	<1.00	3.73	20	
Cadmium	mg/kg	<0.1	<0.1	0.2	1.5	
Chromium	mg/kg	<1.0	1.3	7.2	80	
Copper	mg/kg	<1.0	2.9	11.7	65	
Lead	mg/kg	<1.0	2.9	14.6	50	
Nickel	mg/kg	<1.0	<1.0	3	21	
Selenium	mg/kg	<0.1	<0.1	0.4		
Zinc	mg/kg	5.1	17.8	81.9	200	
Mercury	mg/kg	<0.01	<0.01	0.03	0.15	
Nutrients						
Total Nitrogen	mg/kg	490	970	1460		
Total Kjeldahl Nitrogen	mg/kg	490	970	1460		
Organic Nitrogen (calculation)	mg/kg	490	970	1460		
Organic Nitrogen % (calculation)	%	100%	100%	100%		
Ammonia-N	mg/kg	<20	<20	<20		
Nitrite-N	mg/kg	<0.1	<0.1	<0.1		
Nitrate-N	mg/kg	<0.1	<0.1	<0.1		
NOx-N	mg/kg	<0.1	<0.1	<0.1		
Total Phosphorus	mg/kg	71	168	172		
Total Organic Carbon	%	3.69	6.98	5.77		

18.3 NUTRIENTS

The nutrient data from sediment samples (Table 12) shows that all nitrogen based nutrients were in organic form, likely contained within sludge and the associated microbial life. No mineral forms of nitrogen, such as ammonia or nitrate/nitrite were detected, which suggests that the availability of nitrogen based nutrients across the sediment locations was in a balance between decomposition of organic nitrogen and release of nitrogen nutrients for growth, and large quantities of readily available forms of nitrogen for growth were not present. Total phosphorus concentrations were detected, and were highest within the Lagoon centre.

18.4 SEDIMENT SUMMARY

Generally speaking, the sediments within the Canning River Estuary, Lagoon channel and Lagoon centre were below the trigger values for metals and metalloids in sediment, and did not have detectable levels of mineralised nitrogen (readily available nutrients). It was clear that the sediments within the Lagoon centre were largely a sink for organic nutrients and metals/metalloids in comparison to the Lagoon channel and Estuary sediment locations. This was likely influenced by the hydrology of the Lagoon, and inputs from stormwater and groundwater. The results of the pH(Fox) tests were highly suggestive of potential acid sulfate material and disturbance of Lagoon sediments, such as by dredging or any form of aeration of the sediments, would result in a dramatic pH shift towards an acidic environment. This in turn would rapidly mobilise toxic metal and metalloids from sediment, likely impacting on flora and fauna. Given the results of the pH (field) and pH(Fox) tests and the balance of mineral to organic nitrogen, sediments would likely act as a source of nutrients and metals/metalloid contamination if disturbed.

19.0 PRIMARY PRODUCTION

19.1 BENTHIC ALGAE

Originally, residents had raised concerns about the extensive mats of filamentous algae observed in 2013 causing impacts to the health of the Lagoon. The mats had dislodged from the sediment and floated to the surface (Figure 23). This is typical of benthic macroalgae. They are unattached and when conditions are optimal they produce large amounts of carbohydrates and become buoyant. On examination, microscopically, the mats were a collection of various filamentous forms, the dominant being green algae *Cladophora* and *Chaetomorpha* species. Other taxa present were typical of the estuarine benthos (the community of organisms that live on or near the sediment of aquatic systems) such as filamentous cyanobacteria and diatoms living epiphytically on the filaments.

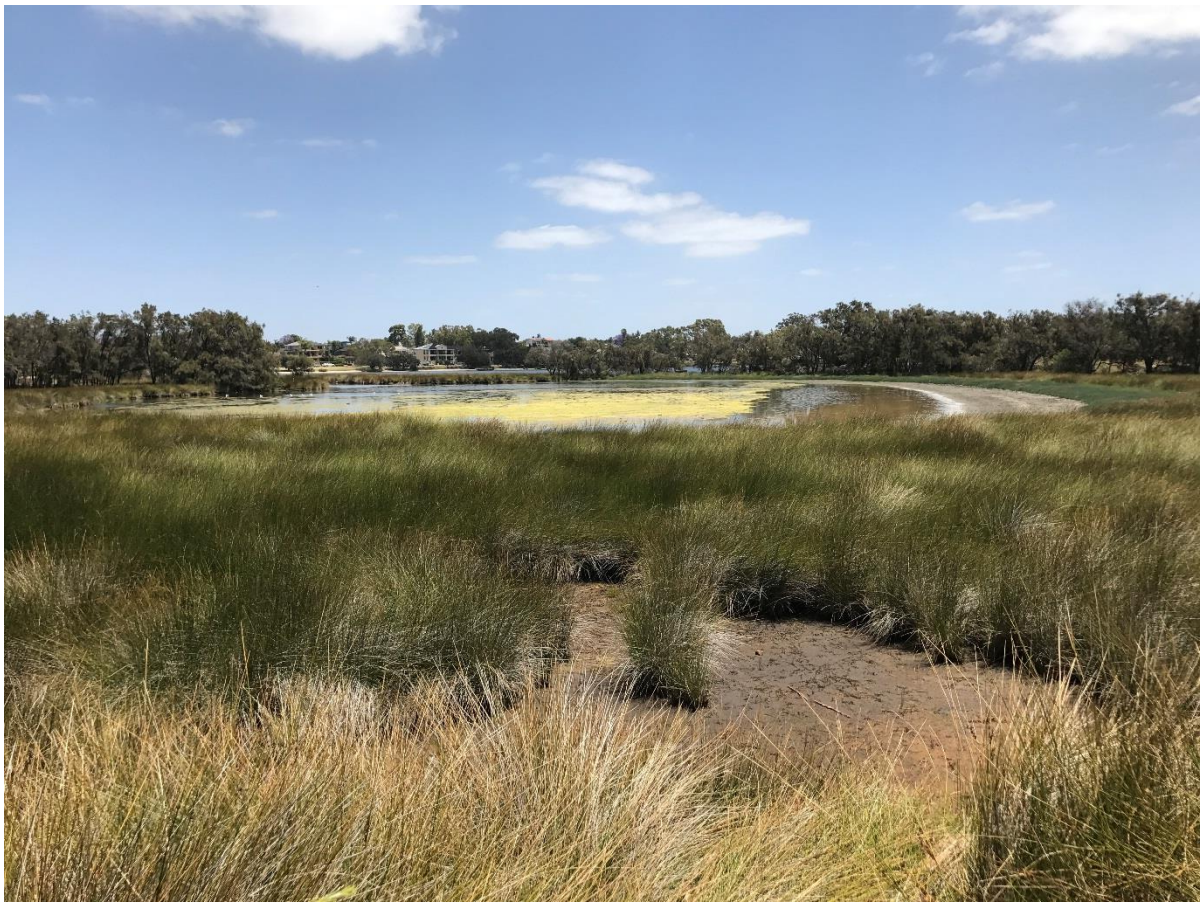


Figure 23. Free-floating filamentous mats, Salter Point Lagoon, December 2016

Both *Chaetomorpha* sp. and *Cladophora* spp. are present across many of the wetlands on the Swan Coastal Plain and within the shallow Lagoons of the Swan - Canning Estuary. They are more obvious during the spring and summer months when conditions such as light intensity and warmer waters favour their growth (DoW, 2010). They belong to the Chlorophyta (green algae); Family Cladophorophyceae (ABRS systematics) (McCarthy and Orchards, 2007). They are non-toxic and may be referred to as drift algae – unattached macroalgae that are subject to the movement of the surface water. The cosmopolitan taxon, *Chaetomorpha linum*, is common in the Estuary (DoW, 2010). Due to its high capacity for nutrient uptake and growth (Hauxwell et al., 2003) *Chaetomorpha* species will proliferate during the warmer months. In areas of low hydrodynamic activity or quiescent waters (Hoffle et al., 2012) they can form large floating mats which become more prominent as the water levels decline. In terms of total biomass, the green filamentous macroalgae usually account for 40% to 85% of total biomass in estuaries in SW Australia during the warmer months (Hillman et al., 2000). The importance of macroalgae in maintaining the ecological processes in the Swan-Canning Estuary is well understood (DoW, 2010).

Drift algae have a boom-and-bust lifecycle and supply rapidly decomposing organic material to the sediment (Pedersen et al., 2005). Odour complaints will typically come from this decomposition and have been documented from the Swan Estuary since 1870 (Brearley, 2005; Hodgkin and Vicker, 1987). Wetlands in Western Australia undergo periods of low hydrological flow during the summer

months with many drying. This is a natural part of their hydrocycle with many of the resident aquatic biota require periods of drying to fulfil their lifecycles.

During this study benthic microbial mats were also observed on the surface of the Lagoon sediment. The mats were identified as the cyanobacterium, *Microcystis botrys*. In Australia this taxon is not considered to be harmful (NRMMC, 2005). While normally a freshwater taxon, *M. botrys* is often found in slightly saline environments the large quantities of mucilage they produce producing a slightly less saline microenvironment allowing them to exist in a normally saline habitat. This mucilage also provided a habitat for other biota with a high diversity of diatoms and microinvertebrates present in the mats.

The *M. botrys* mats covered 100% of the Lagoon sediment during the field study. The mats were not cohesive and readily dispersed when manipulated. During the field study small mat fragments of the mats were observed dislodging from the sediment and floating to the surface (Figure 24) and out of the Lagoon via the inlet/outlet channel with the ebb current.

Figure 24. Benthic mat and floating dislodged fragments of *Microcystis botrys* (24th April 2018)

The mat fragments covered 0% of the Lagoon water surface on the 28 March 2018 and approximately 25% on 24 April 2018 and <5% on 30 May 2018. Although the presence of the mat was obvious while out in the Lagoon in the canoe, it was not easily visible from the shore.

Algal and cyanobacterial mats (benthic microbial communities) are important components of aquatic systems. They are the building blocks of complex food webs and support large numbers of invertebrates and higher order fauna. Both mats types form the benthos of the Lagoon. When the waters are calm, resulting in more light penetration (limited turbidity) and warmer temperatures this will increase their ability to uptake phosphorous and ammonium nitrogen and therefore grow quickly. Any disturbance of the resulting dense mats will cause them to float and they become drift algae. The filamentous forms are more visible as they are more cohesive and have a high cellulose content

because of the taxa present (dominated by green filamentous forms such as *Cladphora*). The *Microystis* spp are coccoid Cyanobacteria and are less able to form cohesive mats.

Both types of mats produce habitat (substrate) for other algal groups, in particular, diatoms. This in turn provide a valuable food source for many grazers such as crustaceans. Diatoms have a high oil content and are easily consumed. The mats can also produce a micro climate that is slightly less saline and therefore habitable. In terms of habitat they provide additional areas that increases the heterogeneity of habitats in the Lagoon leading to greater diversity and higher order consumers such as waders and raptors. Drift algae, globally, are recognised as a valuable habitat and the base of complex food webs. They contribute to habit complexity in surface waters and provide a substratum for various organisms to complete various stages of their life-cycles, in-particular invertebrates and fish. They also play a role in the redistribution of organisms in estuaries and the ocean (Kingsford, 1995) and algal spores (Reed at al., 1988). A study by Astill and Lavery (2001) found that macroalgae material (including the nutrients absorbed) is lost primarily through water movement with winter freshwater flows. In a period of 36 days up to 20 % of the tagged macroalgae were lost from Salter Point to the Estuary.

19.2 PHYTOPLANKTON

The phytoplankton of a waterbody is the assemblage of photosynthetic organisms that are subject to distribution by water movement (Wetzel, 2001). Generally, phytoplankton is the term assigned to the microalgae and cyanobacteria that are unattached or “free-floating” in the water. They are the primary producers and respond to any modifications to nutrient availability. The density (number of cells per mL of water) and the taxa (species) present in a waterbody can be used as a measure of ecological health (Deeley and Paling, 1999).

Two of the three sampling sites (SW02 and SW03) were located within Salter Point Lagoon and the third (SW01) located in the Estuary (Figure 5). The phytoplankton within the Lagoon showed little variation between the two sites, while SW01 showed slight variation in terms of dominant taxa (Table 13). Overall the community structure (percentage composition of the phytoplankton taxonomic groups) was similar for each of the sampling periods (March to May 2018) (Figure 25).

The taxa (phytoplankton) were all typical of an estuarine system with a mixture of groups. Absent were the cyanobacteria (blue-green algae) which is characteristic of saline systems. The dominance of the diatoms in late April through to May is typical of the phytoplankton succession in the Estuary (Brearley, 2005).

Table 13. Phytoplankton from Salter Point Lagoon sampling sites (March to May 2018). Enumerated in cells/mL.

Group	Taxa	28/03/2018			24/04/2018			30/05/2018		
		SW01	SW02	SW03	SW01	SW02	SW03	SW01	SW02	SW03
Diatoms	*Chaetoceros* spp.	225	25	25	914	963	1500			
	Cyclotella spp.	50			25	25	25		25	25
	Rhizosolenia spp.		5	10						
	Skeletonema spp.				7750	4500	6000		25	
	Thalassiosira spp.					50	225	425	650	300
	Navicula spp.		100					25		
	Nitzschia spp.	25	50	50			25	25	25	75
	Synedra spp.		50							
	Thalassionema spp.		15	5						
Chlorophyta	*Carteria* spp.	25								
	Chlamydomonas spp.	75	100	25	25			25		25
	Dictyosphaerium spp.								300	350
	Kirchneriella spp.					25				25
	Monoraphidium spp.								50	50
	Oocystis spp.	25								
	Pyramimonas spp.	25			125		25			
	Scenedesmus spp.								50	75
Cryptophyta	*Chroomonas* spp.	722	50		125			175	350	375
	Cryptomonas spp.	75	125	25				175	300	375
Euglenophyta	*Euglena* spp.		25			25		100		
	Trachelomonas spp.							5		
	Eutreptiella spp.					125	100	25		
Dinophyta	*Ceratium* spp.		25							
	Gymnodinium spp.	125	125	150	25	75	5			
	Peridinium spp.	200	75	100	25		100			
	Protoperidinium spp.						50			
Total Algae Count		**1572**	**770**	**390**	**9010**	**5790**	**8060**	**980**	**1780**	**1680**

Phytoplankton data collected from the Salter Point weekly routine sampling site (*Swan-Canning Clean-up Program Action Plan*) was comparable to the Lagoon phytoplankton data, taking into account variation in sampling methods. Diatoms dominated the Estuary in early Autumn and cryptophytes increasing later in May (Source: PEU, DWER, 2018 unpublished data). The trend in the phytoplankton community was typical to that seen in the Canning River Estuary in previous years (DoW, 2016). In terms of indicators of ecosystem health, the community structure was diverse and no potentially harmful taxa were identified. In April the chain forming diatom, *Skeletonema costatum*, dominated the sample. This was typical seasonal succession in the Estuary and of no concern. The phytoplankton data collected during the study did not indicate eutrophic conditions nor a degraded system. The community structure reflected that in the Estuary at time of sampling, indicating a connection between both systems.

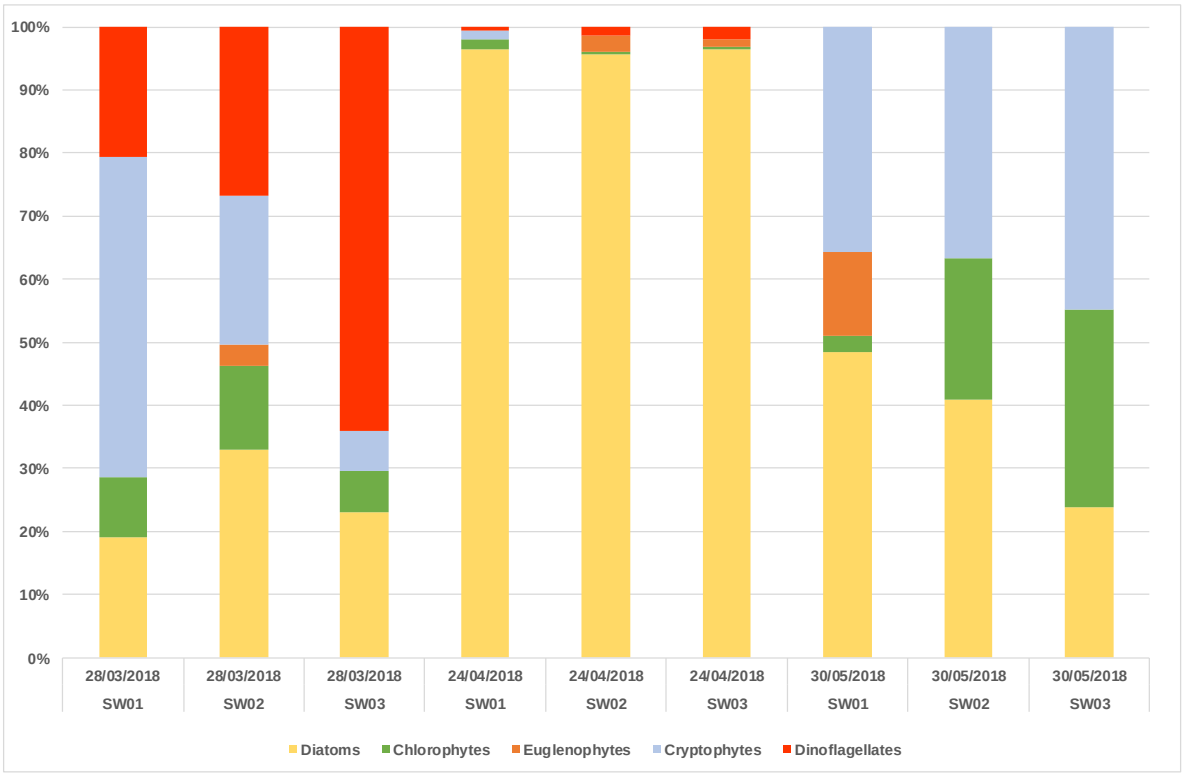


Figure 25. Phytoplankton community composition of the Salt Point Lagoon study area (March to May 2018)

19.3 SUMMARY OF PRIMARY PRODUCTION

The Lagoon supports an algal and cyanobacterial community characteristic of estuarine systems. The community structure is reflective of the seasonal conditions present in the Lagoon and correspond to those in the Canning River Estuary. During this study the phytoplankton community consisted of saline species with diatoms dominating in April and continuing through to the end of May. Species diversity was similar at all sites, the Estuary site (SW01) had a slightly different species composition than the Lagoon sites however, the groups were the same. None of the taxa identified, nor their densities, were of concern, indicating a healthy system.

The benthic microbial communities were also identified in the Lagoon and varied temporally. Mats of filamentous forms dominated by the green macroalgae, Chaetomorpha sp. and Cladophora spp., were identified in 2016. In 2018, the benthos was covered in a mat produced by the cyanobacterium, Microcystis botrys, and was less cohesive. This species is not considered a toxin producer in Australia. Both mats types form the benthos of the Lagoon and are important habitat for many epiphytic algae and micronvertebrates that live in the Lagoon. They form the basis of the food chain. Both types are readily dislodged from the surface of the sediment and become buoyant, floating on the surface of the water.

20.0 LAGOON VEGETATION CONDITION

Based on the recent site assessment, Salter Point Lagoon supports four major vegetation communities that are distributed along the hydrological gradient:

1. Closed Low Shrubland of *Sarcocornia quinqueflora* over Herbland of *Suaeda australis* and *Samolus repens* with Scattered rushes of *Juncus kraussii.*

2. Closed Rushes of *Juncus kraussii* with Scattered trees of *Casuarina obesa* and very open grasses of *Sporobolus virginicus*.

3. Closed sedgeleland of *Schoenus subfascicularis* with Scattered grasses of *Sporobolus virginicus*;

4. Closed herbland of *Phlebocarya ciliata* and *Dasypogon bromeliifolius*, open rushes of *Alexgeorgea nitens* and Scattered mixed low shrubs and scattered trees of *Nuytsia floribunda;*

5. Mixed shrubland and herbland (revegetated) of the upland areas.

Vegetation condition of the Lagoon is predominantly in very good to excellent condition and this vegetation comprises of Juncus kraussii rushes and Sarcocornia quinqueflora and Suaeda australis samphire saltmarsh. The upland areas are of variable condition and have been impacted by clearing, trampling and weeds. Several areas have been revegetated to improve overall stability of the sand spit, and to increase diversity and amenity of the area.

To distinguish between areas that have been revegetated and those that are remnant, the revegetated areas have been hatched in Figure 26.

The remnant vegetation (which occupies 76% of the site overall, with 53% in Excellent condition) mostly surrounds the Lagoon basin where no vegetation clearing has occurred since European settlement. The remainder of the remnant vegetation is in Very Good (4%) or Degraded (4%) condition. Approximately 2% of the site has been labelled as Completely Degraded due to lack of indigenous to site flora, and presence of weeds such as Couch (*Cynodon dactylon*). Regular maintenance and weed control of the reserve has resulted in low weed cover and an overall improvement in vegetation condition rating.

The revegetation efforts particularly those along the western side of the spit have resulted in improved vegetation cover and condition, however anthropogenic influences such as trampling of vegetation combined with the drying climate, storm surges and salt incursion continues to have an impact on plant establishment particularly to the south western edge of the site.

Figure 26. Salter Point Lagoon vegetation condition map

To investigate the extent of changes in vegetation condition as a result of water movements in and out of the Lagoon, all available aerial photographs were examined to note changes in vegetation cover in addition to changes noted during maintenance and restoration works conducted by Syrinx between 2012 – 2018.

Major vegetation clearing activities that occurred in the Salter Point area particularly during late the 1950s to mid 1960s (Figure 27) have mostly impacted the upland areas of the site. While the upland areas have recovered slightly, most areas have succumbed to weeds, introduction of fill to elevate Salter Point Parade, climate change, planting of flora species that are not native to site (e.g. *Acacia cyclops, Scaevola crassifolia* etc.) and increased public visitation to the spit reducing overall condition.

Figure 27. Salter Point Lagoon and surrounding areas 1965 aerial image (left) and the 2018 image (right) showing vegetation extent and areas of vegetation degradation (Source: Landgate, 2014 and Nearmaps, 2018)

Unlike upland areas, vegetation bordering the Lagoon water body did not experience changes until more recently. Since 2006 there has been a steady increase in expansion of saltmarsh community in response to lower water levels in the Lagoon. This expansion is mostly confined to the north west edge of the Lagoon water body consistent with bathymetry and the likely groundwater discharge point.

To the north of the Lagoon three small salt pans have formed where previously (2006) they were vegetated with rushes. Disappearance of rushes is most likely a result of salt build-up due to above average temperatures, low tides, and low fresh water flushing which generally stimulates germination of *Juncus* seed and its active growth. Small salt pans like this appear in the most saltmarsh communities and hence have not been given a Completely Degraded ranking but rather incorporated in the overall condition of bordering rushes and samphires.

Further to salt pan formation, sedges of *Schoenus subfascicularis* which grow in transition of *Juncus* rushes to dampland vegetation communities (incorporating scattered shrubs and *Xanthorrhoea* spp over closed herbland of *Phlebocarya ciliata* and *Dasypogon bromeliifolius* and. Scattered trees of *Allocasuarina fraseriana* and *Nuytsia floribunda*) are showing signs of water stress. This is most likely a result of reduced groundwater levels / freshwater input brought about by lower rainfall and higher than average temperatures particularly since 2006 as well as well as likely salt incursion into the soil profile.

The species recorded during traverses of the site are presented in a tabular form within Appendix 7.

Figure 28. Iconic Western Australian Christmas Tree (*Nuytsia floribunda)* at the entrance to Salter Point Lagoon

21.0 FAUNA

Based on the site inspection, the area can be seen to provide a range of environments for fauna. These include:

- Riverine shallow;
- Very limited shoreline roosting as most of the shoreline is densely vegetated with rushes;
- Roosting opportunities for some waterbirds in dead she-oaks along the shoreline;
- Very dense rushes that provide shelter for cryptic waterbirds; where flooded these also provide shelter for small fish and aquatic invertebrates, and may even have a nursery function;
- Extensive shallows in the Lagoon for foraging; fish and waterbirds; and
- Some upland shrubland and woodland on sandy soil.

Of these environments, the extensive shallows in the Lagoon are very unusual for the Canning River Estuary, and upland vegetation is limited in the area in general. The small area of sandy shoreline where birds roost is also limited along this shoreline. It is also the location where the public can access the Estuary and is thus subject to disturbance.

Fauna species returned from databases are presented in Appendix 8. Each group is discussed below.

21.1 INVERTEBRATES

No invertebrates were returned from databases. The databases generally only include invertebrate species of listed conservation significance (i.e. listed under Federal or State legislation); there are few of these and they are usually not recorded from urban areas that lack extensive native vegetation. If a larger search area had been used that included reserves in the Armadale and Jandakot area, significant insects such as some native bees and the Graceful Sun-moth might have been returned. However, there is a very low likelihood of such species in the small and degraded upland vegetation of the site.

Despite this, the site will support a moderately rich invertebrate fauna, in particular when compared with nearby suburbs. As noted above, the Lagoon and adjacent Estuary will also support aquatic invertebrates, and flooded vegetation along the shoreline and Lagoon may provide shelter for aquatic invertebrates. This could include larval prawns. Shrimps, probably the Glass Shrimp *Paleemonetes australis*, were present in the entrance channel to the Lagoon on 23 February 2018.

The aquatic invertebrate assemblage may be interesting as there is freshwater seepage into the Lagoon. Therefore, while most aquatic invertebrates will be estuarine, there may be some freshwater species present where freshwater occurs around the Lagoon. Microscopic examination of the free-floating mats and the benthos dominated by *Microcsystis botrys* found a large number of rotifers, cladocerans and ciliates.

21.2 FISH

Fish species returned from databases are listed in Appendix 8. Most are estuarine so would occur in the adjacent Estuary and occasionally in the Lagoon. The five species seen on 23 February 2018 were in the entrance channel except for the Mosquitofish, which was seen in brackish pools amongst the rushes on the landward side of the Lagoon. This is a fresh to brackish species which suggests some freshwater seepage even at the end of summer. The Leopard Fish is very unlikely to be present as it is reliant on permanent freshwater.

The Lagoon provides an extensive shallow foraging area for fish and flooded rushes on the shoreline and especially in the Lagoon, where they are sheltered, may provide shelter for fish fry.

21.3 FROGS

The desktop review returned nine frog species, of which four had been recorded by Siemon (2000) in the Salter Point/Waterford area (Appendix 8). The Siemon records are old and without surveys it cannot be predicted reliably which species may still be present, or even which were recorded at Salter Point as opposed to elsewhere in the Waterford area. The Moaning Frog and Banjo Frog are terrestrial outside the breeding season, and the Turtle Frog is exclusively terrestrial, so these may survive in the upland areas. The Motorbike Frog regularly survives in gardens so may occur nearby and individuals could visit the area. All but the Turtle Frog require freshwater for breeding, and it is not clear if freshwater seepages are sufficient to provide this habitat.

None of the frogs is of listed conservation significance, but the Quacking Frog, Turtle Frog and Crawling Toadlet have the most limited distributions in the urban area. At least in the 1990s, there was a thriving population of the Quacking Frog at Cygnia Cove (M. Bamford *pers. obs*.), but that site has an extensive freshwater wetland. The likelihood of any of these three species being present at Salter Point is considered low.

21.4 REPTILES

The desktop review returned 21 reptile species, of which eight had been recorded by Siemon (2000) in the Salter Point/Waterford area and three were observed during 2018 site visits (Appendix 8). Reptiles display a high degree of persistence even in small remnants of native vegetation within Perth urban landscapes (e.g. Bamford and Calver 2012), so an assemblage of around 20 species is quite possible. This could only be confirmed through survey work. The Long-necked Tortoise is aquatic and probably only an occasional visitor to the adjacent Estuary and Lagoon, while most species would be largely restricted to upland vegetation with sandy soil. The Three-lined Skink, Mulch Skink and Tiger Snake will utilise vegetation along the margins of wetlands.

Most of the reptile species are widespread, albeit patchily distributed in urban areas, but the Perth Lined Lerista is listed as Priority 4 by the DBCA because it has a restricted distribution that is extensively overlapped by urban development. It seems to be restricted to sandy soils in stabilised dunes in woodland, but there may be sufficient habitat in the Salter Point area.

21.5 BIRDS

The desktop review returned 116 bird species, of which 52 are waterbirds. Siemon (2000) recorded 61 species in the Salter Point/Waterford area and 21 species were observed during 2018 site visits (Appendix 8). Waterbirds were counted on 23 February 2018 and while numbers were low, the presence of 13 Black Swans was notable. The mobility of birds means that many species can be recorded at a site, but for a lot of these it may just be a case of a single bird flying past. Of importance is the function of the site for birds: does it support a population, provide a stepping stone to move through the landscape, or provide a particular important feature such as a roosting location.

Important features of Salter Point for birds are:

- Part of a corridor along the Estuary for small bushbirds such as the Splendid Fairy-wren and honeyeaters. The presence of some remnant upland vegetation, including banksias, is important in the local context.
- Provides a large area of rushes and sheltered shallow water for shelter and foraging (and possibly breeding) by waterbirds such as crakes and rails, some ducks and herons/egrets/spoonbills. A Pelican was reported feeding in the Lagoon during a site visit in 2018 (R. Tamanovic, pers. comm., Figure 29). The Lagoon is an important aspect of this feature.
- The Estuary shoreline at the mouth of the Lagoon provides a small roosting area for waterbirds.
- Dead trees close to the shoreline provide roosting sites for birds such as the Eastern Osprey and cormorants.

