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Ashfield Flats Hydrological Study

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Ashfield Flats Hydrological Study

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Biodiversity and Conservation Science

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Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

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Cover image: Ashfield Flats Wetland Monitoring, photograph by G. McGrath.

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Acknowledgments

I would like to acknowledge the custodians of the land and the waters of Derbarl Yerrigan (Swan River), the Whadjuk people of the Noongar nation and their Elders past and present. I acknowledge and respect their continuing culture and the contribution they make to this region.

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Contributions

Prof. Andrew Rate coordinated, planned and supervised the analysis of water and sediment samples collected by students from the University of Western Australia. Giles Knight and G. McGrath contributed data analysis and writing of this data that appears in sections 6 and 7. A. Prof. Grzegorz Skyrzpek contributed interpretation of isotope analyses.

A. Prof. Matthias Leopold contributed geophysics equipment, initial data analysis and co-supervised James Barrett's research with G. McGrath and these results appear in section 5. G. McGrath completed remaining geophysics surveys and inversions, the interpretation of data and writing.

G. McGrath completed the remaining data collection, modelling, data analysis and writing. Dr Ryan Vogwill provided an independent peer review and his comments and suggestions were appreciated.

Summary

A hydrological study was undertaken on Ashfield Flats Reserve, in the suburb of Ashfield, Perth, Western Australia. Ashfield Flats contains the largest remaining occurrence of a Temperate Coastal Saltmarsh community in the Swan and Canning River Estuary. This system is regarded as a Threatened Ecological Community (TEC) and falls under national and state protections. The purpose of the study was to help inform the site's future management.

The aim of the hydrological study was to develop an understanding of the dominant hydrological processes currently occurring at the site and to assess the potential that polluted groundwater and surface water is discharging into the site. Historical land use had been known to impact groundwater and urban drainage further up the wetland's catchment. The objectives of the study were to collect data on water levels, water quality and sediment chemistry to inform the development of conceptual and numerical hydrological models of the wetland's hydrology. To that end, between February 2019 and November 2020, a monitoring program was conducted.

The results of the hydrological study showed the wetland has a strong interaction with the Swan River and quantified the relative contributions to flooding from various estuarine processes, though flooding was dominated by tidal processes. The wetland is very flat and low in elevation. Therefore, it floods frequently each year and stores much of the flood water for many months, drying completely over most of the reserve by mid-summer. A hydrological model developed for this study suggests that in recent decades the annual hydroperiod lasts 30 weeks on average. Further modelling, including the effects climate change suggests that in the coming decades the hydroperiod in the areas occupied by the TEC will increase and that by 2090 it will have switched from an ephemeral to a perennial system because of sea-level rise. However, should the site be able to accrete sediments at a sufficient rate it may be able to keep pace with sea level rise and maintain its vegetation composition. The accretion rate is therefore a significant unknown that if quantified would better inform the risks to the TEC.

A hydrogeological characterization suggests the aquifers beneath the wetland comprises a thin surficial layer of organic rich wetland sediments overlaying a semi-confined aquifer consisting of Bassendean sand, Guildford Clay and alluvial deposits. The wetland sediments likely act as a weak aquitard. Groundwater does not appear to contribute significantly to maintaining surface water levels, although along its north-western edge groundwater flow is directed upwards towards the surface. Within the wetland groundwater leaves via evaporation during summer producing high salinity in the sediments and groundwaters. During winter the aquifers are recharged by Swan River tides and floodwaters and the concentrated brine developed over summer.

A key contributor to maintaining the *Tecticornia* and *Salicornia* species in the saltmarsh therefore looks to be a hydrological system that stores brackish river water after a flood and allows that water to evapo-concentrates and generate salinity.

Maintenance of this salinity gives the *Tecticornia* and *Salicornia* their competitive advantage. To support these salt-marsh species management activities should be cognizant of the need to maintain water residence times that are sufficiently long to support salinity production while also allowing ephemeral conditions to occur to continue the evapo-concentration of salts and to allow the root zones of the halophytes to dry out. The *Tecticornia* and *Salicornia* have distributions which are excluded from areas that are wet for a significant part of the year.

Urban drainage appears to be having a significant impact on the wetland. The Kitchener St and Chapman St Drains cross the wetlands but appear to have minimal interaction hydrologically. On the other hand, these drains are still significant sources of metals and nutrients loads to the Swan River. A third stormwater drain, which intercepts groundwater, discharges perennially and directly into the western half of the wetland. This drain lowers the salinity of surface waters and has led to more permanently flooded conditions in part of the wetland, than likely existed prior to its construction. This drain is also a significant source of pollutants to the wetland. Zinc and cobalt discharged by this drain are accumulating in wetland sediments. The wetland is therefore performing a significant ecosystem service by storing these pollutants before they enter the Swan River. The water chemistry of stormwater and nearby groundwater is consistent with a pollutant source related to fertilizer use, fertilizer production and sulphuric acid production.

1 Introduction

1.1 Temperate Costal Saltmarsh

Ashfield Flats Reserve is in the Perth suburb of Ashfield, on the banks of the Swan River. The reserve contains an occurrence of a Subtropical and Temperate Coastal Saltmarsh community, which is listed as a threatened ecological community (TEC) under the Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act). This TEC is ranked as 'vulnerable'. Under section 182 (3)(b) of the EPBC Act. A TEC is listed as vulnerable if it is considered to face a 'high risk of extinction in the wild in the medium-term future'; the indicative timeframe being the next 50 years. The key characteristics of Temperate Coastal Saltmarsh are:

- occurs on the coastal margin, along estuaries and coastal embayments and on low wave energy coasts;
- occurs on places with at least some tidal connection, including rarely-inundated supratidal areas, intermittently opened or closed lagoons, and groundwater tidal influences, but not areas receiving only aerosol spray;
- occurs on sandy or muddy substrate and may include coastal clay pans (and the like);
- consists of dense to patchy areas of characteristic coastal saltmarsh plant species (i.e. salt-tolerant herbs, succulent shrubs or grasses, that may also include bare sediment as part of the mosaic); and
- proportional cover by tree canopy such as mangroves, *Melaleucas* or *Casuarinas* is not greater than 50%, nor is proportional ground cover by seagrass greater than 50%.

Ashfield Flats is also a Bush Forever Site (Site 214 – Ashfield Flats – Bassendean/ Ashfield) and is reserved as Parks and Recreation under the Metropolitan Region Scheme (MRS). State Planning Policy 2.8 – Bushland Policy for the Perth Metropolitan Region states that Bush Forever areas are defined as a 'classification of land in the MRS to protect and manage regionally significant bushland in accordance with this policy'. The policy also provides a level of intent that Bush Forever Sites are retained for conservation.

A recent vegetation survey identified 47 native and 65 introduced taxa from 34 families (DBCA, 2019). The families with the greatest representation of taxa were *Chenopodiaceae* (samphires) with 10 taxa, *Cyperaceae* with 10 taxa, *Myrtaceae* with 19 taxa, *Fabaceae* (peas) with 15 taxa, and *Poaceae* (grasses) with 17 taxa. Figure 1 shows the spatial distribution of vegetation units, summarized in Table 1.

Table 1: Description of vegetation units

Symbol	*Vegetation Description*
Te	*Low Shrubland to Closed Low Heath of Tecticornia pergranulata subsp. pergranulata, Tecticornia indica subsp. bidens, Tecticornia lepidosperma, Tecticornia halocnemoides, Salicornia quinqueflora and Suaeda australis on seasonally inundated flats. Dominance of these species varies throughout the community.*
MrJkTe	*Previously burnt Low Open Woodland of Melaleuca rhaphiophylla, over scattered Tecticornia low shrubs spp.*
ErMr	*Woodland to Open Forest of Eucalyptus rudis, over Low Woodland to Low Open Forest of Melaleuca rhaphiophylla.*
B	*Bolboschoenus caldwellii sedgeland*
Mr	*Low Woodland to Low Open Forest of Melaleuca rhaphiophylla, sometimes over Sedgeland to Open Sedgeland of Bolboschoenus caldwellii. Contains some areas of previously burnt Melaleuca rhaphiophylla.*
Co	*Casuarina obesa* occasionally with *Casuarina ?glauca*
CoT	Low Open Woodland (to scattered trees) of *Casuarina obesa* over Low Open Shubland of *Tecticornia* spp. over Grassland of ?*Lolium* sp. (dead). In modified (raised) central area of TEC samphire unit, and small patch to east of 'Te' *Tecticornia* samphire unit
CoJa	Fringing *Casuarina obesa* and *Eucalyptus* sp. trees over scattered *Juncus kraussii* subsp. *australiensis* and *Schoenoplectus tabernaemontani* sedges (including plantings) on river banks.
To	**Typha orientalis* sedgeland
MosMvMr Bc	Mosaic of *Melaleuca viminea*, grasses, previously burnt *Melaleuca* ?*rhaphiophylla*, *Bolboschoenus caldwellii* and *Atriplex prostrata*. Scattered patches of **Typha orientalis*.
Mv	Tall Shrubland of *Melaleuca viminea* subsp. *viminea*
MrBc	Low Woodland to Low Open Forest of *Melaleuca rhaphiophylla,* sometimes over Sedgeland to Open Sedgeland of *Bolboschoenus caldwellii.* Contains some areas of previously burnt *Melaleuca ?rhaphiophylla.*
MosMrTe	Mosaic of *Melaleuca rhaphiophylla* over *Tecticornia* spp.
J1	Closed Sedgeland of *Juncus krausii* subsp. *australiensis* with scattered *Atriplex prostrata* and *Suaeda australis* low shrubs, and scattered emergent *Melaleuca rhaphiophylla* trees. In some areas the *Suaeda australis* is more dominant, and the *Melaleuca rhaphiophylla* is much reduced.
J2	Sedgeland of *Juncus kraussii* subsp. *australiensis*
J3	Closed Sedgeland of *Juncus kraussii* subsp. *australiensis* over scattered *Tecticornia* spp., with occasionally emergent *Casuarina* sp. and *Eucalyptus* sp. saplings.
OW	Open water
SI	Seasonally inundated
Pl	Planted areas (BPG)
PC	Parkland cleared areas with remnant trees and (Pl)
*A	Tall Closed Shrubland of **Acacia* sp. (possibly introduced - more flowering material required to confirm)
*Rl	**Rubus laudatus* (Blackberry) under canopy of *Eucalyptus rudis*.

Source: DBCA (2019) Ashfield Flats Flora and Vegetation Report, Species and Communities Program.

Table 1. Continued

Symbol	Vegetation Description
Mod	Modified river bank (reinforced)
DistEr	*Eucalyptus rudis* over *Melaleuca* rhaphiophylla over disturbed understorey of introduced *Cyperaceae spp*, **Arundo donax* (Giant Reed). A large **Salix babylonica* (Willow Tree) was also recorded in the vicinity.
Dr	Drain
Tracks	Tracks/Paths
CoD	*Casaurina obesa* growing adjacent to drain

Figure 1: Distribution of vegetation units. Vegetation unit codes are described in Table 1 and DBCA (2019).

1.2 Ecohydrological Tolerances

The halophytes, *Tecticornia* and *Salicornia*, are significant components of the TEC. They are known to be drought and salinity tolerant (Marchesini et al., 2014) and have developed opportunistic strategies to quickly adjust their physiology when freshwater inputs arrive, however they also have a conservative water use strategy reducing transpiration and adjusting chlorophyl content as soils dry out. These and other drought responses were found to be similar across *Tecticornia* species occupying differing niches along an inundation gradient in an inland sub-tropical salt lake (Marchesini et al., 2014).

Growth decreases tends to occur at low salinity (10 mM NaCl and below) and very high salinity (above 800 mM NaCl) while extreme salinity (e.g. 2000 mM NaCl) in the absence of drought impeded the growth, and induced mortality in, *T. indica subsp. bidens* (Equinox, 2013). Seedling survival is enhanced by the duration of reduced salinity after germination and growth rates of species seem to differ with varying salinity (English and Colmer, 2013).

Tecticornia species also appear to show a wide variation in tolerance to inundation and submergence (Colmer and Flowers, 2008; Colmer et al., 2009; English and Colmer, 2011). Under experimental conditions *T. medusa* showed a greater tolerance to submergence than *T. auriculata* and *T. indica subsp. bidens* (English and Colmer, 2011). The succulent tissues of *T. auriculata* and *T. indica subsp. bidens* swelled and ruptured when submerged, whereas *T. medusa* resisted such damage and was able to photosynthesise underwater (Equinox, 2013). Prolonged submergence is potentially a selective stress preventing *T. indica subsp. bidens* and *T. auriculata* from invading low-lying habitats subjected to longer and deeper flooding events (Equinox, 2013). Changes to the duration, frequency and depth of inundation and to salinity are therefore expected to have significant impacts on the halophytes at Ashfield Flats.

1.3 Hydrological Considerations

As shallow groundwater and a strong tidal interaction are expected at the site a better understanding of the local hydrology can guide its future management. An improved conceptual model of the hydrology may help mitigate some of the threats to this community which includes processes related to urbanization, pollution, and climate change, including sea level rise.

Historically urbanization developed in Bassendean in association with drainage to lower groundwater levels (APACE, 1988). As a result, several drains convey stormwater through the site and several other stormwater outlets discharge directly into the wetlands. Key unknowns related to this include the quantity of stormwater discharging to and through the site, the quality of this stormwater and how the drains interact with groundwater and surface water at the Reserve and potentially impact the TEC. Sea level rise is likely to modify the functioning of these drains and their interactions with the TEC as well as to raise groundwater levels within the TEC. Urbanization regionally may also potentially raise upgradient groundwater due to increasing stormwater infiltration and reduced evapotranspiration with urbanization (Locatelli et al., 2017). Conversely groundwater abstraction and climate change may have the opposite impact. A better conceptual model of the local hydrology will help assess how these regional processes may impact the Reserve.

A former fertilizer and sulphuric acid manufacturing facility and an iron works were located to the north of Guildford Road are known to have significantly contaminated soils and groundwater which flow toward Ashfield Flats Reserve (DWER, 2019; 2020). Pyritic cinders and demolition wastes were encapsulated within a purpose-built containment cell at one site. Contaminated groundwater reportedly discharged to the adjacent open Chapman Street Drain at the Tonkin Industrial Estate (EPA, 1999). An acidic groundwater plume is thought to have migrated to the Reserve, liberating metals in the aquifer, and may possibly be intercepted by the drains discharging to the site (Kellenberger, 1998). To the south of Guildford Road and to the northwest of the TEC, Ashfield Reserve is also listed as a suspected contaminated site, although there are no details currently available from the Department of Water Environmental Regulation. It is not known if contaminated groundwater or surface water has reached, or is still, discharging to the wetlands.

The Reserve itself is also known to contain acid sulphate soils (ASS; Loos, 2003), naturally arising in estuarine wetlands. At elevations < 5m AHD, which covers most of the Reserve, high acid generation potentials (<88 kg H_2SO_4 m^{-3} soil) were found in the clayey sediments, while in the Bassendean sands at elevations > 5 mAHD, acid generation potentials were lower (0.6 – 68 H_2SO_4 m^{-3} soil). Further assessment of sediment geochemistry at the Reserve would help characterize the hydrological processes as well as inform future management options.

Lastly, climate change has altered the magnitude of winter flows in the Swan River and is raising sea levels which may alter the flooding regime in the future. The way in which the wetland currently interacts with the Swan River is unknown though, due to the presence of temperate estuarine salt marsh vegetation, a tidal influence is expected. The estuarine processes modifying water levels are numerous and include wind, barometric, river flow, regional currents as well as sea-level rise (Savenije et al., 2008; Pattiaratchi, 2011). Furthermore, there is a need to understanding the dynamics of water levels in the wetlands, including the dynamics of flooding, and the subsequent water and solute balances of groundwater recharge, direct rainfall precipitation, stormwater inflows, and evaporative drying. The spatial pattern of inundation may help better define the hydrological niche exploited by various salt marsh species. In addition, climate change in the coming decades will modify the frequency of flooding and the balance between precipitation and evaporation potentially further altering the annual hydro-period. Understanding these potential changes may help set constraints on future management of the site and/or identify critical environmental changes, such as the rate of accretion of wetland sediments, that would be required to maintain the status quo.

1.4 Outline

This study aimed to assess the current hydrological and geochemical status and processes in the Reserve. The objectives were to:

- undertake a monitoring program to measure key aspects of the hydrology in the Reserve;
- assess and model water levels, flows and water quality with a view to estimating components of the water balance; and
- investigate pollutants in soil and groundwater and their potential sources.

In Section 2 the report firstly develops an understating of the stormwater and urban drainage fluxes via a combination of measurements, data analysis and hydrodynamic modelling. Next, Section 3 explores the estuary processes controlling tidal flooding of the Reserve, including analysing and modelling of newly collected measurements at the site as well as existing meteorological, river level and flow data. In addition, a surface water balance model is developed and validated on observed wetland water levels. The model is then used to hindcast historical surface water level dynamics to establish the present range of variation of inundation and then to forecast the impacts of sea-level rise and climate change to 2090. Section 4 focusses on groundwater at the site, reporting the results of geophysics surveys and a groundwater investigation to characterize the local aquifer, the dynamics of measured groundwater levels, to assess aquifer hydraulic properties and the ways in which groundwater interacts with surface water. Section 5 reports groundwater and surface water quality observations, and estimates pollutant loads in the stormwater and their potential sources. Lastly Section 6 reports on the sediment geochemistry, characterising the TEC's substrate, including acid sulphate soils, and identifying pollutants and their possible sources

2 Urban Drainage

The contribution of stormwater to the wetland is not known. Anecdotally the Chapman St drain near the bend at the top of the wetland (Figure 2 and Figure 3) overtops its embankments and contributes to flooding of the wetland. The Water Corporation is responsible for the Chapman St Drain as well as the Kitchener St Drain. These drains convey stormwater as well as groundwater through the site to the Swan River. It is also not known whether they interact with the wetlands via groundwater, though this is explored in Section 4.3. There are at least five other stormwater drains that discharge directly onto the site (Figure 5), and one, the Woolcock Ct Drain, which has been observed to flow perennially.

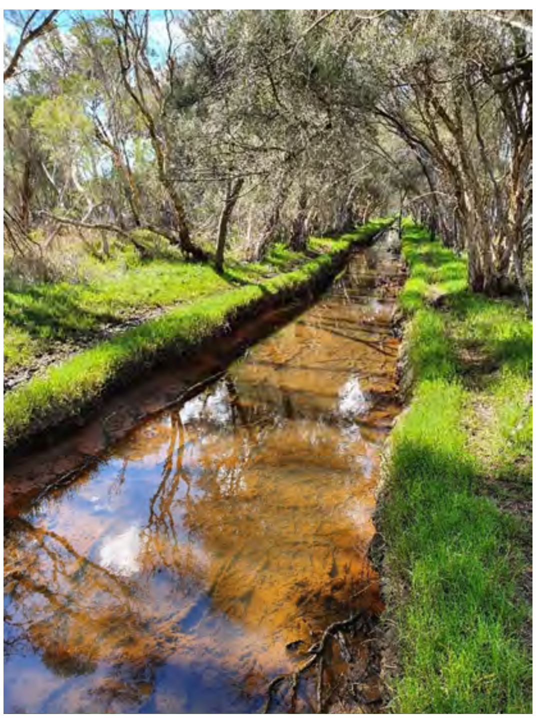
To quantify the stormwater hydrology a monitoring program was established to measure the flows in the Woolcock Ct Drain as it appeared to have the most direct impact on the wetlands. Next, with this and available monitoring of flows in the Chapman St Drain and an adjacent subcatchment (here termed the Lower catchment) numerical hydrodynamic models of the flows were developed and calibrated. Assuming that calibrated catchment properties in the gauged catchments are transferrable the flows in the remaining catchments were simulated to provide estimates of the stormwater flows to the Reserve and the Swan River.

2.1 Methodology

2.1.1 Stormwater Infrastructure

Data detailing stormwater infrastructure was obtained from the Town of Bassendean. This data set consisted of the locations of stormwater pits, pipes and open channels, their inlet and outlet elevations, construction dates and material type. Approximately 30% of this data were missing. Utilizing this data together with a 5 m $\times$ 5 m resolution digital elevation model the topology of the network was estimated along with the extent of surface catchments for each junction. Expert judgment was used to size pipes levels of inverts where this information was missing. In the absence of other information invert elevations were assigned progressively upstream to ensure smooth transitions between pipes and pipe depths at reasonable distances below the ground surface. Subcatchments for pipe inlets were inferred from the surface topography and the connectivity of impervious areas. The fraction of impervious area for subcatchments was estimated from urban land cover (van Dongen, 2020). The spatial distribution of landcover classes is shown in Figure 4.


(a) (b)




(c) (d)

Figure 2. Outlets of the Woolcock Ct (a), Chapman St and Lower catchments near Reid St (b); the Chapman St drain near the Swan River; and (c) Kitchener St Drain.

Figure 3: Open drains discharging to or draining through the Reserve.

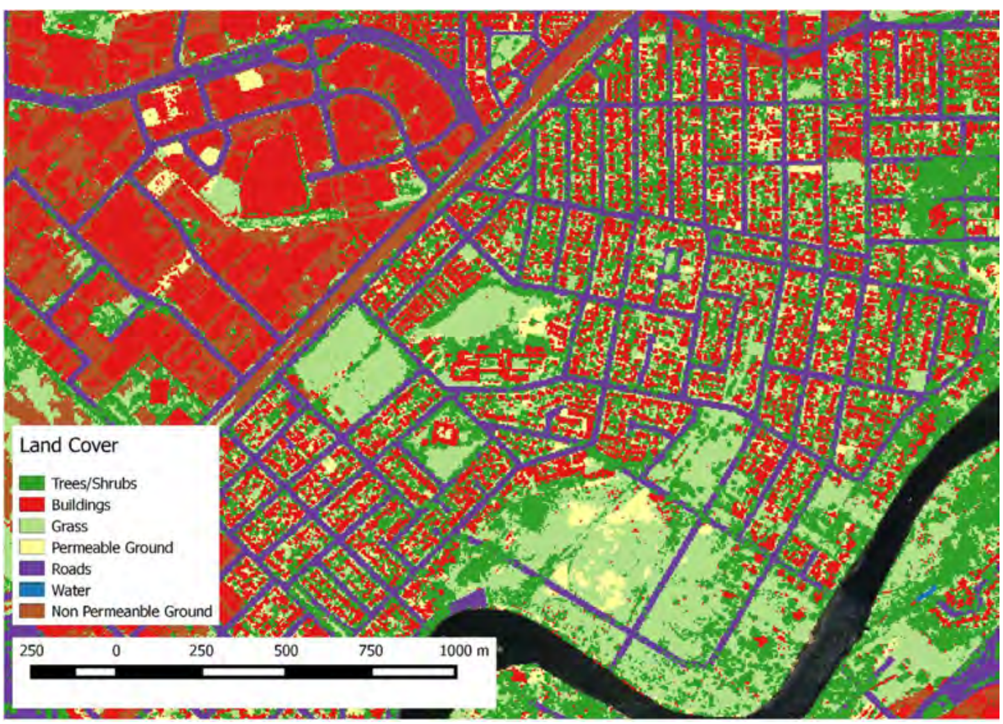


Figure 4: Landcover classes.

2.1.2 Measurement of Urban Runoff

Runoff data for the Chapman Street Drain and Lower catchments were obtained from the Water Corporation. Runoff rates were measured there using acoustic doppler instruments (Unidata, Perth, Australia) deployed approximately 1 m from the outlets in pipes of diameter: 1050 mm (Chapman Street) and 450 mm (Lower) measured average velocities at one-minute intervals (Figure 2). At Woolcock Ct the open drain near the pipe outlet was straightened and stabilized prior to the installation of an unvented water level sensor (Solinst Level Logger Model 3001), barometer (Solins Barrologger Model 3001), acoustic doppler (Unidata Perth, Australia; Starflow ultrasonic, model 6526) and an electrical conductivity probe (Unidata, meter model 6536E and probe model 6536P) (Figure 2). A subsurface pipe conveying water under the pathway acted as the outlet control structure. Manual flow measurements were conducted three times to establish a flow rating curve for the structure however there remained considerable uncertainty for flow estimates of high flow rates. This was due to the very rapid variation in flow of the course of just a few minutes and large flow events occasionally overtopped the open drain and pathway, overwhelming the control structure.

2.1.3 Baseflow Separation

Seasonal and event-based groundwater contributions to outflow at Woolcock Court and Chapman Street were evident from the data. There did not appear to be a significant groundwater contribution to the outflow from the Lower catchment due to the short periods of flow following rain events and the absence of sustained flow between rain events. Baseflow separation analysis was conducted to distinguish the slow baseflow from the quick storm flow responses using a digital filter method (Lyne and Hollick, 1979; Nathan and McMahon 1990). The recommended value used by the digital filter of 0.95 appeared adequate. From this separation a base-flow index (BFI) was calculated as the ratio of total base-flow to total runoff (Table 4). Rainfall data from Perth Airport (Station Number 9021) was aggregated to a resolution of 5 minutes and using rain-free periods of 3 to 7 hours distinct rainfall events were identified. The shorter period was used for Woolcock Ct and Lower catchments as this reflected the time for flow to recede to background levels following the cessation of rainfall. The longer period was used for observed flows from the Chapman St catchment. On this basis runoff coefficients were calculated as the ratio of quick flow occurring from the start of a rainfall event up until the start of the next rainfall event to the rainfall event amount (see Table 4 and Figure 8).

2.1.4 Modelling Stormwater Flows

Characterization of the stormwater system was conducted to facilitate modelling of the longer-term water balance with the use of the Storm Water Management Model (Rossman and Huber, 2015). SWMM was designed to simulate the hydrodynamics of water flow in urban stormwater networks. It applies conservation of mass and momentum using the 1-D Saint Venant equations and a mixture of empirical equations for simulation of infiltration, evaporation and frictional energy losses. The SWMM software version 5.1.012 was used in modelling.

Horton's method was used to simulate infiltration on pervious surfaces. Unlimited ponding was allowed at junctions. Dynamic wave routing was used for modelling flow in the network, with the Hazen-Williams approach used for full pipe flow, dampening of inertial terms and a head convergence criterion of 1.5 mm. A 10 second timestep was used for flow routing and results reported at five minutes intervals.

The initial hydrologic parameters for use with the SWMM model for all catchments are specified in Table 2. Sub-catchment slopes were estimated fitting a plane to the surface elevation data. The hydrological widths of subcatchments were estimated manually by measuring the length perpendicular to the assumed flow directions. The connectivity of pipes in some instances had to be inferred from incomplete pipe and junction data using expert judgement.

Spatial datasets were created containing all the attribute information and default model values. These were then converted to input files for SWMM using the R package *swmmr* (Leutnant et al., 2019). The package was also used to apply automatic calibration methods to adjust uncertain model parameters so as to better reproduce observed flows.

2.1.5 SWMM Model Calibration

Automatic calibration of SWMM model parameters was conducted via the differential evolution algorithm (Storn and Price, 1997; Mullen et al., 2011). The algorithm is global optimization method suited to noisy and non-smooth objective landscapes. As an evolutionary technique it transforms a set of parameter vectors, termed the population, into another set of parameter vectors, the members of which are more likely to minimize the objective function. Over successive generations the population settles into local optima which may be close to the global optimum. The metric used to quantify the goodness of fit between modelled (M) and observed (O) flow rates was the Nash-Sutcliffe Efficiency (NSE):

$$NSE = 1 - \sum_{i=1}^{n}(O_i - M_i)^2 \Bigg/ \sum_{i=1}^{n}(O_i - \bar{O})^2 \qquad \textit{(Equation 1)}$$

Where $\bar{O}$ denotes the mean observed runoff (Nash and Sutcliffe, 1970) of *n* observations. An NSE = 1 indicates an error variance of zero, an NSE = 0 indicates an error variance equal to the variance in the observed data and an NSE < 0 indicates the observed mean is a better predictor than the model. The NSE can be sensitive to outliers and this is particularly the case in urban hydrology with fast response times. Even small differences between rainfall measured at a gauge and that which occurs in a catchment can produce such outliers. A modified NSE can somewhat compensate for outliers and is calculated via the ratio of the sums of the absolute differences, i.e.:

$$NSE_1 = 1 - \sum_{i=1}^{n} |O_i - M_i| \Big/ \sum_{i=1}^{n} |O_i - \bar{O}| \qquad \textit{(Equation 2)}$$

The calibration procedure started with the Lower catchment. The uncalibrated model significantly overestimated runoff. In response the depression storage on pervious areas was increased to minimize significant contributions from these areas. Next the fraction of impervious area contributing runoff (f) (cf. Table 5), Manning's *n* of impervious area (n_I) and the depression storage of impervious area (S_I) were estimated via the optimization algorithm. For Woolcock Ct the optimized parameters from the Lower catchment assumed to initiate the calibration. Optimization in this case also estimated different fractions of impervious area contributing runoff from subcatchments of high imperviousness (f_1) and low – medium imperviousness (f_2), and a scaling factor of the subcatchment widths, f_W. This was applied based on judgement that the peakedness of hydrographs needed to increase while the magnitude of total flow needed to decrease to better match observed flows. Finally, for the Chapman St catchment, only the parameters f_1, f_2 were estimated using other parameters as estimated from calibration of the Lower catchment.

Table 2: Pre-calibration SWMM model parameters.

Parameter	Description	Value
Sub-catchment properties		
n-Imperv (n_I)	Manning's n for impervious surfaces	0.016
n-Perv (n_P)	Manning's n for pervious surfaces	0.03
Dstore-Imperv (S_I)	Depression storage impervious surfaces	2.54 mm
Dstore-Perv (S_P)	Depression storage pervious surfaces	5.08 mm
Percent routed (f)	Amount of runoff routed to the outlet	100 %
Infiltration Properties		
Max-Infil. Rate	Maximum infiltration rate	150 mm hr^{-1}
Min Infil. Rate	Minimum infiltration rate	120 mm hr^{-1}
Decay Const	Infiltration rate decay constant	7 hr^{-1}
Drying Time	Time in days for full recovery of infiltration	3 days
Max. Volume	Maximum infiltration volume possible	33.2 mm
Link Hydraulic properties by material type (Manning's n)		
Manning's n	Asbestos cement	0.011
	Clay tile	0.014
	Concrete	0.012
	Earth channel - weedy	0.030
	PVC	0.009

2.2 Results

2.2.1 Stormwater Catchments and Runoff Characteristics

A total of 11 stormwater catchments of relevance to Ashfield Flats were identified (Figure 6). Catchments identified a range of catchments sizes from 129 ha for the Chapman St Drain to 2.3 ha for the Spring catchment (

Table 3), a set of houses along the escarpment that has been observed to have drainage discharging into the Eucalypt woodland thought to be location of a groundwater spring. Of the catchments discharging directly into the Reserve the Woolcock Ct Drain is the largest, at 16.6 ha.

Table 3: Stormwater catchment characteristics.

Catchment	Area ha	Drainage density m ha^{-1}	Imperious area[a] %
Chapman St	129	121	69
Pearson St	50.7	91	42
Woolcock Ct	16.6	102	45
Kathleen St	16.5	120	50
Lower	10.4	157	49
Kitchener St	9.1	141	52
Dorothy St	8.0	73	51
Iveson Pl	6.4	136	52
Bend	4.1	215	56
Lookout	3.0	92	54
Spring	2.3	70	53

a: Calculated as the sum of road, buildings and non-permeable ground as classified in van Dongen (2020).

Drainage density averaged 115 m ha^{-1} of conduit and impervious area averaged 58% across all catchments. The Chapman St Drain has the highest imperviousness as expected as ~50% of the catchment area is in the industrial area, to the west of Guildford Rd. The connectivity of pipes in the mid-section of the Chapman St Drain was challenging to interpret from the available data and the amount of missing information regarding slope directions and invert levels. As a result, there remains some uncertainty as to how well the model represents the connectivity of the section of the catchment, above Guildford Road, to the lower portion of the catchment and the outlet at the Swan River.

Table 4: Observed stormwater runoff characteristics.

Catchment	Annual Flow ML	Runoff Coefficient[c] mm mm^{-1}	Base flow Index mm mm^{-1}
Chapman St[a]	377.5	0.11±0.06	0.65
Woolcock Ct[b]	55.7	0.15±0.11	0.65
Lower[1]	5.2	0.33±0.33	0

a. For the year September– 2018 – September 2019; b. For the year August – 2019 – August 2020; c. Mean ± the standard deviation

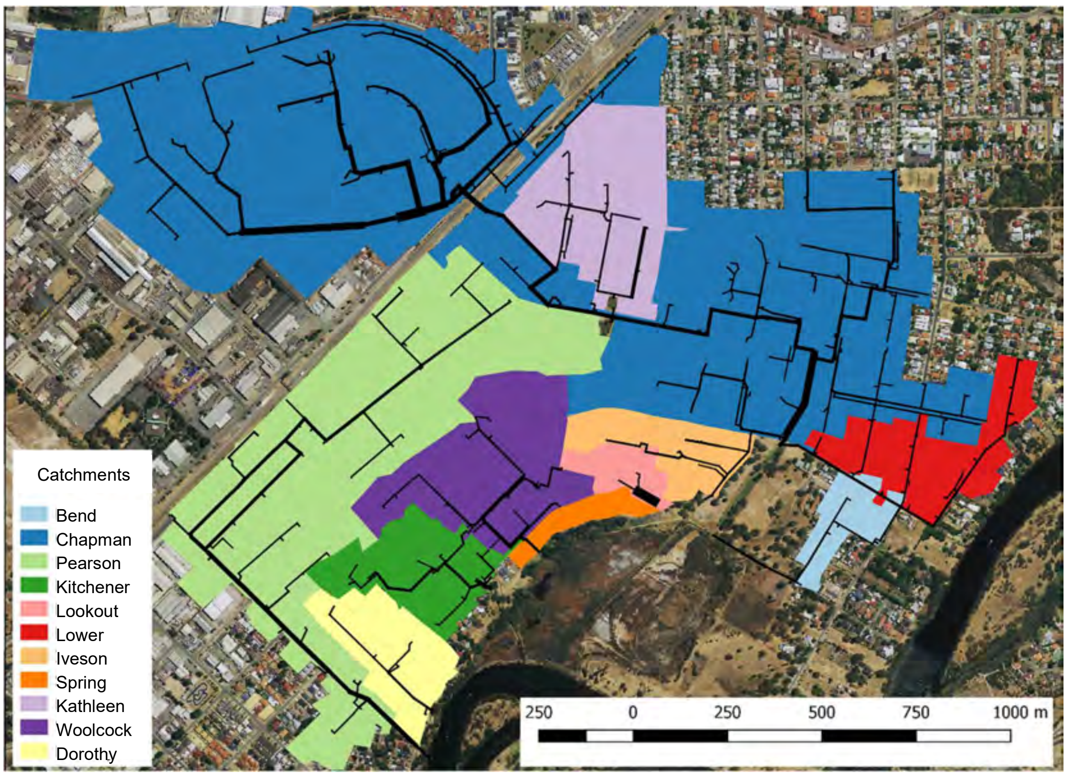


Figure 5: Stormwater network (black) and stormwater catchments. Line widths correspond to conduit sizes.

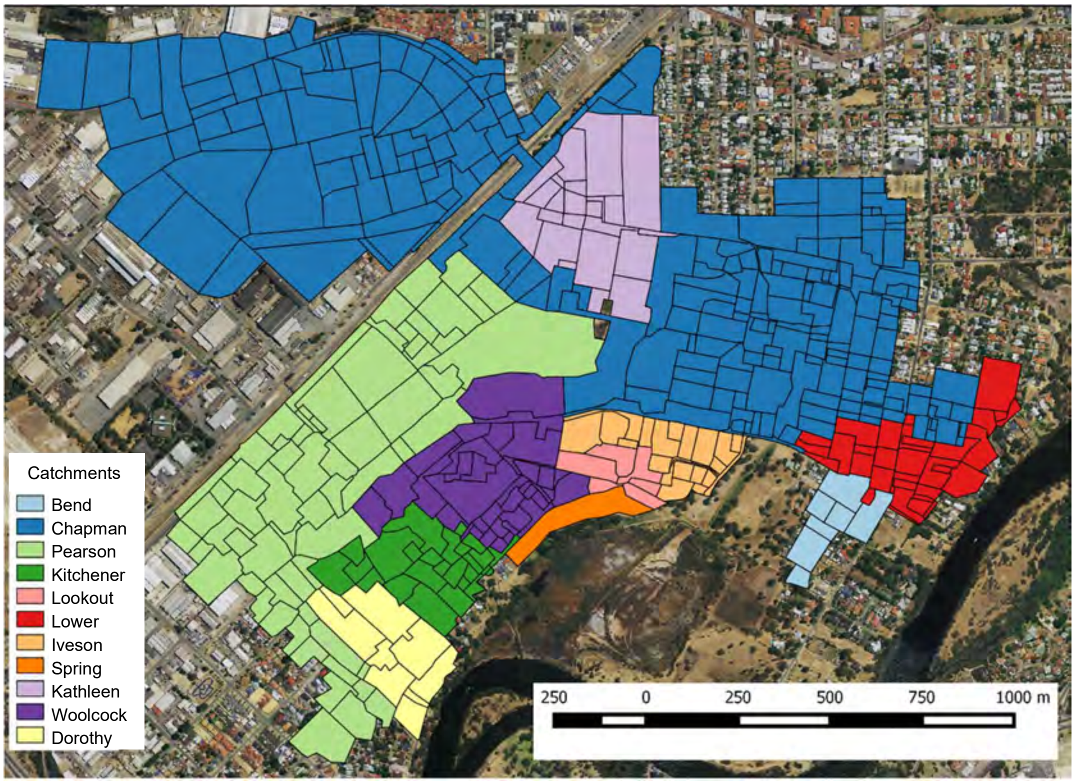


Figure 6: Stormwater subcatchments.

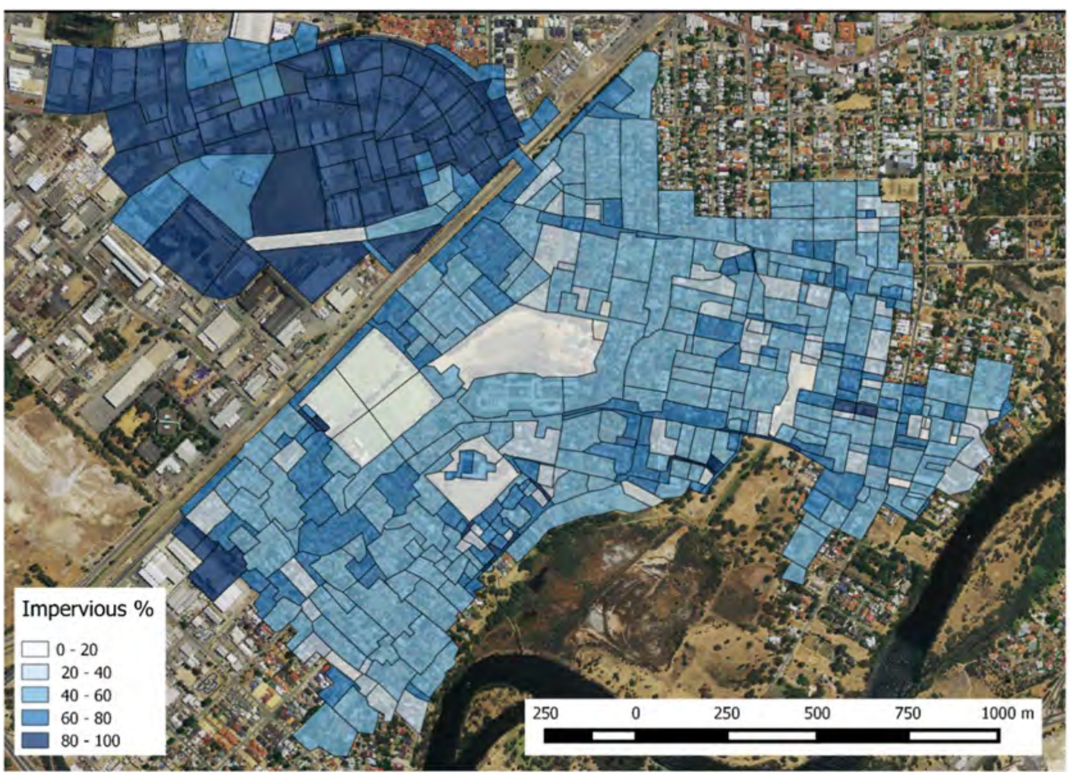


Figure 7: Percent imperious area.

2.2.2 SWMM Model Calibration and Validation

The parameters of the SWMM models estimated via the calibration procedure are shown in Table 5 and the corresponding NSE and NSE_1 for periods of model calibration and separate periods of model validation are shown in Table 6. The calibrated parameters provide insights into possible runoff generation mechanisms in each catchment.

In the Lower catchment the fraction of impervious area contributing runoff was reduced to 28% of that initially assumed. Given impervious area was estimated from remote sensing and the area is primarily residential with a large proportion of roofs and driveways that are connected to sumps and subsurface drains the calibrated value seems reasonable. The calibrated depression storage on impervious area was slightly less than initially estimated and results in more frequent small runoff events to be simulated. Lastly the smaller than initially assumed roughness coefficient allowed more flashy hydrographs. This may be caused by an under-estimate of the flow width for sub-catchments or their slope or for not distinguishing road sub-catchments or highly impervious sub-catchments from low to medium sub-catchments as was deemed necessary for Woolcock Ct and Chapman St catchments. Nevertheless, the calibrated and validated NSEs were large (Table 6) indicated the model reproduced well the observed flows.

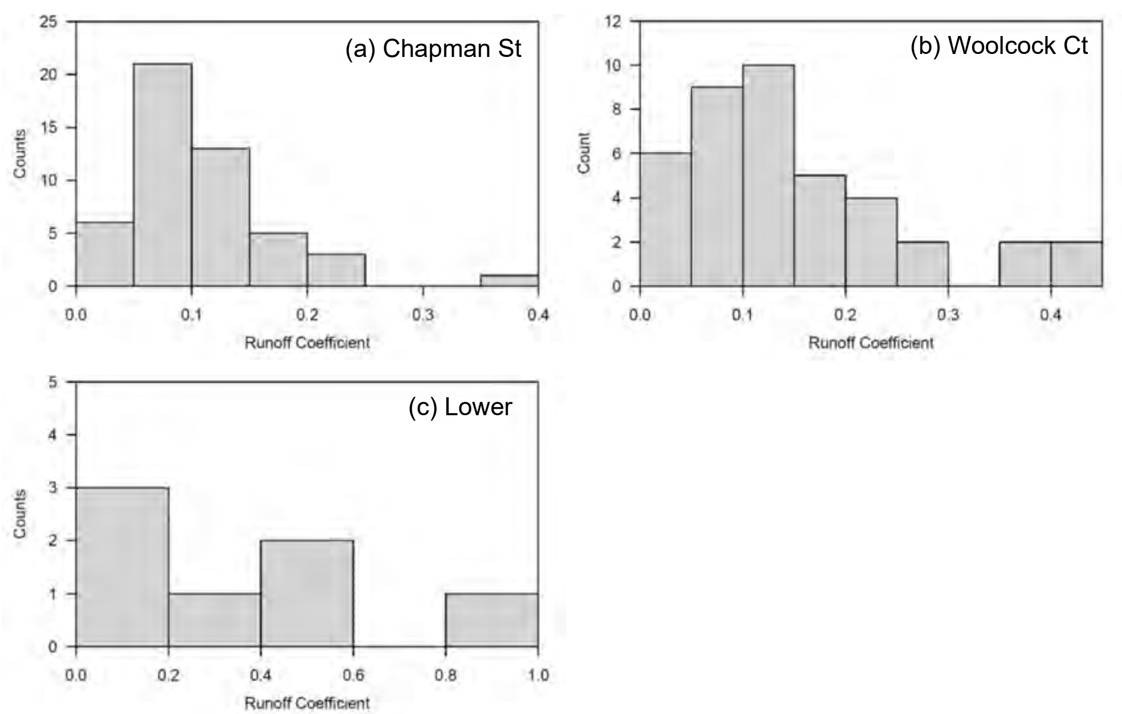


Figure 8: Quick-flow runoff coefficients at monitored stormwater catchments.

Table 5: Calibrated SWMM model parameters

Catchment	f_1	f_2	n_I	S_I mm	S_P mm	f_w
Lower	0.28	0.28	0.01	1.8	25	1
Woolcock Ct	0.01	0.34	0.01	1.8	25	3
Chapman St	0.01	0.20	0.01	1.8	25	1

f_1 = the fraction of connected impervious area for selected highly impervious sub-catchments; f_2: = the fraction of connected impervious area for selected low - medium impervious sub-catchments; n_I = Manning's n of impervious surfaces; S_I: surface detention storage on impervious surfaces; S_P: surface detention storage on pervious surfaces; f_w: multiplier of sub-catchment width

Table 6: Calibration and validation of SWMM model.

Catchment	Period	NSE	NSE_1
Calibration			
Lower	8th – 24th November 2019	0.94	0.70
Woolcock Ct	4th – 15th August 2019	0.60	0.60
Chapman St	4th June – 2nd July 2019	0.85	0.69
Validation			
Lower	1st October – 7th November 2019	0.66	0.42
Woolcock Ct	5th July – 14th October 2020	0.39	0.55
Chapman St	4th October 2018 – 4th June 2019	0.77	0.66

NSE: Nash-Sutcliffe efficiency.

The calibration of the Woolcock Ct model resulted in a significant decrease in the fraction of impervious area contributing runoff from areas deemed to have high imperviousness i.e. f_1 = 0.01 while runoff from low-medium impervious subcachments was higher than the average of the Lower model f_2 = 0.36. In addition, the calibrated subcatchment flow widths were three times larger than initially estimated which may be due to the very fast response times of flow in this catchment and in part to the distance to the Airport rain gauge. Wider subcatchments respond more quickly and have shorter times to peak flow than narrow catchments of a similar area. Rainfall arriving slightly later at the Airport gauge than at the Woolcock Ct catchment would lead to delays in the simulated runoff as compared to observed flows and, as a result, skew parameters towards values reflecting a "flashy" or rapid hydrological response. An additional reason could be the presence of high groundwater leading to partially flooded pipes. Flow from this network is perennial with baseflows during dry periods of the order of 1 – 2 L s^{-1}. The celerity of the hydrological response would be faster in partially filled pipes and the simulation model may be underestimating the extent of the network that is partially flooded.

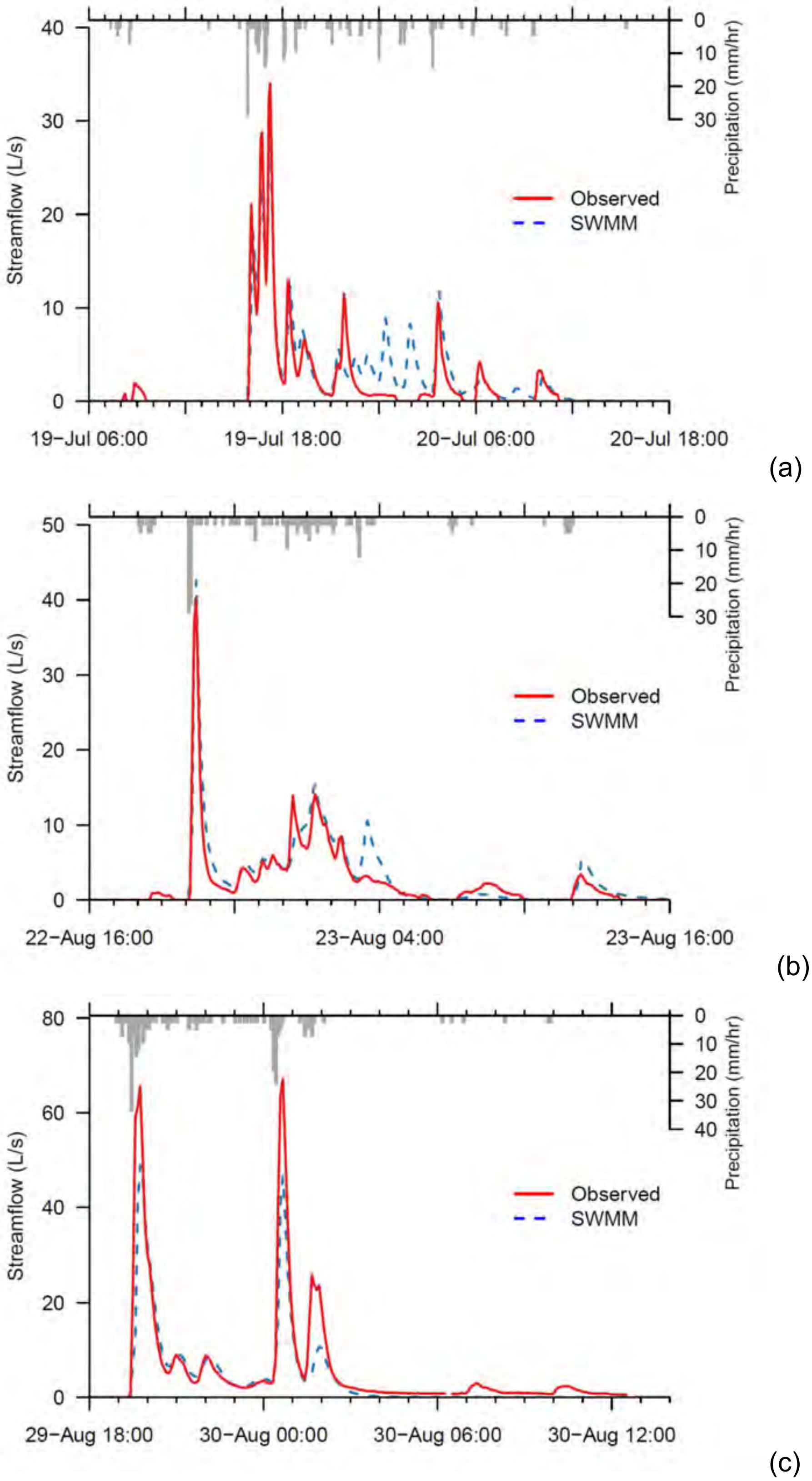


Figure 9: Observed and simulated (SWMM) hydrographs at the outlet of the Lower catchment, July 2019 (a) and August 2019 (b, c).

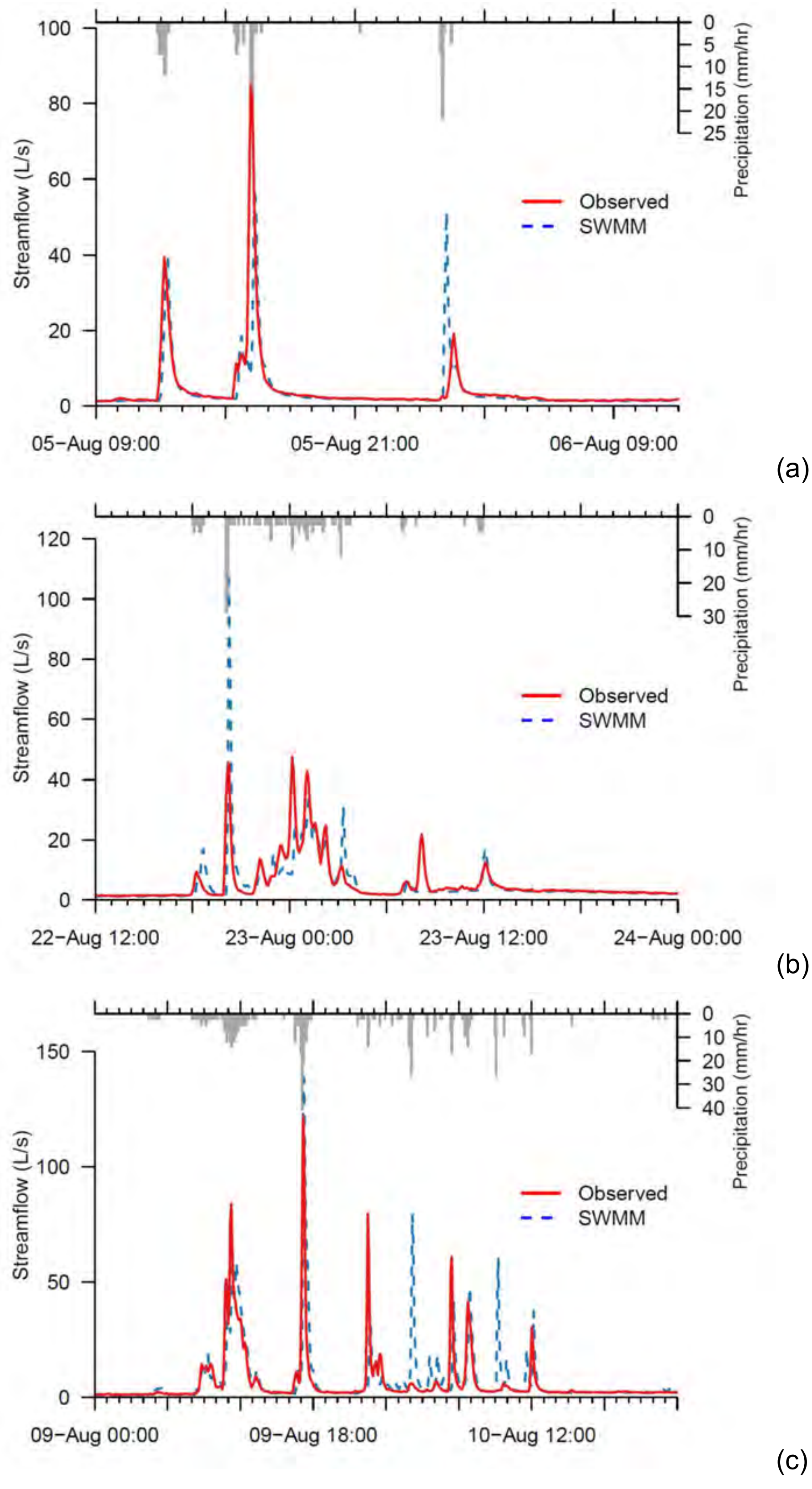


Figure 10: Observed and simulated (SWMM) hydrographs at the outlet of the Woolcock Ct catchment, August 2019 (a, b); and August 2020 (c).

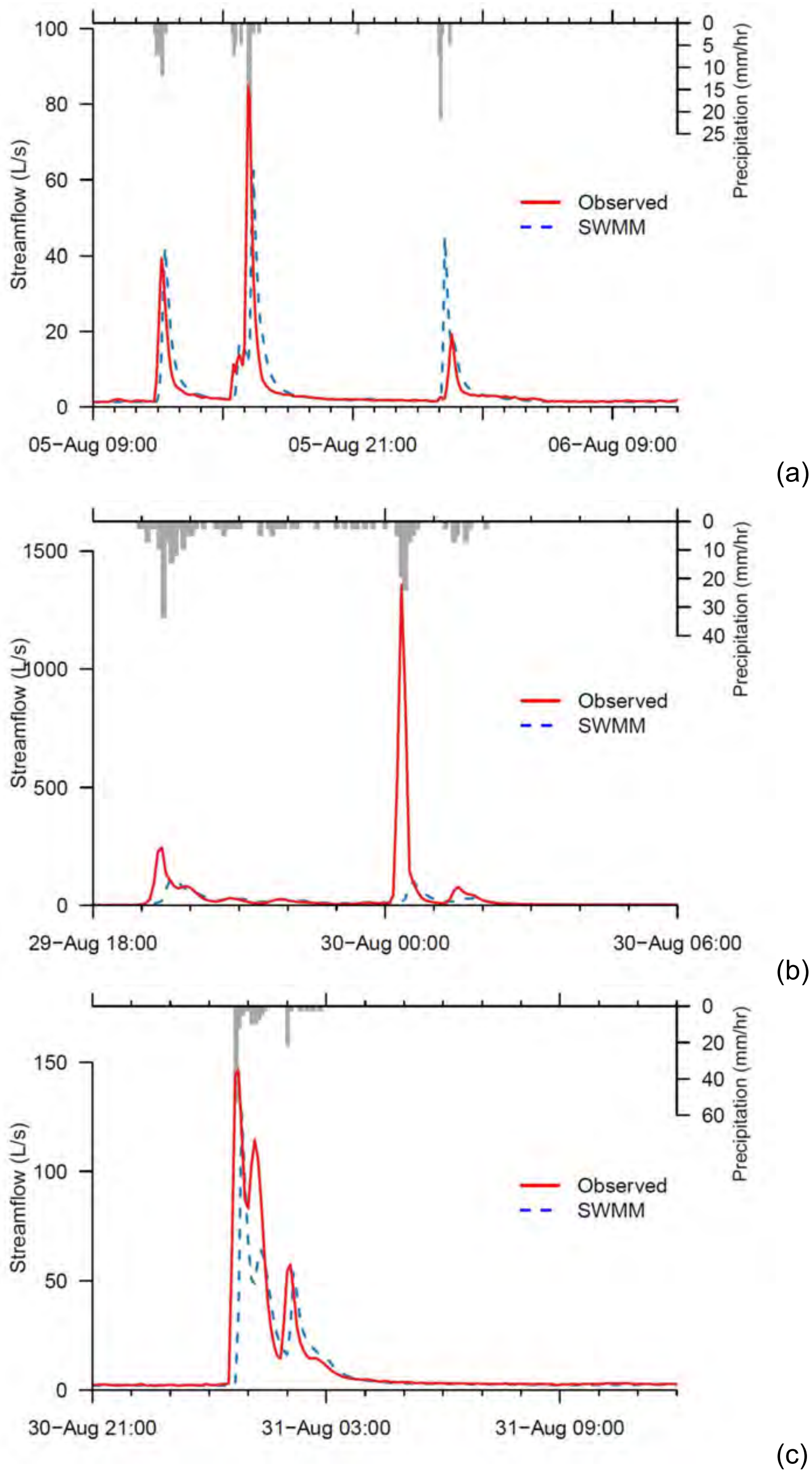


Figure 11: Observed and simulated (SWMM) hydrographs at the outlet of the Chapman Street catchment, August 2019 (a, b, c).

Like the Woolcock Ct model the calibration of the Chapman St model suggested a small contribution from subcatchments with high impervious area (f1 = 0.01) while 20% of the impervious area in subcatchments classed as low to medium imperviousness was estimated to contribute runoff. In the Chapman St model the subcatchments with high imperviousness were nearly all from the industrial area, north of Guildford Rd (Figure 7). This parameterization suggests there may be weak hydrological connectivity between the upper and lower parts of the catchment (Figure 5). This may be due to infiltration in the open drains and overflow to the retention basin that the Kathleen St catchment discharges to. Regulations requiring infiltration of stormwater onsite in the industrial area may be another factor. There is a need to continue to improve the hydrological model for both the Woolcock Ct and Chapman St catchments as they are known sources of pollutants to the wetland and Swan River.

The models generally reproduce the observed runoff well (Figures 9 - 11 and Table 6). Some of the discrepancies are clearly the result of differences between rainfall that occurred at the Airport gauge and in the catchments.

2.2.3 Long – Term Runoff Characteristics

To simulate the hydrology of the stormwater catchments over a longer period first the parameters of the ungauged catchments needed to be assigned. Parameters for the Woolcock Ct catchment were applied to Kitchener St, Lookout and Spring catchments. Parameters for Dorothy St, Pearson St, Bend, Iveson Pl, and Kathleen St catchments were adopted from Lower. Baseflow was not simulated. Visual observations suggest baseflow occurs at Kitchener St and does not to occur at Lookout, Spring, Kathleen St, and Bend. It is unknow if Baseflow occurs at Dorothy St and Pearson St and while these two catchments do not discharge directly to the wetland they are considered here as they potentially capture contaminated groundwater that has been observed at Woolcock Ct and Kitchener St.

Table 7: Modelled annual runoff characteristics.

Catchment	Annual Flow ML	Range ML	Runoff Coefficient -
Chapman St	86.4 ± 90.1	24.4 – 320.1	0.10 ± 0.11
Pearson St	41.1 ± 27.9	16.4 – 125.4	0.12 ± 0.07
Woolcock Ct	52.9 ± 12.0	16.4 – 125.4	0.12 ± 0.07
Kathleen St	4.3 ± 4.1	1.8 – 17.1	0.04 ± 0.03
Lower	9.3 ± 5.7	3.9 – 26.6	0.13 ± 0.07
Kitchener St	11.8 ± 5.0	6.3 – 27.3	0.19 ± 0.06
Dorothy St	7.4 ± 4.4	3.2 – 20.8	0.13 ± 0.07
Iveson Pl	4.4 ± 2.6	1.9 – 12.3	0.10 ± 0.04
Bend	4.0 ± 2.2	1.8 – 10.8	0.20 ± 0.09
Lookout	3.9 ± 1.5	2.2 – 8.3	0.19 ± 0.05
Spring	7.5 ± 1.6	4.7 – 11.5	0.48 – 0.04±

Modelled flows for the period 1997 – 2019. Values shown are the mean ± the standard deviation.

2.3 Summary

The assessment of urban drainage above identified nine stormwater catchments that discharge to or through Ashfield Flats Reserve. An additional two catchments were also identified and characterized as they may be intercepting groundwater pollutants associated with Ashfield Reserve or the encased pyritic cinders at Yelland Way.

A groundwater spring along the escarpment is known to occur and anecdotal observations of ponding of significant amounts of water there seasonally was suggestive of a contribution of the groundwater spring to the TEC communities. Quantification of the urban drainage inflows from the Spring stormwater catchment suggests as much as 7.5 ML a^{-1} of runoff could be discharged to this area. This is equivalent to an average inflow of 7 mm day^{-1} along the edge of the escarpment where the groundwater spring is said to occur. Furthermore, as described in Section 4, there is also a surface water contribution to this area from Swan River tides and river flooding. Both these contributions to surface water reduce the significance of a groundwater spring acting as a significant source of observed surface water ponding along the escarpment. Nevertheless, the high groundwater table there would help sustain pools of fresh water for longer.

During the monitoring program only one occurrence of direct inflows into the wetlands from the Chapman St drain were observed, and this occurred at a time when the wetlands were already being flooded by the Swan River. The Kitchener St drains similarly appears to have a minimal interaction with the wetlands. Sea-level rise will change these interactions as tidal levels begin to exceed the drain banks. With projected sea level rise these drains may have a more significant direct impact on the TEC in the coming decades. Were the drain to directly flow into the TEC because of such changes the present mean annual flow would contribute 1 mm/day to the entire TEC potentially lowering the salinity of any remaining *Salicornia* and *Tecticornia* habitat.

The Woolcock Ct drain however, discharges directly into the western wetlands presently. Monitoring and modelling conducted as part of this study suggest that this flow averages 53 ML a^{-1}, 65% of which comes from a perennial groundwater baseflow. Based upon the approximate area of the three wetland pools in the vicinity of the outlet of the Woolcock Ct drain and the areas between totalling 3 ha, (see Section 6) this discharge contributes on average 5 mm day^{-1} to sustain water levels. While some of this water leaves the wetlands via a side drain to the Chapman St drain it is evident that the construction of the Woolcock Ct drain has led to a freshening of the wetland water pools on the western side of the TEC as well as contributed to a more perennially inundated state. This drain has likely already impacted fringing salt-marsh species and favoured the proliferation of sedges and *Melaleuca* in this western half of the Reserve.

3 Estuarine Water Level Dynamics

3.1 Background

Ashfield Flats is located 33 km upriver from the coast towards at the upper extent of the Swan River Estuary (Figure 12). Water levels in the river adjacent the wetland are therefore influenced by a variety of processes affecting coastal water levels as well as river runoff from several tributaries which converge upstream of the site. Tides are gauged at the coast at Fremantle Fisherman's Wharf, at the centre of the estuary at Barrack Street Jetty, and near the landward extent of the salt-water-wedge, at Meadow Street Bridge in Guildford.

The regional catchments that contribute runoff to the Swan River include the Avon River (gauged at Walyunga), the Helena River, as well as smaller contributions from gauged streams including Bennet Brook, Ellen Brook, Jane Brook and Susannah Brook. The Avon River delivers 84% of the annual inflow into the north-eastern portion of the estuary with typically 85% of these inflows concentrated between June to September (Table 8, Figure 13). The remaining catchments deliver 16% of annual inflows with a similar seasonal pattern.

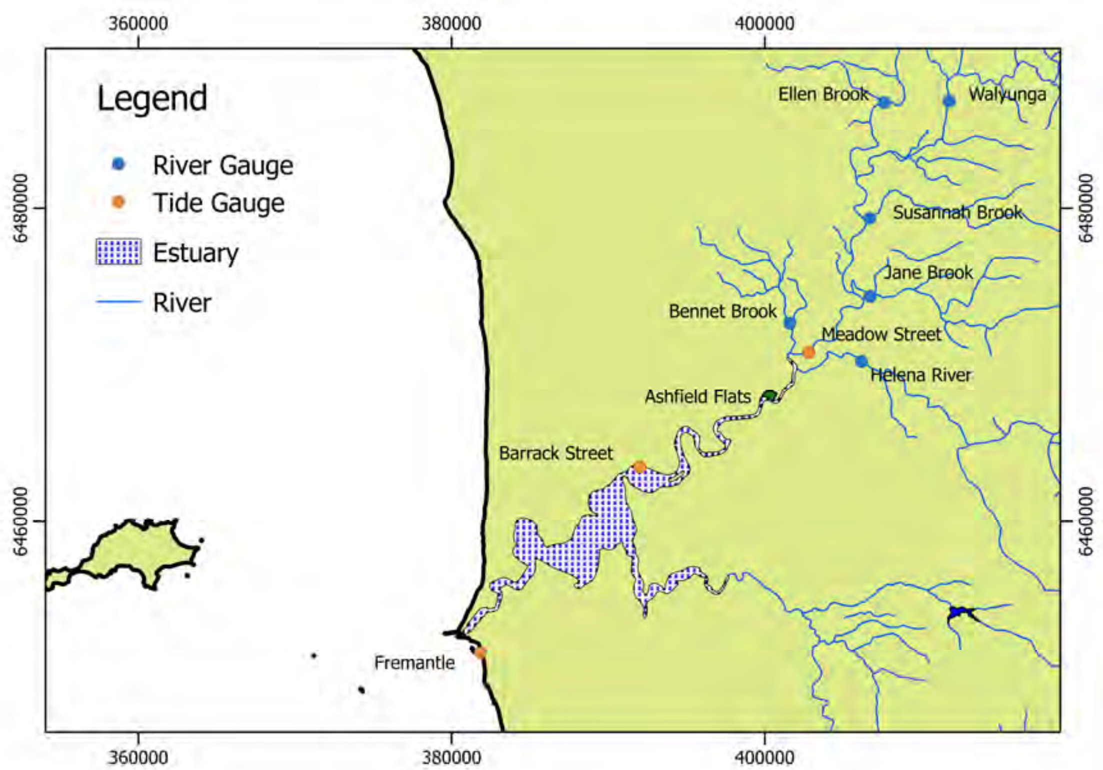


Figure 12 Tidal and river flow gauging stations on the Swan River Estuary. Coordinates are UTM, Zone 50.

Table 8 Characteristics of regional tributaries.

River	Gauging Station ID	Catchment Area km^2	Mean Annual Flow GL	Seasonality Index %	Span of Record
Avon River	616011	18633	287.3	85	1970 - 2020
Ellen Brook	616189	581.4	26.6	91	1965 - 2020
Helena River	616086	161.0	8.6	79	1988 - 2014
Jane Brook	616088	138.1	10.9	87	1988 - 2015
Bennet Brook	616084	99.0	5.9	61	1988 - 2020
Susannah Brook	616099	55.1	4.6	91	1997 - 2020

Station ID is the Department of Water and Environmental Regulation identification number.
Seasonality index is the percentage of annual flows occurring between June – September.

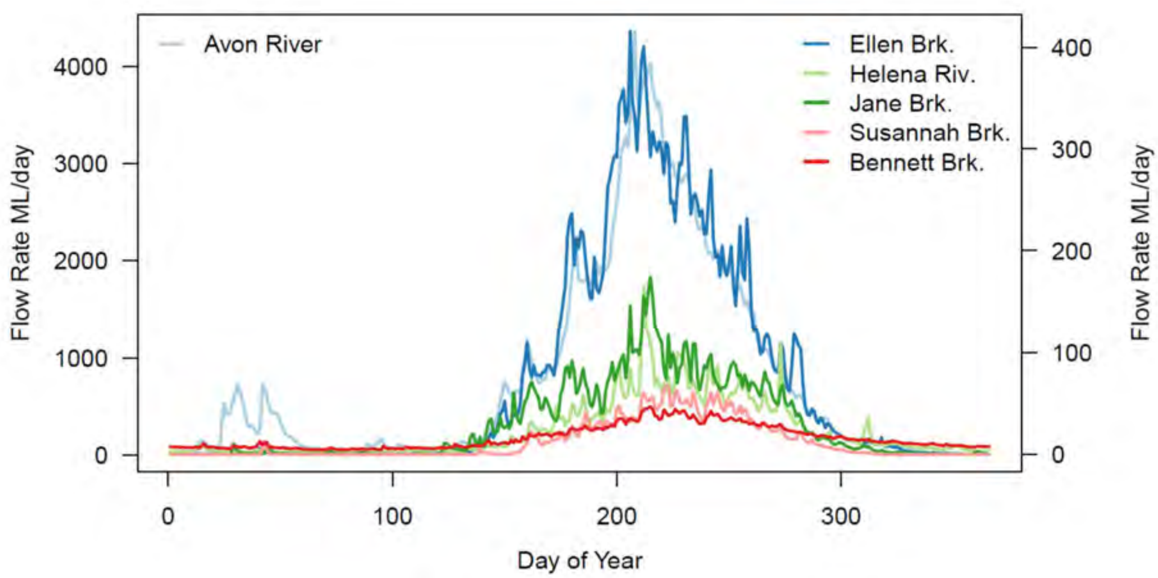


Figure 13: Distribution of mean flows by day of year.

The water levels in the Swan River at Ashfield are expected to be closer to those recorded at Meadow Street than Barrack Street due to their vicinity and the geometry of the river. Tidal data were obtained from DWER and the Department of Transport, the latter adjusted to Australian Height Datum (AHD). At Fremantle the tides are classified as micro-tidal diurnal, with a range of 0.6 m (Pattiarachi, 2011). Due to its microtidal nature, a variety of processes significantly influence water levels at a range of timescales from minutes to decades. Processes that have been quantified include: wind set up (3 – 6 hr, 0.2 m), cold-fronts (1–10 days, ~0.8 m), continental shelf waves forced by remote tropical cyclones (3–10 days, ~0.6 m; O'Callaghan et al., 2007; Eliot and Pattiaratchi, 2010), Leeuwin Current (seasonal, ~0.3 m), inter-annual climate variability such as the El Niño Southern Oscillation (3 - 5 a, ~0.2 m), nodal tides (8.8 - 18.6 a, ~0.2 m; Haig et al., 2011), and climate change (Swan River Trust, 2007).

Water levels in estuaries are impacted by many of these same processes as well as river flows. In shallow water these processes and tides can interact nonlinearly. The combination of estuary geometry, propagating tides and river flows lead to a gradual dampening of tidal amplitudes inland (Jay, 1991; Horrevoets et al., 2004). River flows have a similar impact on dampening (Jay and Flinchem, 1997). In estuaries tidal energy can be progressively transferred from major astronomical constituents to overtides and subtidal frequencies, contributing to tidal asymmetry (Jay, 1991; Savenije et al., 2008). The mechanism for tidal asymmetry stems from the effect of water depth on wave speed (celerity) in shallow waters. Waves propagate faster in deeper water and slower in shallower water leading to unequal durations of rising and falling water levels and associated currents (Guo et al., 2015). The effect of this is that dominant tidal constituents, for example the diurnal M2 tide, can leak energy to higher frequencies at two, three or four times the tidal frequency producing M4, M6, and M8 tides (Pugh, 1987).

The southwest of Western Australia has experienced significant and prolonged decrease in rainfall since the 1970's of the order of 15 – 20%, which has in turn led to a 70% decline of inflows to Perth's water supply dams (Petrone et al., 2010). Furthermore, modelled scenarios of future climates suggest this drying trend will continue (Silberstein et al., 2012). Given the interaction between river flow and tides this raises the possibility that reduced flows may result in an increase in the tidal amplitude and this would be particularly evident in parts of the estuary where both tidal and river flows influence water levels. The extent to which these and future changes impact the occurrence of flooding at Ashfield Flats is a key question. By quantifying the impact of flow on tidal amplitudes the degree to which reduced river flows have been compensated for by rising tidal amplitudes is assessed.

3.2 Methodology

To begin evaluating the above interactions several analyses were performed. First a harmonic analysis was conducted fitting tidal constituents to recorded levels at the Meadow St gauge (Figure 12). Water levels were recorded there every 30 minutes since 1990. Harmonic regression was applied to fit tidal constituents using the R package TideHarmonics (Stephenson, 2016). This accounted for long term variation in mean sea level using a second order loess smooth and nodal variation to account for longer term variations. The analysis was repeated for a range of intervals of flow rate at Walyunga, enabling quantification of the impact of flow on the amplitudes and phases of various tidal constituents.

Wavelet spectra, using a Morlet wavelet basis, were calculated from water levels to assess how tidal energy changed upriver. Cross-wavelet spectra were also determined to further explore the changing dynamics of water levels from the ocean inland (Grinsted et al., 2004; Veleda et al., 2012). To quantify the impact of flow on the water level signals wavelet transforms were performed on data for each year between 1997 – 2019 separately. From these spectra the power signal was extracted at 20 ML hr^{-1} flow intervals from 0 to 200 ML hr^{-1}, and those greater than 200 ML hr^{-1} then the logarithm of these values were then averaged across time to determine an average log power per period. The R package biwavelet (Torrens and Compo, 1998; Gouhier et al., 2019) was used for analysis.

3.3 Results

The distribution of recorded water levels shows that Barrack St and Meadow St have similar occurrences of low water levels while the lowest water levels at Fremantle tend to be 10 cm lower than those at the other two sites (Figure 14). Water levels at Meadow St are on average 3.9 cm higher than at Fremantle (Table 9, **Error! Reference source not found.**). During winter and early spring this increases to a mean difference of 6.5 cm. The frequency of water levels at Meadow St diverges from the other two sites when water levels exceed 0.9 mAHD and this is due to the occurrence of river flows.

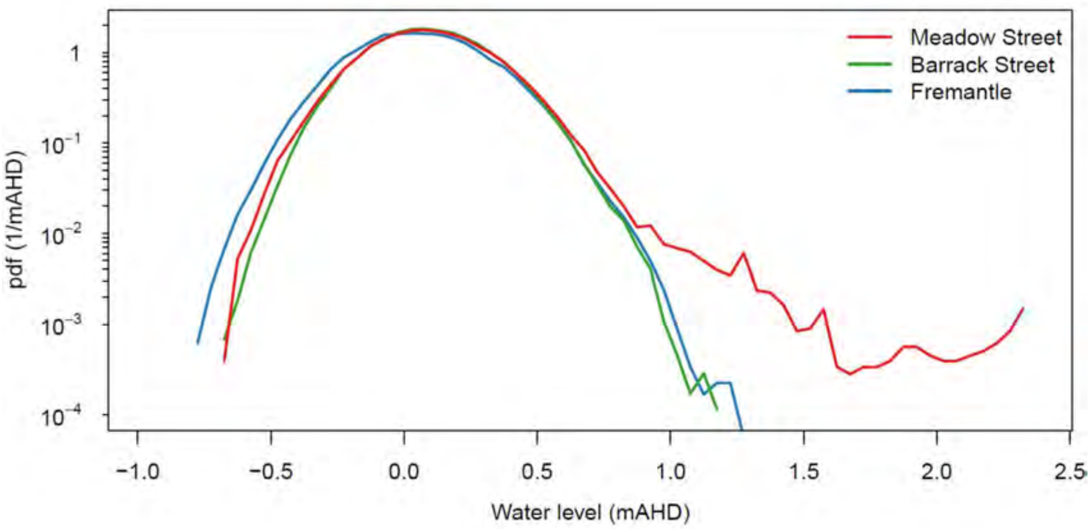


Figure 14 Frequency distributions of water levels in the Swan River Estuary. The relative frequency of occurrence is denoted by the probability density function (pdf).

Table 9: Mean seasonal water levels (mAHD).

Location	October - May	June - September	Span of Record
Meadow St	0.072	0.152	1989 - 2020
Barrack St	0.078	0.133	1988 - 2020
Fremantle	0.046	0.087	1986 - 2020

Table 10: Mean tidal water levels (mAHD).

Location	MLLW	MHLW	MSL	MLHW	MHHW
Meadow St	-0.187	-0.112	0.099	0.310	0.385
Barrack St	-0.196	-0.126	0.096	0.317	0.388
Fremantle	-0.286	-0.179	0.059	0.296	0.403

MHHW / MLHW: The average of the higher/lower high water level of each tidal day over a given period. MHLW / MLLW: The average of the higher/lower low water level of each tidal day over a given period.

The harmonic analysis shows a general trend of weaker tidal amplitudes from the coast inland (Table 11). For example, the K1 tide is reduced by 2.4 cm, the O1 tide by 1.8 cm and the solar annual Sa tide by 1.4 cm by the time the tide propagates to Guildford. One notable exception is an apparent amplification of the fortnightly MSf tide inland. This has been observed in estuaries previously and is thought to be the result of nonlinear interactions between the lunar M2 and solar S2 tides (Pugh, 1987), giving rise to an interaction term of the form:

$$\mathrm{A_{M_2} A_{S_2} \cos\,(2(\omega_0 - \omega_1)t)} \qquad \text{Equation 3}$$

where $A_{M_2} is$ the amplitude of the lunar semi-diurnal tide, $A_{S_2} the$ amplitude of solar semi-diurnal tide, ω_0 and ω_1 their respective angular frequencies, and *t* is time. The resulting period (*T*) of this interaction term is given by:

$$\frac{1}{\mathrm{T}} = 2\left(\frac{1}{\mathrm{T_0}} - \frac{1}{T_1}\right) \qquad \text{Equation 4}$$

where $T_0 and\ T_1 are$ the periods corresponding to ω_0 and ω_1 respectively, which leads to *T* = 14.76 days, similar to the period of the MSf tide. Nevertheless, the amplitude estimated via harmonic analysis is much larger than that predicted by Equation 3 (Table 11). It may be that the harmonic regression is also fitting this tide to river-flow effects which vary on similar timescales though the cause of the discrepancy remains unknown.

Table 11: Amplitude of dominant annual to sub-annual tidal constituents in the estuary.

Tidal Constituent	Meadow St Amplitude m	Barrack St Amplitude m	Fremantle Amplitude m
K1	0.147	0.152	0.171
O1	0.102	0.105	0.120
Sa	0.092	0.093	0.106
P1	0.049	0.046	0.053
M2	0.037	0.035	0.054
S1	0.035	0.023	0.019
S2	0.031	0.029	0.048
Q1	0.023	0.024	0.029
Ssa	0.023	0.024	0.025
K2	0.017	0.014	0.015
MSf	0.013	0.010	0.004
N2	0.010	0.010	0.015

The impact of increased flow rate at Walyunga is to decrease the amplitude of the major diurnal and semi-diurnal tides at Meadow St (Figure 15). The amplitude of the six tidal constituents shown change by ~0.17 m between flow rates of 0 to 200 ML hr^{-1}, which, in the context of the microtidal environment, is a significant change. The flow rate also impacts the phase of the tides, generally leading to an increase in the phase and thus the time for the tide to propagate from Fremantle to Meadow St. At flow rates of ~160 ML hr^{-1} the phase of the diurnal O1 and K1 tides increase by ~20° which equates to an additional lag of 1.3 hr. The semi-diurnal tides are similarly impacted with the most significant changes seen in the K2 tide which shifts by as much as 60° (~2 hr). At the highest of flows evaluated (i.e. > 160 ML hr^{-1}) the phase shift of many of the tides decreases from the peak lag.

Wavelet spectra for the three sites shows the dominant diurnal and semi-diurnal tides along with the fortnightly spring-neap cycle (Figure 17). The inland tides are lagged with respect to Fremantle and show a broadening of energy around the diurnal and semi-diurnal periods and leakage of energy to higher frequency (~ 8 hr) components. There is little significant energy at periods smaller than 6 hr.

Cross-wavelet spectra were calculated for a period of zero flow at Walyunga between January and February 2000, and these show the dominant frequencies shared between Meadow St and Barrack St (Figure 18a) and Meadow St and Fremantle (Figure 18b). The phase lags show the delay at Meadow St relative to the other sites. The time lag can be calculated as:

$$t_{lag} = \varphi\, T/2\pi \qquad \text{Equation 3}$$

where φ is the phase angle and T is the associated period. The dominant diurnal and semi-diurnal tides with a fortnightly spring-neap cycle are evident in the comparison of Meadow St to the other two sites. A small lag of ~1.5 hr occur for the diurnal tides at Meadow St in comparison to Barrack St. The time lag for the semi-diurnal tides is also typically 1.5 hr but can be as small as 45 min. The time lags between Meadow St and Fremantle are ~3 hr (24 hr tides) and 2.5 – 4.5 hr (12 hr tides).

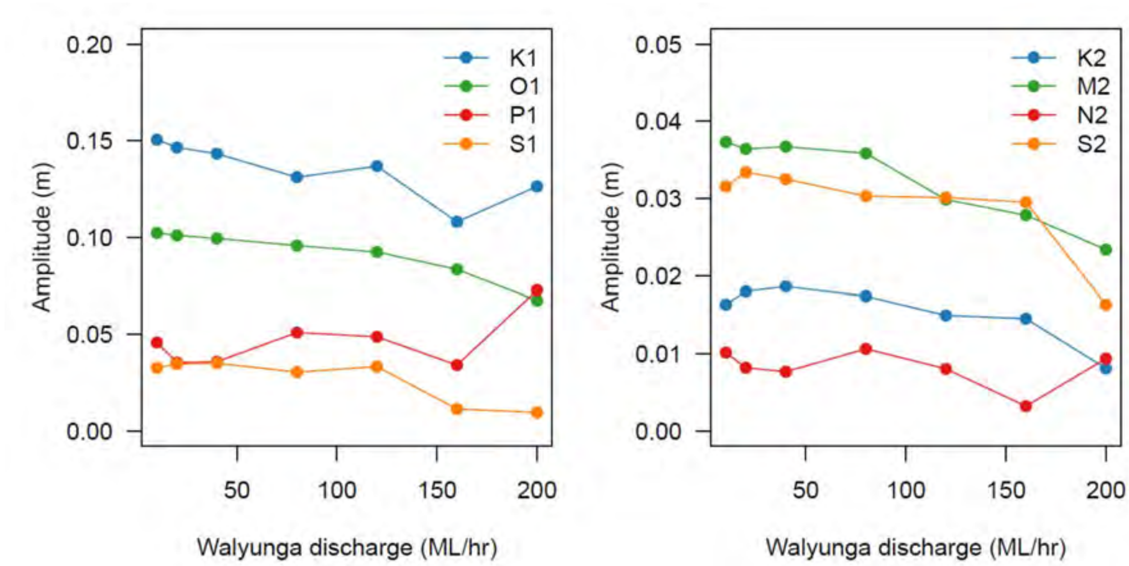


Figure 15 Effect of river flow rates on the amplitudes of tidal constituents.

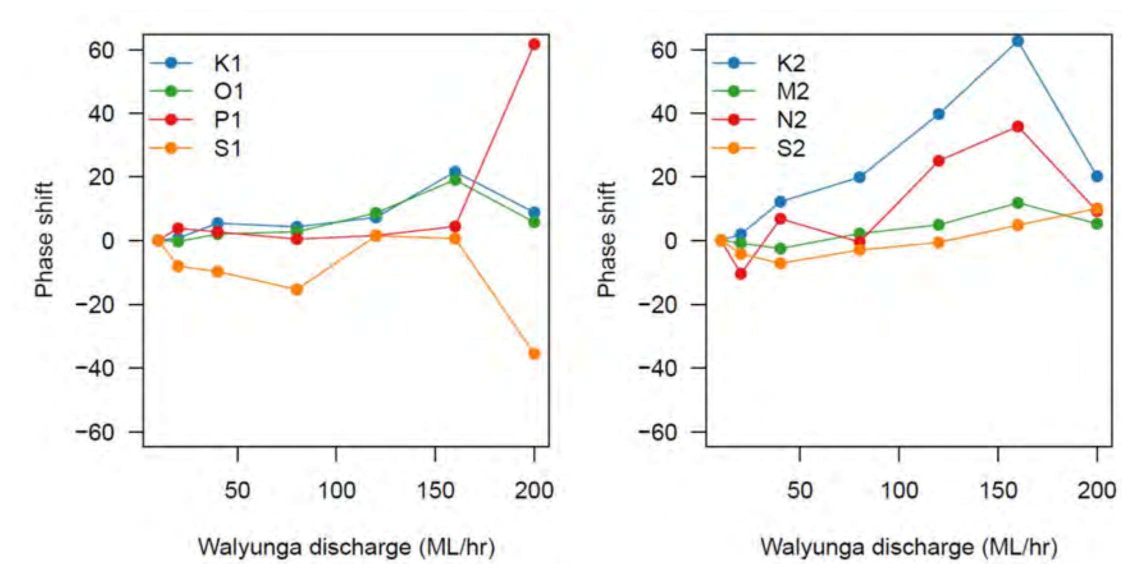
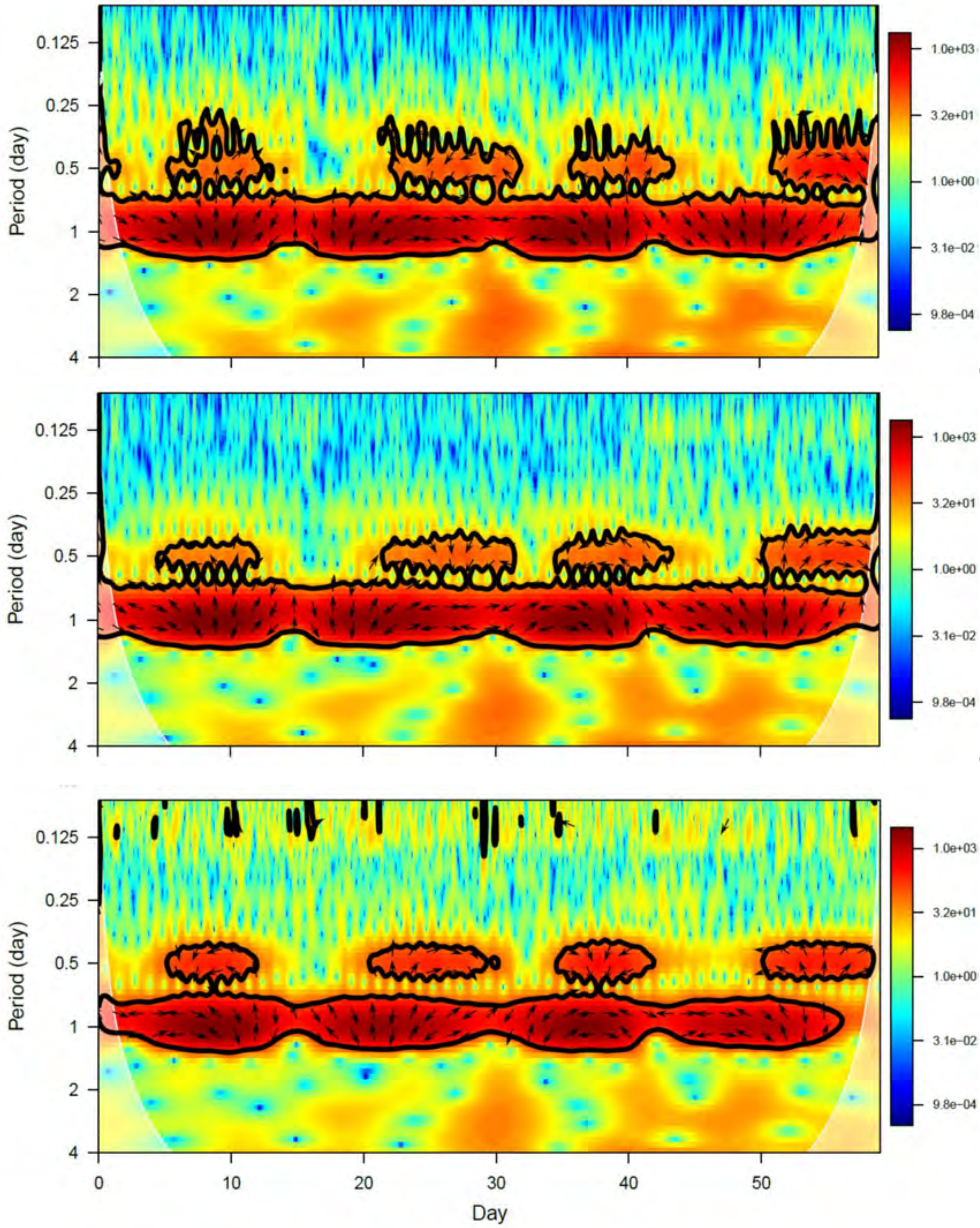


Figure 16 Effect of river flow rates on the shift in phase (degrees) of tidal constituents.



(a)

(b)

(c)

Figure 17: Wavelet spectra for January and February 2001 during a period of zero flow at Walyunga, at (a) Meadow St, (b) Barrack St; and (c) Fremantle. Colours refer to the wavelet power. Black lines demark areas exceeding 95% significance. Arrows denote the phase angle.