The bird assemblage includes some species of conservation significance, (Appendix 8), with 11 species listed under conservation legislation (CS1 in Appendix 8), and 18 species of local conservations significance (CS3 in Appendix 8). These CS3 species are generally species that have declined markedly in the urban area as discussed by Dell and Banyard (2000).

Seven of the CS1 species (Glossy Ibis, Eastern Osprey, Common Greenshank, Wood Sandpiper, Common Sandpiper, Grey Plover and Crested Tern) are waterbirds which will forage along the adjacent estuary and over/in the Lagoon, but will be only occasional visitors in small numbers due to the small area of habitat available. An Osprey and a Common Sandpiper were present on 23 February 2018. The remaining CS1 species will also be only occasional visitors, including Carnaby's Black-Cockatoo (few birds observed feeding *Banksia menziesii* and *Acacia saligna* in 2018; R. Tomanovic pers. comm.). Among the CS3 species are eight small bushbirds that are sedentary and rely heavily on remnants and corridors of native vegetation to persist in the urban landscape. Only one of these, the White-cheeked Honeyeater, was observed on 23 February 2018, but Siemon (2000) observed Inland Yellow-rumped Thornbill in the Salter Point/Waterford area, and there are records of the Splendid Fairy-wren at Cygnia Cove and just upstream of Leach Highway (M. Bamford and P. Agar, pers. obs). These species may not be resident at Salter Point, but are very likely to use it to move through the landscape. The remaining CS3 birds are also likely to be occasional or even regular

visitors in small numbers, but include waterbirds and birds of prey that are generally wide-ranging and less dependent upon connectivity in the landscape.

Figure 29. Black Swans (and a single Australian Pelican) that had been roosting at the mouth of the Lagoon.

Figure 30. View from the Estuary back into the Lagoon with a single Eastern Great Egret foraging in the channel.

Figure 31. Carnaby's Black-Cockatoo feeding on *Acacia saligna*

Figure 32. Pelicans and other waterbirds feeding on school of mullet

21.6 MAMMALS

The desktop review returned 13 mammal species, of which five are introduced (Appendix 8). This does not include marine mammals with dolphins occasionally reported from the nearby estuary, but they are independent of Salter Point and the Lagoon. Siemon (2000) recorded six mammal species in the Salter Point/Waterford area and the only mammal record in 2018 was of the Cat; probably a domestic animal but feral Cats are likely to be present also.

Mammals such as the Quenda, Brush-tailed Possum and bats are sufficiently mobile that they may be able to use the Salter Point area as part of a corridor for movement, and in combination with the extended reserve along the estuary populations may be able to persist. Siemon did report the Quenda but the species is usually easy to detect due to its distinctive foraging holes, and it appeared to be absent at the time of the 2018 inspection. Specialised surveys would be required to confirm the presence of most bat species. The majority of mammals would use the remnant dryland vegetation but the dense rushes would provide shelter for the Quenda and rodents, while the Rakali is semi-aquatic and would use the Lagoon, adjacent Estuary and shorelines. The Rakali is one of two mammal species listed as Priority by the DBCA (the other being the Quenda), and it still occurs along the Canning Estuary (Trocini et al.,2015).

PART 4: KEY FINDINGS AND MANAGEMENT RECOMMENDATIONS

22.0 SUMMARY OF KEY FINDINGS

This study indicates that the most likely cause of the periodic algal blooms (floating mats) is low water levels in the Estuary and reduced flushing of the Lagoon. This issue was first noticed by residents in 2016, but presumably has occurred intermittently over time, during periods of low astronomically generated tides occurring over inter-annual timescales and where drying cycles predominate. Given the trajectory is towards a drying climate, at least for a further 20 to 50 or so years (Semeniuk and Semeniuk, 2013), these episodes are likely to become more frequent.

In general, the filamentous algal issue is not of concern to the environmental health of the Lagoon or to human health, but rather is one of aesthetic concern. Notwithstanding this, there are point sources of pollutants that clearly 'feed-the system' and add to poor water quality and the potential for algal blooms.

The key findings of the study for each study element are summarised below:

22.1 LAGOON MORPHOMETRY AND PROCESSES

- The Lagoon bathymetry was very shallow and predominantly ranged from 0.17 m to 1.0 m deep with depth of water dependant on the tide.
- There was a thick layer of sludge, approximately 1 m to 2 m deep at the bottom of the Lagoon.
- Tidal flushing generally occurred daily. However, in summer flushing is reduced particularly at low points in inter-annual tidal cycles and during the years of low rainfall.
- Tidal exchange with the Estuary was the largest component of the Lagoon water balance during the study. Contributions from groundwater and stormwater were small by comparison and are only important when water levels in the Estuary are very low.

The above factors mean that the floating filamentous algal mats are more likely to occur at low points in inter-annual tidal cycles and during the years of low rainfall when the Estuary water levels are lower and the effect of flushing is minimal.

22.2 WATER AND SEDIMENT QUALITY

- Surface water quality within the Lagoon was characterised by TN that was below the trigger values, but had ammonia-N, TP and DRP concentrations that exceeded the trigger values. Relative concentrations of these nutrients between the Lagoon and the Estuary suggest the Estuary may be a source of these nutrients;

- Groundwater quality was slightly acidic to circumneutral, generally enriched with nutrients with respect to the trigger values for TN, ammonia-N, NOx, and TP. Elevated total metal/metalloid concentrations were detected in the north-eastern and eastern bores.

- Stormwater quality was a source of nutrients and metal contamination which over time may load the Lagoon sediments and water column with nitrogen, phosphorus and metal/metalloids.

- Sediment quality within the Lagoon and Estuary was characterised by 100% organic nitrogen as well as some phosphorus and metal/metalloid loading, and was considered to be stable with respect to nutrient cycling (mineral versus organic nitrogen). The pH(Field) and pH(Fox) tests confirmed that disturbance and exposure of sediments to oxygen would cause a huge pH shift and subsequent release of nutrients and metals from the sediments.

22.3 PRIMARY PRODUCTION

- The phytoplankton and macroalgae (filamentous free-floating mats) were typical of the Swan-Canning Estuary showing similar seasonal succession of taxonomic groups. The phytoplankton collected during the study were well known euryhaline taxa and did not indicate a eutrophic or degraded system.

- The benthic microbial community (mats) identified during the study (2018) was dominated by the coccoid cyanobacterium *Microcystis botrys*. While freshwater *Microsystis* species are linked to known toxic blooms, *M. botrys* is not known to be harmful in Australia.

- The algal (filamentous) and cyanobacterial mats add to habitat heterogeneity in the Lagoon. This is important in maintaining the integrity of the system. Microbial mats are also important in the uptake and removal of nutrients, acting as sinks. If the Lagoon channel is blocked and there is no flow to the Estuary there is a risk that extensive mats, as seen in 2016, may result in increased biomass decomposing in the Lagoon. Typically, drift algae eventually flushed to the ocean/Estuary, as was observed during this study.

22.4 LAGOON VEGETATION

- The Lagoon supports a variety of vegetation communities that are based on the varying lagoon hydrology from saltmarsh communities to fringing rushes of *Juncus* and *Schoenus* spp., and the upland dampland to degraded woodland communities that have largely been cleared and now under restoration.

- The Lagoon vegetation is mostly in Excellent to Very good condition for the riparian fringe, however, the changes due to historical clearing of upland vegetation alongside changes in lagoon hydrology are impacting overall condition of vegetation by build-up of salt in parts of the fringing rush habitat and the lack of freshwater input that generally supports productive woodland / dampland communities.

22.5 FAUNA

The Salter Point area has a depauperate fauna due to extensive development in surrounding areas, but as such it acts as a refuge that enables fauna to persist. A number if features of the site make it particularly important as a refuge and in a functional sense, as follows:

- It provides a wide range of environments in a small area, from upland vegetation on sandy soils to the shallows of the Lagoon and adjacent Estuary.
- Some of the environments are unusual in the immediate region, such as the Lagoon shallows, the roosting area at the mouth of the Lagoon and the remnant upland vegetation.
- The site is part of a corridor for wildlife movement along the Canning River Estuary.
- The freshwater seepage into the Lagoon may support frogs and freshwater aquatic invertebrates that might not otherwise be present.
- The Lagoon provides a relatively large area of shallows that are easily accessed by aquatic fauna from the Estuary, and also provides a large area of emergent vegetation that can be used as shelter by invertebrates and young fish. Most of the Estuary shoreline along this section of the Canning Riverpark is exposed to wave action and drops off to deeper water quickly.

There were Cat tracks through the area and these may be domestic animals. They will prey upon lizards and small birds.

23.0 RECOMMENDATIONS

Given the key findings above the following recommendations are made for management of the Lagoon:

23.1 IMPROVING FLUSHING OF THE LAGOON

23.1.1 Short Term Actions

Flushing of the Lagoon in summer should be increased by:

- Removing all limestone rocks positioned across the outlet channel edge (limestone was positioned by members of public) to reduce sand build up;
- Reducing groundwater abstraction within the City. An immediate target of 10% reduction could be set for the immediate catchment.

The area where groundwater abstraction should be reduced should include the suburbs immediately hydraulically up-gradient of the Lagoon i.e. the eastern half of Salter Point, Manning, Karawara, Waterford and the Collier Park Golf Course in Como as shown on Figure 33. However, a detailed groundwater study would be needed to ascertain the volumes of water abstracted from the superficial aquifer, and the seasonality of this. The location of registered groundwater bores from the Water Information Reporting (WIR) database within the area boundary is shown on Figure 33. It is important to note that garden bores do not require a licence and so are not included within the WIR database, however may contribute significantly to reduced groundwater recharge to the lagoon. A public education campaign should be considered within the area to reduce groundwater abstraction for irrigation of private gardens.

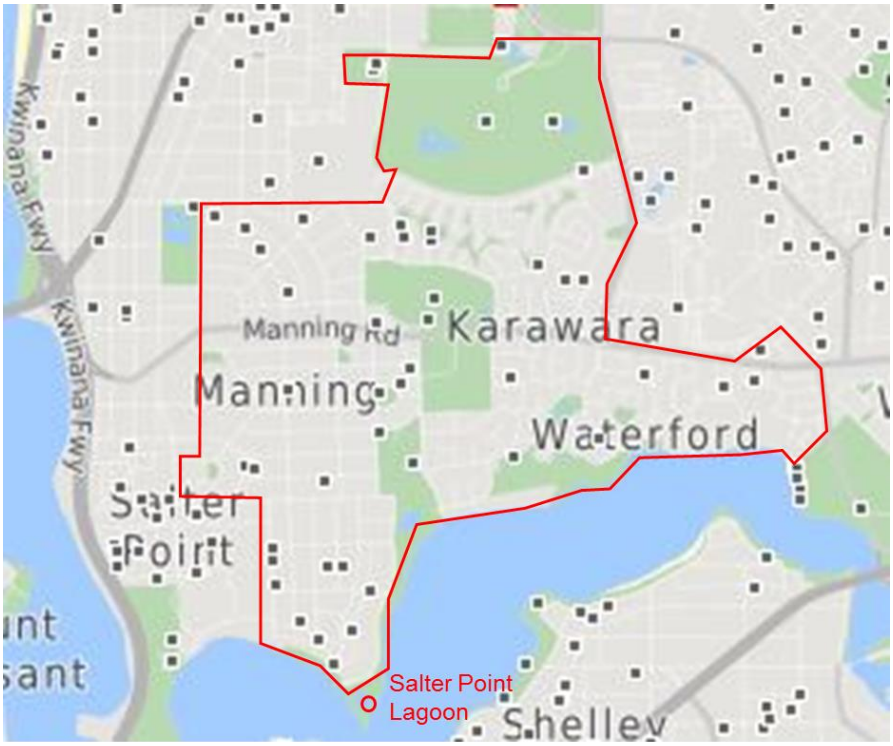


Figure 33. Suggested area for reduction in groundwater abstraction

The freshwater seepage should be protected, which may require developing a greater understanding of its hydrology.

The water level loggers should be maintained to allow for continuous monitoring of water levels in the Lagoon, the adjacent estuary and surrounding groundwater.

23.1.2 Long Term Actions

An engineered structure could be installed to control flushing at low points in inter-annual tidal cycles and low rainfall periods. It is possible that there has been an episodic constriction of the tidal channel due to an increase in sediment influx resulting from sustained high mean water levels during 2011 to

2013 and an enhanced capacity for the Lagoon to choke resulting from declining tidal range from 2006 to 2015 (Seashore Engineering, 2018). Seashore have suggested that a small excavation of sediment build-up in the channel could occur to allow flushing of the Lagoon during low tide/rainfall years and is likely to last for a number of years. Further site investigations by a coastal engineer would be required to better define appropriate locations and extent of works. However, sediment removal works are likely to be focussed on the margins of areas that have an elevation above 0 m AHD, outlined on Figure 34. At this elevation, tidal flushing of the Lagoon currently ceases.

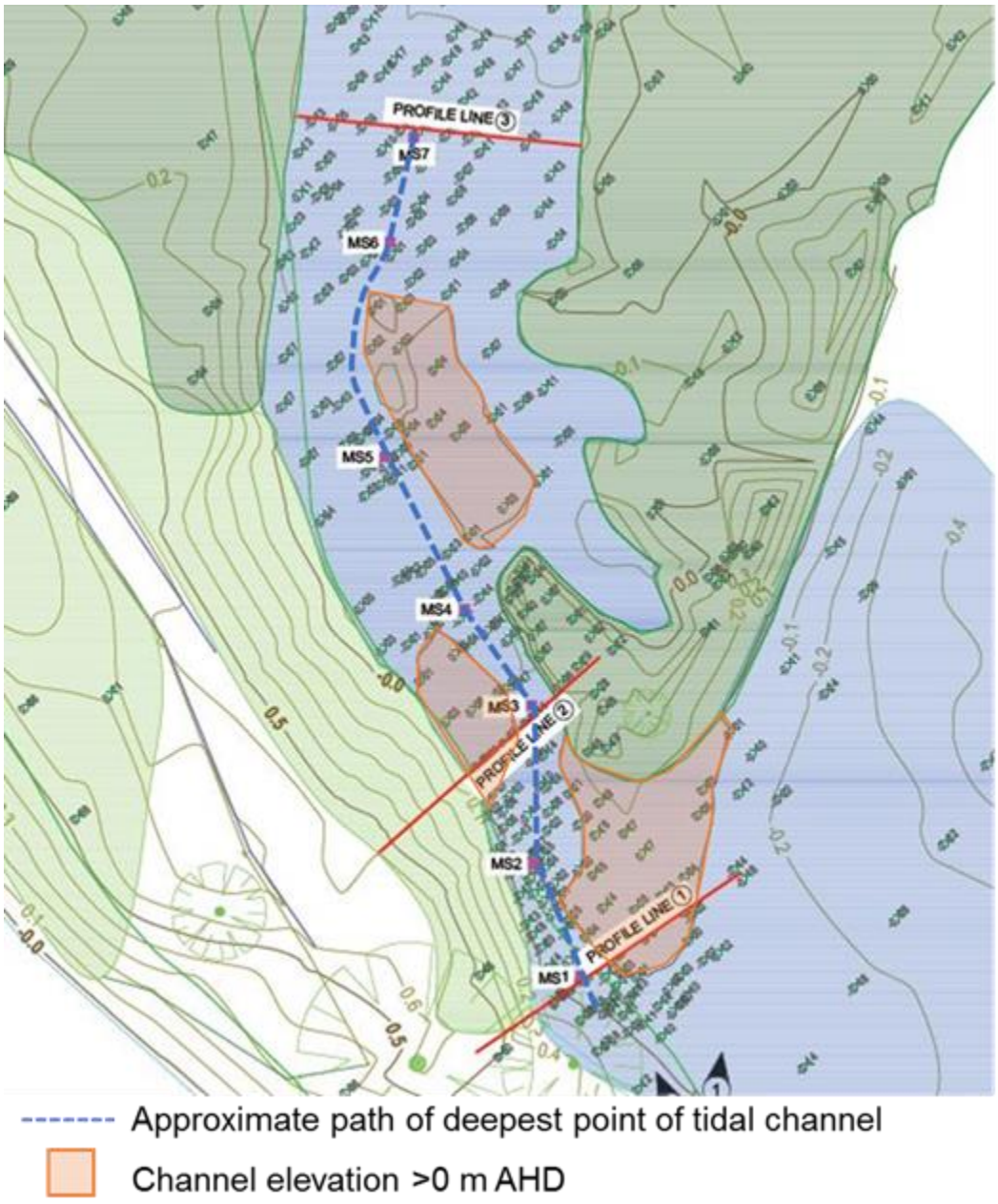


Figure 34. Areas of tidal channel with elevation greater than 0 m AHD

Any proposal to modify the channel needs further study to ensure it does not negatively impact on Lagoon levels and the sediment movement and stability around the Lagoon. An optimal depth of the excavation should be determined to make sure flushing is effective but the Lagoon does not drain and dry out completely. A weir gate control could be installed to enable controlled flushing when needed.

23.2 MECHANICAL REMOVAL OF FLOATING ALGAL MATS

The aesthetics of the Lagoon could also be managed in the short-term through mechanical removal of floating algal mats. This has been conducted in the Swan-Canning Estuary before. Blooming drift algae are relatively easy to remove manually using various types of harvesters (Thomsen and Wernberg, 2009). Harvesting methods suitable for drift algae include raking or manually skimming. More sophisticated skimming techniques such as freely floating skimmers with a pump may also be suitable. A harvesting method should be chosen that does not disturb the benthic algal mat and associated fauna and a plan should be in place for disposal of the harvested mats.

23.3 NUTRIENT AND POLLUTANT SOURCE MANAGEMENT

23.3.1 Short Term Actions

- Formulation of catchment nutrient plans to prevent nutrients such as nitrogen and phosphorus and metal/metalloids from migrating into the Lagoon via the stormwater drain, and potentially incoming groundwater from the northern catchment.

23.3.2 Long Term Actions

- Daylight existing stormwater drains further up the catchment and construct 'living streams', swales and/or biofilters to improve the quality of stormwater entering the Lagoon and Estuary.

23.4 SEDIMENT MANAGEMENT

Dredging of the Lagoon to remove benthic algal mats and/or sludge is not recommended for the following reasons:

- It would destroy an important fauna habitat and refuge;
- The sediments are Acid Sulfate Soils, hence the impacts and costs are likely to be complex to manage and onerous;
- The Lagoon is protected under various Acts.

Should sediment quality deteriorate in the future, consider options to stabilise in-situ sediments using bentonite or other clay amendments and bio-flocculants. Bio-flocculants are an emerging field and a separate study and trials would be needed to ascertain costs:benefits.

23.5 HABITAT MANAGEMENT

Management of Vegetation

The following management measures are recommended to maintain and improve the current vegetation condition:

- Nutrient input into groundwater should be reduced to optimise establishment of native groundwater dependant species;
- Regular weed control should be maintained;
- Upland vegetation should be enhanced through revegetation, with a focus on nectar-bearing trees and shrubs that provide shelter and food (e.g. *Banksia* spp.).

Management of Fauna

The following management measures are recommended to maintain the Lagoon as a refuge for fauna:

- Access into the Lagoon for fish and aquatic invertebrates is important throughout the year. While there are many things to take into account in management of the Lagoon, ensuring that connectivity with the Estuary throughout the year would be beneficial for fauna.
- Waterbirds roosting at the mouth of the Lagoon are important, but the birds are subject to disturbance by people. It is not clear if this can be resolved by 'guiding' people away from the roosting area, or by creating a new roosting area slightly away from the Lagoon entrance. In general, clear trails that manage the movement of people and prevent people from wandering and trampling through the site are important.
- Dead trees along the shoreline and nearby should be retained (for roosting).
- Residents close to reserves should be encouraged to keep their cats indoors at all times, or at least at night.

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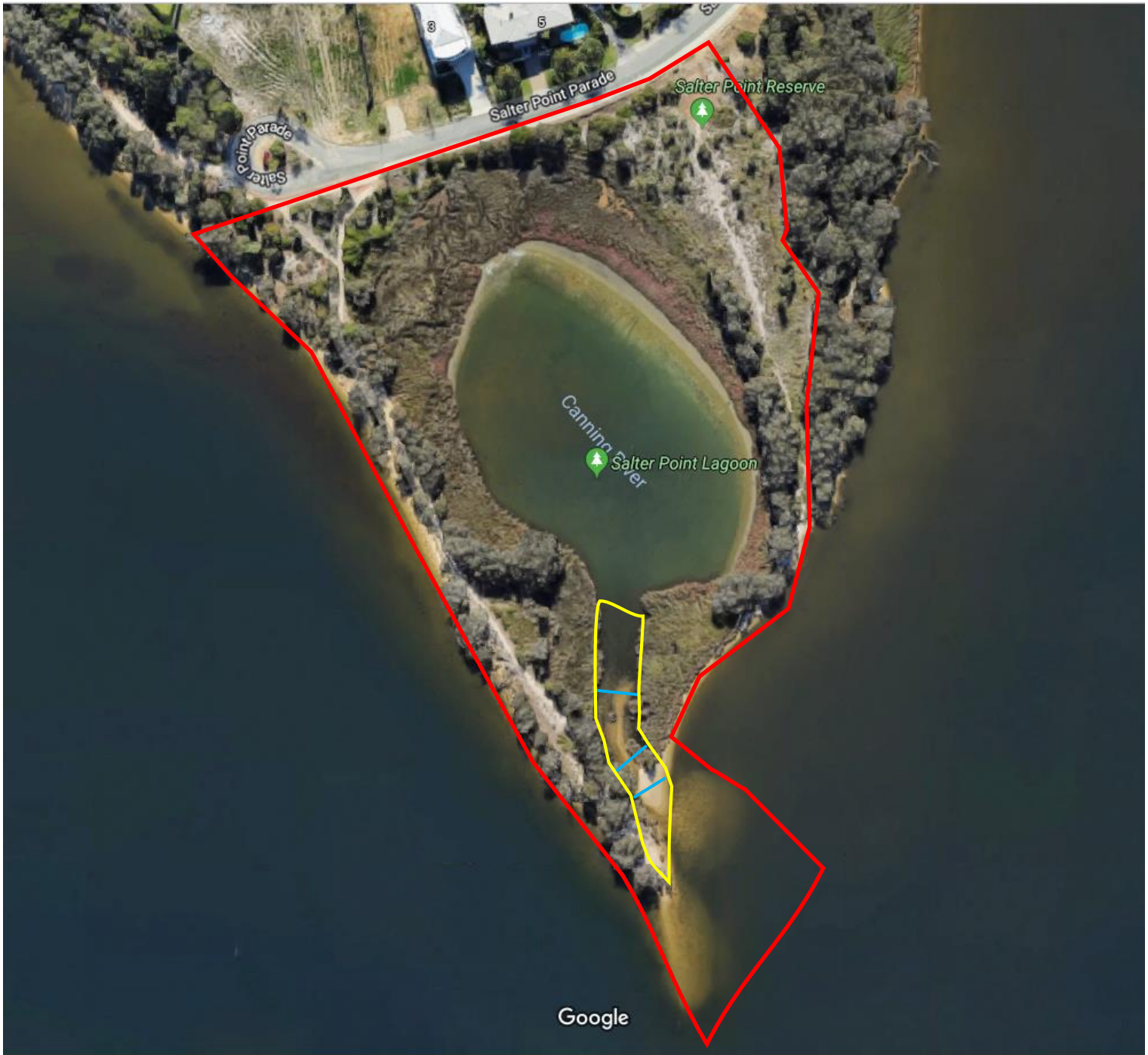
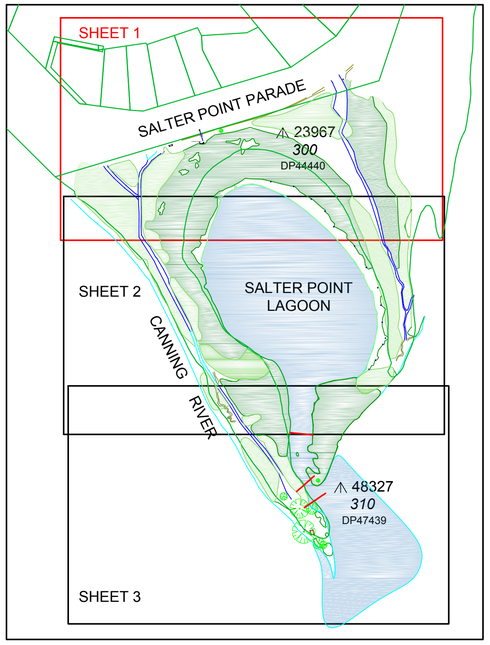
APPENDICES

APPENDIX 1 LEVEL AND FEATURE SURVEY

Approximate Outline of Survey Areas





LOCATION SKETCH
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Photo 3

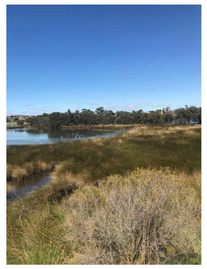

Photo 4

= WATER POND

= TREE LINE

= REEDS AREA

SYMBOL LEGEND

- MONITOR STAKES
- BOLLARD
- TOP OF SLUDGE
- BOTTOM OF SLUDGE
- MONITOR BORE
- WATER LEVEL
- LEVEL LOGGER
- NATURAL SURFACE
- SURVEY CONTROL POINT
- SIGN (ONE POLE)
- TAP
- VALVE
- TELEPHONE
- POLE POST
- TREE

CONTOUR LEGEND

- 5.0 Contour Major Lagoon 1.0m Intervals
- 5.0 Contour Minor Lagoon 0.2m Intervals
- 5.0 Contour Major 0.5m Intervals
- 5.0 Contour Minor 0.1m Intervals

CONTROL POINT SCHEDULE

Point	Easting	Northing	Elevation	Description
9001	393571.330	6455827.342	2.13	Ramset in Path
9002	393666.599	6455884.003	2.66	Ramset in Path
9003	393586.126	6455833.874	2.28	Bridge Nail in Bitumen
9005	393632.011	6455621.974	0.76	Peg at Ground Level
APP14	393655.872	6455794.420	1.61	SSM

SCALE @ A1 1:250

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Data File: 6165-358-F01-1.0.dwg

VER.	DATE	BY	AMENDMENTS	FILE SOURCE
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Notes:

1. Boundary plotted from Landgate SCDB digital data only.
2. True position of Boundary is subject to a re-establishment survey.
3. Heights established from SSM APP14 via GPS connection.

JBA SURVEYS
12b Pepler Ave. Salter Point WA 6152
Ph: 9450 7188
email: admin@jbasurveys.com.au
web: www.jbasurveys.com.au

CLIENT: City of South Perth

JOB NO: 6165-358 | TITLE: FEATURE SURVEY

PROJECT:

SALTER POINT LAGOON
SALTER POINT PARADE
SALTER POINT, WA, 6152

SURVEYOR: RC | DATE OF SURVEY: 04.04.2018 | DRAWN BY: CG | APPROVED BY: NRW

DATUM
VERT: AHD
HORIZ: MGA94 Z50

SCALE: 1:250

DWG NO: 6165-358-F01 VER: 1.0

SHEET NO: 1 OF 3 A1

N

CANNING RIVER

CANNING RIVER

Telstra Manhole

GW2

SW1

Typical top of sludge

Typical bottom of sludge

SALTER POINT LAGOON

Timber Bridge

Lookout Platform

Waterline observed March 19th, 2018 4:02 pm

PROFILE LINE 3

MS7

MS6

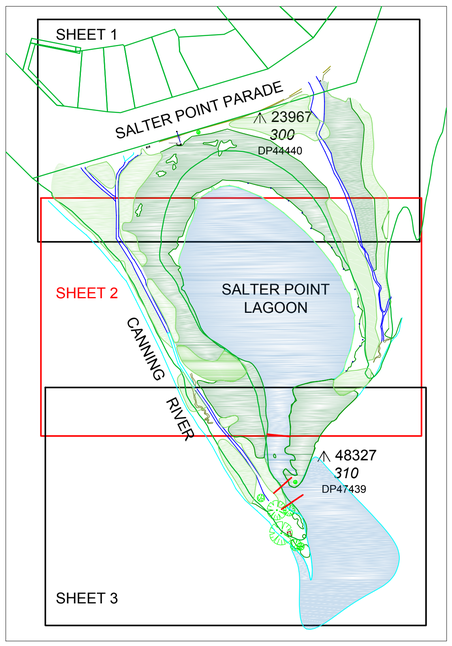
23967
300
DP44440

48327
310
DP47439

= WATER POND

= TREE LINE

= REEDS AREA



LOCATION SKETCH
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SCALE @ A1 1:250

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DATUM
VERT: AHD
HORIZ: MGA94 Z50

SCALE: 1:250

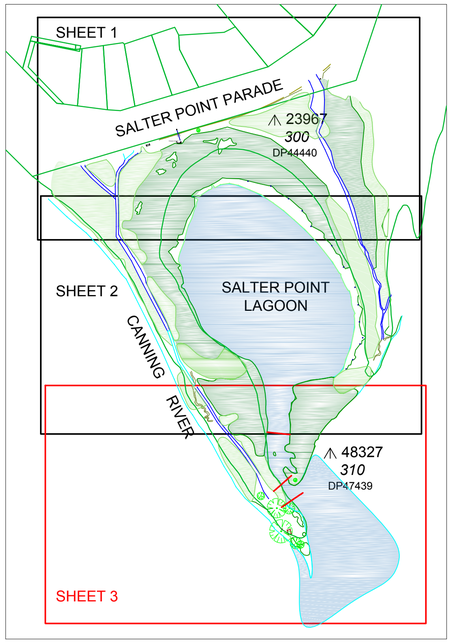
DWG NO: 6165-358-F01 | VER: 1.0

SHEET NO: 2 OF 3 | A1

SURVEYOR: RC | DATE OF SURVEY: 04.04.2018 | DRAWN BY: CG | APPROVED BY: NRW

Photo (1)

Photo (2)



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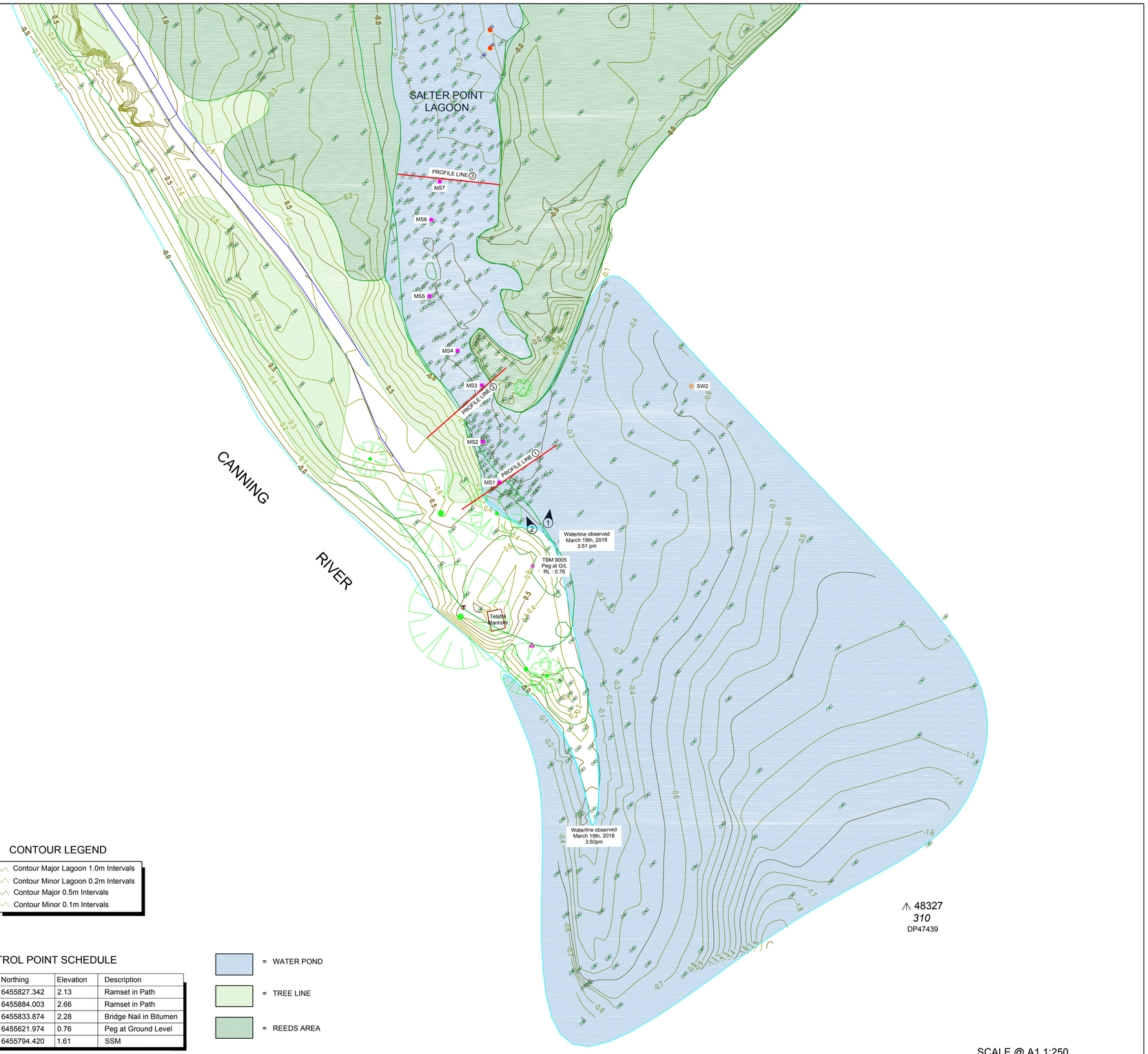

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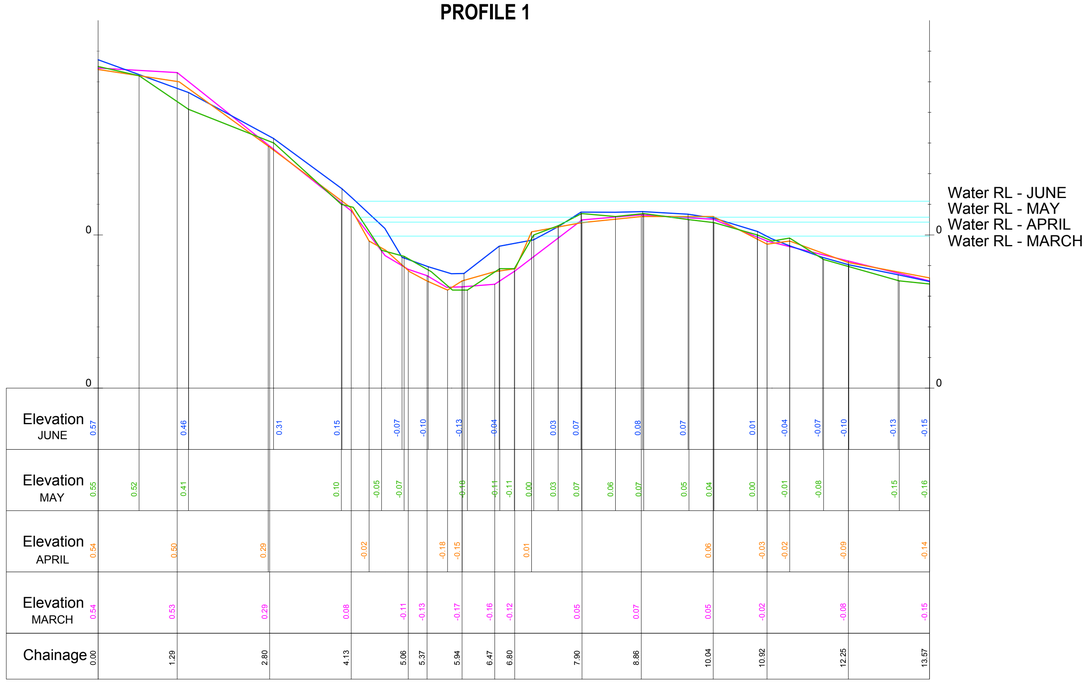
HORIZ: MGA94 Z50
SCALE: 1:250
DWG NO: 6165-358-F01 | VER: 1.0
SHEET NO: 3 OF 3 | A1

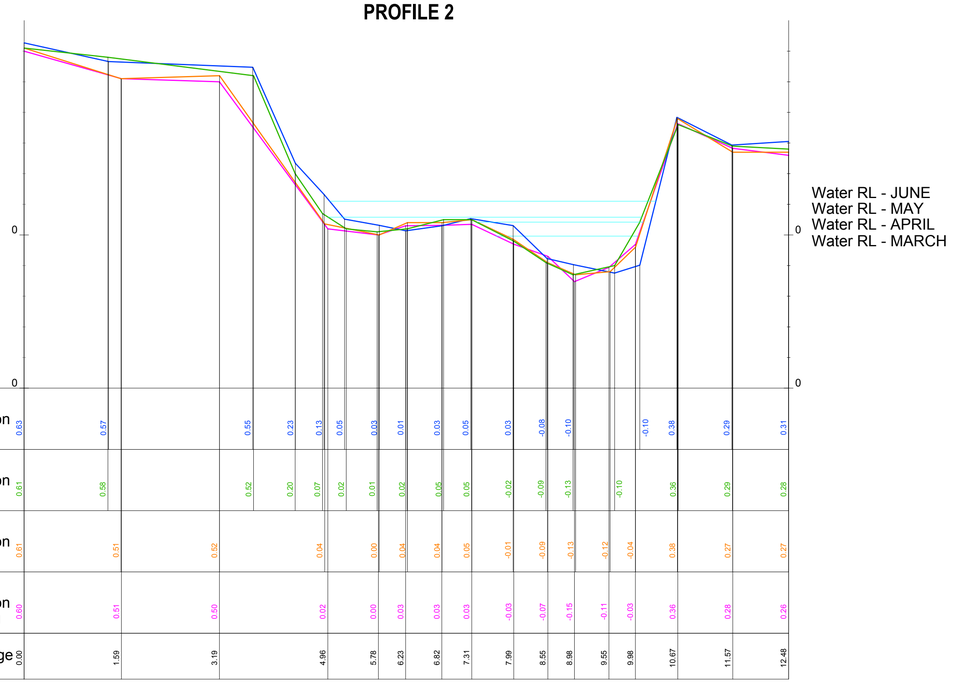
N

PROFILE 1



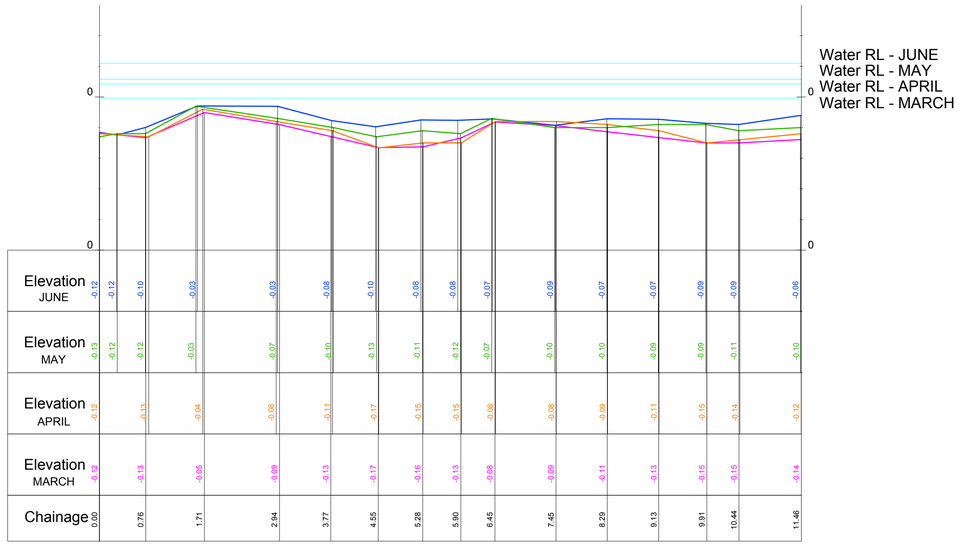
Elevation JUNE	0.57		0.46		0.31		0.15		0.10	-0.05	-0.07	-0.10	-0.13	-0.04	0.03	0.07		0.08	0.07		0.01	-0.04	-0.07	-0.10	-0.13	-0.15
Elevation MAY	0.55	0.52	0.41				0.10	-0.05	-0.07	-0.10	-0.16	-0.11	-0.11	0.00	0.03	0.07	0.06	0.07	0.05	0.04	0.00	-0.01	-0.08		-0.15	-0.16
Elevation APRIL	0.54		0.50		0.29			-0.02		-0.18	-0.15			0.01						0.06	-0.03	-0.02		-0.09		-0.14
Elevation MARCH	0.54		0.53		0.29		0.08		-0.11	-0.13	-0.17	-0.16	-0.12			0.05		0.07		0.05	-0.02			-0.08		-0.15
Chainage	0.00		1.29		2.80		4.13		5.06	5.37	5.84	6.47	6.80			7.90		8.86		10.04	10.92			12.25		13.57

PROFILE 2



Elevation JUNE	0.63		0.57				0.55		0.23	0.13	0.05	0.03	0.01	0.03	0.05	0.03	-0.08	-0.10		-0.10	0.38		0.29		0.31
Elevation MAY	0.61	0.58					0.52		0.20	0.07	0.02	0.01	0.02	0.05	0.05	-0.02	-0.09	-0.13	-0.10		0.38		0.29		0.28
Elevation APRIL	0.61		0.51		0.52					0.04	0.00	0.04	0.04	0.05	-0.01	-0.09	-0.13	-0.12	-0.04		0.38		0.27		0.27
Elevation MARCH	0.60		0.61		0.50					0.02	0.00	0.03	0.03	0.03	-0.03	-0.07	-0.15	-0.11	-0.03		0.36		0.28		0.26
Chainage	0.00		1.59		3.19					4.96	5.78	6.23	6.82	7.31	7.99	8.55	8.98	9.55	9.98		10.67		11.57		12.48

PROFILE 3



Elevation JUNE	-0.12	-0.12	-0.10	-0.03		-0.03		-0.08	-0.10	-0.08	-0.08	-0.07		-0.09		-0.07	-0.07	-0.09	-0.09		-0.06				
Elevation MAY	-0.13	-0.12	-0.12	-0.03		-0.07		-0.10	-0.13	-0.11	-0.12	-0.07		-0.10		-0.10	-0.08	-0.09	-0.11		-0.10				
Elevation APRIL	-0.12		-0.13	-0.04		-0.08		-0.11	-0.17	-0.15	-0.15	-0.08		-0.08		-0.09	-0.11	-0.15	-0.14		-0.12				
Elevation MARCH	-0.12		-0.13	-0.05		-0.09		-0.13	-0.17	-0.16	-0.13	-0.08		-0.09		-0.11	-0.13	-0.15	-0.15		-0.14				
Chainage	0.00		0.76	1.71		2.94		3.77	4.55	5.28	5.90	6.45		7.45		8.29	9.13	9.91	10.44		11.46				

LEGEND

June	06.06.2018	Water RL : 0.55
May	02.05.2018	Water RL : 0.29
April	10.04.2018	Water RL : 0.21
March	27.03.2018	Water RL : -0.02

Horizontal Scale @A1 1:50

0 0.5 1 1.5 2 2.5

Vertical Scale @A2 1:10

0 0.1 0.2 0.3 0.4 0.5

6165-358-PR01-2.0.dwg

VER.	DATE	BY	AMENDMENTS	FILE SOURCE
1.0	10.04.2018	SF	Issued for Information	6165-1.0-16032018-MGA94-F-358
2.0	07.06.2018	SF	Added Current Profile	6165-1.0-16032018-MGA94-F-358

Notes:
1. Heights established from APP14 Via GPS connection.

JBA SURVEYS
12b Pepler Ave, Salter Point WA 6152
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email: admin@jbasurveys.com.au
web: www.jbasurveys.com.au

CLIENT: City of South Perth

JOB NO: 6165-359 | TITLE: PROFILE SURVEY

PROJECT:
SALTER POINT LAGOON
SALTER POINT PARADE
SALTER POINT, WA, 6152

SURVEYOR: SW | DATE OF SURVEY: 27.03.2018 | DRAWN BY: SF | APPROVED BY: NRW

DATUM
VERT: AHD
HORIZ: MGA94 Z50

SCALE: SEE PLAN

DWG NO: 6165-358-PR01 | VER: 2.0

SHEET NO: 1 OF 1 | A1

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SALTER POINT PARADE LAGOON

SALTER POINT, WA, 6152

JBA Job Number:6165-358

Note: See Drawing 6165-358-F01-1.0 for Profile Locations

2018 Profile Survey Schedule

Profile Line 1

March

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393623.64	6455628.69	0.54
1.29	393624.72	6455629.41	0.53
2.80	393625.96	6455630.26	0.29
4.13	393627.06	6455631.01	0.08
4.41	393627.29	6455631.16	-0.02
4.68	393627.52	6455631.32	-0.07
5.06	393627.83	6455631.53	-0.11
5.37	393628.09	6455631.70	-0.13
5.69	393628.35	6455631.88	-0.17
5.94	393628.56	6455632.02	-0.17
6.47	393629.00	6455632.32	-0.16
6.80	393629.27	6455632.51	-0.12
7.07	393629.49	6455632.66	0.02
7.90	393630.18	6455633.12	0.05
8.87	393630.98	6455633.67	0.07
10.04	393631.95	6455634.33	0.05
10.92	393632.68	6455634.82	-0.02
11.28	393632.98	6455635.02	-0.02
12.25	393633.78	6455635.56	-0.09
13.57	393634.88	6455636.31	-0.15

Profile Line 1

April

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393623.64	6455628.69	0.54
1.32	393624.74	6455629.43	0.50
2.78	393625.94	6455630.25	0.29
4.12	393627.05	6455631.00	0.09
4.42	393627.30	6455631.17	-0.02
4.69	393627.53	6455631.32	-0.05

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
5.08	393627.85	6455631.54	-0.12
5.36	393628.08	6455631.70	-0.15
5.70	393628.36	6455631.89	-0.18
5.94	393628.56	6455632.03	-0.15
6.47	393629.00	6455632.32	-0.12
6.81	393629.28	6455632.51	-0.11
7.08	393629.50	6455632.66	0.01
7.90	393630.18	6455633.12	0.04
8.87	393630.98	6455633.67	0.06
10.04	393631.95	6455634.33	0.06
10.92	393632.68	6455634.82	-0.03
11.29	393632.99	6455635.03	-0.02
12.25	393633.78	6455635.56	-0.09
13.57	393634.88	6455636.31	-0.14

Profile Line 1

May

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393623.64	6455628.69	0.55
0.67	393624.20	6455629.06	0.52
1.48	393624.86	6455629.52	0.41
2.87	393626.02	6455630.30	0.30
3.97	393626.93	6455630.92	0.10
4.17	393627.09	6455631.03	0.09
4.63	393627.47	6455631.29	-0.05
5.00	393627.78	6455631.49	-0.07
5.44	393628.14	6455631.74	-0.12
5.78	393628.43	6455631.94	-0.18
6.03	393628.63	6455632.07	-0.18
6.56	393629.07	6455632.37	-0.11
6.79	393629.27	6455632.50	-0.11
7.11	393629.53	6455632.68	0.00
7.51	393629.86	6455632.90	0.03
7.89	393630.17	6455633.12	0.07
8.45	393630.63	6455633.43	0.06
8.91	393631.01	6455633.69	0.07
9.64	393631.63	6455634.10	0.05
10.05	393631.96	6455634.33	0.04
10.76	393632.55	6455634.73	0.00
11.00	393632.75	6455634.87	-0.02
11.29	393632.99	6455635.03	-0.01
11.84	393633.44	6455635.34	-0.08
13.08	393634.47	6455636.03	-0.15
13.57	393634.88	6455636.31	-0.16

Profile Line 1

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	

June

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393623.64	6455628.69	0.57
0.67	393624.20	6455629.07	0.53
1.48	393624.87	6455629.52	0.46
2.86	393626.01	6455630.30	0.31
3.98	393626.94	6455630.92	0.15
4.16	393627.08	6455631.02	0.12
4.68	393627.52	6455631.32	0.02
4.96	393627.75	6455631.47	-0.07
5.39	393628.10	6455631.71	-0.10
5.77	393628.42	6455631.93	-0.13
5.97	393628.59	6455632.04	-0.13
6.55	393629.06	6455632.36	-0.04
6.80	393629.27	6455632.50	-0.03
7.11	393629.52	6455632.68	-0.02
7.51	393629.86	6455632.90	0.03
7.88	393630.17	6455633.11	0.07
8.44	393630.63	6455633.43	0.07
8.89	393631.00	6455633.68	0.08
9.63	393631.61	6455634.09	0.07
10.05	393631.96	6455634.33	0.06
10.76	393632.55	6455634.73	0.01
11.00	393632.75	6455634.86	-0.01
11.29	393632.99	6455635.03	-0.04
11.83	393633.43	6455635.33	-0.07
12.25	393633.79	6455635.57	-0.10
13.06	393634.45	6455636.02	-0.13
13.57	393634.88	6455636.31	-0.15

Profile Line 2

March

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393619.51	6455637.15	0.60
1.59	393620.70	6455638.20	0.51
3.19	393621.90	6455639.27	0.50
4.96	393623.22	6455640.44	0.02
5.78	393623.84	6455640.99	0.00
6.23	393624.17	6455641.28	0.03
6.82	393624.62	6455641.67	0.03
7.31	393624.98	6455641.99	0.04
7.99	393625.49	6455642.45	-0.03
8.55	393625.91	6455642.82	-0.07
8.98	393626.24	6455643.11	-0.15

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
9.55	393626.66	6455643.48	-0.11
9.98	393626.98	6455643.77	-0.03
10.04	393627.03	6455643.81	-0.01
10.67	393627.50	6455644.22	0.36
11.57	393628.17	6455644.82	0.28
12.48	393628.85	6455645.42	0.26

Profile Line 2

April

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393619.51	6455637.15	0.61
1.58	393620.69	6455638.20	0.51
3.19	393621.90	6455639.27	0.52
4.91	393623.18	6455640.40	0.04
5.79	393623.85	6455640.99	0.00
6.26	393624.20	6455641.30	0.04
6.82	393624.62	6455641.67	0.04
7.31	393624.98	6455642.00	0.05
7.98	393625.49	6455642.44	-0.01
8.54	393625.91	6455642.81	-0.09
9.00	393626.25	6455643.12	-0.13
9.57	393626.67	6455643.49	-0.12
9.98	393626.98	6455643.77	-0.04
10.66	393627.49	6455644.22	0.38
11.57	393628.17	6455644.82	0.27
12.48	393628.85	6455645.42	0.27

Profile Line 2

May

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393619.51	6455637.15	0.61
1.37	393620.57	6455638.02	0.58
3.75	393622.34	6455639.61	0.52
4.43	393622.85	6455640.06	0.20
4.87	393623.18	6455640.35	0.07
5.26	393623.47	6455640.62	0.02
5.76	393623.85	6455640.95	0.01
6.26	393624.21	6455641.28	0.02
6.85	393624.66	6455641.67	0.05
7.31	393625.01	6455641.97	0.05
7.99	393625.53	6455642.41	-0.02
8.52	393625.91	6455642.77	-0.09
8.96	393626.24	6455643.07	-0.13

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
9.64	393626.75	6455643.52	-0.10
10.05	393627.06	6455643.78	0.04
10.68	393627.52	6455644.21	0.36
11.56	393628.18	6455644.80	0.29
12.48	393628.85	6455645.42	0.28

Profile Line 2

June

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393619.51	6455637.15	0.63
1.38	393620.54	6455638.06	0.57
3.73	393622.30	6455639.62	0.55
4.43	393622.83	6455640.09	0.23
4.90	393623.18	6455640.40	0.13
5.23	393623.43	6455640.62	0.05
5.80	393623.85	6455640.99	0.03
6.23	393624.17	6455641.28	0.01
6.82	393624.62	6455641.67	0.03
7.29	393624.97	6455641.98	0.05
7.98	393625.49	6455642.44	0.03
8.54	393625.90	6455642.81	-0.08
8.97	393626.22	6455643.09	-0.10
9.64	393626.73	6455643.54	-0.12
10.05	393627.04	6455643.81	-0.10
10.65	393627.49	6455644.21	0.38
11.55	393628.16	6455644.81	0.29
12.39	393628.78	6455645.37	0.30
12.48	393628.85	6455645.42	0.31

Profile Line 3

March

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393616.05	6455668.36	-0.12
0.76	393616.80	6455668.29	-0.13
1.71	393617.75	6455668.19	-0.05
2.94	393618.97	6455668.06	-0.09
3.78	393619.80	6455667.98	-0.13
4.55	393620.57	6455667.90	-0.17
5.28	393621.30	6455667.82	-0.16
5.90	393621.91	6455667.76	-0.13
6.46	393622.47	6455667.70	-0.08
7.45	393623.46	6455667.60	-0.09

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
8.29	393624.29	6455667.51	-0.11
9.13	393625.13	6455667.42	-0.13
9.91	393625.91	6455667.34	-0.15
10.44	393626.43	6455667.29	-0.15
11.46	393627.44	6455667.18	-0.14

Profile Line 3

April

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393616.05	6455668.36	-0.12
0.80	393616.85	6455668.28	-0.13
1.69	393617.73	6455668.19	-0.04
2.88	393618.92	6455668.07	-0.08
3.80	393619.83	6455667.97	-0.11
4.56	393620.58	6455667.89	-0.17
5.28	393621.30	6455667.82	-0.15
5.91	393621.92	6455667.76	-0.15
6.46	393622.48	6455667.70	-0.08
7.46	393623.46	6455667.60	-0.08
8.30	393624.30	6455667.51	-0.09
9.13	393625.13	6455667.42	-0.11
9.92	393625.91	6455667.34	-0.15
10.45	393626.45	6455667.29	-0.14
11.45	393627.44	6455667.18	-0.12

Profile Line 3

May

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393616.05	6455668.36	-0.13
0.29	393616.34	6455668.36	-0.12
0.75	393616.79	6455668.27	-0.12
1.57	393617.61	6455668.18	-0.03
2.91	393618.93	6455668.04	-0.07
3.82	393619.84	6455667.95	-0.10
4.52	393620.54	6455667.87	-0.13
5.27	393621.29	6455667.80	-0.11
5.89	393621.91	6455667.73	-0.12
6.40	393622.41	6455667.67	-0.07
7.43	393623.43	6455667.56	-0.10
8.29	393624.29	6455667.48	-0.10
9.12	393625.12	6455667.40	-0.09
9.90	393625.89	6455667.33	-0.09
10.44	393626.43	6455667.26	-0.11

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
11.44	393627.42	6455667.15	-0.10

Profile Line 3

June

Chainage	Coordinates (MGA94)		RL (AHD)
	Easting	Northing	
0.00	393616.05	6455668.36	-0.12
0.28	393616.33	6455668.34	-0.12
0.75	393616.80	6455668.29	-0.10
1.60	393617.64	6455668.20	-0.03
2.91	393618.94	6455668.06	-0.03
3.79	393619.82	6455667.97	-0.08
4.51	393620.53	6455667.90	-0.10
5.25	393621.27	6455667.82	-0.08
5.85	393621.86	6455667.76	-0.08
6.41	393622.42	6455667.70	-0.07
7.44	393623.45	6455667.60	-0.09
8.28	393624.29	6455667.51	-0.07
9.12	393625.12	6455667.42	-0.07
9.90	393625.89	6455667.34	-0.09
10.43	393626.43	6455667.29	-0.09
11.44	393627.43	6455667.19	-0.06

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SALTER POINT PARADE LAGOON

SALTER POINT, WA, 6152

Method of Survey for Horizontal Positioning : Trimble S6 Total Station
Horizontal Datum : MGA94 Z50
Method of Survey for Vertical Positioning : Trimble S6 Total Station, Trigonometry Heights
Vertical Datum : AHD71
Date : 28.03.2018

Reference Station : **SSM APP14**
Easting : 393655.867
Northing : 6455794.409
Height : 1.607

SALTER POINT PARADE LAGOON - Monitor Well Locations (28.03.2018) Job Ref: 6165-358

Location	Coordinates		Heights			Notes /
Identification	Easting	Northing	Ground	Top of Casing	Top of PVC Pipe	Comments
GW1	393657.506	6455800.141	1.924	1.951	1.858	PVC Pipe in Plastic Black Case
GW2	393549.467	6455755.032	0.719	0.742	0.594	PVC Pipe in Plastic Black Case
GW3	393626.110	6455833.007	2.381	2.404	2.282	PVC Pipe in Plastic Black Case

SALTER POINT PARADE LAGOON - Surface Water Logger Locations (28.03.2018) Job Ref: 6165-358

Location	Coordinates		Heights	Notes /
Identification	Easting	Northing	Top of PVC Pipe	Comments
SW1	393599.345	6455756.995	1.141	PVC Pipe with Cap erected in Lagoon
SW2	393650.798	6455643.268	1.475	PVC Pipe with Cap erected in Lagoon

SALTER POINT PARADE LAGOON - Monitor Stake Locations (28.03.2018) Job Ref: 6165-358

Location	Coordinates		Heights	Notes /
Identification	Easting	Northing	Top of Wooden Stake	Comments
MS1	393628.084	6455631.899	0.591	Wooden Stake Erected in Inlet
MS2	393626.095	6455636.710	0.599	Wooden Stake Erected in Inlet
MS3	393625.976	6455643.371	0.568	Wooden Stake Erected in Inlet
MS4	393623.111	6455647.451	0.594	Wooden Stake Erected in Inlet
MS5	393619.778	6455653.915	0.594	Wooden Stake Erected in Inlet
MS6	393620.006	6455662.975	0.587	Wooden Stake Erected in Inlet
MS7	393620.976	6455667.466	0.576	Wooden Stake Erected in Inlet

***NOTE: Heights taken at highest point of PVC pipe or wooden stake, marked with black pen where possible**

APPENDIX 2 GROUNDWATER WELL CONSTRUCTION LOGS

BOREHOLE NUMBER GW1

SYRINX ENVIRONMENTAL

Syrinx Environmental Pl.

CLIENT City of South Perth **PROJECT NAME** Salter Point Lagoon

PROJECT NUMBER 17102 **PROJECT LOCATION** Salter Point

DATE STARTED 23/3/18 **COMPLETED** 23/3/18 **R.L. SURFACE (m)** _____ **DATUM** _____

DRILLING CONTRACTOR Edge Drilling **NORTHING (m)** _____ **CO-ORDINATE SYSTEM** _____

EQUIPMENT _____ **EASTING (m)** _____ **HOLE LOCATION** Eastern side of lagoon

HOLE SIZE (mm) _____ **LOGGED BY** B.W **CHECKED BY** _____

NOTES _____

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description / Samples Tests Remarks	PID (ppm)	Analysis Schedule	Additional Observations
Direct Push				0		SW	SAND, medium to coarse, well graded, sub-angular, grey, some organic material.			
						SW	SAND, fine to medium, well graded, sub-rounded, pale yellow.			
				1		SW	SAND, fine to medium, well graded, sub-rounded, pale brown, hit water table.			
						SW	SAND, fine to medium, well graded, sub-rounded, grey-pale yellow.			
				2		SW	SAND, fine to medium, well graded, sub-rounded, brown.			
						SW	SAND, fine to medium, well graded, sub-rounded, grey-brown.			
						SW	SAND, fine to medium, well graded, sub-rounded, grey.			
				3		SW	SAND, fine to medium, well graded, rounded, dark orange-dark yellow.			
							Borehole GW1 terminated at 3.6m			
				4						
				5						
				6						
				7						
				8						
				9						
				10						

BOREHOLE NUMBER GW2

SYRINX ENVIRONMENTAL

Syrinx Environmental Pl.