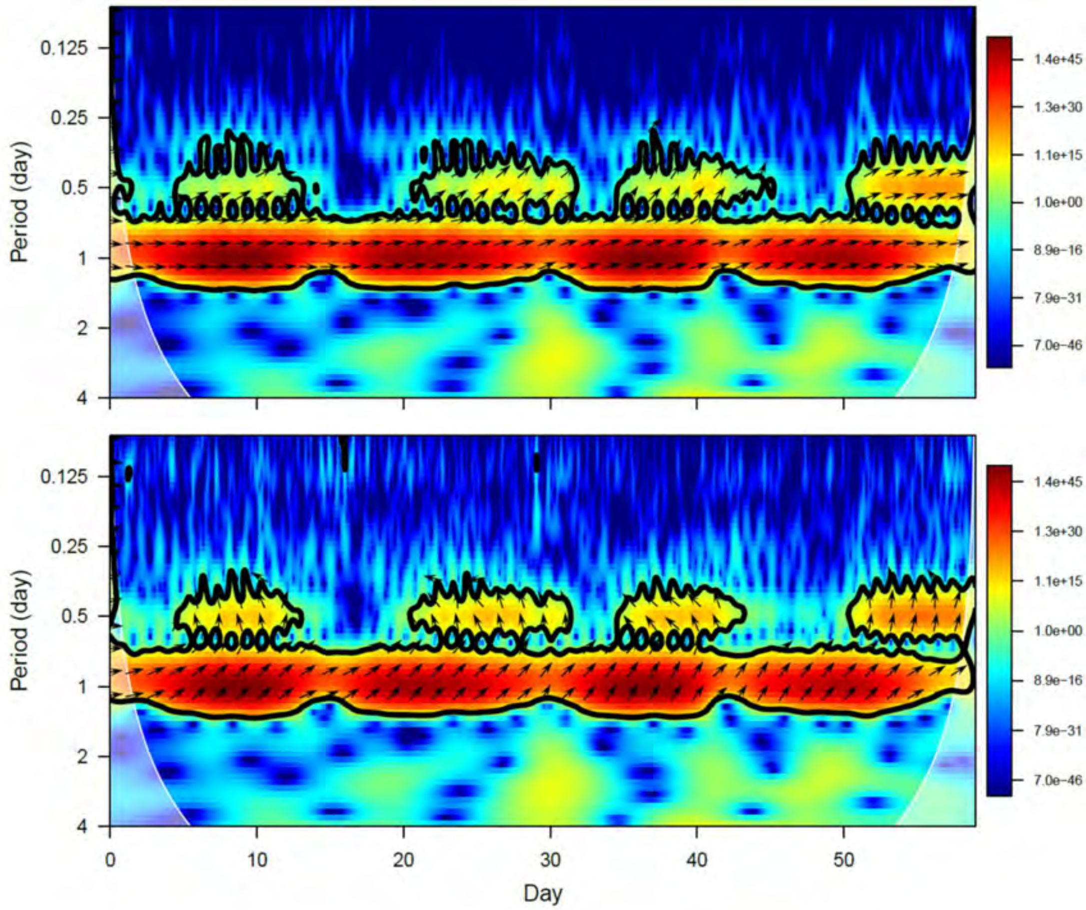


Figure 18: Cross wavelet spectra for January and February 2001 during a period of zero flow at Walyunga for (a) Meadow Street and Barrack St; and (b) Meadow St and Fremantle. Arrows denote the phase lag: horizontal to the right = no lag; 45° up to the right at a period of 24 hours indicates Meadow Street lags behind (Barrack St or Fremantle) by three hours, whereas vertical arrow at the same period indicates a six hours lag.

A large summer flow event causes the tidal signal at Meadow St to be significantly weakened at flow rates above 600 ML hr^{-1} (Figure 19). At flow rates between 400 – 600 ML hr^{-1} the diurnal tide returns, though the semi-diurnal tide is still weakened. At Barrack St, and potentially Fremantle too, the semi-diurnal tide is slightly weakened and there appears to be little impact on the diurnal tides.

The results show a slight weakening of the power spectra around a period of 12 hr when flows exceed 20 ML hr^{-1} and this continues to weaken as flows increase (Figure 20a). There is a similar change in the power associated with periods around 24 hr. With increasing flow rate the average lag in the diurnal tide between Meadow St and Fremantle increases from ~3 hr to 4.5 hr (Figure 20b). The semi-diurnal tide increases in lag from 3 hr to 3.5 hr.

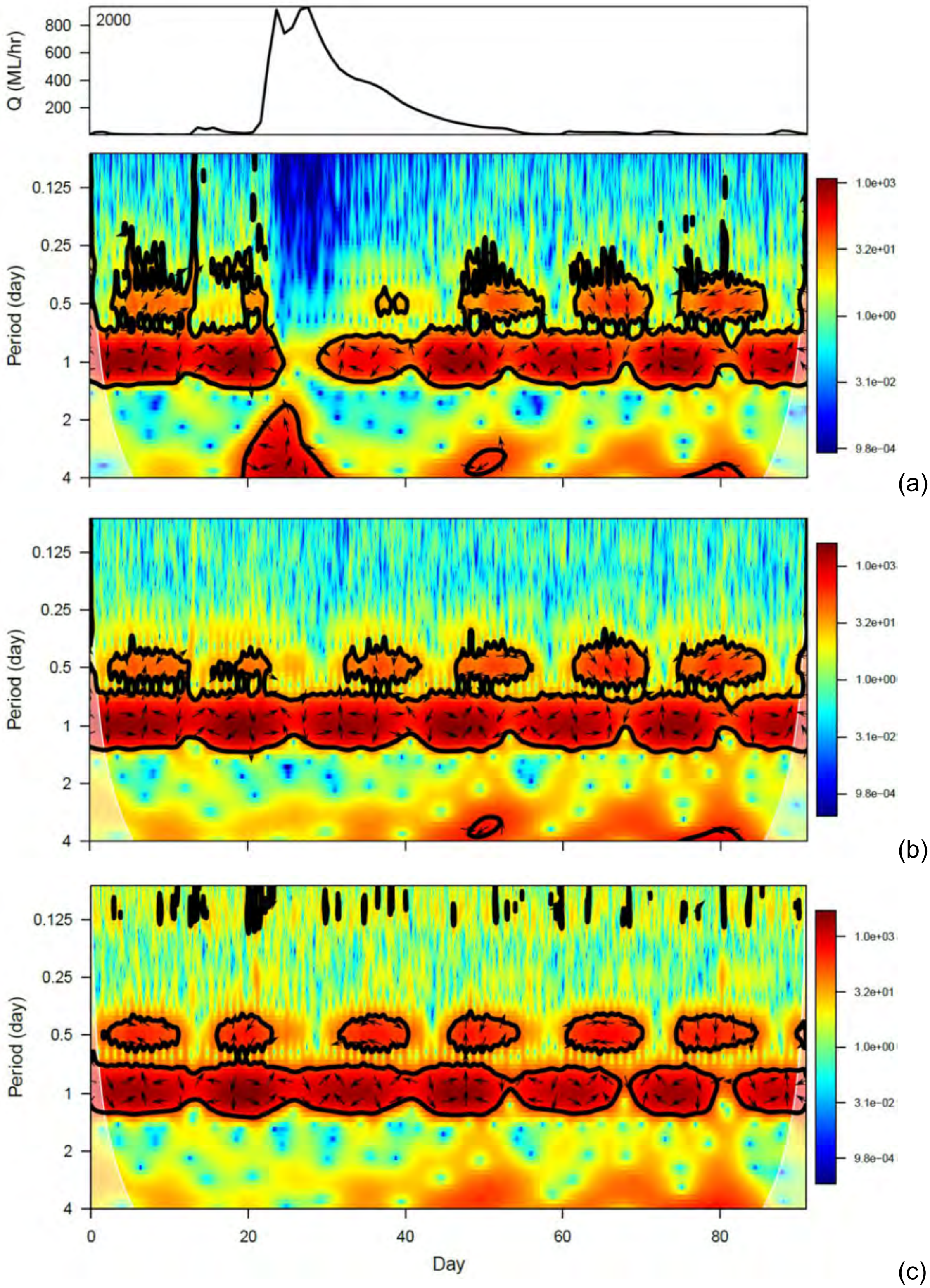
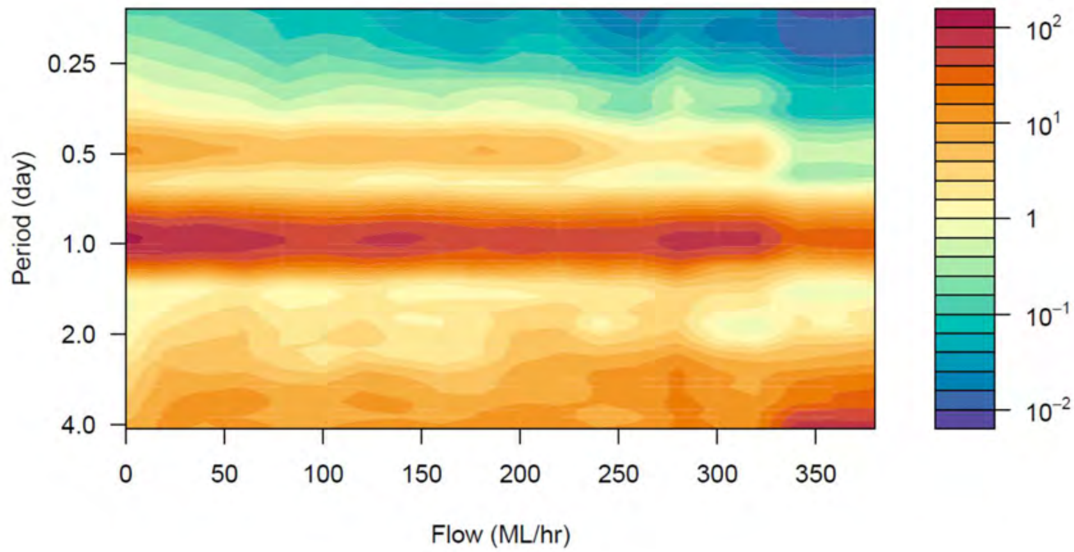
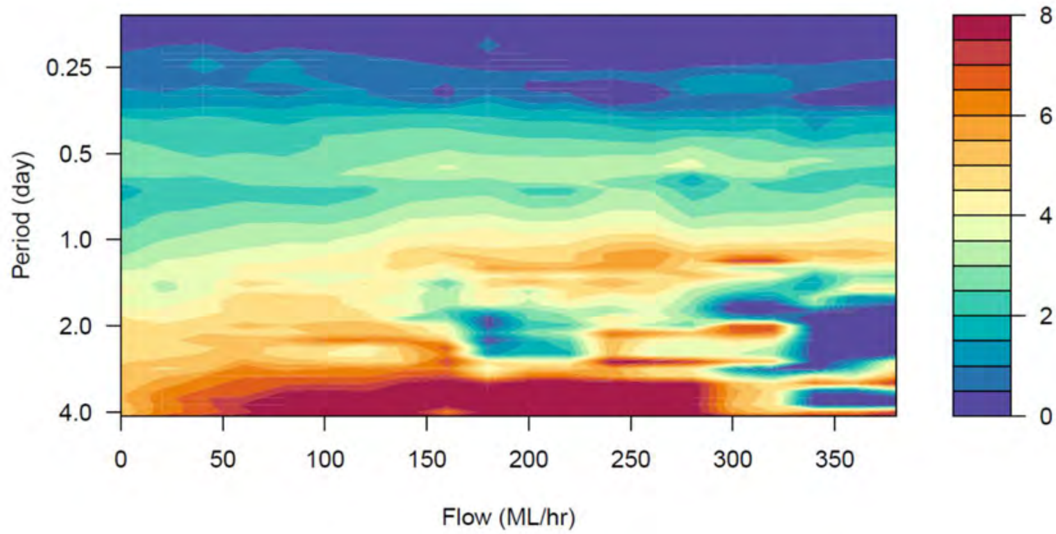


Figure 19 Wavelet spectra during a summer flood event January – March 2000 at (a) Meadow Street; (b) Barrack St; and (c) Fremantle. Corresponding river discharge at Walyunga shown at top. Arrows denote the phase angle, black contours denote the significant spectral energies.



(a)



(b)

Figure 20: Effect of Walyunga flow rate on: (a) average wavelet spectral power at Meadow St; and (b) average phase lag (hr) between Meadow St and Fremantle.

3.4 Summary

The above analysis shows how tides are propagated upriver to Guildford. The lags and the dampening of tidal amplitudes are small, however, given the micro-tidal nature of the river levels even small changes to tides can be significant for wetland flooding. The results also quantified the interaction between river-flows and tides. Large flows tend to dampen tidal amplitudes and increase the time for the tides to propagate upriver. As a result, the declining winter rainfall in the catchments since the 1970s has led to an increase in the tidal amplitude at Ashfield. The net effect of on water levels and thus flooding frequency at Ashfield requires an assessment of the contributions of river flow, tidal and other processes to river levels. This is conducted in the following sections.

4 Wetland Surface Water Dynamics

A surface water monitoring program was conducted with the aim of developing a better conceptual understanding of the wetland's interaction with the Swan River and its likely sources of water. Based upon this the objectives then were to create numerical models of the surface water hydrology useful for hindcasting historical water levels and estimating climate change impacts to a coastal temperate salt marsh subjected to sea-level rise.

4.1 Methodology

4.1.1 Surface Water Monitoring

Monitoring of surface water levels was conducted using a network of staff gauges and capacitance probes. Staff gauges were installed at sites C01 and C02 on 14 August 2018 (Figure 21). Manual readings were conducted daily until both gauges dried completely on 11 December 2018. A total of 12 capacitance probes (Scott Parsons Electronics, Australia) were installed between 11 April and 30 June 2019 (e.g. Figure 22). The probes were calibrated prior to deployment using a three-point calibration. Probes and gauges were surveyed to establish elevations and manual measurements of water depth at each probe were conducted periodically to verify recorded levels. Water level measurements were collected at 15 minutes intervals until November 2020. Capacitance probe data was found to be impacted by diurnal variation in temperature, evapotranspiration, and sensor sensitivity when water levels were low and battery levels depleted. This produced an apparent amplitude in water levels daily of ~5 cm. To correct for this, when water levels dropped below a specified depth (probe specific) the 1 pm reading was adopted as that day's reading.

4.1.2 Spatial Mapping of Flooding

To better understand how the wetland floods a model of wetland flooding based upon a fine resolution topographic model was developed. A regional 1 m × 1 m digital elevation model (DEM) derived from airborne LiDAR was obtained for the site. In addition, spot heights were obtained around the site via a laser theodolite and differential GPS survey. This provided a means to partly correct the DEM for vegetation effects, particularly on the western side of the wetland where the vegetation cover is relatively dense. Krigged surfaces were generated from the spot heights using the DEM elevation as a predictor variable. The resulting smoothed elevation model was then used to estimate river flooding patterns.

To simulate river flooding, surface elevations below the specified river level were identified. Patches of this low-lying area were identified as those connected to the river and sharing neighbouring (a Moore neighbourhood i.e., a central pixel and eight neighbouring cells) pixels. A threshold distance of 10 m was applied between patches to specify interconnectedness and to merge patches, thus defining whether the area was flooded or not. This was done given there remained a degree of uncertainty in the elevation model, however the results were not sensitive to threshold distances from 3 to 20 m.

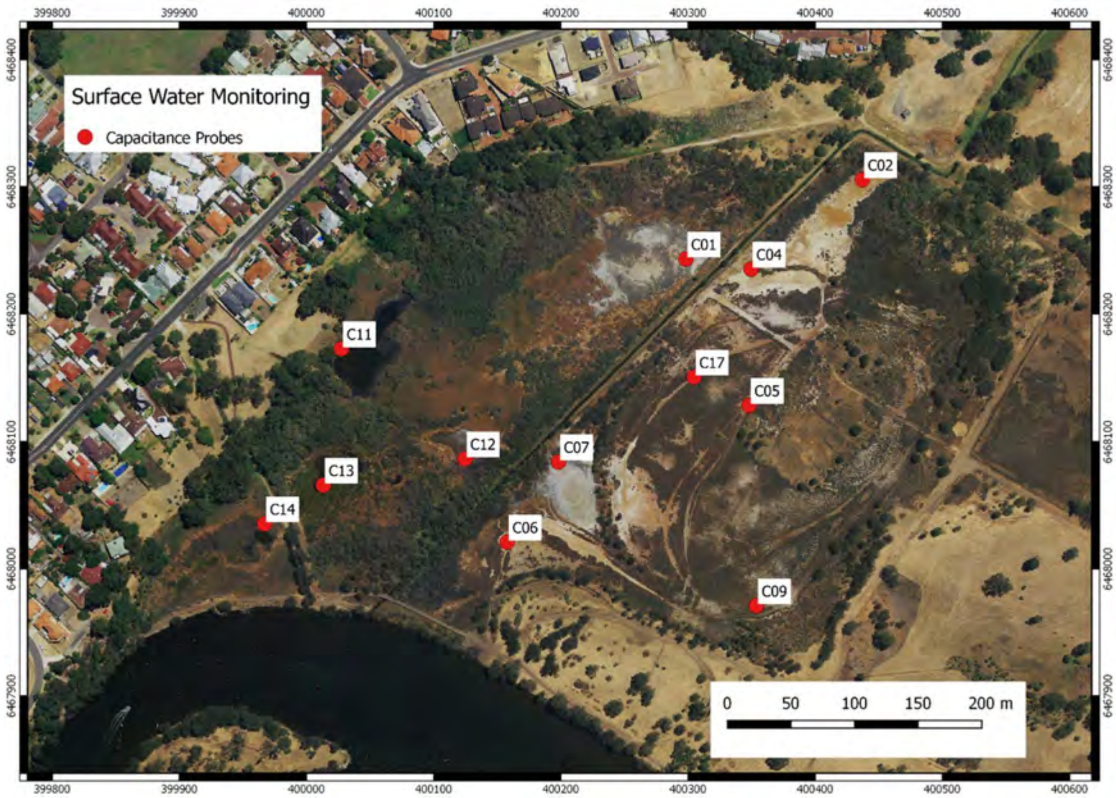


Figure 21: Surface water level monitoring locations.

4.1.3 Disaggregating Flooding Processes

A range of estuarine processes were identified above as impacting water levels in the Swan Estuary. To identify mechanisms causing flooding at Ashfield Flats a disaggregation approach was adopted to disentangle various processes contributing to river water levels. The approach used, proposed by Matte et al., (2013), is a modified harmonic analysis, which includes, in its basis functions, contributions from ocean tides, barometric effects, river flow and their non-linear interactions as derived from a theory of river-tides (Jay, 1991; Kukulka and Jay 2003). The code to perform this analysis, NSTide, was obtained from the author. The results of NSTide provides the decomposed tidal constituents, the effect of river flow on water levels, a term describing the non-linear interaction between river flow and tides, and lastly atmospheric effects. For the analysis, the rising trend and long-period variability were filtered out using a high pass filter leaving constituents equal to or less than one year.


(a)


(b)

Figure 22: Surface water monitoring probe C01 (a) April; and (b) September 2019.

4.1.4 Modelling Observed Surface Water Dynamics

Based upon the observed surface water dynamics in the wetland (Figures 23, 24, 30 and 31) a numerical model is developed here to evaluate the dominant hydrological controls on surface water levels. Reiterating the observed dynamics: an initially dry wetland floods from the river and water levels in the wetland quickly match those in the river when river levels exceed a flooding threshold (h_2). Following a flood, when river levels drop below those in the wetland, there is a slightly delayed recession to a level (h_1). During spring and early summer, the wetland dries over a period of several months. A simple numerical model which attempts to capture these processes is the following:

$$\frac{dh}{dt} = \begin{cases} dz/dt & z > h \,\&\, z > h_2 \\ (h - h_2) & h_2 < h \,\&\, z < h \\ p - k\,(h - h_1) - e & h_1 < h \leq h_2 \,\&\, z \leq h_2 \\ p - e & h_0 < h \leq h_1 \\ 0 & h = h_0 \,\&\, p < e \end{cases} \qquad \text{Equation 4}$$

where h is the wetland water level, z is the river water level, dt is the time step, dz/dt is the rate of change of the river level, p is the change in level due to rainfall and drain inflows, k is a flood recession constant, e is the change in level due to evapotranspiration, and h_0 is the ground elevation. It is assumed for now that due to the expected low permeability of the wetland sediments losses to groundwater and/or upward groundwater discharge to the wetland are negligible. The terms p and e strictly depend upon a volume – elevation relationship, however given the uncertainties in the surface elevation model and the rapid change is wetted area near the flooding threshold a constant wetted area is assumed and thus p and e in Equation 4 can be reduced to depth values. Inflows from the Woolcock Ct drain comprise quick flow and baseflow components. Based upon the average runoff coefficients the quickflow contribution was calculated as 0.43 p where, 0.43 stems from the product of the mean runoff coefficient and the ratio of the catchment of wetland area (assumed to be 5.7 ha).

For longer term simulation of hydroperiods, a model for the baseflow from the Woolcock Ct drain was developed. A two-compartment linear storage model was fitted to simulate the baseflow, q_b. Conceptually, this model describes a lumped catchment that consists of two water stores, s_1 and s_2. The smaller store, s_1, fills and evaporates and drains to store s_2. The store s_2 fills from s_1 and drains to baseflow. Drainage from both stores is assumed to be linear. The model can be summarized as follows:

$$\frac{ds_1}{dt} = p - e\,\frac{s_1}{s_{1x}} - k_1\frac{s_1}{s_{1x}}$$

$$\frac{ds_2}{dt} = k_1\frac{s_1}{s_{1x}} - k_2\frac{s_2}{s_{2x}} \qquad \text{Equation 5}$$

$$q_b = k_2\frac{s_2}{s_{2x}} + c_3 p$$

The model parameters s_{1x}, s_{2x}, k_1, k_2 and c_3 were estimated via a nonlinear optimization with boundary constraints (Byrd et al., 1995). The optimization minimized the sum of squares of model errors. The initial values for stores were set to 10 mm and fitted parameters were not sensitive to this choice as simulations were conducted for the period 1990 – 2020, while data available for calibration data was available for the period June 2019 – November 2020.

The boundary conditions on the surface water model (Equation 4) are half hourly data of river levels (Meadow St Bridge gauge), rainfall and potential evaporation. The weather data was obtained from the Bureau of Meteorology's Perth Airport station (station number 9021, -31.9275°S, 115.9764°E) located approximately 2.4 km to the southeast of Ashfield Flats. Rainfall data was averaged to a 30-minute temporal resolution. Daily evaporation was assumed constant throughout each day and was available for the period 2009 - 2019. For longer term simulations data for the period 1990 – November 2020 were used. Missing evaporation data was sampled randomly from the population of available data from the corresponding day of the year. Missing rainfall data was minimal and assumed to have zero rainfall.

The surface water model has one free parameter which needs to be estimated, i.e., k, however the thresholds h_2 and h_1 were also be added to a calibration routine to fit the model to the data. The model was calibrated using the observed values between August 2018 to November 2020 at 30 minutes temporal resolution. A Bayesian approach to calibration was conducted via a differential evolution Markov-Chain Monte Carlo sampling (Vrught et al., 2009). Broad Gaussian priors were specified for each model parameter as well as the standard deviation of model errors, the difference between modelled and observed water levels. A total of 30,000 model simulations were conducted in the MCMC sampling across three chains. A total of 1000 simulations were sampled from the posterior distributions, ensuring the trace had stabilized and thinned to avoid autocorrelation in parameters. The calibration was implemented in R using the BayesianTools package (Hartig et al., 2019).

4.1.5 Hindcasting and Forecasting Surface Water Dynamics

The hydroperiod is a fundamental metric of relevance to ecological processes in saltmarsh ecosystems (Pechmann et al., 1989; Crase et al., 2013; Estrelles et al., 2018). Sea levels near Perth are presently rising due to anthropogenic climate change at a rate of ~1.5 mm a^{-1}, consistent with global observations (Pattiaratchi, 2011). This rate is expected to accelerate in coming decades. In addition to rising sea levels, climate change is expected to decrease annual rainfall and increase potential evaporation rates (IPCC, 2013). To evaluate the present and future changes to wetland hydrology the calibrated surface water models described above were applied to historical river and climate data (1990 – 2019) and future sea levels and climates (2030 – 2090).

The historical hydroperiods for the wetland were reconstructed at C01 and C02 using the mean of posterior distributions of parameters from the Bayesian calibration. Hindcasts were performed at 30 minute temporal resolution for the period 1990 – 2020, the limits of the available river data.

Sea level rise projections developed by the National Climate Change Adaptation Research Facility were obtained from CoastAdapt (https://www.coastadapt.com.au). These projections are based upon Intergovernmental Panel on Climate Change (IPCC) emissions scenarios from Assessment Report 5 (Wainwright and Verdon-Kidd, 2016). At Ashfield the mean sea level is expected to rise between 0.22 - 0.84 m by 2090, depending upon the climate model and the emission scenario (Table 12).

Table 12: Projected deviations from mean water level at Ashfield for selected IPCC emissions scenarios.

Emissions Scenario		2030	2050	2070	2090
RCP2.6	Very low	0.11 (0.07 to 0.16)	0.20 (0.12 to 0.28)	0.30 (0.18 to 0.42)	0.38 (0.22 to 0.56)
RCP4.5	Low	0.12 (0.07 to 0.16)	0.21 (0.13 to 0.30)	0.33 (0.21 to 0.46)	0.45 (0.28 to 0.64)
RCP6.0	High	0.11 (0.06 to 0.16)	0.21 (0.13 to 0.29)	0.32 (0.20 to 0.45)	0.46 (0.29 to 0.65)
RCP8.5	Very High	0.12 (0.08 to 0.17)	0.24 (0.15 to 0.33)	0.40 (0.26 to 0.53)	0.60 (0.39 to 0.84)

Values shown are the deviation from mean water level (m) and in brackets the lower and upper confidence limits. Mean water levels defined for the period 1986 - 2005. Source: https://www.coastadapt.com.au (last checked 13/01/2020).

Table 13: Projected percentage changes in rainfall and evapotranspiration for selected IPCC emissions scenarios.

Scenario RCP4.5		2030	2090
Rainfall	Summer	–8 (–31 to 17)	2 (–23 to 20)
	Autumn	–4 (–20 to 10)	1 (–20 to 17)
	Winter	–7 (–18 to 4)	–9 (–18 to 2)
	Spring	–11 (–23 to 4)	–11 (–28 to 4)
Evapotranspiration	Summer	1.5 (0.5 to 3.1)	2.3 (0.7 to 3.6)
	Autumn	3.2 (1.3 to 4.5)	3.3 (2.2 to 6.1)
	Winter	4.3 (1.3 to 7.3)	4.4 (2.5 to 7.7)
	Spring	2.4 (0.4 to 3.3)	2.4 (0.5 to 4.5)
Scenario RCP8.5		2030	2090
Rainfall	Summer	–4 (–29 to 28)	–5 (–31 to 36)
	Autumn	–4 (–26 to 12)	–6 (–32 to 13)
	Winter	–14 (–28 to –4)	–29 (–44 to –15)
	Spring	–19 (–36 to 1)	–36 (–59 to –14)
Evapotranspiration	Summer	4.2 (2.5 to 5.9)	9.1 (5.1 to 11.7)
	Autumn	6.8 (4.9 to 9.6)	13.7 (8.4 to 18.3)
	Winter	9.8 (6.2 to 14.3)	18.6 (12.4 to 30.5)
	Spring	4.9 (2.0 to 7.1)	9.2 (4.8 to 14.8)

Source: Sudemeyer et al., (2016). Bracketed terms are the 10th–90th percentile range of model results.

In the southwest of Western Australia projected rainfall is expected to decrease and evapotranspiration to increase by 2090 (Sudemeyer et al., 2016). Seasonal rainfall from emissions scenario RCP4.5 are expected to change by -4 to -11% by 2030 and by -11% to 2% by 2090 while the higher emissions scenario predicts declines up to -36% by 2090 (Table 13). Evapotranspiration is expected to increase by between 2.3 to 4.4% by 2090 for scenario RCP4.5 and 9.1 – 18.6% for the higher emissions scenario, RCP8.5.

The impact of rising sea levels will be to increase the frequency of flooding at Ashfield Flats, while the lower rainfall and higher evapotranspiration would increase the rate of drying. As a result, the net effect on wetland hydroperiods is not immediately obvious. To clarify the impact of these contrasting drivers the surface water model was applied by adjusting the mean river levels and seasonal climate variables in line with the scenarios RCP4.5 and RCP8.5 (Sea level rise projections developed by the National Climate Change Adaptation Research Facility were obtained from the CoastAdapt website (https://www.coastadapt.com.au). These projections are based upon Intergovernmental Panel on Climate Change (IPCC) emissions scenarios from Assessment Report 5 (Wainwright and Verdon-Kidd, 2016). At Ashfield the mean sea level is expected to rise between 0.22 - 0.84 m by 2090, depending upon the climate model and the emission scenario (Table 12 and Table 13).

Changes to climate variables were linearly interpolated between 2030 and 2090 to derive values for 2050 and 2070. For each epoch's climate i.e. 2030, 2050, 2070 and 2090, a 30 year simulation was applied by scaling the historical forcing data (1990-2020). From these simulations the mean annual hydroperiod and mean water depths at C01 and C02 were derived. In this case the hydroperiod was quantified by the average time in any year of simulation the water depth exceeds 10 cm. Note, while climate change is expected to further reduce river flows this effect was not considered. As the mean water level and tide in the river are already the dominant mechanism for flooding this omission is not considered to significantly impact results.

4.2 Results

4.2.1 Surface Water Monitoring

The two longest running monitoring sites C01 and C02 were initially flooded to depths of 25 cm and 40 cm at the time gauges were installed in August 2018 (Figures 23 - 24). These levels remained stable until late September 2018 at which point the wetlands dried gradually. The pool on the east of Chapman St drain (C02) dried 27 days before the pool on the western side of the drain dried completely on 11 December 2018 (C01). The capacitance probe data reveals the higher frequency variation in water levels in the wetland and how they relate to river levels.

During June 2019 and May 2020, we were able to observe the wetland switch from predominantly dry to flooded. Flooding water levels recede quickly and stabilized at levels comparable to those seen in 2018. This is interspersed by regular flooding events, primarily throughout winter and early spring.

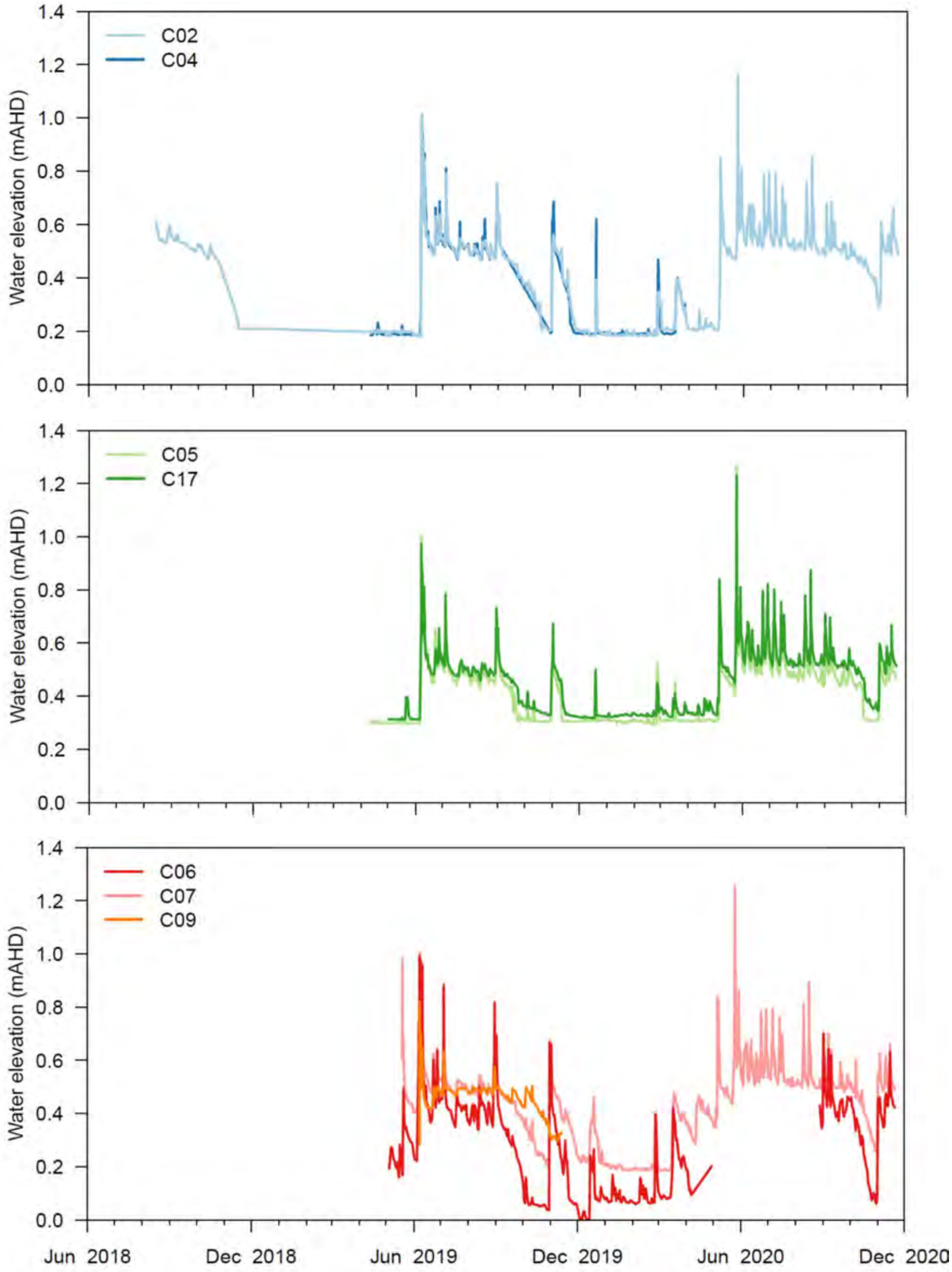


Figure 23: Measured water levels across the eastern side of Ashfield Flats.

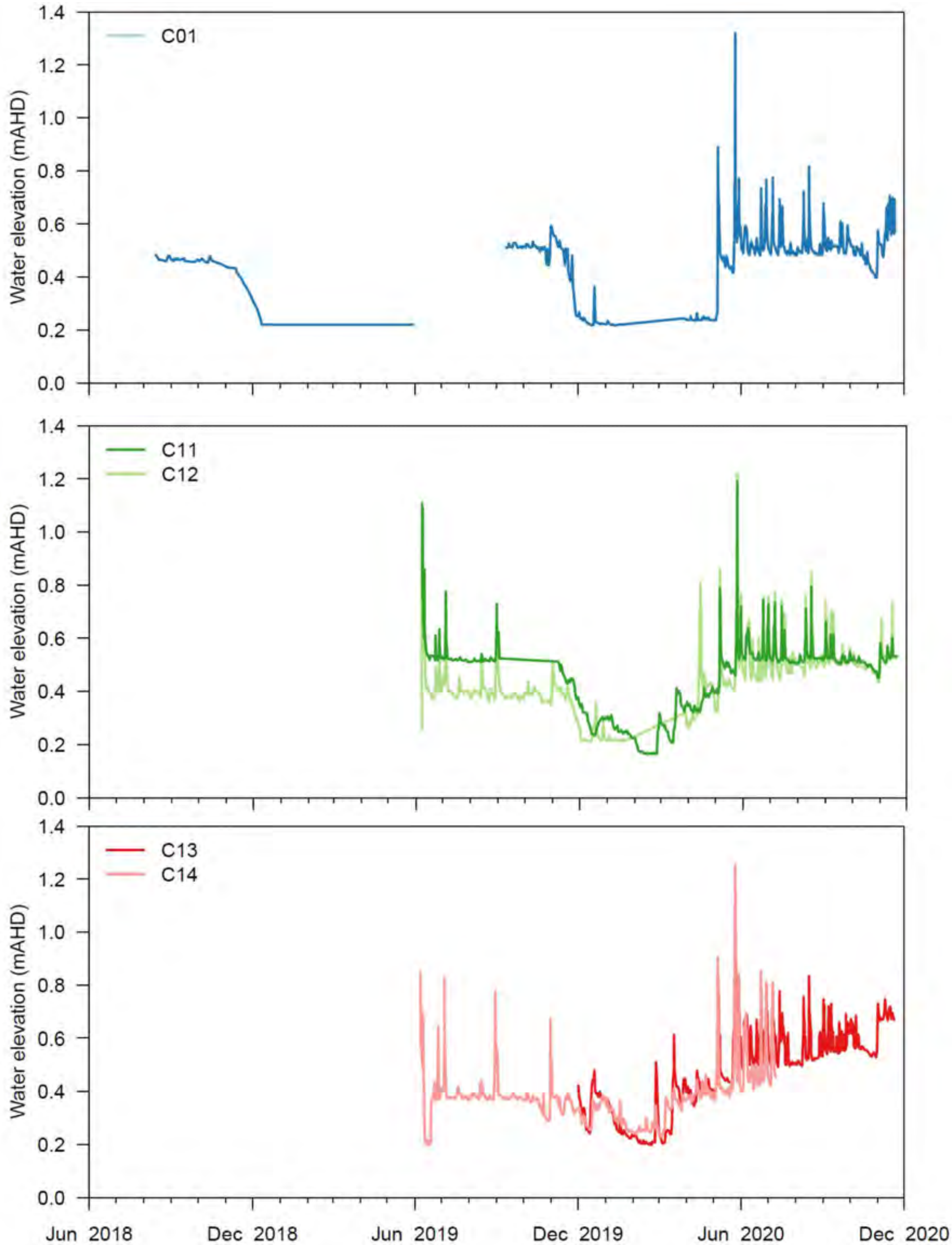


Figure 24: Measured water levels across the western side of Ashfield Flats.

(a) (b)

Figure 25: Commencement (a) and peak (b) water levels at the western end of the walkway during a flood.


(a)


(b)

Figure 26: Pre (a) and post flood (b) adjacent the walkway near the Swan River.


(a)


(b)

Figure 27 Chapman St Drain looking north in March 2019 (a) and during a flood (b).


(a)


(b)

Figure 28: The flooded dirt road at the eastern end of the flats looking north (a) and flooded samphire in September 2019 looking east.


(a)


(b)

Figure 29: Flooded area adjacent the western escarpment (a) and view from the lookout post flood to the southeast (b).

Some pools remain wet throughout the year, particularly those located near probes C11, C13 and C14 whereas the northern pool (C01) and the whole area to the east of the Chapman St drain dry completely during summer. The peak water level observed was 1.3 m AHD.

A flooding event was observed in June 2019 and is documented in a series of photographs (Figures 25 –Figure 29). The wetland primarily floods from the river commencing either side of the walkway over the Chapman St Drain at the southern end of the wetland (Figures 25 - 26). Flooding also enters to the western wetlands via a cut-off drain approximately 50 m from the outlet of the Chapman St Drain (Figure 27a) and during the higher river levels over the embankments of the Chapman St Drain (Figure 27b). The roads along the southern and eastern side of the flats got flooded during this event and all locations where samphire occur were inundated (Figure 28). The area adjacent the western escarpment flooded from the wetland via subsurface drains below the road (Figure 29a). Several days after the event water remained pooled across the entire flats area (Figure 29b).

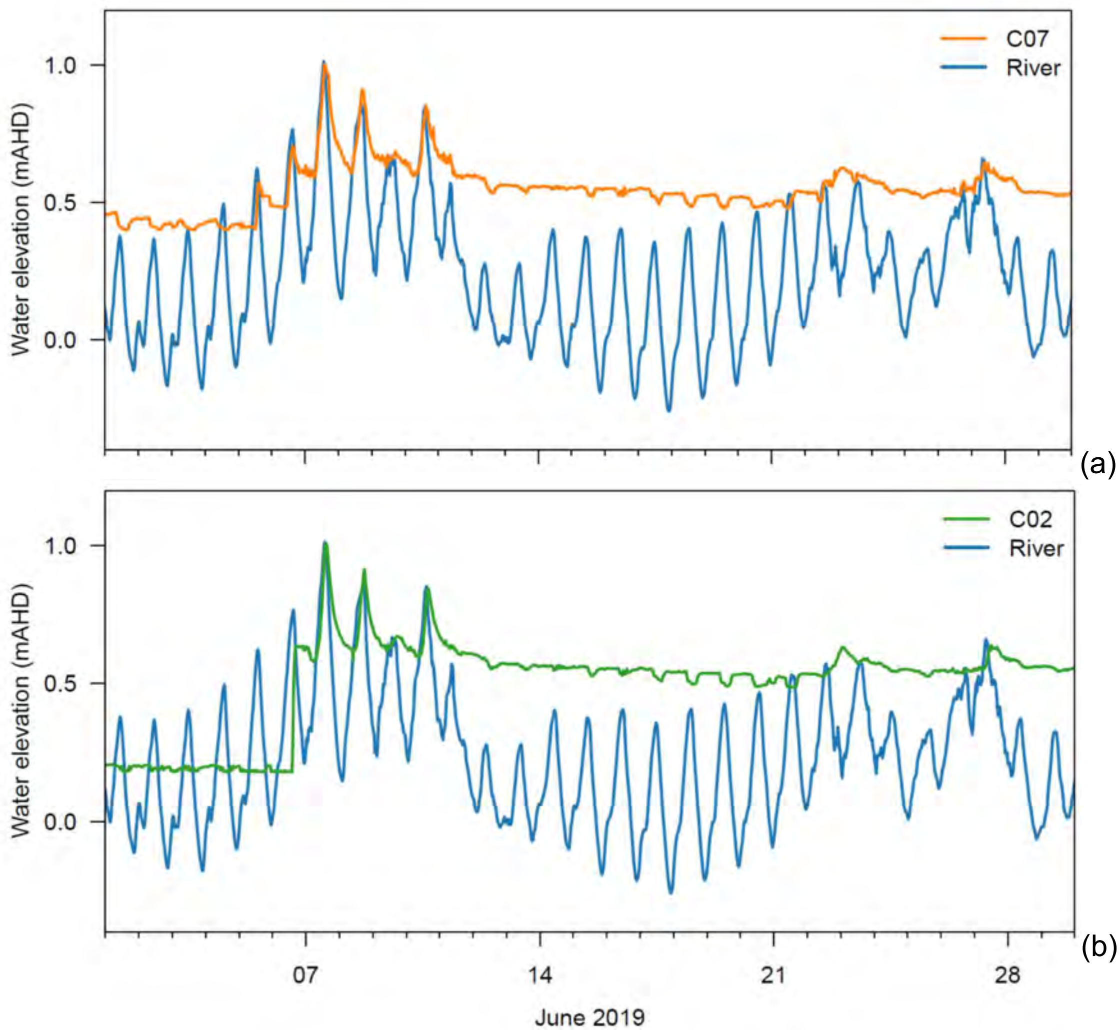


Figure 30 Measured surface water levels at sites (a) C07 and (b) C02 in comparison to river levels at the Meadow St Bridge gauge, spanning a flooding event. Initially both probes are recording zero depth of water. The levels before 5th June (0.45 mAHD at C07 and 0.2 mAHD at C07) reflect the elevation of the dry ground surface at each location.

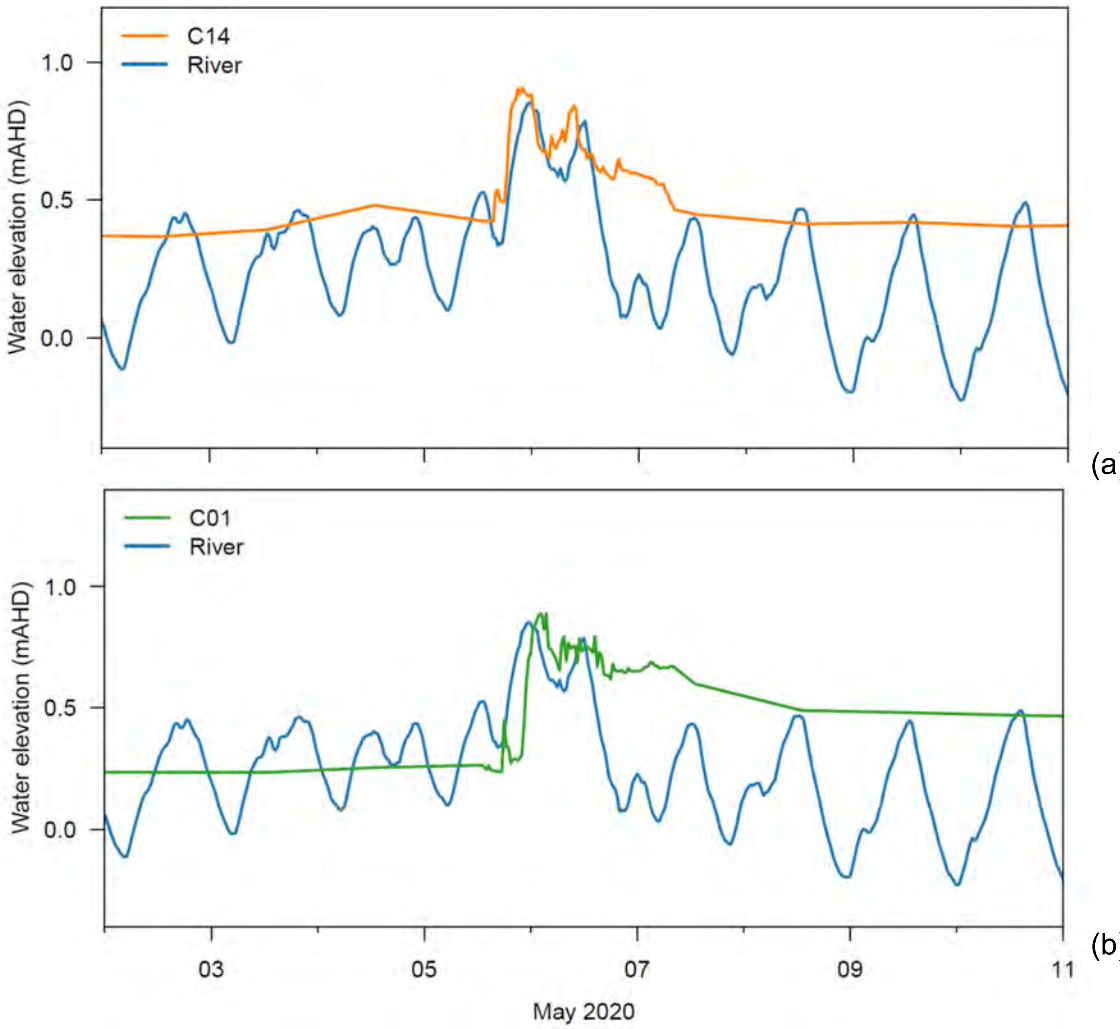


Figure 31 Measured surface water levels at sites (a) C14 and (b) C01 in comparison to river levels at the Meadow St Bridge gauge, spanning a flooding event in 2020. Initially C01 was recording zero depth of water while C14 was recording 25 cm water depth.

The river is therefore a significant control on flooding of the reserve. The dynamics of the water level response to forcing by the river can be seen a comparison of water levels (Figures 30 and 31). Prior to 5th June 2019 probes C07 and C02 on the eastern side of the wetland were dry (Figure 30). On 5th June as river levels rise above 0.6 m AHD probe C02 begins to wet. Then on June 6th coincident with the next higher tide water levels at both sites increase significantly. This is repeated on the next four tides that occur. During the ebb of tides water levels in the wetland fall rapidly, though not as fast as the river and at ~ 0.55 m AHD they tend to stabilize. Similar responses can be seen in the western wetlands during May 2020 (Figure 31).

At a given location in the wetland there appears to be a clear threshold river level before it floods. There is a second threshold level at which water levels stabilize. Between these two levels there is a rapid flow recession which has a characteristic recession rate. This dynamic can be captured rather simply by the following conceptual model (Figure 32). The topography of the wetland is bowl shaped. When river levels overtop the riverbank level the wetland floods. As river levels fall there is rapid drainage by shallow overland flow which is slowed by friction. Once this water has drained the remaining water and is then lost to groundwater recharge or evapotranspiration. This bowl-shaped morphology is consistent with theories of saltmarsh morphodynamics (Friedrichs and Perry, 2001).

The significance of the river in driving flooding events is further highlighted by the frequency with which river levels exceed the flooding threshold (Figure 33). There are clear seasonal and interannual fluctuations in mean water level which contributes to flooding. The latter cyclical effects are related to the 8- and 16-year nodal tide variations (Haigh et al., 2011). There is a bimodal seasonal variation in frequency of exceeding 0.6 m AHD, due to a combination of coastal processes such as the Leeuwin Current, wind setup and storm surge, river flow and likely tropical lows causing summer flood events (Pattiaratchi, 2011; Figure 34). River levels exceed this threshold on average 208 hr per year, with an interannual variability (standard deviation) of 184 hr.

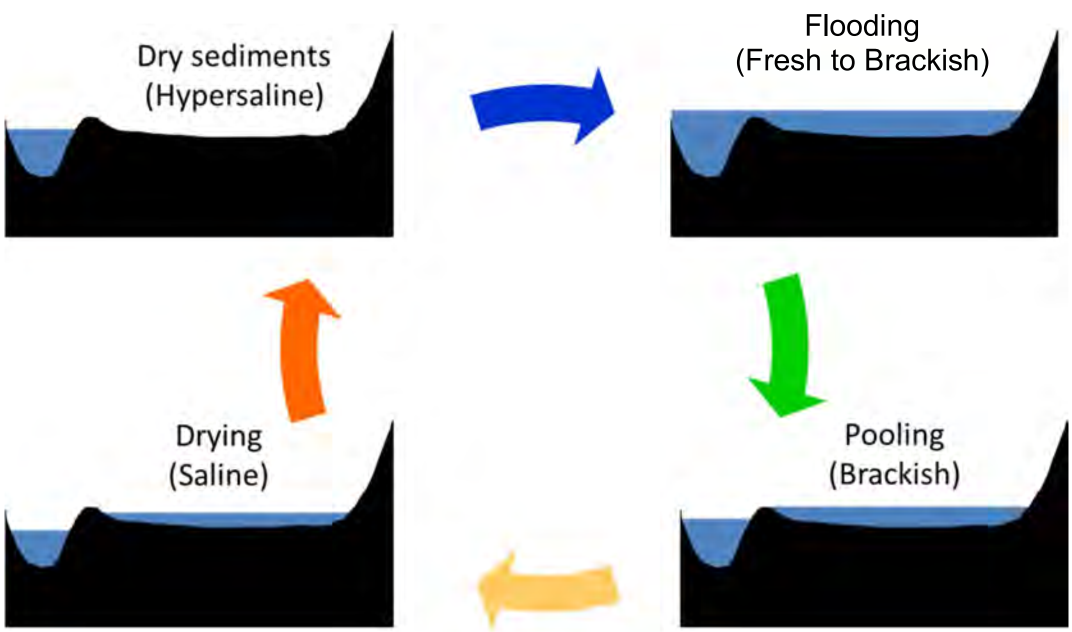


Figure 32 Conceptual model for river-wetland interactions throughout the year.

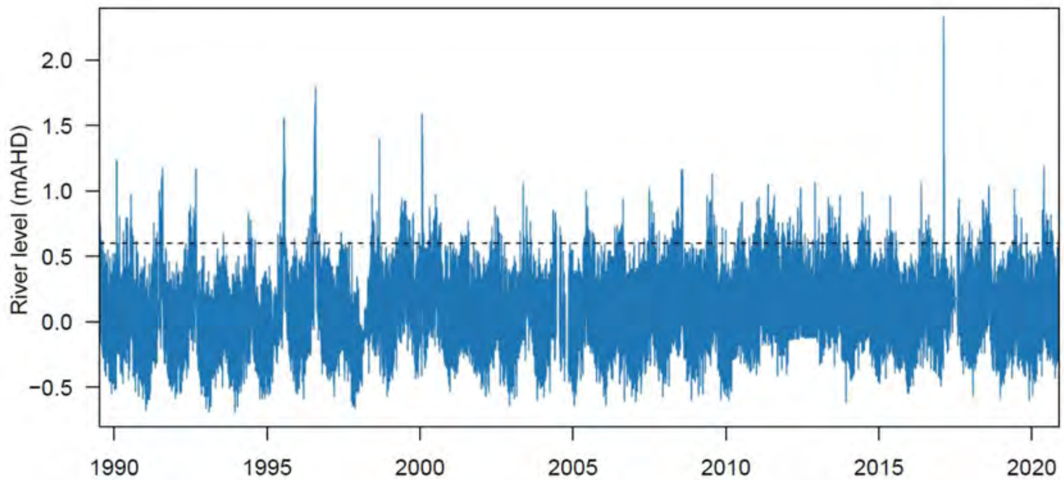


Figure 33 Measured river levels at Meadow Street Bridge. Dashed line corresponds to the approximate threshold (0.6 m AHD) for flooding to site C02 at Ashfield Flats Reserve.

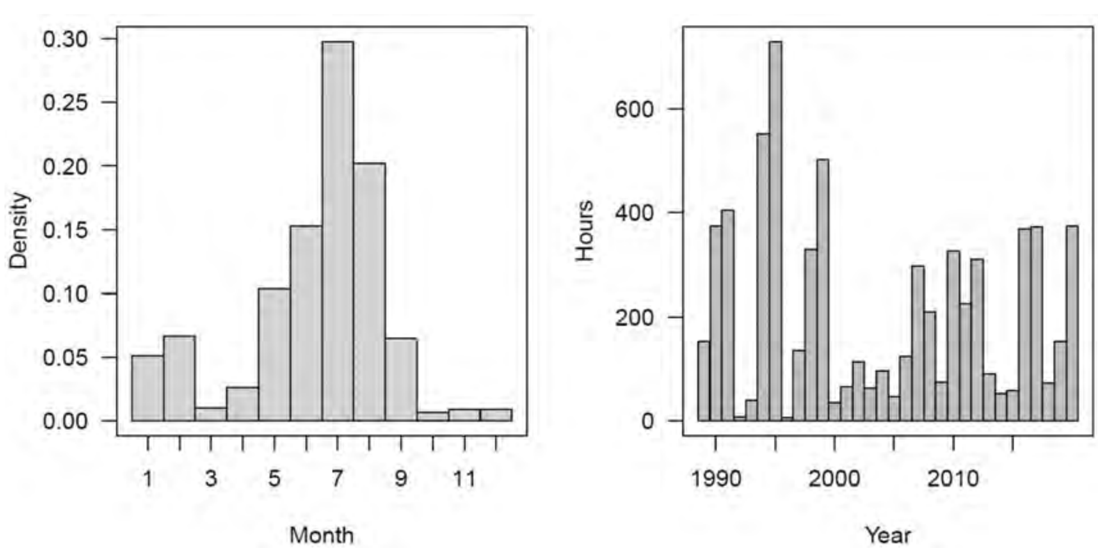


Figure 34: Frequency that river levels exceed a flooding level (0.6 mAHD) by month and hours of exceedance by year.

4.2.2 Flood Mapping

Spatial patterns of wetland area flooded at a range of river levels are shown in Figures 35-38. At river levels of ~0.4 mAHD the wetland begins to flood closest to the river and from a cut-off drain on the Chapman St Drain. At 0.55 mAHD large areas of the wetland are flooded and by 0.6 mAHD the full extent of the samphire habitat and *Melaleuca* woodland are under water. The largest flood in the available record reached 2.4 mAHD, a flood that occurred due to a river runoff event in February 2017. That event would have produced water depths exceeding 2 m across much of the reserve. Water would have also backed up the Chapman St Drain across Chapman Rd.

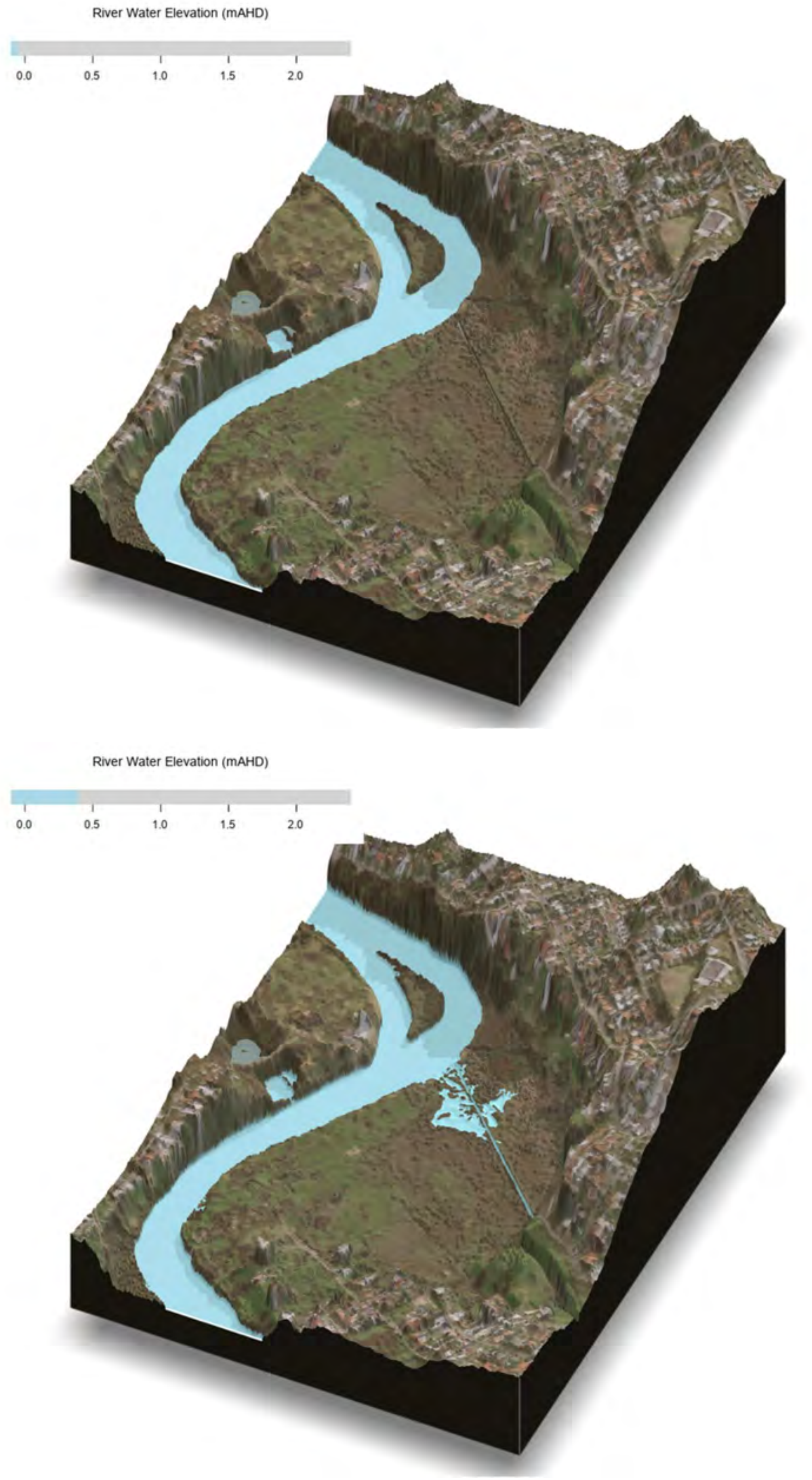


Figure 35 Extent of flooding at selected river levels (top: -0.1 m AHD, bottom: 0.4 m AHD).

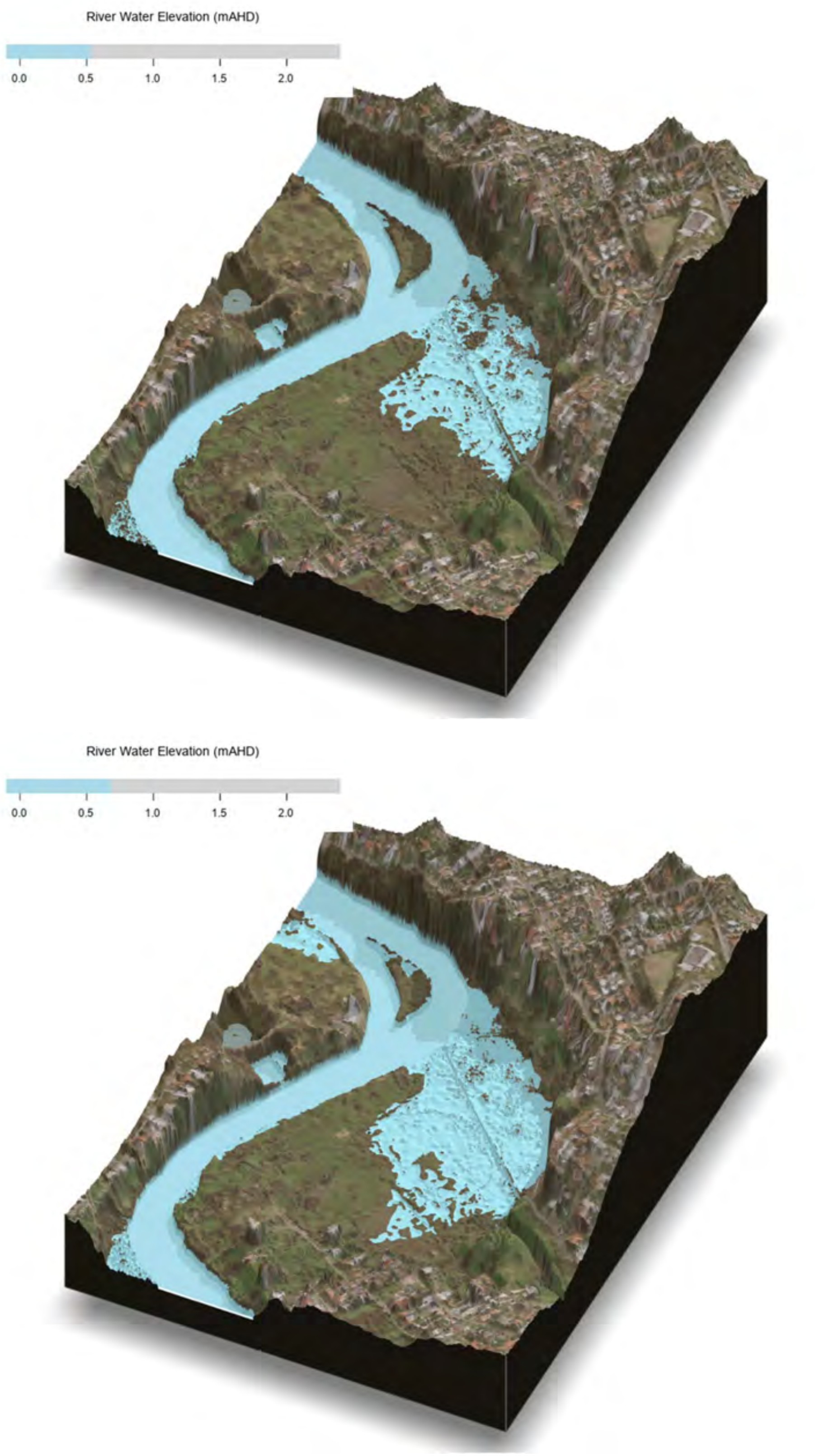


Figure 36 Extent of flooding at selected river levels (top: 0.55 m AHD, bottom: 0.65 m AHD).

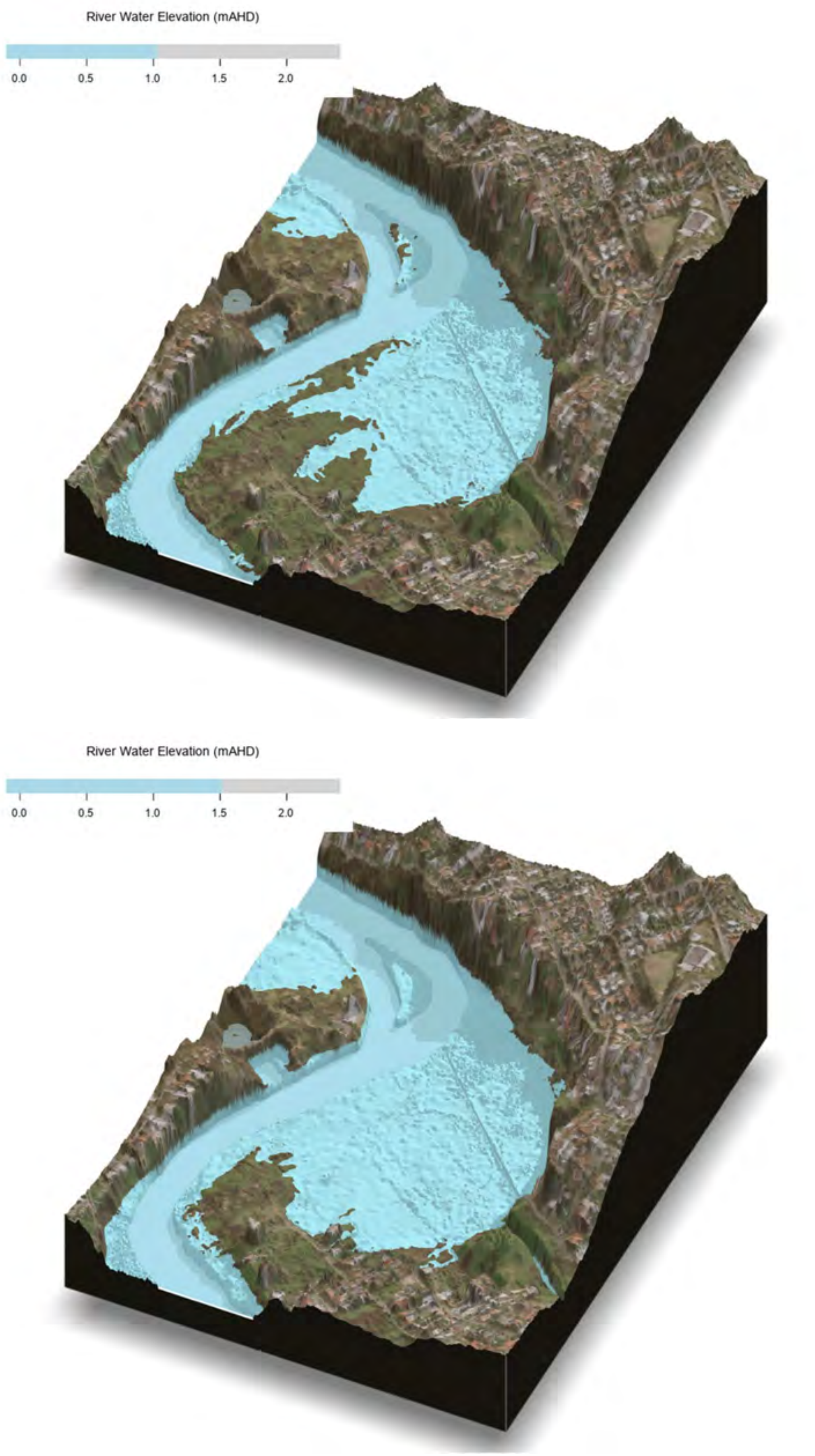
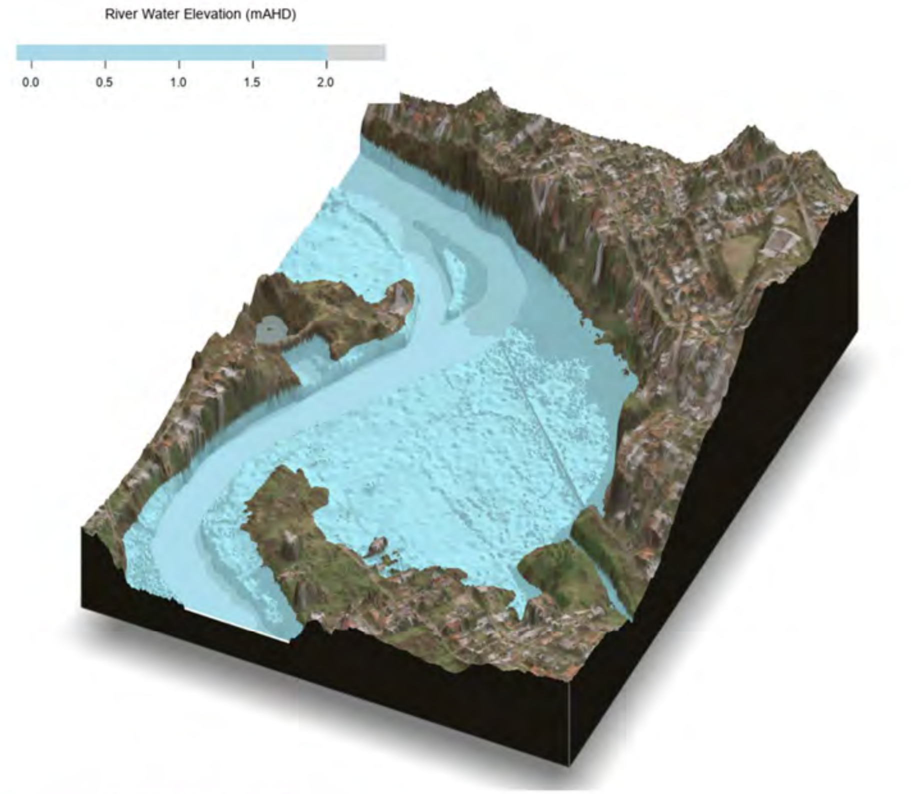


Figure 37: Extent of flooding at selected river levels (top: 1.0 mAHD, bottom: 1.5 m AHD).



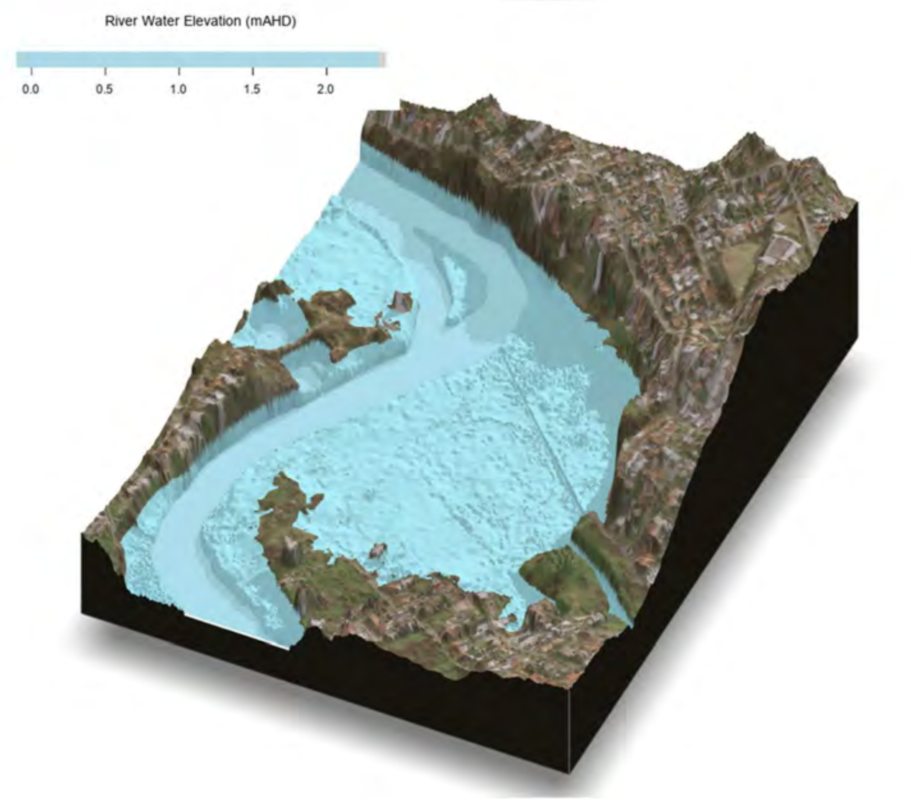


Figure 38: Extent of flooding at selected river levels (top: 2.0 mAHD, bottom: 2.4 mAHD).

This analysis may slightly overestimate the early flooding at river levels of ~0.4 mAHD due to overestimating connectivity with the Chapman St Drain because of microtopography not captured by the DEM. For example, the observed flooding at C07 (Figure 30) occurs after river levels exceed 0.5 m, whereas the connectivity model suggests this starts at 0.4 mAHD (Figure 35). The errors here i.e. ± 0.1 m, are within the errors of the elevation model and therefore this flooding model is considered a reasonable approximation of flooding patterns.

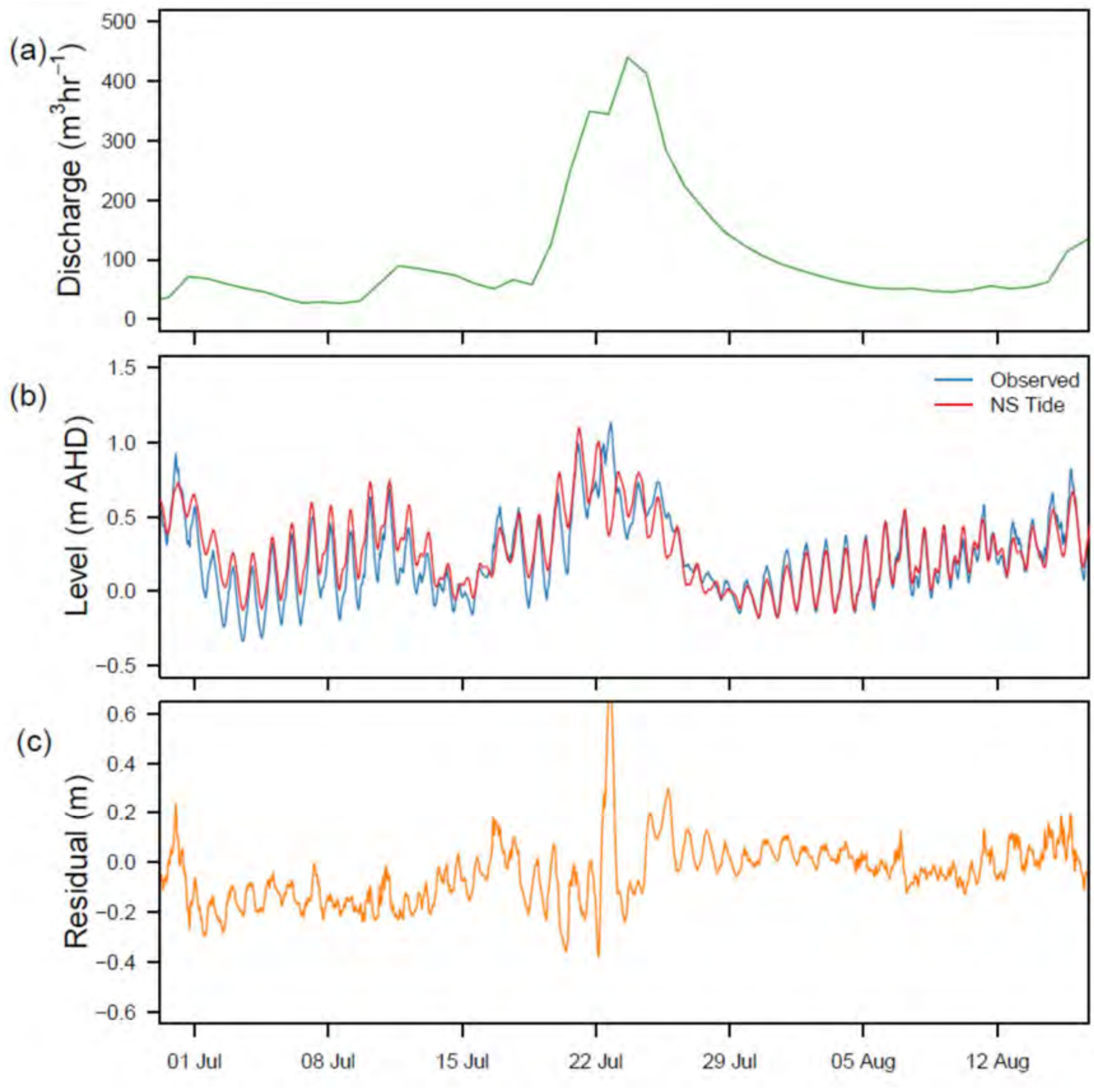


Figure 39: Comparison of NS-Tide to observed data July – August 2009.

4.2.3 Contributions of Estuarine Processes to Wetland Flooding

NSTide reproduced observed water levels well with a root mean square error of 0.1 m. Examples of the results of NSTide are shown in Figures 39-41. The modelled and observed water levels agree well. Errors tend to increase as river flow rates increase. A large part of this error seems to be associated with a discrepancy in timescales of the available river runoff data. Sub-daily river flow rates from the Walyunga gauge and the other smaller tributaries look to be needed to reduce the larger errors associated with the extreme flood event of 2017 for example (Figure 41). As a result, the peak contribution to water levels by river runoff may be underestimated for the larger river flows.

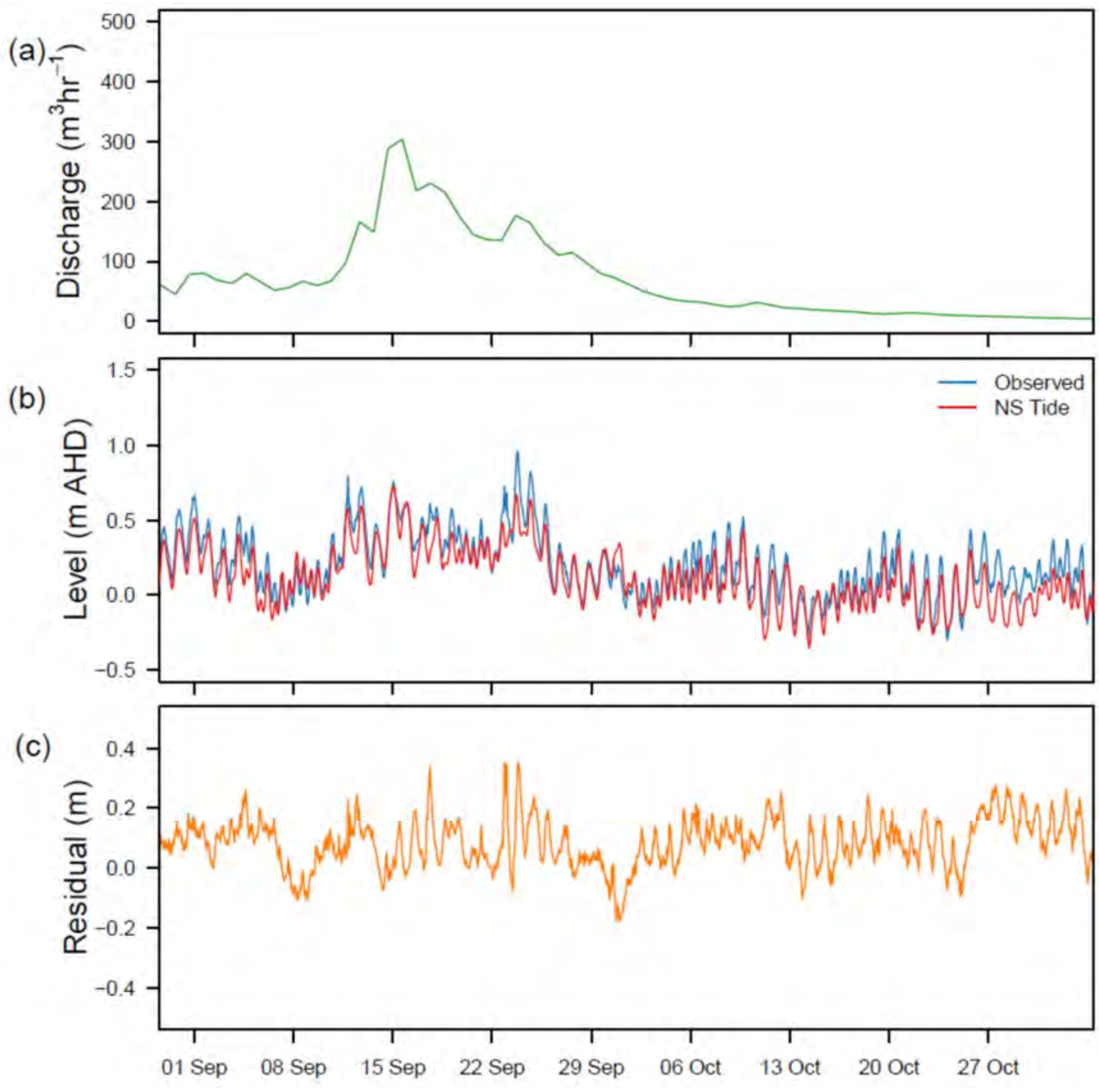


Figure 40: Comparison of NS-Tide to observed data September - October 2013.

With the disaggregated time-series the maximum contribution of each component to river levels during flood events at Ashfield Flats were determined. This enabled their relative contributions to be quantified (Figure 43). The results show that for floods with peak levels between 0.5 - 0.6 mAHD the processes that dominates flooding is the mean water level (MWL) plus the tide, contributing on average 0.35 m to this flood level, whereas atmospheric processes contribute ~0.1 m, followed by smaller contributions from river flows and river-tide interactions. River-tide interactions is generally quite weak. As flood levels increase the contribution from tides remains high and increases up to flood levels between 0.8 – 0.9 mAHD. Atmospheric processes become an increasingly important contributor to flooding until the larger floods i.e. floods greater than 1.1 mAHD. River flows also increase in importance and only really dominate at flood levels that exceed 1.1 mAHD.

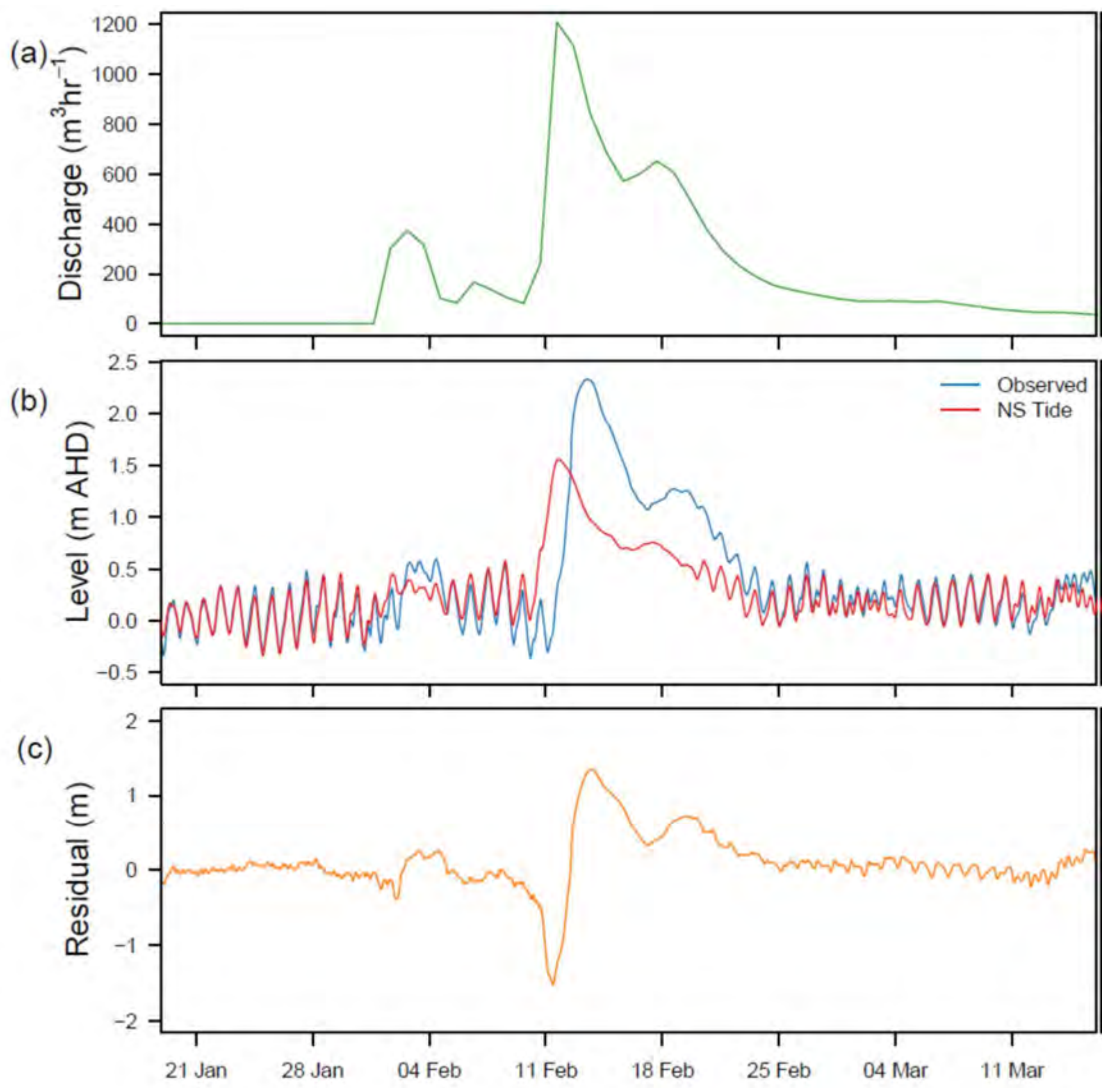


Figure 41: Comparison of NS-Tide to observed data January - March 2017.

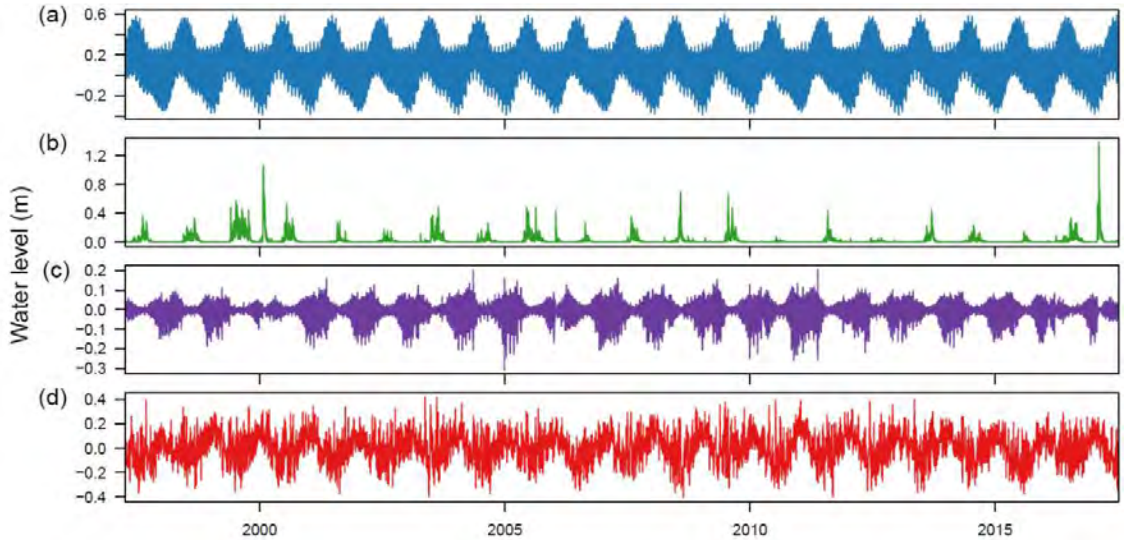


Figure 42 Disaggregated water levels from the Meadow Street Bridge gauge. Shown are the contributions to water levels by (a) the mean water level and tide; (b) river discharge; (c) river-tide interactions; and (d) atmospheric effects.

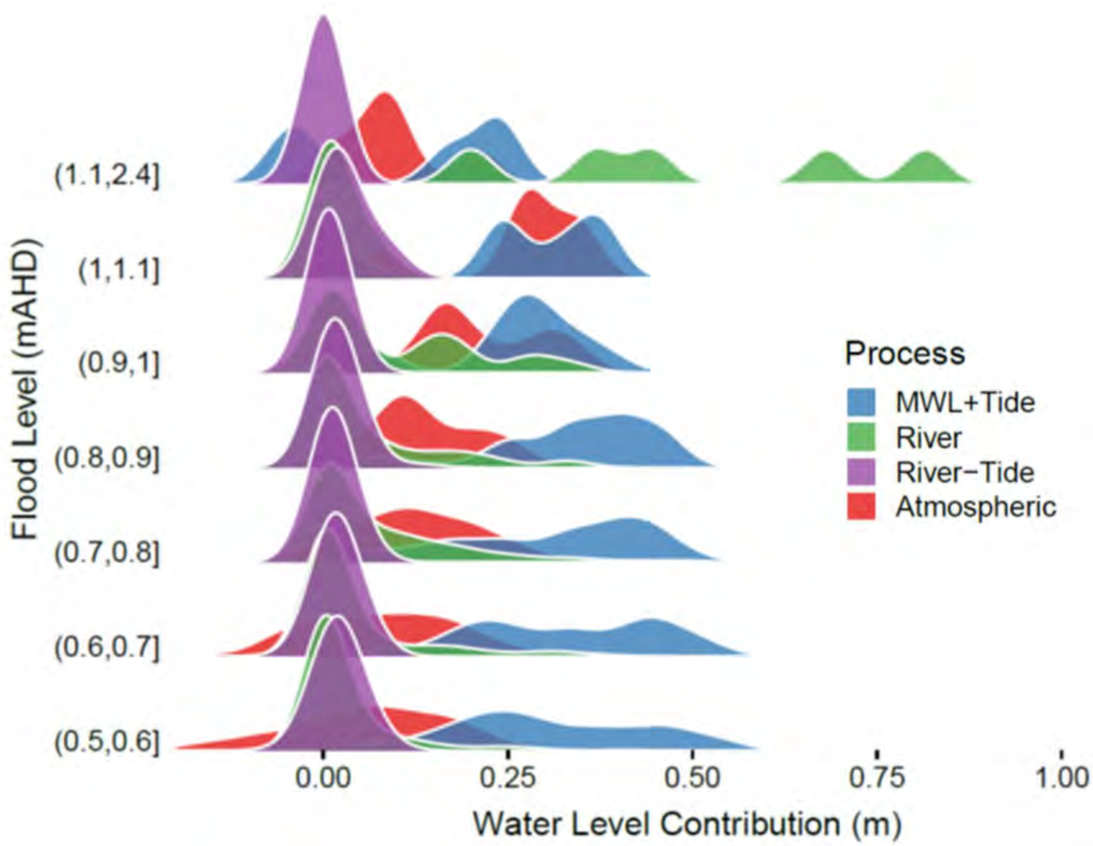


Figure 43 Distributions of contributions to flood levels by river processes.