CLIENT City of South Perth **PROJECT NAME** Salter Point Lagoon

PROJECT NUMBER 17102 **PROJECT LOCATION** Salter Point

DATE STARTED 23/3/18 **COMPLETED** 23/3/18 **R.L. SURFACE (m)** _____ **DATUM** _____

DRILLING CONTRACTOR Edge Drilling **NORTHING (m)** _____ **CO-ORDINATE SYSTEM** _____

EQUIPMENT _____ **EASTING (m)** _____ **HOLE LOCATION** Western side of lagoon

HOLE SIZE (mm) _____ **LOGGED BY** B.W **CHECKED BY** _____

NOTES _____

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	PID (ppm)	Analysis Schedule	Additional Observations
Direct Push	▼			0		SW	SAND, medium to coarse, well graded, sub-rounded, grey-pale yellow, some organic material.				
				1		SW-SC	SAND WITH CLAY, medium to coarse, well graded, sub-rounded, dark grey-dark brown, organic rich, h2s odour.				
						PT	CLAY, well graded, dark brown-black, organic rich.				
						SW	SAND, medium to coarse, well graded, sub-rounded, dark grey, some organic material and roots.				
				2		SW	SAND, fine to medium, well graded, sub-rounded, grey.				
							Borehole GW2 terminated at 2.5m				
				3							
				4							
				5							
				6							
				7							
				8							
				9							
				10							

BOREHOLE NUMBER GW3

SYRINX ENVIRONMENTAL

Syrinx Environmental Pl.

CLIENT City of South Perth **PROJECT NAME** Salter Point Lagoon

PROJECT NUMBER 17102 **PROJECT LOCATION** Salter Point

DATE STARTED 23/3/18 **COMPLETED** 23/3/18 **R.L. SURFACE (m)** _____ **DATUM** _____

DRILLING CONTRACTOR Edge Drilling **NORTHING (m)** _____ **CO-ORDINATE SYSTEM** _____

EQUIPMENT _____ **EASTING (m)** _____ **HOLE LOCATION** North-east of lagoon

HOLE SIZE (mm) _____ **LOGGED BY** B.W **CHECKED BY** _____

NOTES _____

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	PID (ppm)	Analysis Schedule	Additional Observations
Direct Push	▼			1		SW	SAND, medium to coarse, well graded, sub-rounded, grey, tree roots.				
						SW	SAND, fine to medium, well graded, sub-rounded, pale yellow, tree roots up to 0.3 metres.				
				2		SW	SAND, fine to medium, well graded, sub-rounded, pale grey.				
						SW	SAND, fine to medium, well graded, sub-rounded, brown.				
				3		SW	SAND, fine to medium, well graded, sub-rounded, dark grey-brown.				
				4			Borehole GW3 terminated at 4m				
				5							
				6							
				7							
				8							
				9							
				10							

APPENDIX 3 DBCA PERMIT TO CONDUCT A SCIENTIFIC STUDY

Department of Biodiversity, Conservation and Attractions
SWAN CANNING RIVERPARK

Rivers and Estuaries Branch
Ph: 9219 9000
Email: rivers.planning@dbca.wa.gov.au

2018/001563
PERMIT P12159

Pursuant to Part 4 (Regulation 29) of the Swan and Canning Rivers Management Regulations 2007, this is to certify that a permit is issued to the person(s) or organisation described hereunder as permit holder and that person(s) or organisation is permitted to carry out the authorised works, acts or activities for the duration specified, subject to the conditions listed below.

Permit holder:	City of South Perth
Authorised works, acts or activities:	Scientific study – 3 groundwater monitoring bores
Location of works, acts or activities:	Lot 300 on Plan 44440 (Reserve 23967)
Approval date:	13 March 2018
Expiry date:	13 March 2019

CONDITIONS

1. The Applicant shall ensure that all contractors and personnel involved in the works, activities, operations and/or development approved by the Department of Biodiversity, Conservation and Attractions are familiar with the conditions and requirements of this approval at all times.

Prior to the commencement of works

2. The applicant shall notify the Department of Biodiversity, Conservation and Attractions in writing not less than seven 3 days prior to the commencement of works.

During Works

3. The works shall take place in accordance with the approved plans and supporting documentation provided with the permit application, unless modified by a condition of this approval.
4. The Applicant shall take all precautions to ensure no damage to the foreshore or water way (including infrastructure and vegetation) occurs beyond the scope of the approved works.
5. Should any inadvertent damage occur, the Applicant is required to notify the Department within 48 hours of that damage occurring.
6. The Applicant shall rectify at its expense any damage to the foreshore or water way (including infrastructure) that occurs as a result of the works.
7. The Applicant shall take appropriate preventative measures during the works to ensure that no construction material, top soil, runoff or deleterious matter is allowed to enter the river or Salter Point Lagoon.
8. A spill kit shall be maintained at the project site and shall be utilised to contain and clean up any spills. (refer advice Note 3)
9. Refuelling shall take place outside of the Swan Canning Development Control Area or at a licensed refuelling facility.
10. To prevent the spread of dieback (Phytophthora cinnamomi) and other pathogens, the applicant shall treat all soil sampling equipment and footwear immediately prior to entering each sample site (refer to Advice Note 6).
11. Upon completion of the works, the Applicant shall remove all waste materials, equipment and machinery and ensure the site cleaned-up to the satisfaction of the Department of Biodiversity, Conservation and Attractions, on advice from the City of South Perth.

Rivers and Estuaries Branch
Ph: 9219 9000
Email: rivers.planning@dbca.wa.gov.au

2018/001563
PERMIT P12159

12. An electronic copy of the data and findings the Salter Point Lagoon Study approved under this permit shall be forwarded to the Department of Biodiversity, Conservation and Attractions within one (1) .month of completing the document.

ADVICE TO APPLICANT

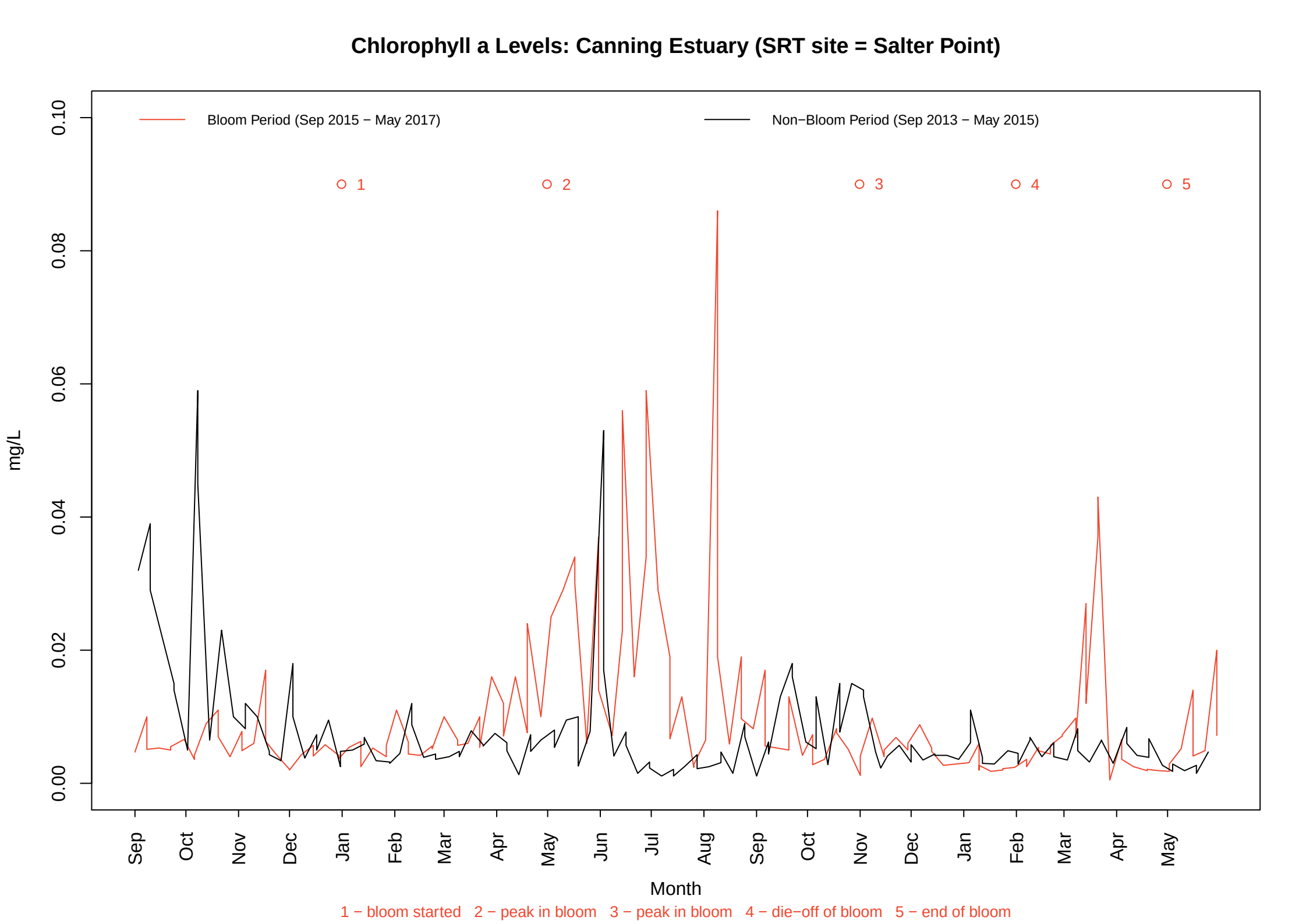
1. Notification of commencement of works and submission of reports required as a condition of this approval can be emailed to rivers.planning@dbca.wa.gov.au.
2. The Applicant is advised that this approval does not negate the need to obtain any other approval from relevant agencies, or from the Department of Biodiversity, Conservation and Attractions.
3. The Applicant is advised that all incidents of pollution or spills within the Development Control Area must be reported immediately to the Department of Biodiversity, Conservation and Attractions, on 9278 0900 or 0419 192 845.
4. The Applicant is reminded to ensure that public access to the foreshore (including the land surrounding the lagoon) is available at all times.
5. The applicant is advised that the proposed works is located in a high to moderate Acid Sulphate Soils risk area. The Acid Sulphate Soils Guideline Series for guidance on the identification, assessment and management of acid sulphate soils in Western Australia is available from the Department of Environment Regulation website at www.der.wa.gov.au. If any Acid Sulphate Soils are exposed during the works the Department of Environment Regulation should be contacted for further advice.
6. In relation to Condition 11, the applicant is advised that Dieback Hygiene guidelines outlining how to treat tools and footwear are available at http://www.dieback.net.au/images/user-images/documents/dieback_hygiene_2_email_version2013.pdf

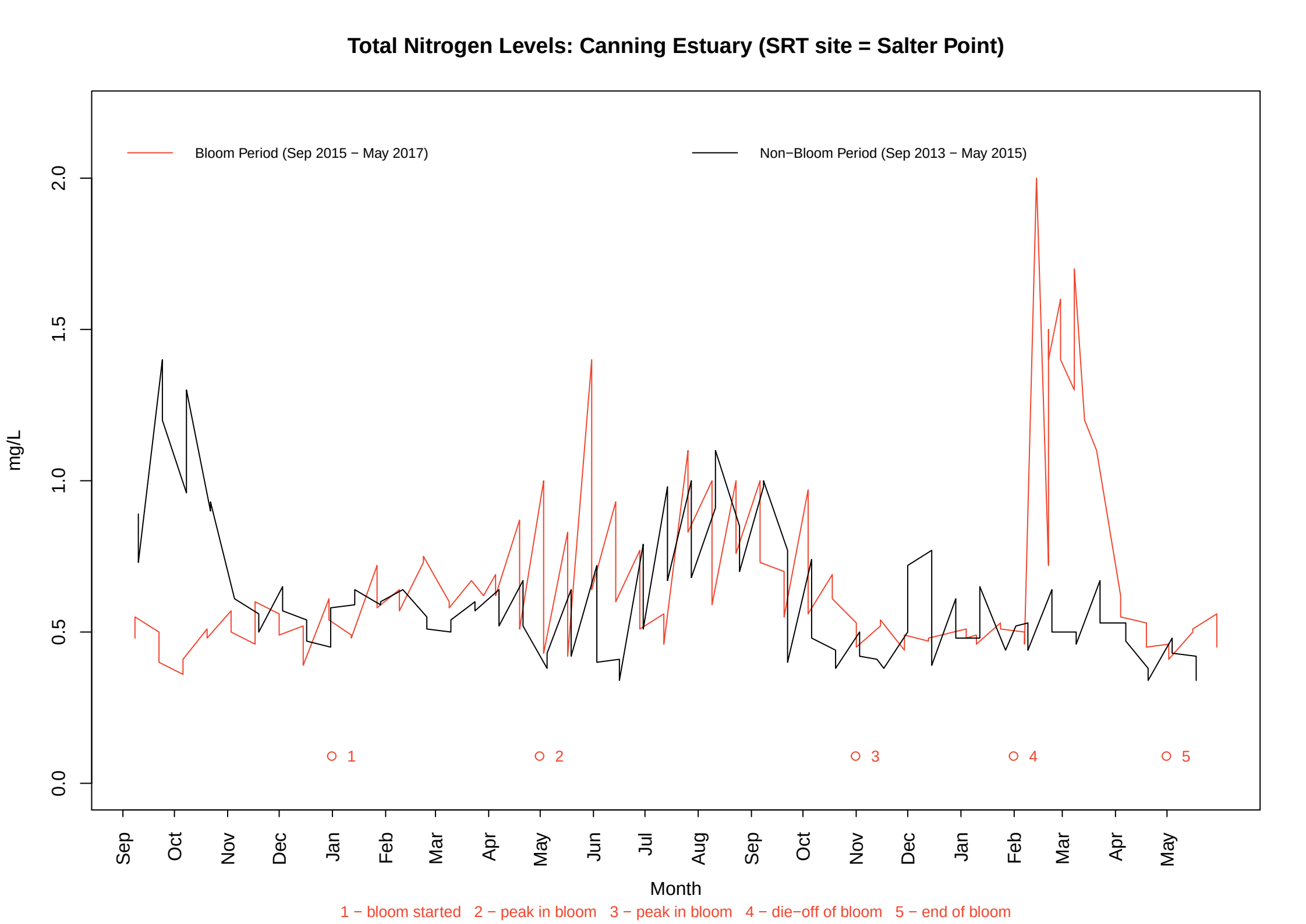
PERMIT APPROVED

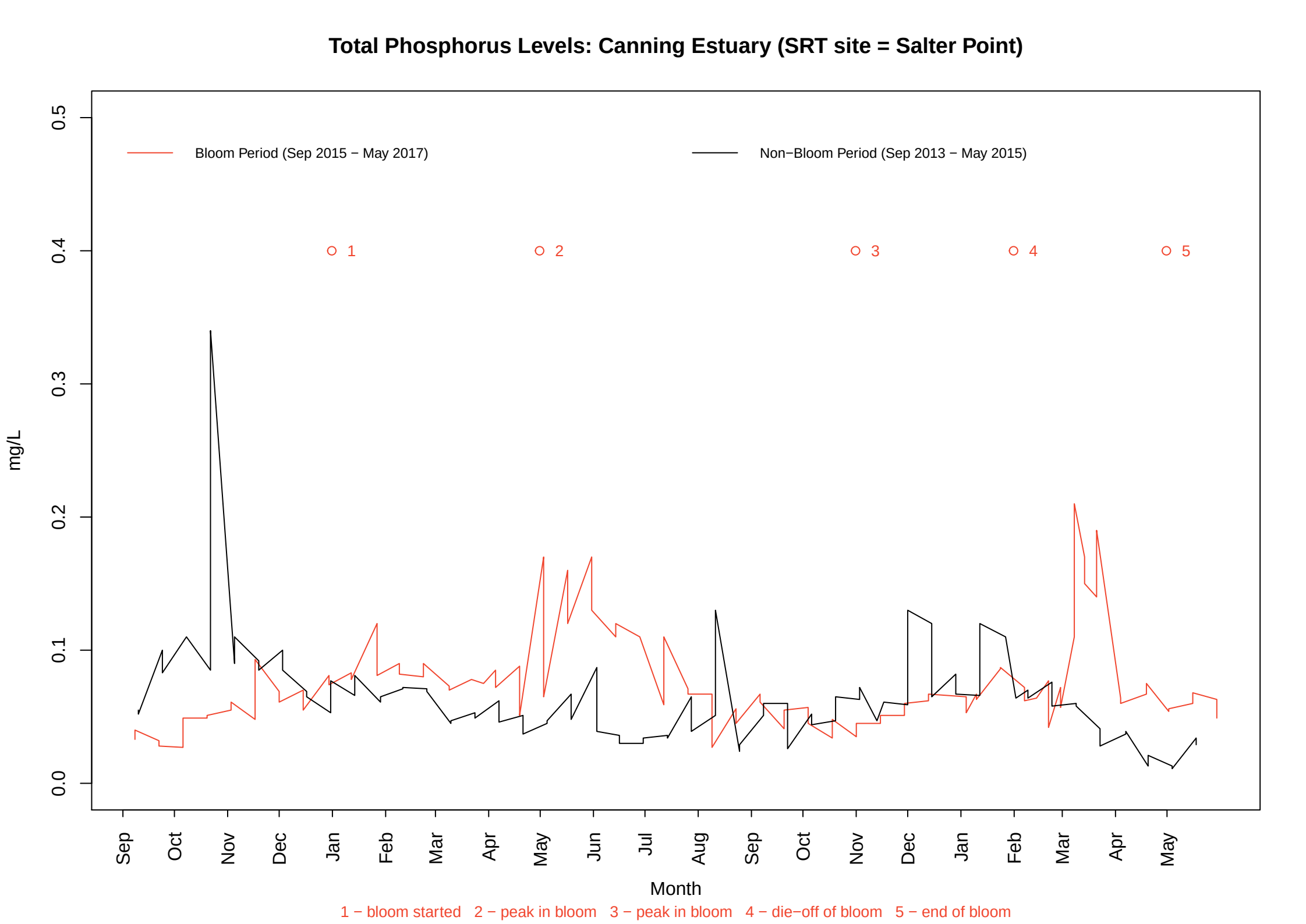
Signed: _____ Date: 15/3/18

Glen McLeod-Thorpe
Manager, Statutory Assessments
As delegate of CEO
Under Section 38 of the SCRM Act 2006

APPENDIX 4 HISTORICAL WATER QUALITY IN CANNING ESTUARY AT SALTER POINT

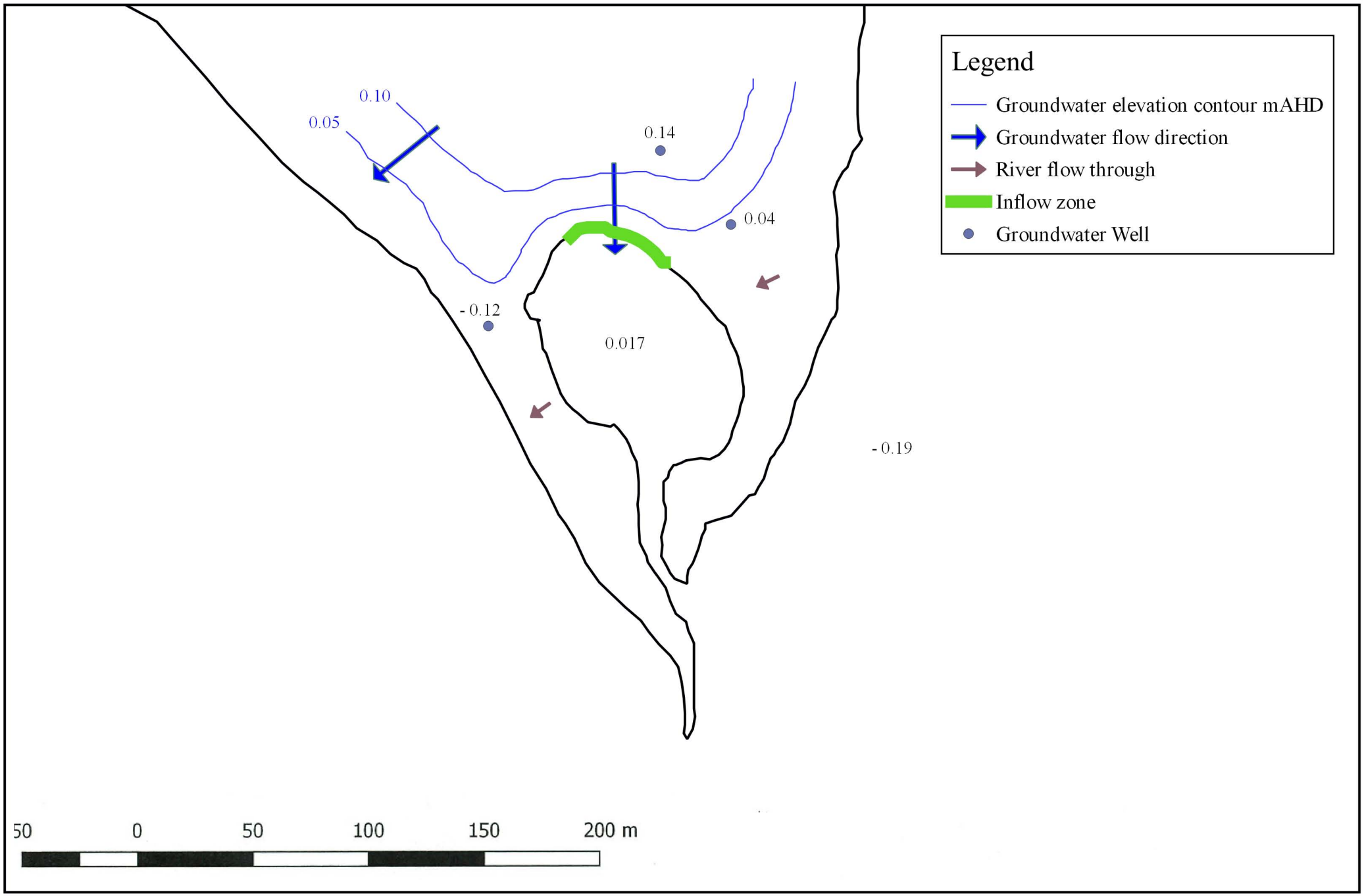

Chlorophyll a Levels: Canning Estuary (SRT site = Salter Point)
Bloom Period (Sep 2015 − May 2017)
Non−Bloom Period (Sep 2013 − May 2015)
1
2
3
4
5
mg/L
0.00
0.02
0.04
0.06
0.08
0.10
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Month
1 − bloom started 2 − peak in bloom 3 − peak in bloom 4 − die−off of bloom 5 − end of bloom


Total Nitrogen Levels: Canning Estuary (SRT site = Salter Point)
Bloom Period (Sep 2015 − May 2017)
Non−Bloom Period (Sep 2013 − May 2015)
mg/L
0.0
0.5
1.0
1.5
2.0
1
2
3
4
5
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Month
1 − bloom started 2 − peak in bloom 3 − peak in bloom 4 − die−off of bloom 5 − end of bloom

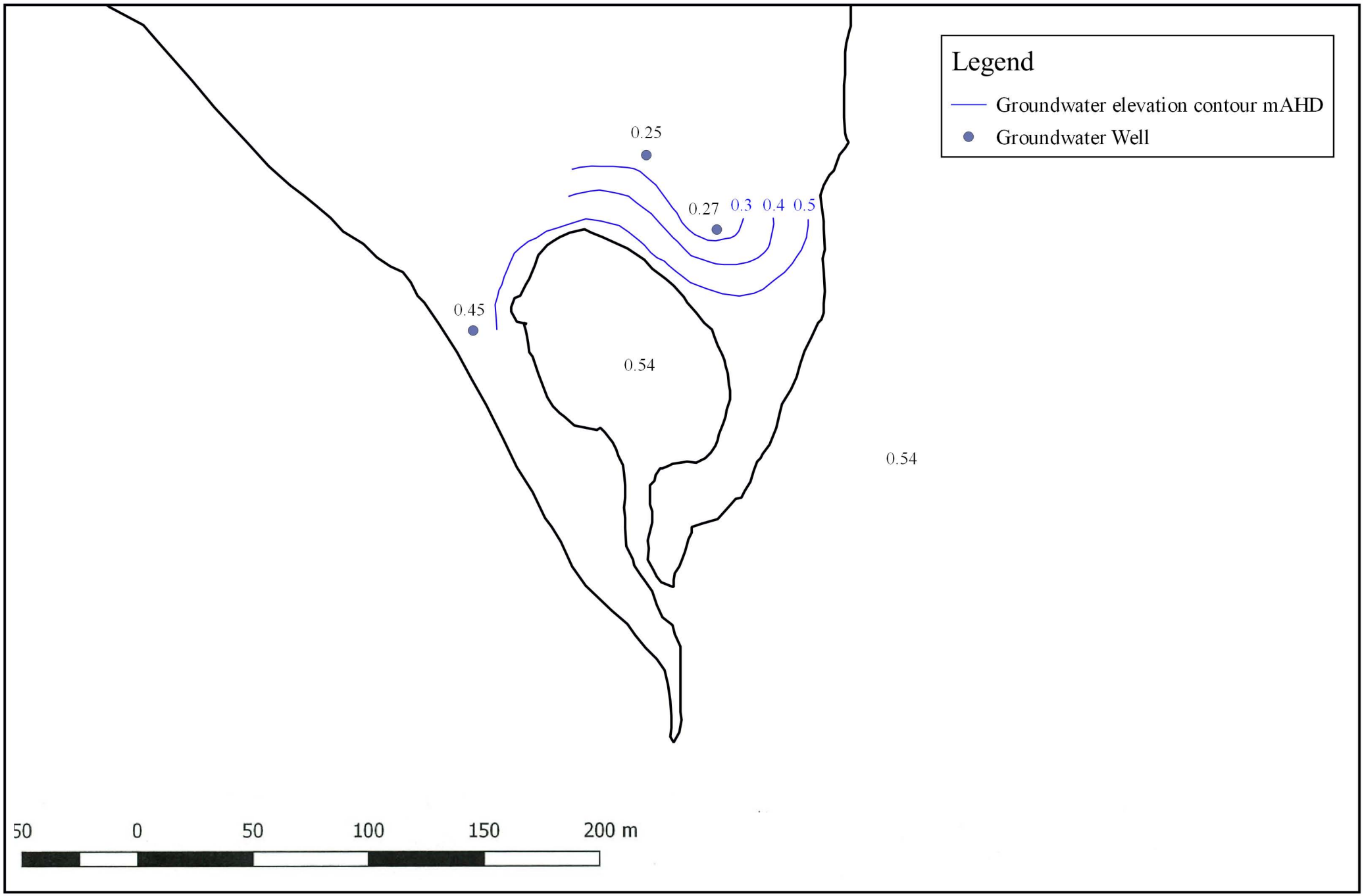

Total Phosphorus Levels: Canning Estuary (SRT site = Salter Point)
Bloom Period (Sep 2015 − May 2017)
Non−Bloom Period (Sep 2013 − May 2015)
1
2
3
4
5
mg/L
0.0
0.1
0.2
0.3
0.4
0.5
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Month
1 − bloom started 2 − peak in bloom 3 − peak in bloom 4 − die−off of bloom 5 − end of bloom

APPENDIX 5 SKETCH OF GROUNDWATER FLOWS

Scenario 1: 2nd April 2018~ 6:30AM - Low Tide



Scenario 2: 6th May 2018~ 12:00PM - High Tide



APPENDIX 6 WATER AND SEDIMENT QUALITY LABORATORY REPORTS

CHAIN OF CUSTODY

SYRIN environmental pl

Email results to:	mhedges@syrinx.net.au [primary contact] bwoodward@syrinx.net.au lpantelic@syrinx.net.au	Project #:	17102
		Project:	Salter Point Lagoon Study
Invoice to:	info@syrinx.net.au	Laboratory:	ALS
Sampled by:	MH	Address:	26 Rigali Way, Wangara WA 6065
Results required:	STANDARD TAT	Quote #:	EP/360/18

12 Monger St, Perth WA 6000

Phone: 9227 9355
Fax: 9481 6299

Sample Information					Analysis Requested														
Lab ID	Sample ID	Sample Matrix	Sampling Time	Sampling date	pH - EA005	Nutrient Suite including FRP*** Total Nitrogen, TKN, NO_x, NO_2, NO_3, NH_3, Total Phosphorus, Reactive Phosphorus NT-8A	Algae – Total Count - MW024TOT		Total metals W-30 (As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe, Se, Hg)	Dissolved metals W-30 (As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe, Se, Hg)		pHF and pHFOX - EA003	TOC – Total Organic Carbon - EP003	Total Nitrogen, TKN, NO_2, NO_3, NH_3, TP - NT-8S				
1	SW01	WATER	see bottle	28/03/2018	✓	✓	✓		✓	✓									
2	SW02	WATER	see bottle	28/03/2018	✓	✓	✓		✓	✓									
3	SW03	WATER	see bottle	28/03/2018	✓	✓	✓		✓	✓									
4	SED1	SOIL	see bottle	28/03/2018					✓			✓	✓	✓					
5	SED2	SOIL	see bottle	28/03/2018					✓			✓	✓	✓					
6	SED3	SOIL	see bottle	28/03/2018					✓			✓	✓	✓					
7	GW01	WATER	see bottle	28/03/2018	✓	✓			✓	✓									
8	GW02	WATER	see bottle	28/03/2018	✓	✓			✓	✓									
9	GW03	WATER	see bottle	28/03/2018	✓	✓			✓	✓									

Comments

*** Additional field filtered bottle provided in a marked up metals bottle for the filterable reactive phosphorus analysis.

Relinquished by:	Mitchell Hedges	Received by:	AM	Samples received chilled	yes / no
Date & time:	29/3/18 10:00am	Date & time:	29/3/18 1180	Security seal intact	yes / no
Signature:	MHedges	Signature:		Lab date & signature:	

Environmental Division
Perth
Work Order Reference
EP1804219

Telephone : +61-8-9406 1301

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EP1804219**

Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: MITCH HEDGES	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: mhedges@syrinx.net.au	E-mail	: ALSEnviro.Perth@alsglobal.com
Telephone	: 08 9227 9355	Telephone	: +61-8-9406 1301
Facsimile	: 08 9227 5033	Facsimile	: +61-8-9406 1399
Project	: 17102 Salter Point Lagoon Study	Page	: 1 of 4
Order number	:	Quote number	: EP2018SYRENV0001 (EP/360/18)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: MITCH HEDGES		

Dates

Date Samples Received	: 29-Mar-2018 11:30	Issue Date	: 29-Mar-2018
Client Requested Due Date	: 13-Apr-2018	Scheduled Reporting Date	: **13-Apr-2018**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: -7/3.4 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 9 / 9

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Please see scanned COC for sample discrepencies: extra samples , samples not received etc.
- Please direct any queries related to sample condition / numbering / breakages to Sample Receipt (SamplesPerth@alsenviro.com)
- Analytical work for this work order will be conducted at ALS Environmental Perth.
- Please direct any turnaround / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **TOC and FRP analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818.**
- **Algae analysis will be conducted by ALS Environmental, Sydney, NATA accreditation no. 825, Site No. 10911.**
- **pH analysis should be conducted within 6 hours of sampling.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

Method Client sample ID	Sample Container Received	Preferred Sample Container for Analysis
Dissolved Reactive Phosphorus as P by DA : EK071FG		
SW01	- Clear Plastic Bottle - Natural (Client Filtered)	- Clear Plastic Bottle - Natural
SW02	- Clear Plastic Bottle - Natural (Client Filtered)	- Clear Plastic Bottle - Natural
SW03	- Clear Plastic Bottle - Natural (Client Filtered)	- Clear Plastic Bottle - Natural
GW01	- Clear Plastic Bottle - Natural (Client Filtered)	- Clear Plastic Bottle - Natural
GW02	- Clear Plastic Bottle - Natural (Client Filtered)	- Clear Plastic Bottle - Natural
GW03	- Clear Plastic Bottle - Natural (Client Filtered)	- Clear Plastic Bottle - Natural

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	Client sampling date / time	Client sample ID	SOIL - NT-8S NH3, NO2, NO3, NOX, TKN, TN, TP
EP1804219-004	28-Mar-2018 00:00	SED1	✓
EP1804219-005	28-Mar-2018 00:00	SED2	✓
EP1804219-006	28-Mar-2018 00:00	SED3	✓

Matrix: **SOIL**

Laboratory sample ID	Client sampling date / time	Client sample ID	SOIL - EA003 pH field/fox	SOIL - EA055-103 Moisture Content	SOIL - EG005-SD Total Iron and Aluminium in Sediments by	SOIL - EG020-SD Total Metals in Sediments by ICPMS (NODG)	SOIL - EG035-SD Mercury in Sediments by FIMS (NODG-required	SOIL - EP003 Total Organic Carbon (TOC) in Soil
EP1804219-004	28-Mar-2018 00:00	SED1	✓	✓	✓	✓	✓	✓
EP1804219-005	28-Mar-2018 00:00	SED2	✓	✓	✓	✓	✓	✓
EP1804219-006	28-Mar-2018 00:00	SED3	✓	✓	✓	✓	✓	✓

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - EA005P pH (PCT)	WATER - EK071FG Dissolved Reactive Phosphorus as P	WATER - MW024_TOT Total Algae Count	WATER - NT-08A Total Nitrogen + NO2 + NO3 + NH3 + Total P +	WATER - W-30 11 Metals	WATER - W-30T 11 Metals (Total)
EP1804219-001	28-Mar-2018 00:00	SW01	✓	✓	✓	✓	✓	✓
EP1804219-002	28-Mar-2018 00:00	SW02	✓	✓	✓	✓	✓	✓
EP1804219-003	28-Mar-2018 00:00	SW03	✓	✓	✓	✓	✓	✓
EP1804219-007	28-Mar-2018 00:00	GW01	✓	✓		✓	✓	✓
EP1804219-008	28-Mar-2018 00:00	GW02	✓	✓		✓	✓	✓
EP1804219-009	28-Mar-2018 00:00	GW03	✓	✓		✓	✓	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER** Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Client Sample ID(s)	Container	Due for extraction	Due for analysis	Samples Received		Instructions Received	
				Date	Evaluation	Date	Evaluation
EA005-P: pH by PC Titrator							
GW01	Clear Plastic Bottle - Natural	----	28-Mar-2018	29-Mar-2018	×	----	----
GW02	Clear Plastic Bottle - Natural	----	28-Mar-2018	29-Mar-2018	×	----	----
GW03	Clear Plastic Bottle - Natural	----	28-Mar-2018	29-Mar-2018	×	----	----
SW01	Clear Plastic Bottle - Natural	----	28-Mar-2018	29-Mar-2018	×	----	----
SW02	Clear Plastic Bottle - Natural	----	28-Mar-2018	29-Mar-2018	×	----	----
SW03	Clear Plastic Bottle - Natural	----	28-Mar-2018	29-Mar-2018	×	----	----

Requested Deliverables

bwoodward

- *AU Certificate of Analysis - NATA (COA)	Email	bwoodward@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	bwoodward@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	bwoodward@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	bwoodward@syrinx.net.au
- Attachment - Report (SUBCO)	Email	bwoodward@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	bwoodward@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	bwoodward@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	bwoodward@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	bwoodward@syrinx.net.au

INVOICES INFO

- A4 - AU Tax Invoice (INV)	Email	info@syrinx.net.au

LJILJANA PANTELIC

- *AU Certificate of Analysis - NATA (COA)	Email	lpantelic@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	lpantelic@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	lpantelic@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	lpantelic@syrinx.net.au
- Attachment - Report (SUBCO)	Email	lpantelic@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	lpantelic@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	lpantelic@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	lpantelic@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	lpantelic@syrinx.net.au

MITCH HEDGES

- *AU Certificate of Analysis - NATA (COA)	Email	mhedges@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	mhedges@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	mhedges@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	mhedges@syrinx.net.au
- Attachment - Report (SUBCO)	Email	mhedges@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	mhedges@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	mhedges@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	mhedges@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	mhedges@syrinx.net.au

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP1804219**	Page	: 1 of 8
Amendment	: **1**		
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: MITCH HEDGES	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: 08 9227 9355	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 29-Mar-2018 11:30
Order number	:	Date Analysis Commenced	: 29-Mar-2018
C-O-C number	: ----	Issue Date	: 16-Apr-2018 16:45
Sampler	: MITCH HEDGES		
Site	: ----		
Quote number	: EP/360/18		
No. of samples received	: 9		
No. of samples analysed	: 9		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Indra Astuty	Instrument Chemist	Perth Inorganics, Wangara, WA
Jeremy Truong	Laboratory Manager	Perth Inorganics, Wangara, WA
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- TOC and FRP conducted by ALS Brisbane, NATA Site No. 818.
- Algae conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- EK067G (Total Phosphorus): Poor spike recovery due to possible sample heterogeneity. Confirmed by re-extraction and re-analysis.
- EG020: Metals LOR for particular sample(s) raised due to high TDS content.
- EG020: It is recognised that total concentration is less than dissolved for some metal analytes. However, the difference is within experimental variation of the methods.
- Amendment (16/04/2018): This report has been amended to include sampling times. All analysis results are as per the previous report.
- Sample 'Sed1' & 'Sed2' results reported as received due to high moisture content.
- ASS: EA003 (NATA Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	SED1	SED2	SED3	----	----
			Client sampling date / time	28-Mar-2018 17:15	28-Mar-2018 16:45	28-Mar-2018 15:45	----	----
Compound	CAS Number	LOR	Unit	EP1804219-004	EP1804219-005	EP1804219-006	--------	--------
				Result	Result	Result	----	----
EA003 :pH (field/fox)								
pH (F)	----	0.1	pH Unit	**7.8**	**7.5**	**8.4**	----	----
pH (Fox)	----	0.1	pH Unit	**2.6**	**2.7**	**2.4**	----	----
Reaction Rate	----	1	Reaction Unit	**2**	**2**	**3**	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**94.6**	**92.8**	**48.5**	----	----
EG005-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**160**	**590**	**2860**	----	----
Iron	7439-89-6	50	mg/kg	**410**	**1580**	**8250**	----	----
EG020-SD: Total Metals in Sediments by ICPMS								
Arsenic	7440-38-2	1.00	mg/kg	<1.00	<1.00	**3.73**	----	----
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	**0.2**	----	----
Chromium	7440-47-3	1.0	mg/kg	<1.0	**1.3**	**7.2**	----	----
Copper	7440-50-8	1.0	mg/kg	<1.0	**2.9**	**11.7**	----	----
Lead	7439-92-1	1.0	mg/kg	<1.0	**2.9**	**14.6**	----	----
Nickel	7440-02-0	1.0	mg/kg	<1.0	<1.0	**3.0**	----	----
Selenium	7782-49-2	0.1	mg/kg	<0.1	<0.1	**0.4**	----	----
Zinc	7440-66-6	1.0	mg/kg	**5.1**	**17.8**	**81.9**	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	**0.03**	----	----
EK055: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	<20	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	14797-55-8	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**490**	**970**	**1460**	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	**490**	**970**	**1460**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**71**	**168**	**172**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	SED1	SED2	SED3	----	----
				Client sampling date / time	28-Mar-2018 17:15	28-Mar-2018 16:45	28-Mar-2018 15:45	----	----
Compound	CAS Number	LOR	Unit		EP1804219-004	EP1804219-005	EP1804219-006	--------	--------
					Result	Result	Result	----	----
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		**3.69**	**6.98**	**5.77**	**----**	**----**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SW01	SW02	SW03	GW01	GW02
				Client sampling date / time	28-Mar-2018 17:15	28-Mar-2018 16:45	28-Mar-2018 15:45	28-Mar-2018 12:40	28-Mar-2018 10:50
Compound	CAS Number	LOR	Unit		EP1804219-001	EP1804219-002	EP1804219-003	EP1804219-007	EP1804219-008
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**8.79**	**8.34**	**7.93**	**6.44**	**6.45**
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		<0.05	<0.05	<0.05	**0.02**	**0.05**
Arsenic	7440-38-2	0.001	mg/L		<0.005	<0.005	<0.005	**0.004**	<0.005
Cadmium	7440-43-9	0.0001	mg/L		<0.0005	<0.0005	<0.0005	<0.0001	<0.0005
Chromium	7440-47-3	0.001	mg/L		<0.005	<0.005	<0.005	<0.001	<0.005
Copper	7440-50-8	0.001	mg/L		<0.005	<0.005	<0.005	<0.001	<0.005
Nickel	7440-02-0	0.001	mg/L		<0.005	<0.005	<0.005	**0.001**	<0.005
Lead	7439-92-1	0.001	mg/L		<0.005	<0.005	<0.005	<0.001	<0.005
Selenium	7782-49-2	0.01	mg/L		<0.05	<0.05	<0.05	<0.01	<0.05
Zinc	7440-66-6	0.005	mg/L		<0.025	<0.025	<0.025	<0.005	**0.026**
Iron	7439-89-6	0.05	mg/L		<0.25	<0.25	<0.25	**2.49**	**1.07**
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.10**	**0.11**	**0.14**	**13.6**	**0.49**
Arsenic	7440-38-2	0.001	mg/L		<0.005	<0.005	<0.005	**0.031**	<0.005
Cadmium	7440-43-9	0.0001	mg/L		<0.0005	<0.0005	<0.0005	**0.0001**	<0.0005
Chromium	7440-47-3	0.001	mg/L		<0.005	<0.005	<0.005	**0.045**	**0.008**
Copper	7440-50-8	0.001	mg/L		<0.005	<0.005	<0.005	**0.016**	<0.005
Nickel	7440-02-0	0.001	mg/L		<0.005	<0.005	<0.005	**0.011**	<0.005
Lead	7439-92-1	0.001	mg/L		<0.005	<0.005	<0.005	**0.018**	<0.005
Selenium	7782-49-2	0.01	mg/L		<0.05	<0.05	<0.05	<0.01	<0.05
Zinc	7440-66-6	0.005	mg/L		<0.025	<0.025	<0.025	**0.006**	<0.025
Iron	7439-89-6	0.05	mg/L		<0.25	<0.25	**0.32**	**14.1**	**2.11**
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.17**	**0.39**	**0.07**	**0.16**	**0.43**
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	**0.01**	<0.01	**0.02**	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SW01	SW02	SW03	GW01	GW02
				Client sampling date / time	28-Mar-2018 17:15	28-Mar-2018 16:45	28-Mar-2018 15:45	28-Mar-2018 12:40	28-Mar-2018 10:50
Compound	CAS Number	LOR	Unit		EP1804219-001	EP1804219-002	EP1804219-003	EP1804219-007	EP1804219-008
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	**0.01**	<0.01	**0.02**	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**0.9**	**0.8**	**0.6**	**0.9**	**1.0**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**0.9**	**0.8**	**0.6**	**0.9**	**1.0**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.10**	**0.09**	**0.08**	**0.46**	**0.09**
EK071FG: Dissolved Reactive Phosphorus as P by DA									
Dissolved Reactive Phosphorus as P	----	0.01	mg/L		<0.01	**0.02**	**0.01**	<0.01	**0.02**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	**0.02**	**0.02**	<0.01	<0.01

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	GW03	----	----	----	----
			Client sampling date / time	28-Mar-2018 14:20	----	----	----	----
Compound	CAS Number	LOR	Unit	EP1804219-009	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.07**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.006**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**1.91**	----	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**8.15**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.024**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0002**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.034**	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.010**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.012**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	**0.007**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.006**	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**10.3**	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.11**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.24**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW03	----	----	----	----
				Client sampling date / time	28-Mar-2018 14:20	----	----	----	----
Compound	CAS Number	LOR	Unit		EP1804219-009	--------	--------	--------	--------
					Result	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.24**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**0.9**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**1.1**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.17**	----	----	----	----
EK071FG: Dissolved Reactive Phosphorus as P by DA									
Dissolved Reactive Phosphorus as P	----	0.01	mg/L		<0.01	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----

CERTIFICATE OF ANALYSIS

Client:	**SYRIN**	**ALS Work Order:**	**EP1804219**
Address:	12 Monger St., Perth WA	**Laboratory:**	ALS Environmental Sydney
		Date Sampled:	28/03/2018
Attention:	M. Hedges	**Date Received:**	4/04/2018
		Date Analysed:	9/04/2018
Quote:	EP/360/18	**Sample Type:**	AQUEOUS
Project:	17102- Salter Point Lagoon Study	**No. of Samples:**	3

PHYTOPLANKTON IDENTIFICATION & ENUMERATION
CYANOPHYTE BIOVOLUME MEASUREMENTS

Comments:
Under microscopic observation, debris present in sample #02 and #03

NOTES

Samples were preserved with Lugols Iodine solution.
Samples were analysed in accordance with ALS Quality Work Instruction QWI-MIC/MW024-25
Biovolume measurements (when required) are conducted on Lugol preserved samples unless indicated otherwise.

Results apply to sample(s) as submitted.
PTP=Potential Toxin Producers
<5 or ND=Not Detected NS=Not Specified
cf. = comparable from
Cell's with Biovolume ≤0.001 will not be reported

Dr. Sunitha Kannampilli
Phycologist (Signatory)

Date Reported:
12/04/2018

ALS sample ID:	EP1804219001	EP1804219002	EP1804219003
Client sample ID:	SW01	SW02	SW03
Sample Date:	28/03/2018	28/03/2018	28/03/2018
Sample Time:	5:15	4:45	3:45
Units	Cells/mL	Cells/mL	Cells/mL
CYANOPHYTES (Blue Green algae)			
Chroococcales			
Total Chroococcales	**ND**	**ND**	**ND**
Nostocales			
Total Nostocales	**ND**	**ND**	**ND**
Oscillatoriales			
Total Oscillatoriales	**ND**	**ND**	**ND**
Stigonematales			
Total Stigonematales	**ND**	**ND**	**ND**
Total Potentially Toxic Cyanophytes	**ND**	**ND**	**ND**
Total Cyanophytes	**ND**	**ND**	**ND**
CHLOROPHYTES (Green algae)			
Carteria spp.	25	ND	ND
Chlamydomonas spp.	75	100	25
Oocystis spp.	25	ND	ND
Scenedesmus spp.	25	ND	ND
Total Chlorophytes	**150**	**100**	**25**
FLAGELLATES			
Euglenophytes			
Euglena spp.	ND	25	ND
Pyrrophytes			
Ceratium spp.	ND	25	ND
Gymnodinium spp.	125	125	150
Peridinium spp.	200	75	100
Cryptophytes			
Chroomonas spp.	722	50	ND
Cryptomonas spp.	75	125	25
Total Flagellates	**1122**	**425**	**275**
Golden/Yellow Green Algae			
Total Golden/yellow green algae	**ND**	**ND**	**ND**
Haptophytes			
Total Haptophytes	**ND**	**ND**	**ND**
RAPHIDOPHYTES			
Total Raphidophytes	**ND**	**ND**	**ND**
BACILLARIOPHYTES (Diatoms)			
Centrales			
Chaetoceros spp.	225	25	25
Cyclotella spp.	50	ND	ND
Rhizosolenia spp.	ND	5	10
Pennales			
Navicula spp.	ND	100	ND
Nitzschia spp.	25	50	50
Synedra spp.	ND	50	ND
Thalassionema spp.	ND	15	5
Total Bacillariophytes	**300**	**245**	**90**
Total Potentially Toxic Algae	**ND**	**ND**	**ND**
TOTAL ALGAE COUNT	**1572**	**770**	**390**

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EP1804219**	Page	: 1 of 10
Amendment	: **1**		
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: MITCH HEDGES	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: 08 9227 9355	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 29-Mar-2018
Order number	:	Date Analysis Commenced	: 29-Mar-2018
C-O-C number	: ----	Issue Date	: 16-Apr-2018
Sampler	: MITCH HEDGES		
Site	: ----		
Quote number	: EP/360/18		
No. of samples received	: 9		
No. of samples analysed	: 9		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Indra Astuty	Instrument Chemist	Perth Inorganics, Wangara, WA
Jeremy Truong	Laboratory Manager	Perth Inorganics, Wangara, WA
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA003 :pH (field/fox) (QC Lot: 1565986)									
EP1804219-004	SED1	EA003: pH (F)	----	0.1	pH Unit	7.8	7.8	0.00	0% - 20%
		EA003: pH (Fox)	----	0.1	pH Unit	2.6	2.7	0.00	0% - 20%
		EA003: Reaction Rate	----	1	Reaction Unit	2	2	0.00	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 1547765)									
EP1804219-004	SED1	EA055: Moisture Content	----	0.1	%	94.6	95.0	0.375	0% - 20%
EP1804359-001	Anonymous	EA055: Moisture Content	----	0.1	%	1.4	1.2	12.4	No Limit
EG005-SD: Total Metals in Sediments by ICP-AES (QC Lot: 1547760)									
EP1804219-004	SED1	EG005-SD: Aluminium	7429-90-5	50	mg/kg	160	170	0.00	No Limit
		EG005-SD: Iron	7439-89-6	50	mg/kg	410	430	5.10	No Limit
EG020-SD: Total Metals in Sediments by ICPMS (QC Lot: 1547759)									
EP1804219-004	SED1	EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
		EG020-SD: Arsenic	7440-38-2	1	mg/kg	<1.00	<1.00	0.00	No Limit
		EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	<1.0	0.00	No Limit
		EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	<1.0	0.00	No Limit
		EG020-SD: Lead	7439-92-1	1	mg/kg	<1.0	<1.0	0.00	No Limit
		EG020-SD: Nickel	7440-02-0	1	mg/kg	<1.0	<1.0	0.00	No Limit
		EG020-SD: Zinc	7440-66-6	1	mg/kg	5.1	5.4	5.57	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1547758)									
EP1804219-004	SED1	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EK055: Ammonia as N (QC Lot: 1541205)									
EP1803862-002	Anonymous	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.00	No Limit
EP1803862-051	Anonymous	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.00	No Limit
EK055: Ammonia as N (QC Lot: 1541206)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EK055: Ammonia as N (QC Lot: 1541206) - continued									
EP1804219-005	SED2	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 1547763)									
EP1804219-004	SED1	EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 1547764)									
EP1804219-004	SED1	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 1548035)									
EP1804219-004	SED1	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	490	520	6.93	0% - 20%
EP1804275-008	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	100	90	11.5	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 1548034)									
EP1804219-004	SED1	EK067G: Total Phosphorus as P	----	2	mg/kg	71	76	7.07	0% - 20%
EP1804275-008	Anonymous	EK067G: Total Phosphorus as P	----	2	mg/kg	237	250	5.48	0% - 20%
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 1553740)									
EB1808617-001	Anonymous	EP003: Total Organic Carbon	----	0.02	%	33.9	34.3	1.06	0% - 20%

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA005P: pH by PC Titrator (QC Lot: 1550693)									
EP1804219-001	SW01	EA005-P: pH Value	----	0.01	pH Unit	8.79	8.93	1.58	0% - 20%
EP1804392-005	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.90	8.94	0.448	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1558348)									
EP1804219-001	SW01	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.025	<0.025	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.25	<0.25	0.00	No Limit
EP1804423-005	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.207	0.208	0.260	0% - 20%
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	11.2	11.0	0.953	0% - 20%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	1.46	1.46	0.455	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.038	0.039	0.00	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	59.5	59.0	0.956	0% - 20%
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.02	0.02	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 1561449)									
EP1804219-001	SW01	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.025	<0.025	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.10	0.14	39.8	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.25	<0.25	0.00	No Limit
EP1804423-005	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	0.200	0.199	0.820	0% - 20%
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	11.0	11.0	0.354	0% - 20%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	1.40	1.40	0.00	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.039	0.039	0.00	0% - 20%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	58.6	57.9	1.24	0% - 20%
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.20	0.17	17.4	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.26	0.24	8.86	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1558347)									
EP1804219-003	SW03	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP1804423-006	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1561456)									
EP1804219-003	SW03	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP1804423-007	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 1562613)									
EP1804414-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	29.2	29.8	2.01	0% - 20%
EP1804219-001	SW01	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.17	0.16	7.95	0% - 50%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 1534928)									
EP1804203-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EP1804219-002	SW02	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 1562614)									
EP1804414-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	4.65	4.80	3.32	0% - 20%
EP1804219-001	SW01	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 1559009)									
EP1804219-001	SW01	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.9	0.6	37.1	No Limit
EP1804400-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.9	2.9	0.00	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 1559008)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 1559008) - continued									
EP1804219-001	SW01	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.10	0.05	73.1	No Limit
EP1804400-003	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.10	0.10	0.00	0% - 50%
EK071FG: Dissolved Reactive Phosphorus as P by DA (QC Lot: 1544387)									
EP1804219-001	SW01	EK071FG: Dissolved Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 1534927)									
EP1804203-002	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EP1804219-002	SW02	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.02	0.02	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 1547760)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	----	----	----	----
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	----	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 1547759)								
EG020-SD: Arsenic	7440-38-2	1	mg/kg	<1.00	21.62091 mg/kg	111	74	130
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	4.6838 mg/kg	105	97	113
EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	33.904 mg/kg	108	72	152
EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	33.782 mg/kg	94.7	76	116
EG020-SD: Lead	7439-92-1	1	mg/kg	<1.0	40.33169 mg/kg	96.5	74	124
EG020-SD: Nickel	7440-02-0	1	mg/kg	<1.0	51.10088 mg/kg	104	81	135
EG020-SD: Selenium	7782-49-2	0.1	mg/kg	<0.1	----	----	----	----
EG020-SD: Zinc	7440-66-6	1	mg/kg	<1.0	61.70999 mg/kg	104	81	143
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1547758)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	2.154 mg/kg	106	80	120
EK055: Ammonia as N (QCLot: 1541205)								
EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	50 mg/kg	96.8	70	130
EK055: Ammonia as N (QCLot: 1541206)								
EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	50 mg/kg	93.2	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1547763)								
EK057G: Nitrite as N (Sol.)	14797-65-0	0.1	mg/kg	<0.1	2.5 mg/kg	102	89	121
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1547764)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	95.4	90	112
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1548035)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	1000 mg/kg	85.6	78	112
				<20	100 mg/kg	90.7	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1548034)								
EK067G: Total Phosphorus as P	----	2	mg/kg	<2	440 mg/kg	90.6	78	108
				<2	44 mg/kg	101	70	130
EP003: Total Organic Carbon (TOC) in Soil (QCLot: 1553740)								
EP003: Total Organic Carbon	----	0.02	%	<0.02	17.51 %	98.5	70	130

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 1550693)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EA005P: pH by PC Titrator (QCLot: 1550693) - continued								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	99	102
				----	7 pH Unit	99.7	99	102
EG020F: Dissolved Metals by ICP-MS (QCLot: 1558348)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	95.4	84	120
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	102	84	120
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	100	86	120
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	91.3	85	120
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	92.3	84	120
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	97.3	85	120
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	94.4	84	120
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	99.0	88	120
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	103	89	120
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	98.2	84	120
EG020T: Total Metals by ICP-MS (QCLot: 1561449)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	93.6	84	120
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	97.2	85	120
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	96.0	84	120
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	92.9	85	120
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	92.8	83	120
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	93.8	86	120
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	97.2	83	120
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	96.1	83	120
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	95.5	84	120
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	93.6	77	120
EG035F: Dissolved Mercury by FIMS (QCLot: 1558347)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	98.9	92	116
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1561456)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	109	87	115
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1562613)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	102	87	115
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1534928)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	102	86	112
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1562614)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	95.4	92	112
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1559009)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	85.6	82	110
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1559008)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1559008) - continued								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	93.9	70	130
EK071FG: Dissolved Reactive Phosphorus as P by DA (QCLot: 1544387)								
EK071FG: Dissolved Reactive Phosphorus as P	----	0.01	mg/L	<0.01	0.5 mg/L	94.0	88	115
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1534927)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	97.4	87	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG005-SD: Total Metals in Sediments by ICP-AES (QCLot: 1547760)							
EP1804219-005	SED2	EG005-SD: Aluminium	7429-90-5	50 mg/kg	# Not Determined	70	130
		EG005-SD: Iron	7439-89-6	50 mg/kg	# Not Determined	70	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 1547759)							
EP1804219-005	SED2	EG020-SD: Arsenic	7440-38-2	50 mg/kg	96.2	70	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	93.2	70	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	93.4	70	130
		EG020-SD: Copper	7440-50-8	50 mg/kg	82.2	70	130
		EG020-SD: Lead	7439-92-1	50 mg/kg	87.6	70	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	91.5	70	130
		EG020-SD: Selenium	7782-49-2	10 mg/kg	99.1	70	130
		EG020-SD: Zinc	7440-66-6	50 mg/kg	93.2	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1547758)							
EP1804219-005	SED2	EG035T-LL: Mercury	7439-97-6	10 mg/kg	97.7	70	130
EK055: Ammonia as N (QCLot: 1541205)							
EP1803862-004	Anonymous	EK055: Ammonia as N	7664-41-7	50 mg/kg	87.2	70	130
EK055: Ammonia as N (QCLot: 1541206)							
EP1804219-006	SED3	EK055: Ammonia as N	7664-41-7	50 mg/kg	94.7	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1547763)							
EP1804219-005	SED2	EK057G: Nitrite as N (Sol.)	14797-65-0	3 mg/kg	90.5	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1547764)							

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1547764) - continued							
EP1804219-005	SED2	EK059G: Nitrite + Nitrate as N (Sol.)	----	3 mg/kg	85.3	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1548035)							
EP1804275-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	500 mg/kg	93.3	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1548034)							
EP1804275-001	Anonymous	EK067G: Total Phosphorus as P	----	100 mg/kg	# 64.8	70	130

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	Matrix Spike (MS) Report: SpikeRecovery(%) MS	Recovery Limits (%) Low	Recovery Limits (%) High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1558348)							
EP1804219-002	SW02	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	113	70	130
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	108	70	130
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	101	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	100	70	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	102	70	130
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	99.9	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	103	70	130
EG020T: Total Metals by ICP-MS (QCLot: 1561449)							
EP1804219-002	SW02	EG020A-T: Arsenic	7440-38-2	1 mg/L	104	70	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	98.1	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	93.7	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	92.8	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	95.3	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	99.4	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	100	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 1558347)							
EP1804219-007	GW01	EG035F: Mercury	7439-97-6	0.01 mg/L	90.3	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1561456)							
EP1804219-007	GW01	EG035T: Mercury	7439-97-6	0.01 mg/L	86.0	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1562613)							
EP1804219-001	SW01	EK055G: Ammonia as N	7664-41-7	1 mg/L	106	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1534928)							
EP1804203-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	102	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1562614)							
EP1804219-001	SW01	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	87.4	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1559009)							