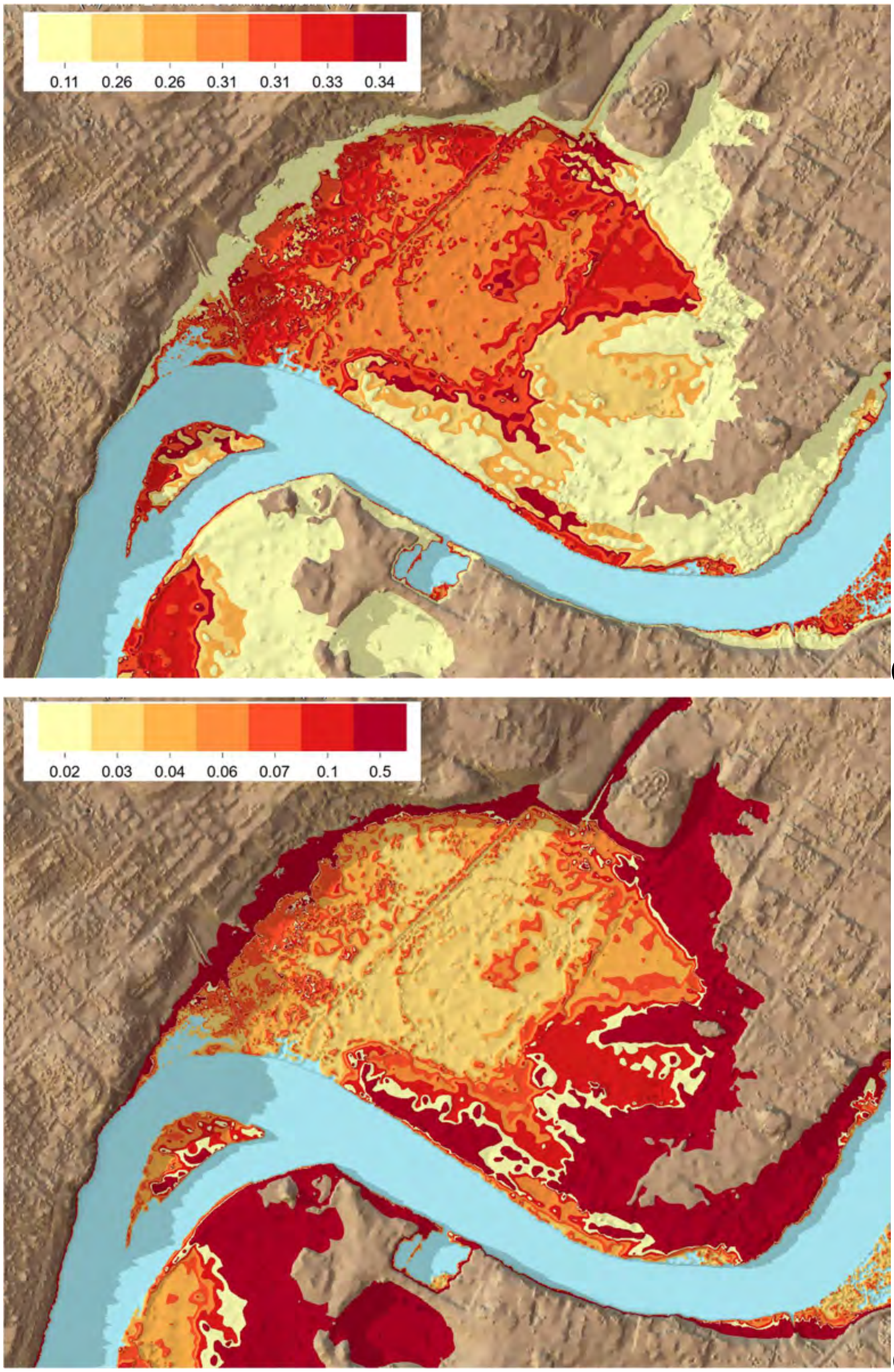
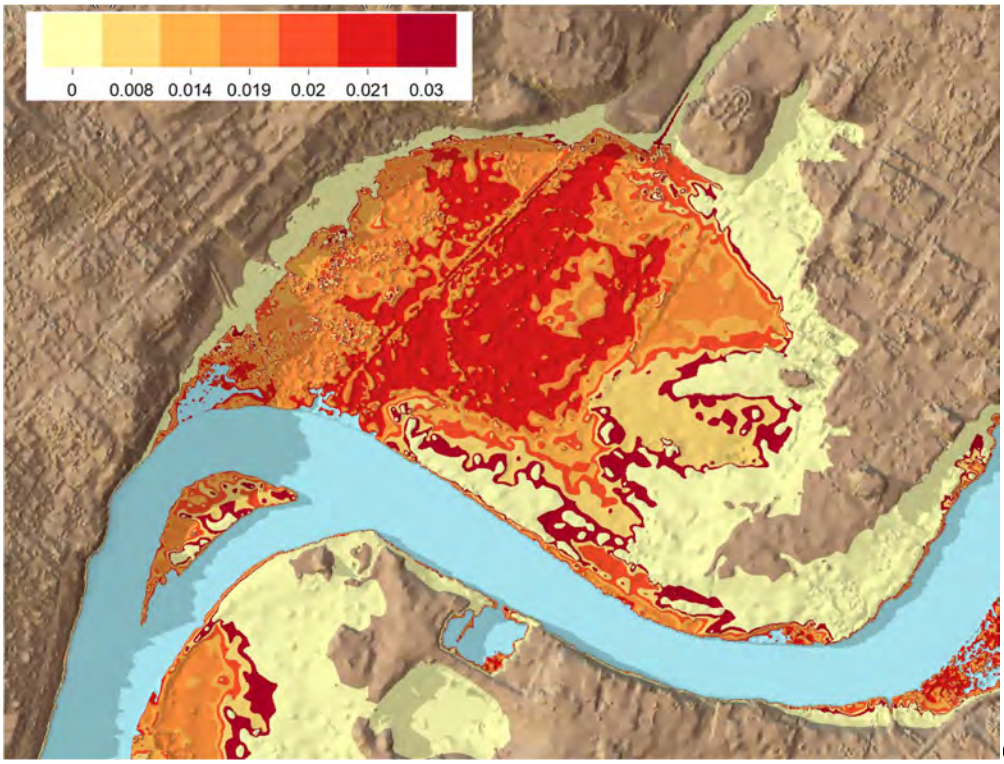
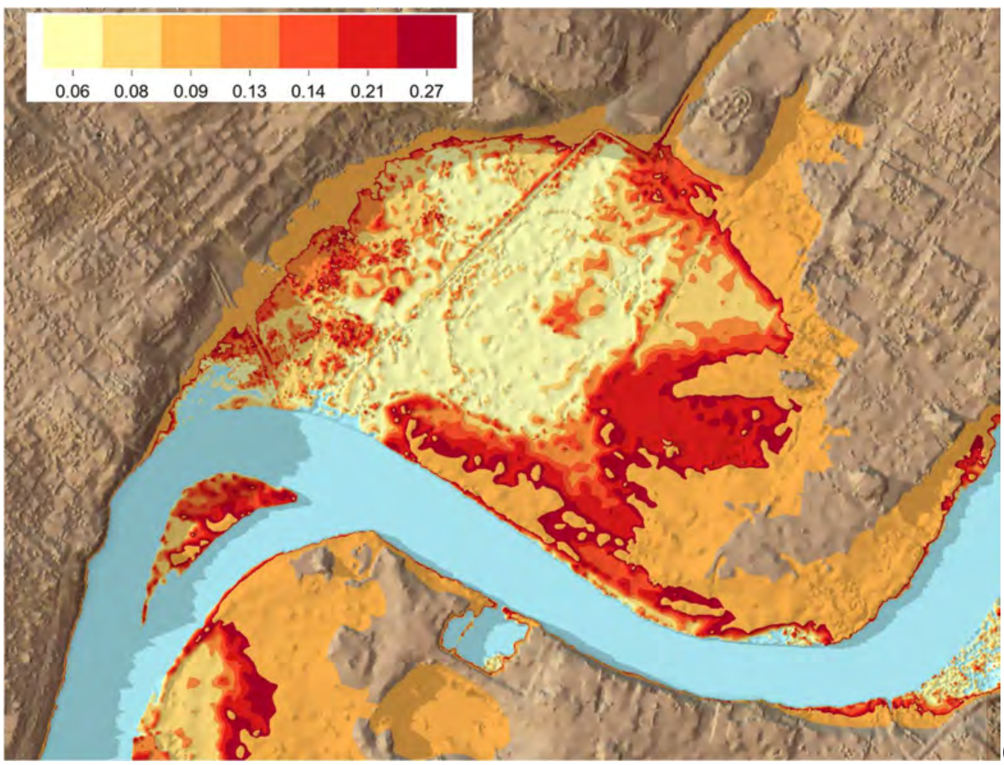


Figure 44 Spatial distribution of the average contribution peak water level (m) during flood events by: (a) mean water level (MWL) and tides; and (b) river flows.



(a)



(b)

Figure 45 Spatial distribution of the average contribution to peak water level (m) during flood events by: (a) river-tide interactions, and (b) atmospheric processes.

The average contributions of these processes to each flood level can be mapped spatially (Figures 44 and 45). This provides a means to assess the dominant processes impacting flooding within the wetland. Mean water level and tide contribute between 0.31 – 0.34 m to floods that inundate most of the wetland. This is by far the largest contributor to flooding of the TEC. In comparison, atmospheric processes contribute 8 – 9 cm, river flows 6 cm and river-tide interactions <2 cm to this area. River flooding only has a significant impact at the extremities of the reserve.

These results are based upon water level measurements collected at the Meadow St gauge between 1989 – 2020. Historically river flows were much larger than during this later period, particularly prior to the drying trend which became apparent since the 1970's. River flows may therefore have contributed to more frequent, more prolonged and fresher floods historically. However, given the high frequency of tidal flooding the tidal contribution is still expected to have dominated the flood frequency.

4.2.4 Modelling Observed Wetland Surface Water Dynamics

The baseflow model reproduced the observed baseflow well. The calibrated parameters are summarized in Table 14. Generally, the calibrated surface water models reproduced observed water levels well, with a narrow distribution of errors (Figure 46). The models tend to be slightly biased toward underestimating water levels. Small rates of upward groundwater flow not considered by the model, and rates of evapotranspiration below potential rates may be contributing factors. The Bayesian calibrations well constrain model parameters and model errors (Table 15). The standard deviations of error distributions were less than 10 cm.

The threshold river level triggering flooding, h_2, averaged 0.55 mAHD, while the threshold elevation at which flood recession ceases averaged 0.46 mAHD and the median rate of recession was 0.05 hr^{-1}. A faster rate of recession, 0.65 hr^{-1}, was determined for the pool located adjacent the river at monitoring site C14, which is expected given the short length of overland flow to the river as well as the presence of piped connections to the Kitchener St drain.

The simple model accurately reproduces various aspects of the water level dynamics observed at the site (Figures 47-50). These include: the sudden transition from dry to flooded in response to river tides; the rapid recession of a flood event; the maintenance of a near-stable water levels during winter around h_1; the convex shape of the drying during spring, and the extended period of dry conditions over summer. The omitted processes such as groundwater recharge, upward groundwater flow, unsaturated soil physics etc., are therefore likely to contribute only a small amount to surface water dynamics here. Potential surface water – groundwater interactions are evaluated further in Section 5.

Rainfall events have only a weak effect on water levels in comparison to river flooding. A comparison of simulations with and without inflow from the Woolcock Ct drain to the western wetlands (not shown) demonstrates that the drain flow contributes to sustaining water levels near h_1 for longer periods through spring, delaying the dry down. The major contribution at this time stems from off-site groundwater derived baseflow in the drain. Using daily rainfall, the potential rise in water levels from runoff events were calculated and assessed via an exceedance probability plot (Figure 51).

The largest contribution from the Woolcock Ct drain in the 30 years of daily rainfall is estimated to be 60 mm, while 50% of runoff events contribute less than 2 mm. The seasonal change in surface water in the north-western wetlands varies from ~1.7 ha to 5.7 ha and therefore a baseflow of 2 L s^{-1}, observed near the start of spring, contributes approximately 3 to 10 mm of water depth daily which is of a similar magnitude to potential evaporation rates from early to late spring. This baseflow maintains saturated conditions throughout summer in the pools to which it drains to. The Woolcock Ct drainage system appears to perform two functions, stormwater drainage and groundwater lowering to facilitate the urban development. The model results suggest the urban drainage has extended the hydroperiod at the northern extent of the wetland and may have made the pool adjacent the drain outlet perennial.

Table 14: Calibrated parameters of the Woolcock Ct baseflow model

Parameter	Value
s_{1x}	37 mm
s_{2x}	1500 mm
k_1	4.7 mm day^{-1}
k_2	14.4 mm day^{-1}
c_3	0.05

Table 15: Estimated surface water model parameters.

Site	a	h_0 (m AHD)	h_1 (m AHD)	h_2 (m AHD)	σ (m)
C01	-1.30 ± 0.20	0.24	0.51	0.56 ± 0.007	0.08 ± 0.003
C02	-1.54 ± 0.06	0.20	0.33 ± 0.003	0.42 ± 0.003	0.06 ± 0.06
C04	-1.66 ± 0.05	0.20	0.50 ± 0.005	0.64 ± 0.011	0.04 ± 0.002
C06	-1.83 ± 0.08	0.07	0.34 ± 0.006	0.55 ± 0.007	0.08 ± 0.003
C07	-1.61 ± 0.04	0.20	0.49 ± 0.004	0.53 ± 0.004	0.047 ± 0.001
C12	-1.22 ± 0.13	0.22	0.40	0.65 ± 0.004	0.076 ± 0.002
C13	-1.69 ± 0.06	0.20	0.51 ± 0.001	0.52 ± 0.001	0.080 ± 0.003
C14	-0.49 ± 0.17	0.20	0.40 ± 0.004	0.46 ± 0.005	0.057 ± 0.002
C17	-1.59 ± 0.03	0.32	0.52 ± 0.003	0.62 ± 0.003	0.047 ± 0.001

The parameter $k = 2 \times 10^a$ with units of hr^{-1}. The ± denotes the standard deviation of the posterior distribution. Values without an estimated error were assumed a priori. The parameter σ, denotes the standard deviation of the model error distribution.

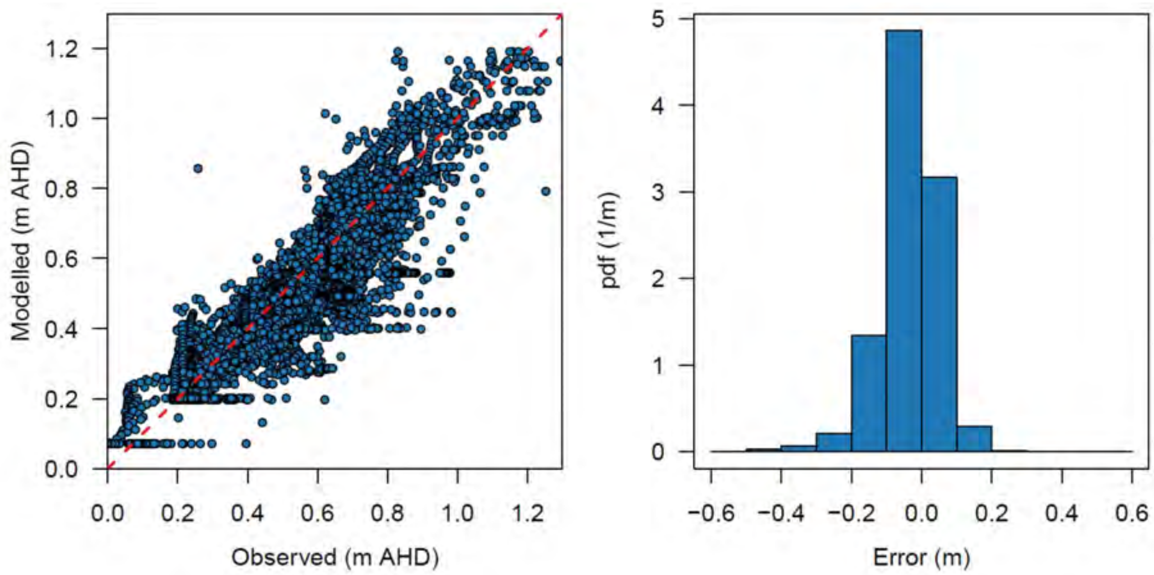


Figure 46 Modelled vs observed water levels all sites (left, dashed line denotes the 1:1 line) and the distribution of errors (right).

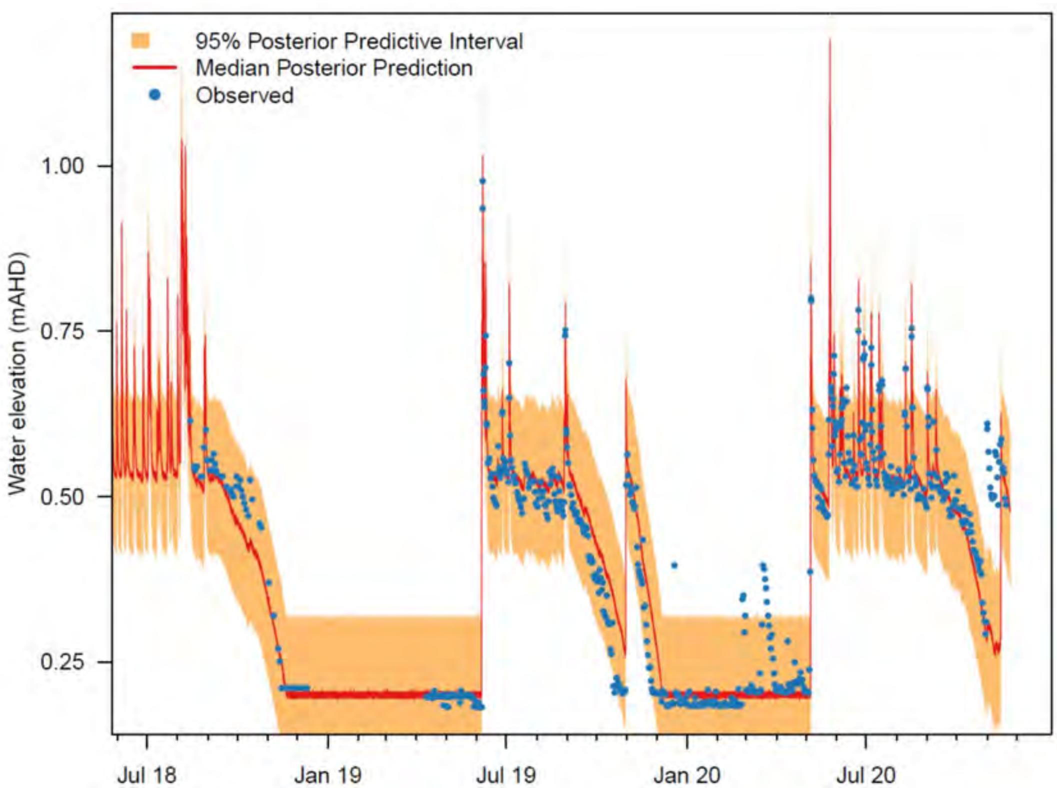


Figure 47: Observed and modelled water levels at C02.

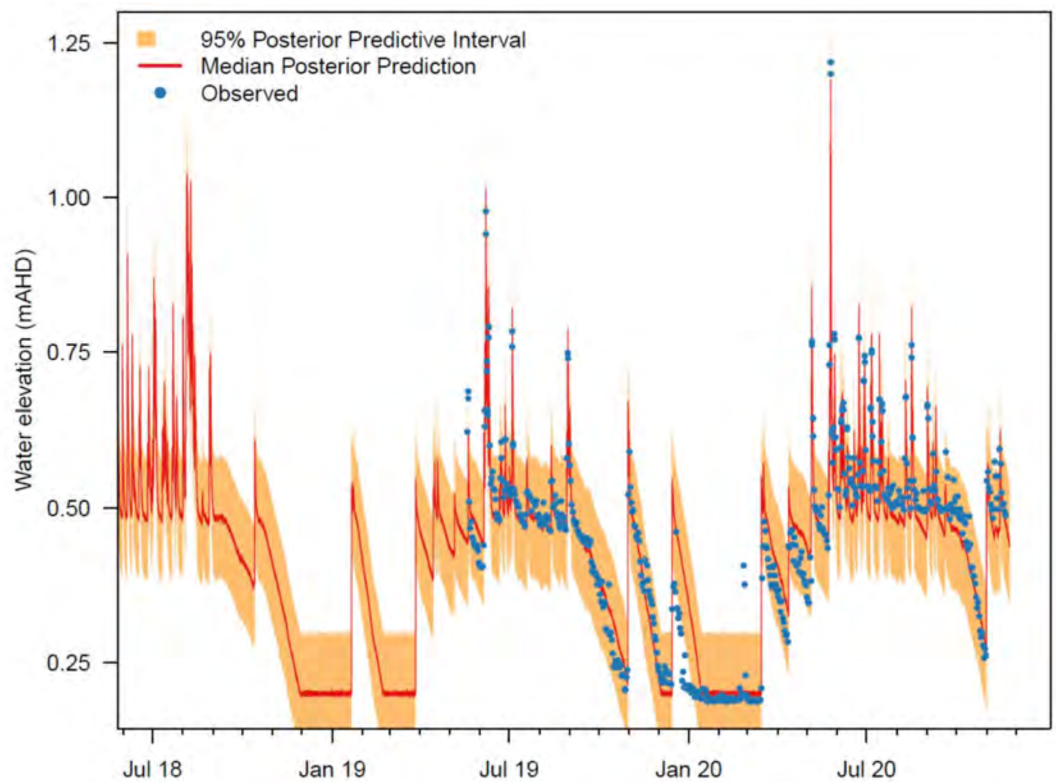


Figure 48: Observed and modelled water levels at C07.

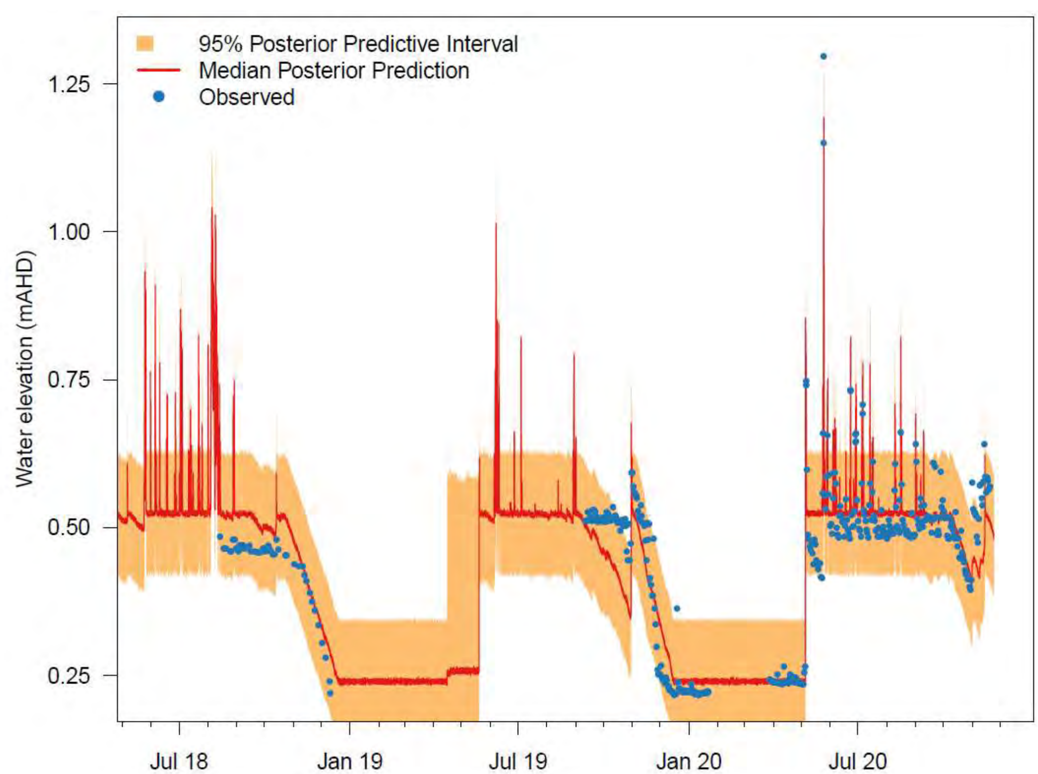


Figure 49: Observed and modelled water levels at C01.

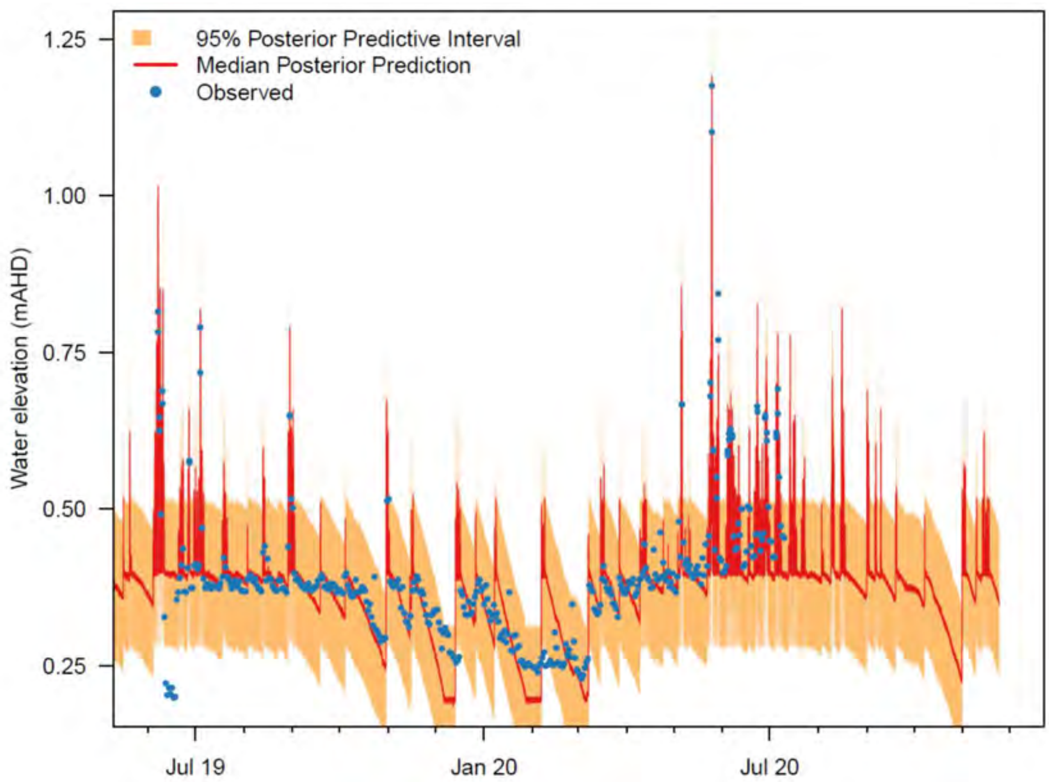


Figure 50: Observed and modelled water levels at C14.

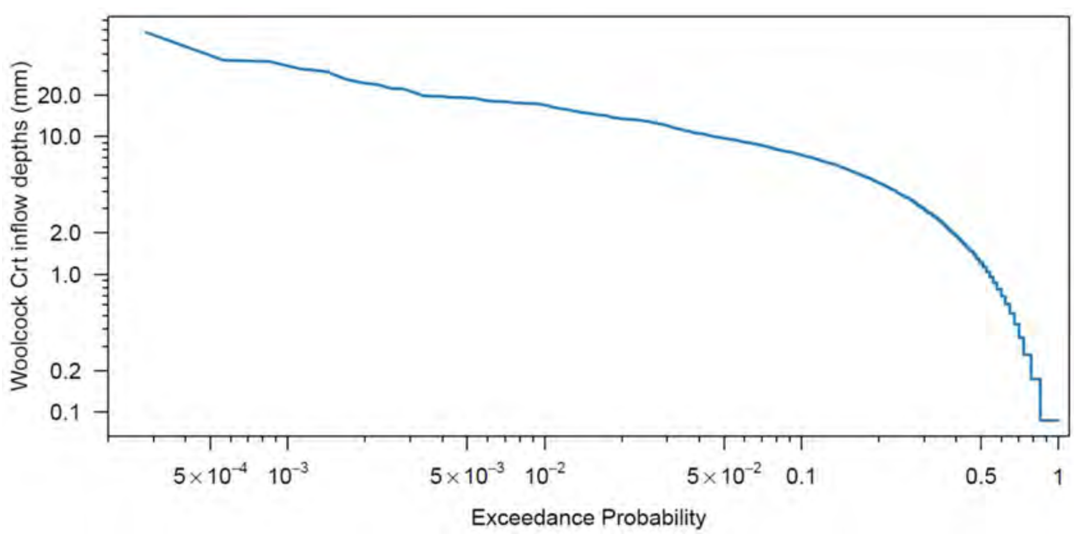


Figure 51: Estimated contributions to water levels in the western wetlands by runoff events from the Woolcock Ct drain.

4.2.5 Historical and Future Hydroperiods

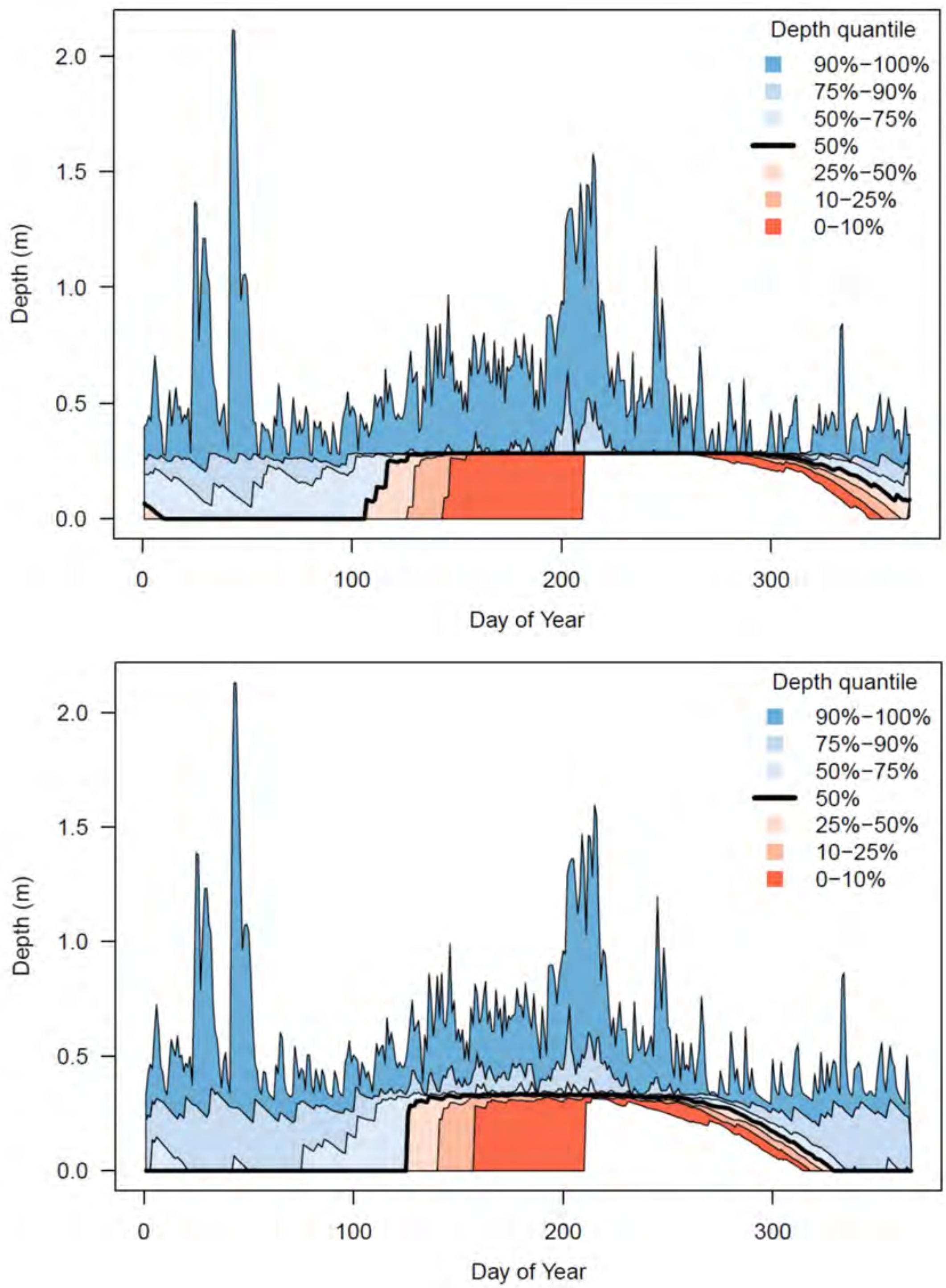
From the simulated water levels the distributions of water depth by day of year show the envelope of surface water level variability across the year (Figure 52). On average the wetland at C01 begins to flood around day 105 and has reached its capacity by the 120th day of the year. Of the 30 years of simulated hydrology the wetland floods every year and the latest it has in any year was day 210. The wetland then typically remains wet until early January the following year. Flooding events occur throughout the year and can occasionally sustain a wet state throughout the year. In comparison the average hydroperiod at C02 is shorter. Defining a wet period as a 50% quantile depth greater than 0.1 m the hindcast hydroperiods are 246 days (C01) and 188 days (C02).

The results of the climate change simulations are shown in Table 16 and Figure 53. In a short period of time (2030) the average hydroperiod at C01 is expected to increase by 59 days a^{-1} from a present mean value of 266 days a^{-1}. At C02 the increase in hydroperiod is predicted to average 70 days a^{-1}. By 2090 both emissions scenarios suggest the wetland will be effectively permanently underwater at C01 and C02 with only brief periods when it dries completely during exceptionally dry years. The hydrodynamics are expected to also change significantly. As river levels rise the average water level in the wetland will exceed the threshold at which the river presently floods, ~0.55 mAHD. Most tides will modulate wetland water levels. The Chapman St Drain embankments will be frequently underwater. The seasonal pattern of autumn flooding by brackish river water and gradual evapo-concentration to hypersaline conditions through spring and summer will be replaced by permanently brackish, river-like conditions.

Table 16: Modelled climate change impacts on mean wetland water depths and hydroperiod.

		C01		C02	
Scenario	Year	Mean Water Depth (m)	Mean Hydroperiod[1] (days a^{-1})	Mean Water Depth (m)	Mean Hydroperiod[1] (days a^{-1})
Present	1990-2020	0.20	266	0.19	216
RCP4.5	2030	0.25	325	0.26	286
	2050	0.29	351	0.32	332
	2070	0.33	361	0.40	357
	2090	0.39	362	0.48	362
RCP8.5	2030	0.25	324	0.26	284
	2050	0.30	356	0.35	341
	2070	0.36	362	0.45	361
	2090	0.48	364	0.59	364

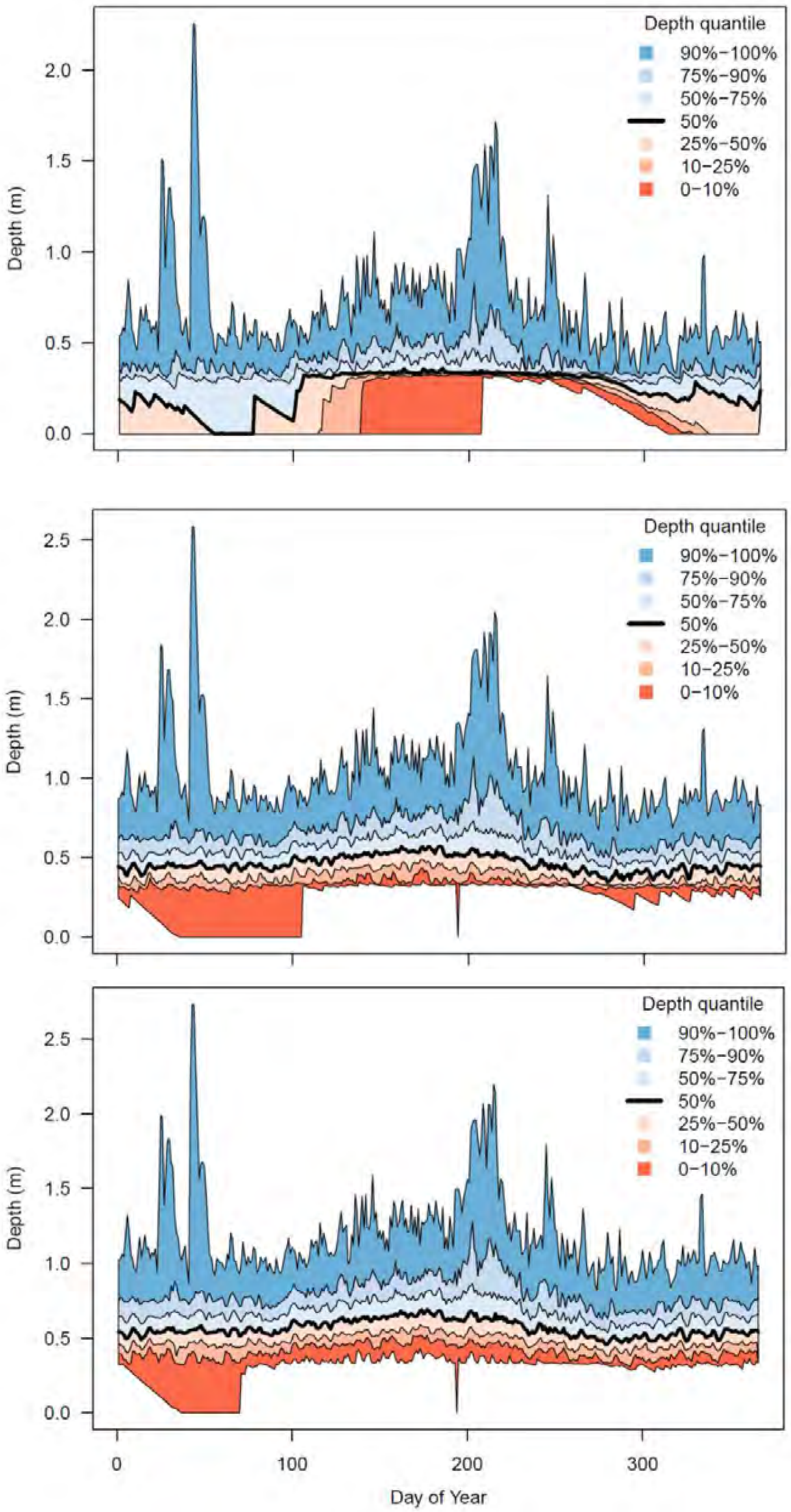
1. Hydroperiod defined as proportion of time water depth greater than 0.1 m.



(a)

(b)

Figure 52: Distributions of hindcast water depths by day of year for the period 1990 – 2020 at C01 (a) and C02 (b).

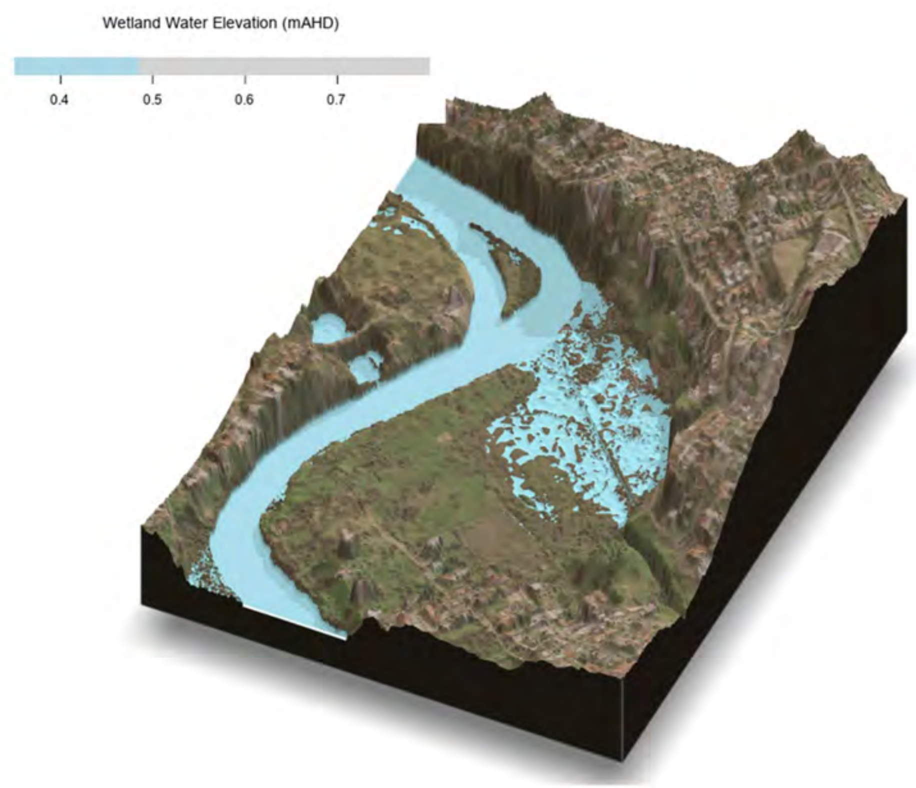


(a) RCP4.5 – 2030

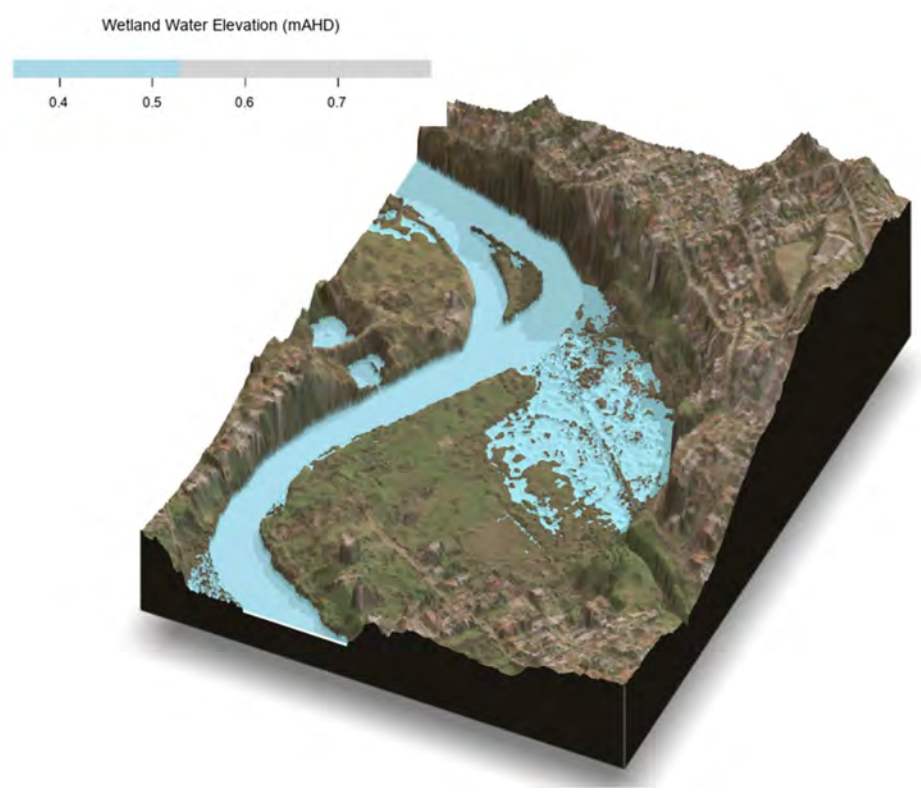
(b) RCP4.5 – 2090

(c) RCP8.5 – 2090

Figure 53: Simulated climate change impacts on water depth at C02 by day of year. Shown are scenarios RCP4.5 (a-b) and RCP8.5 (c).



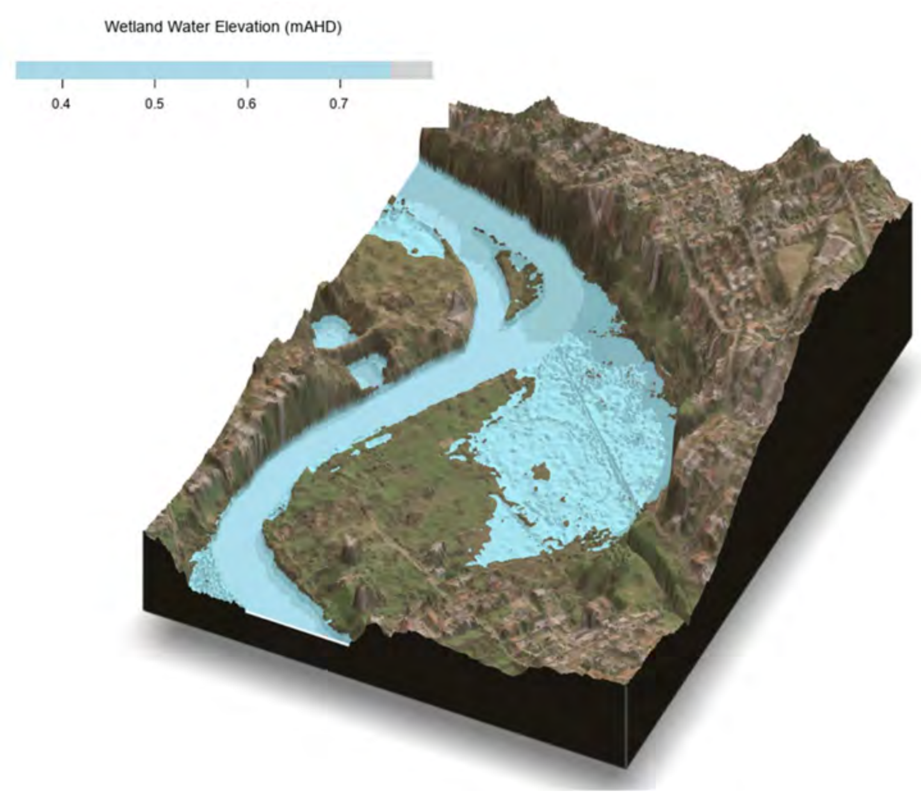
(a) 2030



(b) 2050

Figure 54: Spatial extent of inundation at mean annual wetland water levels for emissions Scenario RCP8.5 for the periods 2030 to 2090 (a – b above, c – d below).

(c) 2070



(d) 2090

Figure 54 continued.

4.3 Summary

The surface water monitoring program measured the spatial distribution of water levels across Ashfield Flats between August 2018 to November 2020. The monitoring clearly demonstrated the strong interaction with the Swan River and established a river level at the Meadow St gauge, Guildford, of ~0.5 mAHD at which Ashfield Flats begins to flood and a river level of 0.6 mAHD at which it floods to its northern extent. While water levels in the river are governed by numerous estuarine processes, tidal processes dominate the frequency and spatial distribution of flooding where the key species comprising the TEC inhabit. While elevated river levels due to river runoff occur infrequently, they are responsible for flooding the site to its full extent. Barometric effects also play a role in flooding events.

After flooding water levels are maintained for many weeks to several months, with the deeper pools to the east of the Chapman St Drain maintaining water until mid-summer. Other pools to the south-west stay permanently wet.

Modelled water levels reproduced well observed levels. The model was based upon a simple conceptualisation, driven by river levels and to a lesser extent by rainfall, storage of floodwaters and thereafter evaporative losses. Potential evaporation could account for the drop in river levels and the balance between rainfall and evaporation the maintenance of stable water levels during winter, with additional losses due to rapid surface water flow when levels exceed a threshold. Groundwater recharge is expected to be a minor contributor to the surface water balance.

The modelling established a historical distribution of annual water levels based on a recent 30-year weather record. Forecasting future water levels, incorporating climate change impacts, including sea-level rise, suggests the wetland could be at risk of becoming permanently flooded before 2090 and changes to the hydroperiod are likely to be seen within the next 30 years.

This wetland has formed via accretion of wetland sediments and may continue to accrete in the future. Whether accretion rates can keep pace with sea-level rise remains a significant unknown. If not, then management to preserve the saltmarsh could consider managed retreat as sea-levels rise. The current spatial distribution of the salt tolerant *Salicornia* and *Tecticornia* is expected to change if accretion rates are low.

5 Groundwater

A groundwater monitoring program was established with the aim of developing a conceptual understanding of the groundwater hydrology and the potential for surface water – groundwater interactions. The objectives were to collect data on Superficial Aquifer lithology, groundwater levels and water quality for the purpose of quantifying components of the conceptual model, including aquifer hydraulic properties, water flow directions and water fluxes.

5.1 Regional Hydrogeology

The following description of the local geology stems from Davidson and Y (1998). The surficial geology of the area consists of Bassendean Sands, Guildford Clays and alluvium. Bassendean Sands are leached pale grey to white, fine- to coarse-grained moderately sorted, quartz sands, varying in thickness up to 80 m, depending on the topography. The Bassendean Sands are highly permeable with horizontal hydraulic conductivities between 10 - 50 m day^{-1} and a specific yield of 0.2. This unit interfingers with the Guildford Clay near the site. The Guildford Clay consists of pale grey, blue, but mostly brown, silty, and slightly sandy clay, with lenses of fine- to coarse grained, very poorly sorted conglomeratic and sometimes shelly sand. The Guildford Clay can be up to 35 m thick, and the clay sediments have low hydraulic conductivity of less than 0.1 m day^{-1} and specific yields of 0.05, while the sandy lenses have a horizontal hydraulic conductivity of up to 10 m day^{-1}.

The Superficial Aquifer is thought to overly the Mirrabooka Formation which begins at approximately -20 mAHD although, in Ashfield the thickness of the Mirrabooka Formation is uncertain with the top of the Kardinya Shale Member occurring at similar depths in the area too. The Mirrabooka Member consists of sandstone with thin interbeds of siltstone and shale. The sandstone is weakly consolidated, dark greenish-brown, fine to very coarse-grained, very poorly sorted, silty and richly glauconitic. The siltstones and shales are moderately consolidated, dark green to black, glauconitic, and contain common spherical, coarse to gravel-sized quartz grains.

In the area of Ashfield the Superficial Aquifer is recharged at a rate of 5% of annual rainfall (i.e. ~40 mm a^{-1}) and groundwater flows to the southeast towards the Swan River. It is also thought that the Mirrabooka Aquifer flows upwards to the Superficial Aquifer at Ashfield.

Using a transect of groundwater bores across the Swan River and bisecting Ron Courtney Island, just to the south of Ashfield Flats Smith (1999) evaluated a tidal method to estimate aquifer properties. The estimates of aquifer diffusivity (the ratio of transmissivity to storativity were in the range of 14,00 to 270,000 m^2 day^{-1} and with a reasonable assumption of a transmissivity of 600 m^2 day^{-1} the storativity was estimated to be 0.002 to 0.04, characteristic of a confined aquifer. Linderfelt and Turner (2001) also assessed water quality variations along the same transect. They identified salinities in groundwater upgradient of the river in Ashfield of <2 mS cm^{-1} from the water table to -20 mAHD and on the norther side of the river there was only weak ingress of saline convection cells in groundwater as compared to the southern side of the river, the inside of the river meander (Smith and Turner, 2001). They estimated groundwater velocities there to be 0.5 m day^{-1}, albeit with significant heterogeneity where well screens in localized clay layers between 0 to –10 mAHD were found to be relatively unproductive in comparison to deeper and shallower screened intervals.

5.2 Methodology

5.2.1 Groundwater Monitoring

A total of 16 groundwater monitoring wells were installed using a direct push drill rig (Geoprobe® Model 7822DT). Soil cores were retained for characterization of texture and geochemistry. The 50 mm diameter PVC wells were installed with either shallow (~3 – 4.5 m below ground surface) or deep (~8 -13.5 m below ground surface) screens, 1.5m in length, in a coarse sand packing and a 0.5 – 1.0 m thick bentonite seal. The remainder of the drill hole was repacked with coarse sand. The texture of sediments in drill cores were characterized by hand (DPIRD, 2019).

Wells were developed using a Waterra Power-Pack PP1 pump extracting a minimum of 120 L and until water quality parameters such as electrical conductivity, dissolved oxygen, pH and temperature had stabilised. Water quality parameters were measured using a Hydrolab Quanta Sonde. Wells were developed on three occasions between April and June 2019. Unvented Diver water level loggers (Schlumberger Water Services, Netherlands) with a range of 0 – 10 m were installed in all monitoring wells recoding hourly. A Baro-Diver, recording hourly barometric pressure was installed adjacent MW12s. Barometric data was supplemented with measurements from the nearby Airport weather station as the Baro-Diver logger failed operating in January 2020. Manual measurements of depth to water were conducted on at least four occasions in each well to verify logger data.

Feature surveys were conducted at the site in September 2019 and May 2020 using a differential GPS and a laser theodolite. The accuracy across the two surveys was determined from differences in elevations of the well casings. Mean elevations of casings differed by 3.5 cm between surveys with a standard deviation of 11 cm.

Groundwater heads were corrected for salinity following Post (2012). The salinity corrections were then used to determine local hydraulic gradients (Post et al., 2007) and the development of groundwater flow nets.

5.2.2 Environmental Geophysics

To assist with the planning and interpretation of groundwater monitoring data an electrical resistivity geophysics survey was undertaken. The resistivity survey was conducted using a 4Point Light resistivity meter (Lipmann Geophysics, Germany) with smart electrodes and an electrode spacing of 1 to 4 m. A combination of Wenner and Schlumberger arrays were programmed into the meter using the software GeoTest version 2.49 (Lipmann Geophysics, Germany). An error tolerance target of 0.1% was set with a minimum of five and a maximum of 20 repeat measurements. The injected current ranged between 0.1 to 100 mA, varying at 4.16 Hz. The average value of the voltage measurements from either the number achieving the error tolerance, or the full 20 measurements were calculated along with 90th percentile range. A total of five resistivity transects were completed between January and May 2019 (Figure 56).

Geophysics data were cleaned of noisy data, removing local spikes and data with a relatively high 90th percentile repeat error range. In general, greater than 95% of the measured data were retained. The retained data was inverted using the software EarthImager (Advanced Geosciences Inc, Texas) and RES2Inv (Geotomo Inc, Kuala Lumpur). The two programs gave similar results. Smooth models were obtained by inverting the logarithm of the apparent resistivity, applying dampening factors to emphasize vertical layering.

Figure 55: Installation of groundwater monitoring wells MW04D and MW04S.

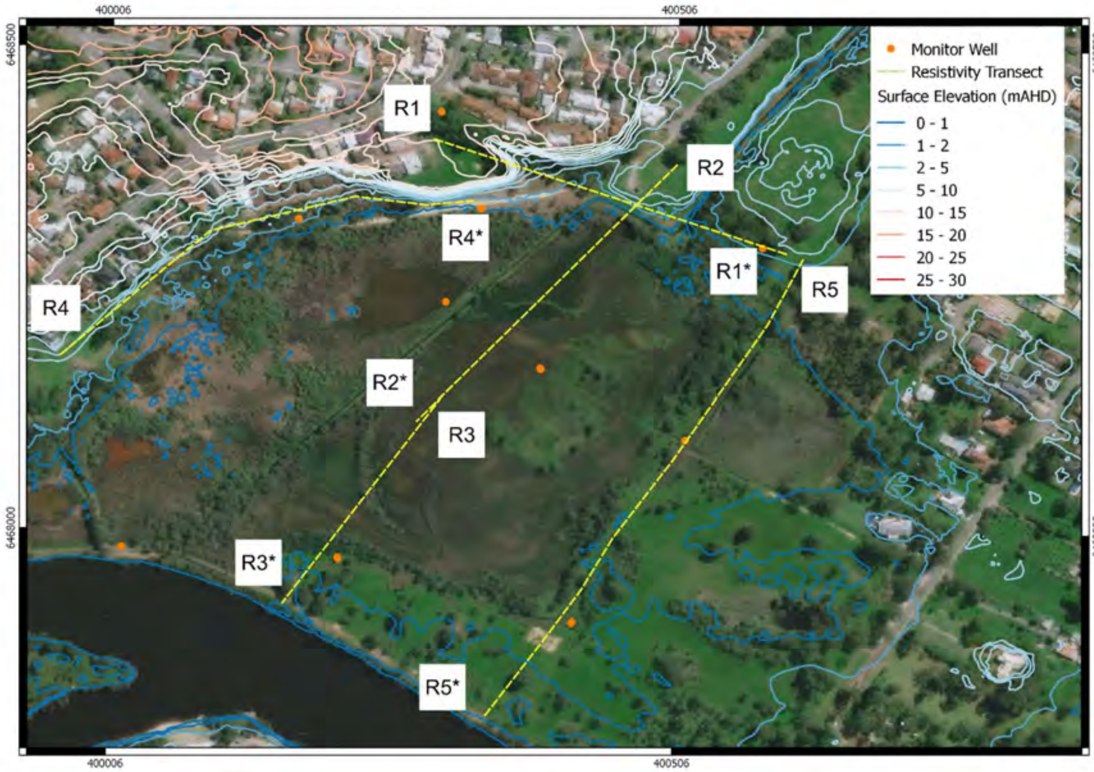


Figure 56: Electrical resistivity imaging transects.

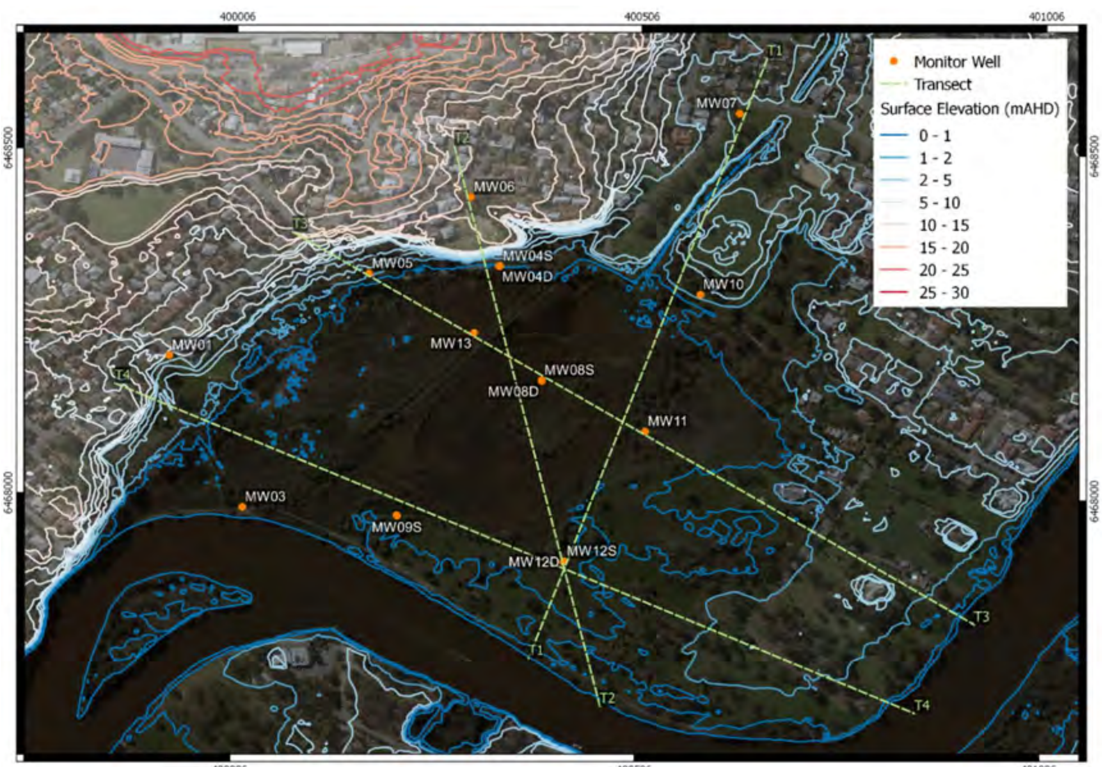


Figure 57: Location of groundwater monitor wells and conceptual groundwater transects.

Table 17: Monitoring wells coordinates.

Well ID	Easting m	Northing m	Casing Elevation mAHD	Ground Elevation mAHD	Screen Depths mBGS
MW01	399925.6	6468201	5.509	5.574	2.0 – 3.5
MW03	400017.9	6467982	0.986	0.460	7.5 – 9.0
MW04S	400333.2	6468334	1.617	0.939	2.0 – 3.5
MW04D	400332.1	6468334	1.598	0.888	9.0 – 10.5
MW05	400171.5	6468322	1.919	1.763	2.0 - 3.5
MW06	400296.5	6468434	12.554	12.660	1.0 – 2.5
MW07	400627.4	6468558	3.733	3.818	2.0 – 3.5
MW08S	400386.1	6468169	0.987	0.390	3.0 – 4.5
MW08D	400386.4	6468168	0.884	0.405	9.0 – 10.5
MW09S	400209.3	6467971	1.357	0.870	2.0 – 3.5
MW09D	400208.7	6467972	1.307	0.895	10.5 – 12.0
MW10	400581.2	6468295	2.929	2.527	5.0 – 6.5
MW11	400514.8	6468096	1.066	0.806	3.0 – 4.5
MW12S	400416.4	6467907	1.475	0.816	1.5 – 3.0
MW12D	400415.8	6467906	1.469	0.808	8.0 – 9.5
MW13	400302.0	6468237	0.729	0.372	7.5 – 9.0

5.2.3 Drain – Groundwater Interactions

A study to assess hyporheic exchange in the Chapman St Drain was conducted as part of a Master’s Thesis (Barrett, 2020). The objective of the study was to assess the potential for cross-borehole electrical resistivity geophysics to image drain-water groundwater interaction via changes in the spatial patterns of resistivity. Borehole electrodes were constructed and installed in two 4 m deep boreholes at two locations, one near the northern extent of the wetlands near the Water Corporation pumping station and a second location 100 m from the river. In addition to geophysics measurements of pore-water chloride concentrations were conducted prior to each survey and at four depths below the base of the drain sediments Details of the experimental set up and measurements are documented in Barret (2020). The results are summarized in Section 5.3.4.

5.2.4 Aquifer Properties From Tidal Dampening

The variation of groundwater in response to tides can be used to infer hydraulic properties of aquifers (Townley, 1995; Li et al., 2001; Trefry and Bekele, 2004; Turnadge et al., 2019). Specifically, it is the dampening of tidal amplitude and the shift in the phase of tidal signals in groundwater that can be used to quantify these aquifer properties.

To quantify tidal dynamics in groundwater the measured water levels were first processed using a high-pass filter, passing frequencies higher than 1 month^{-1} using a 4th order Butterworth filter. The subsequent times series were then detrended and demeaned before Hanning windowing coefficients were applied. To this filtered data a discrete Fourier transform (DFT) was applied, i.e.:

$$\mathcal{F}(x_n) = \sum_{n=0}^{N-1} x_n e^{-\frac{i2\pi kn}{N}} \qquad \text{Equation 6}$$

where x_n denotes the prefiltered water level data, N is the length of that time series, $k = 0,\ldots,N\text{-}1$, and $\mathcal{F}$ denotes the Fourier transform. The amplitude spectrum relates the amplitude of a signal in the time series to its frequency and can be obtained from the DFT via its modulus, i.e.

$$A_k = \frac{1}{N}|\mathcal{F}(x_n)| = \sqrt{(\mathrm{Re}[\mathcal{F}(x_n)])^2 + (\mathrm{Im}[\mathcal{F}(x_n)])^2} \qquad \text{Equation 7}$$

where Re and Im denote the real and imaginary parts. Similarly, the phase spectrum is given by the argument of the DFT i.e.:

$$\varphi_k = \tan^{-1}\left(\frac{\mathrm{Im}[\mathcal{F}(x_n)]}{\mathrm{Re}[\mathcal{F}(x_n)]}\right) \qquad \text{Equation 8}$$

Following Trefry and Bekele (2004), the amplitudes were corrected to account somewhat for spectral leakage by taking the root of the sum of squares of the amplitude at the target frequency A_i and the two adjacent frequencies, i.e.

$$\bar{A_i} = \sqrt{|A_{i-1}|^2 + |A_i|^2 + |A_{i+1}|^2} \qquad \text{Equation 9}$$

Following the above methodology, the tidal amplitude, $\bar{A_i}$, the attenuation factor ($\alpha = \bar{A_i}/A_{river}*100$) and the phase lag were determined. The phase lag, Φ_i (hr) is related to the phase shift via:

$$\Phi_i = \frac{1}{\omega_i}\begin{cases} 1 - \dfrac{(\varphi_i - \varphi_{river})}{2\pi}, & \text{for} \quad 0 < \varphi_i - \varphi_{river} \le \pi \\ -\dfrac{(\varphi_i - \varphi_{river})}{2\pi}, & \text{for} \quad -\pi < \varphi_i - \varphi_{river} \le 0 \end{cases} \qquad \text{Equation 10}$$

The characteristics of the stratigraphy and the groundwater level fluctuations in the wetland suggested the aquifer at the site may comprise a shallow unconfined aquifer over a leaky, semi-confined aquifer. Previously Jiao and Tang (1999) developed a simplified model of the groundwater heads of a similar system subjected to tidal fluctuations at one boundary and a constant head at a far (infinite) boundary. Their analytical solution to the one-dimensional flow problem describes the pressure head fluctuations in the confined aquifer dependent upon the tidal frequency, ω_i, the transmissivity, T (m^2 s^{-1}), and the storativity, S (-). The resulting amplitude and phase shift in the aquifer are given by (Jiao and Tang, 1999):

$$A_i(x) = A_0 e^{-d_i x} \qquad \text{Equation 11}$$

and

$$\Phi_i(x) = \frac{x}{2\delta_i D}$$ Equation 12

respectively, where:

$$\delta_i = \frac{1}{\sqrt{2}}\left\{\left[M^2 + \left(\frac{\omega_i}{D}\right)^2\right]^{\frac{1}{2}} + M\right\}^{1/2}$$ Equation 13

and $M = L/T$ (m^{-2}) is the ratio of specific leakage (s^{-1}) to transmissivity and $D = T/S$ is the hydraulic diffusivity ($m^2\ s^{-1}$). The equations therefore describe an exponential decay in amplitude and a linear increase in the phase with distance from the tidal boundary.

Using the amplitudes and phase lags from the Fourier analysis of water levels from the river and the deep wells (MW09d, MW12d, MW08d and MW04d) exponential and linear models were fitted to the observed trends. Extracting δ_i from the exponential regression and substituting into the slope of Equation 12 and Equation 13 allows M and D to be calculated.

5.2.5 Barometric Efficiency

Water in pressure in aquifers is influenced by variation is atmospheric pressure and measures of the degree of this influence can provide information on the degree of aquifer confinement (Rasmussen and Crawford, 1997; Turnadge et al., 2019). These groundwater responses to atmospheric pressure fluctuations can be characterised using the metric of barometric efficiency (BE), which is calculated using the ratio of changes in groundwater pressure to changes in barometric pressure at the ground surface.

In unconfined aquifers, the atmospheric load is accommodated by the water table. Groundwater responds to the downward propagation of air pressure through the vadose zone and this propagation can occur quickly in areas with shallow groundwater and more slowly and with delay in areas with deep unsaturated zones and low permeability substrates. In confined aquifers, part of the load is accommodated by the aquifer matrix and part by the water column, both of which can compress and expand. Aquifers with a value of $\mathrm{BE} = 0$ have all of the imposed load taken by the pore water whereas when $BE = 1$ all of the atmospheric load is taken up by the sediment.

Clark (1967) suggested a simple means to quantify the barometric efficiency via cumulative sums of changes in barometric and water pressure. Specifically, BE was calculated as follows:

$$BE = \frac{\mathrm{Sum}\ W^*}{\mathrm{Sum}\ B^*} = \frac{\sum_i -\mathrm{sign}[(w_i - w_{i-1})(b_i - b_{i-1})]|w_i - w_{i-1}|}{\sum_i |b_i - b_{i-1}|}$$ Equation 14

where w_i is the water pressure at time t_i, b_i is the atmospheric pressure. Clark adds the caveat that instances when $|b_i - b_{i-1}| = 0$ are omitted. While Clark's method is simple it can include contributions to changes in water level that are not associated with barometric effects. In order to rectify this Rahi (2010) modified Clark's algorithm only includes instances when the absolute change in water level was less than the absolute change in barometric pressure, i.e. $|w - w_{i-1}| < |b_i - b_{i-1}|$ and when the changes are out of phase, i.e. $(w_i - w_{i-1})(b_i - b_{i-1}) < 0$. These approaches may be influenced by tides, as well as diurnal variation in water levels due to transpiration and evaporation, particularly as atmospheric pressure shares similar diurnal and semi-diurnal frequencies (e.g. Trefry and Bekele, 2004). Additionally, the effect of measurement frequency on the calculation of BE via the Clark and Rahi methods has not previously been assessed. To compare these two methods the BEs were evaluated for water levels measured at MW07 and MW12d. Well MW07 is located far from the river and contains a weak diurnal pattern associated with evaporative demand (which includes transpiration) and diurnal air pressure variations, while MW12d has a strong tidal signal.

5.3 Results

5.3.1 Sediment Characteristics

The materials encountered during drilling, were stiff gray/green plastic clays, likely Guildford Clay, medium – coarse grained sands, likely Bassendean Sand, organic and silty/clayey wetland sediments, a clayey sand interspersed with Guildford Clay and coarse sandy alluvial deposits with shell grit. These materials fit with what was expected to occur at the site based upon hydrogeological models of the region (Davidson, 1995; Davidson and Yu, 1998; Silberstein et al., 2009). A summary of bore-logs is shown in Figure 58. At the northern end of the wetland drilling encountered Bassendean sands below a thin near surface layer of clays and silty clay. Apart from the organic rich surficial sediments in the wetland there was little consistent layering of materials and much of the wetland subsurface comprises interspersed layers of clay and sandy clays with more evident alluvial deposits of coarse sand with shell grit.

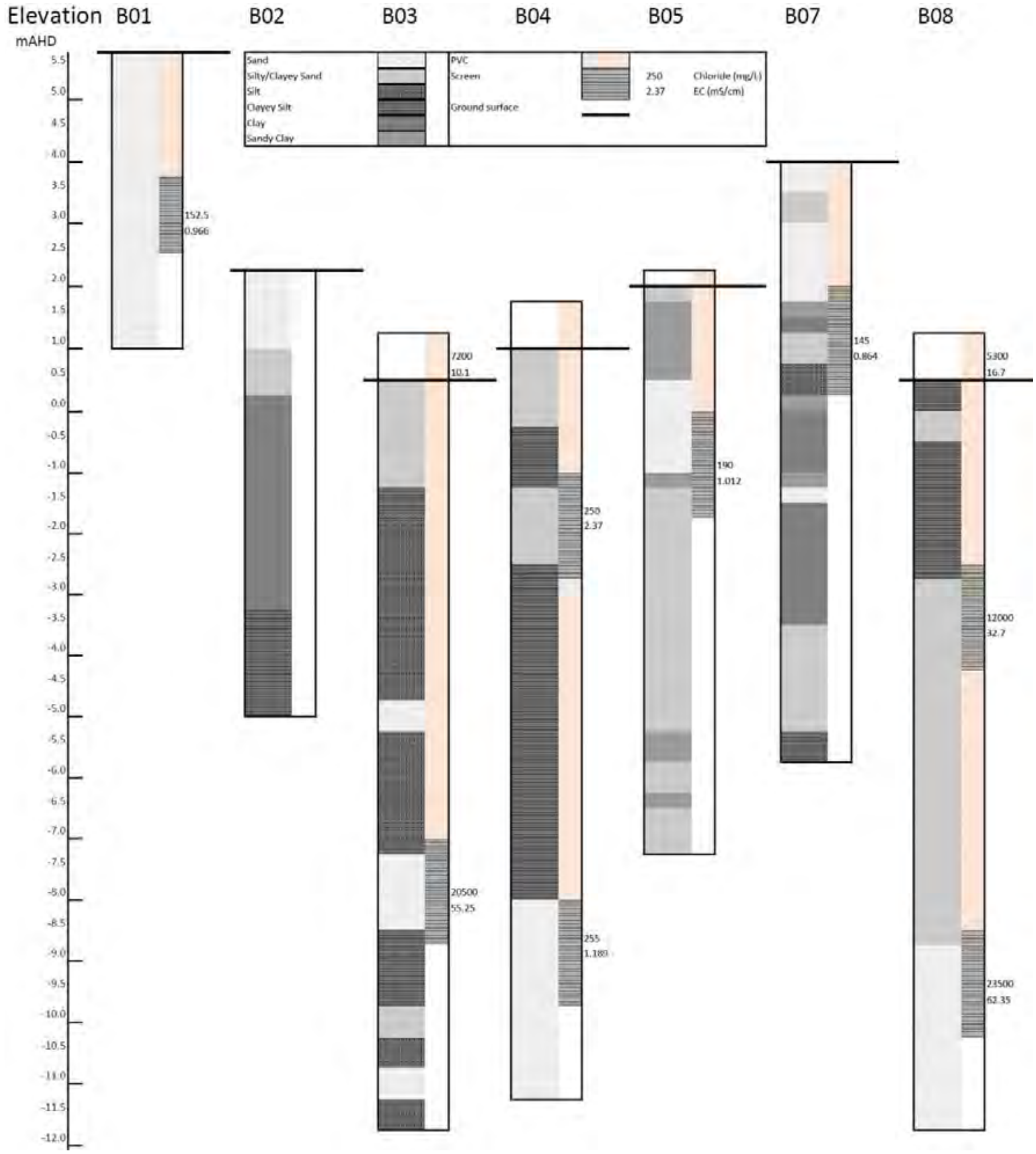


Figure 58: Borelogs

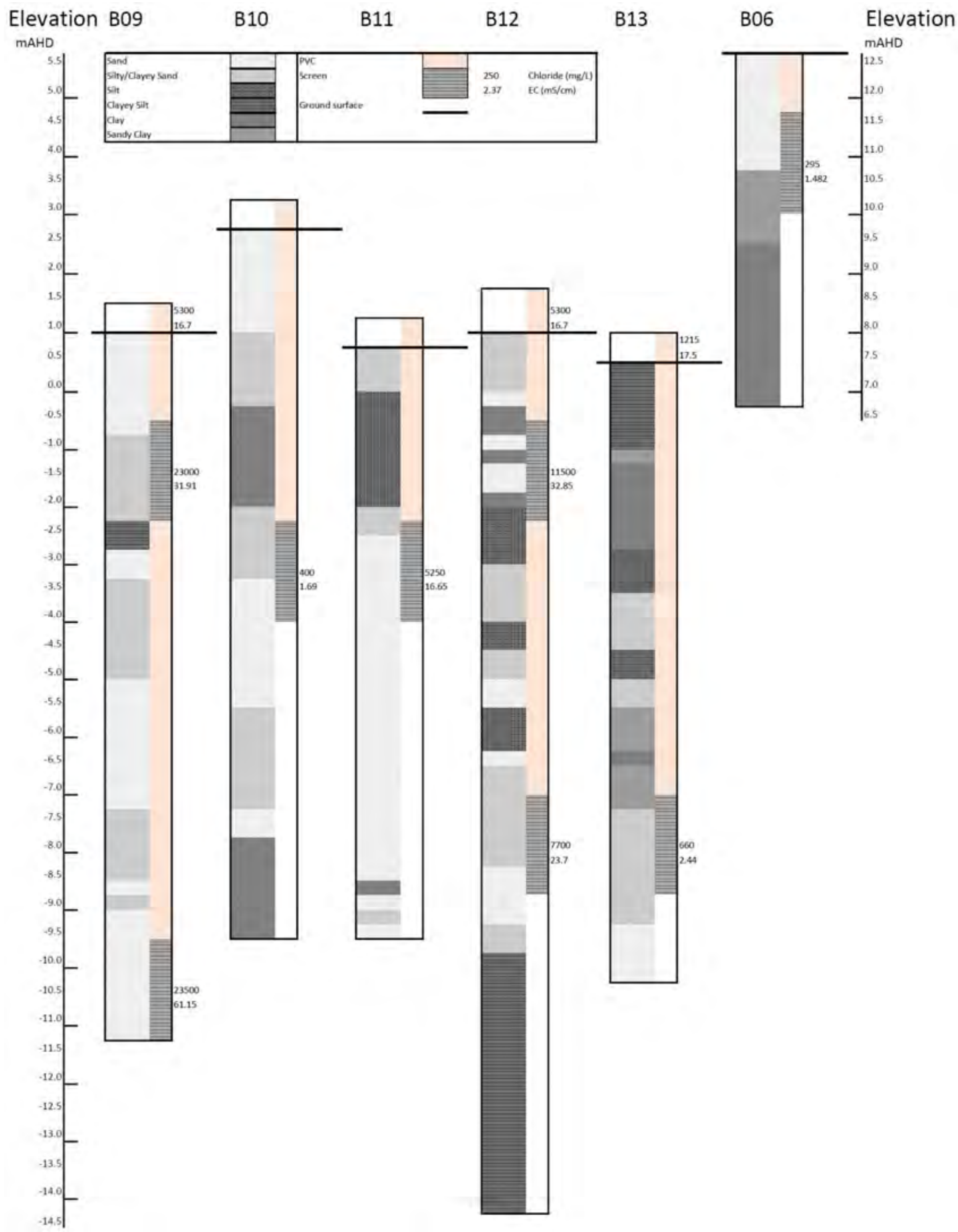


Figure 58. Borelogs Continued.

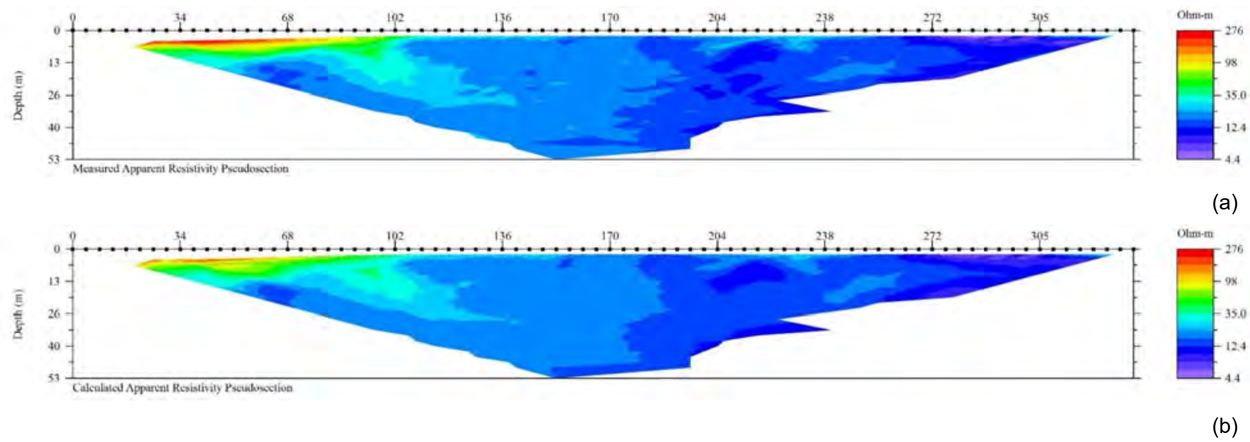
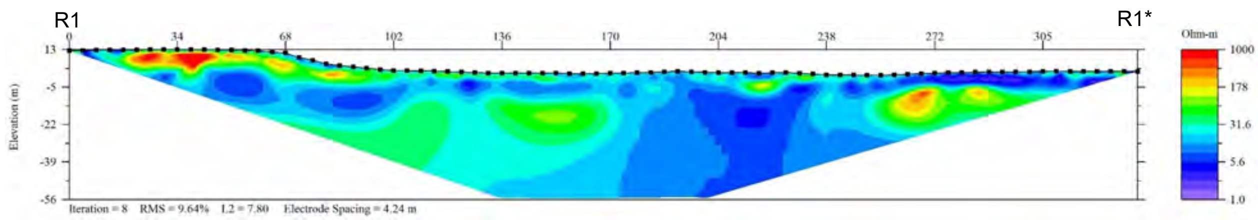
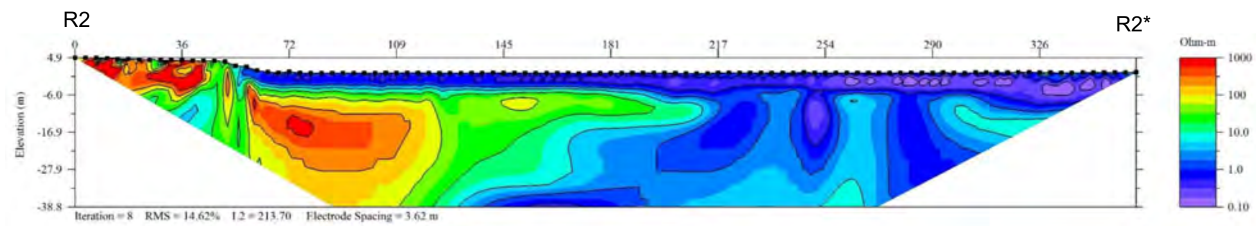


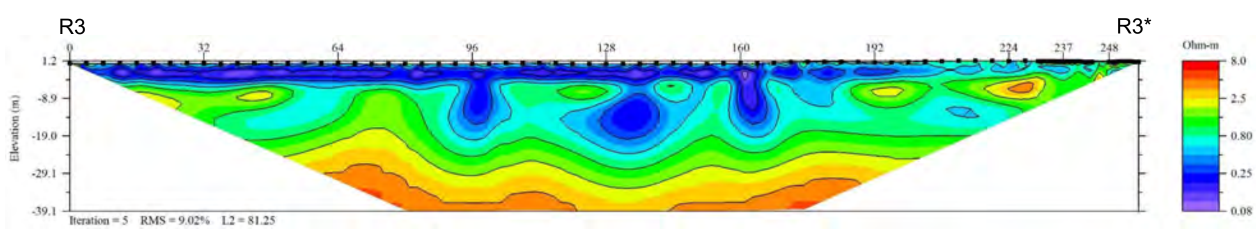
Figure 59:Observed (a) and modelled (b) apparent resistivity sections for Transect R1 (c.f. Figure 56).



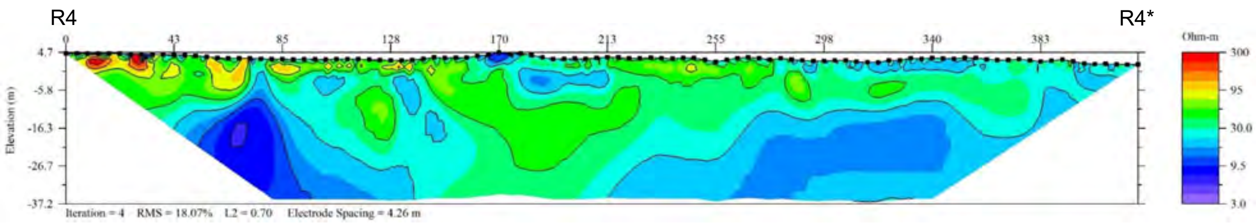
(a) Transect 1



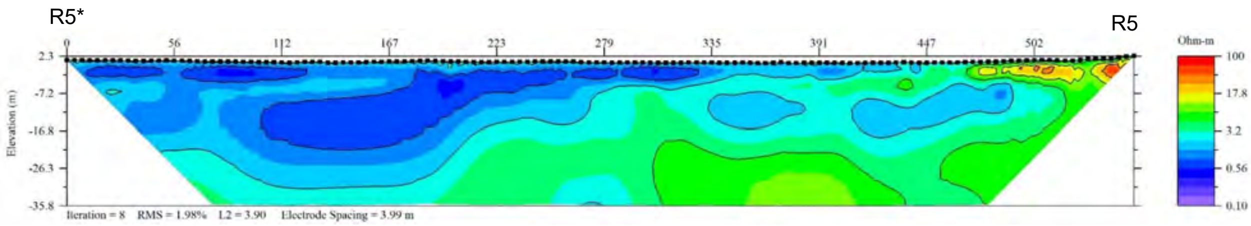
(b) Transect 2



(c) Transect 3



(d) Transect 4



(e) Transect 5

Figure 60: Inverted resistivity sections for Transects R1 to R5 (a – e). See Figure 56 for locations. RMS denotes the root mean square error of modelled and observed apparent resistivities. Black dots show electrode locations. The top axis is distance (m) along the transect. Elevation is relative to AHD.

5.3.2 Geophysics

The inverted resistivity models had root mean square errors between 2% to 18%. As the patterns of measured and modelled apparent resistivity were also similar for all transects (Figure 59). The highest errors occurred in Transect 4, which was far from a linear transect, and was adjacent a significant elevation change. A 3D inversion was conducted on this data, though model errors were similar, as were the resulting modelled spatial patterns.

The average maximum depth of investigation was 39 m. However, the resistivities are very low in places, i.e. <1 Ωm, particularly near the surface of the wetlands. As a result, the spatial variation in electrical properties in the lower portions of models is likely to be poorly resolved.

Transect R1, which started at the lookout, crossed the steep embankment, and ended near MW10, appears to show highly resistive material near the surface at the lookout, likely dry sandy fill, consistent with reports about the site (DWER, 2018). Below the fill, there looks to be a clay layer, and possibly the water table, consistent with drilling the nearby well MW06, although the depth to clay in MW06 (2 m) was much shallower than modelled (~ 9 m). Clay also outcrops just to the east of MW06 and is visible in the narrow valley that drops to the wetland. The discrepancy may be due to a dip in the clay layer to the south. This is supported by the results of transect R4. The wide spacing (4 m) of electrodes, the high resistivity of the surface layer there, and the high dampening applied to surface layers in the inversion, may also be factors contributing to lessen the resolution of fine scale structures within the top 4 m. A thin, low resistivity (<10 Ωm) layer (clay and water table), extends across the section just below the surface. On the left and right of the section the resistivity increases to >30 Ωm, while in the center right of the section the resistivity is low (< 5 Ωm). The resistivity sections with values ~30 Ωm are consistent with locations where saturated Bassendean Sand was observed in drilling at MW04 and MW10 and hand auguring on the Chapman St Drain. The deeper low resistivity region coincides with the ERT transect passing close to the bend in the Chapman St Drain and therefore may be revealing a 3-dimensional artifact associated with the presence of the drain, although it may also reflect a real low resistivity fluid from the drain and/or saline groundwater developed from the clay-pan wetland just to the south of the drain.

This pattern of a low resistivity surface layer underlain by a higher resistivity material ~ 30 Ωm is repeated in the northern half of Transect R2. Again, there looks to be a highly resistive, fill material, associated with the location around Water Corporation's sewer pump station, located at ~ 35 m along that transect. The thin lens of low resistivity material along the surface along the wetland suggests, and is corroborated by drilling (MW13, and hand auguring), the clayey and silty wetland sediments (~ 2 – 4 m thick) overlie sands. Towards the center of the transect the resistivity reduces at depth and the surface layer resistivity drops from 1 Ωm to 0.1 Ωm. This and the vertically oriented low-resistivity features suggest development of saline groundwater below the wetland is lowering resistivity. Similar features are repeated in transect R3 despite the application of dampening in the inversion to exaggerate expected horizontal layering. Drilling also indicated at MW12D/S, MW09D/S, MW11 and

MW08 that the materials consisted of frequent layers of clay of variable thickness interspersed with thin sandy lenses throughout the deeper profile. The vertically oriented features may be density driven (hypersaline) instabilities. In both R2 and R3 these 'plumes' have a characteristic spacing of ~32 m. Similar patterns in resistivity imaging of convection plumes in a saline aquifer were reported by van Dam et al., (2009).

Transect R4, along the edge of the escarpment suggests there is a deep 'valley' shaped section of Bassendean sands (~30 Ωm), bookended by two low resistivity areas ~10 Ωm. The high resistivity area at the southern end of the transect is again associated with fill related to the nearby housing development.

Transect R5, outside the eastern margins of the salt flats, imaged a thin, low resistivity surface layer, though less well defined as in R2 and R3. A low resistivity 'plume' extends to depth, plunging towards the river. Mid way along the transect the resistivity increases (~3 – 10 Ω m) with distance from the river and increases further (~30 Ωm) as the elevation rises in the direction of Reid St.

None of the transects suggest the presence of deeper layering with a sufficiently large enough contrast in resistivity to image the presence of the lower margins of the Superficial Aquifer within 40 m below the surface. As the Mirrabooka Member contains materials expected to be of a similar resistivity to those in the Superficial Aquifer the shallow geophysics would be unlikely to be able to differentiate the aquifers.

5.3.3 Groundwater Dynamics

Time series of groundwater heads, and air pressure are shown in Figures 61-65. The time series show a persistently higher head in MW04d than MW04s suggesting upward groundwater flow. Seasonally the pressure head varies by 1.0 m at depth and 1.8 m in the shallow well. At MW08 there is very little difference in pressure between the deep and shallow screened intervals with a seasonal variation of 1.0 m and a downward head of 0.1 to 0.2 m. Unlike the previous monitoring well pairs, MW09d looks to be strongly tidally influenced and has a reduced seasonal dynamic compared to MW04s. MW09s/d show alternating periods of higher head suggesting shallow/deep groundwater flow direction alternates. At MW12 the deep screened interval shows a seasonal fluctuation and damped tidal variations. The shallow and deep wells again show alternating periods of higher head suggesting shallow/deep groundwater flow direction alternates, but hydraulic gradients are not large. The seasonal variability at MW03 is the smallest of all the monitoring sites and is also strongly tidal. Salinity in MW03 ranged between 52 – 59 mS cm^{-1} indicating hypersaline conditions were maintained although two episodes where the salinity dropped slightly suggests a possible mixing with a fresher water source. The largest seasonal variations were seen in MW13 (~2.1 m).

Groundwater levels on the edge of the escarpment, MW05, varied by 1.0 m and were on average 2 m lower than those measured at MW01, located closer to Hardy Rd, and 10 m lower than the average levels measured at the top of the escarpment at MW06. This indicates that the fringing water table has elevated heads compared to the wetland, which will cause groundwater inflow into the margins of the wetland.

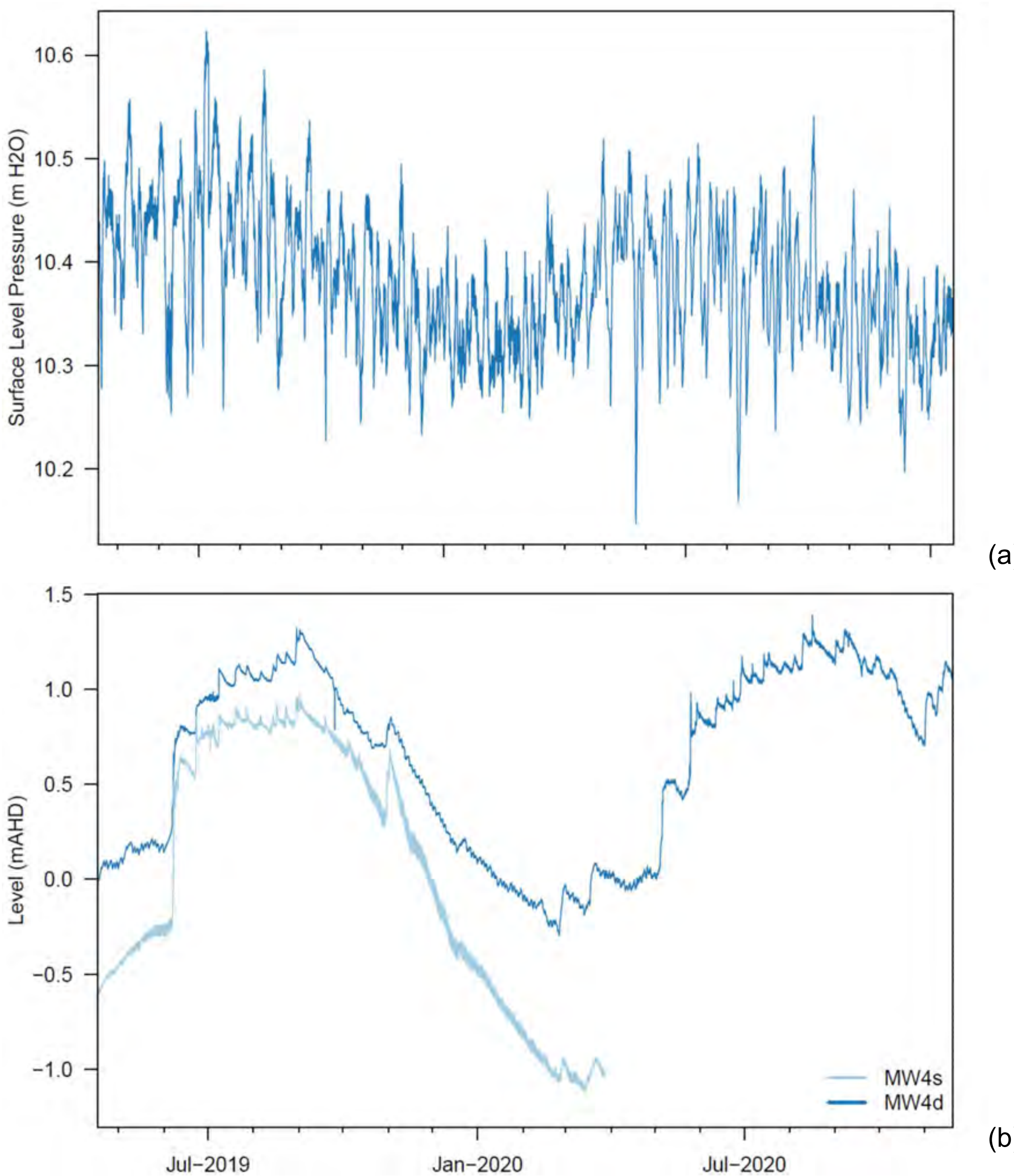


Figure 61: Barometric pressure (a) and water level pressure head at MW4s and MW4d (b).