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1559009) - continued							
EP1804219-002	SW02	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	105	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1559008)							
EP1804219-002	SW02	EK067G: Total Phosphorus as P	----	1 mg/L	99.7	70	130
EK071FG: Dissolved Reactive Phosphorus as P by DA (QCLot: 1544387)							
EP1804219-002	SW02	EK071FG: Dissolved Reactive Phosphorus as P	----	0.4 mg/L	115	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1534927)							
EP1804203-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	106	70	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP1804219**	Page	: 1 of 11
Amendment	: **1**		
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: MITCH HEDGES	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 29-Mar-2018
Site	: ----	Issue Date	: 16-Apr-2018
Sampler	: MITCH HEDGES	No. of samples received	: 9
Order number	:	No. of samples analysed	: 9

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG005-SD: Total Metals in Sediments by ICP-AES	EP1804219--005	SED2	**Aluminium**	7429-90-5	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EG005-SD: Total Metals in Sediments by ICP-AES	EP1804219--005	SED2	**Iron**	7439-89-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
EK067G: Total Phosphorus as P by Discrete Analyser	EP1804275--001	Anonymous	**Total Phosphorus as P**	----	64.8 %	70-130%	**Recovery less than lower data quality objective**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural							
SW01,	SW02,	----	----	----	07-Apr-2018	28-Mar-2018	**10**
SW03,	GW01,						
GW02,	GW03						
EK071FG: Dissolved Reactive Phosphorus as P by DA							
Clear Plastic Bottle - Natural (Client Filtered)							
SW01,	SW02,	----	----	----	05-Apr-2018	29-Mar-2018	**7**
SW03,	GW01,						
GW02,	GW03						

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA003 :pH (field/fox)							
Snap Lock Bag - frozen on receipt at ALS (EA003)							
SED1, SED2, SED3	**28-Mar-2018**	**13-Apr-2018**	21-Dec-2020	✓	**13-Apr-2018**	12-Jul-2018	✓
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055)							
SED1, SED2, SED3	**28-Mar-2018**	**----**	----	----	**06-Apr-2018**	11-Apr-2018	✓
EG005-SD: Total Metals in Sediments by ICP-AES							
Soil Glass Jar - Unpreserved (EG005-SD)							
SED1, SED2, SED3	**28-Mar-2018**	**06-Apr-2018**	24-Sep-2018	✓	**09-Apr-2018**	24-Sep-2018	✓
EG020-SD: Total Metals in Sediments by ICPMS							
Soil Glass Jar - Unpreserved (EG020-SD)							
SED1, SED2, SED3	**28-Mar-2018**	**06-Apr-2018**	24-Sep-2018	✓	**09-Apr-2018**	24-Sep-2018	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T-LL)							
SED1, SED2, SED3	**28-Mar-2018**	**06-Apr-2018**	25-Apr-2018	✓	**10-Apr-2018**	25-Apr-2018	✓
EK055: Ammonia as N							
Soil Glass Jar - Unpreserved (EK055)							
SED1, SED2, SED3	**28-Mar-2018**	**----**	----	----	**04-Apr-2018**	24-Sep-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK057G)							
SED1, SED2, SED3	**28-Mar-2018**	**09-Apr-2018**	24-Sep-2018	✓	**09-Apr-2018**	24-Sep-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK059G)							
SED1, SED2, SED3	**28-Mar-2018**	**09-Apr-2018**	24-Sep-2018	✓	**09-Apr-2018**	24-Sep-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Soil Glass Jar - Unpreserved (EK061G)							
SED1, SED2, SED3	**28-Mar-2018**	**06-Apr-2018**	24-Sep-2018	✓	**10-Apr-2018**	24-Sep-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Soil Glass Jar - Unpreserved (EK067G)							
SED1, SED2, SED3	**28-Mar-2018**	**06-Apr-2018**	24-Sep-2018	✓	**10-Apr-2018**	24-Sep-2018	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP003: Total Organic Carbon (TOC) in Soil							
Soil Glass Jar - Unpreserved (EP003)							
SED1, SED2, SED3	**28-Mar-2018**	**09-Apr-2018**	25-Apr-2018	✓	**09-Apr-2018**	25-Apr-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**----**	----	----	**07-Apr-2018**	28-Mar-2018	×
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020A-F)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**----**	----	----	**12-Apr-2018**	24-Sep-2018	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020A-T)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**12-Apr-2018**	24-Sep-2018	✓	**12-Apr-2018**	24-Sep-2018	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**----**	----	----	**12-Apr-2018**	25-Apr-2018	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**----**	----	----	**12-Apr-2018**	25-Apr-2018	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**----**	----	----	**13-Apr-2018**	25-Apr-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**----**	----	----	**29-Mar-2018**	30-Mar-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**----**	----	----	**13-Apr-2018**	25-Apr-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**12-Apr-2018**	25-Apr-2018	✓	**13-Apr-2018**	25-Apr-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**12-Apr-2018**	25-Apr-2018	✓	**13-Apr-2018**	25-Apr-2018	✓
EK071FG: Dissolved Reactive Phosphorus as P by DA							
Clear Plastic Bottle - Natural (Client Filtered) (EK071FG)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**----**	----	----	**05-Apr-2018**	29-Mar-2018	×
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
SW01, SW02, SW03, GW01, GW02, GW03	**28-Mar-2018**	**----**	----	----	**29-Mar-2018**	30-Mar-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Buchi Ammonia	EK055	3	21	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH field/fox	EA003	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Buchi Ammonia	EK055	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Buchi Ammonia	EK055	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Buchi Ammonia	EK055	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosporus By Discrete Analyser	EK067G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Reactive Phosphorus as P by DA	EK071FG	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Reactive Phosphorus as P by DA	EK071FG	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Reactive Phosphorus as P by DA	EK071FG	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Reactive Phosphorus as P by DA	EK071FG	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH field/fox	EA003	SOIL	In house: Referenced to Ahern et al 1998 - determined on a 1:5 soil/water extract designed to simulate field measured pH and pH after the extract has been oxidised with peroxide.
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Total Fe and Al in Sediments by ICPAES	EG005-SD	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3). LORs per NODG
Total Metals in Sediments by ICPMS	EG020-SD	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector. Analyte list and LORs per NODG.
Total Mercury by FIMS (Low Level)	EG035T-LL	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Buchi Ammonia	EK055	SOIL	In house: Referenced to APHA 4500-NH3 B&G, H Samples are steam distilled (Buchi) prior to analysis and quantified using titration, FIA or Discrete Analyser.
Nitrite as N - Soluble by Discrete Analyser	EK057G	SOIL	In house: Referenced to APHA 4500-NO3- B. Nitrite in a water extract is determined by direct colourimetry by Discrete Analyser.
Nitrate as N - Soluble by Discrete Analyser	EK058G	SOIL	In house: Referenced to APHA 4500-NO3- F. Nitrate in the 1:5 soil:water extract is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results.
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	SOIL	In house: Thermo Scientific Method D08727 and NEMI (National Environmental Method Index) Method ID: 9171. This method covers the determination of total oxidised nitrogen (NOx-N) and nitrate (NO3-N) by calculation, Combined oxidised Nitrogen (NO2+NO3) in a water extract is determined by direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NOx) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500 Norg/NO3- Total Nitrogen is determined as the sum of TKN and Oxidised Nitrrogen, each determined seperately as N.
Total Phosporus By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.
Total Organic Carbon	EP003	SOIL	In house C-IR17. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a LECO furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO2) is automaticaly measured by infra-red detector.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Reactive Phosphorus as P by DA	EK071FG	WATER	In house: Referenced to APHA 4500-P F Water samples are filtered through a 0.45um filter prior to analysis. Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is achieved by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	SOIL	In house: Referenced to APHA 4500 Norg- D; APHA 4500 P - H. Macro Kjeldahl digestion.
Drying only	EN020D	SOIL	In house
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (2013) Schedule B(3) (Method 202)
Dry and Pulverise (up to 100g)	GEO30	SOIL	#
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

CHAIN OF CUSTODY

SYRINX environmental pl

12 Monger St, Perth WA 6000

Phone: 9227 9355
Fax: 9481 6299
Page: 1 of 1

Email results to:	bwoodward@syrinx.net.au [primary contact] mhedges@syrinx.net.au lpantelic@syrinx.net.au lurosevic@syrinx.net.au	Project #:	17102
		Project:	Salter Point Lagoon Study
Invoice to:	info@syrinx.net.au	Laboratory:	ALS
Sampled by:	BW and LU	Address:	26 Rigali Way, Wangara WA 6065
Results required:	**STANDARD TAT**	Quote #:	

Sample Information

Lab ID	Sample ID	Sample Matrix	Sampling Time	Sampling date	Analysis Requested: pH - EA005	Nutrient Suite including FRP*** Total Nitrogen, TKN, NO_2, NO_3, NH_3, Total Phosphorus, Reactive Phosphorus NT-8A	Algae – Total Count - MW024TOT
1	SW01	WATER	see bottle	24/04/2018	✓	✓	✓
2	SW02	WATER	see bottle	24/04/2018	✓	✓	✓
3	SW03	WATER	see bottle	24/04/2018	✓	✓	✓

Comments

*** Additional field filtered bottle provided in for the filterable reactive phosphorus analysis.

Environmental Division
Perth
Work Order Reference
EP1805164

Telephone : + 61-8-9406 1301

Relinquished by:	Bronwyn Woodward	Received by:	AS	Samples received chilled	yes / no
Date & time:	24/04/2018 14:00:00 PM	Date & time:	24.4.18 1:45pm	Security seal intact	yes / no
Signature:	B.Woodward	Signature:	SP	Lab date & signature:	

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EP1805164**

Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: bwoodward@syrinx.net.au	E-mail	: ALSEnviro.Perth@alsglobal.com
Telephone	: ----	Telephone	: +61-8-9406 1301
Facsimile	: ----	Facsimile	: +61-8-9406 1399
Project	: 17102 Salter Point Lagoon Study	Page	: 1 of 3
Order number	:	Quote number	: EP2017SYRENV0003 (EN/222/17)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: bwoodward, L Urosevic		

Dates

Date Samples Received	: 24-Apr-2018 13:45	Issue Date	: 24-Apr-2018
Client Requested Due Date	: 02-May-2018	Scheduled Reporting Date	: **02-May-2018**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 24.6 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 3 / 3

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Please see scanned COC for sample discrepencies: extra samples , samples not received etc.
- Please direct any queries related to sample condition / numbering / breakages to Sample Receipt (SamplesPerth@alsenviro.com)
- Analytical work for this work order will be conducted at ALS Environmental Perth.
- Please direct any turnaround / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Algae analysis will be conducted by ALS Environmental, Sydney, NATA accreditation no. 825, Site No. 10911.**
- **pH analysis should be conducted within 6 hours of sampling.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EA005P pH (PCT)	WATER - MW024_TOT Total Algae Count	WATER - NT-08A Total Nitrogen + NO2 + NO3 + NH3 + Total P +
EP1805164-001	24-Apr-2018 00:00	SW01	✓	✓	✓
EP1805164-002	24-Apr-2018 00:00	SW02	✓	✓	✓
EP1805164-003	24-Apr-2018 00:00	SW03	✓	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

bwoodward

- *AU Certificate of Analysis - NATA (COA)	Email	bwoodward@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	bwoodward@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	bwoodward@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	bwoodward@syrinx.net.au
- Attachment - Report (SUBCO)	Email	bwoodward@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	bwoodward@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	bwoodward@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	bwoodward@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	bwoodward@syrinx.net.au

INVOICES INFO

- A4 - AU Tax Invoice (INV)	Email	info@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	info@syrinx.net.au

L Urosevic

- *AU Certificate of Analysis - NATA (COA)	Email	lurosevic@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	lurosevic@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	lurosevic@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	lurosevic@syrinx.net.au
- Attachment - Report (SUBCO)	Email	lurosevic@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	lurosevic@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	lurosevic@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	lurosevic@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	lurosevic@syrinx.net.au

LJILJANA PANTELIC

- *AU Certificate of Analysis - NATA (COA)	Email	lpantelic@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	lpantelic@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	lpantelic@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	lpantelic@syrinx.net.au
- Attachment - Report (SUBCO)	Email	lpantelic@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	lpantelic@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	lpantelic@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	lpantelic@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	lpantelic@syrinx.net.au

M Hedges

- *AU Certificate of Analysis - NATA (COA)	Email	mhedges@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	mhedges@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	mhedges@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	mhedges@syrinx.net.au
- Attachment - Report (SUBCO)	Email	mhedges@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	mhedges@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	mhedges@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	mhedges@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	mhedges@syrinx.net.au

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP1805164**	Page	: 1 of 4
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 24-Apr-2018 13:45
Order number	:	Date Analysis Commenced	: 24-Apr-2018
C-O-C number	: ----	Issue Date	: 02-May-2018 17:13
Sampler	: bwoodward, L Urosevic		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 3		
No. of samples analysed	: 3		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Jeremy Truong	Laboratory Manager	Perth Inorganics, Wangara, WA
Sunitha Kannampilli	Phycologist	Sydney Phycology, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Algae conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- Under microscopic observation, debris present in sample #01, #02 and #03

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	SW01	SW02	SW03	----	----
			Client sampling date / time	24-Apr-2018 00:00	24-Apr-2018 00:00	24-Apr-2018 00:00	----	----
Compound	CAS Number	LOR	Unit	EP1805164-001	EP1805164-002	EP1805164-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.85**	**7.83**	**7.82**	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.08**	**0.06**	**0.06**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.04**	**0.03**	**0.03**	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.04**	**0.03**	**0.03**	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.7**	**0.7**	**0.7**	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.7**	**0.7**	**0.7**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	**0.09**	**0.09**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.02**	**0.03**	**0.02**	----	----
MW025: Bacillariophytes (Diatoms) - Centrales								
Chaetoceros spp.	----	5	cells/ml	**914**	**963**	**1500**	----	----
Cyclotella spp.	----	5	cells/ml	**25**	**25**	**25**	----	----
Skeletonema spp.	----	5	cells/ml	**7750**	**4500**	**6000**	----	----
Thalassiosira spp.	----	5	cells/ml	----	**50**	**225**	----	----
MW025: Bacillariophytes (Diatoms) - Pennales								
Nitzschia spp.	----	5	cells/ml	----	----	**25**	----	----
MW025: Bacillariophytes (Diatoms) - TOTAL BACILLARIOPHYTES								
Total Bacillariophytes	----	5	cells/ml	**8690**	**5540**	**7780**	----	----
MW025: Chlorophytes (Green Algae)								
Chlamydomonas spp.	----	5	cells/ml	**25**	----	----	----	----
Kirchneriella spp.	----	5	cells/ml	----	**25**	----	----	----
Pyramimonas spp.	----	5	cells/ml	**125**	----	**25**	----	----
MW025: Chlorophytes (Green Algae) - TOTAL CHLOROPHYTES								
Total Chlorophytes	----	5	cells/ml	**150**	**25**	**25**	----	----
MW025: Cyanophytes (Blue Green Algae) - TOTAL CYANOPHYTES								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SW01	SW02	SW03	----	----
				Client sampling date / time	24-Apr-2018 00:00	24-Apr-2018 00:00	24-Apr-2018 00:00	----	----
Compound	CAS Number	LOR	Unit		EP1805164-001	EP1805164-002	EP1805164-003	--------	--------
					Result	Result	Result	----	----
MW025: Cyanophytes (Blue Green Algae) - TOTAL CYANOPHYTES - Continued									
Total Cyanophytes	----	5	cells/ml		<5	<5	<5	----	----
MW025: Cyanophytes (Blue Green Algae) - TOTAL POTENTIALLY TOXIC CYANOPHYTES									
Total Potentially Toxic Cyanophytes	----	5	cells/ml		<5	<5	<5	----	----
MW025: Flagellates - Cryptophytes									
Chroomonas spp.	----	5	cells/ml		**125**	----	----	----	----
MW025: Flagellates - Euglenophytes									
Euglena spp.	----	5	cells/ml		----	**25**	----	----	----
Eutreptiella spp.	----	5	cells/ml		----	**125**	**100**	----	----
MW025: Flagellates - Pyrrophytes									
Gymnodinium spp.	----	5	cells/ml		**25**	**75**	**5**	----	----
Peridinium spp.	----	5	cells/ml		**25**	----	**100**	----	----
Protoperidinium spp.	----	5	cells/ml		----	----	**50**	----	----
MW025: Flagellates - TOTAL FLAGELLATES									
Total Flagellates	----	5	cells/ml		**175**	**225**	**255**	----	----
MW025: TOTAL ALGAE									
Total Algae Count	----	5	cells/ml		**9010**	**5790**	**8060**	----	----
MW025: TOTAL POTENTIALLY TOXIC ALGAE									
Total Potentially Toxic Algae	----	5	cells/ml		<5	<5	<5	----	----

QUALITY CONTROL REPORT

Work Order	: **EP1805164**	Page	: 1 of 4
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 24-Apr-2018
Order number	:	Date Analysis Commenced	: 24-Apr-2018
C-O-C number	: ----	Issue Date	: 02-May-2018
Sampler	: bwoodward, L Urosevic		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 3		
No. of samples analysed	: 3		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Jeremy Truong	Laboratory Manager	Perth Inorganics, Wangara, WA
Sunitha Kannampilli	Phycologist	Sydney Phycology, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 1605706)									
EP1805142-003	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.31	6.33	0.316	0% - 20%
EP1805337-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.13	7.17	0.559	0% - 20%
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 1593122)									
EP1805138-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	15.3	15.2	0.626	0% - 20%
EP1805164-003	SW03	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.06	0.06	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 1592719)									
EP1805138-007	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.57	0.58	1.81	0% - 20%
EP1805137-018	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 1593121)									
EP1805138-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	14.6	14.4	1.44	0% - 20%
EP1805164-003	SW03	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.03	0.02	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 1605805)									
EP1805139-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	4.4	4.3	2.74	0% - 20%
EP1805164-003	SW03	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	0.8	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 1605806)									
EP1805139-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.07	0.07	0.00	No Limit
EP1805164-003	SW03	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.09	0.09	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 1592721)									
EP1805138-007	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EP1805137-018	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 1605706)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	99	102
				----	7 pH Unit	99.7	99	102
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1593122)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	107	87	115
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1592719)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	102	86	112
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1593121)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	105	92	112
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1605805)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	86.5	82	110
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1605806)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	88.8	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1592721)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	105	87	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1593122)							
EP1805138-001	Anonymous	EK055G: Ammonia as N	7664-41-7	1 mg/L	126	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1592719)							
EP1805126-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	104	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1593121)							
EP1805138-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	93.4	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1605805)							
EP1805139-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	85.8	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1605806)							
EP1805139-002	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	98.4	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1592721)							
EP1805127-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	109	70	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP1805164**	Page	: 1 of 7
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 24-Apr-2018
Site	: ----	Issue Date	: 02-May-2018
Sampler	: bwoodward, L Urosevic	No. of samples received	: 3
Order number	:	No. of samples analysed	: 3

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
SW01, SW02, SW03	----	----	----	30-Apr-2018	24-Apr-2018	**6**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**30-Apr-2018**	24-Apr-2018	×
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**24-Apr-2018**	22-May-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**24-Apr-2018**	26-Apr-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**24-Apr-2018**	22-May-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
SW01, SW02, SW03	**24-Apr-2018**	**02-May-2018**	22-May-2018	✓	**02-May-2018**	22-May-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
SW01, SW02, SW03	**24-Apr-2018**	**02-May-2018**	22-May-2018	✓	**02-May-2018**	22-May-2018	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**24-Apr-2018**	26-Apr-2018	✓
MW025: Bacillariophytes (Diatoms) - Centrales							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Bacillariophytes (Diatoms) - Pennales							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Bacillariophytes (Diatoms) - TOTAL BACILLARIOPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Chlorophytes (Green Algae)							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Chlorophytes (Green Algae) - TOTAL CHLOROPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Cyanophytes (Blue Green Algae)							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Cyanophytes (Blue Green Algae) - Other Cyanophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Cyanophytes (Blue Green Algae) - TOTAL CYANOPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
MW025: Cyanophytes (Blue Green Algae) - TOTAL POTENTIALLY TOXIC CYANOPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Cyanophytes (Blue Green Algae) - Unidentified Cyanophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Dictyochophyceae							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Dictyochophyceae- TOTAL DICTYOCHOPHYCEAE							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Flagellates - Cryptophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Flagellates - Euglenophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Flagellates - Other Flagellates							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Flagellates - Pyrrophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Flagellates - TOTAL FLAGELLATES							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Flagellates - Unidentified Flagellates							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
MW025: Golden and Yellow-Green Algae							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Golden and Yellow-Green Algae - TOTAL GOLDEN AND YELLOW-GREEN ALGAE							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Haptophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Pyrrophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Raphidophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: Raphidophytes - TOTAL RAPHIDOPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: TOTAL ALGAE							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓
MW025: TOTAL POTENTIALLY TOXIC ALGAE							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**24-Apr-2018**	**----**	----	----	**01-May-2018**	21-Oct-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Algae Count	MW025 TOT	WATER	In house: Referenced to Hotzel and Groome, 1999 and APHA 10200

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)

CHAIN OF CUSTODY

SYRINX environmental pl

Email results to:	bwoodward@syrinx.net.au [primary contact] ✓ mhedges@syrinx.net.au lpantelic@syrinx.net.au lurosevic@syrinx.net.au	Project #:	17102
		Project:	Salter Point Lagoon Study
Invoice to:	info@syrinx.net.au	Laboratory:	ALS
Sampled by:	BW and LU	Address:	26 Rigali Way, Wangara WA 6065
Results required:	STANDARD TAT	Quote #:	

12 Monger St, Perth WA 6000

Phone: 9227 9355
Fax: 9481 6299
Page: 1 of 1

Sample Information					Analysis Requested									
Lab ID	Sample ID	Sample Matrix	Sampling Time	Sampling date	pH - EA005	Nutrient Suite including FRP*** Total Nitrogen, TKN, NO_x, NO_2, NO_3, NH_3, Total Phosphorus, Reactive Phosphorus NT-8A	Salinity		Total metals W-30 (As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe, Se, Hg)	Dissolved metals W-30 (As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe, Se, Hg)				
1	SD1	WATER	9:30am	25/05/2018	✓	✓	✓		✓	✓				

Comments

*** Additional field filtered bottle provided in a marked up metals bottle for the filterable reactive phosphorus analysis.

Environmental Division
Perth
Work Order Reference
EP1806507

Telephone : + 61-8-9406 1301

Relinquished by:	Bronwyn Woodward	Received by:	SP
Date & time:	25/05/2018 12:00	Date & time:	3:59PM 25-5-18
Signature:	B. Woodward	Signature:	

Samples received chilled: yes / no
Security seal intact: yes / no
Lab date & signature:

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EP1806507**

Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: bwoodward@syrinx.net.au	E-mail	: ALSEnviro.Perth@alsglobal.com
Telephone	: ----	Telephone	: +61-8-9406 1301
Facsimile	: ----	Facsimile	: +61-8-9406 1399
Project	: 17102 Salter Point Lagoon Study	Page	: 1 of 3
Order number	: ----	Quote number	: EP2017SYRENV0003 (EN/222/17)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: bwoodward, L Urosevic		

Dates

Date Samples Received	: 25-May-2018 13:05	Issue Date	: 25-May-2018
Client Requested Due Date	: 05-Jun-2018	Scheduled Reporting Date	: **05-Jun-2018**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 13.0 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 1 / 1

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Please see scanned COC for sample discrepencies: extra samples , samples not received etc.
- Please direct any queries related to sample condition / numbering / breakages to Sample Receipt (SamplesPerth@alsenviro.com)
- Analytical work for this work order will be conducted at ALS Environmental Perth.
- Please direct any turnaround / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **pH analysis should be conducted within 6 hours of sampling.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

Method Client sample ID	Sample Container Received	Preferred Sample Container for Analysis
Nitrite as N by Discrete Analyser : EK057G		
SD1	- Clear Plastic Bottle - Natural (Client Filtered)	- Clear Plastic Bottle - Natural
Reactive Phosphorus as P-By Discrete Analyser : EK071G		
SD1	- Clear Plastic Bottle - Natural (Client Filtered)	- Clear Plastic Bottle - Natural

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EA005P pH (PCT)	WATER - EA020-EC-P Salinity	WATER - NT-08A Total Nitrogen + NO2 + NO3 + NH3 + Total P +	WATER - W-30 11 Metals	WATER - W-30T 11 Metals (Total)
EP1806507-001	25-May-2018 09:30	SD1	✓	✓	✓	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

bwoodward

- *AU Certificate of Analysis - NATA (COA)	Email	bwoodward@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	bwoodward@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	bwoodward@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	bwoodward@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	bwoodward@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	bwoodward@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	bwoodward@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	bwoodward@syrinx.net.au

INVOICES INFO

- A4 - AU Tax Invoice (INV)	Email	info@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	info@syrinx.net.au

L Urosevic

- *AU Certificate of Analysis - NATA (COA)	Email	lurosevic@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	lurosevic@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	lurosevic@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	lurosevic@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	lurosevic@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	lurosevic@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	lurosevic@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	lurosevic@syrinx.net.au

LJILJANA PANTELIC

- *AU Certificate of Analysis - NATA (COA)	Email	lpantelic@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	lpantelic@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	lpantelic@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	lpantelic@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	lpantelic@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	lpantelic@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	lpantelic@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	lpantelic@syrinx.net.au

M Hedges

- *AU Certificate of Analysis - NATA (COA)	Email	mhedges@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	mhedges@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	mhedges@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	mhedges@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	mhedges@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	mhedges@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	mhedges@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	mhedges@syrinx.net.au

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP1806507**	Page	: 1 of 4
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 25-May-2018 13:05
Order number	: ----	Date Analysis Commenced	: 25-May-2018
C-O-C number	: ----	Issue Date	: 05-Jun-2018 17:11
Sampler	: bwoodward, L Urosevic		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 1		
No. of samples analysed	: 1		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Indra Astuty	Instrument Chemist	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG035: Poor matrix spike recovery due to possible matrix effects.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SD1	----	----	----	----
				Client sampling date / time	25-May-2018 09:30	----	----	----	----
Compound	CAS Number	LOR	Unit		EP1806507-001	--------	--------	--------	--------
					Result	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.02**	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**15700**	----	----	----	----
EA020EC: Salinity									
Salinity	----	0.01	g/kg		**10.3**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		<0.01	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		**0.0004**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.003**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.079**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.16**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.001**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		**0.0004**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.005**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.001**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		**0.003**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.092**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**0.16**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.32**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SD1	----	----	----	----
				Client sampling date / time	25-May-2018 09:30	----	----	----	----
Compound	CAS Number	LOR	Unit		EP1806507-001	--------	--------	--------	--------
					Result	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser - Continued									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.10**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.10**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**0.9**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**1.0**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.15**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.05**	----	----	----	----

QUALITY CONTROL REPORT

Work Order	: **EP1806507**	Page	: 1 of 6
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 25-May-2018
Order number	: ----	Date Analysis Commenced	: 25-May-2018
C-O-C number	: ----	Issue Date	: 05-Jun-2018
Sampler	: bwoodward, L Urosevic		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Indra Astuty	Instrument Chemist	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 1691081)									
EP1806515-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.43	6.43	0.00	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 1691079)									
EP1806473-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	1340	1340	0.600	0% - 20%
EP1806482-015	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	1570	1540	1.85	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1690476)									
EP1806410-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EP1806515-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0080	0.0088	9.89	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	6.21	6.33	1.91	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.020	<0.020	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	22.6	23.1	1.98	0% - 20%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.020	<0.020	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	424	428	1.10	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	1.37	1.36	0.791	0% - 50%
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.41	0.37	10.5	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.20	0.22	12.1	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1690476) - continued									
EP1806515-002	Anonymous	EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.20	<0.20	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 1686815)									
EP1806497-002	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.013	0.013	0.00	0% - 50%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.033	0.034	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.22	0.21	8.52	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.26	0.23	9.69	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1690477)									
EP1806497-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP1806524-006	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1686809)									
EP1806481-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP1806482-007	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 1678052)									
EP1806514-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	46.0	50.8	9.79	0% - 20%
EP1806517-009	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.25	0.25	0.00	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 1677995)									
EP1806517-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EP1806517-011	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 1678051)									
EP1806514-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	48.2	49.7	3.08	0% - 20%
EP1806517-009	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.01	0.01	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 1691929)									
EP1806501-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	5.5	6.1	10.6	No Limit
EP1806516-005	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.6	0.6	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 1691930)									
EP1806501-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.46	0.49	5.71	No Limit
EP1806516-005	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.11	0.10	12.8	0% - 50%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 1677996)									
EP1806517-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.02	0.01	0.00	No Limit
EP1806517-011	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 1691081)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	99	102
				----	7 pH Unit	99.7	99	102
EA010P: Conductivity by PC Titrator (QCLot: 1691079)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	24800 µS/cm	100	95	105
EG020F: Dissolved Metals by ICP-MS (QCLot: 1690476)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	95.5	84	120
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	98.8	84	120
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	95.4	86	120
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	96.0	85	120
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	93.4	84	120
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	92.4	85	120
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	94.7	84	120
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	93.7	88	120
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	109	89	120
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	92.6	84	120
EG020T: Total Metals by ICP-MS (QCLot: 1686815)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	94.6	84	120
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	94.8	85	120
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	94.1	84	120
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	93.0	85	120
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	89.5	83	120
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	91.0	86	120
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	89.1	83	120
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.6	83	120
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	92.6	84	120
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	92.8	77	120
EG035F: Dissolved Mercury by FIMS (QCLot: 1690477)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	104	92	116
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1686809)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	101	87	115
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1678052)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	111	87	115
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1677995)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1677995) - continued								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	103	86	112
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1678051)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	98.0	92	112
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1691929)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	89.0	82	110
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1691930)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	99.4	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1677996)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	110	87	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1690476)							
EP1806410-003	Anonymous	EG020A-F: Arsenic	7440-38-2	0.2 mg/L	104	70	130
		EG020A-F: Cadmium	7440-43-9	0.05 mg/L	104	70	130
		EG020A-F: Chromium	7440-47-3	0.2 mg/L	103	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	104	70	130
		EG020A-F: Lead	7439-92-1	0.2 mg/L	98.7	70	130
		EG020A-F: Nickel	7440-02-0	0.2 mg/L	104	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	105	70	130
EG020T: Total Metals by ICP-MS (QCLot: 1686815)							
EP1806497-003	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	102	70	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	105	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	104	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	99.3	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	102	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	98.4	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	104	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 1690477)							
EP1806497-002	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	100	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1678052)							
EP1806507-001	SD1	EK055G: Ammonia as N	7664-41-7	1 mg/L	109	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1677995)							
EP1806507-001	SD1	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	106	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1678051)							
EP1806507-001	SD1	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	102	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1691929)							
EP1806501-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	50 mg/L	91.7	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1691930)							
EP1806501-001	Anonymous	EK067G: Total Phosphorus as P	----	10 mg/L	103	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1677996)							
EP1806507-001	SD1	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	110	70	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP1806507**	Page	: 1 of 7
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 25-May-2018
Site	: ----	Issue Date	: 05-Jun-2018
Sampler	: bwoodward, L Urosevic	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
SD1	----	----	----	31-May-2018	25-May-2018	**6**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Total Mercury by FIMS	0	20	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
SD1	**25-May-2018**	**----**	----	----	**31-May-2018**	25-May-2018	×
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
SD1	**25-May-2018**	**----**	----	----	**31-May-2018**	22-Jun-2018	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG020A-F)							
SD1	**25-May-2018**	**----**	----	----	**01-Jun-2018**	21-Nov-2018	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020A-T)							
SD1	**25-May-2018**	**31-May-2018**	21-Nov-2018	✓	**31-May-2018**	21-Nov-2018	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F)							
SD1	**25-May-2018**	**----**	----	----	**05-Jun-2018**	22-Jun-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T)							
SD1	**25-May-2018**	**----**	----	----	**01-Jun-2018**	22-Jun-2018	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
SD1	**25-May-2018**	**----**	----	----	**25-May-2018**	22-Jun-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (Client Filtered) (EK057G)							
SD1	**25-May-2018**	**----**	----	----	**25-May-2018**	27-May-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
SD1	**25-May-2018**	**----**	----	----	**25-May-2018**	22-Jun-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
SD1	**25-May-2018**	**01-Jun-2018**	22-Jun-2018	✓	**01-Jun-2018**	22-Jun-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
SD1	**25-May-2018**	**01-Jun-2018**	22-Jun-2018	✓	**01-Jun-2018**	22-Jun-2018	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (Client Filtered) (EK071G)							
SD1	**25-May-2018**	**----**	----	----	**25-May-2018**	26-May-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	9	**22.22**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	0	20	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Salinity	EA020-EC-P	WATER	In house: Referenced to APHA 2520B. Calculation from Electrical conductivity. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

CHAIN OF CUSTODY

SYRINX environmental pl

12 Monger St, Perth WA 6000

Phone: 9227 9355
Fax: 9481 6299
Page: 1 of 1

Email results to:	**bwoodward@syrinx.net.au [primary contact]** mhedges@syrinx.net.au lpantelic@syrinx.net.au lurosevic@syrinx.net.au	Project #:	17102
		Project:	Salter Point Lagoon Study
Invoice to:	info@syrinx.net.au	Laboratory:	ALS
Sampled by:	BW, LU	Address:	26 Rigali Way, Wangara WA 6065
Results required:	**STANDARD TAT**	Quote #:	

Sample Information					Analysis Requested														Comments
Lab ID	Sample ID	Sample Matrix	Sampling Time	Sampling date	pH - EA005	Nutrient Suite including FRP*** Total Nitrogen, TKN, NO_x, NO_2, NO_3, NH_3, Total Phosphorus, Reactive Phosphorus NT-8A	Algae – Total Count - MW024TOT		Total metals W-30 (As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe, Se, Hg)	Dissolved metals W-30 (As, Cd, Cr, Cu, Pb, Ni, Zn, Al, Fe, Se, Hg)								***** Additional field filtered bottle provided in a marked up metals bottle for the filterable reactive phosphorus analysis.**
1	SW01	WATER	see bottle	30/05/2018	✓	✓	✓		✓	✓									
2	SW02	WATER	see bottle	30/05/2018	✓	✓	✓		✓	✓									
3	SW03	WATER	see bottle	30/05/2018	✓	✓	✓		✓	✓									
4	GW01	WATER	see bottle	30/05/2018	✓	✓			✓	✓									
5	GW02	WATER	see bottle	30/05/2018	✓	✓			✓	✓									
6	GW03	WATER	see bottle	30/05/2018	✓	✓			✓	✓									

Relinquished by:	Bronwyn Woodward	Received by:	MD	Samples received chilled	yes / no
Date & time:	31/5/18 9:00am	Date & time:	31-5-18 11am	Security seal intact	yes / no
Signature:	B. Woodward	Signature:		Lab date & signature:	

Environmental Division
Perth
Work Order Reference
EP1806696

Telephone : +61-8-9406 1301

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EP1806696**

Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: bwoodward@syrinx.net.au	E-mail	: ALSEnviro.Perth@alsglobal.com
Telephone	: ----	Telephone	: +61-8-9406 1301
Facsimile	: ----	Facsimile	: +61-8-9406 1399
Project	: 17102 Salter Point Lagoon Study	Page	: 1 of 3
Order number	:	Quote number	: EP2017SYRENV0003 (EN/222/17)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: bwoodward, L Urosevic		

Dates

Date Samples Received	: 31-May-2018 11:00	Issue Date	: 31-May-2018
Client Requested Due Date	: 11-Jun-2018	Scheduled Reporting Date	: **11-Jun-2018**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Not Available
No. of coolers/boxes	: 2	Temperature	: 1.7 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 6 / 6

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Please see scanned COC for sample discrepencies: extra samples , samples not received etc.
- Please direct any queries related to sample condition / numbering / breakages to Sample Receipt (SamplesPerth@alsenviro.com)
- Analytical work for this work order will be conducted at ALS Environmental Perth.
- Please direct any turnaround / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Algae Total Count MW024TOT analysis will be conducted by ALS Environmental, Sydney, NATA accreditation no. 825, Site No. 10911.**
- **pH analysis should be conducted within 6 hours of sampling.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	WATER - EA005P pH (PCT)	WATER - MW024_TOT Total Algae Count	WATER - NT-08A Total Nitrogen + NO2 + NO3 + NH3 + Total P +	WATER - W-30 11 Metals	WATER - W-30T 11 Metals (Total)
EP1806696-001	30-May-2018 13:40	SW01	✓	✓	✓	✓	✓
EP1806696-002	30-May-2018 14:10	SW02	✓	✓	✓	✓	✓
EP1806696-003	30-May-2018 14:40	SW03	✓	✓	✓	✓	✓
EP1806696-004	30-May-2018 10:30	GW01	✓		✓	✓	✓
EP1806696-005	30-May-2018 11:50	GW02	✓		✓	✓	✓
EP1806696-006	30-May-2018 09:20	GW03	✓		✓	✓	✓

Proactive Holding Time Report

The following table summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory.

Matrix: **WATER** Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Client Sample ID(s)	Container	Due for extraction	Due for analysis	Samples Received		Instructions Received	
				Date	Evaluation	Date	Evaluation
EA005-P: pH by PC Titrator							
GW01	Clear Plastic Bottle - Natural	----	30-May-2018	31-May-2018	✘	----	----
GW02	Clear Plastic Bottle - Natural	----	30-May-2018	31-May-2018	✘	----	----
GW03	Clear Plastic Bottle - Natural	----	30-May-2018	31-May-2018	✘	----	----
SW01	Clear Plastic Bottle - Natural	----	30-May-2018	31-May-2018	✘	----	----
SW02	Clear Plastic Bottle - Natural	----	30-May-2018	31-May-2018	✘	----	----
SW03	Clear Plastic Bottle - Natural	----	30-May-2018	31-May-2018	✘	----	----

Requested Deliverables

bwoodward

- *AU Certificate of Analysis - NATA (COA)	Email	bwoodward@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	bwoodward@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	bwoodward@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	bwoodward@syrinx.net.au
- Attachment - Report (SUBCO)	Email	bwoodward@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	bwoodward@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	bwoodward@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	bwoodward@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	bwoodward@syrinx.net.au

INVOICES INFO

- A4 - AU Tax Invoice (INV)	Email	info@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	info@syrinx.net.au

L Urosevic

- *AU Certificate of Analysis - NATA (COA)	Email	lurosevic@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	lurosevic@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	lurosevic@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	lurosevic@syrinx.net.au
- Attachment - Report (SUBCO)	Email	lurosevic@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	lurosevic@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	lurosevic@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	lurosevic@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	lurosevic@syrinx.net.au

LJILJANA PANTELIC

- *AU Certificate of Analysis - NATA (COA)	Email	lpantelic@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	lpantelic@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	lpantelic@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	lpantelic@syrinx.net.au
- Attachment - Report (SUBCO)	Email	lpantelic@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	lpantelic@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	lpantelic@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	lpantelic@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	lpantelic@syrinx.net.au

M Hedges

- *AU Certificate of Analysis - NATA (COA)	Email	mhedges@syrinx.net.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	mhedges@syrinx.net.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	mhedges@syrinx.net.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	mhedges@syrinx.net.au
- Attachment - Report (SUBCO)	Email	mhedges@syrinx.net.au
- Chain of Custody (CoC) (COC)	Email	mhedges@syrinx.net.au
- EDI Format - ENMRG (ENMRG)	Email	mhedges@syrinx.net.au
- EDI Format - ESDAT (ESDAT)	Email	mhedges@syrinx.net.au
- EDI Format - XTab (XTAB)	Email	mhedges@syrinx.net.au

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP1806696**	Page	: 1 of 7
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 31-May-2018 11:00
Order number	:	Date Analysis Commenced	: 31-May-2018
C-O-C number	: ----	Issue Date	: 11-Jun-2018 13:21
Sampler	: bwoodward, L Urosevic		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 6		
No. of samples analysed	: 6		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Indra Astuty	Instrument Chemist	Perth Inorganics, Wangara, WA
Sunitha Kannampilli	Phycologist	Sydney Phycology, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Algae Total Count MW024TOT conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- EG020:Metals LOR for particular sample(s) raised due to high TDS content.
- EG035F : Poor matrix spike recovery due to possible matrix interference.
- EG020: It is recognised that total concentration is less than dissolved for some metal analytes. However, the difference is within experimental variation of the methods.
- Under microscopic observation, debris present in sample #01, #02 and #03

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	SW01	SW02	SW03	GW01	GW02
			Client sampling date / time	30-May-2018 13:40	30-May-2018 14:10	30-May-2018 14:40	30-May-2018 10:30	30-May-2018 11:50
Compound	CAS Number	LOR	Unit	EP1806696-001	EP1806696-002	EP1806696-003	EP1806696-004	EP1806696-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.47**	**7.45**	**7.42**	**6.30**	**6.61**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	**0.07**	<0.05
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	**0.002**	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	**0.0001**	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.005
Copper	7440-50-8	0.001	mg/L	**0.005**	**0.002**	**0.002**	**0.020**	<0.005
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	**0.003**	<0.005
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.005
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.05
Zinc	7440-66-6	0.005	mg/L	**0.013**	**0.020**	**0.016**	**0.024**	<0.025
Iron	7439-89-6	0.05	mg/L	**0.07**	**0.09**	**0.09**	**0.68**	**0.80**
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.09**	**0.10**	**0.12**	**4.75**	**0.14**
Arsenic	7440-38-2	0.001	mg/L	**0.001**	<0.001	<0.001	**0.009**	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	**0.021**	<0.005
Copper	7440-50-8	0.001	mg/L	**0.004**	**0.002**	**0.005**	**0.073**	<0.005
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	**0.001**	**0.006**	<0.005
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	**0.005**	<0.005
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.05
Zinc	7440-66-6	0.005	mg/L	**0.015**	**0.018**	**0.021**	<0.005	<0.025
Iron	7439-89-6	0.05	mg/L	**0.28**	**0.33**	**0.34**	**4.14**	**0.95**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.12**	**0.11**	**0.10**	**0.14**	**0.45**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.06**	**0.08**	**0.07**	**0.01**	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SW01	SW02	SW03	GW01	GW02
				Client sampling date / time	30-May-2018 13:40	30-May-2018 14:10	30-May-2018 14:40	30-May-2018 10:30	30-May-2018 11:50
Compound	CAS Number	LOR	Unit		EP1806696-001	EP1806696-002	EP1806696-003	EP1806696-004	EP1806696-005
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		0.06	0.08	0.07	0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		0.5	0.5	0.5	0.5	0.7
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		0.6	0.6	0.6	0.5	0.7
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.07	0.09	0.07	0.07	0.04
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		0.02	0.03	0.03	<0.01	0.03
MW025: Bacillariophytes (Diatoms) - Centrales									
Cyclotella spp.	----	5	cells/ml		----	25	25	----	----
Skeletonema spp.	----	5	cells/ml		----	25	----	----	----
Thalassiosira spp.	----	5	cells/ml		425	650	300	----	----
MW025: Bacillariophytes (Diatoms) - Pennales									
Navicula spp.	----	5	cells/ml		25	----	----	----	----
Nitzschia spp.	----	5	cells/ml		25	25	75	----	----
MW025: Bacillariophytes (Diatoms) - TOTAL BACILLARIOPHYTES									
Total Bacillariophytes	----	5	cells/ml		475	725	400	----	----
MW025: Chlorophytes (Green Algae)									
Chlamydomonas spp.	----	5	cells/ml		25	----	25	----	----
Dictyosphaerium spp.	----	5	cells/ml		----	300	350	----	----
Kirchneriella spp.	----	5	cells/ml		----	----	25	----	----
Monoraphidium spp.	----	5	cells/ml		----	50	50	----	----
Scenedesmus spp.	----	5	cells/ml		----	50	75	----	----
MW025: Chlorophytes (Green Algae) - TOTAL CHLOROPHYTES									
Total Chlorophytes	----	5	cells/ml		25	400	525	----	----
MW025: Cyanophytes (Blue Green Algae) - TOTAL CYANOPHYTES									
Total Cyanophytes	----	5	cells/ml		<5	<5	<5	----	----
MW025: Cyanophytes (Blue Green Algae) - TOTAL POTENTIALLY TOXIC CYANOPHYTES									
Total Potentially Toxic Cyanophytes	----	5	cells/ml		<5	<5	<5	----	----
MW025: Flagellates - Cryptophytes									
Chroomonas spp.	----	5	cells/ml		175	350	375	----	----
Cryptomonas spp.	----	5	cells/ml		175	300	375	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SW01	SW02	SW03	GW01	GW02
				Client sampling date / time	30-May-2018 13:40	30-May-2018 14:10	30-May-2018 14:40	30-May-2018 10:30	30-May-2018 11:50
Compound	CAS Number	LOR	Unit		EP1806696-001	EP1806696-002	EP1806696-003	EP1806696-004	EP1806696-005
					Result	Result	Result	Result	Result
MW025: Flagellates - Euglenophytes									
Euglena spp.	----	5	cells/ml		**100**	----	----	----	----
Trachelomonas spp.	----	5	cells/ml		**5**	----	----	----	----
Eutreptiella spp.	----	5	cells/ml		**25**	----	----	----	----
MW025: Flagellates - TOTAL FLAGELLATES									
Total Flagellates	----	5	cells/ml		**480**	**650**	**750**	----	----
MW025: TOTAL ALGAE									
Total Algae Count	----	5	cells/ml		**980**	**1780**	**1680**	----	----
MW025: TOTAL POTENTIALLY TOXIC ALGAE									
Total Potentially Toxic Algae	----	5	cells/ml		<5	<5	<5	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW03	----	----	----	----
				Client sampling date / time	30-May-2018 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit		EP1806696-006	--------	--------	--------	--------
					Result	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.12**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.03**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.005**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.002**	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.012**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.005**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.014**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**4.84**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.015**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		**0.0001**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.018**	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.047**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.011**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		**0.003**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.008**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**3.00**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.04**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.01**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**1.02**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW03	----	----	----	----
				Client sampling date / time	30-May-2018 09:20	----	----	----	----
Compound	CAS Number	LOR	Unit		EP1806696-006	--------	--------	--------	--------
					Result	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		**1.03**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.0**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**2.0**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.13**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EP1806696**	Page	: 1 of 7
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Contact	: Customer Services EP
Address	: 12 MONGER ST PERTH AUSTRALIA 6000	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 31-May-2018
Order number	:	Date Analysis Commenced	: 31-May-2018
C-O-C number	: ----	Issue Date	: 11-Jun-2018
Sampler	: bwoodward, L Urosevic		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 6		
No. of samples analysed	: 6		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Indra Astuty	Instrument Chemist	Perth Inorganics, Wangara, WA
Sunitha Kannampilli	Phycologist	Sydney Phycology, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 1705170)									
EP1806652-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	6.57	6.53	0.611	0% - 20%
EP1806696-005	GW02	EA005-P: pH Value	----	0.01	pH Unit	6.61	6.62	0.151	0% - 20%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1704217)									
EP1806688-005	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0100	<0.0100	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.100	<0.100	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.255	0.265	3.68	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.100	<0.100	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.100	<0.100	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.100	<0.100	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.500	<0.500	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<1.00	<1.00	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<1.00	<1.00	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<5.00	<5.00	0.00	No Limit
EP1806688-015	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0100	<0.0100	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.100	<0.100	0.00	No Limit
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.100	<0.100	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.100	<0.100	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.100	<0.100	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.100	<0.100	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.500	<0.500	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<1.00	<1.00	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<1.00	<1.00	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<5.00	<5.00	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 1702907)									

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020T: Total Metals by ICP-MS (QC Lot: 1702907) - continued									
EP1806697-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.002	0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.002	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.02	<0.01	87.0	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.05	0.05	0.00	No Limit
EP1806495-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.008	0.007	14.9	No Limit
		EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.01	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 1704219)									
EP1806696-001	SW01	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 1704210)									
EP1806696-001	SW01	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EP1806743-002	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 1692085)									
EP1806693-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.03	0.00	No Limit
EP1806699-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.02	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 1692621)									
EP1806721-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EP1806705-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 1692086)									
EP1806693-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.04	0.04	0.00	No Limit
EP1806699-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	2.51	2.52	0.672	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 1704609)									
EP1806693-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.3	0.4	0.00	No Limit
EP1806699-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	0.1	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 1704607)									
EP1806693-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.03	0.03	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 1704607) - continued									
EP1806699-003	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 1692620)									
EP1806683-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EP1806705-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 1705170)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	99	102
				----	7 pH Unit	99.7	99	102
EG020F: Dissolved Metals by ICP-MS (QCLot: 1704217)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	95.2	84	120
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.6	84	120
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	98.7	86	120
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	90.4	85	120
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	93.7	84	120
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.2	85	120
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	90.4	84	120
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	90.5	88	120
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	101	89	120
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	102	84	120
EG020T: Total Metals by ICP-MS (QCLot: 1702907)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	97.8	84	120
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	92.9	85	120
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	95.8	84	120
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	93.4	85	120
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.1 mg/L	93.2	83	120
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	94.4	86	120
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	93.7	83	120
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	93.8	83	120
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.1 mg/L	96.2	84	120
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	103	77	120
EG035F: Dissolved Mercury by FIMS (QCLot: 1704219)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	115	92	116
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1704210)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	98.6	87	115
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1692085)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	98.6	87	115
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1692621)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	104	86	112
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1692086)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1692086) - continued								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	104	92	112
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1704609)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	93.8	82	110
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1704607)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	92.0	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1692620)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	103	87	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1704217)							
EP1806688-006	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	126	70	130
		EG020A-F: Cadmium	7440-43-9	0.25 mg/L	121	70	130
		EG020A-F: Chromium	7440-47-3	1 mg/L	113	70	130
		EG020A-F: Copper	7440-50-8	1 mg/L	113	70	130
		EG020A-F: Lead	7439-92-1	1 mg/L	114	70	130
		EG020A-F: Nickel	7440-02-0	1 mg/L	114	70	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	120	70	130
EG020T: Total Metals by ICP-MS (QCLot: 1702907)							
EP1806566-009	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	107	70	130
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	101	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	96.4	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	95.8	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	97.0	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	99.0	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	102	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 1704219)							
EP1806688-016	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	# 19.2	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 1704210)							
EP1806696-002	SW02	EG035T: Mercury	7439-97-6	0.01 mg/L	103	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1692085)							
EP1806693-001	Anonymous	EK055G: Ammonia as N	7664-41-7	1 mg/L	94.6	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1692621)							
EP1806696-001	SW01	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	105	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1692086)							
EP1806693-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	104	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1704609)							
EP1806693-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	10 mg/L	93.4	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1704607)							
EP1806693-001	Anonymous	EK067G: Total Phosphorus as P	----	2 mg/L	103	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1692620)							
EP1806683-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.5 mg/L	106	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP1806696**	Page	: 1 of 10
Client	: **SYRINX ENVIRONMENTAL PL**	Laboratory	: Environmental Division Perth
Contact	: bwoodward	Telephone	: +61-8-9406 1301
Project	: 17102 Salter Point Lagoon Study	Date Samples Received	: 31-May-2018
Site	: ----	Issue Date	: 11-Jun-2018
Sampler	: bwoodward, L Urosevic	No. of samples received	: 6
Order number	:	No. of samples analysed	: 6

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG035F: Dissolved Mercury by FIMS	EP1806688--016	Anonymous	**Mercury**	7439-97-6	19.2 %	70-130%	**Recovery less than lower data quality objective**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural							
SW01,	SW02,	----	----	----	06-Jun-2018	30-May-2018	**7**
SW03,	GW01,						
GW02,	GW03						

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA005P: pH by PC Titrator								
Clear Plastic Bottle - Natural (EA005-P)								
SW01,	SW02,	**30-May-2018**	**----**	----	----	**06-Jun-2018**	30-May-2018	×
SW03,	GW01,							
GW02,	GW03							
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Filtered; Lab-acidified (EG020A-F)								
SW01,	SW02,	**30-May-2018**	**----**	----	----	**07-Jun-2018**	26-Nov-2018	✓
SW03,	GW01,							
GW02,	GW03							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG020A-T)							
SW01, SW02, SW03, GW01, GW02, GW03	**30-May-2018**	**06-Jun-2018**	26-Nov-2018	✓	**06-Jun-2018**	26-Nov-2018	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Filtered; Lab-acidified (EG035F)							
SW01, SW02, SW03, GW01, GW02, GW03	**30-May-2018**	**----**	----	----	**07-Jun-2018**	27-Jun-2018	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Unfiltered; Lab-acidified (EG035T)							
SW01, SW02, SW03, GW01, GW02, GW03	**30-May-2018**	**----**	----	----	**07-Jun-2018**	27-Jun-2018	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
SW01, SW02, SW03, GW01, GW02, GW03	**30-May-2018**	**----**	----	----	**31-May-2018**	27-Jun-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
SW01, SW02, SW03, GW01, GW02, GW03	**30-May-2018**	**----**	----	----	**31-May-2018**	01-Jun-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
SW01, SW02, SW03, GW01, GW02, GW03	**30-May-2018**	**----**	----	----	**31-May-2018**	27-Jun-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
SW01, SW02, SW03, GW01, GW02, GW03	**30-May-2018**	**07-Jun-2018**	27-Jun-2018	✓	**07-Jun-2018**	27-Jun-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
SW01, SW02, SW03, GW01, GW02, GW03	**30-May-2018**	**07-Jun-2018**	27-Jun-2018	✓	**07-Jun-2018**	27-Jun-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
SW01, SW02, SW03, GW01, GW02, GW03	**30-May-2018**	**----**	----	----	**31-May-2018**	01-Jun-2018	✓
MW025: Bacillariophytes (Diatoms) - Centrales							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Bacillariophytes (Diatoms) - Pennales							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Bacillariophytes (Diatoms) - TOTAL BACILLARIOPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Chlorophytes (Green Algae)							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Chlorophytes (Green Algae) - TOTAL CHLOROPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Cyanophytes (Blue Green Algae)							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Cyanophytes (Blue Green Algae) - Other Cyanophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Cyanophytes (Blue Green Algae) - TOTAL CYANOPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Cyanophytes (Blue Green Algae) - TOTAL POTENTIALLY TOXIC CYANOPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT)							
SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
MW025: Cyanophytes (Blue Green Algae) - Unidentified Cyanophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Dictyochophyceae							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Dictyochophyceae- TOTAL DICTYOCHOPHYCEAE							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Flagellates - Cryptophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Flagellates - Euglenophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Flagellates - Other Flagellates							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Flagellates - Pyrrophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Flagellates - TOTAL FLAGELLATES							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Flagellates - Unidentified Flagellates							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Golden and Yellow-Green Algae							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
MW025: Golden and Yellow-Green Algae - TOTAL GOLDEN AND YELLOW-GREEN ALGAE							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Haptophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Pyrrophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Raphidophytes							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: Raphidophytes - TOTAL RAPHIDOPHYTES							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: TOTAL ALGAE							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓
MW025: TOTAL POTENTIALLY TOXIC ALGAE							
Plastic Bottle - Lugols Iodine (MW025_TOT) SW01, SW02, SW03	**30-May-2018**	**----**	----	----	**05-Jun-2018**	26-Nov-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Dissolved Mercury by FIMS	EG035F	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Algae Count	MW025 TOT	WATER	In house: Referenced to Hotzel and Groome, 1999 and APHA 10200

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

APPENDIX 7 VEGETATION SPECIES

Species list for the Salter Point study area - April 2018

Family	Scientific name	Common name
Fabaceae	*Acacia cyclops*	Coastal Wattle
Fabaceae	*Acacia lasiocarpa*	Panjang
Fabaceae	*Acacia pulchella*	Prickly Moses
Fabaceae	*Acacia saligna*	Orange Wattle
Fabaceae	*Acacia stenoptera*	Narrow Winged Wattle
Fabaceae	*Acacia willdenowiana*	Grass Wattle
Cupressaceae	*Callitris pyramidalis*	Swamp Cypress
Proteaceae	*Adenanthos cygnorum*	Woolly Bush
Restionaceae	*Alexgeorgea nitens*	
Casuarinaceae	*Allocasuarina fraseriana*	Sheoak
Casuarinaceae	*Allocasuarina humilis*	Dwarf sheoak
Poaceae	*Amphipogon turbinatus*	
Loranthaceae	*Amyema linophylla*	Mistletoe
Haemodoraceae	*Anigozanthos manglesii*	Red and green kangaroo paw
Myrtaceae	*Astartea scoparia*	
Proteaceae	*Banksia menziesii*	Firewood banksia
Cyperaceae	*Baumea juncea*	Bare Twig Rush
Cyperaceae	*Bolboschoenus caldwellii*	Marsh Club-rush
Fabaceae	*Bossiaea eriocarpa*	Common Brown Pea
Liliaceae	*Burchardia umbellata*	Milkmaids
Orchidaceae	*Caladenia flava*	Cowslip Orchid
Portulacaceae	*Calandrinia sp.*	
Commelinaceae	*Cartonema philydroides*	
Lauraceae	*Cassytha racemosa*	Dodder Laurel
Casuarinaceae	*Casuarina obesa*	Swamp Sheoak
Chenopodiaceae	*Chenopodium album*	Fat Hen
Haemodoraceae	*Conostylis aculeata*	Prickly Conostylis
Haemodoraceae	*Conostylis candicans*	Grey cottonhead
Myrtaceae	*Corymbia calophylla*	Marri
Liliaceae	*Corynotheca micrantha*	
Asteraceae	*Cotula coronopifolia*	Water buttons
Crassulaceae	*Crassula colorata*	Dense Stonecrop
Goodeniaceae	*Dampiera linearis*	Common Dampiera
Xanthorrhoeaceae	*Dasypogon bromeliifolius*	Pineapple Bush
Restionaceae	*Desmocladus flexuosus*	
Liliaceae	*Dianella revoluta*	Blueberry Lily
Proteaceae	*Banksia sessilis*	Parrot Bush
Myrtaceae	*Eremaea pauciflora*	
Myrtaceae	*Eucalyptus gomphocephala*	Tuart
Myrtaceae	*Eucalyptus marginata*	Jarrah
Cyperaceae	*Gahnia trifida*	Coast Saw-sedge
Fabaceae	*Gompholobium tomentosum*	Hairy Yellow Pea
Haemodoraceae	*Haemodorum spicatum*	Mardja
Proteaceae	*Hakea varia*	Variable leafed Heaka
Lamiaceae	*Hemiandra pungens*	Snake bush
Dilleniaceae	*Hibbertia hypericoides*	Yellow Buttercups
Dilleniaceae	*Hibbertia racemosa*	Stalked Guinea Flower
Myrtaceae	*Hypocalymma angustifolium*	White Myrtle
Cyperaceae	*Ficinia nodosa*	Knotted Club Rush
Fabaceae	*Jacksonia furcellata*	Grey Stinkwood
Fabaceae	*Jacksonia sternbergiana*	Stinkwood
Juncaceae	*Juncus kraussii*	Sea Rush
Juncaceae	*Juncus pallidus*	Pale Rush

Fabaceae	*Kennedia prostrata*	Scarlet Runner
Liliaceae	*Laxmannia squarrosa*	
Cyperaceae	*Lepidosperma gladiatum*	Coast Sword-sedge
Goodeniaceae	*Leschenaultia floribunda*	Free-flowering Leschenaultia
Xanthorrhoeaceae	*Lomandra preissii*	
Restionaceae	*Lyginia barbata*	
Zamiaceae	*Macrozamia riedlei*	Zamia
Myrtaceae	*Melaleuca cuticularis*	Saltwater Paperbark
Myrtaceae	*Melaleuca rhaphiophylla*	Swamp Paperbark
Loranthaceae	*Nuytsia floribunda*	Christmas Tree
Rubiaceae	*Opercularia vaginata*	
Iridaceae	*Patersonia occidentalis*	Purple Flag
Haemodoraceae	*Phlebocarya ciliata*	
Scrophulariaceae	*Myoporum insulare*	Blueberry Tree
Chenopodiaceae	*Rhagodia baccata*	Sea berry saltbush
Fabaceae	*Samolus repens*	Creeping brookweed
Chenopodiaceae	*Sarcocornia quinqueflora*	
Goodeniaceae	*Scaevola crassifolia*	Thick-leaved Fan-flower
Cyperaceae	*Schoenus curvifolius*	
Cyperaceae	*Schoenus subfascicularis*	
Myrtaceae	*Scholtzia involucrata*	Spiked Scholtzia
Pittosporaceae	*Sollya heterophylla*	Australian bluebell
Poaceae	*Sporobolus virginicus*	Marine Couch
Chenopodiaceae	*Suaeda australis*	Seablite
Fabaceae	*Templetonia retusa*	Cockies Tongues
Chenopodiaceae	*Threlkeldia diffusa*	Coast Bonefruit
Apiaceae	*Trachymene pilosa*	Native Parsnip
Xanthorrhoeaceae	*Xanthorrhoea brunonis*	
Xanthorrhoeaceae	*Xanthorrhoea preissii*	Grass Tree
WEEDS		
Poaceae	*Avena fatua*	Wild oats
Brassicaceae	*Brassica tournefortii*	Mediterranean Turnip
Poaceae	*Briza minor*	Shivery Grass
Aizoaceae	*Carpobrotus edulis*	Hottentot Fig
Asteraceae	*Conyza bonariensis*	Fleabane
Poaceae	*Cynodon dactylon*	Couch
Poaceae	*Ehrharta calycina*	Veldt Grass
Fumariaceae	*Fumaria capreolata*	Whiteflower Fumitory
Iridaceae	*Gladiolus caryophyllaceus*	Wild Gladiolus
Asteraceae	*Hypochaeris glabra*	Smooth Cats-ear
Oxalidaceae	*Oxalis pes-caprae*	Soursob
Brassicaceae	*Raphanus raphanistrum*	Wild radish
Asteraceae	*Senecio lautus*	Variable Groundsel
Asteraceae	*Sonchus oleraceus**	Common sowthistle
Asteraceae	*Symphyotrichum subulatum*	Bushy starwort
Asteraceae	*Urospermum picroides*	False hawkbit
Asteraceae	*Ursinia anthemoides*	Ursinia
Asteraceae	*Vellereophyton dealbatum*	White Cudweed

APPENDIX 8 FAUNA SPECIES

Table 1. Fish species returned from desktop review. Those observed on 23/02/18 or later in 2018 (reported by Syrinx personnel) are indicated.