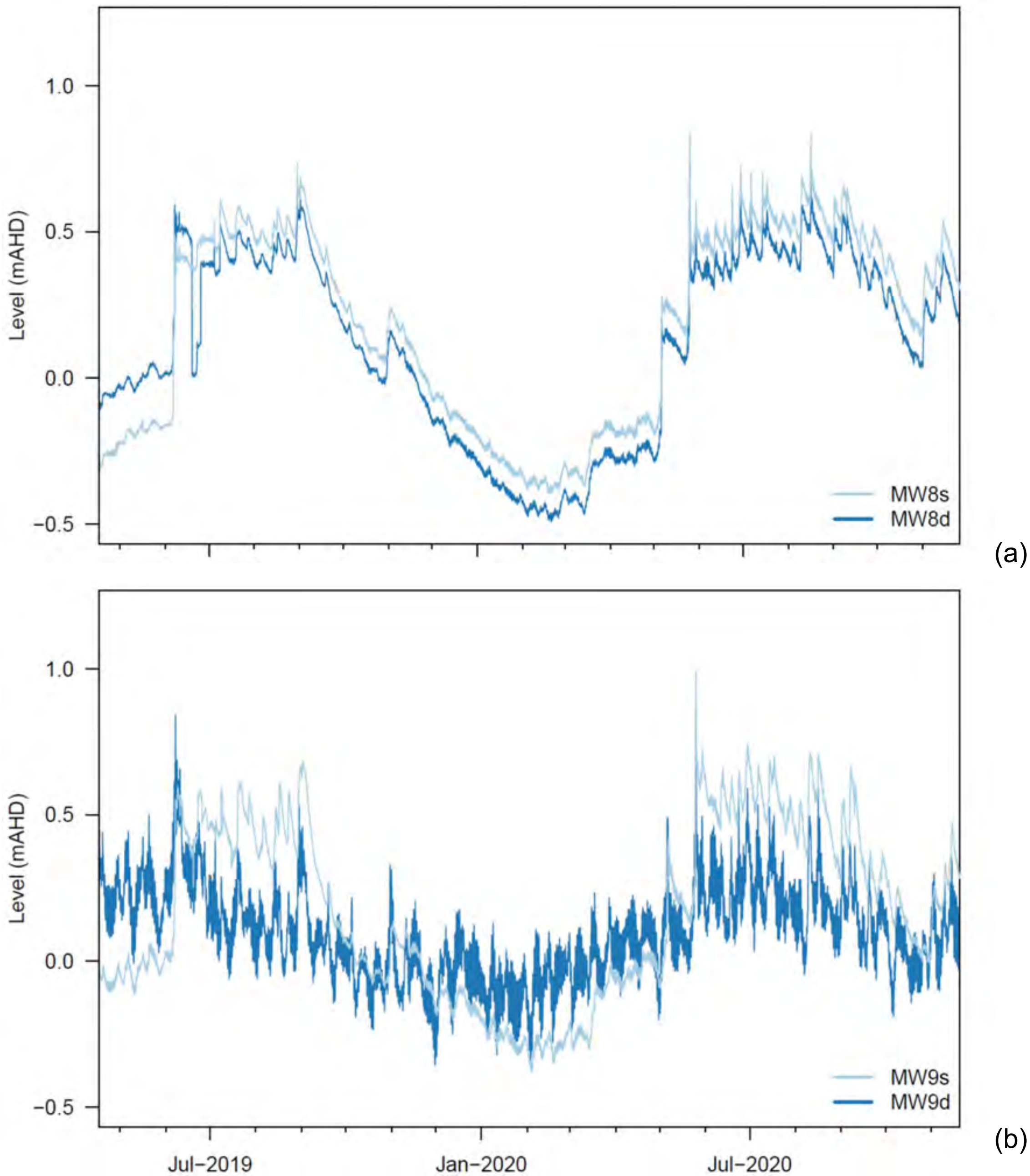
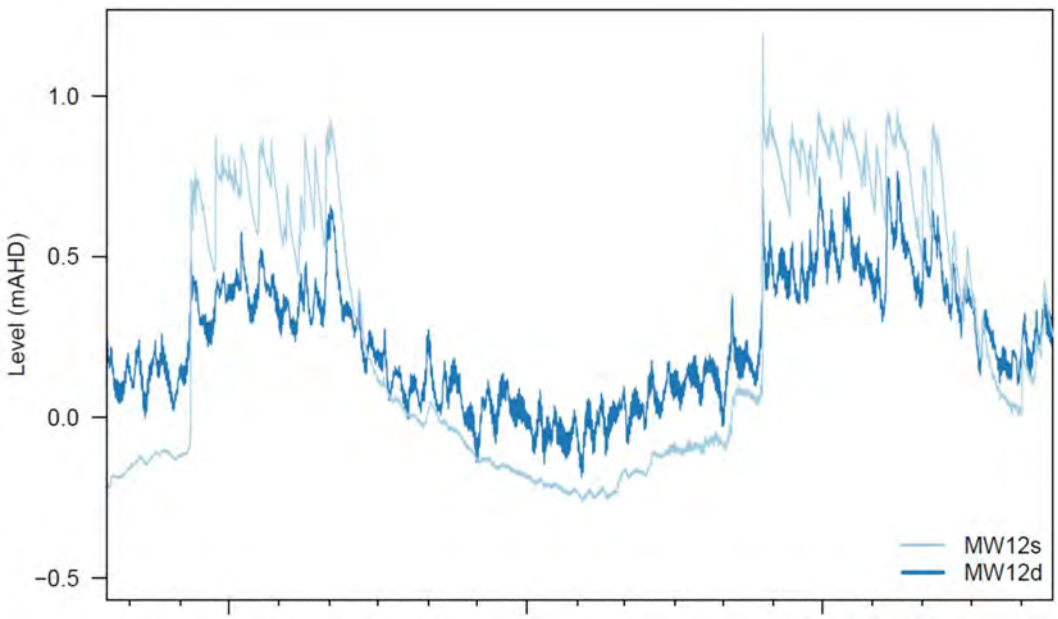
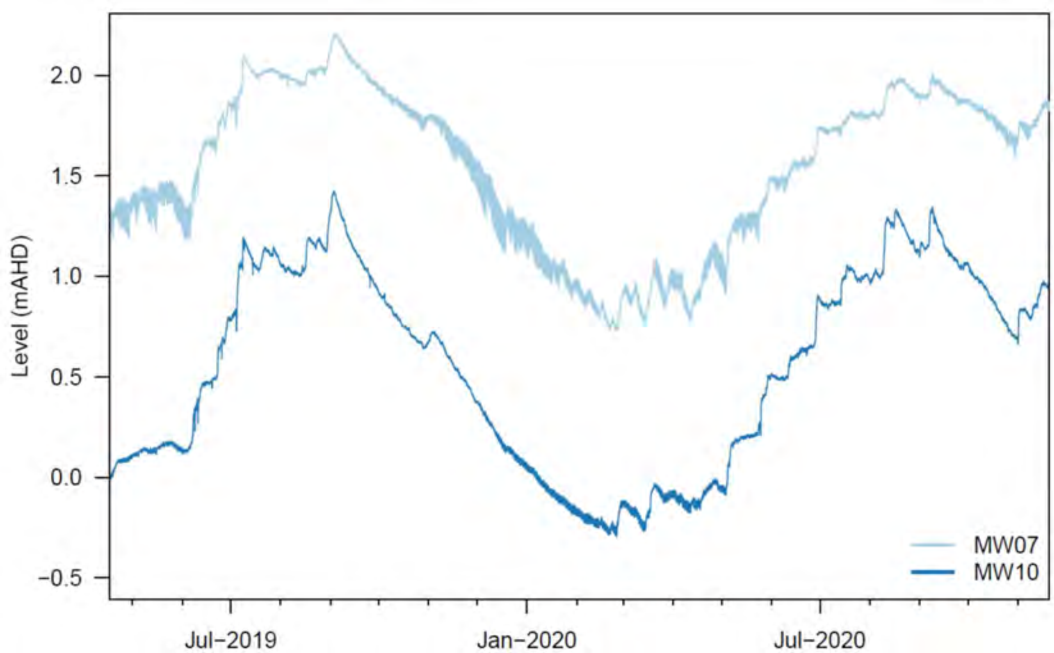


Figure 62: Water level pressure head at MW8s and MW9d (a) and MW9s and MW9d (b).

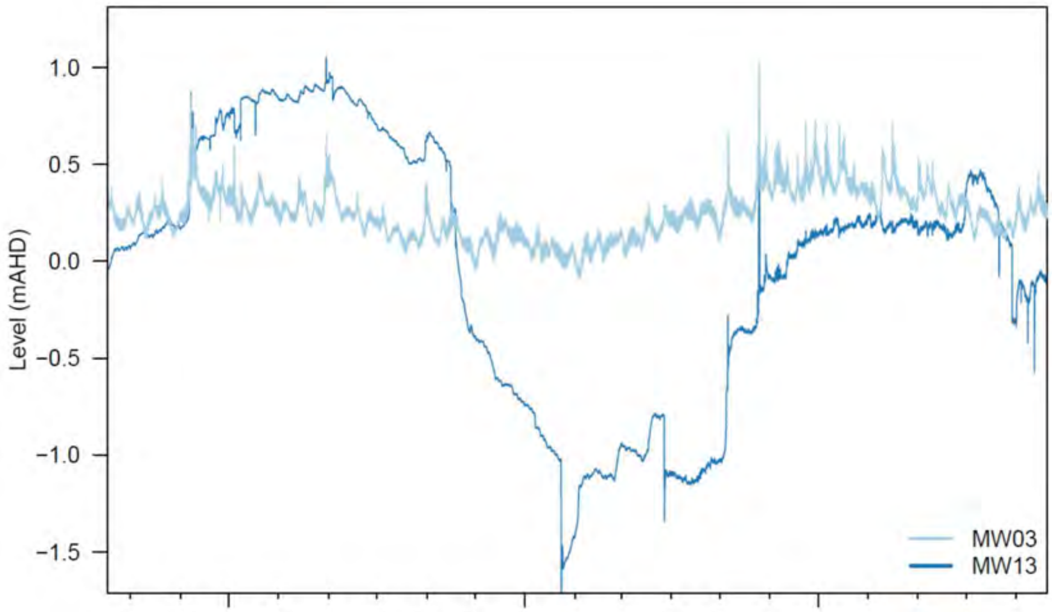


(a)

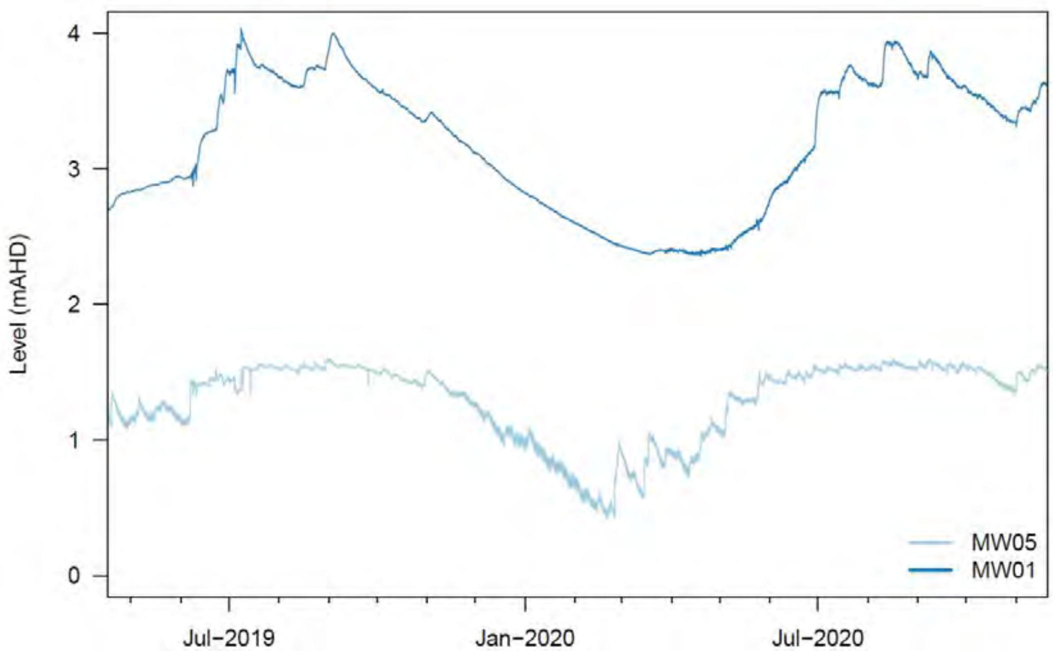


(b)

Figure 63: Water level pressure head at MW12s and MW12d (a) and MW07 and MW10 (b).



(a)



(b)

Figure 64: Water level pressure heads at MW03 and MW13 (a) and MW01 and MW05 (b).

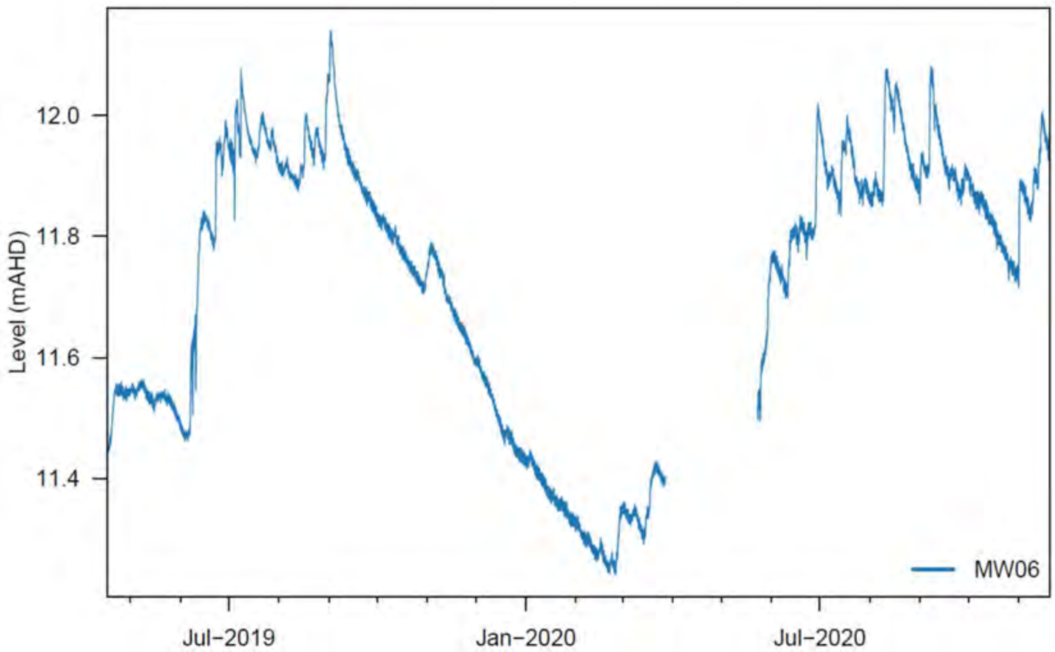


Figure 65: Water level pressure head at MW06.

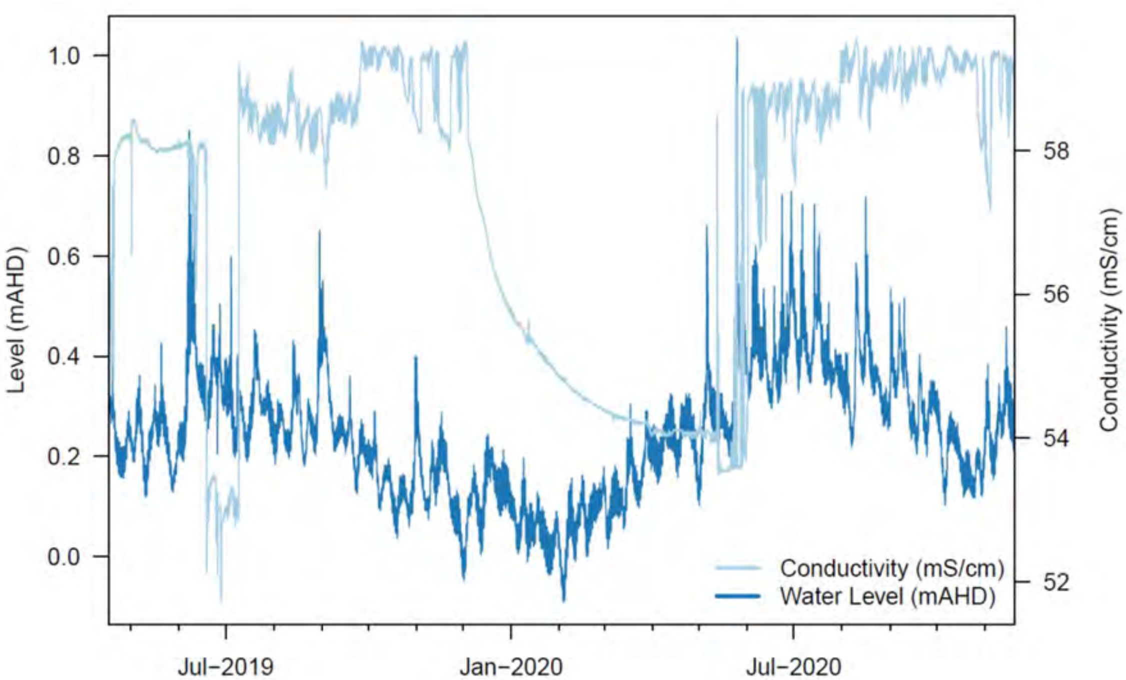


Figure 66: Water level pressure head and electrical conductivity at MW03.

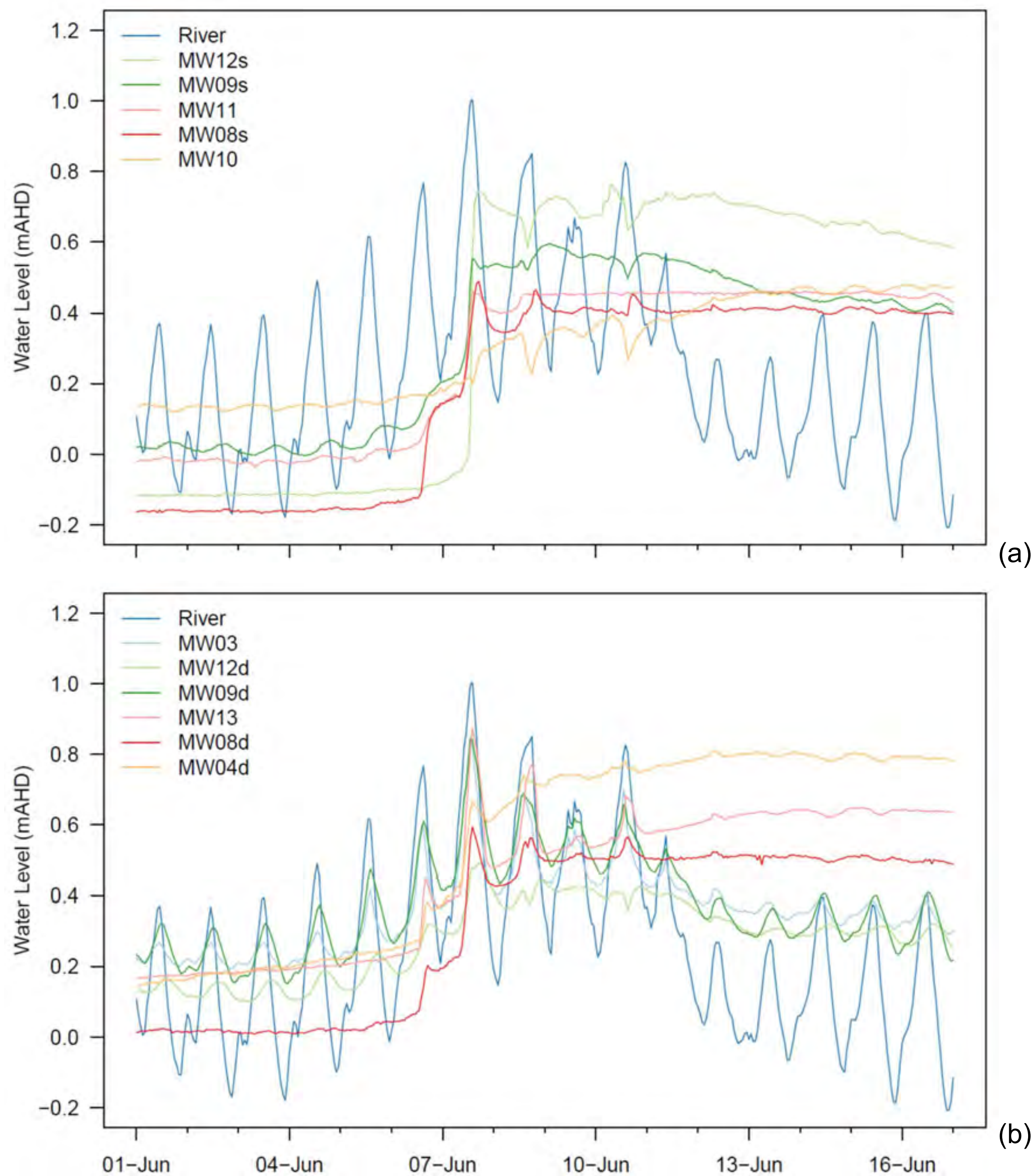


Figure 67: Shallow (a) and deep (b) groundwater response to a river levels and a series of wetland flooding events occurring between 6th – 11th June 2019.

The dynamics of groundwater following a flooding event (Figure 67) and during a late summer typical tidal sequence (Figure 68) also reveals different characteristics of the groundwater system. During the flood event in June 2019 the shallow groundwater wells have a rapid rise in pressure corresponding to the peak of the tide in the river when river levels exceed 0. 6 mAHD on 6th June and then again on 7th June. The two subsequent tides that exceed 0.6 m have little additional effect and instead cause small fluctuations in well pressure at the peak tide that may be due to the timing of surface flood water. As river levels continue to fall the groundwater levels stabilize.

The deeper screened wells, MW04d, MW08d, and MW13 have initially weak tidal amplitudes and as the river floods, the pressures rise rapidly and follow the tides while river levels exceed 0.6 mAHD. Wells MW03, MW09d, and MW12d initially have a clear tidal amplitude and as the river levels rise their pressures track with the river throughout and after the flooding. During summer, the shallow groundwater wells in the wetland shown in Figure 68 (i.e. excluding MW10) look to have a lagged diurnal periodicity, and to a lesser extent follow the fortnightly variation in mean river level. Of the deeper screened wells, MW03, MW09d, MW12d and to a lesser extent MW08d show significant variation related to the river tide during summer.

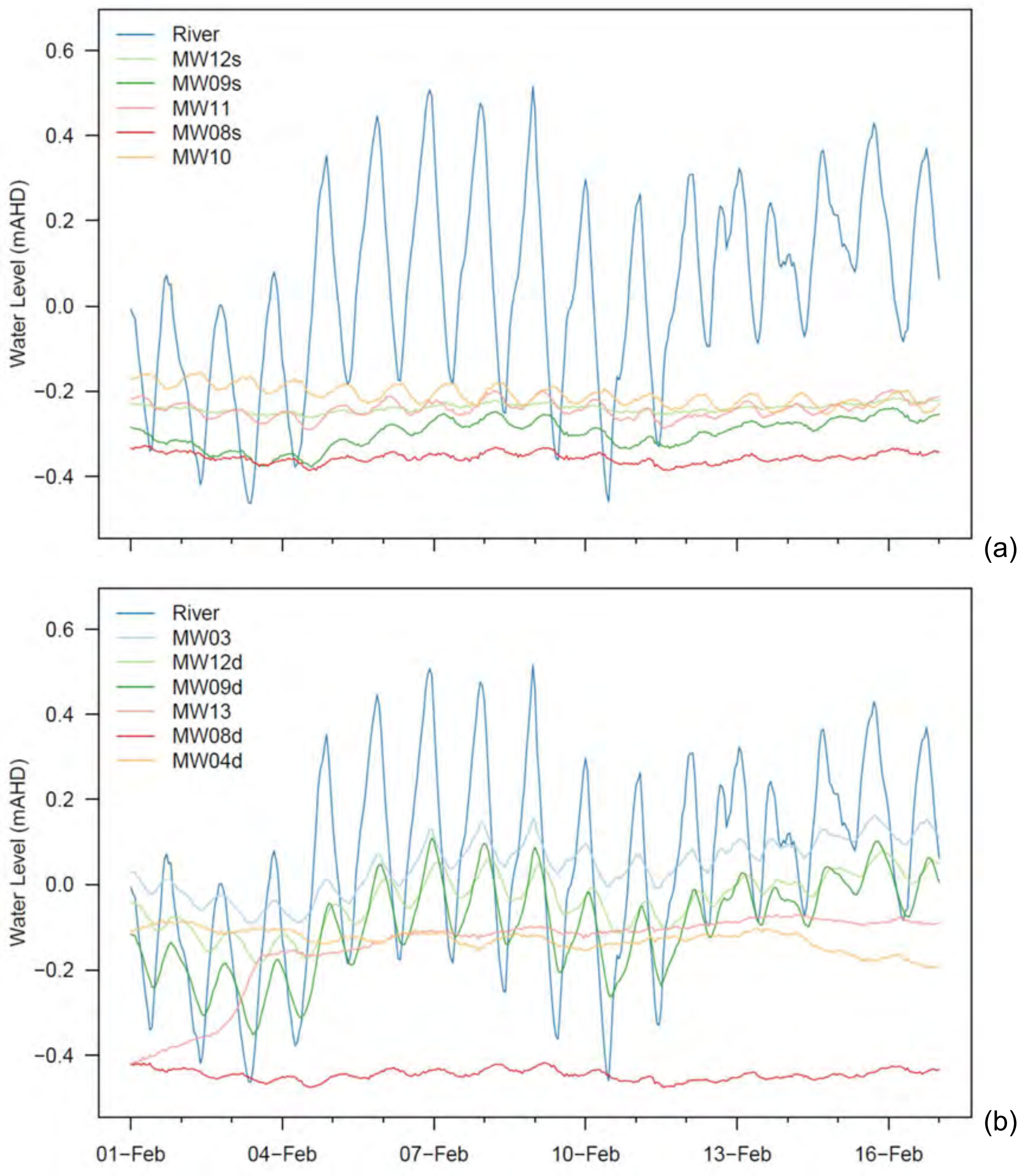
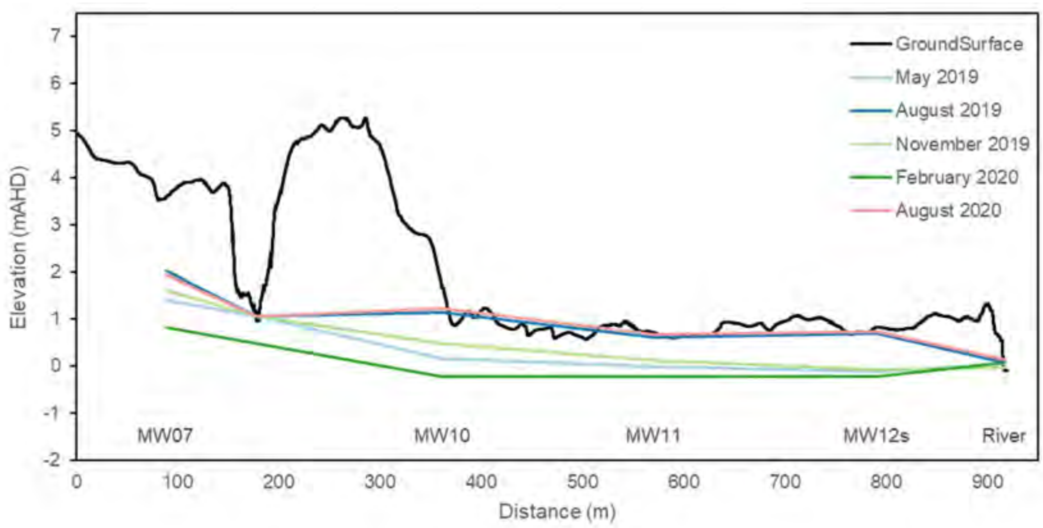
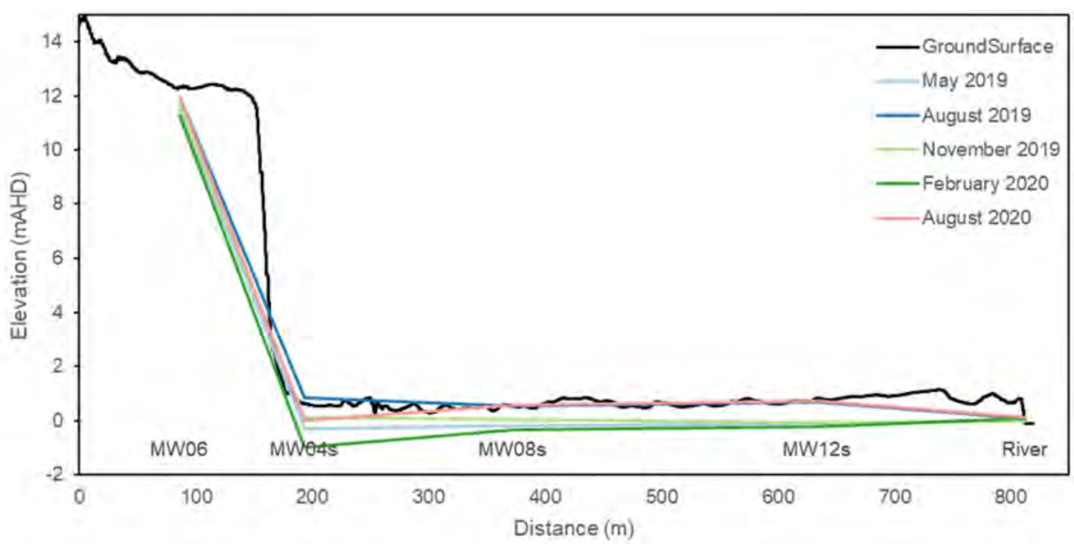


Figure 68: Shallow (a) and deep (b) groundwater response to tides in February 2020. Note: water level of MW13 is 1.0 m lower than shown.



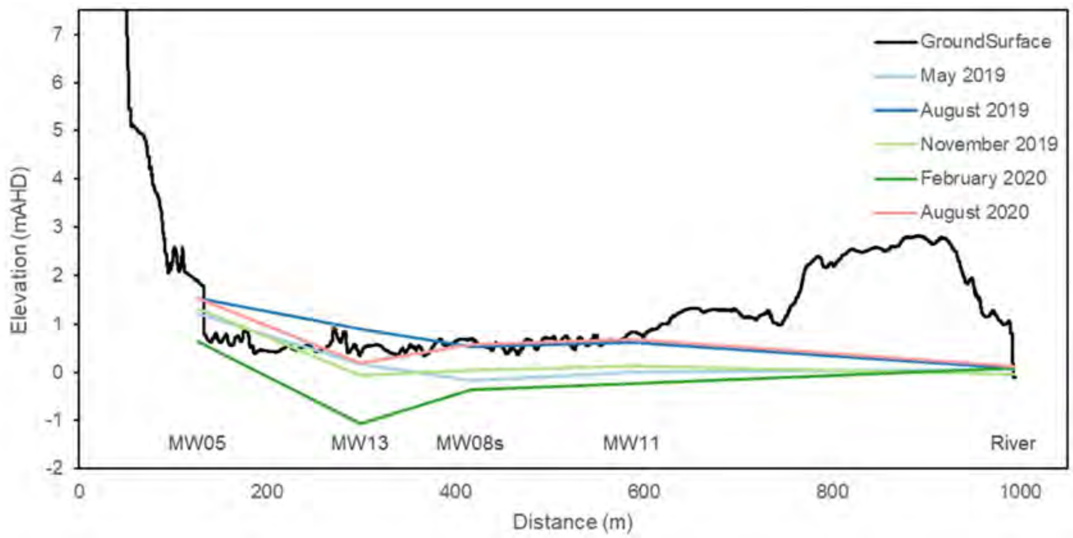
(a)



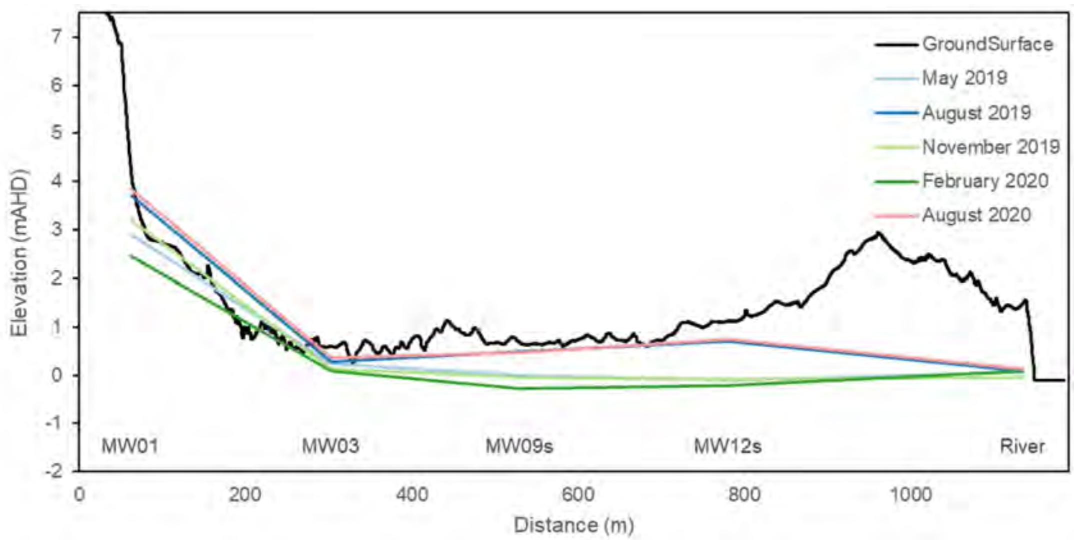
(b)

Figure 69: Water table elevations for transects T_1 (a) and T_2 (b). Transects as defined in Figure 55.

Seasonal variation in the water table along various transects are shown in Figures 69 - 70. From north to south (Figure 69a) the water table drops towards the river and an average hydraulic gradient of 0.002. From northwest to southeast groundwater levels drop across the escarpment from 11.7 mAHD to -0.07 mAHD with an average hydraulic gradient of 0.1 and thereafter actually rise toward the river with an average hydraulic gradient of 0.0006. East to west the water table generally falls to the river, although for a period during February 2020 the data suggests MW13 was near a local depression in the water table. This may be an indication of localized downward leakage through the semi-confining wetland sediments. The time series from this well is quite irregular during that summer and therefore the data may be influenced by artifacts associated with its construction or a localized heterogeneity. During the remainder the data look reasonable and during August 2019 the pressure in the well is well above ground surface.



(a)

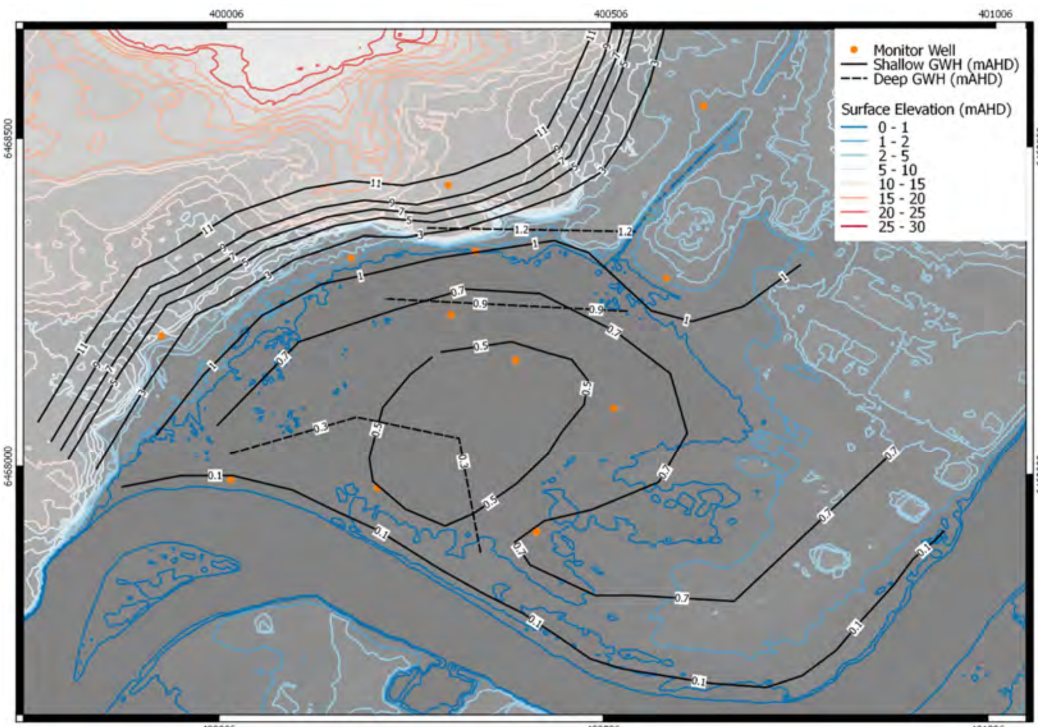


(b)

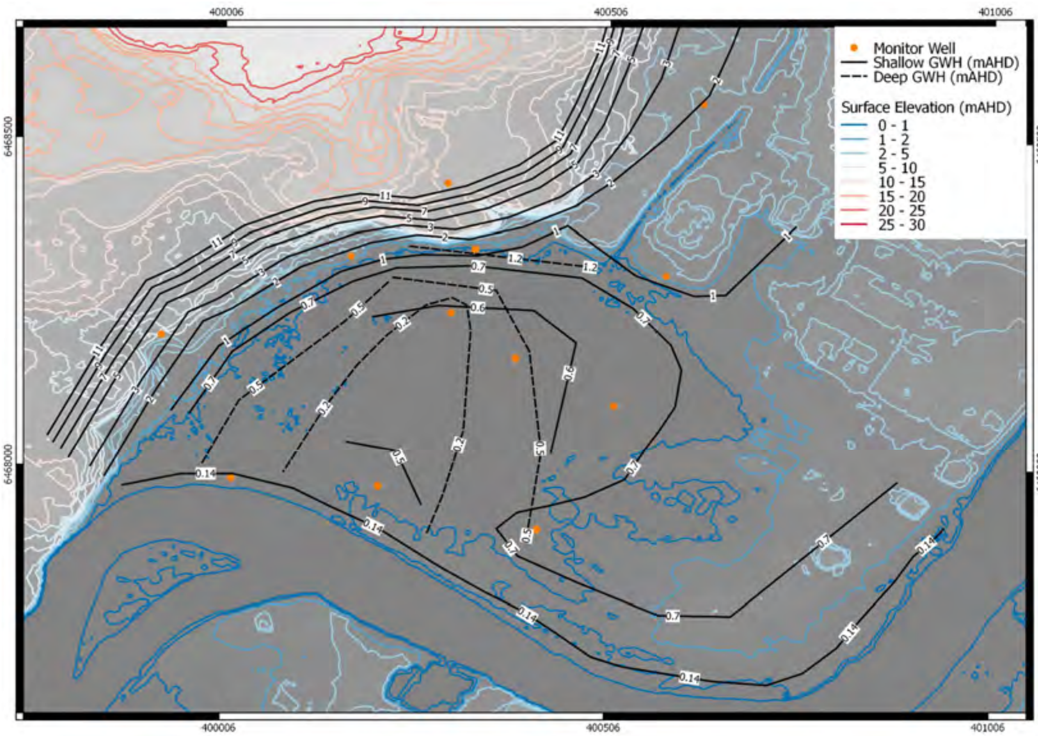
Figure 70: Water table elevations for transects T_3 (a) and T_4 (b). Transects as defined in Figure 55.

The groundwater heads when viewed as interpreted water table elevation contours suggests groundwater flows to the east and southeast across the escarpment, discharging into the wetland. The basin area in the middle of the wetland (near MW13, MW 08 and MW11) shows reduced groundwater elevation hence will be a local focus for groundwater flow within the wetland. Groundwater then flows out of the basin area continuing to follow the topographic gradient towards the river (Figure 71). While there are fewer data points the deeper groundwater wells suggest that during May and August 2019 the deep groundwater flowed towards the south-southeast. In November 2019 and May 2020 the wetland looked to be acting as a local sink of water. By August 2020 however there is sufficient measurement error in the heads that accurate estimation of groundwater contours is challenging. A slight hydraulic gradient toward the southeast within the wetlands is expected.

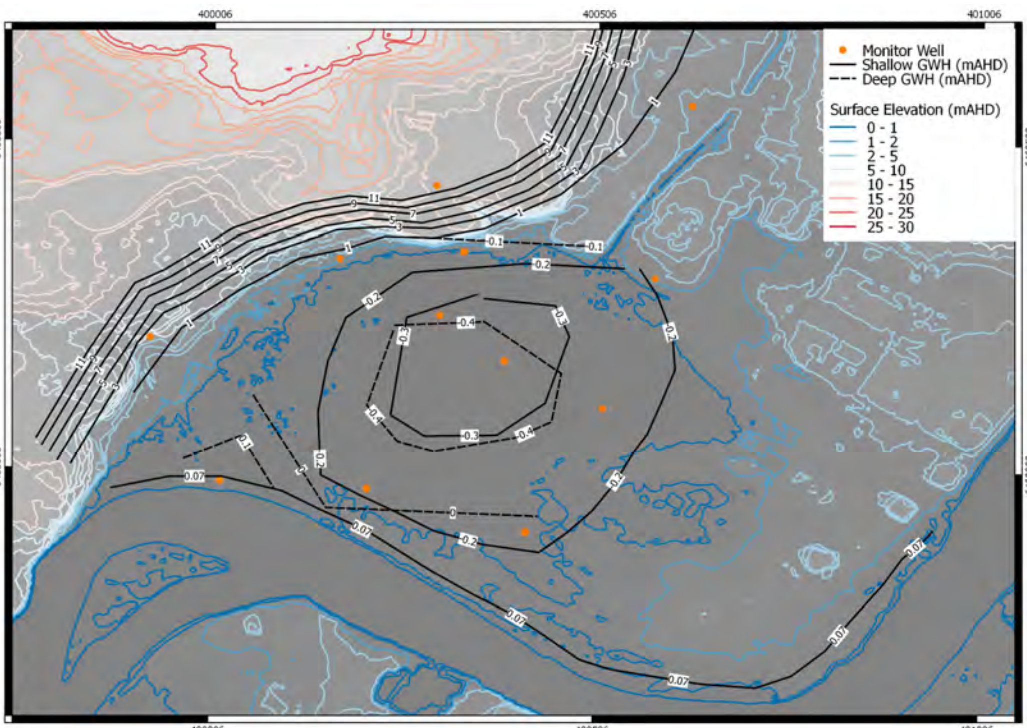
Taking a northwest to southeast transect as a typical representation of groundwater conditions salinity corrected heads were calculated at well locations with both shallow and deep screens (Table 18). From these data conceptual flow nets were constructed, drawn by hand (Figure 72). They generally show downward groundwater flow from the escarpment from MW06 and at the base of the escarpment, upward groundwater flow at MW04. The northern wetlands and the south-eastern wetlands/parkland appear to act as a sink for groundwater during summer. During winter, downward groundwater flow across the wetlands was observed throughout the flats in August 2020, and in the south eastern area in August 2019. In August 2019 there looked to be the potential for upward and downward groundwater flow in close proximity (i.e. MW13 and MW08). Lastly, the groundwater interaction with the Swan River with summer inflows from the river and outflows to the river during winter.


Monitor Well
Shallow GWH (mAHD)
Deep GWH (mAHD)
Surface Elevation (mAHD)
0 - 1
1 - 2
2 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
400006
400506
401006
6468500
6468000

(a) May 2019

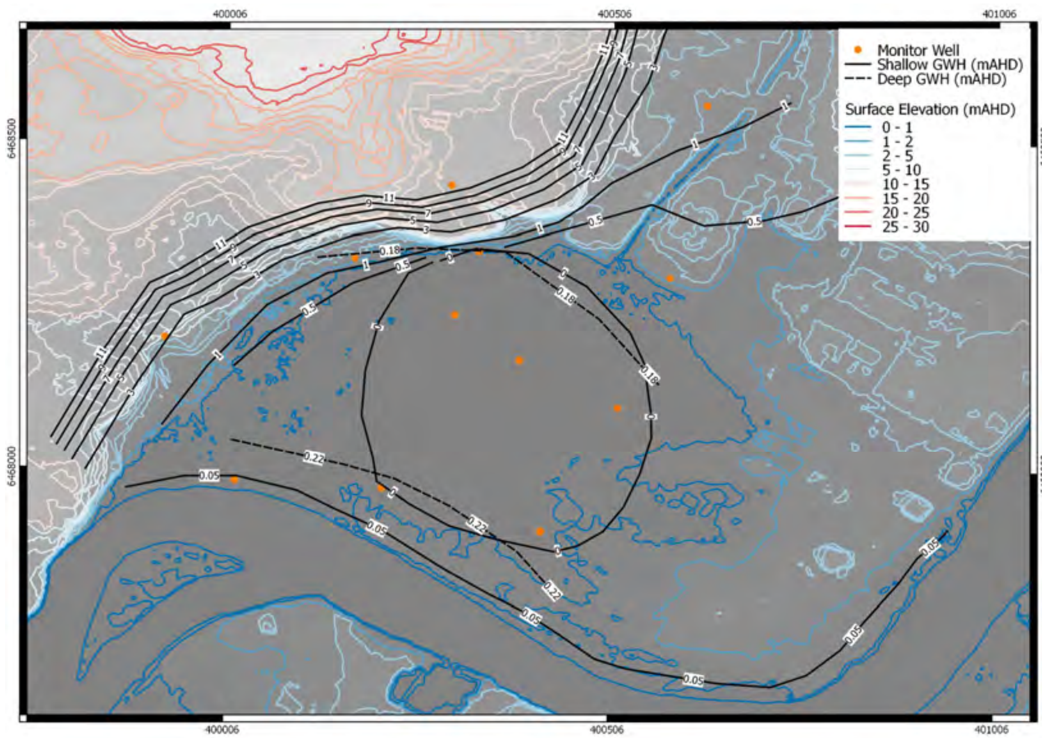


(b) August 2019



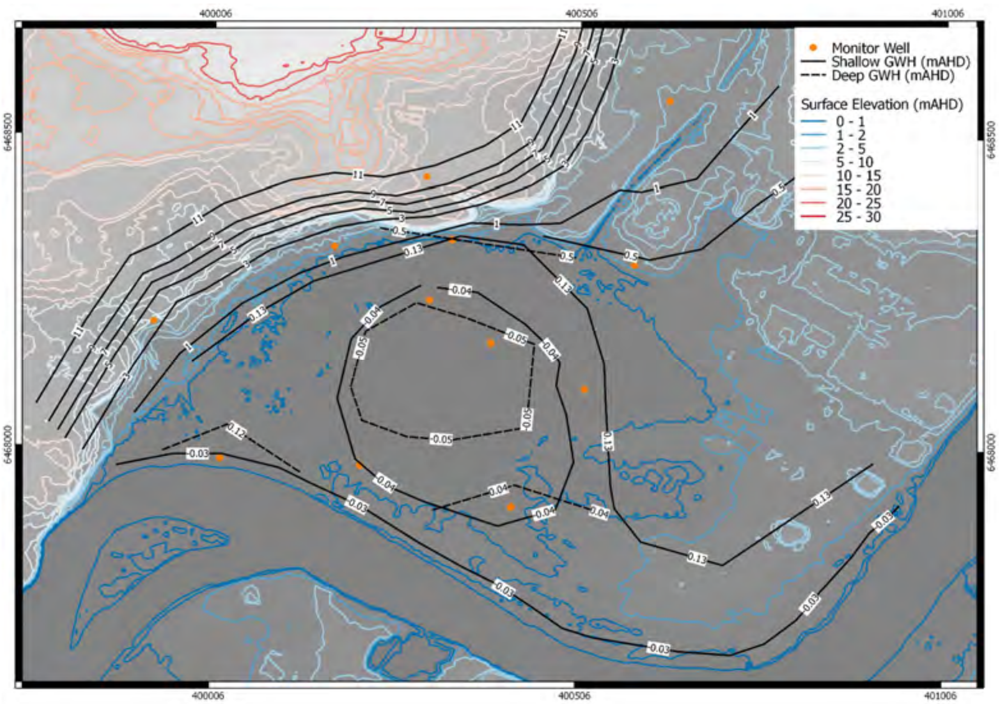
Monitor Well
Shallow GWH (mAHD)
Deep GWH (mAHD)
Surface Elevation (mAHD)
0 - 1
1 - 2
2 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
400006
400506
401006
6468500
6468000

(c) Nov. 2019



Monitor Well
Shallow GWH (mAHD)
Deep GWH (mAHD)
Surface Elevation (mAHD)
0 - 1
1 - 2
2 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
400006
400506
401006
6468500
6468000

(d) May 2020



(e) August 2020

Figure 71 Interpreted groundwater heads (GWH) of shallow (solid line) and deep (dashed) monitoring wells for May 2019 (a), August 2019 (b); November 2019 (c); May 2020 (d); and August 2020 (e).

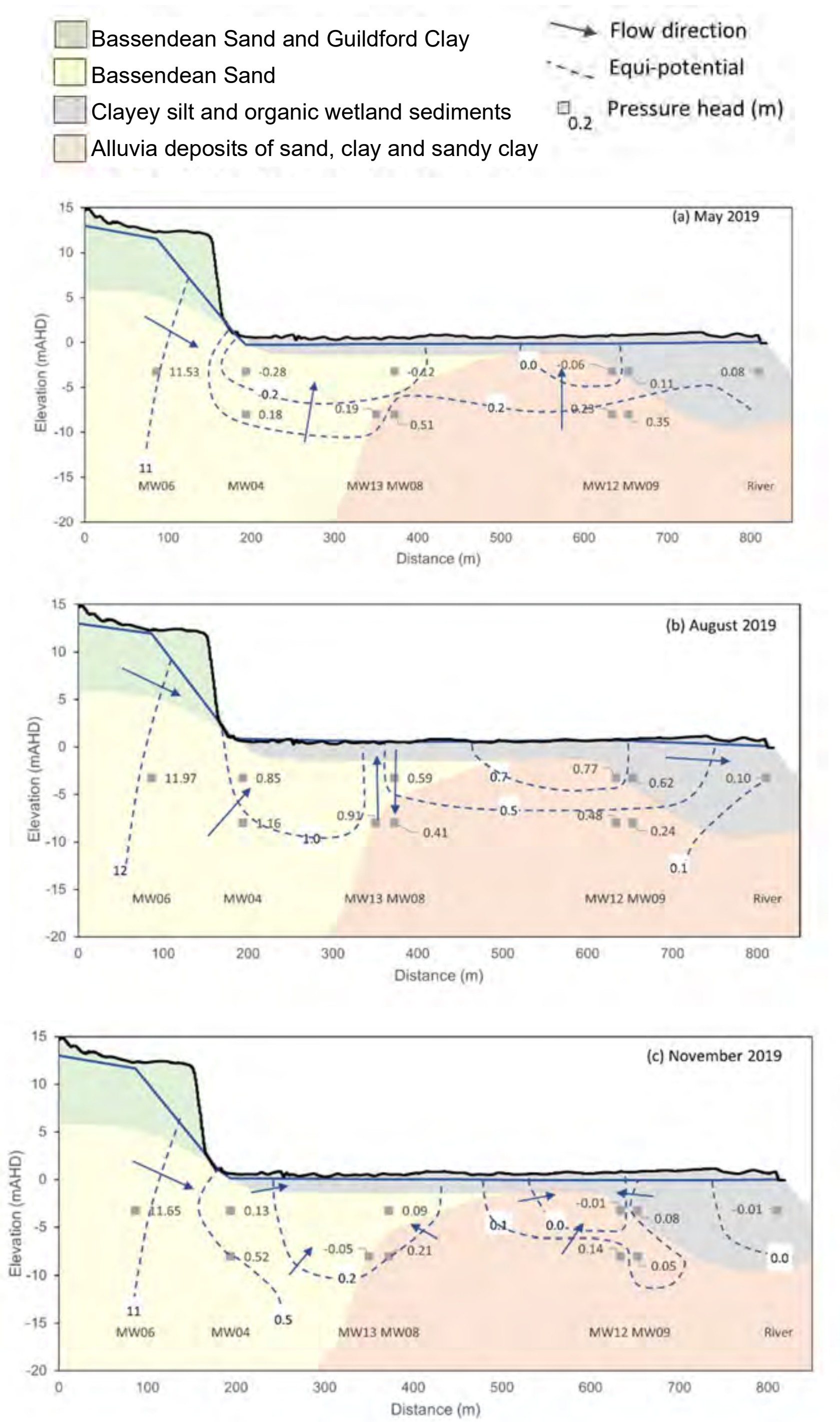


Figure 72: Conceptual groundwater flow nets for May 2019 to August 2020 (a – c above, and d – e continued next page). Measured heads adjusted for salinity to freshwater heads.

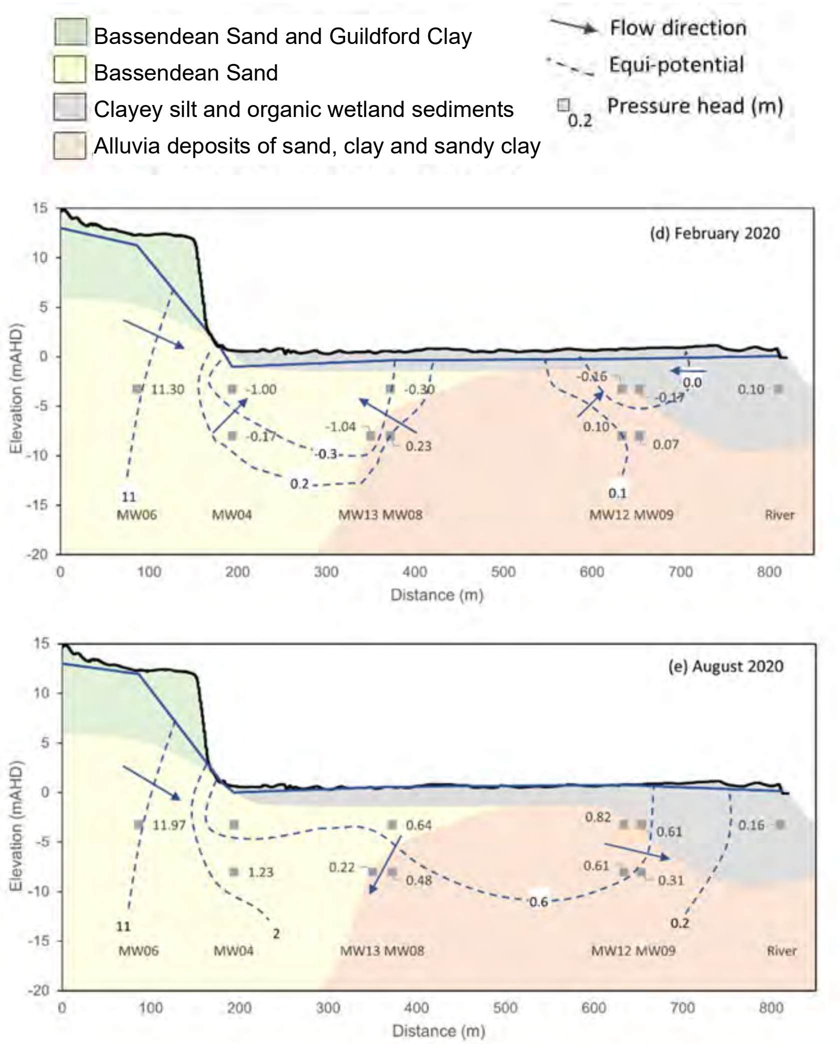


Figure 72 continued.

Table 18: Salinity corrected vertical hydraulic gradients.

	$-\Delta H/\Delta z$				
Location	15/05/2019	15/08/2019	15/11/2019	15/02/2020	15/08/2020
MW04S – 4D	0.07	0.04	0.06	0.12	
MW08S – 8D	0.05	0.01	0.004	0.001	0.003
MW09S – 9D	0.03	-0.04	-0.004	0.03	-0.04
MW12S – 12D	0.04	-0.05	0.01	0.03	-0.04

Positive values denote upwards flow.

5.3.4 Drain – Groundwater Exchange

The cross-borehole experiment revealed the sediments around the drain comprise loams to silty clay and clay at the southern site (Site 1) and loam to silty loam and silty clay at the northern site (Site 2). Site 2 is underlain by sand and loamy sands from 2.4 m below the drain embankments (Figure 73). Chloride concentrations in the sediments at Site 1 changed very little below the base of the drain following a runoff event albeit increasing briefly before returning to near pre-event values. Concentrations at Site 2 on the other hand reduced by up to 1500 mg L^{-1}. These changes are consistent with the different soils at each site.

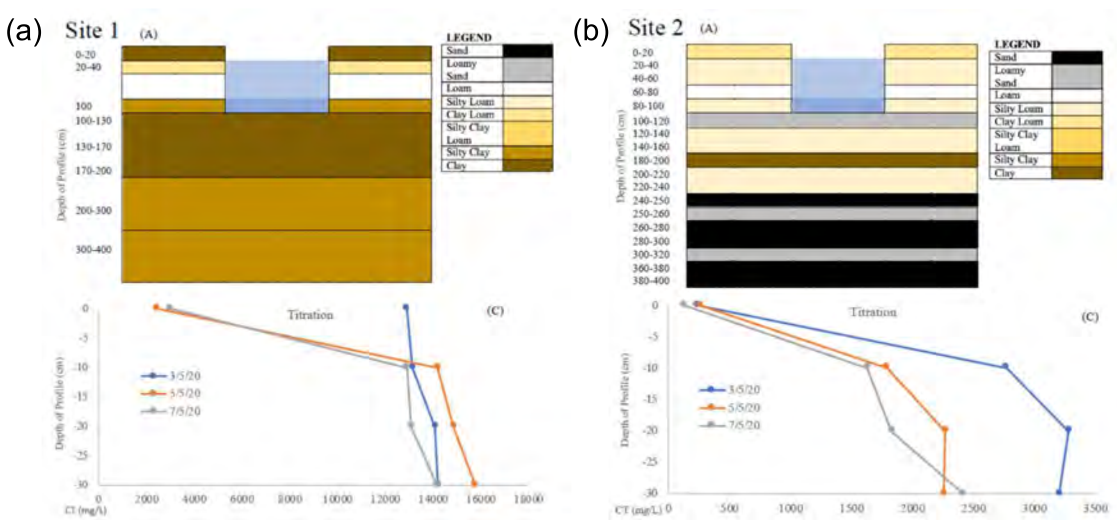


Figure 73: Vertical distribution of sediments around the Chapman St Drain and the chloride concentrations in pore water through the base of the drain.

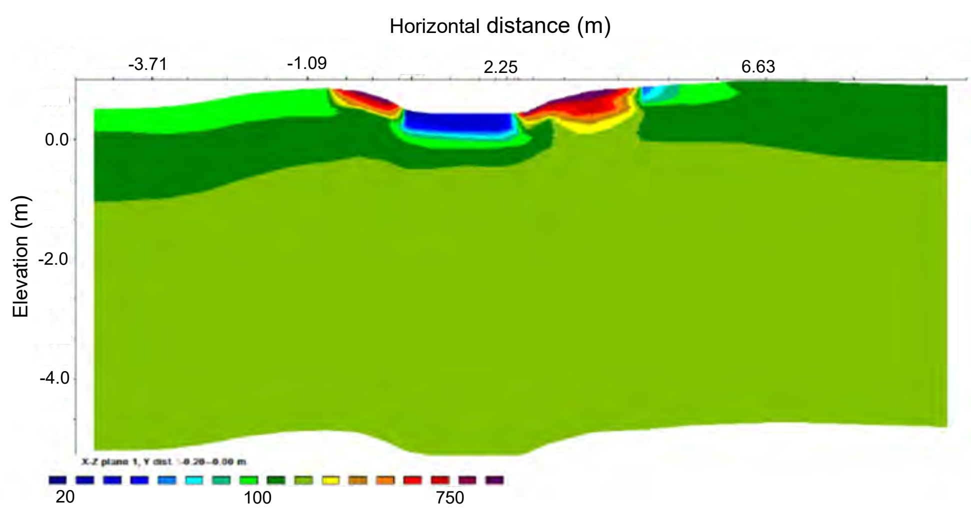


Figure 74: Relative resistivities as a percentage of the post-event image. Higher values indicate a decrease in resistivity, lower values indicate am increase in resistivity. Intermediate, green values suggest no change.

Cross borehole geophysics proved to not be a very useful method to image hyporheic exchange at this site. The low resistivity of water near the river at Site 1, the clayey sediments and the small changes in pore-water salinity meant there was a low signal to noise ratio and little change between measurement times. At Site 2 the resistivity images were marginally better however the imaging of changes between measurements was unable to identify a significant zone where surface waters had increased resistivity following a runoff event (Figure 74). Wetting of the electrodes in the borehole between measurements showed up as a significant change in resistivity, and the drain water showed up as an increase, however below the drain changes appeared to be minimal. Using an EC – chloride relationship the resistivity of pore-water near the drain only increased from 1.4 Ωm to 10 Ωm which, given the nature of the low resistivity materials, looks to have been insufficient to image accurately. The pore water sampling however does suggest there exist only at best a weak interaction between drain water and groundwater.

5.3.5 Tidal Dampening in Groundwater

The Fourier analysis of groundwater tidal signals shows strong spectral power in O1, K1, M2 and K2 tides in MW09d, slightly damped as compared the river (*Figure 75* andTable 19). The tidal amplitude in the shallow screened well at the same location, MW09s, were much less, suggesting a degree of aquifer confinement, promoting more efficient energy transfer at depth than closer to the surface. Moving progressively away from the river the amplitudes of the four tidal constituents in deeper screeded wells decreased exponentially with distance and the phase shifts increased approximately linearly (Figure 76), consistent with Jiao and Tang (1999). All regressions were significant ($p<0.01$ and R^2 between 0.71 to 0.975).

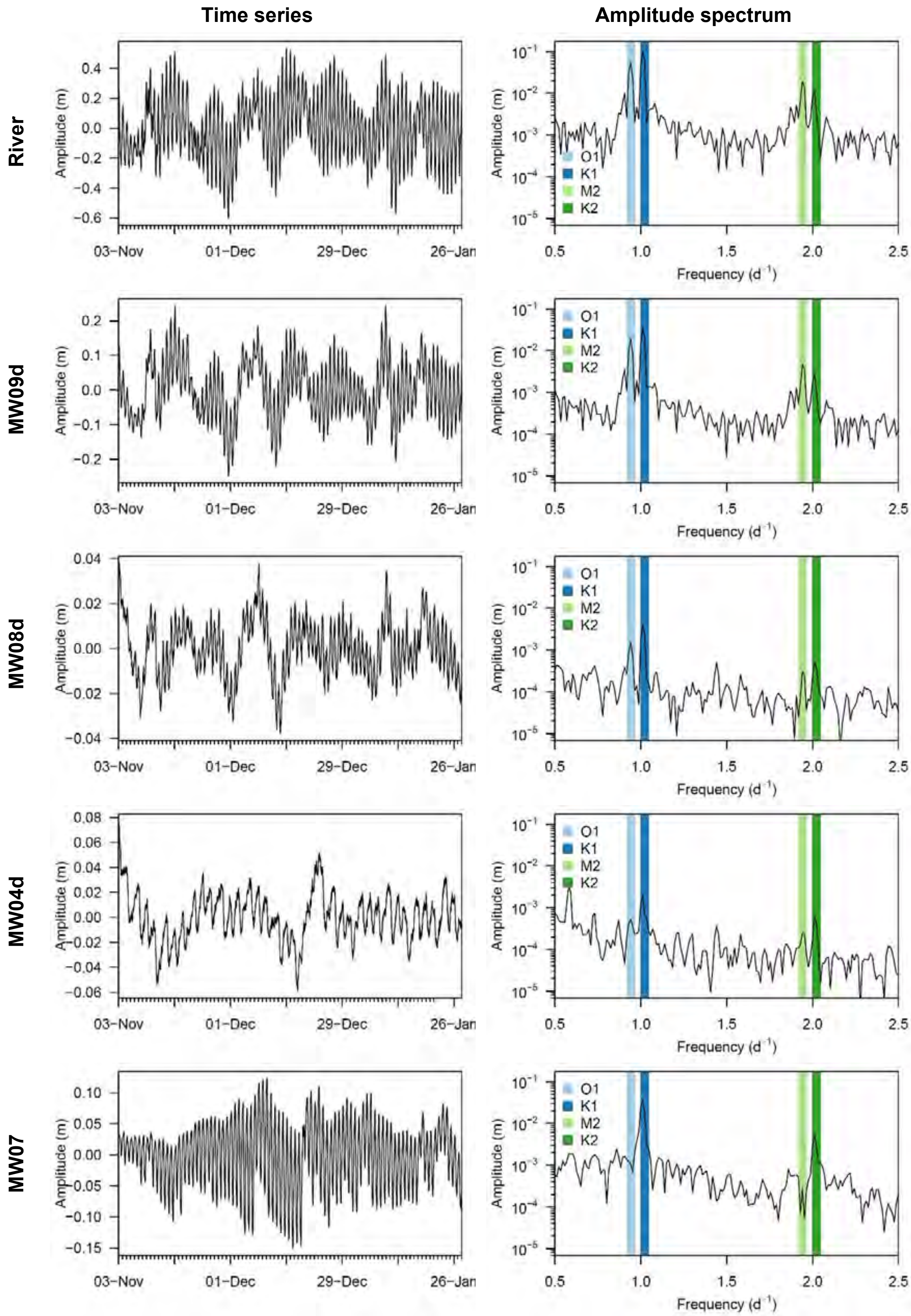
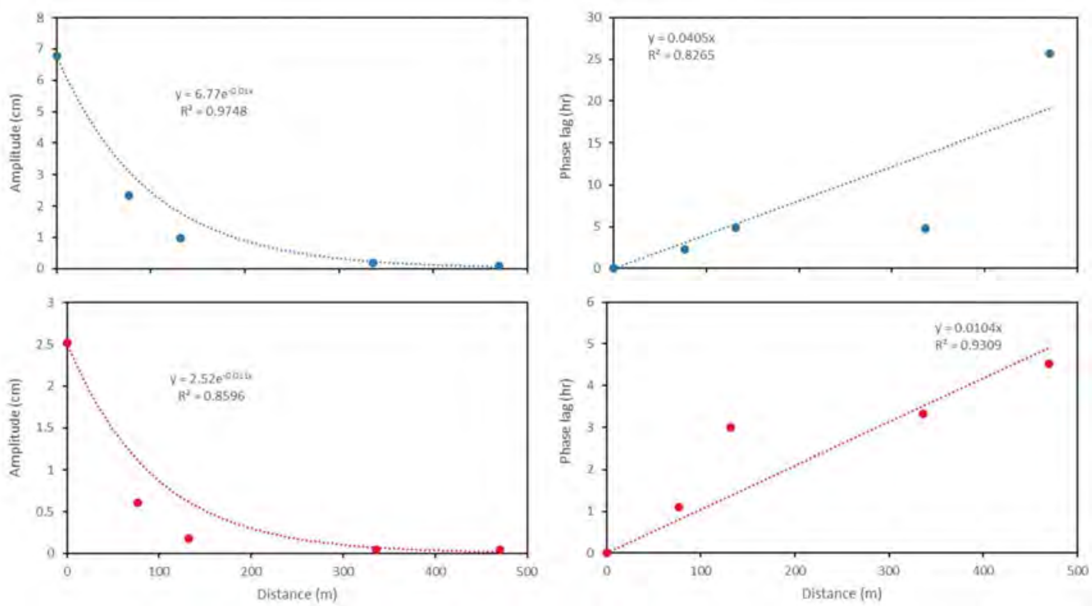


Figure 75: Dampening of the dominant tidal constituents inland and eventual strengthening of diurnal evaporative forcing. Time series shown to the left and the associated amplitude spectrums shown to the right for a selection of wells.

Table 19: Estimated amplitude, attenuation and phase lag of tidal constituents in groundwater.

Location	x (m)	O1 A (cm)	O1 α (%)	O1 τ (hr)	K1 A (cm)	K1 α (%)	K1 τ (hr)	M2 A (cm)	M2 α (%)	M2 τ (hr)	K2 A (cm)	K2 α (%)	K2 τ (hr)
River	0	6.77	100	0	12.82	100	0	2.52	100	0	1.48	100	0
Deep monitoring wells on Flats													
MW03	16	0.88	13	0.4	1.73	14	0.4	0.39	15.5	11.7	0.2	14	11.5
MW09d	77	2.34	35	2.2	4.35	34	2.1	0.61	24.2	1.1	0.35	24	1.2
MW12d	132	0.98	15	4.8	1.82	14	4.5	0.18	7.1	3.0	0.13	8.8	3.4
MW08d	336	0.19	2.8	4.7	0.51	4.0	4.3	0.04	1.6	3.3	0.07	4.7	3.7
MW13	381	0.03	0.4	8.9	0.06	0.5	2.6	0.02	0.8	0.5	0.08	5.4	5.3
MW04d	470	0.08	1.2	25.3	0.25	2.0	6.0	0.04	1.6	4.5	0.08	5.4	3.1
Shallow monitoring wells on Flats													
MW09s	77	0.36	5.3	7.5	0.67	5.2	6.4	0.05	2	4.5	0.08	5.6	5.3
MW12s	132	0.03	0.4	6.3	0.22	1.7	3.8	0.02	0.6	7.8	0.06	3.8	4.0
MW08s	336	0.19	2.7	4.7	0.43	3.3	4.5	0.03	1.3	4.2	0.08	5.4	3.9
MW11	368	0.36	5.3	5.7	0.87	6.8	19.0	0.07	2.8	5.9	0.12	8.3	0.2
MW04s	470	0.08	1.2	3.7	2.56	19.9	12.5	0.04	1.8	0.2	0.26	17.4	7.8
Fringing upgradient monitoring wells													
MW05	387	0.1	1.44	18.6	1.38	10.8	3.4	0.01	0.5	10.8	0.08	5.3	10.0
MW01	235	0.03	0.46	22.4	0.04	0.3	12.9	0.01	0.5	1.3	0.09	5.9	5.2
MW10	524	0.07	1.0	11.8	0.78	6	6.2	0.02	0.9	4.8	0.05	3.4	9.8
MW07	822	0.27	4.0	4.9	4.78	37.3	5.1	0.04	1.5	7.1	0.69	46.6	6.9
MW06	540	0.03	0.45	0.9	0.37	2.9	4.1	0.02	0.8	11.3	0.06	4.3	1.7

x is distance to river; A is the tidal amplitude; α is the attenuation factor (the percentage of the river tide amplitude); and τ is the phase lag relative to the river.



(a)

(b)

Figure 76: Variation in tidal amplitude and phase with distance from the river for the O1 (a) and M2 (b) tidal constituents in deep monitoring wells.

Monitoring well MW03, while screened relatively deep and close to the river, does not show as strong amplitudes as MW09d, emphasising a degree of heterogeneity present in aquifer properties and resulting restrictions on subsurface connectivity. The groundwater chemistry discussed later also reveals MW03 to be different to the other wells located close to the river.

For the shallow screened wells, trends in the amplitudes and phase shifts of the tides were not significant. While amplitudes decreased from the river to MW09s they increased again at MW08s and MW11, perhaps due to evaporative forcing and/or daily patterns of barometric fluctuations rather than heterogeneous tidal propagation (Trefry and Bekele, 2004). Trefry and Bekele, (2004) also suggested the higher frequency components, i.e. M_2 and K_2, are more rapidly damped as they propagate inland making trend detection more difficult. If there is significant eco-hydrological forcing of groundwater levels, due to evapotranspiration mimicking a tidal response, this could further dampen estimated amplitudes. Some modifications to the approaches of Jiao and Tang (1999) and Trefry and Bekele (2004) to account for diurnal eco-hydrological forcing may be useful to further constrain aquifer properties via tidal analysis.

Using the trends in amplitudes and the phase lag the aquifer hydraulic properties were estimated (Table 20). These properties, derived from the deep screened wells, represent an approximate average response across the first 300 m from the river as thereafter tidal amplitudes are dampened significantly. The estimated aquifer diffusivity was in the range 0.34 to 1.93 $m^2\ s^{-1}$. For the purpose of estimating other aquifer properties, it was assumed a confined aquifer thickness of 20 m, consistent with estimates of the depth to the next lower aquifer (DoE, 2004), and hydraulic conductivities were representative of Guildford Clays, reported in the range of 0.1 to 10 m day $^{-1}$, and lastly assuming an aquitard thickness in the range of 2 to 4 m. From these assumptions, estimated vertical hydraulic conductivities ranged between 0.003 and 0.09 m day^{-1} and storativities between 1.2×10^{-4} and 6.8×10^{-3}. These values are within expected values for the silty and sandy – clay materials identified in the drilling and with estimates by Smith (1999).

Based upon the salinity corrected vertical hydraulic gradients (Table 18) and the range of estimated vertical hydraulic conductivities the fluxes of water between the surface and groundwater were estimated using Darcy's Law (Table 21). The results suggest the potential for significant surface water - groundwater interaction of the order of 0.1 to 9 mm day^{-1}. Some caution should be attributed to the highest rates as the tidal response at MW04d was very small and therefore the aquifer properties estimated may not be representative of conditions there. At MW09 and MW12 this shifts seasonally from upwards flow in summer and early autumn to downwards flow in winter. Towards the middle and north of the wetlands however the groundwater flow was predominantly upwards year-round. Upward groundwater flow rates are generally less than the potential evaporative demand year-round.

Table 20: Estimated aquifer hydraulic properties from tidal analysis.

Tidal constituent	D m^2 s^{-1}	M m^{-2} $\times 10^4$	T^a m^2 s^{-1} $\times 10^4$	L s^{-1} $\times 10^8$	K_v m s^{-1} $\times 10^8$	S - $\times 10^4$
O1	0.34	0.98	2.3 - 23	2.3 - 23	4.5 - 97	6.8 - 68
K1	1.08	0.81	2.3 - 23	1.9 - 19	3.7 - 75	2.1 - 21
M2	1.21	1.2	2.3 - 23	2.8 - 28	5.6- 110	1.9 - 19
K2	1.93	0.64	2.3 - 23	1.5 – 15	3.0 - 59	1.2 - 12

a. Assuming a hydraulic conductivity range for Guildford Clay – Bassendean Sand of 0.1 – 10 m day^{-1}, and a confined aquifer thickness of 20 m, and 2 to 4 m of claypan acting as an aquitard. $M = L/T$ is the ratio of specific leakage (L) to transmissivity (T), and $D = T/S$ is the hydraulic diffusivity, the ratio of transmissivity to storativity.

Table 21: Ranges of estimated vertical groundwater fluxes (mm day^{-1}).

Location	May 2019		Aug 2019		Nov 2019		Feb 2020		Aug 2020	
MW04S – 4D	0.3	5.5	0.2	3.1	0.2	4.7	0.5	9.4		
MW08S – 8D	0.2	3.2	0.0	0.6	0.0	0.3	0.0	0.1	0.0	0.2
MW09S – 9D	0.1	2.9	-3.9	-0.2	-0.4	0.0	0.1	2.9	-3.9	-0.2
MW12S – 12D	0.1	2.0	-2.6	-0.1	0.0	0.5	0.1	1.5	-2.0	-0.1

Positive values denote upwards flow.

5.3.6 Barometric Efficiency

The measurement frequency has a significant impact on the Clark method with negative BE estimated for nearly all intervals at MW10 and MW12d at short measurement time intervals gradually approaching values of 0.5 as the measurement interval increased to 48 hrs. In contrast the Rahi method gave consistent values for BE across a range of measurement frequencies (Figures 77 and 78).

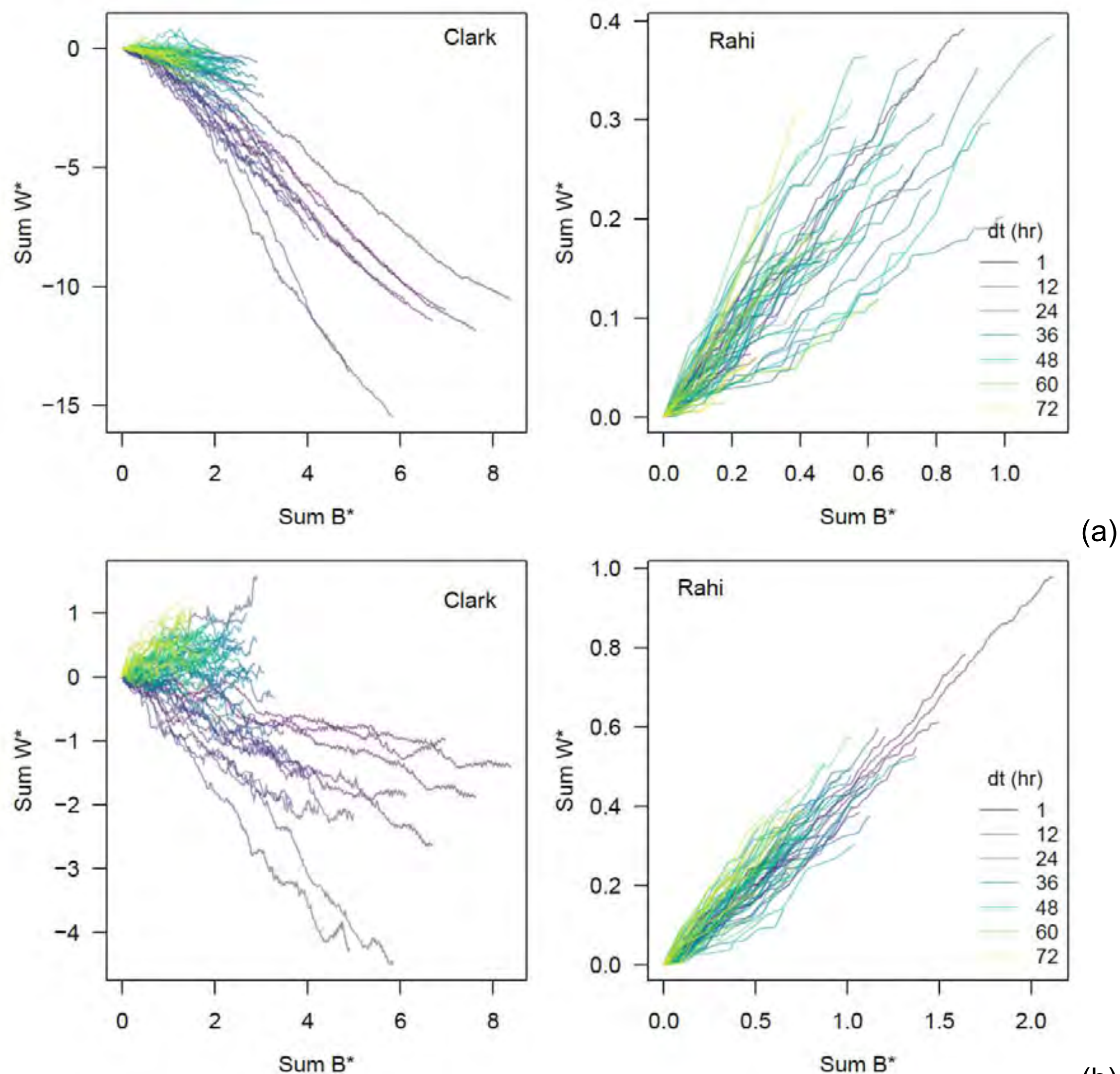


Figure 77: Comparison of the Clark and Rahi approaches to barometric efficiency estimation at MW07 (a) and MW12d (b) as a function of the measurement interval (dt).

As more reliable estimates of BE were obtained from the Rahi method it was applied to evaluate BE for all monitoring wells for the summer of 2019-2020 and winter 2020. Values of BE ranged from 0.31 – 0.53 (Summer) and 0.42 – 0.52 (winter). In general, those wells expressing stronger tidal amplitudes showed slightly higher and more consistent BE values between summer and winter (~0.5) than shallow wells and wells further from the river (~0.4). The larger values in winter for the shallow wells may stem from rainfall recharge of the shallow unconfined aquifer and river flooding inducing rises in water pressure that are also associated with the passage of low-pressure weather systems. The deeper part of the aquifer at the site therefore appears to be only weakly confined, consistent with the high leakage estimates and the vertical saturated hydraulic conductivity of the aquitard from the tidal analysis above.

The specific storage of the semi-confined aquifer can be inferred from estimates of BE ~ 0.5 via:

$$S_s = \frac{\rho\, n}{BE\; E_w} \qquad \text{Equation 15}$$

where ρ is the specific weight of water (9.8 kPa m^{-1}), n the aquifer porosity (~0.4) and $E_w$the bulk modulus of water (2.2 GPa) giving S_s a value of 3.6×10^{-6} m^{-1} and, as above, assuming an aquifer thickness of 20 m, gives a storativity of 7.1×10^{-5} slightly lower than the estimates from the tidal analysis.

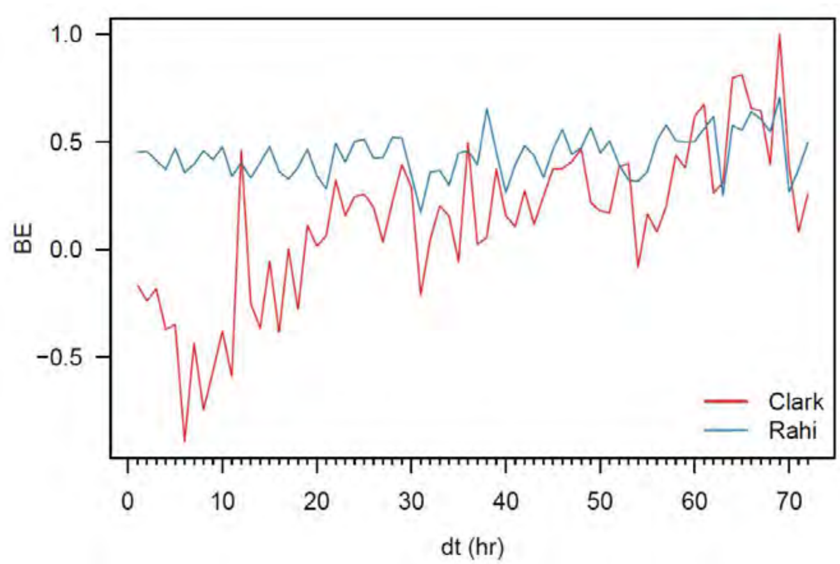


Figure 78: Estimated barometric efficiency at MW12d by the Clark and Rahi methods.

Table 22: Calculated barometric efficiencies (BE) at 1 hour lag, for summer and winter conditions.

	BE	
Well	Nov -2019 – Jan - 2020	Jul – 2020 – Sep - 2020
MW01	0.34	0.43
MW03	0.51	0.51
MW04d	0.39	0.45
MW04s	0.38	-
MW05	0.38	0.47
MW06	0.34	0.46
MW07	0.45	0.42
MW08d	0.34	0.50
MW08s	0.35	0.45
MW09d	0.53	0.52
MW09s	0.35	0.47
MW10	0.36	0.42
MW11	0.37	0.47
MW12d	0.46	0.50
MW12s	0.31	0.48
MW13	0.31	0.51

5.4 Summary

The materials encountered during drilling, were stiff gray/green plastic clays, likely Guildford Clay, medium – coarse grained sands, likely Bassendean Sand, organic and silty/clayey wetland sediments, a clayey sand interspersed with Guildford Clay and coarse sandy alluvial deposits with shell grit. These materials fit with what was expected to occur at the site based upon hydrogeological models of the region (Davidson, 1995). At the northern end of the wetland there is a thin veneer of wetland sediments, 2 – 4 m thick which overlies Bassendean Sand. Towards the middle of the wetland, they overlie a clayey sand interspersed with lenses of Guildford Clay and occasional thin layers of alluvial deposits of coarse sand with shell grit. Guildford Clay outcrops near the lookout.

Groundwater in the wetland and particularly deep groundwater displays tidal dynamics. The stronger tidal signal at depth suggested a degree of aquifer confinement so pressure responses form river water inflow related hydraulic loading will propagate rapidly. There is also support from slightly higher barometric efficiencies in deeper screened wells. From the dampening and phase shift of tidal components in groundwater, key aquifer hydraulic properties were estimated, which in turn provided estimates of vertical groundwater fluxes. The magnitudes of upward and downward fluxes are small, in comparison to rainfall and potential evaporation at the site. This lends support to the surface water balance models which neglected groundwater exchange for the wetland as a whole, but groundwater fluxes may be important in some areas, particularly around the margins of the wetlands and where persistent upward heads occur. The highest vertical fluxes may be occurring upwards near MW04.

Based upon the groundwater monitoring a conceptual hydrogeological model was developed. This suggested a steep hydraulic gradient near the escarpment, and this helped drive lateral and upward groundwater inflow near the northern end of the wetlands. Within the wetlands, groundwater switches between downward and upward flow from winter to summer. When upward groundwater flow occurs, the estimated fluxes are much lower than potential evaporation rates and this helps sustain drying conditions and evaporative concentration of salts. The geophysics also appears to show vertically oriented, low resistivity plumes, spaced at regular intervals which may be an indication of a density instability, i.e. light fresh deeper groundwater and dense, saline, near surface brine. As groundwater progresses towards the river the salinity at depth increased from 1 mS cm^{-1} to 62 mS cm^{-1}, however shallower groundwater increased only to 32 mS cm^{-1} and there was no suggestion a monitoring well intercepted a low resistivity plume. The higher salinities observed would only produce a weak density contrast and so the vertical features may be material heterogeneities and/or preferential flow paths of higher hydraulic conductivity.

6 Surface Water and Groundwater Quality

The aims of the water quality monitoring were to help constrain the conceptual water balance model and to quantify the loads and potentially identify likely sources of pollutants in surface waters. The objectives of this component of the study were to collect water quality data and interpret that data using qualitative and quantitative means, such as mixing models, isotope fractionation models.

6.1 Methodology

6.1.1 Groundwater and Surface Water Sampling

Groundwater sampling was conducted in July and September 2019. Samples were retrieve using a peristaltic pump using 0.5 cm ID Teflon tubing with an inline water quality meter (Hydralab Quanta, OTT HydroMet, Colorado) measuring pH, dissolved oxygen, electrical conductivity and temperature. A minimum of 60 L of water was purged from wells prior to sampling, equivalent to twice the estimated volume of sand pack surrounding each well screen. Purging wells continued beyond 60 L until water quality parameters stabilized.

Figure 79: Surface water monitoring wetlands.

Surface water samples were collected on four dates, two of which were coincident with groundwater sampling (16/07/2019, 24/09/2019, 29/10/2019, 20/12/2019) to assess spatial and temporal variation in water chemistry across eight distinct open pools and from the three drains, namely Chapman St, Woolcock Ct, and Kitchener St drains (Figure 79). One focus of the water quality analyses was the temporal changes in water isotopologues at each location. Using methods described below the fraction of water evaporated from pools and the degree of mixing was evaluated.

To evaluate the sources contributing water and pollutants discharged by the Chapman St Drain water quality measurements were made during four rain events between 5th August - 31st October 2019. Water samples were collected from groundwater (MW-07) at the commencement of each event, from rainfall throughout the events, and from the Chapman St Drain at Reid St (Figure 80). Chloride and water isotopologues were analysed from drain water, rainfall and groundwater samples to partition the sources of water contributing to drain runoff. This partitioning then enabled estimates of loads of pollutants from the water sources.

In addition, spatial sampling was conducted on two occasions (March 2019 and March 2020) by students from the University of Western Australia, under the supervision of Prof. Andrew Rate. The sampling focused on water in drains and the few remaining surface-water pools that were wet at the time of sampling (Figure 80).

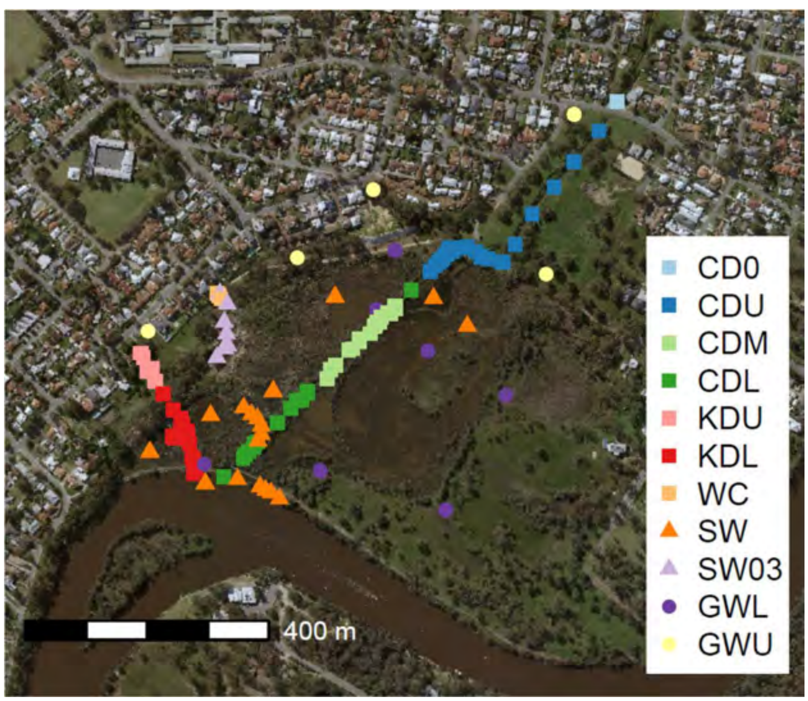


Figure 80: Water quality sampling locations. Chapman St Drain at: north of Reid St (CD0), upper (CDU), mid (CDM) and lower (CDL) sections below Reid St; Kitchener St Drain upper (KDU) and lower (KDL) sections; Woolcock Ct Drain (WC), surface water at SW03 and other surface waters (SW); and groundwaters upgradient of the wetlands (GWU) and within or downgradient of the wetlands (GWL).

6.1.2 Laboratory Methods

Samples were variously analysed for water isotopologues ($\delta^{18}O$, δ^2H), sulphur and oxygen isotopes in sulphate ($\delta^{34}S$, $\delta^{18}O$), concentrations of major cations and anions (Cl^-, Na^+, Ca^{2+}, Mg^{2+}, K^+, SO_4^{2-}, CO_3^{2-}, and the ion balance), nutrients (TP, $PO4^{-3}$, NO_3^-, NO_2^-, TN, TKN, NO_x), carbon constituents (TC, TOC, DIC, DOC) and a suite total and dissolved metals (Al, Ag, As, At, Ba, Be, Bi, Cd, Co, Cr, Fe, Hg, Li, Mn, Mo, Ni, Se, Th, Tl, Pb, ,U, V, Zn). For water isotopes and dissolved metals, samples were filtered in the field to 0.45 μm. Isotopes samples were stored in 20 mL glass vials with Teflon lids and zero headspace. All samples were chilled and then refrigerated prior to laboratory analysis. Laboratory methods are summarized in Table 23.

Table 23: Summary of laboratory methods for water analyses.

Analyte	Laboratory Method
$\delta^{18}O$, δ^2H, $\delta^{34}S$	Refer to Section 6.1.3.
Various metals	ICP-MS.
Mercury	Cold Vapour AAS.
Carbon	Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion.
Anions	Ion Chromatography (APHA 4110-B).
Cations	Cations in water by ICP-OES. Hardness calculated from Calcium and Magnesium (APHA 2340B). Ferrous Iron determined colourimerically (APHA 3500-Fe B).
Alkalinity	Titration (APHA 2320-B).
Nutrients	Colourimetric analysis: Total Phosphorous (APHA 4500-P J); Ammonia (APHA 4500-NH3 F), Total Nitrogen (APHA 4500-P J, 4500-NO3 F); NOx, Nitrate, and Nitrite. TKN by calculation. Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection.
Suspended Solids	Gravimetrically by filtration of the sample and drying at 104±5°C

For APHA methods refer to Rice et al., (2017).

6.1.3 Laboratory Methods for Isotopes

Abundance of water and sulfur isotopes is reported in delta notation and expressed as parts per thousand (per mil, ‰):

$$\mathrm{d}^{34}\mathrm{S}, \delta^{18}\mathrm{O}\ or\ \delta^{2}\mathrm{H} = \left(\frac{R_{sample}}{R_{standard}} - 1\right) \times 1000 \qquad \text{Equation 16}$$

where $R_{sample}$is the respective ratio of the heavy to light stable isotopes, i.e. $^{34}S/^{32}S$, $^{18}O/^{16}O$ or $^2H/^1H$ and $R_{standard}$ refers to the Vienna Standard Mean Ocean Water (VSMOW) standard for the oxygen of hydrogen isotopes and Vienna Canyon Diablo Triolite (VCDT) standard for the sulphur isotopes.

Samples were analyzed for $\delta^{34}S$, using an Automated Nitrogen Carbon Analyzer system consisting of a Sercon 20-22 mass spectrometer connected with an EA (SERCON, UK). All $\delta^{34}S$ values are given in per mil (‰, VCDT) according to delta notation (Skrzypek, 2013). Multi-point normalization was used to reduce raw values to the international scale. Normalization was done using international standards provided by the International Atomic Energy Agency (IAEA): IAEA-S1, IAEA-S2, IAEA-S3 and NBS127 (Skrzypek and Sadler, 2011). The external error of analyses was not more than 0.4‰ (standard deviation).

Samples were analyzed for $\delta^{18}O$ on sulphate, using an TC/EA coupled with Delta XL Mass Spectrometer in continues flow mode (Thermo-Fisher Scientific). All values are given in per mil (‰, VSMOW) according to delta notation. Multi-points normalization used to reduce raw values to the international scale (Paul et al., 2007). Normalization was done using international standards provided by IAEA and NIST: IAEA-S1, IAEA-S2, IAEA-S3, NBS127 (Skrzypek and Sadler 2011). The external error of $\delta^{18}O$ analyses is 0.4 ‰ (standard deviation).

Samples were analysed for $\delta^{18}O$ and $\delta^{2}H$ in water using an Isotopic Liquid Water and Continuous Water Vapour Analyser Picarro 2130i. Normalization was conducted using three laboratory standards, each repeated twice, and calibrated against international standards provided by IAEA: VSMOW2, SLAP2 and GISP (Coplen 1996). Organic contamination was verified based on ChemCorrect algorithm and organic contaminations were removed using a Micro-Combustion Module (Skrzypek and Ford, 2014). The external error for non-enriched water samples (one standard deviation): was 0.10 ‰ ($\delta^{18}O$) and 1.00 ‰ ($\delta^{2}H$).

6.1.4 Estimation of Surface Water Evaporation

The evaporation flux of water is depleted in the heavy isotopic species, ^{2}H, ^{18}O, and ^{17}O, relative to the source water. As a result, source waters tend to enrich in the heavy isotopologues of water in response to evaporation. Similarly mixing of the water pool with inflowing water of a different isotopic composition leads to changes in the isotopic composition of the pool. Knowing the changes in the stable hydrogen and oxygen isotope compositions of pool water and the compositions of inflowing and outflowing water the evaporative loss can be estimated (Craig and Gordon, 1965; Gat and Bowser, 1991).

First the surface water pools that are isolated from groundwater and surface water inputs while receiving direct rainfall and loosing water via evaporation would be considered to have a non-steady state isotopic composition. In this scenario the fraction, f, of remaining water in an isolated evaporating pool of water can be estimated from the change in isotopic composition of the water pool via (Skrzypek et al., 2015):

$$f = 1 - \left(\frac{\delta_L - \delta^*}{(\delta_P - \delta^*)}\right)^{1/m} \qquad \text{Equation 17}$$

where δ_L is the initially measured value of the pool, δ_P, is the final measured value, δ^* is the limiting isotopic composition, given by:

$$\delta^* = \frac{h\,\delta_A + \varepsilon}{h - \frac{\varepsilon}{1000}} \qquad \text{Equation 18}$$

using air humidity (h), the isotope composition of moisture in ambient air (δ_A) and a total enrichment factor (ε, see Eq. 5 in Skrzypek et al., 2015) (Gat and Bowser, 1991) and m is the enrichment slope given by:

$$m = \frac{h - \frac{\varepsilon}{1000}}{1 - h + \frac{\varepsilon_k}{1000}} \qquad \text{Equation 19}$$

with ε_k the kinetic fractionation factor (see Eq. 6 in Skrzypek et al., 2015).

The value δ_A of was estimated from local records of precipitation stable isotope composition (δ_{rain}), corrected using the Local Evaporation Line (LEL) following the approach described via Eq. 3 – 4 in Skrzypek et al., (2015).

Steady state conditions may also occur in particular pools for a period due to upward groundwater flow or surface water inflow. Under steady state conditions inflowing water mixes with the water pool continuously while it is evaporating. The ratio of evaporation to inflow can be estimated from the isotope composition of inflowing water (δ_P) and the outflowing water (δ_L) via:

$$\frac{E}{I} = \frac{\delta_L - \delta_P}{(\delta^* - \delta_L)\,m} \qquad \text{Equation 20}$$

where the ratio E/I is the proportion of water evaporated.

The LEL was estimated via regression of measured pool, surface water and groundwater measurements. Rainfall isotope composition was estimated as the mean of the corresponding month's data in the Global Network of Isotopes in Precipitation (GNIP) database for Perth (www.iaea.org/services/networks/gnip). Twice daily (9 am and 3 pm) humidity and temperature data from the Perth Airport gauge were obtained Bureau of Meteorology and averaged for sampling periods.

Isotopic composition of inflowing groundwater was estimated from nearest groundwater wells and the rates of estimated upward groundwater fluxes if occurring (Section 4.3). The isotopic composition of inflowing water from the Woolcock Ct drain was estimated from the measured baseflow composition mixed with rainfall based on estimated runoff coefficients (Section 2).

6.1.5 Hydrograph Separation

Runoff in the Chapman St drain contains stormwater from recent rainfall as well as baseflow from groundwater. Understanding the relative contributions of these components may help attribute sources of pollutants and to estimate their loads to the Swan River on an annual basis. Hydrograph separation can use chemical tracers carried with the water flow to disentangle the various contributions.

When two water sources with distinct chemical compositions fully mix their fractional contributions to the mixture can be estimated via measurements of water quality (McGlynn and McDonnel, 2003; Klaus and McDonnell, 2013). For example, considering the flow in a drain, Q_t, as comprised of a water flux from a rainfall event, Q_e and a baseflow of pre-event groundwater, Q_p the fraction of event water discharge, f_e, can be estimated via:

$$Q_t = Q_p + Q_e \qquad \text{Equation 21}$$

$$C_t Q_t = C_p Q_p + C_e Q_e \qquad \text{Equation 22}$$

$$f_e = \frac{C_p - C_t}{C_p - C_e} \qquad \text{Equation 23}$$

Equation 21 is the water balance, and Equation 22 the chemical mass balance, with C_t, C_p, and C_e, the concentrations in the drain, pre-event and event water respectively.

A three-component separation was also conducted via the following linear regression:

$$\begin{bmatrix} \mathrm{d}^{18}\mathrm{O}_t - \mathrm{d}^{18}\mathrm{O}_g \\ \mathrm{d}^{2}\mathrm{H}_t - \mathrm{d}^{2}\mathrm{H}_g \\ \mathrm{Cl}_t^- - \mathrm{Cl}_g^- \end{bmatrix} \sim f_e \begin{bmatrix} \mathrm{d}^{18}\mathrm{O}_e - \mathrm{d}^{18}\mathrm{O}_g \\ \mathrm{d}^{2}\mathrm{H}_e - \mathrm{d}^{2}\mathrm{H}_g \\ \mathrm{Cl}_e^- - \mathrm{Cl}_g^- \end{bmatrix} + f_p \begin{bmatrix} \mathrm{d}^{18}\mathrm{O}_p - \mathrm{d}^{18}\mathrm{O}_g \\ \mathrm{d}^{2}\mathrm{H}_p - \mathrm{d}^{2}\mathrm{H}_g \\ \mathrm{Cl}_p^- - \mathrm{Cl}_g^- \end{bmatrix} + r \qquad \text{Equation 24}$$

where the subscripts correspond to the drain (t), and the endmembers of groundwater (g), pre-event drain water (p) and rainfall event water (e). The term r is the error of the linear regression with intercept forced through the origin and the fractional contributions to discharge are f_e (event-water), f_p (pre-event water), and $f_g = 1 - f_e - f_p$ (groundwater). The uncertainties of the fractions in this instance were derived from the standard deviation of the estimated error of the regression coefficients. This approach was taken, as opposed to a more traditional three component separation (i.e. the analytical extension of Equation 19 to three component separation using two tracers) as the traditional approach proved to return unrealistic fractions (i.e. $f < 0$ and $f > 1$). The linear regression (Equation 20) has the advantage that the incorporation of additional information from a third tracer helps better constrain the estimation.

For flow separation the abundance of the water isotopologues, δ^{18}O, δ^{2}H, and the concentration of chloride; were measured in drain water and rainfall. Water quality parameters were measured at 15-minute intervals throughout the event, while water quality samples were collected at ~30-minute intervals. Rainfall was sampled using a 4 mm sequential rainfall sampler (Fischer et al., 2019). The concentration of the rain-event water component was weighted based on the incremental mean weighting method as described by McDonnell et al. (1990). Uncertainty of the estimated fraction of new water contributing to flow was estimated following Genereux (1998).

6.2 Results

6.2.1 Groundwater and Surface Water Quality

6.2.1.1 Major Ion Chemistry

Piper diagrams show the spatial patterns of major ion chemistry of the various waters and identifies how differing locations share similar sources of water (Figure 81). Shallow groundwaters in the wetland look to be evaporatively enriched estuarine waters, low in [SO_4^{2-}], high in [Cl^-] and [Na^+]. The groundwater wells progressively upgradient of the wetland separate by decreasing [Cl^-], increasing [Ca^{2+}] and increasing [SO_4^{2-}], from MW10, MW05, MW07, MW01, to MW04s. Of the deep groundwater wells MW04d has a similar composition of major ions as MW11, while MW13 has a higher proportion of [Ca^{2+}] and lower [Na^+] and [K^+] ions than the other deep groundwater wells. A mixing line from MW04d, MW08d, MW09d, MW12d through to MW03 suggests a progressively increased signature of estuarine and evaporated surface waters. In comparison the composition of groundwater at MW13 looks to be anomalous with relatively high [Cl^-] and [Ca^{2+}] and [Mg^{2+}] while having relatively low [Na^+] + [K^+].

The ratio of [Cl^-] in various groundwaters to long term average concentration in rainfall for Perth (8.85 mg L^{-1}) is an indicator of groundwater recharge (Crosbie et al., 2010). The upgradient groundwaters (MW01, MW05, MW04, MW06, MW07 and MW10) and the drains have estimates of groundwater recharge of 2% to 6% of annual precipitation. The [Cl^-] ratio in SW03 is the highest of all the surface water pools at 0.03 suggesting a significant groundwater/drain water contribution to this area. Groundwater from MW04d also sits close to the composition of long-term average rainfall, whereas the shallower MW04s contains larger [SO_4^{2-}] despite having similar estimates of groundwater recharge of 3 - 4%, suggesting a vertical stratification in water quality not derived from evaporative enrichment. Impact by river water may be a contributing factor.

The surface waters share a similar composition as the shallow wetland groundwaters, the exception being SW03. In SW03 there is higher [SO_4^{2-}], [Ca^{2+}] and lower [Cl^-] as compared the other surface waters. This is intermediate between the other surface waters and the discharge from the Woolcock Ct drain, which also has higher [SO_4^{2-}] and [Ca^{2+}] and low [Cl^-] and is therefore suggestive of a significant drain water contribution to the composition of SW03 waters. The Kitchener St Drain contained lower [Ca^{2+}] and more [Na^+] than the other two drains. The Chapman St drain contained water, like the groundwater in MW07. As shown in Section 6.1.5 the runoff in the Chapman St Drain during rainfall events contains a significant proportion of groundwater.

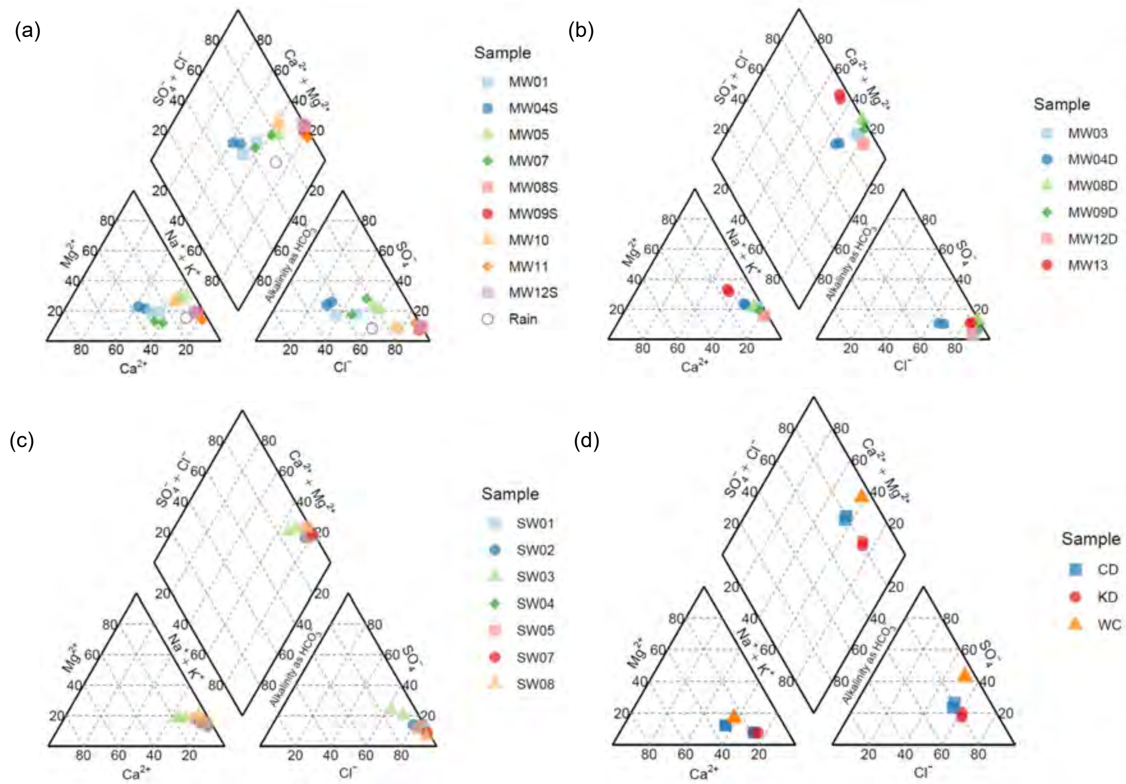


Figure 81: Piper diagrams of major ions in shallow (a) and deep groundwater (b), surface water (c), and drains (d). MW# = groundwater, SW# = surface water and CD (Chapman St), KD (Kitchener St) and WC (Woolcock Ct) refer to drains.

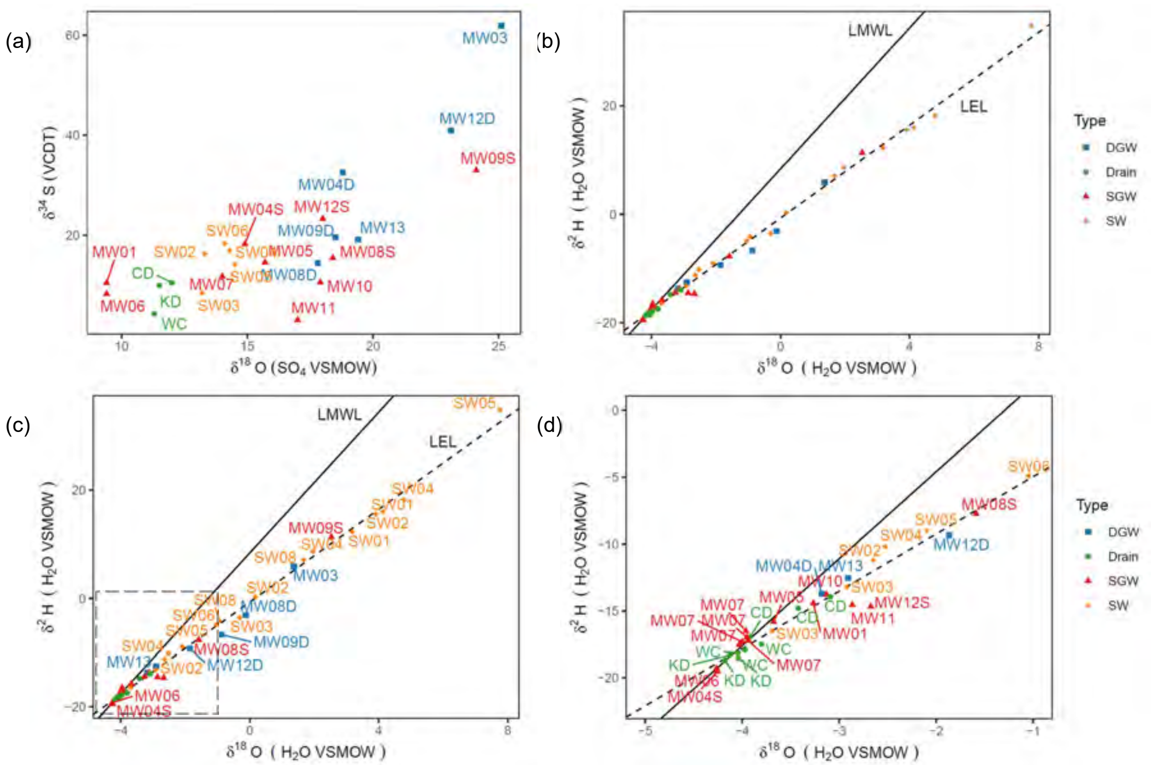


Figure 82: Sulfur (a) and stable (δ^2H and $\delta^{18}O$) water isotopes (b – d) in surface water (SW), drains (Drain), and deep (DWG) and shallow (SWG) groundwater. LML is the local meteoric water line and LEL is the local evaporation line. The dashed inset in (c) is

6.2.1.2 *Water Isotopologues*

Surface, ground, and drain waters sit tightly along a local evaporation line (LEL, Figure 82) given by $\delta^2H = 4.28\ \delta^{18}O - 0.68$ (Adjusted R^2 of 0.99, $p < 2.2 \times 10^{-16}$) as compared the local meteoric water line (LMWL) $\delta^2H = 6.5\ \delta^{18}O + 8.4$ as determined from GNIP sampling (Crosbie et al., 2012). Drain waters and the upgradient monitor wells (MW01, MW04s, MW05, MW06, MW07, and MW10) show the least evaporative enrichment, consistent with the chloride mass balance calculations above. The shallow groundwater near the river (site MW09S) has the highest evaporative enrichment of any of the groundwater sites. This is expected given its position down gradient of the largest wetland feature (SW07). The Chapman St Drain is slightly more evaporatively enriched than Woolcock Ct and Kitchener St drains. This is likely due to the two long sections of open drain within its network.

Enrichment increases in groundwater in a general direction toward the river consistent with groundwater recharge from the evaporatively enriched surface water pools. The deeper groundwater wells also tend to be more evaporatively enriched than the shallow wells, with the exception of MW09S as described above.

The surface water pools all show significant enrichment except for pool SW03, the pool fed by the perennial baseflow from the Woolcock Ct Drain. The pools SW02 and SW04 also had periods of low enrichment suggesting the potential that the Woolcock Ct Drain may also be diluting these pools. However, later in the spring both SW02 and SW04 enrich significantly indicating the connectivity of these pools with the drain may be weakened.

6.2.1.3 *Surface Water Evaporation and Mixing*

Surface water pools were sampled to quantify evaporative losses using the change in isotopic composition between sampling events (Skrzypek et al., 2015). This was complicated by the occurrence of a large flooding event around 30th August 2019 and a smaller event 31st October 2019. The isotopic compositions of the Swan River samples were used as the initial values following the large flooding event. In addition, several pools dried completely between sampling events, preventing sampling. Generally non-steady state conditions were assumed for sample pairs and while rainfall events did occur, they tended to not raise the water level significantly, and were significantly less than the potential evaporation (Table 24). An exception was pool SW03, which received significant inflows from the Woolcock Ct drain, so the steady state approach was adopted for this pool, using the isotopic composition of drain inflows and the isotopic composition of the pool as the pool outflow in the steady-state water balance model (Skrzypek et al., 2015).

The fractions of water evaporated during the sampling periods ranged between 5 - 43%. The low estimates of evaporative fractions were from SW03 when inflows from Woolcock Ct drain were 9.5 ML. Over the open water area of SW03 this is equivalent to 182 mm of evaporative loss when the net deficit between rainfall and potential evaporation was 321 mm. Later (31/10/2019 – 20/12/2019) the fraction lost, as estimated from isotope measurements, was 14% or 281 mm when the deficit between rainfall and potential evaporation was 506 mm. Both periods give a ratio of actual (EA) to potential (PE) evaporation of 0.55. These values should be used with caution as the isotopic composition of inflows during rain events were not measured and are expected to more closely sit on the local meteoric water line, distinct from the more consistent values in the Woolcock Ct baseflow.

Table 24: Estimates of evaporated fractions via water isotopologues.

Site	Dates[a]	T[b] °C	RH[b] %	P – Ep[b] mm	Q[c] m^3	$\delta^{18}O_{rain}$[d] ‰	$\delta^{2}H_{rain}$[d] ‰
SW01	31/10 – 20/12/19	23.6	35.9	-506		-2.7	-9.4
SW02	31/08 – 29/10/19	15.6	57.2	-321		-3.7	-13.3
SW02	31/10 – 20/12/19	23.6	35.9	-506		-2.7	-9.4
SW03	31/08 – 28/10/19	15.6	57.2	-321	9503	-3.7	-13.3
SW03	31/10 – 20/12/19	23.6	36.3	-506	5233	-2.7	-9.4
SW04	31/08 – 28/10/19	15.6	57.2	-321		-3.7	-13.3
SW04	31/10 – 20/12/19	23.6	36.3	-506		-2.7	-9.4
SW05	16/07 – 28/10/19	23.9	46.6	-769		-3.75	-13.7
Site	Dates[a]	$\delta^{18}O_1$[e] ‰	$\delta^{18}O_2$[e] ‰	$\delta^{2}H_1$[e] ‰	$\delta^{2}H_2$[e] ‰	f_O[f]	f_H[f]
SW01	31/10 – 20/12/19	-1.0	4.1	-4.0	16.0	0.21	0.22
SW02	31/08 – 29/10/19	-4.0	0.2	-18.1	0.3	0.17	0.18
SW02	31/10 – 20/12/19	0.2	3.9	0.3	15.6	0.16	0.17
SW03	31/08 – 28/10/19	-4.0	-2.9	-18.1	-13.2	0.04	0.05
SW03	31/10 – 20/12/19	-4.0	-0.3	-17.9	-3.5	0.14	0.15
SW04	31/08 – 28/10/19	-1.0	2.0	-4.0	8.7	0.14	0.14
SW04	31/10 – 20/12/19	-1.0	4.8	-4.0	18.2	0.24	0.24
SW05	16/07 – 28/10/19	-2.1	7.8	-9.0	34.8	0.40	0.43

a: First date denotes first sampling date or the date the river last flooded the wetland between sampling dates; the second date denotes the final sampling date.

b: mean air temperature (T), mean relative humidity (RH), precipitation minus potential evaporation (P – EP) between dates; data from Bureau of Meteorology gauge at Perth Airport;

c: total inflows to SW03 from the Woolcock Ct drain;

d: mean of rainfall isotopes values in the GNIP database for the corresponding months.

e: measured water isotopes in surface water pools; initial values denoted by subscript of 1 and final values by subscript 2; pools that were flooded between sampling events have used Swan River values as initial values. For SW03 the initial values represent isotopic composition of inflowing Woolcock Ct drain water;

f: fraction of water evaporated between dates by the non-steady – state method, for all pools except SW03, which used the steady state model for 31/08 – 28/10/19. The subscripts denote the element used i.e. H or O.

The fractions of water evaporated from SW01 during the first sampling period was estimated at 21%. The observed water levels fell by ~100 mm whereas potential evaporation exceeded precipitation by 506 mm. Groundwater inflows from the river and/or the western escarpment may therefore be sustaining water levels at SW01 and therefore skewing estimates of evaporative loss. SW05 on the other hand shows significant evaporative enrichment. It lacks direct drain inflows, is more open and exposed and receives only a small groundwater inflow insufficient to reduce the degree of isotopic enrichment.

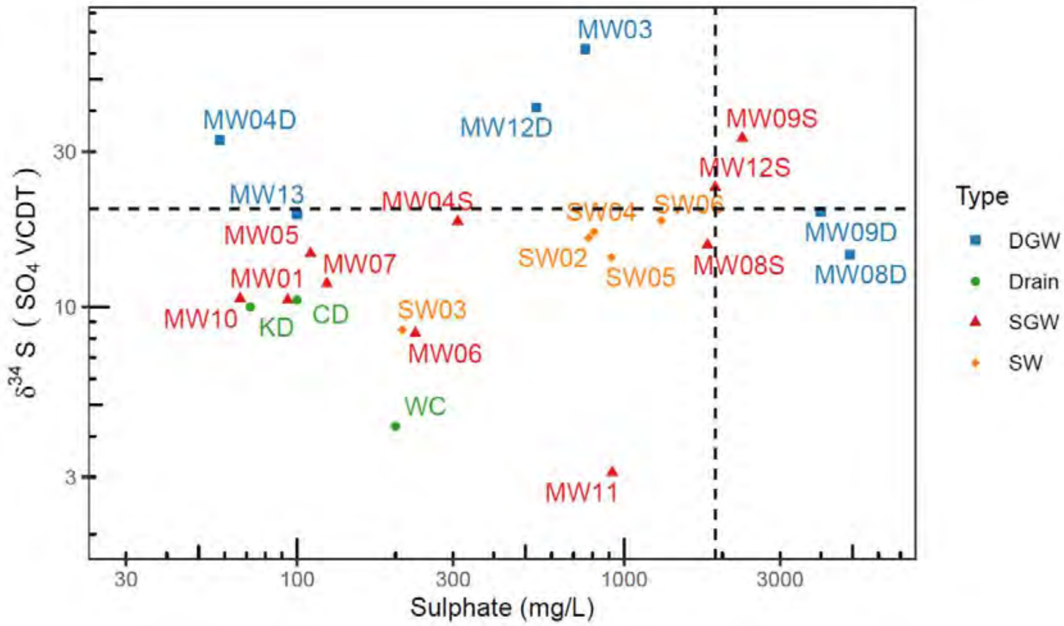
At SW04 the estimated fractions of the pool volume lost as evaporation were 0.14 and 0.24, corresponding to P – Ep values of -321 mm and -506 mm respectively. The ratios of these sets of values are similar i.e. ~0.6. Water levels (measured at C12) however decreased only a little, ~60 mm during the first period and by ~200 mm during the second measurement period.

6.2.1.4 Sulphate Isotopologues

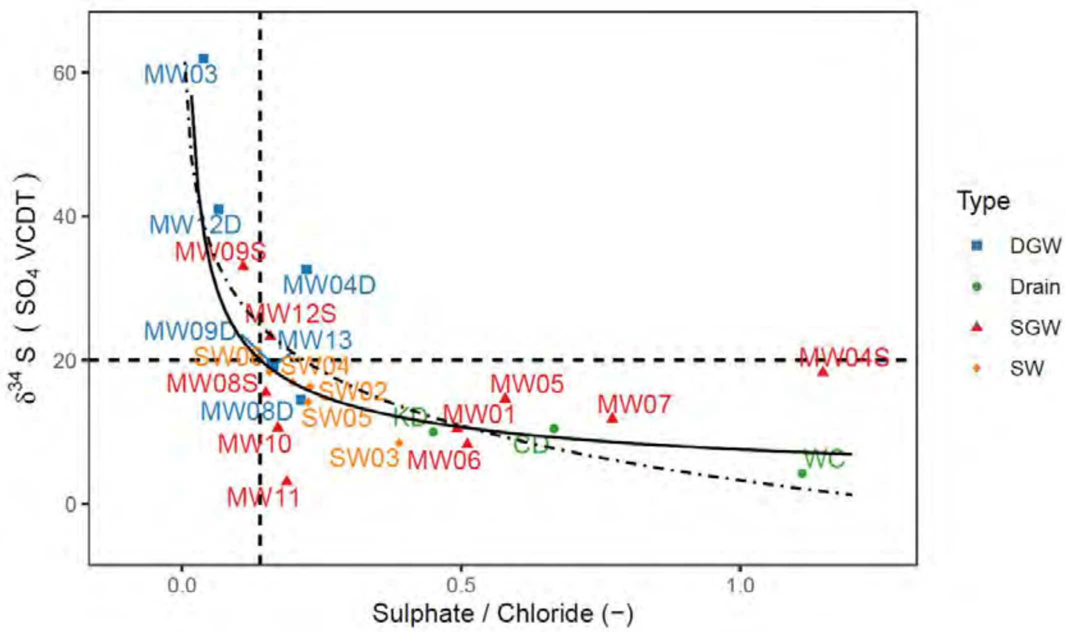
The pattern of $\delta^{18}O$ and $\delta^{34}S$ in sulphate shows a significant positive trend with a slope of ~2 (). The value of $\delta^{34}S$ in seawater is ~20 ‰ with a similar value reported in Australian rainfall (Dogramaci et al., 2001) although lower values are reported elsewhere (Vitòria et al., 2004, Mebus et al., 2000). For the water isotopologues, rainfall in Perth has a weighted mean $\delta^{18}O$ = -4.15 and a $\delta^{2}H$ = -16.77 (Crosbie et al., 2012) while seawater $\delta^{18}O$ (SO_4^{2-}) has a value of 10 ‰. Relative to seawater, most samples were enriched in $\delta^{18}O$ (SO_4^{2-}) and many were slightly depleted in $\delta^{34}S$. Relative to the up-hydraulic gradient groundwater the wetland groundwaters are enriched in $\delta^{18}O$ (SO_4^{2-}) and $\delta^{34}S$.

There is a lack of relationship between $\delta^{34}S$ and [SO_4^{2-}], counter to expectations that sulphate reduction should be occurring within the system (Figure 82). There is a weak tendency for larger SO_4^{2-} concentrations to occur closer to the river. A positive relationship between $\delta^{18}O$ vs $\delta^{34}S$ with a slope between 2 and 4, consistent with the linear regression, could be expected where sulfate reduction processes are occurring (Mebus et al., 2000). However, in conflict with this, sulphate concentrations tend to increase toward the river and $\delta^{34}S$ shows little relationship to [SO_4^{2-}] (Figure 83). If sulfate reduction were dominating the reaction process in the aquifer from inland to the river, then a negative relationship between $\delta^{34}S$ and [SO_4^{2-}] would be expected. The results however suggest a more complex mixing and reaction processes is occurring in the wetland and aquifer. Seasonal oxidation and reduction of surficial sediments is likely, additionally, rejuvenation of SO_4^{2-} from river flooding and subsequent mixing with groundwaters is expected. In combination these processes could explain the lack of a relationship between $\delta^{34}S$ and [SO_4^{2-}].

There is also an inverse relationship between the ratio of [SO_4^{2-}] to [Cl^-] and $\delta^{34}S$ (Figure 83). The mass ratio of [SO_4^{2-}] to [Cl^-] in seawater is 0.14. Sulphate and chloride concentrations in Perth rainfall average 1.61 and 8.85 mg L^{-1} respectively producing a ratio of 0.18 (Crosbie et al., 2012). In groundwaters this ratio can increase from the oxidation of pyrite, from fertilizer contamination and from grey-water (Sammut, 1996; Vitòria et al., 2004; Kilminster and Cartwright, 2011). Oxidation of pyrite can also lower $\delta^{34}S$ (Mebus, et al., 2000). The ratio has also been used previously as an indicator of the location of a groundwater contaminant plume said to have emanated from a sulfuric acid production facility on Guildford Rd (Kellenberger, 1998). The apparent power-law relationship between $\delta^{34}S$ and [SO_4^{2-}]:[Cl^-] therefore looks to arise from a mixture of processes. Saline estuarine waters that have been evaporatively enriched and undergone sulphate reduction, while having [SO_4^{2-}] regularly replenished by river flooding, and on the landward end contamination of groundwater from sulfuric acid production activities providing a depleted source of $\delta^{34}S$ high in [SO_4^{2-}]. The lack of relationship between $\delta^{34}S$ and [SO_4^{2}] therefore is not a good indicator of the absence of sulphate reduction. Indeed, in Section 7 the sediment geochemistry and acid sulphate soils assessments provides further evidence of sulphate reduction taking place in near-surface sediments.



(a)



(b)

Figure 83 Variation of $\delta^{34}S$ as a function of the sulphate concentration (a) and the sulphate to chloride ratio (b). The horizontal line indicates the approximate *value for* seawater and the vertical line the mean of measured sulphate concentration and sulphate to chloride ratio in the Swan River measured at Ron Courtney Island. The solid line is a power-law regression (Model 1) and the dash-dotted line a log-linear regression (Model 2) the results of which are documented in Table 25.

Vitòria et al., (2004) analysed the isotopic compositions of numerous fertilizers and summarized the literature at the time. They found $\delta^{34}S$ to vary from -6.5 to 21.6 ‰, with a median composition of 5.7 ‰. Additionally, fertilizers with H_2SO_4 manufactured from sulfides showed a range of $\delta^{18}O$ (SO_4^{-2}) values between +7.7 ‰ and +16.5 ‰. The $\delta^{18}O$ and $\delta^{34}S$ values in surface and groundwaters at Ashfield Flats are consistent with the isotopic compositions in sulphates emanating from marine evaporites with the potential for some samples to be impacted by fertilizer contamination of the groundwater (Vitòria et al., 2004). In particular, the low $\delta^{34}S$ values in the upgradient wells (MW10, MW06, MW01, MW07), the Woolcock Ct Drain and pool SW03 are suggestive of fertilizer or sulphuric acid contamination. MW11 stands out as a particularly low $\delta^{34}S$ value and the reason for this is unclear.

Table 25: Summary of regressions of sulfur stable isotopes.

Statistic	$\delta^{34}S \sim a\, \delta^{18}O + b$	$\delta^{34}S \sim a\, (\mathrm{SO_4^-/Cl^-})^b$	$\delta^{34}S \sim a\, \log_{10}(\mathrm{SO_4^-/Cl^-}) + b$
a	2.4	7.59± 1.23	-11.0 ± 2.3
b	-20.3	-0.49 ± 0.13	3.31 ± 3.61
Adjusted R^2	0.60	0.37	0.49
p	5×10^{-6}	0.001	8×10^{-5}
AIC	172	0.82	178.5

p denotes the model P-value. AIC denotes Akaike's Information Criterion.

6.2.1.5 Nutrients and Metals

Concentrations of several metals exceeded Australian and New Zealand guidelines for fresh and marine waters (Table 26). As surface waters are brackish to saline the marine guidelines, where available are likely to be more applicable. Note these guideline values are for indicative use only and site-specific values may need to be derived. Concentrations of aluminium, cobalt, copper, and zinc more frequently exceeded the available marine water quality guideline vales. Zinc concentrations were particularly high in the Woolcock Ct Drain, followed by the Chapman and Kitchener St drains (Figures 84 - 87). Surface waters near the outlet of the Woolcock Ct drain (SW03) also had high zinc concentrations. Aluminium followed a similar distribution, whereas cobalt looked to be primarily sourced from the Woolcock Ct drain and in association appeared in high concentrations at SW03. High concentrations of copper were seen in the Chapman St and Kitchener St drains, and high lead concentrations were only found in the Chapman St drain during runoff event sampling.

Relatively higher PO_4^{3-} concentrations were observed in the surface waters of the Chapman St Drain in comparison to groundwater, surface waters and other drain water (Figure 87). Nitrate concentrations in contrast were highest in the upgradient groundwater monitoring wells and in the pre-event drain water above Reid St in the Chapman St drain.

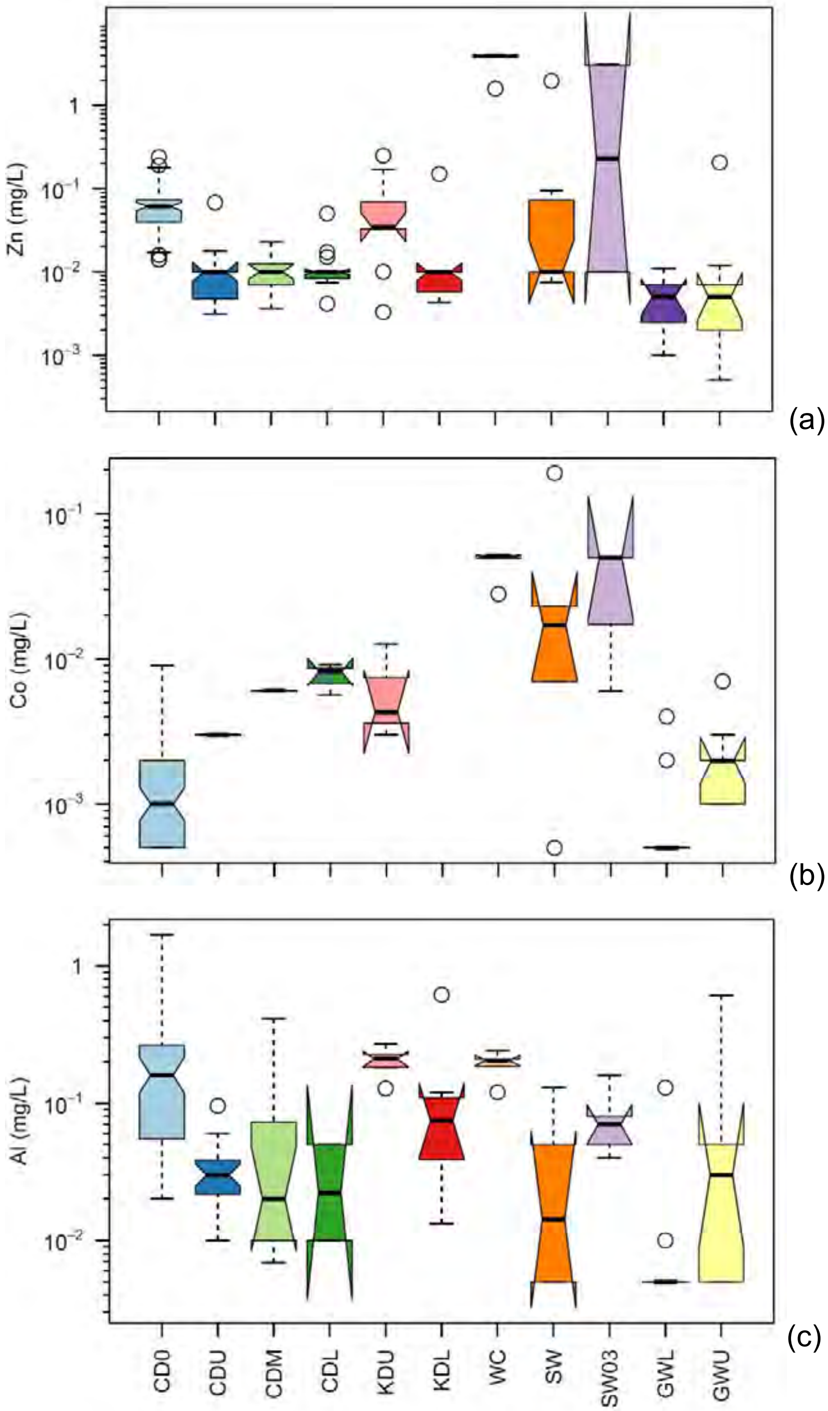


Figure 84: Distributions of zinc (a), cobalt (b) and aluminum (c) concentrations at water quality sampling locations (Figure 80). Box-plots show the median (black line), the interquartile range (box), the 95% range (error bars) and outliers of the distribution (circles).

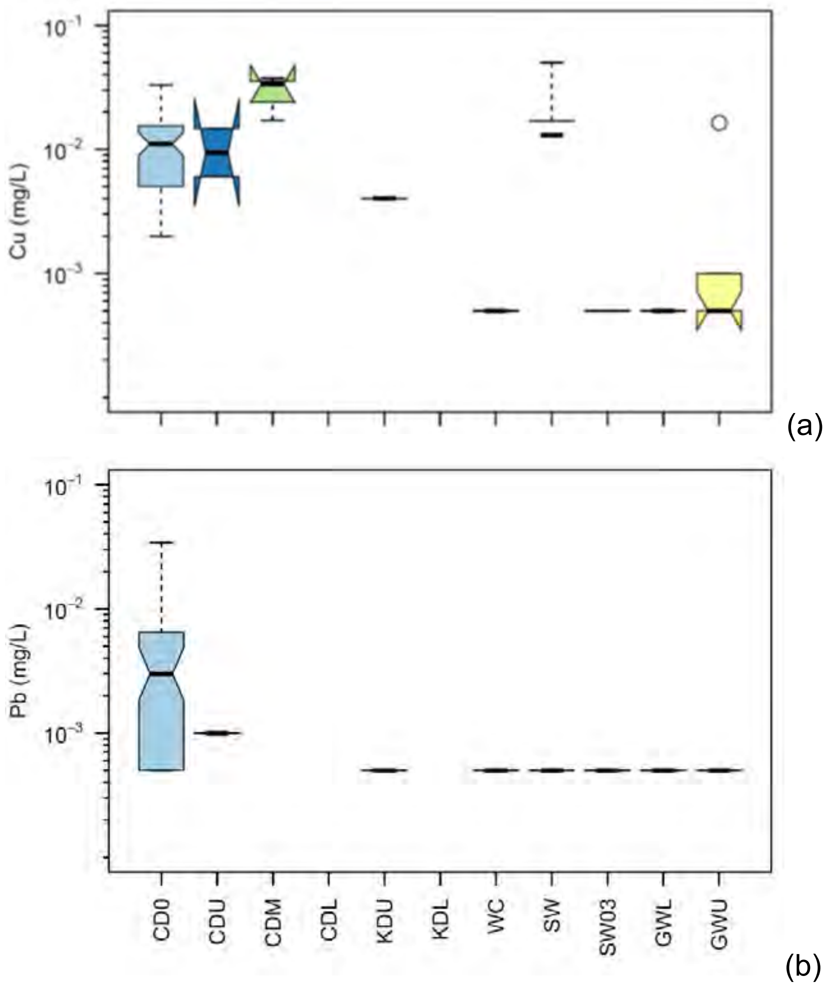


Figure 85: Distributions of copper (a) and lead (b) concentrations at water quality sampling locations (Figure 80).

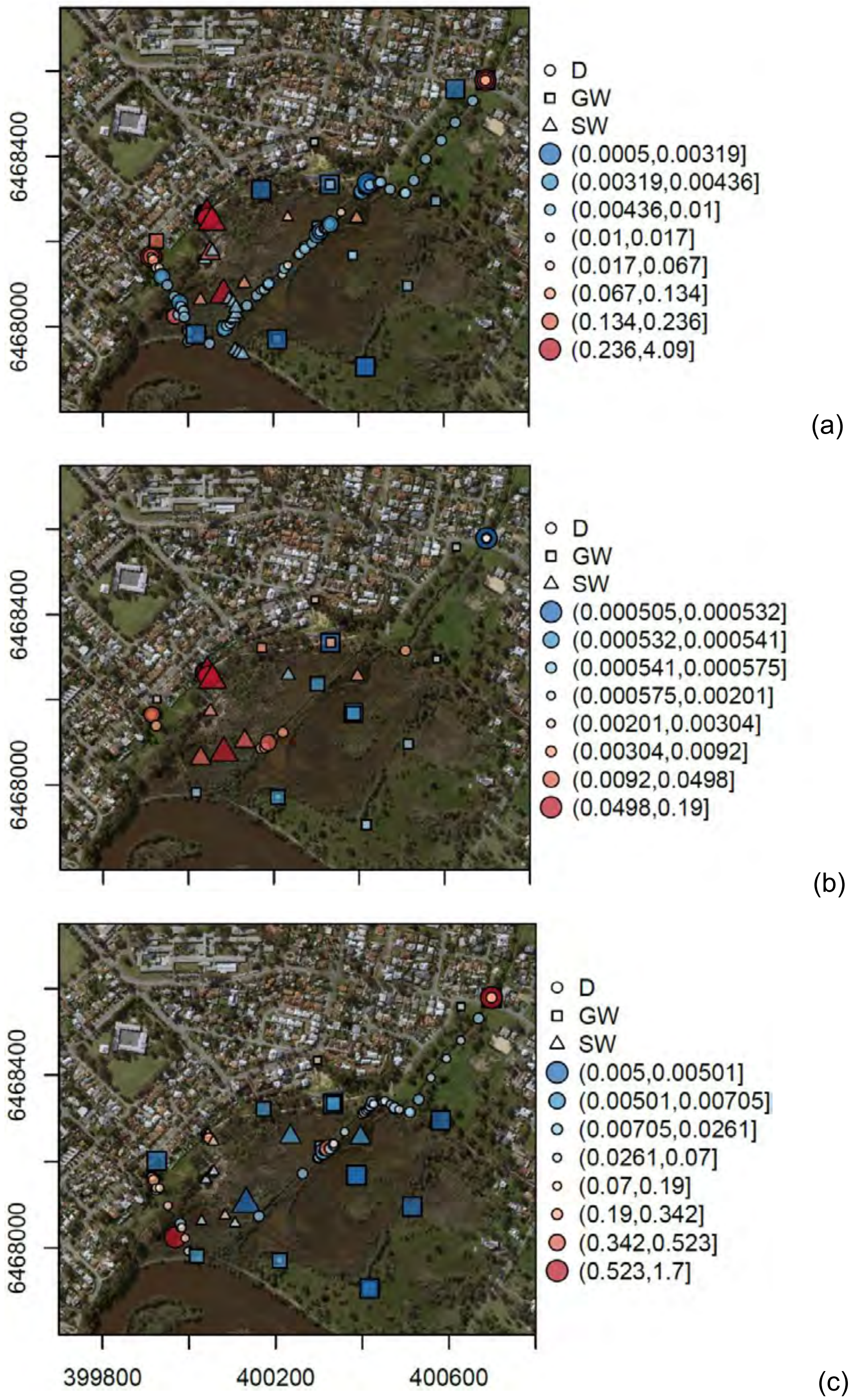


Figure 86: Spatial distribution of Zn (a), Co (b) and Al (c) concentration (mg L^{-1}) quantiles (0 -5%, 5- 10%, 10 – 25%, 25 – 50%, 50 – 75%, 75 – 90%, 90 – 95%, 95 – 100%).

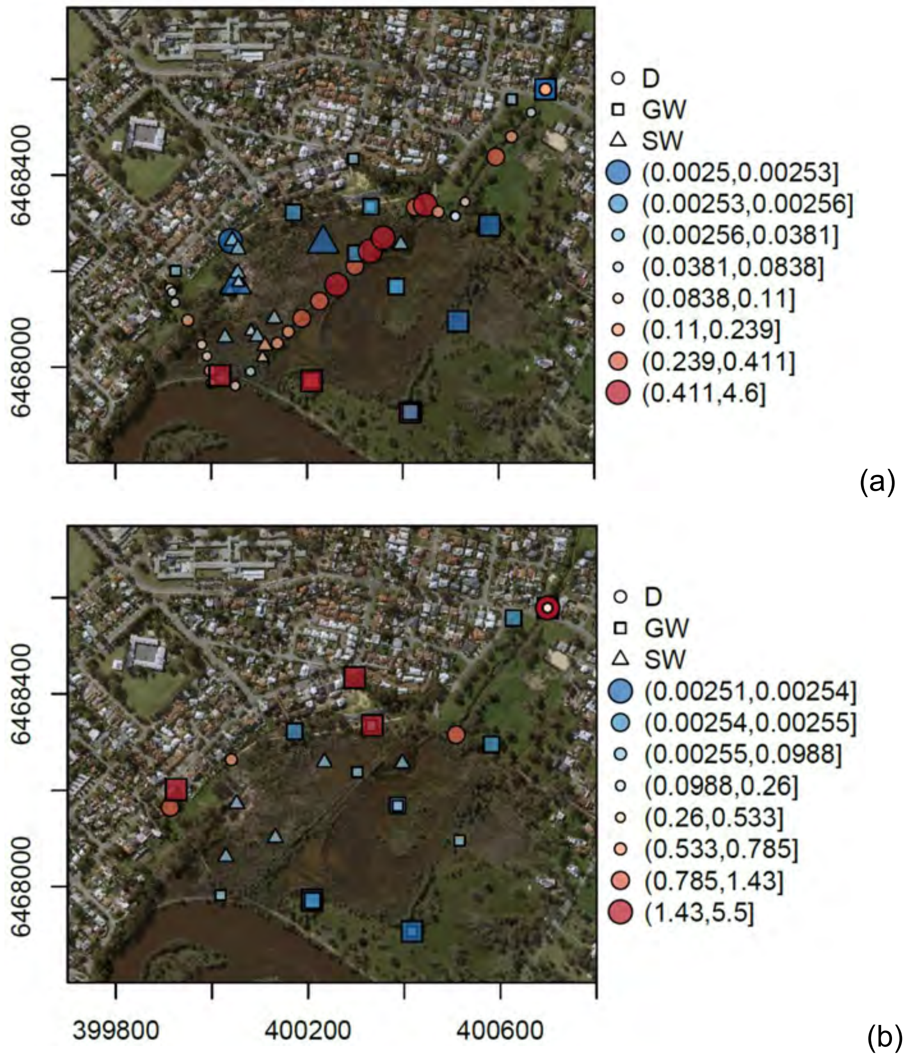


Figure 87: Spatial distribution of PO_4^{3-}(a), and NO_3^- (b) concentration (PO_4^{3-} as P and NO_3^- as N in mg L^{-1}) quantiles (0 -5%, 5- 10%, 10 – 25%, 25 – 50%, 50 – 75%, 75 – 90%, 90 – 95%, 95 – 100%).

Table 26: Exceedances of Australian and New Zealand guidelines for fresh and marine water quality

			Level of Species Protection (LOSP)										
Element	Medium	Reliability	99%	95%	90%	80%	unknown	99%	95%	90%	80%	unknown	
			Concentration ug L^{-1}					Number of samples exceeding LOSP					Total
Aluminium (pH >6.5)	Freshwater	Low	27	55	80	150		119	83	73	52		159
Ammonia	Marine Water	Moderate	500	910	1200	1700		8	8	8	8		96
Ammonia	Freshwater	Very High	320	900	1430	2300		11	8	8	8		96
Antimony	Freshwater	Unknown					9					0	83
Arsenic (AsIII)[a]	Freshwater	Moderate	1	24	94	360		144	21	0	0		171
Arsenic (AsV)[a]	Freshwater	Moderate	0.8	13	42	140		149	39	6	0		171
Boron	Freshwater	High	90	370	680	1300		110	59	55	43		178
Cadmium	Freshwater	Very High	0.06	0.2	0.4	0.8		81	24	0	0		159
Cadmium	Marine Water	Very High	0.7	5.5	14	36		0	0	0	0		159
Chromium (CrIII)[a]	Freshwater	Unknown					3.3					38	170
Chromium (CrIII)[a]	Marine Water	Low	7.7	27	49	91		21	0	0	0		170
Chromium (CrVI)[a]	Freshwater	Very High	0.01	1	6	40		146	77	34	0		170
Chromium (CrVI)[a]	Marine Water	Very High	0.14	4.4	20	85		146	36	0	0		170
Cobalt	Freshwater	Unknown					1.4					60	112
Cobalt	Marine Water	High	0.005	1	14	150		112	60	10	1		112
Copper	Freshwater	Very High	1	1.4	1.8	2.5		82	82	82	81		109
Copper	Marine Water	Very High	0.3	1.3	3	8		104	82	74	48		109
Lead	Freshwater	Moderate	1	3.4	5.6	9.4		46	34	20	13		99
Lead	Marine Water	Low	2.2	4.4	6.6	12		42	24	18	8		99

a: only total concentration determined.

Table 26: Exceedances of Australian and New Zealand guidelines for fresh and marine water quality (continued).

Element	Medium	Reliability	Level of Species Protection (LOSP) 99%	95%	90%	80%	unknown	99%	95%	90%	80%	unknown	
			Concentration ug L^{-1}					Number of samples exceeding LOSP					Total
Manganese	Marine Water	Unknown					80					90	183
Manganese	Freshwater	Moderate	1200	1900	2500	3600		7	5	4	1		183
Mercury (inorganic) [a]	Freshwater	Moderate	0.06	0.6	1.9	5.4		0	0	0	0		99
Mercury (inorganic) [a]	Marine Water	Very High	0.1	0.4	0.7	1.4		0	0	0	0		99
Molybdenum	Freshwater	Unknown					34					0	155
Nickel	Freshwater	Low	8	11	13	17		3	1	1	1		106
Nickel	Marine Water	Very High	7	70	200	560		3	0	0	0		106
Selenium (total)	Freshwater	Moderate	5	11	18	34		42	38	38	26		121
Silver	Freshwater	Low	0.02	0.05	0.1	0.2		83	83	83	83		83
Silver	Marine Water	Moderate	0.8	1.4	1.8	2.6		0	0	0	0		83
Thallium	Freshwater	Unknown					0.03					83	83
Thallium	Marine Water	Unknown					17					0	83
Uranium	Freshwater	Unknown					0.5					13	83
Vadium	Freshwater	Unknown					6					72	168
Vadium	Marine water	Moderate	50	100	160	280		0	0	0	0		168
Zinc	Freshwater	Very High	2.4	8	15	31		182	148	99	81		189
Zinc	Marine water	Moderate	7	15	23	43		154	99	84	71		189

a: only total concentration determined.

6.2.2 Hydrograph Separation of Chapman St Drain Flows

Previous descriptions of water quality in the local urban drains were based on samples collected during low-flow periods. The event-based sampling during four rainfall events reveals the dynamics of water sources contributing to drain flow and the nutrients and metals loads that ultimately enter the Swan River.

The four rain events had peak flows that ranged between 137 – 303 L s^{-1} (Figure 88). Water isotopes in drain water typically followed the variation seen in rainfall, though $\delta^{18}O$ varied in the drain by only ~1 ‰ during an event, $\delta^{2}H$ by 11 ‰ and [Cl^-] by ~110 mg L^{-1}. Using these tracers, biplots of tracers and the end member mixing analyses suggested there were predominantly only two distinct water sources evident in the drain flow (Figures 89-92). The lower uncertainty for end member mixing analysis (EMMA) conducted with [Cl^-] reflects of the large difference between pre-event and rainfall concentrations and the associated large variation in drain concentrations (Genereux, 1998). Peak flows were comprised of between 0 - 70% of pre-event water.

Groundwater sits close to pre-event drain water in biplots for Events 1 and 2, with similar $\delta^{18}O$ and [Cl^-] in both sources. Pre-event drain water tended to have much higher [Cl^-] than groundwater for Events 3 and 4 while also displaying similar $\delta^{18}O$ and $\delta^{2}H$, suggesting the possibility of a third significant source during the event, namely a rapidly responsive (to rainfall) groundwater source. This is likely groundwater that was sitting in or adjacent the drain just prior to a rainfall event. Despite this, the two-component EMMA provided similar patterns of event water in the drain during events for each of the three tracers. The three-component mixing analysis suggests Event 3 may have had a significant within-event groundwater contribution of the order of 10 – 30% but only a minor contribution in Event 4 (Figure 93). As pre-event drain water in events 1 and 2 were chemically similar to groundwater it was not possible to distinguish any within-event groundwater contribution using these tracers. Nevertheless, a significant groundwater contribution to flow during an event appears to be possible and may be a source contributing to pollutant loads during rainfall events, in addition to the pre-event load stored in the drainage system prior to the event. Alternatively, there may have been some heterogeneity of water stored in the drainage network prior to the event. For example, the open section of Chapman St Drain, west of Guildford Rd may have evaporatively enriched and then moved as a pulse of water with contrasting chloride concentration during the rain event.

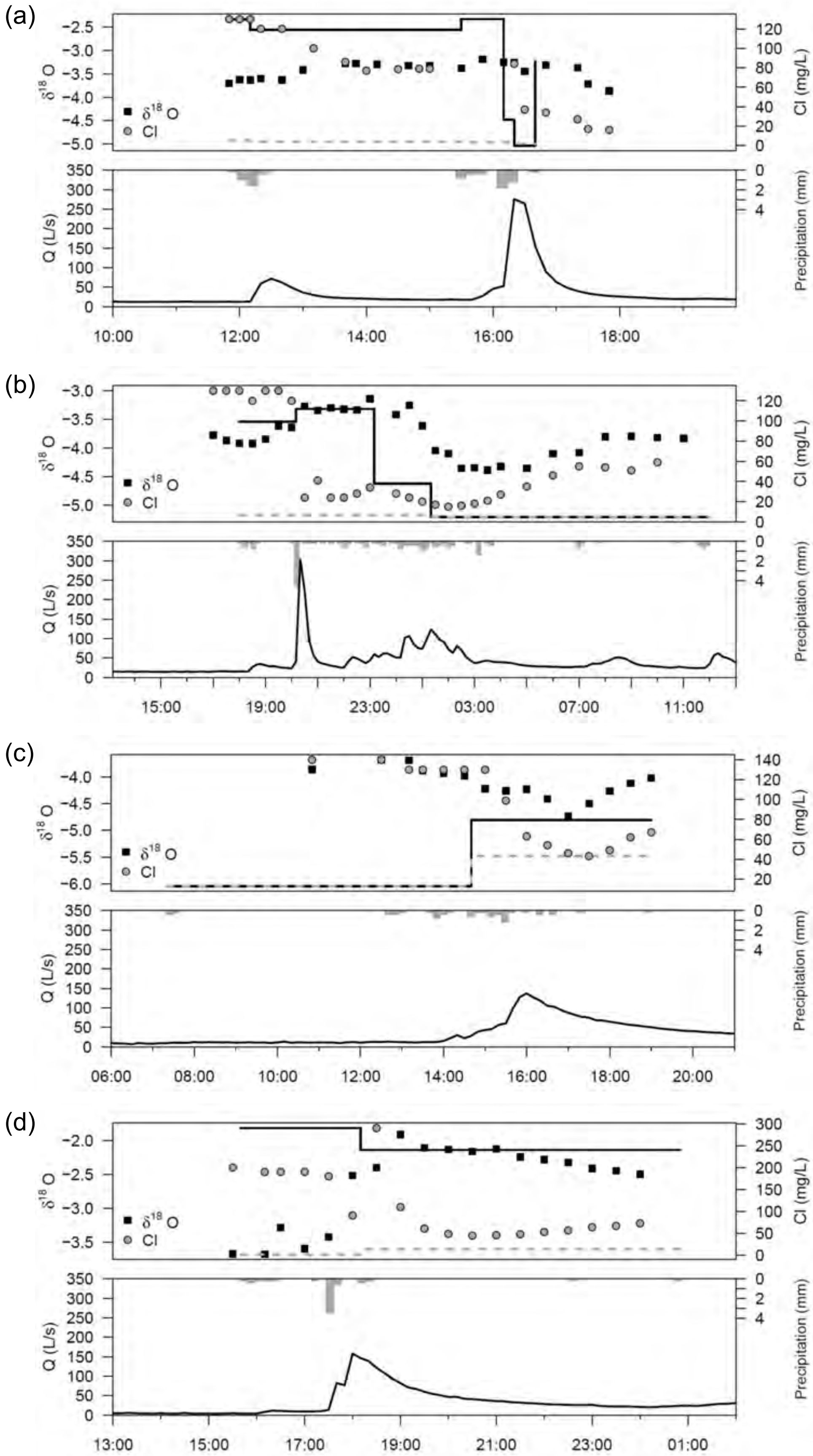


Figure 88: Runoff, rainfall, and concentrations of chloride and $\delta^{18}O$ in rainfall and runoff at Chapman St Drain for events 1 to 4 (a – d). Lines denote the collection interval and concentration (dark solid line $\delta^{18}O$; dashed gray line Cl^-) in rainfall. Points denote the drain concentration.

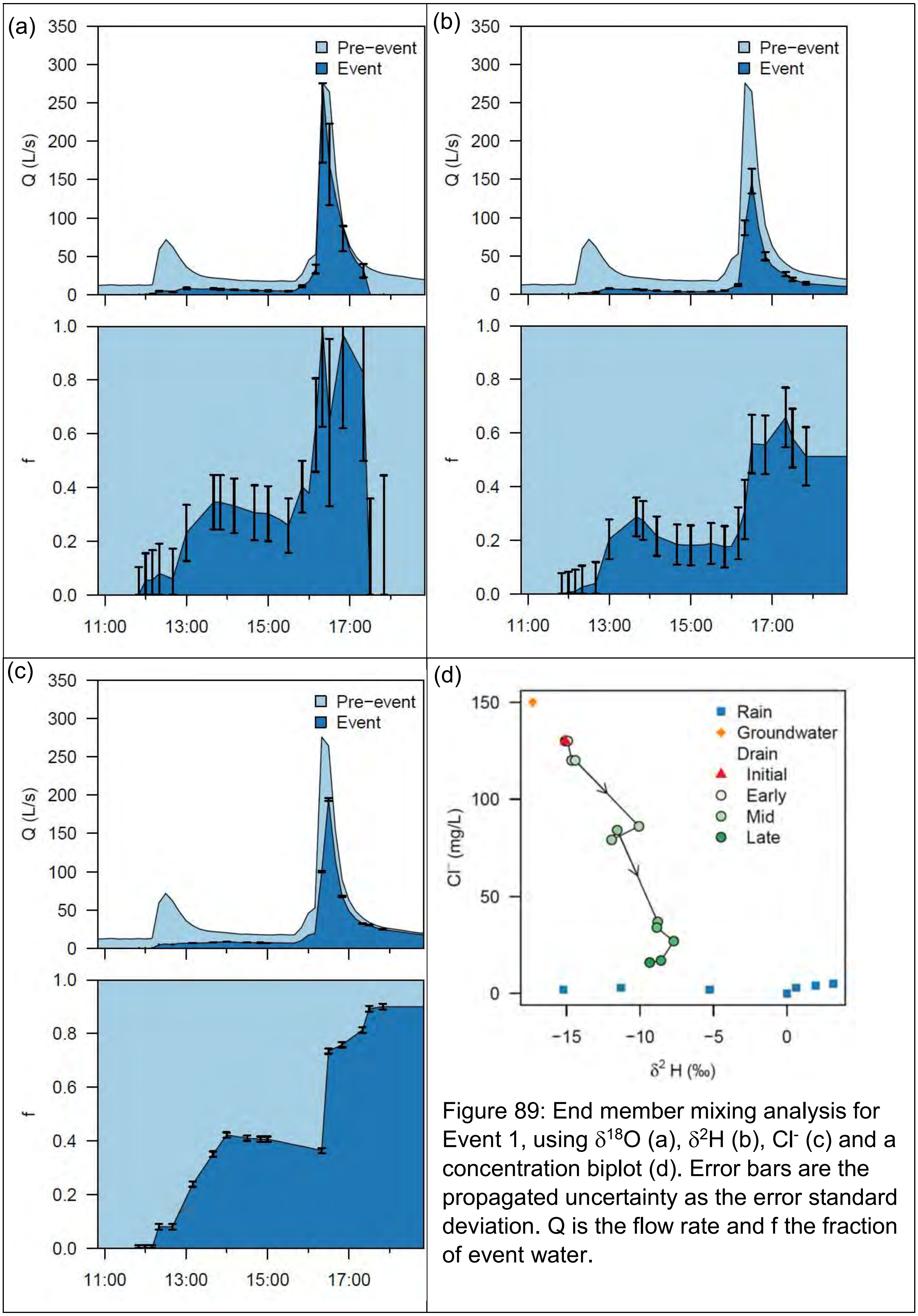


Figure 89: End member mixing analysis for Event 1, using $\delta^{18}O$ (a), $\delta^{2}H$ (b), Cl^{-} (c) and a concentration biplot (d). Error bars are the propagated uncertainty as the error standard deviation. Q is the flow rate and f the fraction of event water.

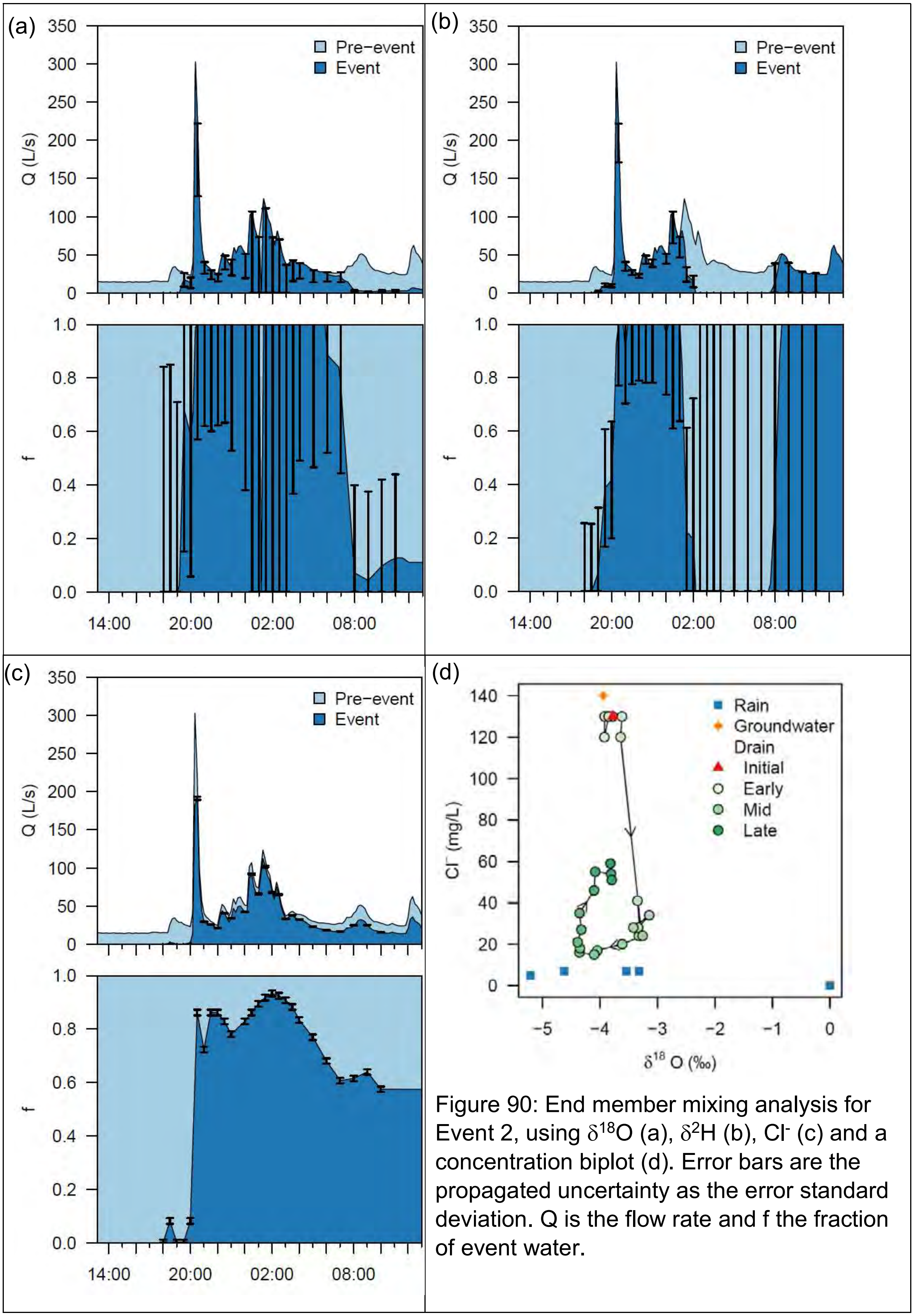


Figure 90: End member mixing analysis for Event 2, using δ^{18}O (a), δ^{2}H (b), Cl^{-} (c) and a concentration biplot (d). Error bars are the propagated uncertainty as the error standard deviation. Q is the flow rate and f the fraction of event water.

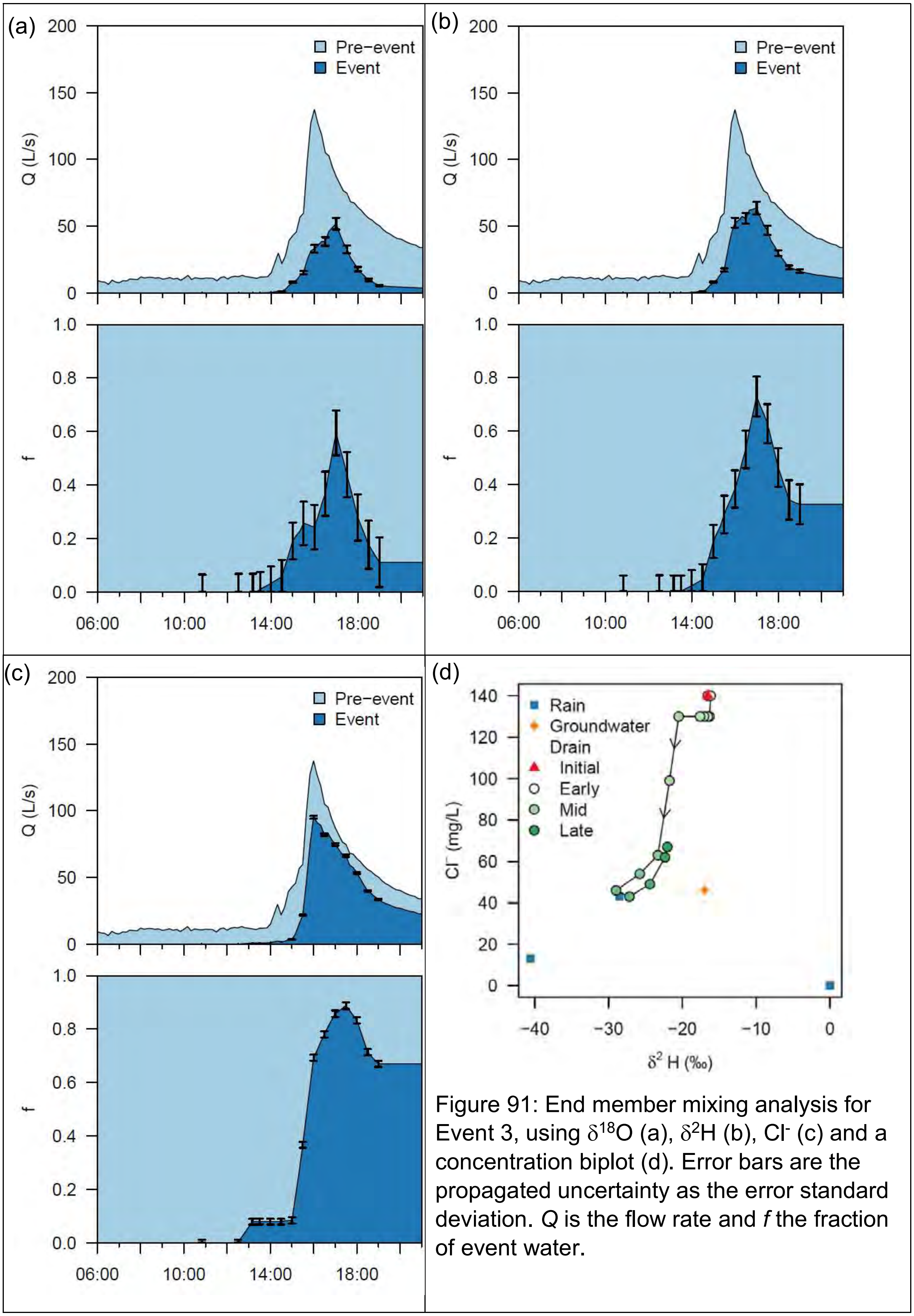


Figure 91: End member mixing analysis for Event 3, using $\delta^{18}O$ (a), $\delta^{2}H$ (b), Cl^{-} (c) and a concentration biplot (d). Error bars are the propagated uncertainty as the error standard deviation. *Q* is the flow rate and *f* the fraction of event water.

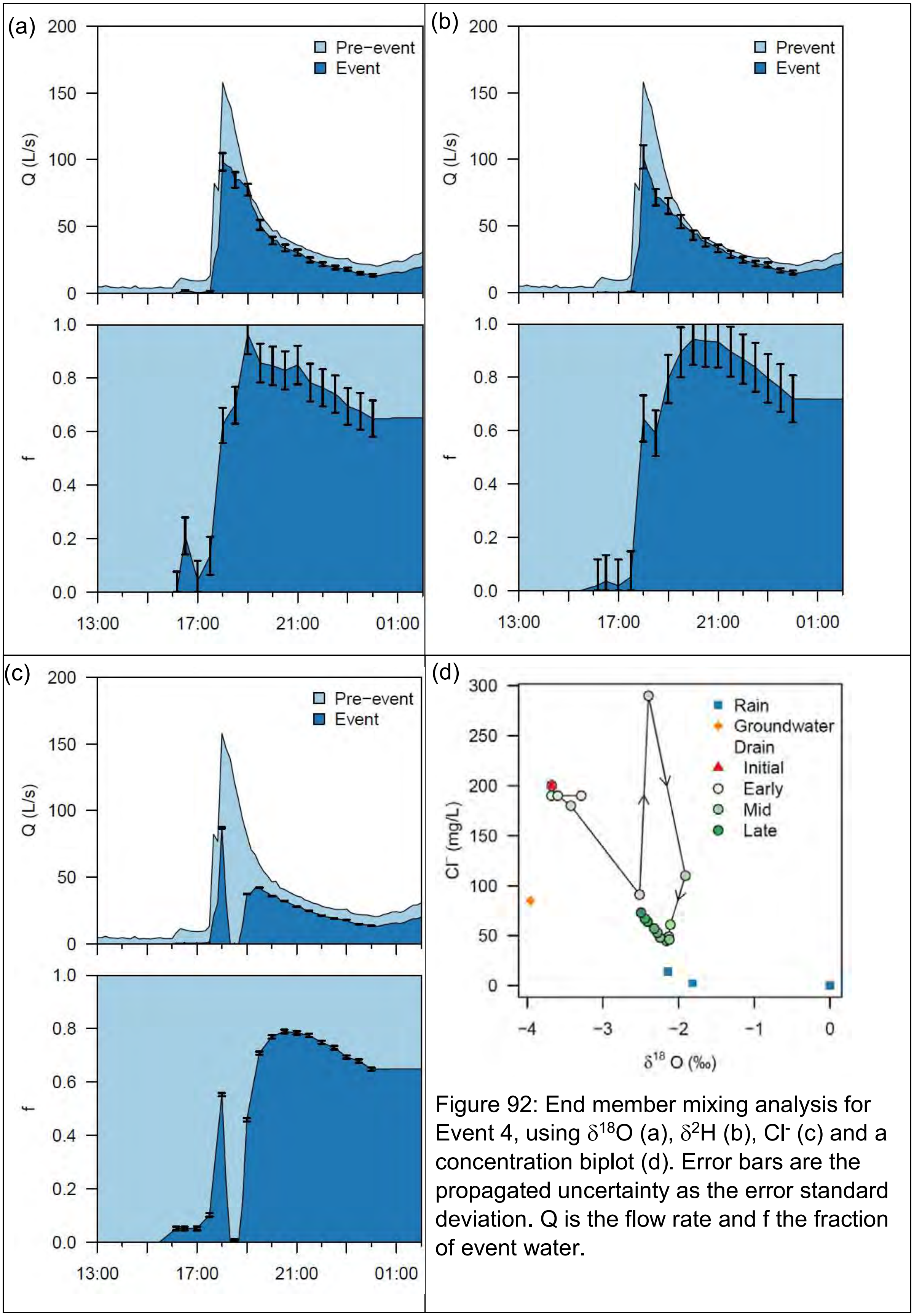


Figure 92: End member mixing analysis for Event 4, using $\delta^{18}O$ (a), $\delta^{2}H$ (b), Cl^{-} (c) and a concentration biplot (d). Error bars are the propagated uncertainty as the error standard deviation. Q is the flow rate and f the fraction of event water.

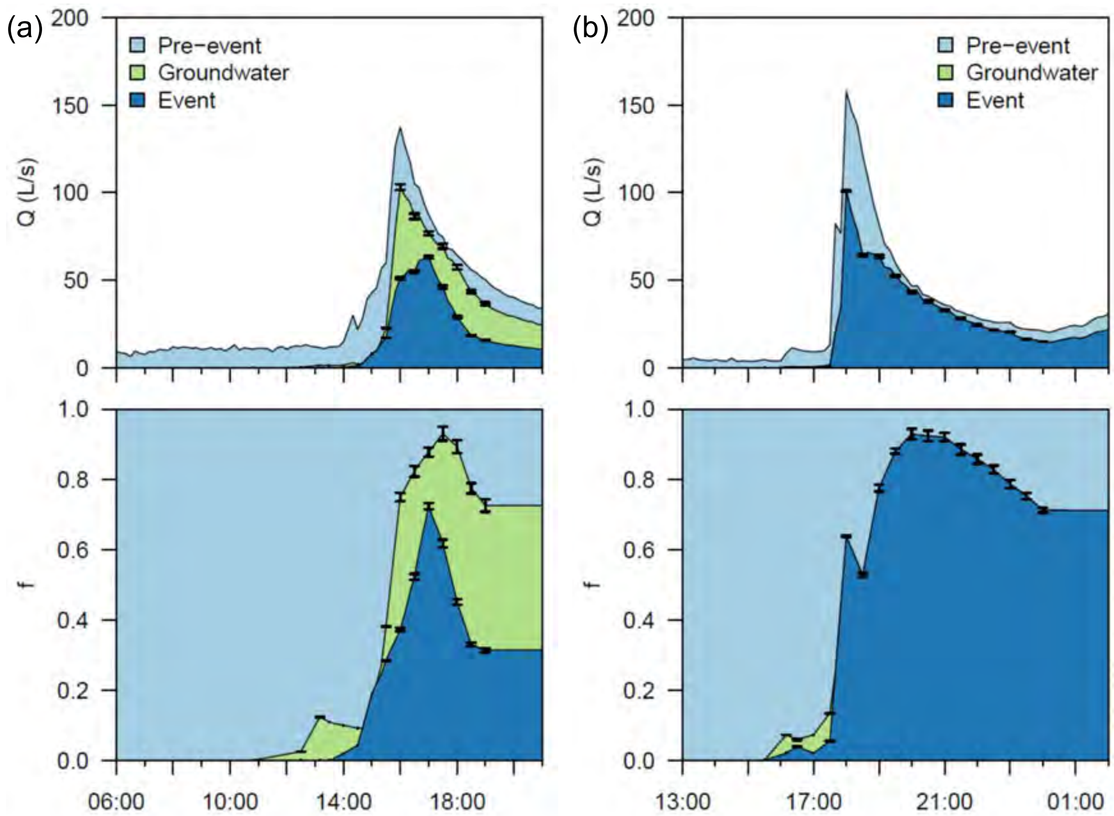


Figure 93: Three component end member mixing of Event 3 (a) and Event 4 (b). Q denotes drain flow rate and f the cumulative fractional contributions of end members.

6.3 Summary

The major ion and water isotope analyses provided further qualitative information in support of the conceptual groundwater model of the site. That is fresh groundwater entering the site becomes progressively more saline. The shallow groundwaters in the wetland are less enriched in the heavy water isotopologues due to mixing with brackish water flooding from the Swan River and during evaporative drying in spring and summer. Reflooding of hypersaline sediments and shallow groundwater drives increased salinity deeper into the aquifer.

The major ion and water isotope analyses also show that the Woolcock Ct Drain is contributing significantly to water storage in the wetland at SW03, leading to fresher conditions. This corroborates the modelling of the urban hydrology and modelling of wetland water levels which described the potential for a significant contribution from the drain.

The source of baseflow in the drains is groundwater of similar character as measured at MW04s, MW06 and MW07. The hydrograph separation for the Chapman St Drain also showed that groundwater and pre-event drain water were mostly of a similar composition. This pre-event water was a significant component of runoff during rainfall events.

While the measured groundwaters do not have high concentrations of metals, the groundwater intercepted by the drains, likely further to the west, do appear to have high concentrations of metals, notably, aluminium, cobalt and zinc. Lead and copper are also prevalent in stormflow in the Chapman St drain. The highly depleted sulfur isotopes in upgradient groundwater, and particularly in the Woolcock Ct drain, indicate the source of metals may be associated with an acidic groundwater plume from fertilizer manufacture. This plume is likely also be transporting metals to the site or liberating them from in situ wetland sediments (Section 7).

The oxygen and sulphur isotopes in sulphate together with the water isotopes and the sulphate to chloride ratio together describe the processes contributing to the oxidation and reduction of sulphur through the system. The sulphur isotope enriches in groundwater from an initially depleted state suggestive that reduction is occurring however sulphate concentrations do not decrease along a flow path through the wetland as one would expect if this were the case. Consistent with the conceptual hydrological model the lack of a trend in sulphate this is likely due to repeated rejuvenation from sulphate rich estuarine flood water and evaporative concentration in surface waters which recharge groundwater.

7 Sediment Geochemistry

Management of urban drainage or other activities that may disturb the soils at the site need consideration of the sediment geochemistry. Acid sulfate soils (ASS) are naturally occurring soils that make up 12-13 million ha of coastal lowland areas worldwide (Morgan et al., 2012). Ashfield Flats is known to contain acid sulphate soils (ASS; Loos, 2003). When exposed to oxygen, iron sulfides in these soils react to produce sulfuric acid that spreads through the soil, lowering pH, and enabling the mobilisation of ionic forms of iron, aluminium, and a range of trace elements including the rare earth elements (REE).

The REE, or lanthanides (elements 58 to 71, La to Lu, and commonly including element 39, Y) are a group of chemically similar elements. They all exist as trivalent cations in natural environments; in addition, cerium (Ce) is stable as Ce(IV) in more oxidising environments, and europium (Eu) exists as Eu(II) in reducing environments. Their chemical properties show consistent trends partly related to their consistent decrease in ionic radius as atomic number increases. Rare earth elements have been shown to be released in significant amounts from oxidising acid sulfate soils (Åström, 2001; Morgan et al., 2012; Xu et al., 2018). The receiving environments for acid sulfate drainage, such as streams or drains, consequently become enriched in REE. The REE can therefore represent a tracer of the impact of acid sulfate oxidation on receiving environments.

The spatial distribution of metals, and REE, and sulphur were evaluated at Ashfield for the purpose of characterizing the sediments, assessing the degree of acid sulphate soils and to evaluate the impact of anthropogenic activities leading to metal accumulation in the wetlands.

7.1 Methodology

7.1.1 Acid Sulphate Soils Assessment

The consultants, RPS, were engaged to conduct an acid sulphate soils survey in June 2020. Sampling and laboratory analysis were conducted following DWER guidelines, albeit with a lower density than recommended as acid sulphate soils were known to occur on site and specific future management objectives for the site had not been specified (DWER, 2015). Details of the sampling and analysis procedures can be found in the report (RPS, 2020; see Appendix 2). A summary of the report is described in the results.

7.1.2 Sediment Sampling and Analysis

Sediment sampling was conducted by UWA in March 2019 and March 2020 (Figure 94). In March samples were collected from the Chapman St and Kitchener St drains as well as transects across SW01, SW05, and SW07. More detailed sampling of sediments in SW03, SW05 and SW02/SW04 was conducted in March 2020.

The electrical conductivity (EC; approximates soluble salt content) of sediment and soil samples was determined on 1:5 solid to deionised water suspensions using a calibrated conductivity cell electrode. The pH was measured on the same suspensions using a glass-reference pH electrode after a 2-point buffer calibration (Rayment and Lyons, 2010).

The concentrations of 28 elements (Al, As, Ba, Ca, Cd, Ce, Co, Cr, Cu, Fe, Gd, K, La, Li, Mg, Mn, Mo, Na, Nd, Ni, P, Pb, S, Sr, Th, V, Y, Zn) were measured on samples by inductively-coupled plasma optical emission spectrometry (ICP-OES) following digestion of sediment and soil in concentrated nitric and hydrochloric acids (i.e. aqua regia) at ca. 130 °C (U.S. EPA, 2007). Before acid digestion, samples were ground to ≲ 50 µm using ceramic mortars and pestles. Reagent blanks, and grinding blanks composed of acid-washed silica sand, were included in analytical runs to check for contamination. A standard reference material, stream sediment STSD 2 (Lynch, 1999), was analysed in the same ways as samples to assess analytical accuracy. Measurement precision was assessed using analytical duplicates on approximately 10% of samples.

7.1.3 Statistical Analyses

The lower limits of analytical detection were calculated, where possible, from 3 × the standard deviation of reagent blank concentrations (Long and Winefordner, 1983). Concentrations lower than mean blank values, or below calculated lower detection limits, or both, were deleted from the dataset. Statistical and graphical analyses of data were performed in the statistical computing environment 'R' (R Core Team, 2019) and associated packages, in particular 'car' (Fox and Weisberg, 2019). Skewed variables (identified with the Shapiro-Wilk test for normality) were log10-transformed and re-checked for normality. A general inability of variables to be transformed to yield normal distributions, even when transformed, dictated the use of the non-parametric Kruskal-Wallis tests for mean comparisons. If the Kruskal-Wallis test showed a significant difference, the R package 'PMCMRplus' (Pohlert, 2018) was used to apply the post-hoc Conover test for pairwise comparisons of mean rank sums. Standardised effect sizes were calculated as Cohen's d for pairwise comparisons. Bivariate and multiple regression models were fitted using the log10-transformed variables. Multiple regression models were refined by omission of collinear predictors (based on Pearson correlations and variance inflation factors) and by backward-forward selection to maximise the Aikake Information Criterion. Post-hoc checks using the Shapiro-Wilk test were used to verify normally distributed regression residuals. The potentially misleading effects of compositional closure were addressed using transformations to centred log-ratios (Reimann et al., 2008), which were used for correlation and principal components analyses.

Rare earth element data were analysed as appropriately transformed concentrations, and also as ∑REE (the sum of individual Ce, Gd, La, Nd and Y concentrations). Normalised REE concentrations were calculated by dividing measured element concentrations by the concentrations in the Post-Archean Australian Shale reference material (PAAS) given by Taylor and McLennan (1985).

Figure 94: Surface sediment sampling locations.

7.2 Results

7.2.1 Acid Sulphate Soils

Soil sampling predominately encountered as a mixture of brown clayey sands, sandy clays, and sands, overlaying, grey clays to a depth of 1.5 m below the surface. Sediments along the drains consisted of black silts and silty sands, overlying dark grey clays (McDonald et al., 2009). The soil texturing based upon particle size separation is consistent with the hand texturing conducted on drill cores as part of the groundwater monitoring program.

As expected, the site contains actual acid sulphate soils and potential acid sulphate soils (RPS, 2020). From a total of nine surface water sampling locations pH was observed in the range 6.7 to 7.3, EC in the range 0.14 – 17 mS cm^{-1}. The sediment samples had field pH values in the range of 3.4 to 7.9. The net acidity of soil types, with the exception of shallow soils along the western boundary, exceeded the relevant DWER action management criteria. Surficial soils along the western boundary, external to the wetland/vegetated areas do not require management with respect to ASS.

PASS have been identified within sediment along the length of the Chapman St Drain. The PASS is predominantly in the form of pyrite although isolated pockets of potential mono sulphidic black ooze (MBO) were present in the drain based upon the acid volatile sulfur concentrations and visual observations.

7.2.2 Sediment Sampling

A significant positive relationship between iron and sulphur was found across all sites (Figure 95, $p<0.001$, $R^2 = 0.13$) however, when separated by wetland zone, the relationship was strongest for the SW03 wetland (i.e. S ~ 1.97 Fe - 5.07, with concentration units of mg kg^{-1}, $p<0.002$, $R^2 = 0.37$) and not significant for SW02, SW04, and SW05. The strong relationship at SW03 is consistent with sulfate reduction and formation of FeS and/or FeS_2 in the sediments there.

Significant relationships between iron were also found with phosphorous (P ~ 1.43 Fe – 3.86 with concentration units of mg kg^{-1}, $p < 2 \times 10^{-16}$, $R^2 = 0.64$) and arsenic (Figure 95, As ~ 1.31 Fe – 5.06 (mg kg^{-1}), $p < 2 \times 10^{-16}$, $R^2 = 0.86$). Wetland zone SW02/SW04 had a weak interaction only for phosphorous ($p<0.1$). Since the Fe-S relationship is only significant for the SW03 wetland, the relationships of P and As with Fe are likely to represent adsorption of phosphate and arsenate on Fe oxyhydroxides and subsequent release during periods of oxidation. It's possible that arsenopyrite exists though, and we know of its existence on the Swan Coastal Plain from the Stirling acid sulfate soils (Appleyard et al. 2004).