Latin Name	English Name	23/02/18
Acanthopagrus butcheri	Black Bream	
Aldrichetta forsteri	Yelloweye Mullet	X
Amniataba caudavittata	Yellowtail Grunter	X
Apogon rueppellii	Gobbleguts	
Arenigobius bifrenatus	Bridled Goby	X
Argyrosomus japonicus	Mulloway	
Cnidoglanis macrocephalus	Estuary Cobbler	
Dactylopus dactylopus	Finger Dragonet	
Leptatherina wallacei	Wallace's Hardyhead	X
Hyporhamphus regularis	River Garfish	
Mugil cephalus	Sea Mullet	
Nematalosa vlaminghi	Perth Herring	
Gambusia holbrooki	Mosquitofish	X (introduced)
Phalloceros harpagos	Leopard Fish	(introduced)
Rhabdosargus sarba	Tarwhine	
Torquigener pleurogramma	Common Blowfish	

Table 2. Frog species returned from desktop review. Species recorded by Siemon (2000) at Salter Point/Waterford are indicated.

Latin Name	English Name	Siemon (2000)	23/02/18
HYLIDAE (Tree frogs)			
Litoria adelaidensis	Slender Tree Frog		
Litoria moorei	Motorbike Frog		
LIMNODYNASTIDAE (Burrowing Frogs)			
Heleioporus eyrei	Moaning Frog		
Limnodynastes dorsalis	Western Banjo Frog	X	
MYOBATRACHIDAE (Ground frogs)			
Crinia georgiana	Quacking Frog	X	
Crinia glauerti	Clicking Frog	X	
Crinia insignifera	Squelching Frog	X	
Myobatrachus gouldii	Turtle Frog		
Pseudophryne guentheri	Crawling Toadlet		

Table 3. Reptile species returned from desktop review. Species recorded by Siemon (2000) at Salter Point/Waterford are indicated. Those observed on 23/02/18 or later in 2018 (reported by Syrinx personnel) are indicated.

Latin Name	English Name	Siemon (2000)	2018
CHELUIDAE			
Chelodina colliei	South-West Long-necked Tortoise		
DIPLODACTYLIDAE			
Strophurus spinigerus	Western Spiny-tailed Gecko		
GEKKONIDAE			
Christinus marmoratus	Marbled Gecko		
PYGOPODIDAE			
Lialis burtonis	Burton's Legless Lizard	X	
Aprasia repens	Sand-plain Worm-lizard		
AGAMIDAE			
Pogona minor	Western Bearded Dragon		
SCINCIDAE			
Acritoscincus trilineatus	Western Three-lined Skink	X	
Cryptoblepharus buchananii	Fence Skink	X	
Ctenotus australis	Long-tailed Ctenotus		
Ctenotus fallens	West Coast Ctenotus		
Hemiergis quadrilineata	Two-toed Mulch Skink		
Lerista elegans	West Coast Four-toed Lerista	X	
Lerista lineata	Perth Lined Lerista	X	
Menetia greyii	Dwarf Skink	X	X
Morethia lineoocellata			
Morethia obscura			
Tiliqua rugosa	Bobtail		X
VARANIDAE			
Varanus gouldii	Bungarra or Sand Goanna		
TYPHLOPIDAE			
Anilios australis	Southern Blind Snake	X	
ELAPIDAE			
Notechis scutatus	Tiger Snake		
Pseudonaja affinis	Dugite	X	X

Table 4. Bird species returned from desktop review. Species recorded by Siemon (2000) at Salter Point/Waterford are indicated. Those observed on 23/02/18 or later in 2018 (reported by Syrinx personnel) are indicated. (Conservation Listing: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant (including species listed by DEP 2000).

Species		Cons. Listing	Siemon 2000	2018
Anatidae (ducks, geese and swans)				
Black Swan	*Cygnus atratus*		X	X (13)
Australian Shelduck	*Tadorna tadornoides*		X	
Pacific Black Duck	*Anas superciliosus*		X	
Grey Teal	*Anas gibberifrons*		X	
Domestic Mallard	*Anas platyrhnychos*			
Australasian Shoveler	*Anas rhynchotis*			
Pink-eared Duck	*Malacorhynchus membranaceous*			
Hardhead	*Aythya australis*	CS3	X	
Australian Wood Duck	*Chenonetta jubata*		X	
Musk Duck	*Biziura lobata*	CS3	X	
Blue-billed Duck	*Oxyura australis*	CS3		
Podicepididae (grebes)				
Great Crested Grebe	*Podiceps cristatus*			
Hoary-headed Grebe	*Poliocephalus poliocephalus*		X	
Australasian Grebe	*Tachybaptus novaehollandiae*		X	
Anhingidae (darters)				
Darter	*Anhinga melanogaster*		X	
Phalacrocoracidae (cormorants)				
Great Cormorant	*Phalacrocorax carbo*		X	
Pied Cormorant	*Phalacrocorax varius*		X	
Little Black Cormorant	*Phalacrocorax sulcirostris*			
Little Pied Cormorant	*Phalacrocorax melanoleucos*		X	X (1)
Pelicanidae (pelicans)				
Australian Pelican	*Pelecanus conspicillatus*		X	X (3)
Ardeidae (herons and egrets)				
White-faced Heron	*Egretta novaehollandiae*		X	X (1)
Little Egret	*Egretta garzetta*			
White-necked Heron	*Ardea pacifica*			
Eastern Great Egret	*Egretta modesta*		X	X (1)
Nankeen Night Heron	*Nycticorax caledonicus*	CS3		
Plataleidae (ibis and spoonbills)				
Glossy Ibis	*Plegadis falcinellus*	CS1		
Australian White Ibis	*Threskiornis molucca*		X	
Straw-necked Ibis	*Threskiornis spinicollis*			
Yellow-billed Spoonbill	*Platalea flavipes*		X	
Accipitridae (kites, hawks and eagles)				
Eastern Osprey	*Pandion cristatus*	CS1	X	X (1)
Black-shouldered Kite	*Elanus notatus*		X	
Whistling Kite	*Haliastur sphenurus*	CS3	X	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*			
Swamp Harrier	*Circus approximans*			X
Brown Goshawk	*Accipiter fasciatus*	CS3	X	
Collared Sparrowhawk	*Accipiter cirrhocephalus*	CS3	X	
Little Eagle	*Hieraaetus morphnoides*	CS3		
Falconidae (falcons)				
Brown Falcon	*Falco berigora*	CS3	X	
Peregrine Falcon	*Falco peregrinus*	CS1		
Australian Hobby	*Falco longipennis*		X	
Nankeen Kestrel	*Falco cenchroides*		X	

Species		Cons. Listing	Siemon 2000	2018
Rallidae (crakes and rails)				
Buff-banded Rail	*Rallus philippensis*			X
Baillon's Crake	*Porzana pusilla*			
Spotless Crake	*Porzana tabuensis*			
Australian Crake	*Porzana fluminea*			
Dusky Moorhen	*Gallinula tenebrosa*	CS3	X	
Purple Swamphen	*Porphyrio porphyrio*			
Eurasian Coot	*Fulica atra*		X	
Scolopacidae (sandpipers)				
Common Greenshank	*Tringa nebularia*	CS1	X	
Wood Sandpiper	*Tringa stagnatilis*	CS1		
Common Sandpiper	*Tringa hypoleucos*	CS1	X	X (1)
Recurvirostridae (stilts and avocets)				
Black-winged Stilt	*Himantopus himantopus*		X	
Red-necked Avocet	*Recurvirostra novaehollandiae*		X	
Charadriidae (lapwings and plovers)				
Grey Plover	*Pluvialis squatarola*	CS1		X
Red-capped Plover	*Charadrius ruficapillus*			X
Black-fronted Dotterel	*Elseyornis melanops*			X
Laridae (gulls and terns)				
Silver Gull	*Chroicocephalus novaehollandiae*		X	X (3)
Caspian Tern	*Sterna caspia*		X	
Crested Tern	*Thalasseus bergii*	CS1	X	
Columbidae (pigeons and doves)				
Rock Pigeon	*Columbia livia*	Int		
Spotted Dove	*Streptopelia chinensis*	Int	X	
Laughing Dove	*Streptopelia senegalensis*	Int	X	
Cacatuidae (cockatoos)				
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii*	CS1		
Carnaby's Black-Cockatoo	*Calyptorhynchus latirostris*	CS1	X	X
Galah	*Cacatua roseicapilla*			
Eastern Long-billed Corella	*Cacatua tenuirostris*	Int		
Little Corella	*Cacatua sanguinea*	Int		
Western Corella	*Cacatua pastinator*			
Psittacidae (lorikeets and parrots)				
Rainbow Lorikeet	*Trichoglossus haematodus*	Int		
Red-capped Parrot	*Purpureicephalus spurius*			
Australian Ringneck	*Barnardius zonarius*		X	
Cuculidae (cuckoos)				
Pallid Cuckoo	*Cuculus pallidus*			
Fan-tailed Cuckoo	*Cuculus pyrrhophanus*			
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*			
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*			
Strigidae (hawk-owls)				
Southern Boobook Owl	*Ninox novaeseelandiae*			
Tytonidae (barn owls)				
Barn Owl	*Tyto alba*			
Podargidae (frogmouths)				
Tawny Frogmouth	*Podargus strigoides*			
Apodidae (swifts)				
Fork-tailed Swift	*Apus pacificus*	CS1		
Halcyonidae (forest kingfishers)				
Laughing Kookaburra	*Dacelo novaeguineae*	Int	X	
Sacred Kingfisher	*Todiramphus sanctus*		X	
Meropidae (bee-eaters)				

Species		Cons. Listing	Siemon 2000	2018
Rainbow Bee-eater	*Merops ornatus*		X	
Maluridae (fairy-wrens)				
Splendid Fairy-wren	*Malurus splendens*	CS3		
Pardalotidae (pardalotes)				
Spotted Pardalote	*Pardalotus punctatus*			
Striated Pardalote	*Pardalotus striatus*			
White-browed Scrubwren	*Sericornis frontalis*	CS3		
Western Gerygone	*Gerygone fusca*			X
Weebill	*Smicrornis brevirostris*	CS3		
Inland Thornbill	*Acanthiza apicalis*	CS3	X	
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	CS3	X	
Meliphagidae (honeyeaters)				
Red Wattlebird	*Anthochaera carunculata*		X	
Western Wattlebird	*Anthochaera lunulata*	CS3		
Singing Honeyeater	*Lichenostomus virescens*		X	X
Brown Honeyeater	*Lichmera indistincta*		X	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	CS3		
White-cheeked Honeyeater	*Phylidonyris nigra*	CS3		X
Pachycephalidae (whistlers)				
Rufous Whistler	*Pachycephala rufiventris*			
Dicruridae (flycatchers)				
Magpie-lark	*Grallina cyanoleuca*		X	X
Grey Fantail	*Rhipidura fuliginosa*		X	
Willie Wagtail	*Rhipidura leucophrys*		X	X
Campephagidae (cuckoo-shrikes)				
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		X	
White-winged Triller	*Lalage sueurii*			
Artamidae (woodswallows, magpies and allies)				
Grey Butcherbird	*Cracticus torquatus*		X	
Australian Magpie	*Gymnorhina tibicen*		X	
Corvidae (ravens and crows)				
Australian Raven	*Corvus coronoides*		X	
Motacillidae (pipits and true wagtails)				
Richard's (Australian) Pipit	*Anthus novaeseelandiae*		X	
Dicaeidae (flowerpeckers)				
Mistletoebird	*Diceum hirundinaceum*		X	X
Hirundinidae (swallows)				
Welcome Swallow	*Hirundo neoxena*		X	X
Tree Martin	*Hirundo nigricans*		X	
Sylviidae (old world warblers)				
Australian Reed-Warbler	*Acrocephalus australis*		X	
Little Grassbird	*Megalurus gramineus*		X	
Zosteropidae (white-eyes)				
Silvereye	*Zosterops lateralis*		X	

Table 5. Mammal species returned from desktop review. Species recorded by Siemon (2000) at Salter Point/Waterford are indicated. Those observed on 23/02/18 or later in 2018 (reported by Syrinx personnel) are indicated. (Conservation Listing: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant (including species listed by DEP 2000).

Latin Name	English Name	Cons Listing	Siemon 2000	2018
PERAMELIDAE				
Quenda (Bandicoot)	*Isoodon fusciventer*	CS2	X	
PHALANGERIDAE				
Common Brushtail Possum	*Trichosurus vulpecula*	CS3		
MURIDAE				
Water-rat, Rakali	*Hydromys chrysogaster*	CS2		
House Mouse	*Mus musculus*	Int	X	
Brown Rat	*Rattus norvegicus*			
Black Rat	*Rattus rattus*	Int	X	
LEPORIDAE				
Rabbit	*Oryctolagus cuniculus*	Int		
MOLOSSIDAE				
White-striped Freetail Bat	*Austronomus australis*		X	
VESPERTILIONIDAE				
Gould's Wattled Bat	*Chalinolobus gouldii*			
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	CS3		
Southern Forest Bat	*Vespadelus regulus*			
CANIDAE				
Red Fox	*Vulpes vulpes*	Int	X	
FELIDAE				
Cat	*Felis catus*	Int	X	X

Table 1. Fish species returned from desktop review. Those observed on 23/02/18 or later in 2018 (reported by Syrinx personnel) are indicated.

Latin Name	English Name	23/02/18
Acanthopagrus butcheri	Black Bream	
Aldrichetta forsteri	Yelloweye Mullet	X
Amniataba caudavittata	Yellowtail Grunter	X
Apogon rueppellii	Gobbleguts	
Arenigobius bifrenatus	Bridled Goby	X
Argyrosomus japonicus	Mulloway	
Cnidoglanis macrocephalus	Estuary Cobbler	
Dactylopus dactylopus	Finger Dragonet	
Leptatherina wallacei	Wallace's Hardyhead	X
Hyporhamphus regularis	River Garfish	
Mugil cephalus	Sea Mullet	
Nematalosa vlaminghi	Perth Herring	
Gambusia holbrooki	Mosquitofish	X (introduced)
Phalloceros harpagos	Leopard Fish	(introduced)
Rhabdosargus sarba	Tarwhine	
Torquigener pleurogramma	Common Blowfish	

Table 2. Frog species returned from desktop review. Species recorded by Siemon (2000) at Salter Point/Waterford are indicated.

Latin Name	English Name	Siemon (2000)	23/02/18
HYLIDAE (Tree frogs)			
Litoria adelaidensis	Slender Tree Frog		
Litoria moorei	Motorbike Frog		
LIMNODYNASTIDAE (Burrowing Frogs)			
Heleioporus eyrei	Moaning Frog		
Limnodynastes dorsalis	Western Banjo Frog	X	
MYOBATRACHIDAE (Ground frogs)			
Crinia georgiana	Quacking Frog	X	
Crinia glauerti	Clicking Frog	X	
Crinia insignifera	Squelching Frog	X	
Myobatrachus gouldii	Turtle Frog		
Pseudophryne guentheri	Crawling Toadlet		

Table 3. Reptile species returned from desktop review. Species recorded by Siemon (2000) at Salter Point/Waterford are indicated. Those observed on 23/02/18 or later in 2018 (reported by Syrinx personnel) are indicated.

Latin Name	English Name	Siemon (2000)	2018
CHELUIDAE			
Chelodina colliei	South-West Long-necked Tortoise		
DIPLODACTYLIDAE			
Strophurus spinigerus	Western Spiny-tailed Gecko		
GEKKONIDAE			
Christinus marmoratus	Marbled Gecko		
PYGOPODIDAE			
Lialis burtonis	Burton's Legless Lizard	X	
Aprasia repens	Sand-plain Worm-lizard		
AGAMIDAE			
Pogona minor	Western Bearded Dragon		
SCINCIDAE			
Acritoscincus trilineatus	Western Three-lined Skink	X	
Cryptoblepharus buchananii	Fence Skink	X	
Ctenotus australis	Long-tailed Ctenotus		
Ctenotus fallens	West Coast Ctenotus		
Hemiergis quadrilineata	Two-toed Mulch Skink		
Lerista elegans	West Coast Four-toed Lerista	X	
Lerista lineata	Perth Lined Lerista	X	
Menetia greyii	Dwarf Skink	X	X
Morethia lineoocellata			
Morethia obscura			
Tiliqua rugosa	Bobtail		X
VARANIDAE			
Varanus gouldii	Bungarra or Sand Goanna		
TYPHLOPIDAE			
Anilios australis	Southern Blind Snake	X	
ELAPIDAE			
Notechis scutatus	Tiger Snake		
Pseudonaja affinis	Dugite	X	X

Table 4. Bird species returned from desktop review. Species recorded by Siemon (2000) at Salter Point/Waterford are indicated. Those observed on 23/02/18 or later in 2018 (reported by Syrinx personnel) are indicated. (Conservation Listing: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant (including species listed by DEP 2000).

Species		Cons. Listing	Siemon 2000	2018
Anatidae (ducks, geese and swans)				
Black Swan	*Cygnus atratus*		X	X (13)
Australian Shelduck	*Tadorna tadornoides*		X	
Pacific Black Duck	*Anas superciliosus*		X	
Grey Teal	*Anas gibberifrons*		X	
Domestic Mallard	*Anas platyrhnychos*			
Australasian Shoveler	*Anas rhynchotis*			
Pink-eared Duck	*Malacorhynchus membranaceous*			
Hardhead	*Aythya australis*	CS3	X	
Australian Wood Duck	*Chenonetta jubata*		X	
Musk Duck	*Biziura lobata*	CS3	X	
Blue-billed Duck	*Oxyura australis*	CS3		
Podicepididae (grebes)				
Great Crested Grebe	*Podiceps cristatus*			
Hoary-headed Grebe	*Poliocephalus poliocephalus*		X	
Australasian Grebe	*Tachybaptus novaehollandiae*		X	
Anhingidae (darters)				
Darter	*Anhinga melanogaster*		X	
Phalacrocoracidae (cormorants)				
Great Cormorant	*Phalacrocorax carbo*		X	
Pied Cormorant	*Phalacrocorax varius*		X	
Little Black Cormorant	*Phalacrocorax sulcirostris*			
Little Pied Cormorant	*Phalacrocorax melanoleucos*		X	X (1)
Pelicanidae (pelicans)				
Australian Pelican	*Pelecanus conspicillatus*		X	X (3)
Ardeidae (herons and egrets)				
White-faced Heron	*Egretta novaehollandiae*		X	X (1)
Little Egret	*Egretta garzetta*			
White-necked Heron	*Ardea pacifica*			
Eastern Great Egret	*Egretta modesta*		X	X (1)
Nankeen Night Heron	*Nycticorax caledonicus*	CS3		
Plataleidae (ibis and spoonbills)				
Glossy Ibis	*Plegadis falcinellus*	CS1		
Australian White Ibis	*Threskiornis molucca*		X	
Straw-necked Ibis	*Threskiornis spinicollis*			
Yellow-billed Spoonbill	*Platalea flavipes*		X	
Accipitridae (kites, hawks and eagles)				
Eastern Osprey	*Pandion cristatus*	CS1	X	X (1)
Black-shouldered Kite	*Elanus notatus*		X	
Whistling Kite	*Haliastur sphenurus*	CS3	X	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*			
Swamp Harrier	*Circus approximans*			X
Brown Goshawk	*Accipiter fasciatus*	CS3	X	
Collared Sparrowhawk	*Accipiter cirrhocephalus*	CS3	X	
Little Eagle	*Hieraaetus morphnoides*	CS3		
Falconidae (falcons)				
Brown Falcon	*Falco berigora*	CS3	X	
Peregrine Falcon	*Falco peregrinus*	CS1		
Australian Hobby	*Falco longipennis*		X	
Nankeen Kestrel	*Falco cenchroides*		X	

Species		Cons. Listing	Siemon 2000	2018
Rallidae (crakes and rails)				
Buff-banded Rail	*Rallus philippensis*			X
Baillon's Crake	*Porzana pusilla*			
Spotless Crake	*Porzana tabuensis*			
Australian Crake	*Porzana fluminea*			
Dusky Moorhen	*Gallinula tenebrosa*	CS3	X	
Purple Swamphen	*Porphyrio porphyrio*			
Eurasian Coot	*Fulica atra*		X	
Scolopacidae (sandpipers)				
Common Greenshank	*Tringa nebularia*	CS1	X	
Wood Sandpiper	*Tringa stagnatilis*	CS1		
Common Sandpiper	*Tringa hypoleucos*	CS1	X	X (1)
Recurvirostridae (stilts and avocets)				
Black-winged Stilt	*Himantopus himantopus*		X	
Red-necked Avocet	*Recurvirostra novaehollandiae*		X	
Charadriidae (lapwings and plovers)				
Grey Plover	*Pluvialis squatarola*	CS1		X
Red-capped Plover	*Charadrius ruficapillus*			X
Black-fronted Dotterel	*Elseyornis melanops*			X
Laridae (gulls and terns)				
Silver Gull	*Chroicocephalus novaehollandiae*		X	X (3)
Caspian Tern	*Sterna caspia*		X	
Crested Tern	*Thalasseus bergii*	CS1	X	
Columbidae (pigeons and doves)				
Rock Pigeon	*Columbia livia*	Int		
Spotted Dove	*Streptopelia chinensis*	Int	X	
Laughing Dove	*Streptopelia senegalensis*	Int	X	
Cacatuidae (cockatoos)				
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii*	CS1		
Carnaby's Black-Cockatoo	*Calyptorhynchus latirostris*	CS1	X	X
Galah	*Cacatua roseicapilla*			
Eastern Long-billed Corella	*Cacatua tenuirostris*	Int		
Little Corella	*Cacatua sanguinea*	Int		
Western Corella	*Cacatua pastinator*			
Psittacidae (lorikeets and parrots)				
Rainbow Lorikeet	*Trichoglossus haematodus*	Int		
Red-capped Parrot	*Purpureicephalus spurius*			
Australian Ringneck	*Barnardius zonarius*		X	
Cuculidae (cuckoos)				
Pallid Cuckoo	*Cuculus pallidus*			
Fan-tailed Cuckoo	*Cuculus pyrrhophanus*			
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*			
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*			
Strigidae (hawk-owls)				
Southern Boobook Owl	*Ninox novaeseelandiae*			
Tytonidae (barn owls)				
Barn Owl	*Tyto alba*			
Podargidae (frogmouths)				
Tawny Frogmouth	*Podargus strigoides*			
Apodidae (swifts)				
Fork-tailed Swift	*Apus pacificus*	CS1		
Halcyonidae (forest kingfishers)				
Laughing Kookaburra	*Dacelo novaeguineae*	Int	X	
Sacred Kingfisher	*Todiramphus sanctus*		X	
Meropidae (bee-eaters)				

Species		Cons. Listing	Siemon 2000	2018
Rainbow Bee-eater	*Merops ornatus*		X	
Maluridae (fairy-wrens)				
Splendid Fairy-wren	*Malurus splendens*	CS3		
Pardalotidae (pardalotes)				
Spotted Pardalote	*Pardalotus punctatus*			
Striated Pardalote	*Pardalotus striatus*			
White-browed Scrubwren	*Sericornis frontalis*	CS3		
Western Gerygone	*Gerygone fusca*			X
Weebill	*Smicrornis brevirostris*	CS3		
Inland Thornbill	*Acanthiza apicalis*	CS3	X	
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	CS3	X	
Meliphagidae (honeyeaters)				
Red Wattlebird	*Anthochaera carunculata*		X	
Western Wattlebird	*Anthochaera lunulata*	CS3		
Singing Honeyeater	*Lichenostomus virescens*		X	X
Brown Honeyeater	*Lichmera indistincta*		X	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	CS3		
White-cheeked Honeyeater	*Phylidonyris nigra*	CS3		X
Pachycephalidae (whistlers)				
Rufous Whistler	*Pachycephala rufiventris*			
Dicruridae (flycatchers)				
Magpie-lark	*Grallina cyanoleuca*		X	X
Grey Fantail	*Rhipidura fuliginosa*		X	
Willie Wagtail	*Rhipidura leucophrys*		X	X
Campephagidae (cuckoo-shrikes)				
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		X	
White-winged Triller	*Lalage sueurii*			
Artamidae (woodswallows, magpies and allies)				
Grey Butcherbird	*Cracticus torquatus*		X	
Australian Magpie	*Gymnorhina tibicen*		X	
Corvidae (ravens and crows)				
Australian Raven	*Corvus coronoides*		X	
Motacillidae (pipits and true wagtails)				
Richard's (Australian) Pipit	*Anthus novaeseelandiae*		X	
Dicaeidae (flowerpeckers)				
Mistletoebird	*Diceum hirundinaceum*		X	X
Hirundinidae (swallows)				
Welcome Swallow	*Hirundo neoxena*		X	X
Tree Martin	*Hirundo nigricans*		X	
Sylviidae (old world warblers)				
Australian Reed-Warbler	*Acrocephalus australis*		X	
Little Grassbird	*Megalurus gramineus*		X	
Zosteropidae (white-eyes)				
Silvereye	*Zosterops lateralis*		X	

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Latin Name	English Name	Cons Listing	Siemon 2000	2018
PERAMELIDAE				
Quenda (Bandicoot)	*Isoodon fusciventer*	CS2	X	
PHALANGERIDAE				
Common Brushtail Possum	*Trichosurus vulpecula*	CS3		
MURIDAE				
Water-rat, Rakali	*Hydromys chrysogaster*	CS2		
House Mouse	*Mus musculus*	Int	X	
Brown Rat	*Rattus norvegicus*			
Black Rat	*Rattus rattus*	Int	X	
LEPORIDAE				
Rabbit	*Oryctolagus cuniculus*	Int		
MOLOSSIDAE				
White-striped Freetail Bat	*Austronomus australis*		X	
VESPERTILIONIDAE				
Gould's Wattled Bat	*Chalinolobus gouldii*			
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	CS3		
Southern Forest Bat	*Vespadelus regulus*			
CANIDAE				
Red Fox	*Vulpes vulpes*	Int	X	
FELIDAE				
Cat	*Felis catus*	Int	X	X