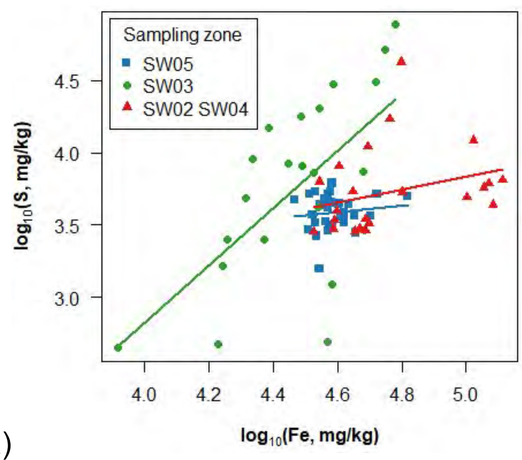
Table 27: Mean concentrations of elements in wetland sediments.

Element	SW05	SW03	SW02, SW04	Element	SW05	SW03	SW02, SW04
pH	5.91	6.57	5.65	Li	43	25	27
EC	7,834	13,650	21,880	Mg	5,785	2,319	7,449
Al	45,430	27,340	33,530	Mn	96	104	312
As	8.2	7.6	21.0	Mo	1.8	3.6	3.9
Ba	59	44	79	Na	15,370	3,033	29,390
Ca	5,085	6,613	5,518	Nd	61	20	29
Cd	0	0.09	0.04	Ni	28	13	21
Ce	175	53	69	P	580	368	1,522
Co	16	24	21	Pb	54	32	57
Cr	69	39	54	S	3,998	13,810	7,246
Cu	216	28	172	Sr	70	46	106
Fe	39,120	32,810	64,150	Th	17.27	9	13.65
Gd	11.2	4.2	6.6	V	78	48	80
K	4,070	1,461	3,285	Y	41.4	10.9	16.6
La	86	28	41	Zn	334	1,552	419

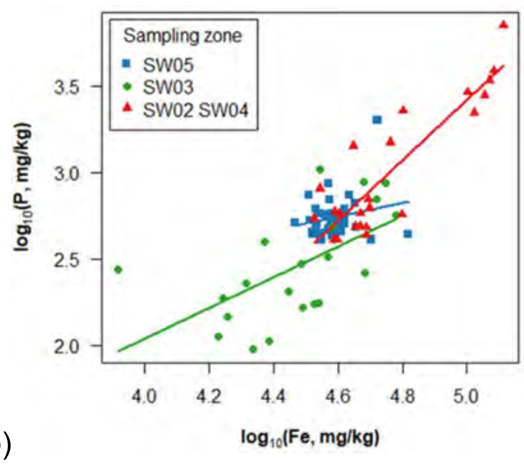
Concentrations as mg kg^{-1} except for electrical conductivity (EC in $\mu S\ cm^{-1}$) and pH (pH units).

Mean values of pH, EC, metals and REEs are summarized in Table 27 and the distributions of values are shown in Figures 96-98. Wetland SW05 was found to have the largest mean concentrations ($p<0.05$) of several of the REEs and metals i.e. Al, Ce, Cr, Cu, Gd, K, La, Li, Nd, Ni, Th, Y. While wetland SW03 had the highest mean concentrations ($p<0.05$) of Ca, Co, and Zn. The SW02 SW04 wetlands (and the associated Chapman St side drain) have greatest mean EC and mean concentrations of As, Ba, Fe, Mg, Mn, Mo, Na, P, Pb, and Sr and V which is also similar in SW03, and lowest pH, but this is not significantly different from SW05.

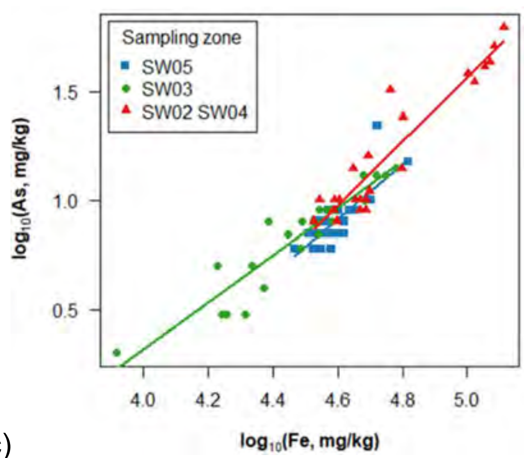
Most samples contained zinc concentrations (74 of 78) that exceeded the ISQG-Low level, and 33 samples exceeded the ISQG-High level (Table 28). The high exceedances were mostly in wetland SW03, but high Zn is widespread. Most (56 of 78) samples contained copper concentrations exceeding ISQG-Low, and 8 samples exceeded ISQG-High, 6 in the SW05 wetland, and two in the SW02 SW04 zone. Many samples exceeded ISQG-Low levels for As, Pb, and Ni, but no samples exceed ISQG-High. The greatest numbers of samples exceeding ISQG-Low for Ni and Pb are in the SW05 wetland, and As has most samples exceeding ISQG-Low in the SW02 SW04 zone.



(a)



(b)



(c)

Figure 95: Iron relationships with sulphur (a), phosphorus (b), and arsenic (c) in wetland sediments.

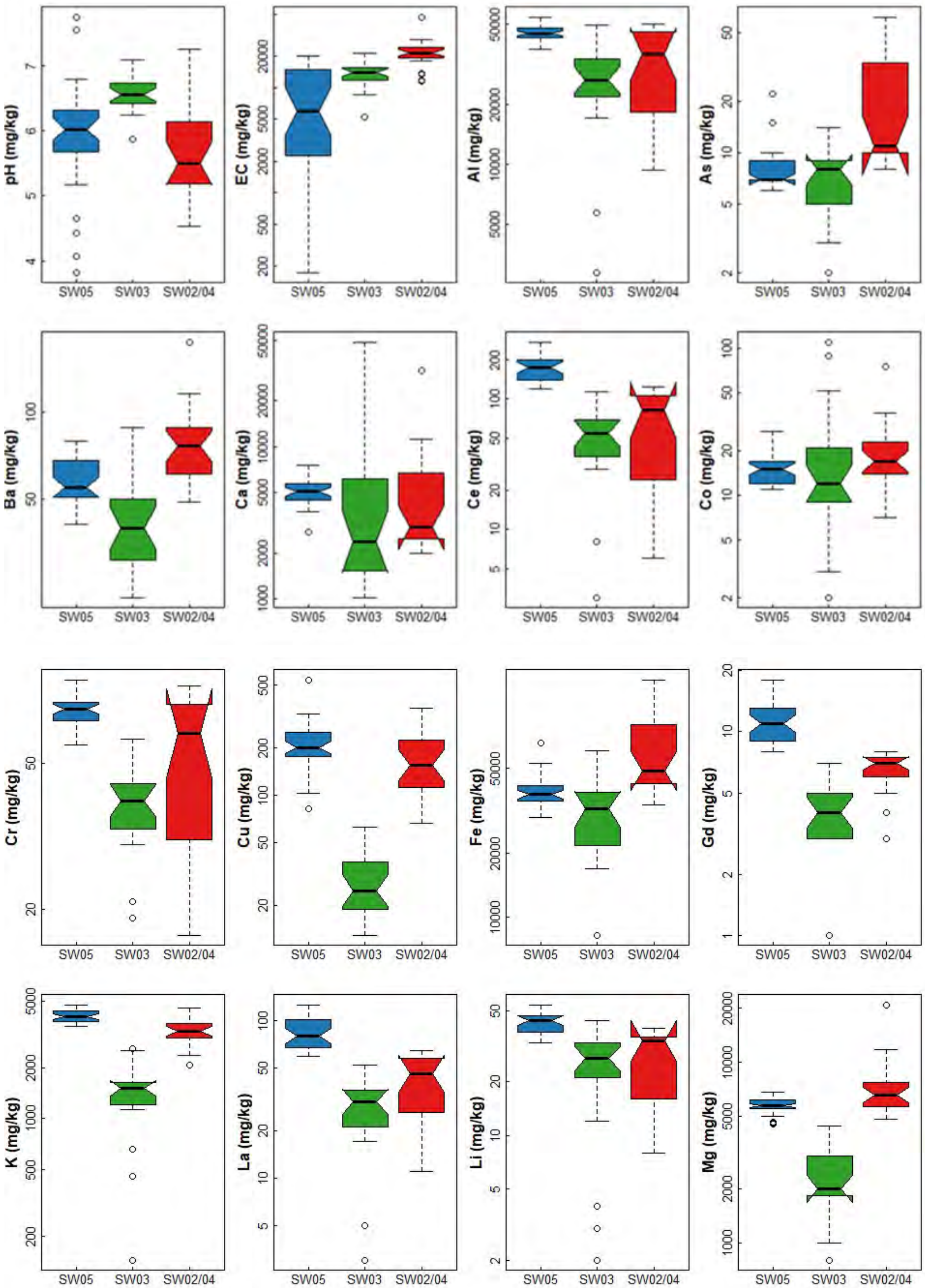


Figure 96: Distributions of pH, EC, metals and REEs across wetlands. Box-plots show the median (black line), the interquartile range (box), the 95% range (error bars) and outliers of the distribution (circles).

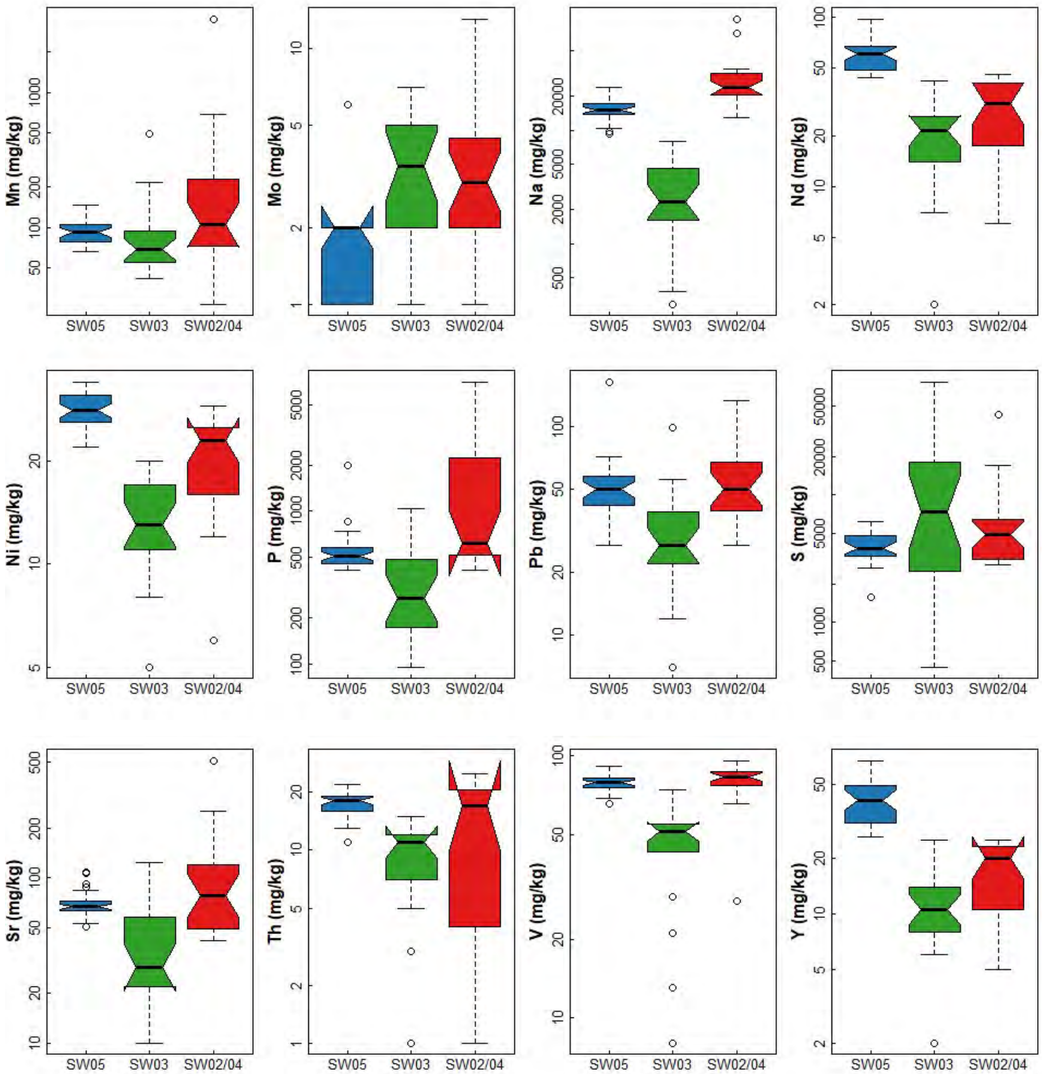


Figure 97: Distributions of metals and REEs across wetlands. Box-plots show the median (black line), the interquartile range (box), the 95% range (error bars) and outliers of the distribution (circles).

Table 28: Number of samples exceeding Interim Sediment Quality Guidelines (ISQG) high (H) and low (L) concentrations.

	ISQG (mg kg^{-1})		SW05		SW03		SW02 SW04	
Element	L	H	L	H	L	H	L	H
As	20	70	1	0	0	0	8	0
Cd	1.5	10	0	0	0	0	0	0
Cr	80	370	1	0	0	0	1	0
Cu	65	270	33	6	0	0	23	2
Pb	50	220	15	0	2	0	11	0
Ni	21	52	33	0	0	0	13	0
Zn	200	410	31	5	20	17	23	11

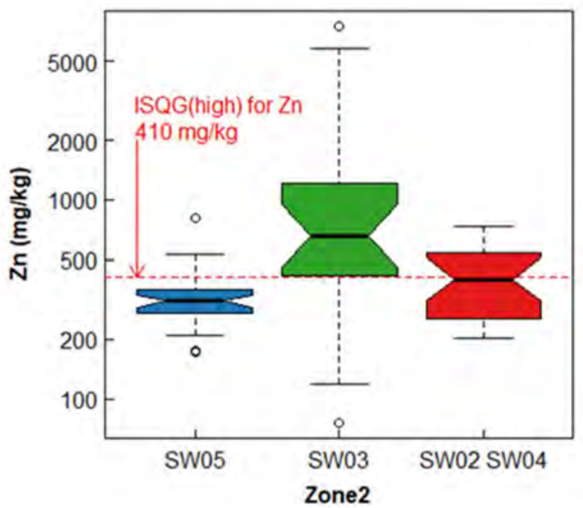
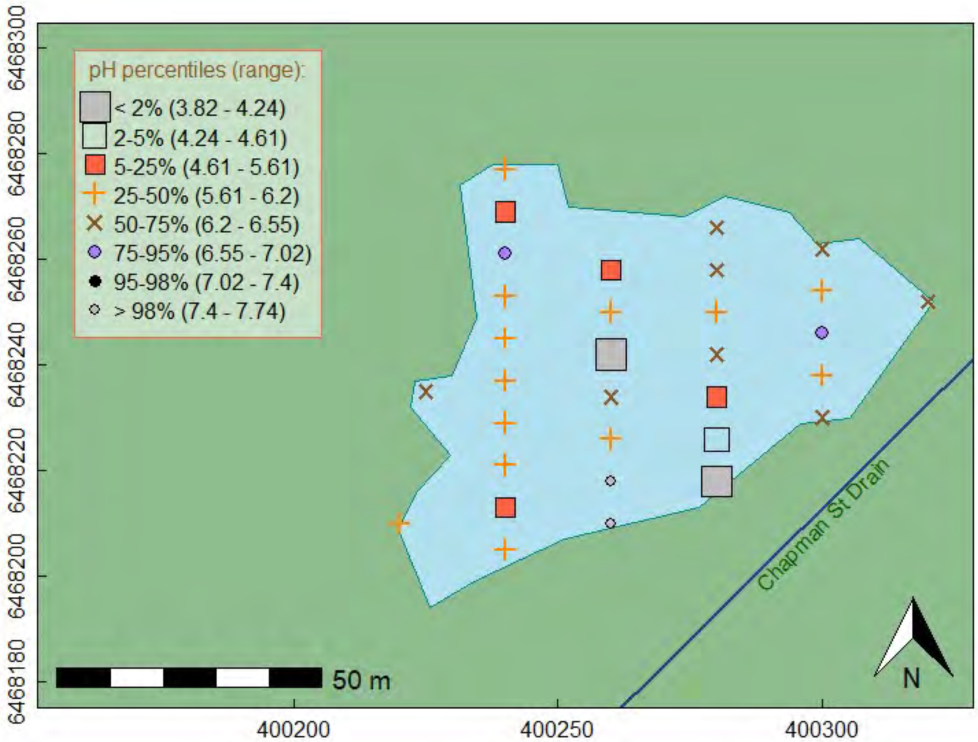


Figure 98: Distribution of Zn in wetland sediments and the ISQG high concentration.

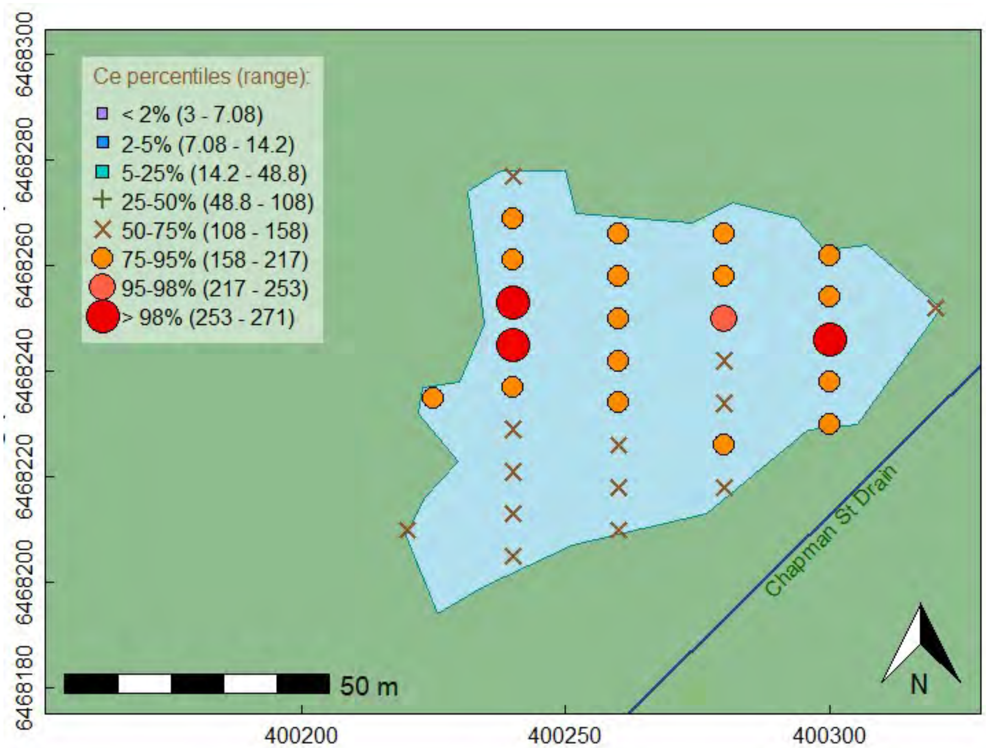
The high concentrations of Ce in the sediments of the SW05 wetland show a spatial distribution with highest values in the northern half of the wetland (Figure 99). For comparison, the commonly used Post-Archean Australian Shale (PAAS), supposedly representative of mean continental crustal concentrations, has Ce = 80 mg kg^{-1} (Taylor & McClennan 1985), whereas the mean Ce concentration in SW05 is 175 mg kg^{-1} (median 172 mg kg^{-1}).

There is large spatial variation, of Zn within SW03 (Figure 100), which had the highest concentrations of Zn of the three areas sampled. The minimum Zn concentration measured in 2020 was also found in SW03. There is a tendency for the greatest Zn concentrations to cluster near the outlet of the Woolcock Court drain. The map of the spatial distribution of S also shows high concentrations of S in the surface sediments near the outlet of the Woolcock Ct drain. Consistent with the previous water quality analyses it is possible that sulfate contaminated groundwater is being reduced in the organic carbon rich wetland sediments. If this the case, then the Zn is likely to be present in a sulfide and therefore prone to release if the sediment dries and oxidizes. Significant [Zn] can also be seen in the sediments of the Kitchener St Drain (Figure 101) and there are relatively high [S] along the Kitchener St and Chapman St drains as well as SW01.

Relatively high concentrations of REEs and Al can be found in the sediments of SW05 (Figure 103). Across the range of concentrations rare earths show a strong linear relationship ($p < 1e\text{-}16$) with Al (Figure 104) and Li (not shown). The slopes of the linear relationships between REE and Al are similar when grouped by SW05 and the remainder however the intercept is higher for SW05 samples indicating some accumulation of REEs above that seen elsewhere.



(a)



(b)

Figure 99: Spatial distributions of pH and Ce in SW05.

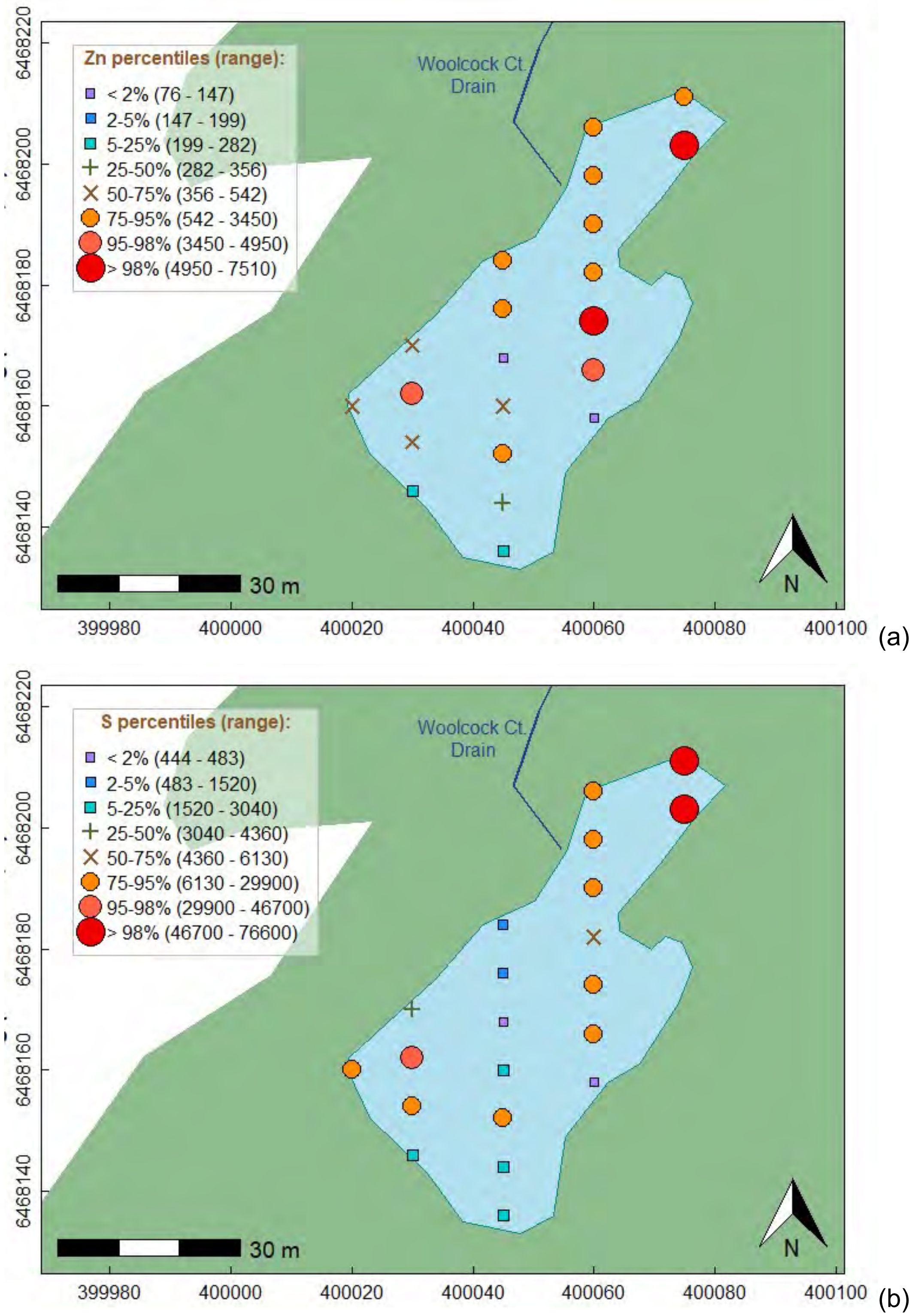


Figure 100: Spatial distributions of Zn (a) and S (b) in SW03.

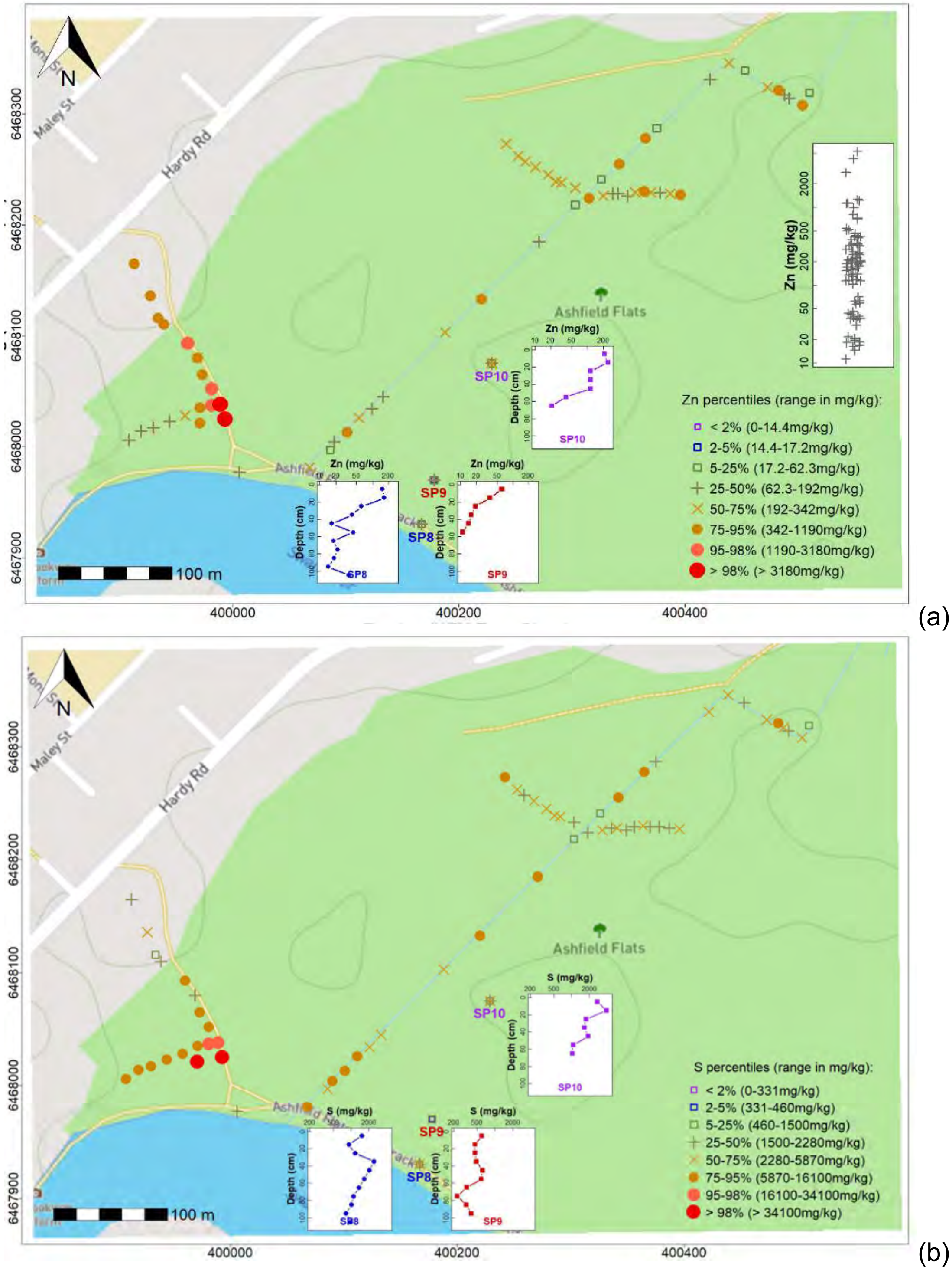


Figure 101: Spatial distributions of Zn (a) and S (b) along the Kitchener St Drain, Chapman St Drain, SW01, SW05, and SW07.

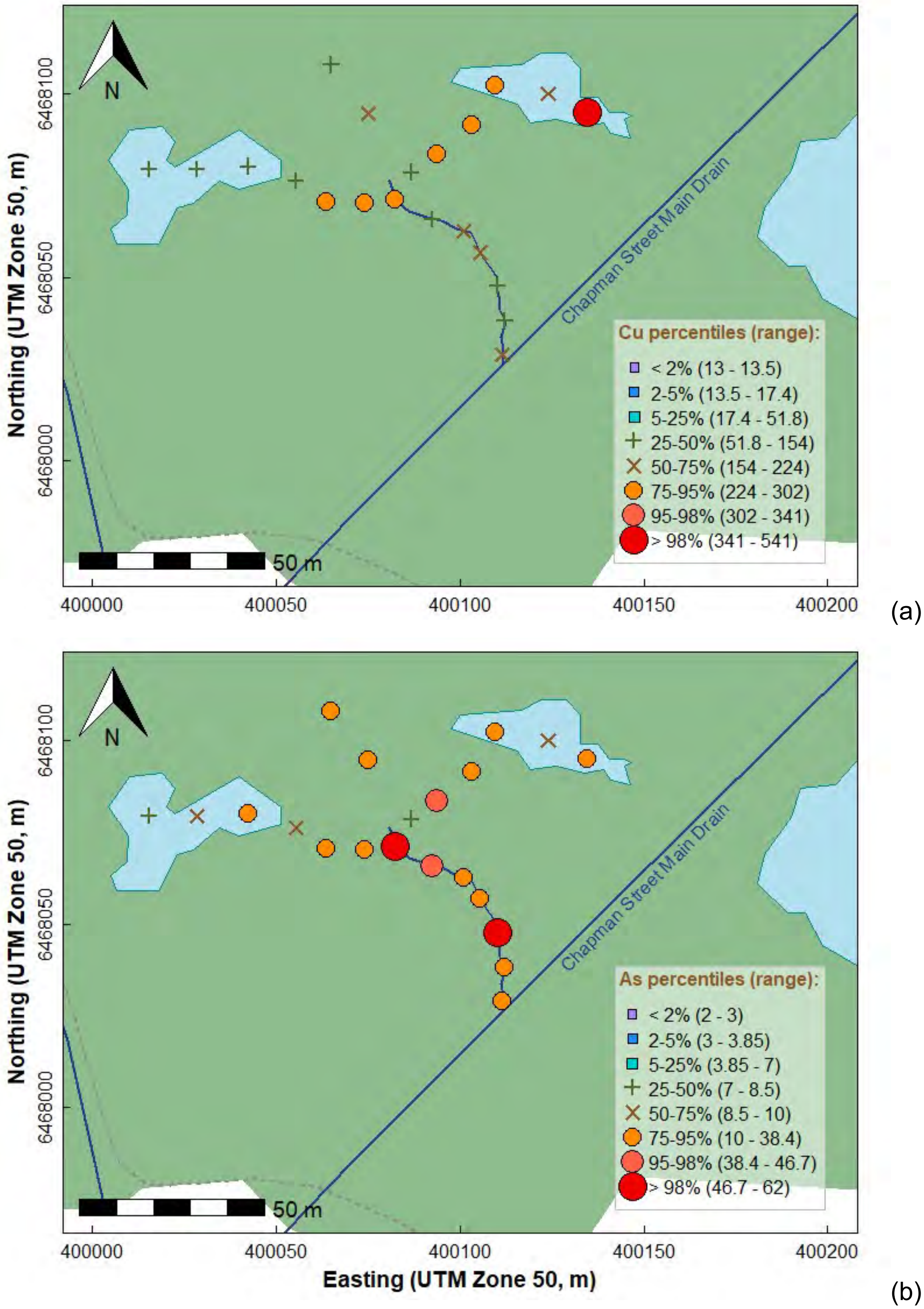


Figure 102: Spatial distribution of Cu and As in SW02, SW04.

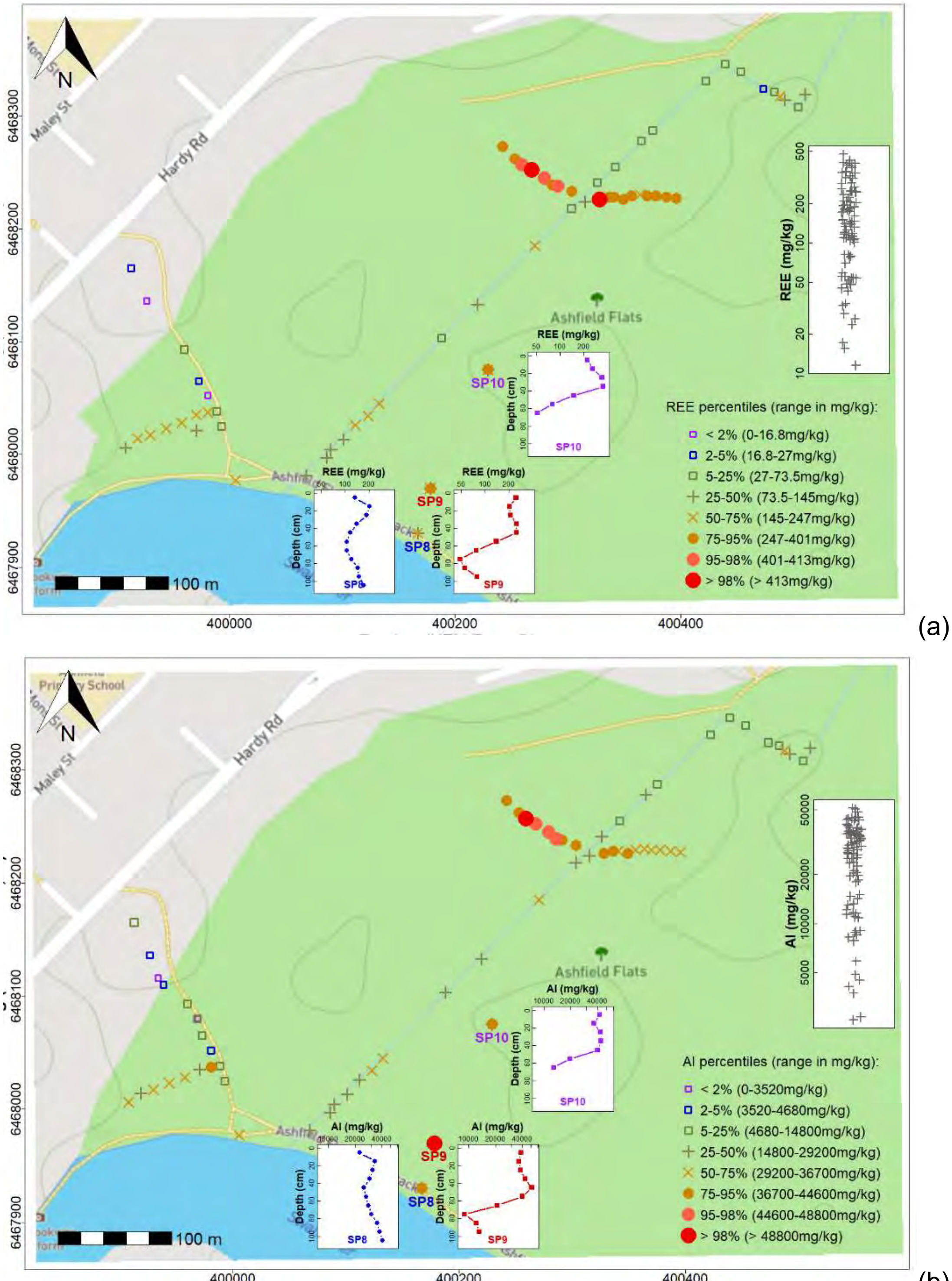


Figure 103: Spatial distributions of REE (a) and Al (b) concentration percentiles from the March 2019 sampling.

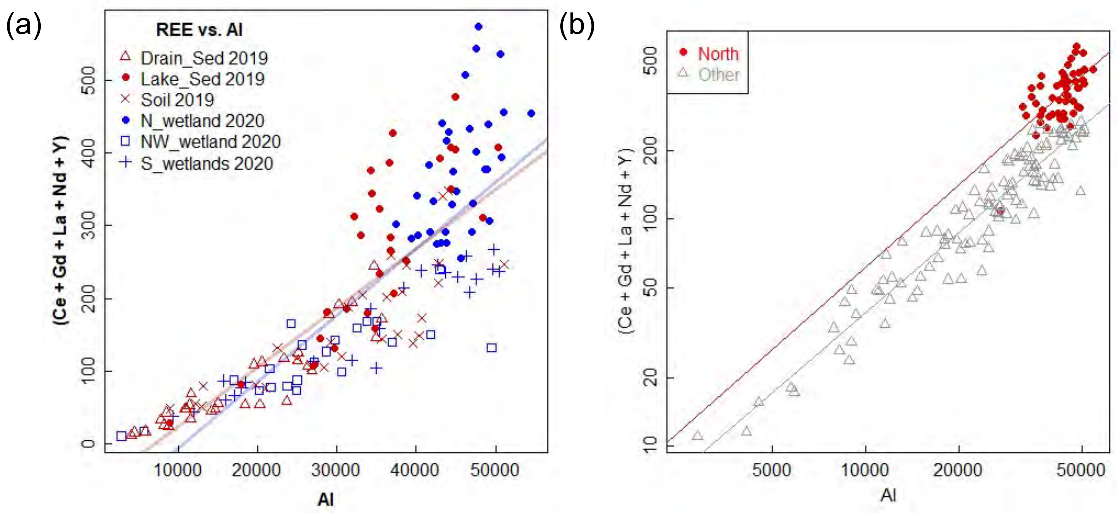


Figure 104: Relationship between Al and REE (a), Al and separated by location (b). North refers to SW05.

The first three principal components explained 43% (PC1), 16% (PC2), 8% (PC3) of the variance in the data. Biplots (Figure 105) show separation of elemental concentrations by sampling zones of the geochemical principal components. The PC1-PC2 biplot suggests association, in SW05 samples, of REE with major elements Al and K, possibly representing clays or residual primary silicates, and trace elements Th. The PC1-PC2 biplot also implies a Zn-Mo-S association for SW03 wetland samples, consistent with high Zn and reduced conditions observed, but the observations are spread out in PC1-PC2 space and there is also a possible Fe-Ba-Co association.

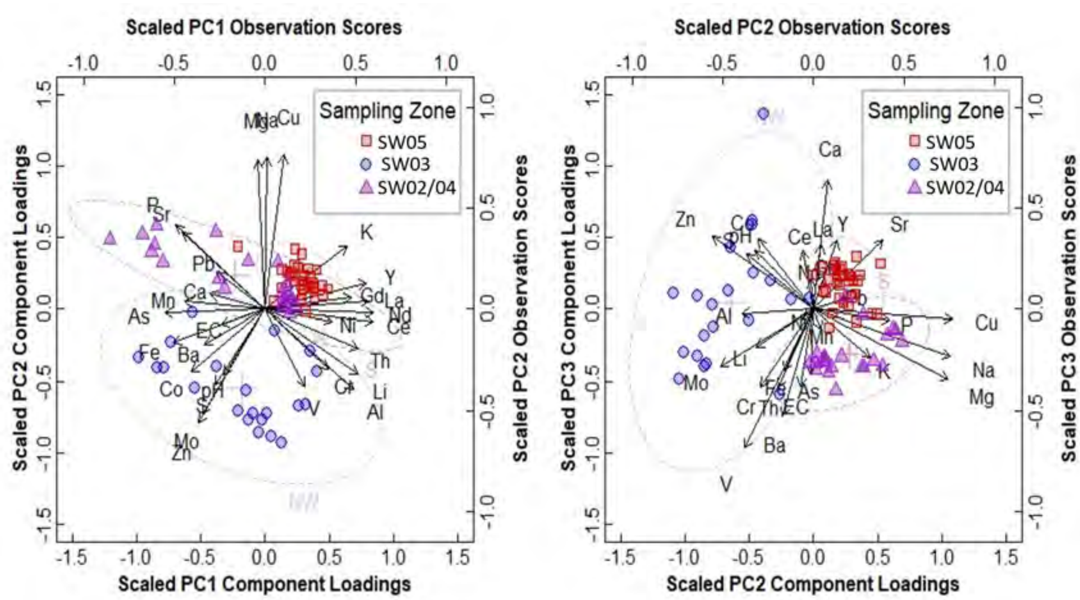


Figure 105: PCA biplots of sediment metal and REE elements. Ellipses are the 95% confidence region of wetland zones.

The PC2-PC3 biplot has a weaker REE-Ca-Sr association for SW05 samples, so potentially carbonates are involved in REE accumulation. The SW03 wetland sample cluster is broad though looks to have a Zn-Co-pH association. The SW02, SW04 wetland samples seem to be dominated by a high Na and Mg association that likely reflects more regular interaction of estuarine water.

7.3 Summary

Soil sampling confirmed the near-surface wetland sediments comprise a mixture of brown clayey sands, sandy clays, and sands, overlaying, grey clays to a depth of 1.5 m below the surface. These wetland sediments and surrounding soils contain ASS and PASS that would require management if disturbed. The exception being the sandy soils in the parkland along the southwestern end of the reserve and the escarpment.

There was significant heterogeneity in the metals and S concentrations between drains and between surface water pools. The relationships between S and Fe in SW03 suggests that at the time of sampling the sediments were actively reducing sulphate to FeS or FeS_2 in sediments. This corroborates the conclusions from interpretation of the sulphur isotope analyses conducted on water samples.

SW03 was also a site where there was significant accumulation of S and Zn in sediments. The contaminated groundwater emanating from the Woolcock Ct drain is the most likely source of these elements. REEs also look to have accumulated in SW05. The source of these rare earths is not clear and could stem from historical dumping, surface runoff from nearby stormwater or possibly by stormwater overflowing the Chapman St Drain.

8 Conclusions

Ashfield Flats Reserve contains the largest remaining example of the threatened Temperate Costal Salt Marsh Community in the Swan and Canning Rivers Estuary. The key members of the ecological community are the various halophytes, species of *Tecticornia* and *Salicornia*. Amongst the treats to this ecological community are urban pollution and climate change induced sea-level rise.

This hydrological study evaluated components of the water balance at the site and related pressures from polluted groundwaters. The site floods frequently in response to river tides and, on occasion runoff events in the Avon River catchment. Tides dominate flooding of the ecological community and on average river levels exceed the flooding threshold 208 hours each year. The wetland however retains this flood water in its ephemeral pools for 26 weeks a year on average. During this time the surface waters evaporate and concentrate the originally brackish river water, drain inflow and groundwater to a brine. Some pools adjacent the river and in the southwestern part of the reserve are perennial. Urban drainage directly into the wetland, freshens surface waters, contributing to making some pools permanently inundated.

Modelling and data analysis suggests there is some minor downward flow of surface water into the groundwater system beneath the flats during high water periods, with some minor upward flow of groundwater during low surface water periods. Surface water exchange with the river and incident rainfall are the dominant water sources. Groundwater levels are also close to the surface at the flats varying in depth from 0 to ~1 m below ground surface seasonally. The groundwater system also looks to be semi-confined as evidenced by pressure heads at various depths in the aquifer, the deep portion of the aquifer’s responses to tides and atmospheric fluctuations and water chemistry reinforces this.

Modelling also suggests that locked-in sea-level rise poses a significant and increasing threat to the ecological community which the duration of inundation of ephemeral pools increasing from 30 weeks per year to 40 weeks per year by 2030 and being permanently underwater before 2090 under even low emissions scenarios. The present distribution of halophytes will be challenged by such conditions, and they are expected to retreat to the margins of the wetland over time. If the wetland cannot accrete sediments to keep pace with rising sea levels their distribution is expected to shrink significantly. Monitoring efforts to quantify sediment accretion rates and sedimentation processes seem warranted to predict the future of the TEC.

There is also clear evidence of polluted groundwater discharging directly into the wetlands, primarily via urban drainage. Zinc, cobalt and several other metals exceed Australian and New Zealand Guidelines for marine waters in the discharge from that drain. Elevated levels of zinc also exceed interim sediment quality guidelines near the drain outlet, and therefore the wetland looks to be providing a significant ecosystem service, trapping, and storing metal contaminated groundwater before it discharges to the Swan River. Isotope and chemical analyses of water samples is suggestive that the source of that pollution is consistent with acidified groundwater due to activities associated with the manufacture of fertilizers and/or sulphuric acid. Aluminium and lead concentrations in runoff from the Chapman St Drain also exceed guideline values.

The site contains acid sulphate soils as expected. Any future management activities that may disturb the soils, or lower groundwater levels, including disturbance to the urban drains may need to consider the associated potential for adverse outcomes.

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Appendices

Appendix 1 Laboratory Reports

Appendix 2 Acid Sulphate Soils Assessment Report

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph 08 9317 2505 fax 08 9317 4163
lab@mpl.com.au
www.mpl.com.au

CERTIFICATE OF ANALYSIS 229816

Client Details

Client	Dept of Biodiversity,Conservation and Attractions
Attention	Dr Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details

Your Reference	Ashfield Flats
Number of Samples	14 Waters
Date samples received	16/07/2019
Date completed instructions received	16/07/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	22/07/2019
Date of Issue	22/07/2019

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Results Approved By
Heram Halim, Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorganics							
Our Reference	UNITS	PQL	229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference			MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	17/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	17/07/2019	16/07/2019	16/07/2019	16/07/2019
Bromide	mg/L	0.5	<0.5	67	0.6	0.8	<0.5

Miscellaneous Inorganics							
Our Reference	UNITS	PQL	229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference			MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Bromide	mg/L	0.5	39	74	68	79	1.3

Miscellaneous Inorganics						
Our Reference	UNITS	PQL	229816-11	229816-12	229816-13	229816-14
Your Reference			MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Bromide	mg/L	0.5	38	27	<0.5	15

Ionic Balance							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	65	390	180	20	18
Potassium - Dissolved	mg/L	0.5	6.6	310	16	4.5	5.5
Magnesium - Dissolved	mg/L	0.5	28	1,700	72	29	35
Sodium - Dissolved	mg/L	0.5	140	11,000	280	150	140
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	220	3,500	650	160	120
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	220	3,500	650	160	120
Chloride	mg/L	1	190	20,000	270	260	190
Sulphate	mg/L	1	92	760	310	58	110
Ionic Balance	%		1.3	-1.5	0.64	-7.1	-0.48
Hardness as $CaCO_3$	mg/L	3	280	8,000	750	170	190

Ionic Balance							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	320	820	410	700	35
Potassium - Dissolved	mg/L	0.5	150	280	360	320	7.3
Magnesium - Dissolved	mg/L	0.5	840	2,000	1,600	1,900	45
Sodium - Dissolved	mg/L	0.5	6,600	13,000	12,000	13,000	200
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	110	340	1,100	210	130
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	110	340	1,100	210	130
Chloride	mg/L	1	12,000	23,000	21,000	25,000	390
Sulphate	mg/L	1	1,800	4,900	2,300	4,000	67
Ionic Balance	%		0.079	-0.040	0.80	-1.0	-2.6
Hardness as $CaCO_3$	mg/L	3	4,300	10,000	7,400	9,800	270

Ionic Balance						
Our Reference			229816-11	229816-12	229816-13	229816-14
Your Reference	UNITS	PQL	MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	380	110	63	120
Potassium - Dissolved	mg/L	0.5	110	160	7.0	97
Magnesium - Dissolved	mg/L	0.5	860	510	30	280
Sodium - Dissolved	mg/L	0.5	6,500	4,600	160	3,000
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	200	1,300	200	250
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	200	1,300	200	250
Chloride	mg/L	1	12,000	8,300	190	4,900
Sulphate	mg/L	1	1,900	540	97	920
Ionic Balance	%		-1.1	-3.5	4.0	-0.23
Hardness as $CaCO_3$	mg/L	3	4,500	2,400	280	1,400

Nutrients in Water							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Date analysed	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	4.6	170	6.7	0.5	0.6
Total Kjeldahl Nitrogen	mg/L	0.1	0.7	170	1.1	0.5	0.6
Nitrate as N	mg/L	0.005	3.9	<0.1	5.5	<0.1	<0.1
Nitrite as N	mg/L	0.005	<0.005	<0.1	0.069	<0.1	<0.1
NOx as N	mg/L	0.005	3.9	<0.1	5.5	<0.1	<0.1
Ammonia as N	mg/L	0.005	0.010	150	0.25	0.34	0.40
Phosphate as P	mg/L	0.005	0.008	4.6	<0.005	<0.1	<0.1
Total Phosphorus	mg/L	0.01	<0.01	4.6	<0.01	<0.01	<0.01
Organic N	mg/L	0.1	0.7	18	0.9	0.2	0.2

Nutrients in Water							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Date analysed	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	4.8	9.4	35	11	0.4
Total Kjeldahl Nitrogen	mg/L	0.1	4.8	9.4	35	11	0.4
Nitrate as N	mg/L	0.005	<0.1	<0.1	<0.005	<0.005	<0.1
Nitrite as N	mg/L	0.005	<0.1	<0.1	<0.005	<0.005	<0.1
NOx as N	mg/L	0.005	<0.1	<0.1	<0.005	<0.005	<0.1
Ammonia as N	mg/L	0.005	4.1	8.6	31	8.8	0.24
Phosphate as P	mg/L	0.005	<0.1	<0.25	1.2	0.26	<0.1
Total Phosphorus	mg/L	0.01	<0.01	<0.01	1.2	0.22	<0.01
Organic N	mg/L	0.1	0.7	0.7	4.2	2.0	0.2

Nutrients in Water						
Our Reference	UNITS	PQL	229816-11	229816-12	229816-13	229816-14
Your Reference			MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019
Date analysed	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	6.6	35	4.2	3.2
Total Kjeldahl Nitrogen	mg/L	0.1	6.6	35	0.7	3.2
Nitrate as N	mg/L	0.005	<0.1	<0.1	3.5	<0.1
Nitrite as N	mg/L	0.005	<0.1	<0.1	0.005	<0.1
NOx as N	mg/L	0.005	<0.1	<0.1	3.5	<0.1
Ammonia as N	mg/L	0.005	4.9	31	0.030	4.3
Phosphate as P	mg/L	0.005	<0.25	0.84	0.007	<0.1
Total Phosphorus	mg/L	0.01	0.01	1.5	<0.01	0.01
Organic N	mg/L	0.1	1.7	4.3	0.7	<0.1

Dissolved Metals in Water							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Iron (HCl preserved)	mg/L	0.02	0.06	<0.1	2.9	42	23
Ferrous Iron - Fe^{2+}	mg/L	0.05	0.07	<0.25	1.8	39	21
Ferric Iron - Fe^{3+}	mg/L	0.05	<0.05	<0.05	1.1	3.1	2.4
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.02	<0.01	<0.01	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.002	0.001	0.002	0.005
Barium-Dissolved	mg/L	0.001	0.071	0.49	0.077	0.11	0.28
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.09	4.5	0.2	0.03	0.03
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	0.003	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.003	<0.002	0.004	<0.001	0.007
Copper-Dissolved	mg/L	0.001	0.017	<0.002	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	0.08	<0.02	3.0	42	22
Lead-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	<0.0005	0.047	0.0008	0.0021	0.0008
Manganese-Dissolved	mg/L	0.005	0.11	<0.01	0.37	0.074	0.53
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.003	<0.002	0.005	<0.001	0.005
Nickel-Dissolved	mg/L	0.001	0.004	<0.002	0.003	0.001	0.002
Selenium-Dissolved	mg/L	0.001	<0.001	<0.002	0.005	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	0.0032	<0.001	0.049	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.002	0.011	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.21	0.003	0.005	0.001	0.002

Dissolved Metals in Water							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Iron (HCl preserved)	mg/L	0.02	59	77	<0.1	0.39	26
Ferrous Iron - Fe^{2+}	mg/L	0.05	58	74	<0.05	0.38	25
Ferric Iron - Fe^{3+}	mg/L	0.05	1.7	3.2	<0.05	<0.05	1.5
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.02	<0.02	0.13	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Barium-Dissolved	mg/L	0.001	0.055	0.063	0.066	0.11	0.14
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.001	<0.001	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Boron-Dissolved	mg/L	0.02	1.3	3.0	4.9	4.1	0.04
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	0.002	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	0.002	0.001
Copper-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Iron-Dissolved	mg/L	0.01	58	76	<0.02	0.41	27
Lead-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Lithium-Dissolved	mg/L	0.0005	0.050	0.022	0.096	0.17	0.0009
Manganese-Dissolved	mg/L	0.005	1.0	1.4	0.15	2.9	0.79
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	0.014	<0.002	<0.002	0.006
Nickel-Dissolved	mg/L	0.001	<0.001	0.004	<0.002	<0.002	0.002
Selenium-Dissolved	mg/L	0.001	0.003	0.007	0.006	0.007	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.001	<0.001	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	0.011	<0.001	<0.001	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.005	0.006	0.007	0.006	<0.001
Zinc-Dissolved	mg/L	0.001	0.011	0.005	0.002	0.007	0.007

Dissolved Metals in Water						
Our Reference			229816-11	229816-12	229816-13	229816-14
Your Reference	UNITS	PQL	MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019
Iron (HCl preserved)	mg/L	0.02	46	<0.04	0.1	14
Ferrous Iron - Fe^{2+}	mg/L	0.05	46	<0.25	0.09	14
Ferric Iron - Fe^{3+}	mg/L	0.05	<0.05	<0.05	<0.05	0.26
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	0.001
Barium-Dissolved	mg/L	0.001	0.10	0.048	0.071	0.074
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	2.5	4.2	0.09	2.7
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	0.001	0.002	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	0.003	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	<0.001	0.016	<0.001
Iron-Dissolved	mg/L	0.01	47	<0.01	0.13	14
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.081	0.043	<0.0005	0.018
Manganese-Dissolved	mg/L	0.005	8.4	0.039	0.11	0.71
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	0.003	0.005
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	0.004	0.001
Selenium-Dissolved	mg/L	0.001	0.005	0.006	0.001	0.004
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	0.0030	0.0007
Vanadium-Dissolved	mg/L	0.001	0.003	0.004	0.002	0.001
Zinc-Dissolved	mg/L	0.001	0.001	0.003	0.21	0.007

Method ID	Methodology Summary
INORG series	Determination of constituents in waters using colourimetric chemistry
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-060	Total Phosphorus by colourimetric analysis based on APHA latest edition 4500-P J.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-076	Ferrous Iron determination by colourimerically using APHA latest edition 3500-Fe B.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Metals in soil and water by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS. For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-3
Date prepared	-			17/07/2019	1	16/07/2019	16/07/2019		17/07/2019	17/07/2019
Date analysed	-			17/07/2019	1	16/07/2019	16/07/2019		17/07/2019	17/07/2019
Bromide	mg/L	0.5	INORG-081	<0.5	1	<0.5	<0.5	0	102	72

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Bromide	mg/L	0.5	INORG-081	[NT]	11	38	38	0	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-3
Date prepared	-			16/07/2019	1	16/07/2019	16/07/2019		16/07/2019	16/07/2019
Date analysed	-			16/07/2019	1	16/07/2019	16/07/2019		16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	65	[NT]		98	71
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	6.6	[NT]		95	95
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	28	[NT]		97	91
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	140	[NT]		93	#
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	<5	1	220	220	0	100	[NT]
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	INORG-006	<5	1	<5	<5	0	100	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	<5	1	220	220	0	100	[NT]
Chloride	mg/L	1	INORG-081	<1	1	190	190	0	100	92
Sulphate	mg/L	1	INORG-081	<1	1	92	92	0	104	96
Hardness as $CaCO_3$	mg/L	3	METALS-008	<3	1	280	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	2	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	2	16/07/2019	16/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	390	390	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	310	310	0	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	1700	1700	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	11000	11000	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	2	3500	[NT]		[NT]	[NT]
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	INORG-006	[NT]	2	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	2	3500	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	2	20000	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	2	760	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	2	8000	7900	1	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	380	[NT]		[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	110	[NT]		[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	860	[NT]		[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	6500	[NT]		[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	200	200	0	[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	200	200	0	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	12000	12000	0	[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	11	1900	1900	0	[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	11	4500	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	12	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	12	16/07/2019	16/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	110	110	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	160	160	0	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	510	510	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	4600	4600	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	12	1300	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	12	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	12	1300	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	12	8300	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	12	540	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	12	2400	2400	0	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-4
Date prepared	-			17/07/2019	1	17/07/2019	17/07/2019		17/07/2019	17/07/2019
Date analysed	-			17/07/2019	1	17/07/2019	17/07/2019		17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	4.6	4.6	0	106	103
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	0.7	0.7	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	3.9	3.9	0	104	103
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	107	128
NOx as N	mg/L	0.005	INORG-055	<0.005	1	3.9	3.9	0	104	103
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.010	0.009	11	100	105
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	0.008	0.008	0	105	85
Total Phosphorus	mg/L	0.01	INORG-060	<0.01	1	<0.01	<0.01	0	100	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	17/07/2019	17/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	17/07/2019	17/07/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	11	6.6	6.7	2	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	11	6.6	6.7	2	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	4.9	4.8	2	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	11	<0.25	<0.25	0	[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	11	0.01	0.01	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-5
Date prepared	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	22/07/2019
Date analysed	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	22/07/2019
Iron (HCl preserved)	mg/L	0.02	METALS-020	<0.02	1	0.06	[NT]		103	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	<0.05	1	0.07	0.05	33	95	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	1	<0.01	<0.01	0	100	98
Antimony-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	102	106
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	93	99
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.071	0.073	3	100	93
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	98	104
Bismuth-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	99	84
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	1	0.09	0.09	0	110	99
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	99	105
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	92	90
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.003	0.003	0	90	87
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.017	0.016	6	89	83
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	1	0.08	0.08	0	103	#
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	97	90
Lithium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	106	107
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	1	0.11	0.11	0	94	113
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	[NT]		114	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.003	0.003	0	98	104
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.004	0.004	0	90	85
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	95	101
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	97
Thallium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	100	94
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	99	95
Tin-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	101	100
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	0.0032	0.0033	3	99	94
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	96	97
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.21	0.20	5	92	92

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	5	19/07/2019	19/07/2019		[NT]	[NT]
Date analysed	-			[NT]	5	19/07/2019	19/07/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	5	23	24	4	[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	5	21	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	5	<0.01	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.005	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.28	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	5	0.03	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	5	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.007	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	5	22	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	0.0008	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	5	0.53	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	5	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.005	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.002	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.002	[NT]		[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	11	46	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	11	46	46	0	[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.10	0.099	1	[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	11	2.5	2.6	4	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	11	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	11	47	47	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	0.081	0.082	1	[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	11	8.4	8.1	4	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	[NT]		[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.005	0.005	0	[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.003	0.003	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Percent recovery not available due to the analyte signal being much greater
than the spike amount. An acceptable recovery was achieved for the LCS.

Note: Some results have raised pqls. In these cases the sample's high TDS required the sample to be diluted prior to analysis.

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr: Jasmine Rutherford	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensignton, 6151, WA	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day — standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format:** esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

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Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample information / **Tests Required** / **Comments**

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Ionic Balance	Bromide	Nutrient Suite	Dissolved Metals (26)	Dissolved Ferrous Iron	Comments: Provide as much information about the sample as you can
1	~~[illegible]~~ MW2		18/7/19	Water	X	X	X	X	X	
2	~~[illegible]~~ MW6		17/7/19	Water	X	X	X	X	X	
3	~~[illegible]~~ MW7		18/7/19	Water	X	X	X	X	X	
4	~~[illegible]~~ MW13		17/7/19	Water	X	X	X	X	X	
5	~~[illegible]~~ KD		16/7/19	Water	X	X	X	X	X	Samples could not be field F.ltered
6	~~[illegible]~~ CD		"	Water	X	X	X	X	X	
7	~~[illegible]~~ WL		"	Water	X	X	X	X	X	
8	~~[illegible]~~ SW2		"	Water	X	X	X	X	X	
9	~~[illegible]~~ SW3		"	Water	X	X	X	X	X	
10	~~[illegible]~~ SW4		"	Water	X	X	X	X	X	
11	~~[illegible]~~ SW5		"	Water	X	X	X	X	X	
12	~~[illegible]~~ SW6		"	Water	X	X	X	X	X	

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company): DBCA	**Received by (Company):** MPL	**Lab Use Only**
Print Name: Gavan McGrath	**Print Name:** MC	**Job number:** 229958 — **Cooling:** Ice / Ice pack / None
Date & Time: 18/7/19 15:15	**Date & Time:** 18-7-19 1500	**Temperature:** 9 — **Security seal:** Intact / Broken / None
Signature:	**Signature:**	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
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16-18 Hayden Court Myaree WA 6154
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CERTIFICATE OF ANALYSIS 229958

Client Details

Client	Dept of Biodiversity,Conservation and Attractions
Attention	Dr. Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details

Your Reference	**Ashfield Flats**
Number of Samples	12 Water
Date samples received	18/07/2019
Date completed instructions received	18/07/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	24/07/2019
Date of Issue	24/07/2019

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Results Approved By
Heram Halim, Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorganics							
Our Reference	UNITS	PQL	229958-1	229958-2	229958-3	229958-4	229958-5
Your Reference			QW2	MW6	MW7	MW13	KD
Date Sampled			18/07/2019	17/07/2019	18/07/2019	17/07/2019	16/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Bromide	mg/L	0.5	<0.5	<0.5	<0.5	1.8	<0.5

Miscellaneous Inorganics							
Our Reference	UNITS	PQL	229958-6	229958-7	229958-8	229958-9	229958-10
Your Reference			CD	WC	SW2	SW3	SW4
Date Sampled			16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Bromide	mg/L	0.5	<0.5	<0.5	11	1.5	13

Miscellaneous Inorganics				
Our Reference	UNITS	PQL	229958-11	229958-12
Your Reference			SW5	SW6
Date Sampled			16/07/2019	16/07/2019
Type of sample			Water	Water
Date prepared	-		19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019
Bromide	mg/L	0.5	12	26

Ionic Balance							
Our Reference			229958-1	229958-2	229958-3	229958-4	229958-5
Your Reference	UNITS	PQL	QW2	MW6	MW7	MW13	KD
Date Sampled			18/07/2019	17/07/2019	18/07/2019	17/07/2019	16/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Calcium - Dissolved	mg/L	0.5	49	89	49	53	29
Potassium - Dissolved	mg/L	0.5	6.4	31	6.5	11	8.1
Magnesium - Dissolved	mg/L	0.5	13	24	13	70	7.3
Sodium - Dissolved	mg/L	0.5	120	280	120	220	120
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	120	120	120	73	81
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	120	120	120	73	81
Chloride	mg/L	1	160	450	160	610	160
Sulphate	mg/L	1	120	230	130	100	72
Ionic Balance	%		-3.8	-1.3	-3.7	-6.6	-1.0
Hardness as $CaCO_3$	mg/L	3	170	320	170	420	100

Ionic Balance							
Our Reference			229958-6	229958-7	229958-8	229958-9	229958-10
Your Reference	UNITS	PQL	CD	WC	SW2	SW3	SW4
Date Sampled			16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Calcium - Dissolved	mg/L	0.5	53	48	110	53	120
Potassium - Dissolved	mg/L	0.5	7.4	11	75	15	85
Magnesium - Dissolved	mg/L	0.5	12	19	230	46	270
Sodium - Dissolved	mg/L	0.5	100	120	2,000	320	2,400
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	90	31	75	110	81
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	90	31	75	110	81
Chloride	mg/L	1	150	180	3,400	540	4,100
Sulphate	mg/L	1	100	200	780	210	810
Ionic Balance	%		-0.66	-2.4	0.32	-2.4	0.20
Hardness as $CaCO_3$	mg/L	3	180	200	1,200	320	1,400

Ionic Balance				
Our Reference			229958-11	229958-12
Your Reference	UNITS	PQL	SW5	SW6
Date Sampled			16/07/2019	16/07/2019
Type of sample			Water	Water
Date prepared	-		19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019
Calcium - Dissolved	mg/L	0.5	200	250
Potassium - Dissolved	mg/L	0.5	76	140
Magnesium - Dissolved	mg/L	0.5	300	610
Sodium - Dissolved	mg/L	0.5	2,300	4,700
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	160	46
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	160	46
Chloride	mg/L	1	4,100	8,300
Sulphate	mg/L	1	920	1,300
Ionic Balance	%		0.12	1.8
Hardness as $CaCO_3$	mg/L	3	1,700	3,100

Nutrients in Water							
Our Reference			229958-1	229958-2	229958-3	229958-4	229958-5
Your Reference	UNITS	PQL	QW2	MW6	MW7	MW13	KD
Date Sampled			18/07/2019	17/07/2019	18/07/2019	17/07/2019	16/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		24/07/2019	24/07/2019	24/07/2019	24/07/2019	24/07/2019
Date analysed	-		24/07/2019	24/07/2019	24/07/2019	24/07/2019	24/07/2019
Total Nitrogen	mg/L	0.1	0.7	2.8	0.7	0.6	2.7
Total Kjeldahl Nitrogen	mg/L	0.1	0.7	1.3	0.7	0.6	1.2
Nitrate as N	mg/L	0.005	<0.005	1.5	<0.005	<0.005	1.4
Nitrite as N	mg/L	0.005	<0.005	0.034	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	<0.005	1.5	<0.005	<0.005	1.4
Ammonia as N	mg/L	0.005	0.38	0.012	0.38	0.30	0.016
Total Phosphorus	mg/L	0.05	<0.05	<0.05	<0.05	0.07	0.15
Phosphate as P	mg/L	0.005	<0.005	0.007	<0.005	<0.005	0.10
Organic N	mg/L	0.1	0.3	1.3	0.3	0.3	1.2

Nutrients in Water							
Our Reference			229958-6	229958-7	229958-8	229958-9	229958-10
Your Reference	UNITS	PQL	CD	WC	SW2	SW3	SW4
Date Sampled			16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		24/07/2019	19/07/2019	24/07/2019	24/07/2019	24/07/2019
Date analysed	-		24/07/2019	19/07/2019	24/07/2019	24/07/2019	24/07/2019
Total Nitrogen	mg/L	0.1	1.6	1.4	1.8	1	0.9
Total Kjeldahl Nitrogen	mg/L	0.1	0.7	0.8	1.8	0.9	0.9
Nitrate as N	mg/L	0.005	0.92	0.61	<0.005	0.034	0.014
Nitrite as N	mg/L	0.005	0.012	0.007	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	0.93	0.61	<0.005	0.037	0.017
Ammonia as N	mg/L	0.005	0.048	0.23	0.17	0.008	0.080
Total Phosphorus	mg/L	0.05	0.17	<0.05	0.26	<0.05	<0.05
Phosphate as P	mg/L	0.005	0.082	<0.005	0.032	<0.005	<0.005
Organic N	mg/L	0.1	0.6	0.6	1.7	0.9	0.9

Nutrients in Water				
Our Reference			229958-11	229958-12
Your Reference	UNITS	PQL	SW5	SW6
Date Sampled			16/07/2019	16/07/2019
Type of sample			Water	Water
Date prepared	-		24/07/2019	24/07/2019
Date analysed	-		24/07/2019	24/07/2019
Total Nitrogen	mg/L	0.1	2.1	2.5
Total Kjeldahl Nitrogen	mg/L	0.1	2.1	2.5
Nitrate as N	mg/L	0.005	0.020	<0.005
Nitrite as N	mg/L	0.005	<0.005	<0.005
NOx as N	mg/L	0.005	0.021	<0.005
Ammonia as N	mg/L	0.005	0.061	0.15
Total Phosphorus	mg/L	0.05	0.1	0.14
Phosphate as P	mg/L	0.005	<0.005	0.031
Organic N	mg/L	0.1	2.0	2.4

Dissolved Metals in Water							
Our Reference			229958-1	229958-2	229958-3	229958-4	229958-5
Your Reference	UNITS	PQL	QW2	MW6	MW7	MW13	KD
Date Sampled			18/07/2019	17/07/2019	18/07/2019	17/07/2019	16/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019
Date analysed	-		23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019
Iron (HCl preserved)	mg/L	0.02	10	0.34	11	60	0.43
Ferrous Iron - Fe^{2+}	mg/L	0.05	9.8	0.33	9.7	60	0.18
Ferric Iron - Fe^{3+}	mg/L	0.05	0.71	<0.05	0.90	0.84	0.24
Aluminium-Dissolved	mg/L	0.01	0.03	0.16	0.03	0.01	0.27
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.007	<0.001	0.007	0.002	0.001
Barium-Dissolved	mg/L	0.001	0.045	0.026	0.044	0.12	0.016
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.07	0.21	0.07	0.04	0.1
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Copper-Dissolved	mg/L	0.001	<0.001	0.001	<0.001	<0.001	0.004
Cobalt-Dissolved	mg/L	0.001	0.001	0.002	0.001	<0.001	0.003
Iron-Dissolved	mg/L	0.01	9.0	0.36	9.0	59	0.39
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0015	0.0007	0.0015	0.0035	<0.0005
Manganese-Dissolved	mg/L	0.005	0.039	0.031	0.041	0.17	0.021
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.002	0.001	0.002	<0.001	0.001
Nickel-Dissolved	mg/L	0.001	<0.001	0.001	<0.001	<0.001	0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.001	<0.001	0.001	<0.001	0.002
Zinc-Dissolved	mg/L	0.001	<0.001	0.012	<0.001	0.010	0.25

Dissolved Metals in Water							
Our Reference	UNITS	PQL	229958-6	229958-7	229958-8	229958-9	229958-10
Your Reference			CD	WC	SW2	SW3	SW4
Date Sampled			16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019
Date analysed	-		23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019
Iron (HCl preserved)	mg/L	0.02	1.2	0.38	2.9	0.92	0.13
Ferrous Iron - Fe^{2+}	mg/L	0.05	0.15	[NT]	0.63	0.15	0.14
Ferric Iron - Fe^{3+}	mg/L	0.05	1.1	[NT]	2.3	0.77	<0.05
Aluminium-Dissolved	mg/L	0.01	0.05	0.12	0.04	0.04	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.005	<0.001	<0.001	<0.001	<0.001
Barium-Dissolved	mg/L	0.001	0.042	0.029	0.042	0.020	0.045
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.08	0.07	1.0	0.2	1.2
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.006	<0.001	0.001	<0.001	0.013
Cobalt-Dissolved	mg/L	0.001	0.003	0.028	0.017	0.006	0.023
Iron-Dissolved	mg/L	0.01	1.1	0.35	3.1	0.85	0.12
Lead-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0012	0.0031	0.023	0.0039	0.027
Manganese-Dissolved	mg/L	0.005	0.045	0.090	0.24	0.12	0.44
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	0.005	0.002
Nickel-Dissolved	mg/L	0.001	0.001	0.004	0.003	0.003	0.005
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	0.0005	<0.0005	<0.0005	0.0013	0.0006
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.069	1.6	0.082	0.23	0.096

Dissolved Metals in Water				
Our Reference			229958-11	229958-12
Your Reference	UNITS	PQL	SW5	SW6
Date Sampled			16/07/2019	16/07/2019
Type of sample			Water	Water
Date prepared	-		23/07/2019	23/07/2019
Date analysed	-		23/07/2019	23/07/2019
Iron (HCl preserved)	mg/L	0.02	0.07	0.28
Ferrous Iron - Fe^{2+}	mg/L	0.05	<0.05	0.08
Ferric Iron - Fe^{3+}	mg/L	0.05	0.07	0.20
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.001	0.002
Barium-Dissolved	mg/L	0.001	0.040	0.071
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.92	1.5
Cadmium-Dissolved	mg/L	0.0001	0.0001	0.0002
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.019	0.015
Cobalt-Dissolved	mg/L	0.001	<0.001	0.007
Iron-Dissolved	mg/L	0.01	0.07	0.28
Lead-Dissolved	mg/L	0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.017	0.044
Manganese-Dissolved	mg/L	0.005	0.009	0.57
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.006	<0.001
Nickel-Dissolved	mg/L	0.001	0.004	0.006
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	0.019	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.024	0.073

Method ID	Methodology Summary
INORG series	Determination of constituents in waters using colourimetric chemistry
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-076	Ferrous Iron determination by colourimerically using APHA latest edition 3500-Fe B.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Metals in soil and water by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS. For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229958-2
Date prepared	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	19/07/2019
Date analysed	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	19/07/2019
Bromide	mg/L	0.5	INORG-081	<0.5	1	<0.5	<0.5	0	101	101

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Bromide	mg/L	0.5	INORG-081	[NT]	11	12	12	0	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229958-2
Date prepared	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	19/07/2019
Date analysed	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	19/07/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	49	[NT]		97	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	6.4	[NT]		97	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	13	[NT]		100	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	120	[NT]		98	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	<5	1	120	120	0	100	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	<5	1	<5	<5	0	100	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	<5	1	120	120	0	100	[NT]
Chloride	mg/L	1	INORG-081	<1	1	160	160	0	99	99
Sulphate	mg/L	1	INORG-081	<1	1	120	120	0	104	104
Hardness as $CaCO_3$	mg/L	3	METALS-008	<3	1	170	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	229958-4
Date prepared	-			[NT]	3	19/07/2019	19/07/2019		[NT]	19/07/2019
Date analysed	-			[NT]	3	19/07/2019	19/07/2019		[NT]	19/07/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	3	49	48	2	[NT]	86
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	3	6.5	6.4	2	[NT]	99
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	3	13	13	0	[NT]	94
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	3	120	120	0	[NT]	70
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	3	120	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	3	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	3	120	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	3	160	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	3	130	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	3	170	170	0	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	10	19/07/2019	19/07/2019		[NT]	[NT]
Date analysed	-			[NT]	10	19/07/2019	19/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	120	120	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	85	84	1	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	270	270	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	2400	2400	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	10	81	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	10	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	10	81	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	10	4100	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	10	810	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	10	1400	1400	0	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	200	[NT]		[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	76	[NT]		[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	300	[NT]		[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	2300	[NT]		[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	160	150	6	[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	160	150	6	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	4100	4000	2	[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	11	920	910	1	[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	11	1700	[NT]		[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229958-2
Date prepared	-			24/07/2019	1	24/07/2019	24/07/2019		24/07/2019	24/07/2019
Date analysed	-			24/07/2019	1	24/07/2019	24/07/2019		24/07/2019	24/07/2019
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	0.7	0.7	0	104	98
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	0.7	0.7	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	110	[NT]
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	104	[NT]
NOx as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	103	[NT]
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.38	0.38	0	90	[NT]
Total Phosphorus	mg/L	0.05	METALS-020	<0.05	1	<0.05	<0.05	0	102	102
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	<0.005	<0.005	0	111	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	24/07/2019	24/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	24/07/2019	24/07/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	11	2.1	2.5	17	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	11	2.1	2.5	17	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	11	0.020	0.021	5	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	11	0.021	0.022	5	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	0.061	0.060	2	[NT]	[NT]
Total Phosphorus	mg/L	0.05	METALS-020	[NT]	11	0.1	0.09	11	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	11	<0.005	<0.005	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229958-3
Date prepared	-			23/07/2019	1	23/07/2019	23/07/2019		23/07/2019	23/07/2019
Date analysed	-			23/07/2019	1	23/07/2019	23/07/2019		23/07/2019	23/07/2019
Iron (HCl preserved)	mg/L	0.02	METALS-020	<0.02	1	10	[NT]		104	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	<0.05	1	9.8	10	2	102	75
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	1	0.03	[NT]		94	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		99	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.007	[NT]		94	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.045	[NT]		93	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		102	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		97	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	1	0.07	[NT]		104	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	[NT]		95	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		88	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		92	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.001	[NT]		90	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	1	9.0	[NT]		95	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		96	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	0.0015	[NT]		101	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	1	0.039	[NT]		93	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	<0.00005	0	111	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.002	[NT]		96	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		91	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		94	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		100	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		97	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		97	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		95	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		99	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.001	[NT]		92	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		92	[NT]

QUALITY CONTROL: Dissolved Metals in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	6	23/07/2019	23/07/2019		[NT]	[NT]
Date analysed	-			[NT]	6	23/07/2019	23/07/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	6	1.2	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	6	0.15	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	6	0.05	0.05	0	[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	6	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	6	0.005	0.005	0	[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	6	0.042	0.044	5	[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	6	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	6	<0.001	<0.001	0	[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	6	0.08	0.08	0	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	6	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	6	<0.001	<0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	6	0.006	0.006	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	6	0.003	0.003	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	6	1.1	1.1	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	6	0.001	0.001	0	[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	6	0.0012	0.0012	0	[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	6	0.045	0.044	2	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	6	<0.00005	[NT]		[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	6	0.001	0.001	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	6	0.001	0.001	0	[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	6	<0.001	<0.001	0	[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	6	<0.001	<0.001	0	[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	6	<0.001	<0.001	0	[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	6	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	6	<0.001	<0.001	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	6	0.0005	0.0006	18	[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	6	<0.001	<0.001	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	6	0.069	0.067	3	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	9	23/07/2019	23/07/2019		[NT]	[NT]
Date analysed	-			[NT]	9	23/07/2019	23/07/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	9	0.92	0.92	0	[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	9	0.15	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	9	0.04	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.020	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	9	0.2	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	9	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.006	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	9	0.85	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	0.0039	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	9	0.12	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	9	<0.00005	[NT]		[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.005	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.003	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	0.0013	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.23	[NT]		[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	23/07/2019	23/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	23/07/2019	23/07/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	11	0.07	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	11	<0.05	<0.05	0	[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	11	<0.01	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.040	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	11	0.92	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	11	0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.019	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	11	0.07	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	0.017	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	11	0.009	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.006	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.004	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	0.019	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.024	[NT]		[NT]	[NT]

Result Definitions	
NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

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ENVIROLAB ENVIROLAB mpl

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr: Jasmine Rutherford	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensignton, 6151, WA	**Date results required:** **Or choose: standard / same day / 1 day / 2 day / 3 day** standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format: esdat / equis /**
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Ph: 02 9910 6200 / sydney@envirolab.com.au

Perth Lab - MPL Laboratories
16-18 Hayden Crt, Myaree, WA 6154
Ph: 08 9317 2505 / lab@mpl.com.au

Melbourne Lab - Envirolab Services
25 Research Drive, Croydon South, VIC 3136
Ph: 03 9763 2500 / melbourne@envirolab.com.au

Adelaide Office - Envirolab Services
7a The Parade, Norwood, SA 5067
Ph: 08 7087 6800 / adelaide@envirolab.com.au

Brisbane Office - Envirolab Services
20a, 10-20 Depot St, Banyo, QLD 4014
Ph: 07 3266 9532 / brisbane@envirolab.com.au

Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample information					Tests Required		Comments
Envirolab Sample ID	**Client Sample ID or information**	**Depth**	**Date sampled**	**Type of sample**	Ion Balance	Bromide	**Provide as much information about the sample as you can**
1	MW01		25/09/2019	Water	x	x	
2	MW03		25/09/2019	Water	x	x	
3	MW04S		25/09/2019	Water	x	x	
4	MW04D		25/09/2019	Water	x	x	
5	MW05		25/09/2019	Water	x	x	
6	MW06		25/09/2019	Water	x	x	
7	MW07		25/09/2019	Water	x	x	
8	MW08S		25/09/2019	Water	x	x	
9	MW08D		25/09/2019	Water	x	x	
10	MW09S		25/09/2019	Water	x	x	
11	MW09D		25/09/2019	Water	x	x	
12	MW10		25/09/2019	Water	x	x	

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company):	**Received by (Company):** MPL	***Lab Use Only***
Print Name:	**Print Name:** C. Jadena	**Job number:** 233514 — **Cooling: Ice / Ice pack / None**
Date & Time:	**Date & Time:** 26/9/19 @ 1550	**Temperature:** 9 — **Security seal: Intact / Broken / None**
Signature:	**Signature:** CG	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr: Jasmine Rutherford	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensignton, 6151, WA	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day — standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format:** esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Ph: 02 9910 6200 / sydney@envirolab.com.au

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Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample information					Tests Required		Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Ion Balance	Bromide	Provide as much information about the sample as you can
13	MW11		25/09/2019	Water	x	x	
14	MW12S		25/09/2019	Water	x	x	
15	MW12D			Water	x	x	
16	MW13			Water	x	x	
17	QAW02			Water	x	x	

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company):	**Received by (Company):** MPL	***Lab Use Only***	
Print Name:	**Print Name:** C Tadeia	**Job number:** 235514	**Cooling:** Ice / Ice pack / None
Date & Time:	**Date & Time:** 26/9/19 8:55	**Temperature:** 9	**Security seal:** Intact / Broken / None
Signature:	**Signature:** CT	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**	

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CHAIN OF CUSTODY - Client

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Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Client: Department of Biodiversity Conservation and Attractions
Contact Person: Dr Gavan McGrath
Project Mgr: Jasmine Rutherford
Sampler: Dr Gavan McGrath
Address: 17 Dick Perry Avenue, Kensignton, 6151, WA
Phone: 08 9219 9447 **Mob:** 0458 559 765
Email: gavan.mcgrath@dbca.wa.gov.au

Client Project Name / Number / Site etc (ie report title): Ashfield Flats
PO No.:
Envirolab Quote No. : 19P132
Date results required:
Or choose: standard / same day / 1 day / 2 day / 3 day
standard
Additional report format: esdat / equis /
Lab Comments:

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Ion Balance	Bromide	Comments: Provide as much information about the sample as you can
18	SW01		24/09/2019	Water	x	x	
19	SW02		24/09/2019	Water	x	x	
20	SW03		24/09/2019	Water	x	x	
21	SW04		24/09/2019	Water	x	x	
22	SW05		24/09/2019	Water	x	x	
23	SW06		24/09/2019	Water	x	x	
24	SW07		24/09/2019	Water	x	x	
25	SW08		24/09/2019	Water	x	x	
26	CD		24/09/2019	Water	x	x	
27	KD		24/09/2019	Water	x	x	
28	WC		24/09/2019	Water	x	x	
29	QW01		24/09/2019	Water	x	x	

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company):	Received by (Company): MPL	*Lab Use Only*	
Print Name:	Print Name: C. Tadora	Job number: 233514	Cooling: Ice / Ice pack / None
Date & Time:	Date & Time: 26/9/19	Temperature: 9	Security seal: Intact / Broken / None
Signature:	Signature:	TAT Req - SAME day / 1 / 2 / 3 / 4 / STD	

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
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16-18 Hayden Court Myaree WA 6154
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lab@mpl.com.au
www.mpl.com.au

CERTIFICATE OF ANALYSIS 230938

Client Details

Client	Dept of Biodiversity,Conservation and Attractions
Attention	Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details

Your Reference	**Ashfield Flats**
Number of Samples	28 Water
Date samples received	07/08/2019
Date completed instructions received	07/08/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	16/08/2019
Date of Issue	16/08/2019

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Results Approved By
Heram Halim, Operations Manager
Michael Mowle, Metals/Inorganics Supervisor

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorganics							
Our Reference			230938-1	230938-2	230938-3	230938-4	230938-5
Your Reference	UNITS	PQL	GW-7	CD-1	CD-2	CD-3	CD-5
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Date analysed	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Total Carbon	mg/L	1	41	34	46	34	34
Total Organic Carbon	mg/L	1	9	16	28	16	16
Dissolved Inorganic Carbon	mg/L	1	33	18	20	17	19
Dissolved Organic Carbon	mg/L	1	8	16	17	16	15
Total Suspended Solids	mg/L	5	12	15	94	73	49
Chloride	mg/L	1	150	130	130	130	120

Miscellaneous Inorganics							
Our Reference			230938-6	230938-7	230938-8	230938-9	230938-10
Your Reference	UNITS	PQL	CD-7	CD-9	CD-11	CD-13	CD-15
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Date analysed	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Total Carbon	mg/L	1	34	30	29	28	28
Total Organic Carbon	mg/L	1	15	12	12	12	15
Dissolved Inorganic Carbon	mg/L	1	19	18	17	15	13
Dissolved Organic Carbon	mg/L	1	15	12	12	12	14
Total Suspended Solids	mg/L	5	18	10	11	9	12
Chloride	mg/L	1	120	100	93	86	77

Miscellaneous Inorganics							
Our Reference			230938-11	230938-12	230938-13	230938-17	230938-18
Your Reference	UNITS	PQL	CD-17	CD-19	CD-20	CD-25	CD-26
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Date analysed	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Total Carbon	mg/L	1	29	29	30	29	14
Total Organic Carbon	mg/L	1	16	16	17	15	7
Dissolved Inorganic Carbon	mg/L	1	13	13	14	15	8
Dissolved Organic Carbon	mg/L	1	16	16	16	14	6
Total Suspended Solids	mg/L	5	11	7	8	56	120
Chloride	mg/L	1	78	79	79	84	37

Miscellaneous Inorganics							
Our Reference			230938-19	230938-20	230938-21	230938-22	230938-23
Your Reference	UNITS	PQL	CD-27	CD-28	CD-29	CD-30	P-1
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Date analysed	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Total Carbon	mg/L	1	16	15	9.9	9	[NA]
Total Organic Carbon	mg/L	1	10	10	6	5	[NA]
Dissolved Inorganic Carbon	mg/L	1	7	6	4	4	[NA]
Dissolved Organic Carbon	mg/L	1	9	8	5	5	[NA]
Total Suspended Solids	mg/L	5	73	140	47	29	[NA]
Chloride	mg/L	1	34	27	17	16	5

Miscellaneous Inorganics							
Our Reference			230938-24	230938-25	230938-26	230938-27	230938-28
Your Reference	UNITS	PQL	P-2	P-3	P-4	P-5	P-6
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Date analysed	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Chloride	mg/L	1	4	3	3	2	2

Nutrients in Water							
Our Reference			230938-1	230938-2	230938-3	230938-4	230938-5
Your Reference	UNITS	PQL	GW-7	CD-1	CD-2	CD-3	CD-5
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Date analysed	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Total Nitrogen	mg/L	0.1	0.6	2.2	3.2	2.9	1.3
Total Kjeldahl Nitrogen	mg/L	0.1	0.6	0.6	1.8	0.7	0.6
Nitrate as N	mg/L	0.005	<0.005	1.6	1.4	2.2	0.65
Nitrite as N	mg/L	0.005	<0.005	0.007	0.009	0.006	0.006
NOx as N	mg/L	0.005	<0.005	1.6	1.4	2.2	0.66
Ammonia as N	mg/L	0.005	0.27	0.013	0.051	0.006	0.006
Organic N	mg/L	0.1	0.3	0.6	1.7	0.6	0.6
Total Phosphorus	mg/L	0.01	<0.01	0.15	0.35	0.33	0.24
Phosphate as P	mg/L	0.005	<0.005	0.10	0.074	0.092	0.098
Soluble Nitrogen	mg/L	0.1	0.6	2.1	1.2	2.8	1.2

Nutrients in Water							
Our Reference			230938-6	230938-7	230938-8	230938-9	230938-10
Your Reference	UNITS	PQL	CD-7	CD-9	CD-11	CD-13	CD-15
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Date analysed	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Total Nitrogen	mg/L	0.1	1.3	1.2	1.1	1	1.0
Total Kjeldahl Nitrogen	mg/L	0.1	0.6	0.6	0.6	0.6	0.7
Nitrate as N	mg/L	0.005	0.67	0.60	0.50	0.40	0.31
Nitrite as N	mg/L	0.005	0.006	<0.005	<0.005	0.005	0.005
NOx as N	mg/L	0.005	0.68	0.60	0.51	0.41	0.32
Ammonia as N	mg/L	0.005	0.009	<0.005	<0.005	<0.005	<0.005
Organic N	mg/L	0.1	0.6	0.6	0.6	0.6	0.7
Total Phosphorus	mg/L	0.01	0.16	0.13	0.12	0.16	0.31
Phosphate as P	mg/L	0.005	0.090	0.061	0.056	0.090	0.17
Soluble Nitrogen	mg/L	0.1	1.2	1.1	0.9	0.9	0.9

Client Reference: Ashfield Flats

Nutrients in Water							
Our Reference			230938-11	230938-12	230938-13	230938-17	230938-18
Your Reference	UNITS	PQL	CD-17	CD-19	CD-20	CD-25	CD-26
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Date analysed	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019	08/08/2019
Total Nitrogen	mg/L	0.1	1.0	1.0	1.0	1.4	1.2
Total Kjeldahl Nitrogen	mg/L	0.1	0.7	0.7	0.7	0.9	0.9
Nitrate as N	mg/L	0.005	0.32	0.33	0.33	0.51	0.32
Nitrite as N	mg/L	0.005	0.006	0.006	0.006	0.008	<0.005
NOx as N	mg/L	0.005	0.33	0.33	0.33	0.52	0.33
Ammonia as N	mg/L	0.005	0.008	0.009	0.007	0.023	<0.005
Organic N	mg/L	0.1	0.7	0.7	0.7	0.8	0.9
Total Phosphorus	mg/L	0.01	0.29	0.32	0.31	0.37	0.56
Phosphate as P	mg/L	0.005	0.20	0.19	0.21	0.096	0.038
Soluble Nitrogen	mg/L	0.1	0.9	0.9	0.9	1.0	0.6

Nutrients in Water						
Our Reference			230938-19	230938-20	230938-21	230938-22
Your Reference	UNITS	PQL	CD-27	CD-28	CD-29	CD-30
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019
Date analysed	-		08/08/2019	08/08/2019	08/08/2019	08/08/2019
Total Nitrogen	mg/L	0.1	1.0	1.2	0.9	0.5
Total Kjeldahl Nitrogen	mg/L	0.1	0.8	1.0	0.7	0.4
Nitrate as N	mg/L	0.005	0.18	0.17	0.16	0.16
Nitrite as N	mg/L	0.005	<0.005	0.007	0.007	0.006
NOx as N	mg/L	0.005	0.19	0.18	0.16	0.16
Ammonia as N	mg/L	0.005	0.016	0.020	0.015	0.019
Organic N	mg/L	0.1	0.8	1.0	0.7	0.4
Total Phosphorus	mg/L	0.01	0.78	0.67	0.30	0.16
Phosphate as P	mg/L	0.005	0.079	0.044	0.041	0.035
Soluble Nitrogen	mg/L	0.1	0.6	0.6	0.5	0.5

Total Metals in water							
Our Reference			230938-1	230938-2	230938-3	230938-4	230938-5
Your Reference	UNITS	PQL	GW-7	CD-1	CD-2	CD-3	CD-5
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date digested	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Date analysed	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Aluminium-Total	mg/L	0.01	0.01	0.15	0.34	0.35	0.18
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.007	0.008	0.009	0.009	0.008
Barium-Total	mg/L	0.001	0.048	0.043	0.068	0.051	0.048
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.07	0.08	0.08	0.08	0.08
Cadmium-Total	mg/L	0.0001	<0.0001	0.0004	0.0002	0.0002	<0.0001
Chromium-Total	mg/L	0.001	<0.001	0.001	0.002	0.002	0.001
Cobalt-Total	mg/L	0.001	0.002	0.001	0.002	0.002	0.001
Copper-Total	mg/L	0.001	<0.001	0.011	0.028	0.016	0.011
Iron-Total	mg/L	0.01	7.9	1.7	2.7	2.7	2.0
Lead-Total	mg/L	0.001	<0.001	0.003	0.010	0.015	0.005
Lithium-Total	mg/L	0.0005	0.0012	0.0016	0.0015	0.0014	0.0013
Manganese-Total	mg/L	0.005	0.040	0.024	0.031	0.026	0.025
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.002	0.001	<0.001	<0.001	<0.001
Nickel-Total	mg/L	0.001	<0.001	0.002	0.004	0.002	0.001
Selenium-Total	mg/L	0.001	<0.001	0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	0.0007	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.001	0.002	0.002	0.002	0.002
Zinc-Total	mg/L	0.001	0.002	0.061	0.12	0.11	0.069

Total Metals in water							
Our Reference			230938-6	230938-7	230938-8	230938-9	230938-10
Your Reference	UNITS	PQL	CD-7	CD-9	CD-11	CD-13	CD-15
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date digested	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Date analysed	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Aluminium-Total	mg/L	0.01	0.18	0.13	0.16	0.16	0.20
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.008	0.005	0.005	0.008	0.013
Barium-Total	mg/L	0.001	0.048	0.041	0.041	0.036	0.037
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.07	0.06	0.06	0.06	0.07
Cadmium-Total	mg/L	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.001	<0.001	<0.001	0.001	0.002
Cobalt-Total	mg/L	0.001	0.001	<0.001	<0.001	0.001	0.002
Copper-Total	mg/L	0.001	0.01	0.007	0.007	0.009	0.014
Iron-Total	mg/L	0.01	2.3	1.5	1.4	1.9	2.9
Lead-Total	mg/L	0.001	0.004	0.002	0.003	0.003	0.004
Lithium-Total	mg/L	0.0005	0.0013	0.0011	0.0009	0.0010	0.0013
Manganese-Total	mg/L	0.005	0.029	0.024	0.023	0.023	0.032
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel-Total	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	0.0005	0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.002	0.002	0.002	0.002	0.002
Zinc-Total	mg/L	0.001	0.067	0.055	0.058	0.061	0.073

Total Metals in water							
Our Reference	UNITS	PQL	230938-11	230938-12	230938-13	230938-14	230938-15
Your Reference			CD-17	CD-19	CD-20	CD-22	CD-23
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date digested	-		13/08/2019	16/08/2019	13/08/2019	13/08/2019	13/08/2019
Date analysed	-		13/08/2019	16/08/2019	13/08/2019	13/08/2019	13/08/2019
Aluminium-Total	mg/L	0.01	0.19	0.23	0.23	0.23	0.23
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.013	0.015	0.014	0.014	0.013
Barium-Total	mg/L	0.001	0.035	0.034	0.033	0.033	0.036
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.07	0.07	0.07	0.07	0.07
Cadmium-Total	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium-Total	mg/L	0.001	0.002	0.002	0.002	0.002	0.002
Cobalt-Total	mg/L	0.001	0.002	0.002	0.002	0.002	0.002
Copper-Total	mg/L	0.001	0.014	0.015	0.015	0.015	0.014
Iron-Total	mg/L	0.01	3.1	3.1	3.1	3.2	3.3
Lead-Total	mg/L	0.001	0.004	0.004	0.004	0.004	0.005
Lithium-Total	mg/L	0.0005	0.0013	0.0013	0.0013	0.0013	0.0012
Manganese-Total	mg/L	0.005	0.033	0.034	0.033	0.031	0.032
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Nickel-Total	mg/L	0.001	0.001	0.002	0.001	0.002	0.002
Selenium-Total	mg/L	0.001	0.001	0.001	0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.002	0.002	0.002	0.002	0.002
Zinc-Total	mg/L	0.001	0.069	0.071	0.068	0.073	0.071

Total Metals in water							
Our Reference			230938-16	230938-17	230938-18	230938-19	230938-20
Your Reference	UNITS	PQL	CD-24	CD-25	CD-26	CD-27	CD-28
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date digested	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Date analysed	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Aluminium-Total	mg/L	0.01	0.25	0.56	0.96	0.51	1.0
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.002
Arsenic-Total	mg/L	0.001	0.012	0.016	0.014	0.025	0.063
Barium-Total	mg/L	0.001	0.034	0.052	0.052	0.030	0.042
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.06	0.05	0.03	0.05	0.04
Cadmium-Total	mg/L	0.0001	<0.0001	0.0002	0.0003	0.0002	0.0003
Chromium-Total	mg/L	0.001	0.002	0.002	0.003	0.002	0.005
Cobalt-Total	mg/L	0.001	0.002	0.003	0.003	0.003	0.003
Copper-Total	mg/L	0.001	0.013	0.019	0.023	0.021	0.031
Iron-Total	mg/L	0.01	3.2	5.8	6.6	6.7	20
Lead-Total	mg/L	0.001	0.005	0.014	0.023	0.013	0.023
Lithium-Total	mg/L	0.0005	0.0012	0.0012	0.0010	0.0011	0.0014
Manganese-Total	mg/L	0.005	0.031	0.045	0.074	0.054	0.056
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.001	<0.001	<0.001	<0.001	0.002
Nickel-Total	mg/L	0.001	0.001	0.002	0.002	0.002	0.003
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	0.0006	<0.0005	0.0008
Vanadium-Total	mg/L	0.001	0.002	0.003	0.005	0.003	0.006
Zinc-Total	mg/L	0.001	0.068	0.13	0.18	0.12	0.19

Total Metals in water				
Our Reference			230938-21	230938-22
Your Reference	UNITS	PQL	CD-29	CD-30
Date Sampled			05/08/2019	05/08/2019
Type of sample			Water	Water
Date digested	-		13/08/2019	13/08/2019
Date analysed	-		13/08/2019	13/08/2019
Aluminium-Total	mg/L	0.01	0.52	0.26
Antimony-Total	mg/L	0.001	0.001	<0.001
Arsenic-Total	mg/L	0.001	0.009	0.004
Barium-Total	mg/L	0.001	0.020	0.014
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.02	<0.02
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.003	0.001
Cobalt-Total	mg/L	0.001	0.001	<0.001
Copper-Total	mg/L	0.001	0.014	0.008
Iron-Total	mg/L	0.01	3.0	1.1
Lead-Total	mg/L	0.001	0.009	0.004
Lithium-Total	mg/L	0.0005	0.0008	0.0006
Manganese-Total	mg/L	0.005	0.027	0.014
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	<0.001	<0.001
Nickel-Total	mg/L	0.001	0.003	<0.001
Selenium-Total	mg/L	0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.003	0.002
Zinc-Total	mg/L	0.001	0.11	0.066

Dissolved Metals in Water							
Our Reference			230938-1	230938-2	230938-3	230938-4	230938-5
Your Reference	UNITS	PQL	GW-7	CD-1	CD-2	CD-3	CD-5
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Date analysed	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Aluminium-Dissolved	mg/L	0.01	<0.01	0.07	0.06	0.06	0.06
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.005	0.005	0.004	0.004	0.004
Barium-Dissolved	mg/L	0.001	0.047	0.039	0.033	0.041	0.041
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.05	0.06	0.06	0.06	0.06
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	0.006	0.007	0.005	0.004
Iron-Dissolved	mg/L	0.01	5.6	0.81	0.83	0.80	0.75
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0025	0.0044	0.0030	0.0026	0.0024
Manganese-Dissolved	mg/L	0.005	0.039	0.011	0.015	0.014	0.013
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.002	<0.001	0.001	0.001	<0.001
Nickel-Dissolved	mg/L	0.001	<0.001	0.001	0.002	0.001	0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.003	0.046	0.051	0.042	0.038

Dissolved Metals in Water							
Our Reference	UNITS	PQL	230938-6	230938-7	230938-8	230938-9	230938-10
Your Reference			CD-7	CD-9	CD-11	CD-13	CD-15
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Date analysed	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019	13/08/2019
Aluminium-Dissolved	mg/L	0.01	0.05	0.03	0.03	0.04	0.08
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.004	0.003	0.003	0.004	0.008
Barium-Dissolved	mg/L	0.001	0.040	0.038	0.035	0.033	0.031
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.06	0.05	0.05	0.05	0.06
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.005	0.004	0.003	0.004	0.008
Iron-Dissolved	mg/L	0.01	0.81	0.39	0.34	0.60	1.3
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.002
Lithium-Dissolved	mg/L	0.0005	0.0022	0.0019	0.0016	0.0016	0.0019
Manganese-Dissolved	mg/L	0.005	0.008	0.008	0.009	0.009	0.016
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	<0.001	0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.042	0.040	0.039	0.041	0.054

Dissolved Metals in Water							
Our Reference	UNITS	PQL	230938-11	230938-12	230938-13	230938-17	230938-18
Your Reference			CD-17	CD-19	CD-20	CD-25	CD-26
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		13/08/2019	16/08/2019	13/08/2019	13/08/2019	13/08/2019
Date analysed	-		13/08/2019	16/08/2019	13/08/2019	13/08/2019	13/08/2019
Aluminium-Dissolved	mg/L	0.01	0.08	0.09	0.08	0.06	0.02
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.008	0.009	0.009	0.004	0.002
Barium-Dissolved	mg/L	0.001	0.030	0.028	0.031	0.029	0.019
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.06	0.08	0.06	0.04	0.02
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	0.001	0.001	0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.001	0.001	0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.008	0.008	0.008	0.005	0.003
Iron-Dissolved	mg/L	0.01	1.4	1.6	1.6	0.82	0.19
Lead-Dissolved	mg/L	0.001	0.002	0.002	0.002	0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0020	0.0015	0.0021	0.0019	0.0010
Manganese-Dissolved	mg/L	0.005	0.020	0.021	0.021	0.008	<0.005
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	0.001	0.001	0.001	<0.001
Nickel-Dissolved	mg/L	0.001	0.001	0.001	0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	0.001	<0.001	0.001	0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.054	0.053	0.052	0.046	0.029

Dissolved Metals in Water						
Our Reference			230938-19	230938-20	230938-21	230938-22
Your Reference	UNITS	PQL	CD-27	CD-28	CD-29	CD-30
Date Sampled			05/08/2019	05/08/2019	05/08/2019	05/08/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019
Date analysed	-		13/08/2019	13/08/2019	13/08/2019	13/08/2019
Aluminium-Dissolved	mg/L	0.01	0.05	0.03	0.02	0.02
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.006	0.003	0.002	0.002
Barium-Dissolved	mg/L	0.001	0.016	0.011	0.009	0.009
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.03	0.03	<0.02	<0.02
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.007	0.006	0.004	0.004
Iron-Dissolved	mg/L	0.01	0.81	0.40	0.15	0.12
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0013	0.0012	0.0009	0.0008
Manganese-Dissolved	mg/L	0.005	0.011	0.010	0.006	0.005
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.045	0.033	0.043	0.040

Method ID	Methodology Summary
INORG series	Determination of constituents in waters using colourimetric chemistry
INORG-019	Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104+/-5oC.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Total Nitrogen by colourimetric analysis based on APHA 4500-P J, 4500-NO3 F.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-060	Total Phosphorus by colourimetric analysis based on APHA latest edition 4500-P J.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-021	Determination of Mercury by Cold Vapour AAS. For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

Client Reference: Ashfield Flats

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	230938-2
Date prepared	-			08/08/2019	1	08/08/2019	08/08/2019		08/08/2019	08/08/2019
Date analysed	-			08/08/2019	1	08/08/2019	08/08/2019		08/08/2019	08/08/2019
Total Carbon	mg/L	1	INORG-110	<1	1	41	41	0	105	105
Total Organic Carbon	mg/L	1	INORG-110	<1	1	9	9	0	110	109
Dissolved Inorganic Carbon	mg/L	1	INORG-110	<1	1	33	33	0	109	92
Dissolved Organic Carbon	mg/L	1	INORG-110	<1	1	8	8	0	109	107
Total Suspended Solids	mg/L	5	INORG-019	<5	1	12	[NT]		105	[NT]
Chloride	mg/L	1	INORG-081	<1	1	150	150	0	97	98

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	230938-22
Date prepared	-			[NT]	11	08/08/2019	08/08/2019		08/08/2019	08/08/2019
Date analysed	-			[NT]	11	08/08/2019	08/08/2019		08/08/2019	08/08/2019
Total Carbon	mg/L	1	INORG-110	[NT]	11	29	29	0	[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	11	16	16	0	[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	11	13	13	0	[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	11	16	15	6	[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	11	11	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	78	79	1	97	98

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	08/08/2019	08/08/2019		[NT]	[NT]
Date analysed	-			[NT]	21	08/08/2019	08/08/2019		[NT]	[NT]
Total Carbon	mg/L	1	INORG-110	[NT]	21	9.9	10	1	[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	21	6	6	0	[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	21	4	4	0	[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	21	5	5	0	[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	21	47	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	21	17	17	0	[NT]	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	230938-2
Date prepared	-			08/08/2019	1	08/08/2019	08/08/2019		08/08/2019	08/08/2019
Date analysed	-			08/08/2019	1	08/08/2019	08/08/2019		08/08/2019	08/08/2019
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	0.6	0.6	0	105	110
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	0.6	0.6	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	101	[NT]
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	106	125
NOx as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	100	102
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.27	0.27	0	98	96
Total Phosphorus	mg/L	0.01	INORG-060	<0.01	1	<0.01	<0.01	0	105	80
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	<0.005	<0.005	0	114	87
Soluble Nitrogen	mg/L	0.1	INORG-055	<0.1	1	0.6	0.6	0	110	110

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	08/08/2019	08/08/2019		[NT]	[NT]
Date analysed	-			[NT]	11	08/08/2019	08/08/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	11	1.0	1.0	0	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	11	0.7	0.7	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	11	0.32	0.31	3	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	11	0.006	0.006	0	[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	11	0.33	0.32	3	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	0.008	0.008	0	[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	11	0.29	0.29	0	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	11	0.20	0.20	0	[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	11	0.9	0.9	0	[NT]	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	08/08/2019	08/08/2019		[NT]	[NT]
Date analysed	-			[NT]	21	08/08/2019	08/08/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	21	0.9	1	11	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	21	0.7	[NT]		[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	21	0.16	[NT]		[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	21	0.007	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	21	0.16	[NT]		[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	21	0.015	[NT]		[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	21	0.30	[NT]		[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	21	0.041	[NT]		[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	21	0.5	0.5	0	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	230938-2
Date digested	-			13/08/2019	1	13/08/2019	13/08/2019		13/08/2019	13/08/2019
Date analysed	-			13/08/2019	1	13/08/2019	13/08/2019		13/08/2019	13/08/2019
Aluminium-Total	mg/L	0.01	METALS-022	<0.01	1	0.01	0.01	0	99	92
Antimony-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	82	104
Arsenic-Total	mg/L	0.001	METALS-022	<0.001	1	0.007	0.007	0	99	99
Barium-Total	mg/L	0.001	METALS-022	<0.001	1	0.048	0.047	2	105	99
Beryllium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	109	110
Bismuth-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	92
Boron-Total	mg/L	0.02	METALS-022	<0.02	1	0.07	0.07	0	120	112
Cadmium-Total	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	103	100
Chromium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	95	94
Cobalt-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	95	93
Copper-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	94	89
Iron-Total	mg/L	0.01	METALS-022	<0.01	1	7.9	7.9	0	101	#
Lead-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	99	91
Lithium-Total	mg/L	0.0005	METALS-022	<0.0005	1	0.0012	0.0013	8	103	102
Manganese-Total	mg/L	0.005	METALS-022	<0.005	1	0.040	0.040	0	96	92
Mercury-Total	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	[NT]		105	[NT]
Molybdenum-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	98	105
Nickel-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	93	90
Selenium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	100	98
Silver-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	98
Thallium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	93
Thorium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	101	94
Tin-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	99	100
Uranium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	102	96
Vanadium-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	0.001	0	98	100
Zinc-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	99	86

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	230938-6
Date digested	-			[NT]	5	13/08/2019	13/08/2019		13/08/2019	13/08/2019
Date analysed	-			[NT]	5	13/08/2019	13/08/2019		13/08/2019	13/08/2019
Aluminium-Total	mg/L	0.01	METALS-022	[NT]	5	0.18	[NT]		94	[NT]
Antimony-Total	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		84	[NT]
Arsenic-Total	mg/L	0.001	METALS-022	[NT]	5	0.008	[NT]		101	[NT]
Barium-Total	mg/L	0.001	METALS-022	[NT]	5	0.048	[NT]		105	[NT]
Beryllium-Total	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		95	[NT]
Bismuth-Total	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		101	[NT]
Boron-Total	mg/L	0.02	METALS-022	[NT]	5	0.08	[NT]		100	[NT]
Cadmium-Total	mg/L	0.0001	METALS-022	[NT]	5	<0.0001	[NT]		102	[NT]
Chromium-Total	mg/L	0.001	METALS-022	[NT]	5	0.001	[NT]		98	[NT]
Cobalt-Total	mg/L	0.001	METALS-022	[NT]	5	0.001	[NT]		99	[NT]
Copper-Total	mg/L	0.001	METALS-022	[NT]	5	0.011	[NT]		100	[NT]
Iron-Total	mg/L	0.01	METALS-022	[NT]	5	2.0	[NT]		107	[NT]
Lead-Total	mg/L	0.001	METALS-022	[NT]	5	0.005	[NT]		98	[NT]
Lithium-Total	mg/L	0.0005	METALS-022	[NT]	5	0.0013	[NT]		97	[NT]
Manganese-Total	mg/L	0.005	METALS-022	[NT]	5	0.025	[NT]		98	[NT]
Mercury-Total	mg/L	0.00005	METALS-021	[NT]	5	<0.00005	<0.00005	0	120	94
Molybdenum-Total	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		96	[NT]
Nickel-Total	mg/L	0.001	METALS-022	[NT]	5	0.001	[NT]		97	[NT]
Selenium-Total	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		109	[NT]
Silver-Total	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		103	[NT]
Thallium-Total	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		100	[NT]
Thorium-Total	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		99	[NT]
Tin-Total	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		100	[NT]
Uranium-Total	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		100	[NT]
Vanadium-Total	mg/L	0.001	METALS-022	[NT]	5	0.002	[NT]		101	[NT]
Zinc-Total	mg/L	0.001	METALS-022	[NT]	5	0.069	[NT]		101	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	230938-21
Date digested	-			[NT]	11	13/08/2019	13/08/2019		[NT]	13/08/2019
Date analysed	-			[NT]	11	13/08/2019	13/08/2019		[NT]	13/08/2019
Aluminium-Total	mg/L	0.01	METALS-022	[NT]	11	0.19	0.20	5	[NT]	#
Antimony-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	98
Arsenic-Total	mg/L	0.001	METALS-022	[NT]	11	0.013	0.014	7	[NT]	100
Barium-Total	mg/L	0.001	METALS-022	[NT]	11	0.035	0.034	3	[NT]	104
Beryllium-Total	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	92
Bismuth-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	96
Boron-Total	mg/L	0.02	METALS-022	[NT]	11	0.07	0.07	0	[NT]	93
Cadmium-Total	mg/L	0.0001	METALS-022	[NT]	11	0.0001	0.0001	0	[NT]	100
Chromium-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	97
Cobalt-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	97
Copper-Total	mg/L	0.001	METALS-022	[NT]	11	0.014	0.014	0	[NT]	97
Iron-Total	mg/L	0.01	METALS-022	[NT]	11	3.1	3.0	3	[NT]	#
Lead-Total	mg/L	0.001	METALS-022	[NT]	11	0.004	0.004	0	[NT]	97
Lithium-Total	mg/L	0.0005	METALS-022	[NT]	11	0.0013	0.0013	0	[NT]	94
Manganese-Total	mg/L	0.005	METALS-022	[NT]	11	0.033	0.033	0	[NT]	96
Mercury-Total	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	[NT]		[NT]	127
Molybdenum-Total	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	98
Nickel-Total	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	96
Selenium-Total	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	103
Silver-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	100
Thallium-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	96
Thorium-Total	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	85
Tin-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	94
Uranium-Total	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	99
Vanadium-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	100
Zinc-Total	mg/L	0.001	METALS-022	[NT]	11	0.069	0.070	1	[NT]	101

Client Reference: Ashfield Flats

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date digested	-			[NT]	15	13/08/2019	13/08/2019		[NT]	[NT]
Date analysed	-			[NT]	15	13/08/2019	13/08/2019		[NT]	[NT]
Aluminium-Total	mg/L	0.01	METALS-022	[NT]	15	0.23	[NT]		[NT]	[NT]
Antimony-Total	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Arsenic-Total	mg/L	0.001	METALS-022	[NT]	15	0.013	[NT]		[NT]	[NT]
Barium-Total	mg/L	0.001	METALS-022	[NT]	15	0.036	[NT]		[NT]	[NT]
Beryllium-Total	mg/L	0.0005	METALS-022	[NT]	15	<0.0005	[NT]		[NT]	[NT]
Bismuth-Total	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Boron-Total	mg/L	0.02	METALS-022	[NT]	15	0.07	[NT]		[NT]	[NT]
Cadmium-Total	mg/L	0.0001	METALS-022	[NT]	15	0.0001	[NT]		[NT]	[NT]
Chromium-Total	mg/L	0.001	METALS-022	[NT]	15	0.002	[NT]		[NT]	[NT]
Cobalt-Total	mg/L	0.001	METALS-022	[NT]	15	0.002	[NT]		[NT]	[NT]
Copper-Total	mg/L	0.001	METALS-022	[NT]	15	0.014	[NT]		[NT]	[NT]
Iron-Total	mg/L	0.01	METALS-022	[NT]	15	3.3	[NT]		[NT]	[NT]
Lead-Total	mg/L	0.001	METALS-022	[NT]	15	0.005	[NT]		[NT]	[NT]
Lithium-Total	mg/L	0.0005	METALS-022	[NT]	15	0.0012	[NT]		[NT]	[NT]
Manganese-Total	mg/L	0.005	METALS-022	[NT]	15	0.032	[NT]		[NT]	[NT]
Mercury-Total	mg/L	0.00005	METALS-021	[NT]	15	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Total	mg/L	0.001	METALS-022	[NT]	15	0.001	[NT]		[NT]	[NT]
Nickel-Total	mg/L	0.001	METALS-022	[NT]	15	0.002	[NT]		[NT]	[NT]
Selenium-Total	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Silver-Total	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Thallium-Total	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Thorium-Total	mg/L	0.0005	METALS-022	[NT]	15	<0.0005	[NT]		[NT]	[NT]
Tin-Total	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Uranium-Total	mg/L	0.0005	METALS-022	[NT]	15	<0.0005	[NT]		[NT]	[NT]
Vanadium-Total	mg/L	0.001	METALS-022	[NT]	15	0.002	[NT]		[NT]	[NT]
Zinc-Total	mg/L	0.001	METALS-022	[NT]	15	0.071	[NT]		[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date digested	-			[NT]	20	13/08/2019	13/08/2019		[NT]	[NT]
Date analysed	-			[NT]	20	13/08/2019	13/08/2019		[NT]	[NT]
Aluminium-Total	mg/L	0.01	METALS-022	[NT]	20	1.0	1.0	0	[NT]	[NT]
Antimony-Total	mg/L	0.001	METALS-022	[NT]	20	0.002	0.002	0	[NT]	[NT]
Arsenic-Total	mg/L	0.001	METALS-022	[NT]	20	0.063	0.062	2	[NT]	[NT]
Barium-Total	mg/L	0.001	METALS-022	[NT]	20	0.042	0.041	2	[NT]	[NT]
Beryllium-Total	mg/L	0.0005	METALS-022	[NT]	20	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Total	mg/L	0.001	METALS-022	[NT]	20	<0.001	<0.001	0	[NT]	[NT]
Boron-Total	mg/L	0.02	METALS-022	[NT]	20	0.04	0.04	0	[NT]	[NT]
Cadmium-Total	mg/L	0.0001	METALS-022	[NT]	20	0.0003	0.0003	0	[NT]	[NT]
Chromium-Total	mg/L	0.001	METALS-022	[NT]	20	0.005	0.005	0	[NT]	[NT]
Cobalt-Total	mg/L	0.001	METALS-022	[NT]	20	0.003	0.003	0	[NT]	[NT]
Copper-Total	mg/L	0.001	METALS-022	[NT]	20	0.031	0.030	3	[NT]	[NT]
Iron-Total	mg/L	0.01	METALS-022	[NT]	20	20	19	5	[NT]	[NT]
Lead-Total	mg/L	0.001	METALS-022	[NT]	20	0.023	0.022	4	[NT]	[NT]
Lithium-Total	mg/L	0.0005	METALS-022	[NT]	20	0.0014	0.0013	7	[NT]	[NT]
Manganese-Total	mg/L	0.005	METALS-022	[NT]	20	0.056	0.056	0	[NT]	[NT]
Mercury-Total	mg/L	0.00005	METALS-021	[NT]	20	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Total	mg/L	0.001	METALS-022	[NT]	20	0.002	0.001	67	[NT]	[NT]
Nickel-Total	mg/L	0.001	METALS-022	[NT]	20	0.003	0.003	0	[NT]	[NT]
Selenium-Total	mg/L	0.001	METALS-022	[NT]	20	0.001	0.001	0	[NT]	[NT]
Silver-Total	mg/L	0.001	METALS-022	[NT]	20	<0.001	<0.001	0	[NT]	[NT]
Thallium-Total	mg/L	0.001	METALS-022	[NT]	20	<0.001	<0.001	0	[NT]	[NT]
Thorium-Total	mg/L	0.0005	METALS-022	[NT]	20	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Total	mg/L	0.001	METALS-022	[NT]	20	0.001	0.001	0	[NT]	[NT]
Uranium-Total	mg/L	0.0005	METALS-022	[NT]	20	0.0008	0.0007	13	[NT]	[NT]
Vanadium-Total	mg/L	0.001	METALS-022	[NT]	20	0.006	0.006	0	[NT]	[NT]
Zinc-Total	mg/L	0.001	METALS-022	[NT]	20	0.19	0.19	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	230938-2
Date prepared	-			13/08/2019	1	13/08/2019	13/08/2019		13/08/2019	13/08/2019
Date analysed	-			13/08/2019	1	13/08/2019	13/08/2019		13/08/2019	13/08/2019
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	1	<0.01	<0.01	0	93	94
Antimony-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	95	97
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.005	0.004	22	102	105
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.047	0.048	2	107	109
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	87	90
Bismuth-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	94
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	1	0.05	0.05	0	88	90
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	104	108
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	98	96
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	99	95
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	95	90
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	1	5.6	5.5	2	102	#
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	102	97
Lithium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	0.0025	0.0039	44	97	93
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	1	0.039	0.038	3	100	96
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	[NT]		118	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	102	107
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	95	90
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	100	103
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	111	102
Thallium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	107	99
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	104	102
Tin-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	105	107
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	103	101
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	101	102
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.003	0.003	0	99	99

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	230938-4
Date prepared	-			[NT]	3	13/08/2019	13/08/2019		13/08/2019	13/08/2019
Date analysed	-			[NT]	3	13/08/2019	13/08/2019		13/08/2019	13/08/2019
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	3	0.06	[NT]		99	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	3	<0.001	[NT]		98	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	3	0.004	[NT]		101	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	3	0.033	[NT]		108	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	3	<0.0005	[NT]		84	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	3	<0.001	[NT]		103	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	3	0.06	[NT]		81	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	3	<0.0001	[NT]		103	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	3	<0.001	[NT]		96	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	3	<0.001	[NT]		97	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	3	0.007	[NT]		94	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	3	0.83	[NT]		102	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	3	0.001	[NT]		101	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	3	0.0030	[NT]		96	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	3	0.015	[NT]		97	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	3	<0.00005	<0.00005	0	120	114
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	3	0.001	[NT]		100	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	3	0.002	[NT]		94	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	3	<0.001	[NT]		100	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	3	<0.001	[NT]		110	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	3	<0.001	[NT]		105	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	3	<0.0005	[NT]		103	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	3	<0.001	[NT]		106	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	3	<0.0005	[NT]		102	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	3	<0.001	[NT]		100	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	3	0.051	[NT]		98	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	13/08/2019	13/08/2019		[NT]	[NT]
Date analysed	-			[NT]	11	13/08/2019	13/08/2019		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	11	0.08	0.08	0	[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.008	0.009	12	[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.030	0.030	0	[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	11	0.06	0.06	0	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	11	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.008	0.008	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	11	1.4	1.5	7	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	0.0020	0.0020	0	[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	11	0.020	0.021	5	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	[NT]		[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	0.001	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.054	0.054	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	13	13/08/2019	13/08/2019		[NT]	[NT]
Date analysed	-			[NT]	13	13/08/2019	13/08/2019		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	13	0.08	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.009	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.031	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	13	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	13	0.06	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	13	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.001	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.008	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	13	1.6	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.002	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	13	0.0021	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	13	0.021	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	13	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.001	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.001	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	13	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	13	<0.0005	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.052	[NT]		[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Samples received in good order: No
Nutrients received out of holding time.
Sample #1 labelled as MW7
Samples #14-16 - dissolved metals bottles not provided, unable to test.

Percent recovery not available due to the analyte signal being much greater than the spike amount. An acceptable recovery was achieved for the LCS.

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
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Perth Lab - MPL Laboratories
16-18 Hayden Crt, Myaree, WA 6154
Ph: 08 9317 2505 / lab@mpl.com.au

Melbourne Lab - Envirolab Services
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Adelaide Office - Envirolab Services
7a The Parade, Norwood, SA 5067
Ph: 08 7087 6800 / adelaide@envirolab.com.au

Brisbane Office - Envirolab Services
20a, 10-20 Depot St, Banyo, QLD 4014
Ph: 07 3266 9532 / brisbane@envirolab.com.au

Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Client: Department of Biodiversity Conservation and Attractions
Contact Person: Dr Gavan McGrath
Project Mgr: Jasmine Rutherford
Sampler: Dr Gavan McGrath
Address: 17 Dick Perry Avenue, Kensignton, 6151, WA
Phone: 08 9219 9447 **Mob:** 0458 559 765
Email: gavan.mcgrath@dbca.wa.gov.au

Client Project Name / Number / Site etc (ie report title): Ashfield Flats
PO No.:
Envirolab Quote No. : 19P132
Date results required:
Or choose: standard / same day / 1 day / 2 day / 3 day
standard
Additional report format: esdat / equis /
Lab Comments: Nutrients received out of HT. 8/8

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Comments: Provide as much information about the sample as you can
1	GW-7 (MW 7)		5/08/2019	Water	x	x	x	x	x	x	All samples unfiltered
2	CD-1		5/08/2019	Water	x	x	x	x	x	x	
3	CD-2		5/08/2019	Water	x	x	x	x	x	x	
4	CD-3		5/08/2019	Water	x	x	x	x	x	x	
5	CD-5		5/08/2019	Water	x	x	x	x	x	x	
6	CD-7		5/08/2019	Water	x	x	x	x	x	x	
7	CD-9		5/08/2019	Water	x	x	x	x	x	x	
8	CD-11		5/08/2019	Water	x	x	x	x	x	x	
9	CD-13		5/08/2019	Water	x	x	x	x	x	x	
10	CD-15		5/08/2019	Water	x	x	x	x	x	x	
11	CD-17		5/08/2019	Water	x	x	x	x	x	x	
12	CD-19		5/08/2019	Water	x	x	x	x	x	x	

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company): DBCA	Received by (Company): MPL	Lab Use Only	
Print Name: Gavan McGrath	Print Name: C. Tadena	Job number: 230938	Cooling: Ice / Ice pack / None
Date & Time: 07/08/2019 16:00	Date & Time: 7/8/19 @ 1515	Temperature: 8	Security seal: Intact / Broken / None
Signature:	Signature: CT	TAT Req - SAME day / 1 / 2 / 3 / 4 / STD	

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ENVIROLAB mpl

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	**PO No.:**
Project Mgr: Jasmine Rutherford	**Envirolab Quote No. :** 19P132
Sampler: Dr Gavan McGrath	**Date results required:**
Address: 17 Dick Perry Avenue, Kensington, 6151, WA	**Or choose: standard / same day / 1 day / 2 day / 3 day** standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format: esdat / equis /**
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Ph: 02 9910 6200 / sydney@envirolab.com.au

Perth Lab - MPL Laboratories
16-18 Hayden Crt, Myaree, WA 6154
Ph: 08 9317 2505 / lab@mpl.com.au

Melbourne Lab - Envirolab Services
25 Research Drive, Croydon South, VIC 3136
Ph: 03 9763 2500 / melbourne@envirolab.com.au

Adelaide Office - Envirolab Services
7a The Parade, Norwood, SA 5067
Ph: 08 7087 6800 / adelaide@envirolab.com.au

Brisbane Office - Envirolab Services
20a, 10-20 Depot St, Banyo, QLD 4014
Ph: 07 3266 9532 / brisbane@envirolab.com.au

Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample information					Tests Required															Comments
Envirolab Sample ID	**Client Sample ID or information**	**Depth**	**Date sampled**	**Type of sample**	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride										**Provide as much information about the sample as you can**
13	CD-20		5/08/2019	Water	x	x	x	x	x	x										
14	CD-22		5/08/2019	Water	x	~~x~~														
15	CD-23		5/08/2019	Water	x	~~x~~														
16	CD-24		5/08/2019	Water	x	~~x~~														
17	CD-25		5/08/2019	Water	x	x	x	x	x	x										
18	CD-26		5/08/2019	Water	x	x	x	x	x	x										
19	CD-27		5/08/2019	Water	x	x	x	x	x	x										
20	CD-28		5/08/2019	Water	x	x	x	x	x	x										
21	CD-29		5/08/2019	Water	x	x	x	x	x	x										
22	CD-30		5/08/2019	Water	x	x	x	x	x	x										
23	P-1		5/08/2019	Water						x										
24	P-2		5/08/2019	Water						x										

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company):	**Received by (Company):** MPL	***Lab Use Only***
Print Name:	**Print Name:** C. Tadipa	**Job number:** 230938 — **Cooling: Ice / Ice pack / None**
Date & Time:	**Date & Time:** 7/8/19	**Temperature:** — **Security seal: Intact / Broken / None**
Signature:	**Signature:**	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions
Contact Person: Dr Gavan McGrath
Project Mgr: Jasmine Rutherford
Sampler: Dr Gavan McGrath
Address: 17 Dick Perry Avenue, Kensington, 6151, WA
Phone: 08 9219 9447 **Mob:** 0458 559 765
Email: gavan.mcgrath@dbca.wa.gov.au

Client Project Name / Number / Site etc (ie report title): Ashfield Flats
PO No.:
Envirolab Quote No. : 19P132
Date results required:
Or choose: standard / same day / 1 day / 2 day / 3 day
standard
Additional report format: esdat / equis /
Lab Comments:

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Ph: 02 9910 6200 / sydney@envirolab.com.au

Perth Lab - MPL Laboratories
16-18 Hayden Crt, Myaree, WA 6154
Ph: 08 9317 2505 / lab@mpl.com.au

Melbourne Lab - Envirolab Services
25 Research Drive, Croydon South, VIC 3136
Ph: 03 9763 2500 / melbourne@envirolab.com.au

Adelaide Office - Envirolab Services
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Ph: 08 7087 6800 / adelaide@envirolab.com.au

Brisbane Office - Envirolab Services
20a, 10-20 Depot St, Banyo, QLD 4014
Ph: 07 3266 9532 / brisbane@envirolab.com.au

Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Chloride	Comments: Provide as much information about the sample as you can
25	P-3		5/08/2019	Water	x	
26	P-4		5/08/2019	Water	x	
27	P-5		5/08/2019	Water	x	
28	P-6		5/08/2019	Water	x	

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company):		**Received by (Company):**	MPL	**Lab Use Only**	
Print Name:		**Print Name:**	C. Todino	**Job number:** 230938	**Cooling: Ice / Ice pack / None**
Date & Time:		**Date & Time:**	7/8/19	**Temperature:**	**Security seal: Intact / Broken / None**
Signature:	[signature]	**Signature:**	[signature]	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**	

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph 08 9317 2505 fax 08 9317 4163
lab@mpl.com.au
www.mpl.com.au

SAMPLE RECEIPT ADVICE

Client Details	
Client	Dept of Biodiversity,Conservation and Attractions
Attention	Gavan McGrath

Sample Login Details	
Your reference	Ashfield Flats
MPL Reference	230938
Date Sample Received	07/08/2019
Date Instructions Received	07/08/2019
Date Results Expected to be Reported	16/08/2019

Sample Condition	
Samples received in appropriate condition for analysis	No
No. of Samples Provided	28 Water
Turnaround Time Requested	Standard
Temperature on Receipt (°C)	8
Cooling Method	Ice Pack
Sampling Date Provided	Yes

Comments

Nutrients received out of holding time.
Sample #1 labelled as MW7
Samples #14-16 - dissolved metals bottles not provided, unable to test.

Please contact the laboratory within 24 hours if you wish to cancel the aformentioned testing. Otherwise testing will proceed as per the COC and hence invoice accordingly.

Please direct any queries to:

Heram Halim	Meredith Conroy
Phone: 08 9317 2505	**Phone: 08 9317 2505**
Fax: 08 9317 4163	**Fax: 08 9317 4163**
Email: hhalim@mpl.com.au	**Email: mconroy@mpl.com.au**

Analysis Underway, details on the following page:

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
ABN 53 140 099 207
16-18 Hayden Court Myaree WA 6154
ph 08 9317 2505 fax 08 9317 4163
lab@mpl.com.au
www.mpl.com.au

Sample ID	Total Carbon	Total Organic Carbon	Dissolved Inorganic Carbon	Dissolved Organic Carbon	Total Suspended Solids	Chloride	Nutrients in Water	Total Metals in water	Dissolved Metals in Water
GW-7	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-1	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-2	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-3	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-5	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-7	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-9	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-11	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-13	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-15	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-17	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-19	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-20	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-22								✓	
CD-23								✓	
CD-24								✓	
CD-25	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-26	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-27	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-28	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-29	✓	✓	✓	✓	✓	✓	✓	✓	✓
CD-30	✓	✓	✓	✓	✓	✓	✓	✓	✓
P-1						✓			
P-2						✓			
P-3						✓			
P-4						✓			
P-5						✓			
P-6						✓			

The '✓' indicates the testing you have requested. **THIS IS NOT A REPORT OF THE RESULTS.**

Additional Info

Sample storage - Waters are routinely disposed of approximately 1 month and soils approximately 2 months from receipt.
Requests for longer term sample storage must be received in writing.

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr: Jasmine Rutherford	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensignton, 6151, WA	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day — standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format:** esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Ph: 02 9910 6200 / sydney@envirolab.com.au

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Adelaide Office - Envirolab Services
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Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample information					Tests Required						Comments
Envirolab Sample ID	Client Sample ID or information	Time	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Provide as much information about the sample as you can
1	MW-7	16:30	22/08/2019	Water	x	x	x	x		x	All samples unfiltered
2	CD-1	17:00	22/08/2019	Water	x	x	x	x	x	x	Dates on bottles offset
3	CD-2	17:30	22/08/2019	Water	x	x	x'	x	x	x	by 1 day
4	CD-3	18:00	22/08/2019	Water						x	Hold for metals
5	CD-4	18:30	22/08/2019	Water	x	x	x	x	x	x	
6	CD-5	19:00	22/08/2019	Water						x	Hold for metals
7	CD-6	19:30	22/08/2019	Water	x	x	x	x	x	x	
8	CD-7	20:00	22/08/2019	Water						x	Hold for metals
9	CD-8	20:30	22/08/2019	Water	x	x	x	x	x	x	
10	CD-9	21:00	22/08/2019	Water						x	Hold for metals
11	CD-10	21:30	22/08/2019	Water	x	x	x	x	x	x	
12	CD-11	22:00	22/08/2019	Water						x	Hold for metals

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company): DBCA	**Received by (Company):** MPL	**Lab Use Only**
Print Name: Gavan McGrath	**Print Name:** C. Tagina	**Job number:** 23729 — **Cooling:** Ice / Ice pack / None
Date & Time: 23/8/19 16:00	**Date & Time:** 23/8/19 @ 1425	**Temperature:** 15 — **Security seal:** Intact / Broken / None
Signature:	**Signature:**	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

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CHAIN OF COUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr: Jasmine Rutherford	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensington, 6151, WA	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day — standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format:** esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Ph: 02 9910 6200 / sydney@envirolab.com.au

Perth Lab - MPL Laboratories
16-18 Hayden Crt, Myaree, WA 6154
Ph: 08 9317 2505 / lab@mpl.com.au

Melbourne Lab - Envirolab Services
25 Research Drive, Croydon South, VIC 3136
Ph: 03 9763 2500 / melbourne@envirolab.com.au

Adelaide Office - Envirolab Services
7a The Parade, Norwood, SA 5067
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Brisbane Office - Envirolab Services
20a, 10-20 Depot St, Banyo, QLD 4014
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Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample information					Tests Required						Comments
Envirolab Sample ID	Client Sample ID or information	Time	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Provide as much information about the sample as you can
13	CD-12	22:30	22/08/2019	Water	x	x	x	x	x	x	All samples unfiltered
14	CD-13	23:00	22/08/2019	Water	x	x	x	x	x	x	
15	CD-14	00:00	23/08/2019	Water	x	x	x	x	x	x	
DNR	+ CD-15	00:30	23/08/2019	Water						x	Hold for metals
16	CD-16	01:00	23/08/2019	Water	x	x	x	x	x	x	
17	CD-17	01:30	23/08/2019	Water						x	Hold for metals
18	CD-18	02:00	23/08/2019	Water	x	x	x	x	x	x	
19	CD-19	02:30	23/08/2019	Water						x	Hold for metals
20	CD-20	03:00	23/08/2019	Water	x	x	x	x	x	x	
21	CD-21	03:30	23/08/2019	Water	x	x	x	x	x	x	
22	CD-22	04:00	23/08/2019	Water						x	Hold for metals
~~23~~	60										

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

		Lab Use Only	
Relinquished by (Company): DBCA	**Received by (Company):** MPL		
Print Name: Gavan McGrath	**Print Name:** C. Taylor	**Job number:**	**Cooling: Ice / Ice pack / None**
Date & Time:	**Date & Time:** 23/8/19	**Temperature:**	**Security seal: Intact / Broken / None**
Signature:	**Signature:** Cf	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**	

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ENVIROLAB ENVIROLAB mpl

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr: Jasmine Rutherford	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensignton, 6151, WA	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day — standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format:** esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

Sydney Lab - Envirolab Services
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Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample information					Tests Required														Comments
Envirolab Sample ID	Client Sample ID or information	Time	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Hold								Provide as much information about the sample as you can
23	CD-23	05:00	23/08/2019	Water	x	x	x	x	x	x									All samples unfiltered
24	CD-24	06:00	23/08/2019	Water						x									Hold for metals
25	CD-25	07:00	23/08/2019	Water	x	x	x	x	x	x									
26	x CD-26	08:00	23/08/2019	Water						x									Hold for metals
27	CD-27	09:00	23/08/2019	Water	x	x	x	x	x	x									
28	CD-28	10:00	23/08/2019	Water						x									Hold for metals
29	CD-29	11:00	23/08/2019	Water	x	x	x	x	x	x									
30	P1		23/08/2019	Water						x									
31	P2		23/08/2019	Water						x									
32	P3		23/08/2019	Water						x									
Empty	P4		23/08/2019	Water						x									
33	CD-13	0600	23/8/19								x	WE23/8							

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company): DBCA	**Received by (Company):** MPL	**Lab Use Only**
Print Name: Gavan McGrath	**Print Name:** C. Tagina	**Job number:** / **Cooling:** Ice / Ice pack / None
Date & Time:	**Date & Time:** 23/8/19	**Temperature:** / **Security seal:** Intact / Broken / None
Signature:	**Signature:** CT	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
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16-18 Hayden Court Myaree WA 6154
ph 08 9317 2505 fax 08 9317 4163
lab@mpl.com.au
www.mpl.com.au

CERTIFICATE OF ANALYSIS 231729

Client Details

Client	Dept of Biodiversity,Conservation and Attractions
Attention	Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details

Your Reference	Ashfield Flats
Number of Samples	33 Water
Date samples received	26/08/2019
Date completed instructions received	23/08/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	29/08/2019
Date of Issue	02/09/2019

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Heram Halim, Operations Manager
Michael Mowle, Metals/Inorganics Supervisor

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorganics							
Our Reference			231729-1	231729-2	231729-3	231729-4	231729-5
Your Reference	UNITS	PQL	MW-7	CD-1	CD-2	CD-3	CD-4
Date Sampled			22/08/2019	22/08/2019	22/08/2019	22/08/2019	22/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			04:30 PM	05:00 PM	05:30 PM	06:00 PM	06:30 PM
Date prepared	-		26/08/2019	26/08/2019	26/08/2019	[NA]	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019	[NA]	26/08/2019
Total Carbon	mg/L	1	47	38	38	[NA]	38
Total Organic Carbon	mg/L	1	6	16	16	[NA]	16
Dissolved Inorganic Carbon	mg/L	1	38	22	22	[NA]	22
Dissolved Organic Carbon	mg/L	1	5	16	16	[NA]	16
Total Suspended Solids	mg/L	5	[NA]	<5	<5	[NA]	<5
Chloride	mg/L	1	140	130	130	130	120

Miscellaneous Inorganics							
Our Reference			231729-6	231729-7	231729-8	231729-9	231729-10
Your Reference	UNITS	PQL	CD-5	CD-6	CD-7	CD-8	CD-9
Date Sampled			22/08/2019	22/08/2019	22/08/2019	22/08/2019	22/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			07:00 PM	07:30 PM	08:00 PM	08:30 PM	09:00 PM
Date prepared	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Total Carbon	mg/L	1	[NA]	38	[NA]	13	[NA]
Total Organic Carbon	mg/L	1	[NA]	15	[NA]	9	[NA]
Dissolved Inorganic Carbon	mg/L	1	[NA]	23	[NA]	7	[NA]
Dissolved Organic Carbon	mg/L	1	[NA]	15	[NA]	6	[NA]
Total Suspended Solids	mg/L	5	[NA]	<5	[NA]	110	[NA]
Chloride	mg/L	1	130	130	120	24	41

Miscellaneous Inorganics							
Our Reference			231729-11	231729-12	231729-13	231729-14	231729-15
Your Reference	UNITS	PQL	CD-10	CD-11	CD-12	CD-13	CD-14
Date Sampled			22/08/2019	22/08/2019	22/08/2019	22/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			09:30 PM	10:00 PM	10:30 PM	11:00 PM	12:00 AM
Date prepared	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Total Carbon	mg/L	1	13	[NA]	14	16	12
Total Organic Carbon	mg/L	1	10	[NA]	7	8	7
Dissolved Inorganic Carbon	mg/L	1	6	[NA]	8	9	6
Dissolved Organic Carbon	mg/L	1	7	[NA]	6	7	5
Total Suspended Solids	mg/L	5	36	[NA]	18	8	20
Chloride	mg/L	1	24	24	28	34	28

Miscellaneous Inorganics							
Our Reference			231729-16	231729-17	231729-18	231729-19	231729-20
Your Reference	UNITS	PQL	CD-16	CD-17	CD-18	CD-19	CD-20
Date Sampled			23/08/2019	23/08/2019	23/08/2019	23/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			01:00 PM	01:30 PM	02:00 AM	02:30 AM	03:00 AM
Date prepared	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Total Carbon	mg/L	1	11	[NA]	9	[NA]	9
Total Organic Carbon	mg/L	1	6	[NA]	5	[NA]	5
Dissolved Inorganic Carbon	mg/L	1	6	[NA]	5	[NA]	4
Dissolved Organic Carbon	mg/L	1	5	[NA]	4	[NA]	4
Total Suspended Solids	mg/L	5	8	[NA]	11	[NA]	<5
Chloride	mg/L	1	24	20	17	15	16

Miscellaneous Inorganics							
Our Reference			231729-21	231729-22	231729-23	231729-24	231729-25
Your Reference	UNITS	PQL	CD-21	CD-22	CD-23	CD-24	CD-25
Date Sampled			23/08/2019	23/08/2019	23/08/2019	23/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:30 AM	04:00 AM	05:00 AM	06:00 AM	07:00 AM
Date prepared	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Total Carbon	mg/L	1	9	[NA]	11	[NA]	16
Total Organic Carbon	mg/L	1	5	[NA]	6	[NA]	9
Dissolved Inorganic Carbon	mg/L	1	5	[NA]	6	[NA]	9
Dissolved Organic Carbon	mg/L	1	4	[NA]	5	[NA]	8
Total Suspended Solids	mg/L	5	7	[NA]	<5	[NA]	7
Chloride	mg/L	1	18	21	27	35	46

Miscellaneous Inorganics							
Our Reference			231729-26	231729-27	231729-28	231729-29	231729-30
Your Reference	UNITS	PQL	CD-26	CD-27	CD-28	CD-29	P1
Date Sampled			23/08/2019	23/08/2019	23/08/2019	23/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 AM	09:00 AM	10:00 AM	11:00 AM	
Date prepared	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Total Carbon	mg/L	1	[NA]	20	[NA]	21	[NA]
Total Organic Carbon	mg/L	1	[NA]	9	[NA]	10	[NA]
Dissolved Inorganic Carbon	mg/L	1	[NA]	12	[NA]	12	[NA]
Dissolved Organic Carbon	mg/L	1	[NA]	8	[NA]	9	[NA]
Total Suspended Solids	mg/L	5	[NA]	<5	[NA]	<5	[NA]
Chloride	mg/L	1	55	54	51	59	7

Miscellaneous Inorganics				
Our Reference			231729-31	231729-32
Your Reference	UNITS	PQL	P2	P3
Date Sampled			23/08/2019	23/08/2019
Type of sample			Water	Water
Time Sampled				
Date prepared	-		26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019
Chloride	mg/L	1	7	5

Nutrients in Water							
Our Reference			231729-1	231729-2	231729-3	231729-5	231729-7
Your Reference	UNITS	PQL	MW-7	CD-1	CD-2	CD-4	CD-6
Date Sampled			22/08/2019	22/08/2019	22/08/2019	22/08/2019	22/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			04:30 PM	05:00 PM	05:30 PM	06:30 PM	07:30 PM
Date prepared	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Total Nitrogen	mg/L	0.1	0.6	1.4	1.4	1.4	1.5
Total Kjeldahl Nitrogen	mg/L	0.1	0.6	0.7	0.9	0.8	0.7
Nitrate as N	mg/L	0.005	<0.005	0.65	0.50	0.60	0.77
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	<0.005	0.65	0.50	0.60	0.78
Ammonia as N	mg/L	0.005	0.30	0.008	0.007	0.008	<0.005
Organic N	mg/L	0.1	0.3	0.7	0.9	0.8	0.7
Total Phosphorus	mg/L	0.01	<0.01	0.12	0.12	0.11	0.11
Phosphate as P	mg/L	0.005	<0.005	0.097	0.10	0.084	0.081
Soluble Nitrogen	mg/L	0.1	0.5	1.3	1.3	1.4	1.4

Nutrients in Water							
Our Reference			231729-9	231729-11	231729-13	231729-14	231729-15
Your Reference	UNITS	PQL	CD-8	CD-10	CD-12	CD-13	CD-14
Date Sampled			22/08/2019	22/08/2019	22/08/2019	22/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:30 PM	09:30 PM	10:30 PM	11:00 PM	12:00 AM
Date prepared	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Total Nitrogen	mg/L	0.1	1.6	0.9	0.6	0.7	0.5
Total Kjeldahl Nitrogen	mg/L	0.1	1.4	0.8	0.4	0.4	0.4
Nitrate as N	mg/L	0.005	0.17	0.13	0.22	0.23	0.15
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	0.17	0.13	0.22	0.23	0.15
Ammonia as N	mg/L	0.005	<0.005	<0.005	0.045	<0.005	<0.005
Organic N	mg/L	0.1	1.4	0.8	0.4	0.4	0.4
Total Phosphorus	mg/L	0.01	0.36	0.25	0.09	0.09	0.12
Phosphate as P	mg/L	0.005	0.048	0.037	0.038	0.047	0.047
Soluble Nitrogen	mg/L	0.1	0.5	0.5	0.5	0.6	0.5

Nutrients in Water							
Our Reference			231729-16	231729-18	231729-20	231729-21	231729-23
Your Reference	UNITS	PQL	CD-16	CD-18	CD-20	CD-21	CD-23
Date Sampled			23/08/2019	23/08/2019	23/08/2019	23/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			01:00 PM	02:00 AM	03:00 AM	03:30 AM	05:00 AM
Date prepared	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019	26/08/2019	26/08/2019
Total Nitrogen	mg/L	0.1	0.4	0.4	0.3	0.4	0.4
Total Kjeldahl Nitrogen	mg/L	0.1	0.3	0.3	0.3	0.3	0.3
Nitrate as N	mg/L	0.005	0.12	0.095	0.074	0.10	0.11
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	0.12	0.096	0.075	0.10	0.11
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Organic N	mg/L	0.1	0.3	0.3	0.3	0.3	0.3
Total Phosphorus	mg/L	0.01	0.09	0.09	0.06	0.06	0.07
Phosphate as P	mg/L	0.005	0.034	0.044	0.037	0.040	0.046
Soluble Nitrogen	mg/L	0.1	0.4	0.3	0.3	0.3	0.4

Nutrients in Water					
Our Reference			231729-25	231729-27	231729-29
Your Reference	UNITS	PQL	CD-25	CD-27	CD-29
Date Sampled			23/08/2019	23/08/2019	23/08/2019
Type of sample			Water	Water	Water
Time Sampled			07:00 AM	09:00 AM	11:00 AM
Date prepared	-		26/08/2019	26/08/2019	26/08/2019
Date analysed	-		26/08/2019	26/08/2019	26/08/2019
Total Nitrogen	mg/L	0.1	0.6	0.7	0.7
Total Kjeldahl Nitrogen	mg/L	0.1	0.4	0.5	0.5
Nitrate as N	mg/L	0.005	0.12	0.23	0.22
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	0.12	0.24	0.22
Ammonia as N	mg/L	0.005	0.01	0.008	0.01
Organic N	mg/L	0.1	0.4	0.5	0.5
Total Phosphorus	mg/L	0.01	0.12	0.07	0.08
Phosphate as P	mg/L	0.005	0.038	0.027	0.040
Soluble Nitrogen	mg/L	0.1	0.5	0.7	0.7

Dissolved Metals in Water							
Our Reference			231729-1	231729-2	231729-3	231729-5	231729-7
Your Reference	UNITS	PQL	MW-7	CD-1	CD-2	CD-4	CD-6
Date Sampled			22/08/2019	22/08/2019	22/08/2019	22/08/2019	22/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			04:30 PM	05:00 PM	05:30 PM	06:30 PM	07:30 PM
Date prepared	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Date analysed	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Aluminium-Dissolved	mg/L	0.01	<0.01	0.08	0.08	0.07	0.06
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.006	0.004	0.004	0.004	0.003
Barium-Dissolved	mg/L	0.001	0.042	0.040	0.041	0.042	0.040
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.06	0.08	0.08	0.08	0.07
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.002	0.001	0.001	0.001	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	0.004	0.004	0.004	0.004
Iron-Dissolved	mg/L	0.01	7.3	1.2	1.1	1.2	0.81
Lead-Dissolved	mg/L	0.001	<0.001	0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0013	0.0013	0.0013	0.0013	0.0012
Manganese-Dissolved	mg/L	0.005	0.039	0.025	0.027	0.028	0.024
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.002	<0.001	<0.001	<0.001	0.001
Nickel-Dissolved	mg/L	0.001	<0.001	0.001	0.001	0.001	0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0007
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.001	0.042	0.044	0.047	0.047

Dissolved Metals in Water							
Our Reference			231729-9	231729-11	231729-13	231729-14	231729-15
Your Reference	UNITS	PQL	CD-8	CD-10	CD-12	CD-13	CD-14
Date Sampled			22/08/2019	22/08/2019	22/08/2019	22/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:30 PM	09:30 PM	10:30 PM	11:00 PM	12:00 AM
Date prepared	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Date analysed	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Aluminium-Dissolved	mg/L	0.01	0.02	0.03	0.02	0.03	0.02
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.001	0.002	0.002	0.003	0.002
Barium-Dissolved	mg/L	0.001	0.011	0.009	0.012	0.015	0.011
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.02	0.02	0.02	0.03	0.03
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.002	0.004	0.003	0.003	0.003
Iron-Dissolved	mg/L	0.01	0.20	0.19	0.15	0.33	0.19
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	0.0005	0.0007	0.0007
Manganese-Dissolved	mg/L	0.005	<0.005	0.01	0.009	0.013	0.0099
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.022	0.036	0.036	0.046	0.044

Dissolved Metals in Water							
Our Reference			231729-16	231729-18	231729-20	231729-21	231729-23
Your Reference	UNITS	PQL	CD-16	CD-18	CD-20	CD-21	CD-23
Date Sampled			23/08/2019	23/08/2019	23/08/2019	23/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			01:00 PM	02:00 AM	03:00 AM	03:30 AM	05:00 AM
Date prepared	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Date analysed	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Aluminium-Dissolved	mg/L	0.01	0.03	0.02	0.02	0.02	0.03
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.002	0.002	0.002	0.002	0.004
Barium-Dissolved	mg/L	0.001	0.01	0.008	0.008	0.009	0.012
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.03	0.02	0.02	0.02	0.04
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.003	0.003	0.003	0.003	0.004
Iron-Dissolved	mg/L	0.01	0.17	0.15	0.15	0.16	0.25
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0006	0.0005	0.0005	0.0005	0.0008
Manganese-Dissolved	mg/L	0.005	0.01	0.008	0.007	0.008	0.012
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.044	0.039	0.039	0.040	0.053

Dissolved Metals in Water					
Our Reference			231729-25	231729-27	231729-29
Your Reference	UNITS	PQL	CD-25	CD-27	CD-29
Date Sampled			23/08/2019	23/08/2019	23/08/2019
Type of sample			Water	Water	Water
Time Sampled			07:00 AM	09:00 AM	11:00 AM
Date prepared	-		29/08/2019	29/08/2019	29/08/2019
Date analysed	-		29/08/2019	29/08/2019	29/08/2019
Aluminium-Dissolved	mg/L	0.01	0.03	0.03	0.04
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.005	0.002	0.003
Barium-Dissolved	mg/L	0.001	0.027	0.029	0.028
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.1	0.1	0.1
Cadmium-Dissolved	mg/L	0.0001	0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.002	0.002	0.002
Copper-Dissolved	mg/L	0.001	0.007	0.004	0.004
Iron-Dissolved	mg/L	0.01	0.27	0.17	0.28
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0022	0.0019	0.0018
Manganese-Dissolved	mg/L	0.005	0.046	0.050	0.048
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	0.001	0.001	0.001	0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.15	0.15	0.13

Total Metals in water							
Our Reference			231729-1	231729-2	231729-3	231729-5	231729-7
Your Reference	UNITS	PQL	MW-7	CD-1	CD-2	CD-4	CD-6
Date Sampled			22/08/2019	22/08/2019	22/08/2019	22/08/2019	22/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			04:30 PM	05:00 PM	05:30 PM	06:30 PM	07:30 PM
Date digested	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Date analysed	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Aluminium-Total	mg/L	0.01	0.05	0.15	0.14	0.15	0.14
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.007	0.006	0.006	0.006	0.005
Barium-Total	mg/L	0.001	0.043	0.043	0.044	0.043	0.043
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.06	0.08	0.08	0.08	0.07
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	<0.001	0.001	0.001	0.001	0.001
Cobalt-Total	mg/L	0.001	0.002	0.001	0.001	0.001	0.001
Copper-Total	mg/L	0.001	<0.001	0.008	0.007	0.008	0.007
Iron-Total	mg/L	0.01	8.0	2.1	2.1	2.1	1.7
Lead-Total	mg/L	0.001	<0.001	0.002	0.002	0.002	0.002
Lithium-Total	mg/L	0.0005	0.0015	0.0015	0.0016	0.0015	0.0014
Manganese-Total	mg/L	0.005	0.041	0.030	0.031	0.035	0.031
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.002	0.001	0.001	0.001	0.001
Nickel-Total	mg/L	0.001	<0.001	0.001	0.001	0.001	0.001
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0007
Vanadium-Total	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Zinc-Total	mg/L	0.001	0.001	0.058	0.057	0.060	0.060

Total Metals in water							
Our Reference			231729-9	231729-11	231729-13	231729-14	231729-15
Your Reference	UNITS	PQL	CD-8	CD-10	CD-12	CD-13	CD-14
Date Sampled			22/08/2019	22/08/2019	22/08/2019	22/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:30 PM	09:30 PM	10:30 PM	11:00 PM	12:00 AM
Date digested	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Date analysed	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Aluminium-Total	mg/L	0.01	1.2	0.39	0.22	0.15	0.16
Antimony-Total	mg/L	0.001	<0.001	0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.006	0.005	0.003	0.004	0.004
Barium-Total	mg/L	0.001	0.030	0.017	0.015	0.017	0.016
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.02	0.02	0.02	0.04	0.03
Cadmium-Total	mg/L	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.004	0.002	0.001	0.001	0.001
Cobalt-Total	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001
Copper-Total	mg/L	0.001	0.018	0.011	0.007	0.007	0.007
Iron-Total	mg/L	0.01	4.0	2.0	0.90	1.0	0.85
Lead-Total	mg/L	0.001	0.021	0.007	0.003	0.002	0.003
Lithium-Total	mg/L	0.0005	0.0012	0.0009	0.0008	0.0009	0.0009
Manganese-Total	mg/L	0.005	0.044	0.020	0.017	0.019	0.018
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel-Total	mg/L	0.001	0.002	0.001	<0.001	<0.001	<0.001
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	0.0006	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.004	0.002	0.001	0.001	0.001
Zinc-Total	mg/L	0.001	0.15	0.079	0.056	0.062	0.065

Total Metals in water							
Our Reference			231729-16	231729-18	231729-20	231729-21	231729-23
Your Reference	UNITS	PQL	CD-16	CD-18	CD-20	CD-21	CD-23
Date Sampled			23/08/2019	23/08/2019	23/08/2019	23/08/2019	23/08/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			01:00 PM	02:00 AM	03:00 AM	03:30 AM	05:00 AM
Date digested	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Date analysed	-		29/08/2019	29/08/2019	29/08/2019	29/08/2019	29/08/2019
Aluminium-Total	mg/L	0.01	0.14	0.16	0.09	0.09	0.07
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.003	0.004	0.003	0.003	0.007
Barium-Total	mg/L	0.001	0.012	0.011	0.009	0.01	0.013
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.03	0.02	0.02	0.02	0.04
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	<0.001	0.001	0.001	0.001	0.001
Cobalt-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Total	mg/L	0.001	0.007	0.007	0.005	0.005	0.007
Iron-Total	mg/L	0.01	0.73	0.86	0.54	0.52	0.78
Lead-Total	mg/L	0.001	0.002	0.003	0.001	0.001	0.001
Lithium-Total	mg/L	0.0005	0.0008	0.0008	0.0006	0.0007	0.0009
Manganese-Total	mg/L	0.005	0.015	0.013	0.01	0.010	0.014
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.001	0.001	<0.001	<0.001	<0.001
Zinc-Total	mg/L	0.001	0.061	0.061	0.049	0.049	0.063

Total Metals in water					
Our Reference			231729-25	231729-27	231729-29
Your Reference	UNITS	PQL	CD-25	CD-27	CD-29
Date Sampled			23/08/2019	23/08/2019	23/08/2019
Type of sample			Water	Water	Water
Time Sampled			07:00 AM	09:00 AM	11:00 AM
Date digested	-		29/08/2019	29/08/2019	29/08/2019
Date analysed	-		29/08/2019	29/08/2019	29/08/2019
Aluminium-Total	mg/L	0.01	0.11	0.099	0.11
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.018	0.007	0.007
Barium-Total	mg/L	0.001	0.028	0.031	0.030
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.1	0.1	0.1
Cadmium-Total	mg/L	0.0001	0.0002	0.0001	0.0001
Chromium-Total	mg/L	0.001	0.001	<0.001	<0.001
Cobalt-Total	mg/L	0.001	0.002	0.003	0.002
Copper-Total	mg/L	0.001	0.022	0.012	0.011
Iron-Total	mg/L	0.01	1.6	1.0	1.1
Lead-Total	mg/L	0.001	0.002	0.001	0.002
Lithium-Total	mg/L	0.0005	0.0022	0.0019	0.0018
Manganese-Total	mg/L	0.005	0.050	0.054	0.053
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	<0.001	<0.001	<0.001
Nickel-Total	mg/L	0.001	0.002	0.002	0.002
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	<0.001	<0.001	0.001
Zinc-Total	mg/L	0.001	0.18	0.17	0.15

Method ID	Methodology Summary
INORG series	Determination of constituents in waters using colourimetric chemistry
INORG-019	Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104+/-5oC.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Total Nitrogen by colourimetric analysis based on APHA 4500-P J, 4500-NO3 F.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-060	Total Phosphorus by colourimetric analysis based on APHA latest edition 4500-P J.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-021	Determination of Mercury by Cold Vapour AAS. For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

Client Reference: Ashfield Flats

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	231729-2
Date prepared	-			26/08/2019	1	26/08/2019	26/08/2019		26/08/2019	26/08/2019
Date analysed	-			26/08/2019	1	26/08/2019	26/08/2019		26/08/2019	26/08/2019
Total Carbon	mg/L	1	INORG-110	<1	1	47	45	4	102	[NT]
Total Organic Carbon	mg/L	1	INORG-110	<1	1	6	6	0	105	104
Dissolved Inorganic Carbon	mg/L	1	INORG-110	<1	1	38	36	5	101	82
Dissolved Organic Carbon	mg/L	1	INORG-110	<1	1	5	5	0	106	99
Total Suspended Solids	mg/L	5	INORG-019	<5	2	<5	<5	0	100	[NT]
Chloride	mg/L	1	INORG-081	<1	1	140	140	0	102	98

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	231729-22
Date prepared	-			[NT]	2	26/08/2019	26/08/2019		26/08/2019	26/08/2019
Date analysed	-			[NT]	2	26/08/2019	26/08/2019		26/08/2019	26/08/2019
Total Carbon	mg/L	1	INORG-110	[NT]	2	38	[NT]		[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	2	16	[NT]		[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	2	22	[NT]		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	2	16	[NT]		[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	11	36	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	2	130	[NT]		102	101

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	26/08/2019	26/08/2019		[NT]	[NT]
Date analysed	-			[NT]	11	26/08/2019	26/08/2019		[NT]	[NT]
Total Carbon	mg/L	1	INORG-110	[NT]	11	13	[NT]		[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	11	10	[NT]		[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	11	6	[NT]		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	11	7	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	24	24	0	[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	16	8	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	16	26/08/2019	26/08/2019		[NT]	[NT]
Date analysed	-			[NT]	16	26/08/2019	26/08/2019		[NT]	[NT]
Total Carbon	mg/L	1	INORG-110	[NT]	16	11	10	10	[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	16	6	6	0	[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	16	6	5	18	[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	16	5	5	0	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	16	24	[NT]		[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	21	7	6	15	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	26/08/2019	26/08/2019		[NT]	[NT]
Date analysed	-			[NT]	21	26/08/2019	26/08/2019		[NT]	[NT]
Total Carbon	mg/L	1	INORG-110	[NT]	21	9	[NT]		[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	21	5	[NT]		[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	21	5	[NT]		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	21	4	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	21	18	18	0	[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	31	26/08/2019	26/08/2019		[NT]	[NT]
Date analysed	-			[NT]	31	26/08/2019	26/08/2019		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	31	7	7	0	[NT]	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	231729-2
Date prepared	-			26/08/2019	1	26/08/2019	26/08/2019		26/08/2019	26/08/2019
Date analysed	-			26/08/2019	1	26/08/2019	26/08/2019		26/08/2019	26/08/2019
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	0.6	0.6	0	105	101
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	0.6	0.6	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	105	[NT]
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	94	110
NOx as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	96	99
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.30	0.29	3	100	95
Total Phosphorus	mg/L	0.01	INORG-060	<0.01	1	<0.01	<0.01	0	101	73
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	<0.005	<0.005	0	109	101
Soluble Nitrogen	mg/L	0.1	INORG-055	<0.1	1	0.5	0.6	18	101	98

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	14	26/08/2019	26/08/2019		[NT]	[NT]
Date analysed	-			[NT]	14	26/08/2019	26/08/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	14	0.7	[NT]		[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	14	0.4	[NT]		[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	14	0.23	0.22	4	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	14	<0.005	<0.005	0	[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	14	0.23	0.22	4	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	14	<0.005	<0.005	0	[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	14	0.09	0.09	0	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	14	0.047	0.047	0	[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	14	0.6	[NT]		[NT]	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	26/08/2019	26/08/2019		[NT]	[NT]
Date analysed	-			[NT]	21	26/08/2019	26/08/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	21	0.4	0.4	0	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	21	0.3	[NT]		[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	21	0.10	[NT]		[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	21	<0.005	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	21	0.10	[NT]		[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	21	<0.005	[NT]		[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	21	0.06	[NT]		[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	21	0.040	[NT]		[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	21	0.3	0.3	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	231729-14
Date prepared	-			29/08/2019	11	29/08/2019	29/08/2019		29/08/2019	28/08/2019
Date analysed	-			29/08/2019	11	29/08/2019	29/08/2019		29/08/2019	28/08/2019
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	11	0.03	[NT]		112	111
Antimony-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		103	105
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	11	0.002	[NT]		99	101
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	11	0.009	[NT]		101	100
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	11	<0.0005	[NT]		112	110
Bismuth-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		108	100
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	11	0.02	[NT]		105	101
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	11	<0.0001	[NT]		103	105
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		96	94
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		94	93
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	11	0.004	[NT]		95	93
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	11	0.19	[NT]		104	92
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		104	101
Lithium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	11	<0.0005	[NT]		109	108
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	11	0.01	[NT]		99	97
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	11	<0.00005	<0.00005	0	104	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		100	104
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		95	92
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		98	100
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		104	101
Thallium-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		107	103
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	11	<0.0005	[NT]		109	105
Tin-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		99	104
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	11	<0.0005	[NT]		109	106
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	11	<0.001	[NT]		98	99
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	11	0.036	[NT]		99	101

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	231729-15
Date prepared	-			[NT]	13	29/08/2019	28/08/2019		[NT]	29/08/2019
Date analysed	-			[NT]	13	29/08/2019	28/08/2019		[NT]	29/08/2019
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	13	0.02	0.02	0	[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.002	0.002	0	[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.012	0.012	0	[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	13	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	13	0.02	0.02	0	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	13	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.003	0.003	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	13	0.15	0.15	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	13	0.0005	0.0005	0	[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	13	0.009	0.01	11	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	13	<0.00005	[NT]		[NT]	105
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	13	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	13	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	13	<0.001	<0.001	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	13	0.036	0.036	0	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	25	29/08/2019	29/08/2019		[NT]	[NT]
Date analysed	-			[NT]	25	29/08/2019	29/08/2019		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	25	0.03	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	25	0.005	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	25	0.027	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	25	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	25	0.1	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	25	0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	25	0.002	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	25	0.007	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	25	0.27	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	25	0.0022	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	25	0.046	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	25	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	25	0.001	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	25	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	25	<0.0005	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	25	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	25	0.15	[NT]		[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	27	29/08/2019	28/08/2019		[NT]	[NT]
Date analysed	-			[NT]	27	29/08/2019	28/08/2019		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	27	0.03	0.03	0	[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	27	0.002	0.002	0	[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	27	0.029	0.029	0	[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	27	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	27	0.1	0.1	0	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	27	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	27	0.002	0.002	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	27	0.004	0.004	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	27	0.17	0.17	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	27	0.0019	0.0019	0	[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	27	0.050	0.050	0	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	27	<0.00005	[NT]		[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	27	0.001	0.002	67	[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	27	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	27	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	27	<0.001	<0.001	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	27	0.15	0.15	0	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	231729-2
Date digested	-			29/08/2019	1	29/08/2019	29/08/2019		29/08/2019	29/08/2019
Date analysed	-			29/08/2019	1	29/08/2019	29/08/2019		29/08/2019	29/08/2019
Aluminium-Total	mg/L	0.01	METALS-022	<0.01	1	0.05	0.05	0	111	127
Antimony-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	111	117
Arsenic-Total	mg/L	0.001	METALS-022	<0.001	1	0.007	0.007	0	103	112
Barium-Total	mg/L	0.001	METALS-022	<0.001	1	0.043	0.043	0	102	106
Beryllium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	99	105
Bismuth-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	98
Boron-Total	mg/L	0.02	METALS-022	<0.02	1	0.06	0.06	0	105	108
Cadmium-Total	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	102	105
Chromium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	105	111
Cobalt-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	100	104
Copper-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	106	108
Iron-Total	mg/L	0.01	METALS-022	<0.01	1	8.0	8.0	0	110	72
Lead-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	102	99
Lithium-Total	mg/L	0.0005	METALS-022	<0.0005	1	0.0015	0.0016	6	104	107
Manganese-Total	mg/L	0.005	METALS-022	<0.005	1	0.041	0.041	0	104	111
Mercury-Total	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	<0.00005	0	106	105
Molybdenum-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	103	111
Nickel-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	104	106
Selenium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	108
Silver-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	104	106
Thallium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	102	98
Thorium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	103	102
Tin-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	104	106
Uranium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	103	103
Vanadium-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	0.001	0	105	113
Zinc-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	0.001	0	105	108

Client Reference: Ashfield Flats

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	231729-21
Date digested	-			[NT]	16	29/08/2019	29/08/2019		[NT]	29/08/2019
Date analysed	-			[NT]	16	29/08/2019	29/08/2019		[NT]	29/08/2019
Aluminium-Total	mg/L	0.01	METALS-022	[NT]	16	0.14	0.14	0	[NT]	[NT]
Antimony-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Total	mg/L	0.001	METALS-022	[NT]	16	0.003	0.003	0	[NT]	[NT]
Barium-Total	mg/L	0.001	METALS-022	[NT]	16	0.012	0.012	0	[NT]	[NT]
Beryllium-Total	mg/L	0.0005	METALS-022	[NT]	16	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Boron-Total	mg/L	0.02	METALS-022	[NT]	16	0.03	0.03	0	[NT]	[NT]
Cadmium-Total	mg/L	0.0001	METALS-022	[NT]	16	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Cobalt-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Copper-Total	mg/L	0.001	METALS-022	[NT]	16	0.007	0.006	15	[NT]	[NT]
Iron-Total	mg/L	0.01	METALS-022	[NT]	16	0.73	0.71	3	[NT]	[NT]
Lead-Total	mg/L	0.001	METALS-022	[NT]	16	0.002	0.002	0	[NT]	[NT]
Lithium-Total	mg/L	0.0005	METALS-022	[NT]	16	0.0008	0.0008	0	[NT]	[NT]
Manganese-Total	mg/L	0.005	METALS-022	[NT]	16	0.015	0.014	7	[NT]	[NT]
Mercury-Total	mg/L	0.00005	METALS-021	[NT]	16	<0.00005	<0.00005	0	[NT]	104
Molybdenum-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Nickel-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Selenium-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Silver-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Thallium-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Thorium-Total	mg/L	0.0005	METALS-022	[NT]	16	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Total	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Uranium-Total	mg/L	0.0005	METALS-022	[NT]	16	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Total	mg/L	0.001	METALS-022	[NT]	16	0.001	0.001	0	[NT]	[NT]
Zinc-Total	mg/L	0.001	METALS-022	[NT]	16	0.061	0.058	5	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

It is noted that some Dissolved result exceeds the Total result, however all data has been reviewed and the relative percentage difference between results is within tests' estimated measurement uncertainty.

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CHAIN OF CUSTODY FORM - Client

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Client: Dept Biodiversity Conservation & Attractions	Client Project Name/Number/Site etc (ie report title):
Contact Person: Gavan McGrath	
Project Mgr:	PO No.:
Sampler: G McGrath	Envirolab Quote No. : 19P132
Address: 17 Dick Perry Avenue Kensington, 6151, WA	Date results required: Or choose: standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: Mob: 0458557765	Additional report format: esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	Lab Comments: 2x unlabelled metals bottles (either CD05 or CD07). Nutrients received out of HT. 09/10

	Sample information					Tests Required															Comments
	Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Dissolved Metals 26	Total Metals 26	Nutrient Suite	Ion Balance	Fe^{2+}/Fe^{3+}											Provide as much information about the sample as you can
1	MW-7			4-10-19		✓	X	X	X	X											
2	CD01																				
3	CD02				(on bottle)																
4	CD03																				
5	CD04																				
6	CD05																				
7	CD06																				
8	CD07																				
9	CD08				@910																
10	CD09																				
11	CD10																				
12	CD11																				

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company):	Received by (Company): MPL	**Lab Use Only**
Print Name:	Print Name: MC	Job number: 233963 / Cooling: Ice / Ice pack / None
Date & Time:	Date & Time: 07-10-19 800	Temperature: 6 / Security seal: Intact / Broken / None
Signature:	Signature: [signature]	TAT Req - SAME day / 1 / 2 / 3 / 4 / STD

ENVIROLAB	
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CHAIN OF CUSTODY FORM - Client

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Client:	Client Project Name/Number/Site etc (ie report title):
Contact Person:	
Project Mgr:	PO No.:
Sampler:	Envirolab Quote No. : 19P132
Address:	Date results required: Or choose: standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: Mob:	Additional report format: esdat / equis /
Email:	Lab Comments:

	Sample information					Tests Required						Comments
	Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Dissolved Metals x26	Total Metals x26	Nutrient Suite	Ion Balance	Fe^{2+}/Fe^{3+}	Chloride	Provide as much information about the sample as you can
13	CD12			4/10	Water	X	X	X	X	X		
14	CD13				"							
15	CD14				"							
16	CD15				"							
17	QW1				"							
18	P1				"						X	
19	P2				"						X	
				10/10								

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

		Lab Use Only	
Relinquished by (Company):	Received by (Company): MPL		
Print Name:	Print Name: MC	Job number:	Cooling: Ice / Ice pack / None
Date & Time:	Date & Time: 7-10-19 8:00	Temperature:	Security seal: Intact / Broken / None
Signature:	Signature:	TAT Req - SAME day / 1 / 2 / 3 / 4 / STD	

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CERTIFICATE OF ANALYSIS 233514

Client Details	
Client	Dept of Biodiversity,Conservation and Attractions
Attention	Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details	
Your Reference	**Ashfield Flats**
Number of Samples	29 Water
Date samples received	26/09/2019
Date completed instructions received	26/09/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details	
Date results requested by	03/10/2019
Date of Issue	03/10/2019

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Results Approved By
Heram Halim, Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Ionic Balance							
Our Reference			233514-1	233514-2	233514-3	233514-4	233514-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Calcium - Dissolved	mg/L	0.5	59	400	180	18	7.6
Potassium - Dissolved	mg/L	0.5	5.8	300	15	4.3	4.7
Magnesium - Dissolved	mg/L	0.5	22	1,700	70	27	30
Sodium - Dissolved	mg/L	0.5	110	11,000	230	150	120
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	230	<5	640	130	96
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	1,500	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	1,800	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	230	3,200	640	130	96
Chloride	mg/L	1	110	21,000	230	250	190
Sulphate	mg/L	1	72	840	260	51	89
Ionic Balance	%		1.1	-2.7	1.6	-4.5	-4.2
Hardness as $CaCO_3$	mg/L	3	240	8,000	740	160	140

Ionic Balance							
Our Reference			233514-6	233514-7	233514-8	233514-9	233514-10
Your Reference	UNITS	PQL	MW06	MW07	MW08S	MW08D	MW09S
Date Sampled			25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Calcium - Dissolved	mg/L	0.5	52	51	320	830	730
Potassium - Dissolved	mg/L	0.5	13	6.4	150	280	320
Magnesium - Dissolved	mg/L	0.5	17	13	810	2,100	2,000
Sodium - Dissolved	mg/L	0.5	91	100	6,400	13,000	14,000
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	91	170	22	270	190
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	91	170	22	270	190
Chloride	mg/L	1	140	130	12,000	24,000	25,000
Sulphate	mg/L	1	100	67	1,500	4,700	3,800
Ionic Balance	%		2.0	-1.3	0.23	0.60	1.3
Hardness as $CaCO_3$	mg/L	3	200	180	4,100	11,000	10,000

Ionic Balance							
Our Reference	UNITS	PQL	233514-11	233514-12	233514-13	233514-14	233514-15
Your Reference			MW09D	MW10	MW11	MW12S	MW12D
Date Sampled			25/09/2019	25/09/2019	25/09/2019	25/09/2019	
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Calcium - Dissolved	mg/L	0.5	420	38	140	360	97
Potassium - Dissolved	mg/L	0.5	360	7.6	110	110	150
Magnesium - Dissolved	mg/L	0.5	1,600	49	320	830	440
Sodium - Dissolved	mg/L	0.5	12,000	200	3,500	5,800	4,400
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	1,100	120	250	170	1,100
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	1,100	120	250	170	1,100
Chloride	mg/L	1	22,000	410	5,600	11,000	7,100
Sulphate	mg/L	1	2,200	58	990	1,700	490
Ionic Balance	%		0.75	-0.74	1.8	-0.20	0.31
Hardness as $CaCO_3$	mg/L	3	7,700	300	1,700	4,300	2,000

Ionic Balance							
Our Reference	UNITS	PQL	233514-16	233514-17	233514-18	233514-19	233514-20
Your Reference			MW13	QAW02	SW01	SW02	SW03
Date Sampled					24/09/2019	24/09/2019	24/09/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Calcium - Dissolved	mg/L	0.5	63	52	55	44	44
Potassium - Dissolved	mg/L	0.5	11	13	51	25	11
Magnesium - Dissolved	mg/L	0.5	87	16	160	70	30
Sodium - Dissolved	mg/L	0.5	250	90	1,600	610	200
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	68	93	52	130	110
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	68	93	52	130	110
Chloride	mg/L	1	710	140	2,700	1,000	310
Sulphate	mg/L	1	130	100	460	240	160
Ionic Balance	%		-6.2	1.1	0.39	-1.4	-1.8
Hardness as $CaCO_3$	mg/L	3	520	200	780	400	230

Client Reference: Ashfield Flats

Ionic Balance							
Our Reference			233514-21	233514-22	233514-23	233514-24	233514-25
Your Reference	UNITS	PQL	SW04	SW05	SW06	SW07	SW08
Date Sampled			24/09/2019	24/09/2019	24/09/2019	24/09/2019	24/09/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Calcium - Dissolved	mg/L	0.5	68	110	180	120	71
Potassium - Dissolved	mg/L	0.5	47	52	100	97	15
Magnesium - Dissolved	mg/L	0.5	130	190	430	320	190
Sodium - Dissolved	mg/L	0.5	1,200	1,800	3,700	3,000	1,300
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	200	31	17	26	110
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	130	<5	33	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	200	160	17	58	110
Chloride	mg/L	1	2,000	3,000	6,400	5,300	2,400
Sulphate	mg/L	1	380	580	990	700	230
Ionic Balance	%		0.48	0.92	1.5	1.0	-0.21
Hardness as $CaCO_3$	mg/L	3	690	1,100	2,200	1,600	950

Ionic Balance						
Our Reference			233514-26	233514-27	233514-28	233514-29
Your Reference	UNITS	PQL	CD	KD	WC	QW01
Date Sampled			24/09/2019	24/09/2019	24/09/2019	24/09/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019
Calcium - Dissolved	mg/L	0.5	50	27	44	44
Potassium - Dissolved	mg/L	0.5	6.6	8.0	10	10
Magnesium - Dissolved	mg/L	0.5	12	7.0	18	18
Sodium - Dissolved	mg/L	0.5	97	120	110	110
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	100	85	26	27
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	100	85	26	27
Chloride	mg/L	1	150	160	170	170
Sulphate	mg/L	1	89	61	200	200
Ionic Balance	%		-0.89	-1.7	-2.5	-2.4
Hardness as $CaCO_3$	mg/L	3	170	96	190	180

Miscellaneous Inorganics							
Our Reference			233514-1	233514-2	233514-3	233514-4	233514-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Bromide	mg/L	0.5	<0.5	67	<0.5	0.7	<0.5

Miscellaneous Inorganics							
Our Reference			233514-6	233514-7	233514-8	233514-9	233514-10
Your Reference	UNITS	PQL	MW06	MW07	MW08S	MW08D	MW09S
Date Sampled			25/09/2019	25/09/2019	25/09/2019	25/09/2019	25/09/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Bromide	mg/L	0.5	<0.5	<0.5	37	72	75

Miscellaneous Inorganics							
Our Reference			233514-11	233514-12	233514-13	233514-14	233514-15
Your Reference	UNITS	PQL	MW09D	MW10	MW11	MW12S	MW12D
Date Sampled			25/09/2019	25/09/2019	25/09/2019	25/09/2019	
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Bromide	mg/L	0.5	68	1.4	18	32	23

Miscellaneous Inorganics							
Our Reference			233514-16	233514-17	233514-18	233514-19	233514-20
Your Reference	UNITS	PQL	MW13	QAW02	SW01	SW02	SW03
Date Sampled					24/09/2019	24/09/2019	24/09/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Bromide	mg/L	0.5	2.0	<0.5	8.1	3.1	0.8

Miscellaneous Inorganics							
Our Reference			233514-21	233514-22	233514-23	233514-24	233514-25
Your Reference	UNITS	PQL	SW04	SW05	SW06	SW07	SW08
Date Sampled			24/09/2019	24/09/2019	24/09/2019	24/09/2019	24/09/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019	27/09/2019
Bromide	mg/L	0.5	6.5	9.2	20	16	6.2

Miscellaneous Inorganics						
Our Reference	UNITS	PQL	233514-26	233514-27	233514-28	233514-29
Your Reference			CD	KD	WC	QW01
Date Sampled			24/09/2019	24/09/2019	24/09/2019	24/09/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019
Date analysed	-		27/09/2019	27/09/2019	27/09/2019	27/09/2019
Bromide	mg/L	0.5	<0.5	<0.5	<0.5	<0.5

Method ID	Methodology Summary
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Metals in soil and water by ICP-OES.

Client Reference: Ashfield Flats

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	233514-2
Date prepared	-			27/09/2019	1	27/09/2019	27/09/2019		27/09/2019	27/09/2019
Date analysed	-			27/09/2019	1	27/09/2019	27/09/2019		27/09/2019	27/09/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	59	60	2	98	122
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	5.8	5.8	0	96	111
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	22	22	0	99	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	110	110	0	97	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	<5	1	230	240	4	98	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	<5	1	<5	<5	0	98	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	<5	1	230	240	4	98	[NT]
Chloride	mg/L	1	INORG-081	<1	1	110	120	9	102	[NT]
Sulphate	mg/L	1	INORG-081	<1	1	72	72	0	102	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	<3	1	240	240	0	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	233514-12
Date prepared	-			[NT]	11	27/09/2019	27/09/2019		27/09/2019	27/09/2019
Date analysed	-			[NT]	11	27/09/2019	27/09/2019		27/09/2019	27/09/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	420	420	0	98	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	360	360	0	96	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	1600	1600	0	99	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	12000	12000	0	97	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	1100	1100	0	98	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	<5	<5	0	98	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	1100	1100	0	98	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	22000	22000	0	100	119
Sulphate	mg/L	1	INORG-081	[NT]	11	2200	2200	0	101	104
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	11	7700	7600	1	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	233514-20
Date prepared	-			[NT]	19	27/09/2019	27/09/2019		[NT]	27/09/2019
Date analysed	-			[NT]	19	27/09/2019	27/09/2019		[NT]	27/09/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	19	44	44	0	[NT]	81
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	19	25	25	0	[NT]	96
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	19	70	70	0	[NT]	93
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	19	610	620	2	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	19	130	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	19	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	19	130	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	19	1000	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	19	240	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	19	400	400	0	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	27/09/2019	27/09/2019		[NT]	[NT]
Date analysed	-			[NT]	21	27/09/2019	27/09/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	21	68	[NT]		[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	21	47	[NT]		[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	21	130	[NT]		[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	21	1200	[NT]		[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	21	200	210	5	[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	21	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	21	200	210	5	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	21	2000	2000	0	[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	21	380	390	3	[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	21	690	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	233514-12
Date prepared	-			27/09/2019	1	27/09/2019	27/09/2019		27/09/2019	27/09/2019
Date analysed	-			27/09/2019	1	27/09/2019	27/09/2019		27/09/2019	27/09/2019
Bromide	mg/L	0.5	INORG-081	<0.5	1	<0.5	<0.5	0	94	81

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	11	27/09/2019	27/09/2019		27/09/2019	[NT]
Date analysed	-			[NT]	11	27/09/2019	27/09/2019		27/09/2019	[NT]
Bromide	mg/L	0.5	INORG-081	[NT]	11	68	68	0	93	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	27/09/2019	27/09/2019		[NT]	[NT]
Date analysed	-			[NT]	21	27/09/2019	27/09/2019		[NT]	[NT]
Bromide	mg/L	0.5	INORG-081	[NT]	21	6.5	6.6	2	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr:	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensignton, 6151, WA	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format:** esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:** Ferrous iron bottles not supplied - not tested. 1/11/19

Sydney Lab - Envirolab Services
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Unit 7, 17 Willes Rd, Berrimah, NT 0820
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Sample information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Time	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Fe^{2+} / Fe^{3+}	Ion Balance								Provide as much information about the sample as you can
1	MW07	15:00	30/10/19	Water	X	X	X	X	X	X	X	X								Unfiltered.
2	CD01	15:30		Water																
3	CD02	16:00		Water																
4	CD03	16:30		Water																
5	CD04	17:00		Water																
6	CD05	17:30		Water																
7	CD06	18:00		Water																
8	CD07	18:30		Water																
9	CD08	19:00		Water																
10	CD09	19:30		Water																
11	CD10	20:00		Water																
12	CD11	20:30		Water																

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company): DBCA	**Received by (Company):** MPL	***Lab Use Only***	
Print Name: Gavan McGrath	**Print Name:** C. Ialdna	**Job number:** 235372	**Cooling:** Ice / Ice pack / None
Date & Time: 31/10/19	**Date & Time:** 31/10/19 @ 1315	**Temperature:**	**Security seal:** Intact / Broken / None
Signature:	**Signature:** CS	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**	

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

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Darwin Office - Envirolab Services
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Ph: 08 8967 1201 / darwin@envirolab.com.au

Client: Department of Biodiversity Conservation and Attractions
Contact Person: Dr Gavan McGrath
Project Mgr:
Sampler: Dr Gavan McGrath
Address: 17 Dick Perry Avenue, Kensington, 6151, WA
Phone: 08 9219 9447 **Mob:** 0458 559 765
Email: gavan.mcgrath@dbca.wa.gov.au

Client Project Name / Number / Site etc (ie report title): Ashfield Flats
PO No.:
Envirolab Quote No. : 19P132
Date results required:
Or choose: standard / same day / 1 day / 2 day / 3 day
standard
Additional report format: esdat / equis /
Lab Comments:

Envirolab Sample ID	Client Sample ID or information	Time	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Fe^{2+}/Fe^{3+}	Ion Balance	Comments: Provide as much information about the sample as you can
13	CD12	21:00	30/10/19	Water	X	X	X	X	X		X	X	Unfilterd
14	CD13	21:30		Water									
15	CD14	22:00		Water									
16	CD15	22:30		Water									
17	CD16	23:00		Water									
18	CD17	23:30		Water									
19	CD18	00:00	31/10/19	Water									
20	P1			Water						X			Filtered 45µm
21	P2			Water						X			"
				Water									
				Water									
				Water									

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company): DBCA	**Received by (Company):** MPL	**Lab Use Only**	
Print Name: Gavan McGrath	**Print Name:** C. Tadena	**Job number:**	**Cooling: Ice / Ice pack / None**
Date & Time: 31/10/19	**Date & Time:** 31/10/19	**Temperature:**	**Security seal: Intact / Broken / None**
Signature: [signature]	**Signature:** [signature]	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**	

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ENVIROLAB ENVIROLAB mpl

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

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Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
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Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr:	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No.:** 19P132
Address: 17 Dick Perry Avenue, Kensington, 6151, WA	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day — standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format:** esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

Sample information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Time	Date sampled 29 [illegible] 31/10	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Major Ions	~~[illegible]~~								Provide as much information about the sample as you can
22	SW01		30/10/19	Water							X									Some sample
23	SW02			Water																bottles have
24	SW03			Water																been labelled
25	SW04			Water																with incorrect
26	SW05			Water																date of 28/10/19
27	SW08			Water																Should be 29/10/19
28	CD			Water																
29	KD			Water																
30	WC			Water																
DNR	GW-1			Water																
				Water																
				Water																

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company): DBCA	**Received by (Company):** MPL	**Lab Use Only**
Print Name: Gavan McGrath	**Print Name:** C. Tadden	**Job number:** / **Cooling:** Ice / Ice pack / None
Date & Time: 31/10/19	**Date & Time:** 31/10/19	**Temperature:** / **Security seal:** Intact / Broken / None
Signature: [signature]	**Signature:** [signature]	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
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CERTIFICATE OF ANALYSIS 233963

Client Details	
Client	Dept of Biodiversity,Conservation and Attractions
Attention	Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details	
Your Reference	**Water Analysis**
Number of Samples	19 Water
Date samples received	07/10/2019
Date completed instructions received	07/10/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details	
Date results requested by	11/10/2019
Date of Issue	11/10/2019

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Results Approved By
Heram Halim, Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorganics				
Our Reference			233963-18	233963-19
Your Reference	UNITS	PQL	P1	P2
Date Sampled			04/10/2019	04/10/2019
Type of sample			Water	Water
Date prepared	-		08/10/2019	08/10/2019
Date analysed	-		08/10/2019	08/10/2019
Chloride	mg/L	1	13	43

Ionic Balance							
Our Reference			233963-1	233963-2	233963-3	233963-4	233963-5
Your Reference	UNITS	PQL	MW7	CD01	CD02	CD03	CD04
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Date analysed	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Calcium - Dissolved	mg/L	0.5	46	47	47	46	46
Potassium - Dissolved	mg/L	0.5	6.0	6.5	6.3	6.4	6.2
Magnesium - Dissolved	mg/L	0.5	12	11	11	11	11
Sodium - Dissolved	mg/L	0.5	98	93	92	90	90
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	160	110	110	110	110
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	160	110	110	110	110
Chloride	mg/L	1	120	140	140	130	130
Sulphate	mg/L	1	63	82	81	80	80
Ionic Balance	%		-2.4	-1.6	-1.6	-1.9	-2.0
Hardness as $CaCO_3$	mg/L	3	160	160	160	160	160

Ionic Balance							
Our Reference			233963-6	233963-7	233963-8	233963-9	233963-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Date analysed	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Calcium - Dissolved	mg/L	0.5	46	46	42	36	24
Potassium - Dissolved	mg/L	0.5	6.3	6.4	7.6	6.1	5.3
Magnesium - Dissolved	mg/L	0.5	11	11	10	7.5	4.6
Sodium - Dissolved	mg/L	0.5	89	88	87	66	40
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	110	110	96	81	54
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	110	110	96	81	54
Chloride	mg/L	1	130	130	130	99	63
Sulphate	mg/L	1	79	78	71	55	35
Ionic Balance	%		-2.1	-2.4	-1.3	-1.2	-1.3
Hardness as $CaCO_3$	mg/L	3	160	160	150	120	80

Ionic Balance							
Our Reference			233963-11	233963-12	233963-13	233963-14	233963-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Date analysed	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Calcium - Dissolved	mg/L	0.5	21	18	15	19	25
Potassium - Dissolved	mg/L	0.5	4.5	3.9	3.7	3.9	4.6
Magnesium - Dissolved	mg/L	0.5	3.9	3.4	3.0	3.6	4.5
Sodium - Dissolved	mg/L	0.5	35	30	27	31	39
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	46	36	32	34	38
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	46	36	32	34	38
Chloride	mg/L	1	54	46	43	49	62
Sulphate	mg/L	1	28	23	19	31	49
Ionic Balance	%		-0.61	1.5	-0.37	0.21	-1.2
Hardness as $CaCO_3$	mg/L	3	69	59	49	63	81

Ionic Balance				
Our Reference			233963-16	233963-17
Your Reference	UNITS	PQL	CD15	QW1
Date Sampled			04/10/2019	04/10/2019
Type of sample			Water	Water
Date prepared	-		08/10/2019	08/10/2019
Date analysed	-		08/10/2019	08/10/2019
Calcium - Dissolved	mg/L	0.5	27	19
Potassium - Dissolved	mg/L	0.5	4.9	3.9
Magnesium - Dissolved	mg/L	0.5	4.7	3.5
Sodium - Dissolved	mg/L	0.5	42	31
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	42	35
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	42	35
Chloride	mg/L	1	67	49
Sulphate	mg/L	1	52	29
Ionic Balance	%		-1.4	-0.43
Hardness as $CaCO_3$	mg/L	3	86	61

Client Reference: Water Analysis

Nutrients in Water							
Our Reference	UNITS	PQL	233963-1	233963-2	233963-3	233963-4	233963-5
Your Reference			MW7	CD01	CD02	CD03	CD04
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Date analysed	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Total Nitrogen	mg/L	0.1	0.6	1.2	1.2	1.2	1.2
Total Kjeldahl Nitrogen	mg/L	0.1	0.6	0.6	0.7	0.6	0.6
Nitrate as N	mg/L	0.005	<0.005	0.55	0.50	0.52	0.53
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	<0.005	0.55	0.51	0.53	0.54
Ammonia as N	mg/L	0.005	0.28	0.007	0.007	0.015	0.018
Total Phosphorus	mg/L	0.01	0.02	0.19	0.23	0.25	0.23
Phosphate as P	mg/L	0.005	<0.005	0.085	0.097	0.094	0.092
Organic N	mg/L	0.1	0.3	0.6	0.6	0.6	0.6

Nutrients in Water							
Our Reference	UNITS	PQL	233963-6	233963-7	233963-8	233963-9	233963-10
Your Reference			CD05	CD06	CD07	CD08	CD09
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Date analysed	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Total Nitrogen	mg/L	0.1	1.1	1.2	1.4	1.3	1.3
Total Kjeldahl Nitrogen	mg/L	0.1	0.6	0.6	0.8	0.8	1.1
Nitrate as N	mg/L	0.005	0.54	0.56	0.67	0.42	0.20
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
NOx as N	mg/L	0.005	0.55	0.56	0.68	0.42	0.20
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus	mg/L	0.01	0.21	0.21	0.28	0.70	1.2
Phosphate as P	mg/L	0.005	0.088	0.086	0.078	0.11	0.088
Organic N	mg/L	0.1	0.6	0.6	0.8	0.8	1.1

Client Reference: Water Analysis

Nutrients in Water							
Our Reference			233963-11	233963-12	233963-13	233963-14	233963-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Date analysed	-		08/10/2019	08/10/2019	08/10/2019	08/10/2019	08/10/2019
Total Nitrogen	mg/L	0.1	1.3	1.3	1.2	1.0	1.0
Total Kjeldahl Nitrogen	mg/L	0.1	1.1	1.0	0.9	0.8	0.8
Nitrate as N	mg/L	0.005	0.21	0.26	0.24	0.27	0.25
Nitrite as N	mg/L	0.005	<0.005	<0.005	0.005	0.013	0.013
NOx as N	mg/L	0.005	0.21	0.26	0.24	0.28	0.27
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus	mg/L	0.01	0.63	0.51	0.37	0.23	0.22
Phosphate as P	mg/L	0.005	0.086	0.057	0.050	0.053	0.054
Organic N	mg/L	0.1	1.1	1.0	0.9	0.8	0.8

Nutrients in Water				
Our Reference			233963-16	233963-17
Your Reference	UNITS	PQL	CD15	QW1
Date Sampled			04/10/2019	04/10/2019
Type of sample			Water	Water
Date prepared	-		08/10/2019	08/10/2019
Date analysed	-		08/10/2019	08/10/2019
Total Nitrogen	mg/L	0.1	1	1.1
Total Kjeldahl Nitrogen	mg/L	0.1	0.7	0.8
Nitrate as N	mg/L	0.005	0.25	0.25
Nitrite as N	mg/L	0.005	0.012	0.012
NOx as N	mg/L	0.005	0.26	0.26
Ammonia as N	mg/L	0.005	<0.005	<0.005
Total Phosphorus	mg/L	0.01	0.19	0.23
Phosphate as P	mg/L	0.005	0.056	0.051
Organic N	mg/L	0.1	0.7	0.8

Dissolved Metals in Water							
Our Reference			233963-1	233963-2	233963-3	233963-4	233963-5
Your Reference	UNITS	PQL	MW7	CD01	CD02	CD03	CD04
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Date analysed	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Iron (HCl preserved)	mg/L	0.02	7.5	1.0	1.1	1.3	1.2
Ferrous Iron - Fe^{2+}	mg/L	0.05	8.4	0.46	0.47	0.56	0.58
Ferric Iron - Fe^{3+}	mg/L	0.05	<0.05	0.59	0.63	0.78	0.65
Aluminium-Dissolved	mg/L	0.01	<0.01	0.04	0.04	0.04	0.04
Arsenic-Dissolved	mg/L	0.001	0.003	0.003	0.004	0.004	0.004
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	0.004	0.004	0.004	0.003
Cobalt-Dissolved	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	4.0	0.39	0.42	0.45	0.46
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel-Dissolved	mg/L	0.001	<0.001	0.001	0.001	0.001	0.001
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.005	0.013	0.012	0.012	0.013

Dissolved Metals in Water							
Our Reference	UNITS	PQL	233963-6	233963-7	233963-8	233963-9	233963-10
Your Reference			CD05	CD06	CD07	CD08	CD09
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Date analysed	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Iron (HCl preserved)	mg/L	0.02	1.0	1.0	1.4	4.4	9.3
Ferrous Iron - Fe^{2+}	mg/L	0.05	0.50	0.47	0.70	1.8	3.5
Ferric Iron - Fe^{3+}	mg/L	0.05	0.50	0.55	0.68	2.6	5.9
Aluminium-Dissolved	mg/L	0.01	0.04	0.04	0.03	0.04	0.03
Arsenic-Dissolved	mg/L	0.001	0.003	0.003	0.003	0.004	0.003
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.004	0.005	0.005	0.006	0.005
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	0.41	0.42	0.36	0.55	0.43
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001	<0.001
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.014	0.016	0.018	0.022	0.027

Client Reference: Water Analysis

Dissolved Metals in Water							
Our Reference			233963-11	233963-12	233963-13	233963-14	233963-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Date analysed	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Iron (HCl preserved)	mg/L	0.02	3.9	3.0	1.9	1.1	1.0
Ferrous Iron - Fe^{2+}	mg/L	0.05	1.6	1.4	1.1	0.90	0.75
Ferric Iron - Fe^{3+}	mg/L	0.05	2.2	1.6	0.79	0.19	0.26
Aluminium-Dissolved	mg/L	0.01	0.04	0.03	0.03	0.03	0.04
Arsenic-Dissolved	mg/L	0.001	0.003	0.003	0.003	0.003	0.004
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.006	0.008	0.008	0.008	0.009
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	0.43	0.27	0.21	0.24	0.26
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.001
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.031	0.035	0.10	0.050	0.072

Dissolved Metals in Water				
Our Reference			233963-16	233963-17
Your Reference	UNITS	PQL	CD15	QW1
Date Sampled			04/10/2019	04/10/2019
Type of sample			Water	Water
Date prepared	-		10/10/2019	10/10/2019
Date analysed	-		10/10/2019	10/10/2019
Iron (HCl preserved)	mg/L	0.02	0.70	1.0
Ferrous Iron - Fe^{2+}	mg/L	0.05	0.77	0.78
Ferric Iron - Fe^{3+}	mg/L	0.05	<0.05	0.23
Aluminium-Dissolved	mg/L	0.01	0.03	0.03
Arsenic-Dissolved	mg/L	0.001	0.004	0.003
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	0.009	0.008
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	0.24	0.23
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005
Nickel-Dissolved	mg/L	0.001	0.001	<0.001
Lead-Dissolved	mg/L	0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.071	0.047

Total Metals in water							
Our Reference			233963-1	233963-2	233963-3	233963-4	233963-5
Your Reference	UNITS	PQL	MW7	CD01	CD02	CD03	CD04
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date digested	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Date analysed	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Aluminium-Total	mg/L	0.01	0.03	0.09	0.09	0.12	0.11
Arsenic-Total	mg/L	0.001	0.006	0.005	0.006	0.006	0.006
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	<0.001	<0.001	0.001	0.001	0.001
Copper-Total	mg/L	0.001	<0.001	0.005	0.005	0.006	0.006
Cobalt-Total	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001
Iron-Total	mg/L	0.01	7.5	1.2	1.4	1.7	1.5
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel-Total	mg/L	0.001	<0.001	0.001	0.001	0.001	0.001
Lead-Total	mg/L	0.001	<0.001	0.001	0.001	0.003	0.003
Zinc-Total	mg/L	0.001	0.005	0.020	0.019	0.023	0.024

Total Metals in water							
Our Reference			233963-6	233963-7	233963-8	233963-9	233963-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date digested	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Date analysed	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Aluminium-Total	mg/L	0.01	0.09	0.09	0.13	0.43	1.1
Arsenic-Total	mg/L	0.001	0.005	0.005	0.005	0.016	0.026
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0003
Chromium-Total	mg/L	0.001	<0.001	<0.001	<0.001	0.002	0.004
Copper-Total	mg/L	0.001	0.005	0.005	0.006	0.015	0.027
Cobalt-Total	mg/L	0.001	<0.001	<0.001	0.001	0.003	0.009
Iron-Total	mg/L	0.01	1.2	1.3	1.6	6.1	12
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel-Total	mg/L	0.001	0.001	0.001	0.001	0.002	0.002
Lead-Total	mg/L	0.001	0.002	0.001	0.002	0.011	0.028
Zinc-Total	mg/L	0.001	0.022	0.021	0.031	0.078	0.18

Client Reference: Water Analysis

Total Metals in water							
Our Reference			233963-11	233963-12	233963-13	233963-14	233963-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			04/10/2019	04/10/2019	04/10/2019	04/10/2019	04/10/2019
Type of sample			Water	Water	Water	Water	Water
Date digested	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Date analysed	-		10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Aluminium-Total	mg/L	0.01	0.32	0.29	0.23	0.14	0.13
Arsenic-Total	mg/L	0.001	0.013	0.012	0.008	0.006	0.007
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	0.0001	0.0002
Chromium-Total	mg/L	0.001	0.002	0.002	0.002	0.001	0.001
Copper-Total	mg/L	0.001	0.014	0.015	0.013	0.013	0.016
Cobalt-Total	mg/L	0.001	0.002	0.002	0.001	0.001	0.001
Iron-Total	mg/L	0.01	4.7	3.9	2.4	1.3	1.2
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel-Total	mg/L	0.001	0.001	0.002	0.001	0.001	0.001
Lead-Total	mg/L	0.001	0.011	0.009	0.006	0.003	0.003
Zinc-Total	mg/L	0.001	0.073	0.070	0.061	0.065	0.090

Total Metals in water				
Our Reference			233963-16	233963-17
Your Reference	UNITS	PQL	CD15	QW1
Date Sampled			04/10/2019	04/10/2019
Type of sample			Water	Water
Date digested	-		10/10/2019	10/10/2019
Date analysed	-		10/10/2019	10/10/2019
Aluminium-Total	mg/L	0.01	0.10	0.13
Arsenic-Total	mg/L	0.001	0.007	0.006
Cadmium-Total	mg/L	0.0001	0.0001	0.0001
Chromium-Total	mg/L	0.001	0.001	0.001
Copper-Total	mg/L	0.001	0.016	0.013
Cobalt-Total	mg/L	0.001	0.001	0.001
Iron-Total	mg/L	0.01	1.0	1.3
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005
Nickel-Total	mg/L	0.001	0.001	0.001
Lead-Total	mg/L	0.001	0.002	0.003
Zinc-Total	mg/L	0.001	0.088	0.069

Method ID	Methodology Summary
INORG series	Determination of constituents in waters using colourimetric chemistry
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-060	Total Phosphorus by colourimetric analysis based on APHA latest edition 4500-P J.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-076	Ferrous Iron determination by colourimerically using APHA latest edition 3500-Fe B.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Metals in soil and water by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS. For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

Client Reference: Water Analysis

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			08/10/2019	[NT]	[NT]	[NT]	[NT]	08/10/2019	[NT]
Date analysed	-			08/10/2019	[NT]	[NT]	[NT]	[NT]	08/10/2019	[NT]
Chloride	mg/L	1	INORG-081	<1	[NT]	[NT]	[NT]	[NT]	106	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	233963-11
Date prepared	-			08/10/2019	1	08/10/2019	08/10/2019		08/10/2019	08/10/2019
Date analysed	-			08/10/2019	1	08/10/2019	08/10/2019		08/10/2019	08/10/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	46	[NT]		98	94
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	6.0	[NT]		97	105
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	12	[NT]		97	100
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	98	[NT]		98	91
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	<5	1	160	[NT]		100	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	<5	1	<5	[NT]		100	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	<5	1	160	[NT]		100	[NT]
Chloride	mg/L	1	INORG-081	<1	1	120	120	0	106	[NT]
Sulphate	mg/L	1	INORG-081	<1	1	63	63	0	104	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	<3	1	160	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	233963-12
Date prepared	-			[NT]	6	08/10/2019	08/10/2019		[NT]	08/10/2019
Date analysed	-			[NT]	6	08/10/2019	08/10/2019		[NT]	08/10/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	6	46	46	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	6	6.3	6.3	0	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	6	11	11	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	6	89	89	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	6	110	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	6	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	6	110	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	6	130	[NT]		[NT]	107
Sulphate	mg/L	1	INORG-081	[NT]	6	79	[NT]		[NT]	105
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	6	160	160	0	[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	08/10/2019	08/10/2019		[NT]	[NT]
Date analysed	-			[NT]	11	08/10/2019	08/10/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	21	[NT]		[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	4.5	[NT]		[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	3.9	[NT]		[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	35	[NT]		[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	46	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	46	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	54	54	0	[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	11	28	28	0	[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	11	69	[NT]		[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	233963-2
Date prepared	-			08/10/2019	1	08/10/2019	08/10/2019		08/10/2019	08/10/2019
Date analysed	-			08/10/2019	1	08/10/2019	08/10/2019		08/10/2019	08/10/2019
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	0.6	0.6	0	99	95
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	0.6	0.6	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	97	90
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	101	114
NOx as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	99	90
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.28	0.28	0	90	91
Total Phosphorus	mg/L	0.01	INORG-060	<0.01	1	0.02	0.02	0	115	117
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	<0.005	<0.005	0	104	#

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	08/10/2019	08/10/2019		[NT]	[NT]
Date analysed	-			[NT]	11	08/10/2019	08/10/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	11	1.3	1.4	7	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	11	1.1	1.2	9	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	11	0.21	0.22	5	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	11	0.21	0.22	5	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	11	0.63	0.63	0	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	11	0.086	0.086	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	233963-5
Date prepared	-			10/10/2019	1	10/10/2019	10/10/2019		10/10/2019	10/10/2019
Date analysed	-			10/10/2019	1	10/10/2019	10/10/2019		10/10/2019	10/10/2019
Iron (HCl preserved)	mg/L	0.02	METALS-020	<0.02	1	7.5	[NT]		94	101
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	<0.05	1	8.4	8.3	1	105	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	1	<0.01	[NT]		89	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.003	[NT]		102	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	[NT]		97	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		99	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		102	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.002	[NT]		106	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	1	4.0	[NT]		108	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	[NT]		110	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		101	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	[NT]		104	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.005	[NT]		100	[NT]

QUALITY CONTROL: Dissolved Metals in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	233963-8
Date prepared	-			[NT]	4	10/10/2019	10/10/2019		[NT]	10/10/2019
Date analysed	-			[NT]	4	10/10/2019	10/10/2019		[NT]	10/10/2019
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	4	1.3	1.4	7	[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	4	0.56	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	4	0.04	[NT]		[NT]	84
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	4	0.004	[NT]		[NT]	103
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	4	<0.0001	[NT]		[NT]	102
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	4	<0.001	[NT]		[NT]	96
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	4	0.004	[NT]		[NT]	96
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	4	<0.001	[NT]		[NT]	102
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	4	0.45	[NT]		[NT]	*
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	4	<0.00005	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	4	0.001	[NT]		[NT]	94
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	4	<0.001	[NT]		[NT]	100
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	4	0.012	[NT]		[NT]	98

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	233963-10
Date prepared	-			[NT]	7	10/10/2019	10/10/2019		[NT]	10/10/2019
Date analysed	-			[NT]	7	10/10/2019	10/10/2019		[NT]	10/10/2019
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	7	1.0	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	7	0.47	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	7	0.04	0.04	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	7	0.003	0.003	0	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	7	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	7	<0.001	<0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	7	0.005	0.006	18	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	7	<0.001	<0.001	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	7	0.42	0.41	2	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	7	<0.00005	[NT]		[NT]	113
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	7	0.001	0.001	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	7	<0.001	<0.001	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	7	0.016	0.016	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	9	10/10/2019	10/10/2019		[NT]	[NT]
Date analysed	-			[NT]	9	10/10/2019	10/10/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	9	4.4	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	9	1.8	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	9	0.04	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.004	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	9	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.006	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	9	0.55	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	9	<0.00005	<0.00005	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.001	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.022	[NT]		[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	10/10/2019	10/10/2019		[NT]	[NT]
Date analysed	-			[NT]	11	10/10/2019	10/10/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	11	3.9	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	11	1.6	1.6	0	[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	11	0.04	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.003	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	11	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.006	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	11	0.43	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.031	[NT]		[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	14	10/10/2019	10/10/2019		[NT]	[NT]
Date analysed	-			[NT]	14	10/10/2019	10/10/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	14	1.1	1.1	0	[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	14	0.90	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	14	0.03	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	14	0.003	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	14	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	14	<0.001	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	14	0.008	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	14	<0.001	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	14	0.24	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	14	<0.00005	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	14	<0.001	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	14	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	14	0.050	[NT]		[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	16	10/10/2019	10/10/2019		[NT]	[NT]
Date analysed	-			[NT]	16	10/10/2019	10/10/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	16	0.70	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	16	0.77	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	16	0.03	0.03	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	16	0.004	0.004	0	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	16	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	16	0.009	0.009	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	16	0.24	0.24	0	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	16	<0.00005	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	16	0.001	0.001	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	16	<0.001	<0.001	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	16	0.071	0.072	1	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	17	10/10/2019	10/10/2019		[NT]	[NT]
Date analysed	-			[NT]	17	10/10/2019	10/10/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	17	1.0	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	17	0.78	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	17	0.03	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	17	0.003	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	17	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	17	<0.001	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	17	0.008	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	17	<0.001	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	17	0.23	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	17	<0.00005	<0.00005	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	17	<0.001	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	17	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	17	0.047	[NT]		[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Total Metals in water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	233963-2
Date digested	-			10/10/2019	1	10/10/2019	10/10/2019		10/10/2019	10/10/2019
Date analysed	-			10/10/2019	1	10/10/2019	10/10/2019		10/10/2019	10/10/2019
Aluminium-Total	mg/L	0.01	METALS-022	<0.01	1	0.03	0.03	0	92	90
Arsenic-Total	mg/L	0.001	METALS-022	<0.001	1	0.006	0.007	15	102	101
Cadmium-Total	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	99	101
Chromium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	100	96
Copper-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	95
Cobalt-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	107	101
Iron-Total	mg/L	0.01	METALS-022	<0.01	1	7.5	7.5	0	115	*
Mercury-Total	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	[NT]		108	[NT]
Nickel-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	101	95
Lead-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	98
Zinc-Total	mg/L	0.001	METALS-022	<0.001	1	0.005	0.007	33	100	92

QUALITY CONTROL: Total Metals in water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	233963-12
Date digested	-			[NT]	4	10/10/2019	[NT]		[NT]	10/10/2019
Date analysed	-			[NT]	4	10/10/2019	[NT]		[NT]	10/10/2019
Aluminium-Total	mg/L	0.01	METALS-022	[NT]	4	0.12	[NT]		[NT]	[NT]
Arsenic-Total	mg/L	0.001	METALS-022	[NT]	4	0.006	[NT]		[NT]	[NT]
Cadmium-Total	mg/L	0.0001	METALS-022	[NT]	4	<0.0001	[NT]		[NT]	[NT]
Chromium-Total	mg/L	0.001	METALS-022	[NT]	4	0.001	[NT]		[NT]	[NT]
Copper-Total	mg/L	0.001	METALS-022	[NT]	4	0.006	[NT]		[NT]	[NT]
Cobalt-Total	mg/L	0.001	METALS-022	[NT]	4	<0.001	[NT]		[NT]	[NT]
Iron-Total	mg/L	0.01	METALS-022	[NT]	4	1.7	[NT]		[NT]	[NT]
Mercury-Total	mg/L	0.00005	METALS-021	[NT]	4	<0.00005	<0.00005	0	[NT]	114
Nickel-Total	mg/L	0.001	METALS-022	[NT]	4	0.001	[NT]		[NT]	[NT]
Lead-Total	mg/L	0.001	METALS-022	[NT]	4	0.003	[NT]		[NT]	[NT]
Zinc-Total	mg/L	0.001	METALS-022	[NT]	4	0.023	[NT]		[NT]	[NT]

Client Reference: Water Analysis

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date digested	-			[NT]	11	10/10/2019	10/10/2019		[NT]	[NT]
Date analysed	-			[NT]	11	10/10/2019	10/10/2019		[NT]	[NT]
Aluminium-Total	mg/L	0.01	METALS-022	[NT]	11	0.32	0.33	3	[NT]	[NT]
Arsenic-Total	mg/L	0.001	METALS-022	[NT]	11	0.013	0.013	0	[NT]	[NT]
Cadmium-Total	mg/L	0.0001	METALS-022	[NT]	11	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	[NT]
Copper-Total	mg/L	0.001	METALS-022	[NT]	11	0.014	0.014	0	[NT]	[NT]
Cobalt-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.003	40	[NT]	[NT]
Iron-Total	mg/L	0.01	METALS-022	[NT]	11	4.7	4.7	0	[NT]	[NT]
Mercury-Total	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	<0.00005	0	[NT]	[NT]
Nickel-Total	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]
Lead-Total	mg/L	0.001	METALS-022	[NT]	11	0.011	0.011	0	[NT]	[NT]
Zinc-Total	mg/L	0.001	METALS-022	[NT]	11	0.073	0.074	1	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Samples received in good order: No
Nutrients received outside of recommended holding time.
2 x unlabelled metals bottles - sub-sample from 500ml unpreserved bottle.

Low (or high) spike recovery was obtained for this sample. Sample matrix interference is suspected. However, an acceptable recovery was achieved for the LCS.

* Percent recovery not available due to the analyte signal being much greater than the spike amount. An acceptable recovery was achieved for the LCS.

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CHAIN OF CUSTODY - Client

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Darwin Office - Envirolab Services
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Ph: 08 8967 1201 / darwin@envirolab.com.au

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr:	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensington, 6151, WA	**Date results required:** **Or choose: standard / same day / 1 day / 2 day / 3 day** standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format: esdat / equis /**
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:** Ferrousion bottles not supplied- not tested. 31/10/19.

Envirolab Sample ID	Client Sample ID or information	Time	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Fe^{2+} / Fe^{3+}	Ion Balance								Comments: Provide as much information about the sample as you can
1	MW07	15:00	30/10/19	Water	X	X	X	X	X	X	X	X								Unfiltered.
2	CD01	15:30		Water																
3	CD02	16:00		Water																
4	CD03	16:30		Water																
5	CD04	17:00		Water																
6	CD05	17:30		Water																
7	CD06	18:00		Water																
8	CD07	18:30		Water																
9	CD08	19:00		Water																
10	CD09	19:30		Water																
11	CD10	20:00		Water																
12	CD11	20:30		Water																

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company): DBCA	**Received by (Company):** MPL	***Lab Use Only***
Print Name: Gavan McGrath	**Print Name:** C. Jadlan	**Job number:** 235372 **Cooling: Ice / Ice pack / None**
Date & Time: 31/10/19	**Date & Time:** 31/10/19 @ 1315	**Temperature:** **Security seal: Intact / Broken / None**
Signature:	**Signature:** CJ	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

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CHAIN OF CUSTODY - Client

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Ph: 08 8967 1201 / darwin@envirolab.com.au

Client: Department of Biodiversity Conservation and Attractions

Contact Person: Dr Gavan McGrath

Project Mgr:

Sampler: Dr Gavan McGrath

Address: 17 Dick Perry Avenue, Kensington, 6151, WA

Phone: 08 9219 9447 **Mob:** 0458 559 765

Email: gavan.mcgrath@dbca.wa.gov.au

Client Project Name / Number / Site etc (ie report title): Ashfield Flats

PO No.:

Envirolab Quote No. : 19P132

Date results required:

Or choose: standard / same day / 1 day / 2 day / 3 day

standard

Additional report format: esdat / equis /

Lab Comments:

Sample Information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Time	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Fe^{2+}/Fe^{3+}	Ion Balance								Provide as much information about the sample as you can
13	CD12	21:00	30/10/19	Water	X	X	X	X	X		X	X								Unfilterd
14	CD13	21:30		Water																
15	CD14	22:00		Water																
16	CD15	22:30		Water																
17	CD16	23:00		Water																
18	CD17	23:30		Water																
19	CD18	00:00	31/10/19	Water																
20	P1			Water						X										Filterd 45μm
21	P2			Water						X										"
				Water																
				Water																
				Water																

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company): DBCA	**Received by (Company):** MPL	***Lab Use Only***	
Print Name: Gavan McGrath	**Print Name:** C. Tadena	**Job number:**	**Cooling: Ice / Ice pack / None**
Date & Time: 31/10/19	**Date & Time:** 31/10/19	**Temperature:**	**Security seal: Intact / Broken / None**
Signature: [signature]	**Signature:** [signature]	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**	

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ENVIROLAB ENVIROLAB mpl

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr:	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensington, 6151, WA	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format:** esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

Sydney Lab - Envirolab Services
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Melbourne Lab - Envirolab Services
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Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Time	Date sampled 29 ~~xx~~ 31/10	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Major Ions/	[illegible]								Provide as much information about the sample as you can
22	SW01		30/10/19	Water							X									Some sample
23	SW02			Water																bottles have
24	SW03			Water																been labelled
25	SW04			Water																with incorrect
26	SW05			Water																date of 28/10/19
27	SW08			Water																Should be 29/10/19
28	CD			Water																
29	KD			Water																
30	WC			Water																
DNR	GW-1			Water																
				Water																
				Water																

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company): DBCA	**Received by (Company):** MPL	***Lab Use Only***
Print Name: Gavan McGrath	**Print Name:** C. Tadler	**Job number:** / **Cooling: Ice / Ice pack / None**
Date & Time: 31/10/19	**Date & Time:** 31/10/19	**Temperature:** / **Security seal: Intact / Broken / None**
Signature:	**Signature:**	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
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16-18 Hayden Court Myaree WA 6154
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CERTIFICATE OF ANALYSIS 235372

Client Details

Client	Dept of Biodiversity,Conservation and Attractions
Attention	Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details

Your Reference	**Ashfield Flats**
Number of Samples	30 waters
Date samples received	31/10/2019
Date completed instructions received	31/10/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	07/11/2019
Date of Issue	07/11/2019

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Results Approved By
Heram Halim, Operations Manager
Michael Mowle, Metals/Inorganics Supervisor

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorganics							
Our Reference			235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference	UNITS	PQL	MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Carbon	mg/L	1	39	43	42	43	42
Total Organic Carbon	mg/L	1	5	14	14	14	14
Dissolved Inorganic Carbon	mg/L	1	29	23	24	23	23
Dissolved Organic Carbon	mg/L	1	4	14	14	14	14
Total Suspended Solids	mg/L	5	20	<5	<5	<5	<5

Miscellaneous Inorganics							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Carbon	mg/L	1	41	73	44	44	38
Total Organic Carbon	mg/L	1	14	19	20	22	22
Dissolved Inorganic Carbon	mg/L	1	21	13	11	10	7
Dissolved Organic Carbon	mg/L	1	14	19	19	22	22
Total Suspended Solids	mg/L	5	<5	180	50	36	30

Miscellaneous Inorganics							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Carbon	mg/L	1	34	28	25	31	28
Total Organic Carbon	mg/L	1	19	16	16	16	15
Dissolved Inorganic Carbon	mg/L	1	7	6	7	8	8
Dissolved Organic Carbon	mg/L	1	18	16	16	15	14
Total Suspended Solids	mg/L	5	18	17	10	37	24

Miscellaneous Inorganics							
Our Reference			235372-16	235372-17	235372-18	235372-19	235372-20
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18	P1
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019	31/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM	11:30 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Carbon	mg/L	1	29	29	30	31	[NA]
Total Organic Carbon	mg/L	1	15	16	16	16	[NA]
Dissolved Inorganic Carbon	mg/L	1	9	9	9	10	[NA]
Dissolved Organic Carbon	mg/L	1	14	14	14	14	[NA]
Total Suspended Solids	mg/L	5	10	17	23	7	[NA]
Chloride	mg/L	1	[NA]	[NA]	[NA]	[NA]	<5

Miscellaneous Inorganics			
Our Reference			235372-21
Your Reference	UNITS	PQL	P2
Date Sampled			31/10/2019
Type of sample			Water
Time Sampled			12:00 AM
Date prepared	-		01/11/2019
Date analysed	-		01/11/2019
Chloride	mg/L	1	14

Ionic Balance							
Our Reference			235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference	UNITS	PQL	MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	34	46	45	45	45
Potassium - Dissolved	mg/L	0.5	4.9	7.5	7.5	7.3	7.2
Magnesium - Dissolved	mg/L	0.5	9.4	12	12	12	12
Sodium - Dissolved	mg/L	0.5	81	130	130	130	130
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	150	130	130	120	120
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	150	130	130	120	120
Chloride	mg/L	1	85	200	190	190	190
Sulphate	mg/L	1	53	67	67	68	67
Ionic Balance	%		-3.2	-1.8	-2.6	-2.5	-1.7
Hardness as $CaCO_3$	mg/L	3	120	160	160	160	160

Ionic Balance							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	43	24	29	21	15
Potassium - Dissolved	mg/L	0.5	7.0	7.7	6.9	6.4	5.5
Magnesium - Dissolved	mg/L	0.5	11	6.2	6.1	4.6	3.4
Sodium - Dissolved	mg/L	0.5	120	61	170	72	39
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	120	68	70	59	44
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	120	68	70	59	44
Chloride	mg/L	1	180	91	290	110	61
Sulphate	mg/L	1	65	32	30	25	19
Ionic Balance	%		-1.6	-0.33	-2.8	-2.2	-1.6
Hardness as $CaCO_3$	mg/L	3	150	86	99	72	53

Ionic Balance							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	14	13	14	15	17
Potassium - Dissolved	mg/L	0.5	4.8	4.5	4.5	4.7	5.0
Magnesium - Dissolved	mg/L	0.5	3.1	3.0	3.1	3.4	3.9
Sodium - Dissolved	mg/L	0.5	33	31	31	33	36
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	41	37	39	42	44
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	41	37	39	42	44
Chloride	mg/L	1	49	45	46	48	53
Sulphate	mg/L	1	17	16	18	22	26
Ionic Balance	%		-1.3	-0.29	-0.86	-1.1	-1.2
Hardness as $CaCO_3$	mg/L	3	48	45	47	52	59

Ionic Balance							
Our Reference			235372-16	235372-17	235372-18	235372-19	235372-22
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18	SW01
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019	29/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM	
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	19	21	23	25	69
Potassium - Dissolved	mg/L	0.5	5.3	5.6	5.8	6.1	68
Magnesium - Dissolved	mg/L	0.5	4.2	4.7	5.0	5.3	200
Sodium - Dissolved	mg/L	0.5	39	42	45	52	2,300
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	48	49	51	56	130
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	48	49	51	56	130
Chloride	mg/L	1	57	64	67	73	3,600
Sulphate	mg/L	1	31	37	41	45	490
Ionic Balance	%		-1.4	-2.0	-1.5	-0.25	2.9
Hardness as $CaCO_3$	mg/L	3	65	72	78	84	1,000

Ionic Balance							
Our Reference			235372-23	235372-24	235372-25	235372-26	235372-27
Your Reference	UNITS	PQL	SW02	SW03	SW04	SW05	SW08
Date Sampled			29/10/2019	29/10/2019	29/10/2019	29/10/2019	29/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled							
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	71	47	55	130	110
Potassium - Dissolved	mg/L	0.5	61	8.2	60	91	59
Magnesium - Dissolved	mg/L	0.5	180	30	130	320	320
Sodium - Dissolved	mg/L	0.5	1,800	190	1,600	3,200	2,600
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	96	110	270	210	130
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	14	61	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	96	110	280	270	130
Chloride	mg/L	1	2,800	290	1,800	5,100	4,300
Sulphate	mg/L	1	600	170	280	840	500
Ionic Balance	%		3.1	-2.6	15	2.3	3.6
Hardness as $CaCO_3$	mg/L	3	930	240	690	1,700	1,600

Ionic Balance					
Our Reference			235372-28	235372-29	235372-30
Your Reference	UNITS	PQL	CD	KD	WC
Date Sampled			29/10/2019	29/10/2019	29/10/2019
Type of sample			Water	Water	Water
Time Sampled					
Date prepared	-		01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	52	24	43
Potassium - Dissolved	mg/L	0.5	7.3	7.9	9.3
Magnesium - Dissolved	mg/L	0.5	13	6.5	19
Sodium - Dissolved	mg/L	0.5	230	120	110
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	110	92	19
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	110	92	19
Chloride	mg/L	1	390	150	160
Sulphate	mg/L	1	71	57	200
Ionic Balance	%		-3.1	-1.2	-1.3
Hardness as $CaCO_3$	mg/L	3	180	87	180

Client Reference: Ashfield Flats

Nutrients in Water							
Our Reference			235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference	UNITS	PQL	MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	0.6	2.3	2.0	1.8	1.6
Total Kjeldahl Nitrogen	mg/L	0.1	0.6	1.5	1.2	1	0.8
NOx as N	mg/L	0.005	<0.005	0.83	0.83	0.78	0.77
Nitrate as N	mg/L	0.005	<0.005	0.80	0.81	0.76	0.75
Nitrite as N	mg/L	0.005	<0.005	0.022	0.026	0.025	0.022
Ammonia as N	mg/L	0.005	0.26	0.21	0.14	0.078	0.051
Organic N	mg/L	0.1	0.4	1.3	1.0	0.9	0.8
Total Phosphorus	mg/L	0.01	<0.01	0.11	0.11	0.11	0.11
Phosphate as P	mg/L	0.005	<0.005	0.067	0.085	0.083	0.086
Soluble Nitrogen	mg/L	0.1	0.6	2.3	2.0	1.7	1.6

Nutrients in Water							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	1.5	3.8	2.2	2.3	1.9
Total Kjeldahl Nitrogen	mg/L	0.1	0.8	3.5	2.0	2.0	1.7
NOx as N	mg/L	0.005	0.75	0.32	0.18	0.27	0.20
Nitrate as N	mg/L	0.005	0.73	0.32	0.18	0.27	0.19
Nitrite as N	mg/L	0.005	0.016	<0.005	<0.005	<0.005	0.009
Ammonia as N	mg/L	0.005	0.031	<0.005	<0.005	<0.005	<0.005
Organic N	mg/L	0.1	0.7	3.5	2.0	2.0	1.7
Total Phosphorus	mg/L	0.01	0.10	1.3	0.73	0.67	0.50
Phosphate as P	mg/L	0.005	0.087	0.051	0.17	0.10	0.11
Soluble Nitrogen	mg/L	0.1	1.5	1	1.4	1.4	1.3

Nutrients in Water							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	1.8	1.6	1.4	1.7	1.5
Total Kjeldahl Nitrogen	mg/L	0.1	1.5	1.3	1.1	1.3	1.1
NOx as N	mg/L	0.005	0.22	0.28	0.30	0.36	0.38
Nitrate as N	mg/L	0.005	0.21	0.26	0.28	0.34	0.36
Nitrite as N	mg/L	0.005	0.014	0.015	0.014	0.019	0.020
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Organic N	mg/L	0.1	1.5	1.3	1.1	1.3	1.1
Total Phosphorus	mg/L	0.01	0.33	0.25	0.22	0.38	0.26
Phosphate as P	mg/L	0.005	0.10	0.11	0.11	0.11	0.11
Soluble Nitrogen	mg/L	0.1	1.1	1.1	1.1	1.2	1.2

Nutrients in Water						
Our Reference			235372-16	235372-17	235372-18	235372-19
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019
Type of sample			Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	1.4	1.5	1.6	1.4
Total Kjeldahl Nitrogen	mg/L	0.1	1.0	1.1	1.2	1
NOx as N	mg/L	0.005	0.38	0.39	0.41	0.42
Nitrate as N	mg/L	0.005	0.36	0.37	0.39	0.41
Nitrite as N	mg/L	0.005	0.020	0.018	0.018	0.015
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Organic N	mg/L	0.1	1.0	1.1	1.2	1
Total Phosphorus	mg/L	0.01	0.22	0.31	0.33	0.25
Phosphate as P	mg/L	0.005	0.11	0.11	0.099	0.10
Soluble Nitrogen	mg/L	0.1	1.2	1.2	1.2	1.2

Dissolved Metals in Water							
Our Reference			235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference	UNITS	PQL	MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date prepared	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	<0.01	0.02	0.02	0.02	0.02
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.005	0.003	0.003	0.003	0.003
Barium-Dissolved	mg/L	0.001	0.029	0.040	0.041	0.040	0.040
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.07	0.08	0.08	0.08	0.08
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	0.005	0.005	0.005	0.005
Iron-Dissolved	mg/L	0.01	5.0	0.22	0.20	0.19	0.20
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0012	0.0013	0.0013	0.0013	0.0013
Manganese-Dissolved	mg/L	0.005	0.029	0.024	0.023	0.021	0.022
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	0.001	<0.001	0.001	0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.003	0.012	0.012	0.013	0.013

Dissolved Metals in Water							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date prepared	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	0.02	0.02	0.05	0.05	0.04
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.003	0.003	0.005	0.005	0.004
Barium-Dissolved	mg/L	0.001	0.039	0.025	0.024	0.017	0.014
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.08	0.06	0.07	0.06	0.05
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	0.002	0.002	0.002	0.001
Copper-Dissolved	mg/L	0.001	0.005	0.004	0.009	0.0099	0.009
Iron-Dissolved	mg/L	0.01	0.20	0.36	0.65	0.60	0.44
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	0.001	0.001
Lithium-Dissolved	mg/L	0.0005	0.0012	0.0013	0.0018	0.0014	0.0012
Manganese-Dissolved	mg/L	0.005	0.019	0.091	0.080	0.055	0.042
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	0.001	0.001
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	0.001	0.001	0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	0.001	0.002	0.002
Zinc-Dissolved	mg/L	0.001	0.013	0.020	0.028	0.031	0.031

Dissolved Metals in Water							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date prepared	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	0.03	0.03	0.03	0.03	0.03
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.004	0.004	0.004	0.004	0.004
Barium-Dissolved	mg/L	0.001	0.013	0.013	0.013	0.015	0.017
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.05	0.04	0.04	0.05	0.05
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Copper-Dissolved	mg/L	0.001	0.008	0.008	0.008	0.008	0.008
Iron-Dissolved	mg/L	0.01	0.34	0.28	0.29	0.31	0.31
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0011	0.001	0.0010	0.0010	0.0011
Manganese-Dissolved	mg/L	0.005	0.037	0.035	0.032	0.038	0.040
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Nickel-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	<0.001	0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.002	0.001	0.001	0.001	0.001
Zinc-Dissolved	mg/L	0.001	0.030	0.028	0.027	0.026	0.028

Dissolved Metals in Water						
Our Reference			235372-16	235372-17	235372-18	235372-19
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019
Type of sample			Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM
Date prepared	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	0.03	0.03	0.03	0.03
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.004	0.004	0.004	0.004
Barium-Dissolved	mg/L	0.001	0.019	0.020	0.022	0.024
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.06	0.06	0.07	0.07
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001
Copper-Dissolved	mg/L	0.001	0.008	0.009	0.009	0.009
Iron-Dissolved	mg/L	0.01	0.31	0.31	0.32	0.33
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0013	0.0014	0.0015	0.0015
Manganese-Dissolved	mg/L	0.005	0.040	0.040	0.041	0.040
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001
Nickel-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.002
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.001	0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.031	0.031	0.033	0.034

Total Metals in water							
Our Reference			235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference	UNITS	PQL	MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date digested	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	0.61	0.05	0.05	0.05	0.05
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.006	0.003	0.004	0.004	0.004
Barium-Total	mg/L	0.001	0.031	0.040	0.041	0.042	0.042
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.07	0.08	0.08	0.08	0.08
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Total	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Copper-Total	mg/L	0.001	0.001	0.006	0.006	0.006	0.006
Iron-Total	mg/L	0.01	6.0	0.51	0.51	0.53	0.54
Lead-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Total	mg/L	0.0005	0.0015	0.0014	0.0014	0.0014	0.0014
Manganese-Total	mg/L	0.005	0.032	0.027	0.028	0.027	0.027
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.002	<0.001	0.001	<0.001	<0.001
Nickel-Total	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	0.0007	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.002	0.001	0.001	0.001	0.001
Zinc-Total	mg/L	0.001	0.005	0.014	0.014	0.016	0.016

Total Metals in water							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date digested	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	0.05	1.7	0.55	0.48	0.41
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	0.001	0.001
Arsenic-Total	mg/L	0.001	0.003	0.025	0.015	0.011	0.008
Barium-Total	mg/L	0.001	0.040	0.096	0.041	0.032	0.024
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.08	0.06	0.07	0.06	0.05
Cadmium-Total	mg/L	0.0001	<0.0001	0.0003	0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	<0.001	0.006	0.002	0.002	0.002
Cobalt-Total	mg/L	0.001	<0.001	0.009	0.004	0.003	0.002
Copper-Total	mg/L	0.001	0.006	0.033	0.023	0.022	0.018
Iron-Total	mg/L	0.01	0.54	14	5.0	3.7	2.6
Lead-Total	mg/L	0.001	<0.001	0.034	0.012	0.014	0.010
Lithium-Total	mg/L	0.0005	0.0013	0.0022	0.0022	0.0018	0.0016
Manganese-Total	mg/L	0.005	0.026	0.32	0.14	0.084	0.064
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	<0.001	<0.001	0.001	0.002	0.002
Nickel-Total	mg/L	0.001	0.001	0.003	0.002	0.002	0.002
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	0.0008	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.001	0.008	0.003	0.003	0.003
Zinc-Total	mg/L	0.001	0.017	0.24	0.083	0.074	0.068

Total Metals in water							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date digested	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	0.34	0.21	0.16	0.38	0.25
Antimony-Total	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.006	0.005	0.005	0.008	0.007
Barium-Total	mg/L	0.001	0.021	0.017	0.017	0.026	0.023
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.05	0.04	0.04	0.05	0.05
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.002	0.001	0.001	0.002	0.002
Cobalt-Total	mg/L	0.001	0.002	0.002	0.001	0.002	0.002
Copper-Total	mg/L	0.001	0.016	0.013	0.012	0.017	0.015
Iron-Total	mg/L	0.01	1.8	1.2	0.99	2.6	1.7
Lead-Total	mg/L	0.001	0.007	0.004	0.003	0.009	0.006
Lithium-Total	mg/L	0.0005	0.0015	0.0011	0.0011	0.0013	0.0014
Manganese-Total	mg/L	0.005	0.060	0.049	0.046	0.065	0.063
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.002	0.001	0.001	0.001	0.001
Nickel-Total	mg/L	0.001	0.002	0.001	0.001	0.002	0.001
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.003	0.002	0.002	0.003	0.002
Zinc-Total	mg/L	0.001	0.062	0.046	0.040	0.075	0.056

Total Metals in water						
Our Reference			235372-16	235372-17	235372-18	235372-19
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019
Type of sample			Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM
Date digested	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	0.18	0.22	0.27	0.16
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.006	0.007	0.008	0.007
Barium-Total	mg/L	0.001	0.023	0.026	0.031	0.029
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.05	0.06	0.06	0.07
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.001	0.001	0.002	0.001
Cobalt-Total	mg/L	0.001	0.002	0.002	0.002	0.002
Copper-Total	mg/L	0.001	0.014	0.016	0.018	0.016
Iron-Total	mg/L	0.01	1.3	1.6	2.1	1.3
Lead-Total	mg/L	0.001	0.004	0.005	0.007	0.004
Lithium-Total	mg/L	0.0005	0.0014	0.0015	0.0017	0.0017
Manganese-Total	mg/L	0.005	0.060	0.067	0.070	0.067
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.001	0.001	0.001	0.001
Nickel-Total	mg/L	0.001	0.001	0.002	0.002	0.002
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.002	0.002	0.002	0.002
Zinc-Total	mg/L	0.001	0.047	0.056	0.066	0.051

Method ID	Methodology Summary
INORG series	Determination of constituents in waters using colourimetric chemistry
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-019	Suspended Solids - determined gravimetrically by filtration of the sample. The solids are dried at 104±5°C
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Total Nitrogen by colourimetric analysis based on APHA 4500-P J, 4500-NO3 F.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-060	Total Phosphorus by colourimetric analysis based on APHA latest edition 4500-P J.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Determination of various metals by ICP-AES.
METALS-021	Determination of Mercury by Cold Vapour AAS. For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-2
Date prepared	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Date analysed	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Total Carbon	mg/L	1	INORG-110	<1	1	39	40	3	102	76
Total Organic Carbon	mg/L	1	INORG-110	<1	1	5	[NT]		99	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	<1	1	29	32	10	95	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	<1	1	4	[NT]		97	[NT]
Total Suspended Solids	mg/L	5	INORG-019	<5	1	20	[NT]		96	[NT]
Chloride	mg/L	1	INORG-081	<1	21	14	14	0	95	108

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-4
Date prepared	-			[NT]	3	01/11/2019	01/11/2019		[NT]	01/11/2019
Date analysed	-			[NT]	3	01/11/2019	01/11/2019		[NT]	01/11/2019
Total Carbon	mg/L	1	INORG-110	[NT]	3	42	[NT]		[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	3	14	14	0	[NT]	92
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	3	24	[NT]		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	3	14	14	0	[NT]	97
Total Suspended Solids	mg/L	5	INORG-019	[NT]	3	<5	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	11	01/11/2019	01/11/2019		[NT]	[NT]
Total Carbon	mg/L	1	INORG-110	[NT]	11	34	33	3	[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	11	19	[NT]		[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	11	7	6	15	[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	11	18	[NT]		[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	11	18	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	12	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	12	01/11/2019	01/11/2019		[NT]	[NT]
Total Carbon	mg/L	1	INORG-110	[NT]	12	28	[NT]		[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	12	16	16	0	[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	12	6	[NT]		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	12	16	16	0	[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	12	17	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	21	01/11/2019	01/11/2019		[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-2
Date prepared	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Date analysed	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	34	[NT]		96	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	4.9	[NT]		98	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	9.4	[NT]		99	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	81	[NT]		97	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	<5	1	150	150	0	105	[NT]
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	INORG-006	<5	1	<5	<5	0	105	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	<5	1	150	150	0	105	[NT]
Chloride	mg/L	1	INORG-081	<1	1	85	85	0	95	[NT]
Sulphate	mg/L	1	INORG-081	<1	1	53	54	2	95	104
Hardness as $CaCO_3$	mg/L	3	METALS-008	<3	1	120	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	235372-13
Date prepared	-			[NT]	10	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Date analysed	-			[NT]	10	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	15	16	6	98	95
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	5.5	5.4	2	98	99
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	3.4	3.4	0	100	100
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	39	39	0	98	91
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	10	44	[NT]		105	[NT]
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	INORG-006	[NT]	10	<5	[NT]		105	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	10	44	[NT]		105	[NT]
Chloride	mg/L	1	INORG-081	[NT]	10	61	[NT]		97	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	10	19	[NT]		97	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	10	53	53	0	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-22
Date prepared	-			[NT]	11	01/11/2019	01/11/2019		[NT]	01/11/2019
Date analysed	-			[NT]	11	01/11/2019	01/11/2019		[NT]	01/11/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	14	[NT]		[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	4.8	[NT]		[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	3.1	[NT]		[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	33	[NT]		[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	41	40	2	[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	41	40	2	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	49	49	0	[NT]	92
Sulphate	mg/L	1	INORG-081	[NT]	11	17	17	0	[NT]	84
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	11	48	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-29
Date prepared	-			[NT]	22	01/11/2019	01/11/2019		[NT]	01/11/2019
Date analysed	-			[NT]	22	01/11/2019	01/11/2019		[NT]	01/11/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	22	69	68	1	[NT]	92
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	22	68	68	0	[NT]	97
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	22	200	200	0	[NT]	98
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	22	2300	2300	0	[NT]	85
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	22	130	130	0	[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	22	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	22	130	130	0	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	22	3600	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	22	490	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	22	1000	990	1	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	28	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	28	01/11/2019	01/11/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	28	52	52	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	28	7.3	7.3	0	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	28	13	13	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	28	230	230	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	28	110	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	28	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	28	110	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	28	390	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	28	71	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	28	180	190	5	[NT]	[NT]

QUALITY CONTROL: Nutrients in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-2
Date prepared	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Date analysed	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	0.6	[NT]		102	106
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	0.6	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	96	97
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	95	97
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	103	114
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.26	0.26	0	96	94
Total Phosphorus	mg/L	0.01	INORG-060	<0.01	1	<0.01	<0.01	0	109	98
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	<0.005	<0.005	0	112	82
Soluble Nitrogen	mg/L	0.1	INORG-055	<0.1	1	0.6	[NT]		102	[NT]

QUALITY CONTROL: Nutrients in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-4
Date prepared	-			[NT]	3	01/11/2019	01/11/2019		[NT]	01/11/2019
Date analysed	-			[NT]	3	01/11/2019	01/11/2019		[NT]	01/11/2019
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	3	2.0	2.0	0	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	3	1.2	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	3	0.83	[NT]		[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	3	0.81	[NT]		[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	3	0.026	[NT]		[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	3	0.14	[NT]		[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	3	0.11	[NT]		[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	3	0.085	[NT]		[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	3	2.0	2.0	0	[NT]	103

QUALITY CONTROL: Nutrients in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	11	01/11/2019	01/11/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	11	1.8	[NT]		[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	11	1.5	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	11	0.22	0.23	4	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	11	0.21	0.21	0	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	11	0.014	0.014	0	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	11	0.33	0.33	0	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	11	0.10	0.10	0	[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	11	1.1	[NT]		[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	12	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	12	01/11/2019	01/11/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	12	1.6	1.5	6	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	12	1.3	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	12	0.28	[NT]		[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	12	0.26	[NT]		[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	12	0.015	[NT]		[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	12	<0.005	[NT]		[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	12	0.25	[NT]		[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	12	0.11	[NT]		[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	12	1.1	1.1	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-12
Date prepared	-			04/11/2019	8	04/11/2019	04/11/2019		04/11/2019	04/11/2019
Date analysed	-			04/11/2019	8	04/11/2019	04/11/2019		04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	8	0.05	0.05	0	88	77
Antimony-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	101	102
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.005	0.005	0	97	100
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.024	0.024	0	101	101
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	8	<0.0005	<0.0005	0	103	110
Bismuth-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	101	83
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	8	0.07	0.07	0	112	117
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	8	<0.0001	<0.0001	0	98	103
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	94	92
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.002	0.002	0	95	93
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.009	0.009	0	99	97
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	8	0.65	0.65	0	102	#
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	102	99
Lithium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	8	0.0018	0.0018	0	110	114
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	8	0.080	0.079	1	94	91
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	8	<0.00005	[NT]		109	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	98	102
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.001	0.001	0	98	95
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	101	110
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	103	92
Thallium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	101	96
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	8	<0.0005	<0.0005	0	102	93
Tin-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	103	108
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	8	<0.0005	<0.0005	0	100	95
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.001	0.001	0	97	96
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.028	0.028	0	97	99

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-16
Date prepared	-			[NT]	9	04/11/2019	04/11/2019		[NT]	04/11/2019
Date analysed	-			[NT]	9	04/11/2019	04/11/2019		[NT]	04/11/2019
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	9	0.05	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.005	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.017	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	9	0.06	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	9	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.002	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.0099	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	9	0.60	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	0.0014	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	9	0.055	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	9	<0.00005	<0.00005	0	[NT]	114
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.001	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.001	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	<0.0005	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.002	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.031	[NT]		[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	15	04/11/2019	04/11/2019		[NT]	[NT]
Date analysed	-			[NT]	15	04/11/2019	04/11/2019		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	15	0.03	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.004	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.017	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	15	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	15	0.05	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	15	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.001	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.008	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	15	0.31	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	15	0.0011	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	15	0.040	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	15	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.001	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.001	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	15	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	15	<0.0005	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.028	[NT]		[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	18	04/11/2019	04/11/2019		[NT]	[NT]
Date analysed	-			[NT]	18	04/11/2019	04/11/2019		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	18	0.03	0.03	0	[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.004	0.004	0	[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.022	0.022	0	[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	18	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	18	0.07	0.07	0	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	18	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.001	0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.009	0.009	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	18	0.32	0.32	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	18	0.0015	0.0015	0	[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	18	0.041	0.042	2	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	18	<0.00005	[NT]		[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.001	0.001	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.001	0.001	0	[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	18	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	18	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.033	0.033	0	[NT]	[NT]

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-2
Date digested	-			04/11/2019	1	04/11/2019	04/11/2019		04/11/2019	04/11/2019
Date analysed	-			04/11/2019	1	04/11/2019	04/11/2019		04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	METALS-022	<0.01	1	0.61	0.61	0	107	107
Antimony-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	112	111
Arsenic-Total	mg/L	0.001	METALS-022	<0.001	1	0.006	0.006	0	102	104
Barium-Total	mg/L	0.001	METALS-022	<0.001	1	0.031	0.031	0	104	113
Beryllium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	109	112
Bismuth-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	105	100
Boron-Total	mg/L	0.02	METALS-022	<0.02	1	0.07	0.06	15	114	114
Cadmium-Total	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	101	102
Chromium-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	0.001	0	100	99
Cobalt-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	0.001	0	99	96
Copper-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	<0.001	0	105	100
Iron-Total	mg/L	0.01	METALS-022	<0.01	1	6.0	6.1	2	107	121
Lead-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	99
Lithium-Total	mg/L	0.0005	METALS-022	<0.0005	1	0.0015	0.0014	7	111	110
Manganese-Total	mg/L	0.005	METALS-022	<0.005	1	0.032	0.031	3	102	100
Mercury-Total	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	<0.00005	0	108	102
Molybdenum-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	99	107
Nickel-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	<0.001	0	103	98
Selenium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	104	104
Silver-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	104	99
Thallium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	100	96
Thorium-Total	mg/L	0.0005	METALS-022	<0.0005	1	0.0007	0.0006	15	104	100
Tin-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	101	106
Uranium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	102	103
Vanadium-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.003	40	104	104
Zinc-Total	mg/L	0.001	METALS-022	<0.001	1	0.005	0.006	18	103	101

Client Reference: Ashfield Flats

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date digested	-			[NT]	11	04/11/2019	04/11/2019		[NT]	[NT]
Date analysed	-			[NT]	11	04/11/2019	04/11/2019		[NT]	[NT]
Aluminium-Total	mg/L	0.01	METALS-022	[NT]	11	0.34	0.31	9	[NT]	[NT]
Antimony-Total	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]
Arsenic-Total	mg/L	0.001	METALS-022	[NT]	11	0.006	0.006	0	[NT]	[NT]
Barium-Total	mg/L	0.001	METALS-022	[NT]	11	0.021	0.021	0	[NT]	[NT]
Beryllium-Total	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Boron-Total	mg/L	0.02	METALS-022	[NT]	11	0.05	0.05	0	[NT]	[NT]
Cadmium-Total	mg/L	0.0001	METALS-022	[NT]	11	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	[NT]
Cobalt-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	[NT]
Copper-Total	mg/L	0.001	METALS-022	[NT]	11	0.016	0.015	6	[NT]	[NT]
Iron-Total	mg/L	0.01	METALS-022	[NT]	11	1.8	1.7	6	[NT]	[NT]
Lead-Total	mg/L	0.001	METALS-022	[NT]	11	0.007	0.006	15	[NT]	[NT]
Lithium-Total	mg/L	0.0005	METALS-022	[NT]	11	0.0015	0.0014	7	[NT]	[NT]
Manganese-Total	mg/L	0.005	METALS-022	[NT]	11	0.060	0.058	3	[NT]	[NT]
Mercury-Total	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.001	67	[NT]	[NT]
Nickel-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	[NT]
Selenium-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Silver-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thallium-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thorium-Total	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Uranium-Total	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Total	mg/L	0.001	METALS-022	[NT]	11	0.003	0.003	0	[NT]	[NT]
Zinc-Total	mg/L	0.001	METALS-022	[NT]	11	0.062	0.058	7	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Samples received in good order: No
Ferrous Iron bottles not supplied - not tested.
Did not receive QW-1

Percent recovery not available due to the analyte signal being much greater than the spike amount. An acceptable recovery was achieved for the LCS.

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

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Ph: 08 9317 2505 / lab@mpl.com.au

Melbourne Lab - Envirolab Services
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Adelaide Office - Envirolab Services
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Brisbane Office - Envirolab Services
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Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Client: Department of Biodiversity Conservation and Attractions
Contact Person: Dr Gavan McGrath
Project Mgr:
Sampler: Dr Gavan McGrath
Address: 17 Dick Perry Avenue, Kensington, 6151, WA
Phone: 08 9219 9447 **Mob:** 0458 559 765
Email: gavan.mcgrath@dbca.wa.gov.au

Client Project Name / Number / Site etc (ie report title): Ashfield Flats
PO No.:
Envirolab Quote No. : 19P132
Date results required:
Or choose: standard / same day / 1 day / 2 day / 3 day
standard
Additional report format: esdat / equis /
Lab Comments: Ferrozine bottles not supplied - not tested. 1/03/11/19.

Envirolab Sample ID	Client Sample ID or information	Time	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Fe^{2+} / Fe^{3+}	Ion Balance								Comments: Provide as much information about the sample as you can
1	MW07	15:00	30/10/19	Water	X	X	X	X	X	X	X	X								Unfiltered.
2	CD01	15:30		Water																
3	CD02	16:00		Water																
4	CD03	16:30		Water																
5	CD04	17:00		Water																
6	CD05	17:30		Water																
7	CD06	18:00		Water																
8	CD07	18:30		Water																
9	CD08	19:00		Water																
10	CD09	19:30		Water																
11	CD10	20:00		Water																
12	CD11	20:30		Water																

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company): DBCA	Received by (Company): MPL	Lab Use Only	
Print Name: Gavan McGrath	Print Name: C. Ladina	Job number: 235372	Cooling: Ice / Ice pack / None
Date & Time: 31/10/19	Date & Time: 31/10/19 @ 1315	Temperature:	Security seal: Intact / Broken / None
Signature:	Signature:	TAT Req - SAME day / 1 / 2 / 3 / 4 / STD	

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr:	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensington, 6151, WA	**Date results required:** **Or choose: standard / same day / 1 day / 2 day / 3 day** standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format: esdat / equis /**
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

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Melbourne Lab - Envirolab Services
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Darwin Office - Envirolab Services
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Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample Information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Time	Date sampled	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Fe^{2+} / Fe^{3+}	Ion Balance								Provide as much information about the sample as you can
13	CD12	21:00	30/10/19	Water	X	X	X	X	X		X	X								Unfiltered
14	CD13	21:30		Water																
15	CD14	22:00		Water																
16	CD15	22:30		Water																
17	CD16	23:00		Water																
18	CD17	23:30		Water																
19	CD18	00:00	31/10/19	Water																
20	P1			Water						X										Filtered 45μm
21	P2			Water						X										〃
				Water																
				Water																
				Water																

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company): DBCA	**Received by (Company):** MPL	***Lab Use Only***
Print Name: Gavan McGrath	**Print Name:** C. Tadena	**Job number:** / **Cooling: Ice / Ice pack / None**
Date & Time: 31/10/19	**Date & Time:** 31/10/19	**Temperature:** / **Security seal: Intact / Broken / None**
Signature: [signature]	**Signature:** [signature]	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

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CHAIN OF CUSTODY - Client

ENVIROLAB mpl

ENVIROLAB GROUP - National phone number 1300 424 344

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Ph: 07 3266 9532 / brisbane@envirolab.com.au

Darwin Office - Envirolab Services
Unit 7, 17 Willes Rd, Berrimah, NT 0820
Ph: 08 8967 1201 / darwin@envirolab.com.au

Client: Department of Biodiversity Conservation and Attractions

Contact Person: Dr Gavan McGrath

Project Mgr:

Sampler: Dr Gavan McGrath

Address: 17 Dick Perry Avenue, Kensington, 6151, WA

Phone: 08 9219 9447 **Mob:** 0458 559 765

Email: gavan.mcgrath@dbca.wa.gov.au

Client Project Name / Number / Site etc (ie report title): Ashfield Flats

PO No.:

Envirolab Quote No. : 19P132

Date results required:

Or choose: standard / same day / 1 day / 2 day / 3 day

standard

Additional report format: esdat / equis /

Lab Comments:

Sample information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Time	Date sampled 29 ~~xx~~ 31/10	Type of sample	Total Metals (26)	Dissolved Metals (26)	TC, TOC, DIC, DOC	Nutrient Suite + Total Filtered N	TSS	Chloride	Major Ions/	~~[illegible]~~								Provide as much information about the sample as you can
22	SW01		30/10/19	Water							X	X								Some sample
23	SW02			Water																bottles have
24	SW03			Water																been labled
25	SW04			Water																with incorrect
26	SW05			Water																date of 28/10/19
27	SW08			Water																Should be 29/10/19
28	CD			Water																
29	KD			Water																
30	WC			Water																
DNR	GW-1			Water																
				Water																
				Water																

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company): DBCA	Received by (Company): MPL	Lab Use Only	
Print Name: Gavan McGrath	Print Name: C. Tadden	Job number:	Cooling: Ice / Ice pack / None
Date & Time: 31/10/19	Date & Time: 31/10/19	Temperature:	Security seal: Intact / Broken / None
Signature: [signature]	Signature: [signature]	TAT Req - SAME day / 1 / 2 / 3 / 4 / STD	

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
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lab@mpl.com.au
www.mpl.com.au

CERTIFICATE OF ANALYSIS 235372

Client Details	
Client	Dept of Biodiversity,Conservation and Attractions
Attention	Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details	
Your Reference	**Ashfield Flats**
Number of Samples	30 waters
Date samples received	31/10/2019
Date completed instructions received	31/10/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details	
Date results requested by	07/11/2019
Date of Issue	07/11/2019
NATA Accreditation Number 2901. This document shall not be reproduced except in full.	
Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***	

Results Approved By
Heram Halim, Operations Manager
Michael Mowle, Metals/Inorganics Supervisor

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorganics							
Our Reference			235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference	UNITS	PQL	MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Carbon	mg/L	1	39	43	42	43	42
Total Organic Carbon	mg/L	1	5	14	14	14	14
Dissolved Inorganic Carbon	mg/L	1	29	23	24	23	23
Dissolved Organic Carbon	mg/L	1	4	14	14	14	14
Total Suspended Solids	mg/L	5	20	<5	<5	<5	<5

Miscellaneous Inorganics							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Carbon	mg/L	1	41	73	44	44	38
Total Organic Carbon	mg/L	1	14	19	20	22	22
Dissolved Inorganic Carbon	mg/L	1	21	13	11	10	7
Dissolved Organic Carbon	mg/L	1	14	19	19	22	22
Total Suspended Solids	mg/L	5	<5	180	50	36	30

Miscellaneous Inorganics							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Carbon	mg/L	1	34	28	25	31	28
Total Organic Carbon	mg/L	1	19	16	16	16	15
Dissolved Inorganic Carbon	mg/L	1	7	6	7	8	8
Dissolved Organic Carbon	mg/L	1	18	16	16	15	14
Total Suspended Solids	mg/L	5	18	17	10	37	24

Miscellaneous Inorganics							
Our Reference			235372-16	235372-17	235372-18	235372-19	235372-20
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18	P1
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019	31/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM	11:30 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Carbon	mg/L	1	29	29	30	31	[NA]
Total Organic Carbon	mg/L	1	15	16	16	16	[NA]
Dissolved Inorganic Carbon	mg/L	1	9	9	9	10	[NA]
Dissolved Organic Carbon	mg/L	1	14	14	14	14	[NA]
Total Suspended Solids	mg/L	5	10	17	23	7	[NA]
Chloride	mg/L	1	[NA]	[NA]	[NA]	[NA]	<5

Miscellaneous Inorganics			
Our Reference			235372-21
Your Reference	UNITS	PQL	P2
Date Sampled			31/10/2019
Type of sample			Water
Time Sampled			12:00 AM
Date prepared	-		01/11/2019
Date analysed	-		01/11/2019
Chloride	mg/L	1	14

Ionic Balance							
Our Reference			235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference	UNITS	PQL	MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	34	46	45	45	45
Potassium - Dissolved	mg/L	0.5	4.9	7.5	7.5	7.3	7.2
Magnesium - Dissolved	mg/L	0.5	9.4	12	12	12	12
Sodium - Dissolved	mg/L	0.5	81	130	130	130	130
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	150	130	130	120	120
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	150	130	130	120	120
Chloride	mg/L	1	85	200	190	190	190
Sulphate	mg/L	1	53	67	67	68	67
Ionic Balance	%		-3.2	-1.8	-2.6	-2.5	-1.7
Hardness as $CaCO_3$	mg/L	3	120	160	160	160	160

Ionic Balance							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	43	24	29	21	15
Potassium - Dissolved	mg/L	0.5	7.0	7.7	6.9	6.4	5.5
Magnesium - Dissolved	mg/L	0.5	11	6.2	6.1	4.6	3.4
Sodium - Dissolved	mg/L	0.5	120	61	170	72	39
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	120	68	70	59	44
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	120	68	70	59	44
Chloride	mg/L	1	180	91	290	110	61
Sulphate	mg/L	1	65	32	30	25	19
Ionic Balance	%		-1.6	-0.33	-2.8	-2.2	-1.6
Hardness as $CaCO_3$	mg/L	3	150	86	99	72	53

Ionic Balance							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	14	13	14	15	17
Potassium - Dissolved	mg/L	0.5	4.8	4.5	4.5	4.7	5.0
Magnesium - Dissolved	mg/L	0.5	3.1	3.0	3.1	3.4	3.9
Sodium - Dissolved	mg/L	0.5	33	31	31	33	36
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	41	37	39	42	44
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	41	37	39	42	44
Chloride	mg/L	1	49	45	46	48	53
Sulphate	mg/L	1	17	16	18	22	26
Ionic Balance	%		-1.3	-0.29	-0.86	-1.1	-1.2
Hardness as $CaCO_3$	mg/L	3	48	45	47	52	59

Ionic Balance							
Our Reference			235372-16	235372-17	235372-18	235372-19	235372-22
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18	SW01
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019	29/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM	
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	19	21	23	25	69
Potassium - Dissolved	mg/L	0.5	5.3	5.6	5.8	6.1	68
Magnesium - Dissolved	mg/L	0.5	4.2	4.7	5.0	5.3	200
Sodium - Dissolved	mg/L	0.5	39	42	45	52	2,300
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	48	49	51	56	130
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	48	49	51	56	130
Chloride	mg/L	1	57	64	67	73	3,600
Sulphate	mg/L	1	31	37	41	45	490
Ionic Balance	%		-1.4	-2.0	-1.5	-0.25	2.9
Hardness as $CaCO_3$	mg/L	3	65	72	78	84	1,000

Ionic Balance							
Our Reference			235372-23	235372-24	235372-25	235372-26	235372-27
Your Reference	UNITS	PQL	SW02	SW03	SW04	SW05	SW08
Date Sampled			29/10/2019	29/10/2019	29/10/2019	29/10/2019	29/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled							
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	71	47	55	130	110
Potassium - Dissolved	mg/L	0.5	61	8.2	60	91	59
Magnesium - Dissolved	mg/L	0.5	180	30	130	320	320
Sodium - Dissolved	mg/L	0.5	1,800	190	1,600	3,200	2,600
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	96	110	270	210	130
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	14	61	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	96	110	280	270	130
Chloride	mg/L	1	2,800	290	1,800	5,100	4,300
Sulphate	mg/L	1	600	170	280	840	500
Ionic Balance	%		3.1	-2.6	15	2.3	3.6
Hardness as $CaCO_3$	mg/L	3	930	240	690	1,700	1,600

Ionic Balance					
Our Reference			235372-28	235372-29	235372-30
Your Reference	UNITS	PQL	CD	KD	WC
Date Sampled			29/10/2019	29/10/2019	29/10/2019
Type of sample			Water	Water	Water
Time Sampled					
Date prepared	-		01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	52	24	43
Potassium - Dissolved	mg/L	0.5	7.3	7.9	9.3
Magnesium - Dissolved	mg/L	0.5	13	6.5	19
Sodium - Dissolved	mg/L	0.5	230	120	110
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	110	92	19
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	110	92	19
Chloride	mg/L	1	390	150	160
Sulphate	mg/L	1	71	57	200
Ionic Balance	%		-3.1	-1.2	-1.3
Hardness as $CaCO_3$	mg/L	3	180	87	180

Nutrients in Water							
Our Reference			235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference	UNITS	PQL	MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	0.6	2.3	2.0	1.8	1.6
Total Kjeldahl Nitrogen	mg/L	0.1	0.6	1.5	1.2	1	0.8
NOx as N	mg/L	0.005	<0.005	0.83	0.83	0.78	0.77
Nitrate as N	mg/L	0.005	<0.005	0.80	0.81	0.76	0.75
Nitrite as N	mg/L	0.005	<0.005	0.022	0.026	0.025	0.022
Ammonia as N	mg/L	0.005	0.26	0.21	0.14	0.078	0.051
Organic N	mg/L	0.1	0.4	1.3	1.0	0.9	0.8
Total Phosphorus	mg/L	0.01	<0.01	0.11	0.11	0.11	0.11
Phosphate as P	mg/L	0.005	<0.005	0.067	0.085	0.083	0.086
Soluble Nitrogen	mg/L	0.1	0.6	2.3	2.0	1.7	1.6

Nutrients in Water							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	1.5	3.8	2.2	2.3	1.9
Total Kjeldahl Nitrogen	mg/L	0.1	0.8	3.5	2.0	2.0	1.7
NOx as N	mg/L	0.005	0.75	0.32	0.18	0.27	0.20
Nitrate as N	mg/L	0.005	0.73	0.32	0.18	0.27	0.19
Nitrite as N	mg/L	0.005	0.016	<0.005	<0.005	<0.005	0.009
Ammonia as N	mg/L	0.005	0.031	<0.005	<0.005	<0.005	<0.005
Organic N	mg/L	0.1	0.7	3.5	2.0	2.0	1.7
Total Phosphorus	mg/L	0.01	0.10	1.3	0.73	0.67	0.50
Phosphate as P	mg/L	0.005	0.087	0.051	0.17	0.10	0.11
Soluble Nitrogen	mg/L	0.1	1.5	1	1.4	1.4	1.3

Nutrients in Water							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	1.8	1.6	1.4	1.7	1.5
Total Kjeldahl Nitrogen	mg/L	0.1	1.5	1.3	1.1	1.3	1.1
NOx as N	mg/L	0.005	0.22	0.28	0.30	0.36	0.38
Nitrate as N	mg/L	0.005	0.21	0.26	0.28	0.34	0.36
Nitrite as N	mg/L	0.005	0.014	0.015	0.014	0.019	0.020
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Organic N	mg/L	0.1	1.5	1.3	1.1	1.3	1.1
Total Phosphorus	mg/L	0.01	0.33	0.25	0.22	0.38	0.26
Phosphate as P	mg/L	0.005	0.10	0.11	0.11	0.11	0.11
Soluble Nitrogen	mg/L	0.1	1.1	1.1	1.1	1.2	1.2

Nutrients in Water						
Our Reference			235372-16	235372-17	235372-18	235372-19
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019
Type of sample			Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM
Date prepared	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019
Date analysed	-		01/11/2019	01/11/2019	01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	1.4	1.5	1.6	1.4
Total Kjeldahl Nitrogen	mg/L	0.1	1.0	1.1	1.2	1
NOx as N	mg/L	0.005	0.38	0.39	0.41	0.42
Nitrate as N	mg/L	0.005	0.36	0.37	0.39	0.41
Nitrite as N	mg/L	0.005	0.020	0.018	0.018	0.015
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Organic N	mg/L	0.1	1.0	1.1	1.2	1
Total Phosphorus	mg/L	0.01	0.22	0.31	0.33	0.25
Phosphate as P	mg/L	0.005	0.11	0.11	0.099	0.10
Soluble Nitrogen	mg/L	0.1	1.2	1.2	1.2	1.2

Dissolved Metals in Water							
Our Reference	UNITS	PQL	235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference			MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date prepared	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	<0.01	0.02	0.02	0.02	0.02
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.005	0.003	0.003	0.003	0.003
Barium-Dissolved	mg/L	0.001	0.029	0.040	0.041	0.040	0.040
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.07	0.08	0.08	0.08	0.08
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	0.005	0.005	0.005	0.005
Iron-Dissolved	mg/L	0.01	5.0	0.22	0.20	0.19	0.20
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0012	0.0013	0.0013	0.0013	0.0013
Manganese-Dissolved	mg/L	0.005	0.029	0.024	0.023	0.021	0.022
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001
Nickel-Dissolved	mg/L	0.001	<0.001	0.001	0.001	<0.001	<0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.003	0.012	0.012	0.013	0.013

Dissolved Metals in Water							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date prepared	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	0.02	0.02	0.05	0.05	0.04
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.003	0.003	0.005	0.005	0.004
Barium-Dissolved	mg/L	0.001	0.039	0.025	0.024	0.017	0.014
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.08	0.06	0.07	0.06	0.05
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	0.002	0.002	0.002	0.001
Copper-Dissolved	mg/L	0.001	0.005	0.004	0.009	0.0099	0.009
Iron-Dissolved	mg/L	0.01	0.20	0.36	0.65	0.60	0.44
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	0.001	0.001
Lithium-Dissolved	mg/L	0.0005	0.0012	0.0013	0.0018	0.0014	0.0012
Manganese-Dissolved	mg/L	0.005	0.019	0.091	0.080	0.055	0.042
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	0.001	0.001
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	0.001	0.001	0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	<0.001	<0.001	0.001	0.002	0.002
Zinc-Dissolved	mg/L	0.001	0.013	0.020	0.028	0.031	0.031

Dissolved Metals in Water							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date prepared	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	0.03	0.03	0.03	0.03	0.03
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.004	0.004	0.004	0.004	0.004
Barium-Dissolved	mg/L	0.001	0.013	0.013	0.013	0.015	0.017
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.05	0.04	0.04	0.05	0.05
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Copper-Dissolved	mg/L	0.001	0.008	0.008	0.008	0.008	0.008
Iron-Dissolved	mg/L	0.01	0.34	0.28	0.29	0.31	0.31
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0011	0.001	0.0010	0.0010	0.0011
Manganese-Dissolved	mg/L	0.005	0.037	0.035	0.032	0.038	0.040
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Nickel-Dissolved	mg/L	0.001	0.001	<0.001	<0.001	<0.001	0.001
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.002	0.001	0.001	0.001	0.001
Zinc-Dissolved	mg/L	0.001	0.030	0.028	0.027	0.026	0.028

Dissolved Metals in Water						
Our Reference			235372-16	235372-17	235372-18	235372-19
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019
Type of sample			Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM
Date prepared	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	0.03	0.03	0.03	0.03
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	0.004	0.004	0.004	0.004
Barium-Dissolved	mg/L	0.001	0.019	0.020	0.022	0.024
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.06	0.06	0.07	0.07
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001
Copper-Dissolved	mg/L	0.001	0.008	0.009	0.009	0.009
Iron-Dissolved	mg/L	0.01	0.31	0.31	0.32	0.33
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.0013	0.0014	0.0015	0.0015
Manganese-Dissolved	mg/L	0.005	0.040	0.040	0.041	0.040
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001
Nickel-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.002
Selenium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.001	0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.031	0.031	0.033	0.034

Total Metals in water							
Our Reference			235372-1	235372-2	235372-3	235372-4	235372-5
Your Reference	UNITS	PQL	MW07	CD01	CD02	CD03	CD04
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			03:00 PM	03:30 PM	04:00 PM	04:30 PM	05:00 PM
Date digested	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	0.61	0.05	0.05	0.05	0.05
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.006	0.003	0.004	0.004	0.004
Barium-Total	mg/L	0.001	0.031	0.040	0.041	0.042	0.042
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.07	0.08	0.08	0.08	0.08
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Cobalt-Total	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Copper-Total	mg/L	0.001	0.001	0.006	0.006	0.006	0.006
Iron-Total	mg/L	0.01	6.0	0.51	0.51	0.53	0.54
Lead-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Total	mg/L	0.0005	0.0015	0.0014	0.0014	0.0014	0.0014
Manganese-Total	mg/L	0.005	0.032	0.027	0.028	0.027	0.027
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.002	<0.001	0.001	<0.001	<0.001
Nickel-Total	mg/L	0.001	0.001	0.001	0.001	0.001	0.001
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	0.0007	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.002	0.001	0.001	0.001	0.001
Zinc-Total	mg/L	0.001	0.005	0.014	0.014	0.016	0.016

Total Metals in water							
Our Reference			235372-6	235372-7	235372-8	235372-9	235372-10
Your Reference	UNITS	PQL	CD05	CD06	CD07	CD08	CD09
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			05:30 PM	06:00 PM	06:30 PM	07:00 PM	07:30 PM
Date digested	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	0.05	1.7	0.55	0.48	0.41
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	0.001	0.001
Arsenic-Total	mg/L	0.001	0.003	0.025	0.015	0.011	0.008
Barium-Total	mg/L	0.001	0.040	0.096	0.041	0.032	0.024
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.08	0.06	0.07	0.06	0.05
Cadmium-Total	mg/L	0.0001	<0.0001	0.0003	0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	<0.001	0.006	0.002	0.002	0.002
Cobalt-Total	mg/L	0.001	<0.001	0.009	0.004	0.003	0.002
Copper-Total	mg/L	0.001	0.006	0.033	0.023	0.022	0.018
Iron-Total	mg/L	0.01	0.54	14	5.0	3.7	2.6
Lead-Total	mg/L	0.001	<0.001	0.034	0.012	0.014	0.010
Lithium-Total	mg/L	0.0005	0.0013	0.0022	0.0022	0.0018	0.0016
Manganese-Total	mg/L	0.005	0.026	0.32	0.14	0.084	0.064
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	<0.001	<0.001	0.001	0.002	0.002
Nickel-Total	mg/L	0.001	0.001	0.003	0.002	0.002	0.002
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	0.0008	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.001	0.008	0.003	0.003	0.003
Zinc-Total	mg/L	0.001	0.017	0.24	0.083	0.074	0.068

Total Metals in water							
Our Reference			235372-11	235372-12	235372-13	235372-14	235372-15
Your Reference	UNITS	PQL	CD10	CD11	CD12	CD13	CD14
Date Sampled			30/10/2019	30/10/2019	30/10/2019	30/10/2019	30/10/2019
Type of sample			Water	Water	Water	Water	Water
Time Sampled			08:00 PM	08:30 PM	09:00 PM	09:30 PM	10:00 PM
Date digested	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	0.34	0.21	0.16	0.38	0.25
Antimony-Total	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.006	0.005	0.005	0.008	0.007
Barium-Total	mg/L	0.001	0.021	0.017	0.017	0.026	0.023
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.05	0.04	0.04	0.05	0.05
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.002	0.001	0.001	0.002	0.002
Cobalt-Total	mg/L	0.001	0.002	0.002	0.001	0.002	0.002
Copper-Total	mg/L	0.001	0.016	0.013	0.012	0.017	0.015
Iron-Total	mg/L	0.01	1.8	1.2	0.99	2.6	1.7
Lead-Total	mg/L	0.001	0.007	0.004	0.003	0.009	0.006
Lithium-Total	mg/L	0.0005	0.0015	0.0011	0.0011	0.0013	0.0014
Manganese-Total	mg/L	0.005	0.060	0.049	0.046	0.065	0.063
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.002	0.001	0.001	0.001	0.001
Nickel-Total	mg/L	0.001	0.002	0.001	0.001	0.002	0.001
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.003	0.002	0.002	0.003	0.002
Zinc-Total	mg/L	0.001	0.062	0.046	0.040	0.075	0.056

Total Metals in water						
Our Reference			235372-16	235372-17	235372-18	235372-19
Your Reference	UNITS	PQL	CD15	CD16	CD17	CD18
Date Sampled			30/10/2019	30/10/2019	30/10/2019	31/10/2019
Type of sample			Water	Water	Water	Water
Time Sampled			10:30 PM	11:00 PM	11:30 PM	11:00 PM
Date digested	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019
Date analysed	-		04/11/2019	04/11/2019	04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	0.18	0.22	0.27	0.16
Antimony-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Total	mg/L	0.001	0.006	0.007	0.008	0.007
Barium-Total	mg/L	0.001	0.023	0.026	0.031	0.029
Beryllium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Boron-Total	mg/L	0.02	0.05	0.06	0.06	0.07
Cadmium-Total	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Total	mg/L	0.001	0.001	0.001	0.002	0.001
Cobalt-Total	mg/L	0.001	0.002	0.002	0.002	0.002
Copper-Total	mg/L	0.001	0.014	0.016	0.018	0.016
Iron-Total	mg/L	0.01	1.3	1.6	2.1	1.3
Lead-Total	mg/L	0.001	0.004	0.005	0.007	0.004
Lithium-Total	mg/L	0.0005	0.0014	0.0015	0.0017	0.0017
Manganese-Total	mg/L	0.005	0.060	0.067	0.070	0.067
Mercury-Total	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Total	mg/L	0.001	0.001	0.001	0.001	0.001
Nickel-Total	mg/L	0.001	0.001	0.002	0.002	0.002
Selenium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Silver-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Total	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Total	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Vanadium-Total	mg/L	0.001	0.002	0.002	0.002	0.002
Zinc-Total	mg/L	0.001	0.047	0.056	0.066	0.051

Method ID	Methodology Summary
INORG series	Determination of constituents in waters using colourimetric chemistry
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-019	Suspended Solids - determined gravimetrically by filtration of the sample. The solids are dried at 104±5°C
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Total Nitrogen by colourimetric analysis based on APHA 4500-P J, 4500-NO3 F.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-060	Total Phosphorus by colourimetric analysis based on APHA latest edition 4500-P J.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Determination of various metals by ICP-AES.
METALS-021	Determination of Mercury by Cold Vapour AAS. For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

Client Reference: Ashfield Flats

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-2
Date prepared	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Date analysed	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Total Carbon	mg/L	1	INORG-110	<1	1	39	40	3	102	76
Total Organic Carbon	mg/L	1	INORG-110	<1	1	5	[NT]		99	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	<1	1	29	32	10	95	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	<1	1	4	[NT]		97	[NT]
Total Suspended Solids	mg/L	5	INORG-019	<5	1	20	[NT]		96	[NT]
Chloride	mg/L	1	INORG-081	<1	21	14	14	0	95	108

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-4
Date prepared	-			[NT]	3	01/11/2019	01/11/2019		[NT]	01/11/2019
Date analysed	-			[NT]	3	01/11/2019	01/11/2019		[NT]	01/11/2019
Total Carbon	mg/L	1	INORG-110	[NT]	3	42	[NT]		[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	3	14	14	0	[NT]	92
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	3	24	[NT]		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	3	14	14	0	[NT]	97
Total Suspended Solids	mg/L	5	INORG-019	[NT]	3	<5	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	11	01/11/2019	01/11/2019		[NT]	[NT]
Total Carbon	mg/L	1	INORG-110	[NT]	11	34	33	3	[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	11	19	[NT]		[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	11	7	6	15	[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	11	18	[NT]		[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	11	18	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	12	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	12	01/11/2019	01/11/2019		[NT]	[NT]
Total Carbon	mg/L	1	INORG-110	[NT]	12	28	[NT]		[NT]	[NT]
Total Organic Carbon	mg/L	1	INORG-110	[NT]	12	16	16	0	[NT]	[NT]
Dissolved Inorganic Carbon	mg/L	1	INORG-110	[NT]	12	6	[NT]		[NT]	[NT]
Dissolved Organic Carbon	mg/L	1	INORG-110	[NT]	12	16	16	0	[NT]	[NT]
Total Suspended Solids	mg/L	5	INORG-019	[NT]	12	17	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	21	01/11/2019	01/11/2019		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-2
Date prepared	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Date analysed	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	34	[NT]		96	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	4.9	[NT]		98	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	9.4	[NT]		99	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	81	[NT]		97	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	<5	1	150	150	0	105	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	<5	1	<5	<5	0	105	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	<5	1	150	150	0	105	[NT]
Chloride	mg/L	1	INORG-081	<1	1	85	85	0	95	[NT]
Sulphate	mg/L	1	INORG-081	<1	1	53	54	2	95	104
Hardness as $CaCO_3$	mg/L	3	METALS-008	<3	1	120	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	235372-13
Date prepared	-			[NT]	10	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Date analysed	-			[NT]	10	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	15	16	6	98	95
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	5.5	5.4	2	98	99
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	3.4	3.4	0	100	100
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	10	39	39	0	98	91
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	10	44	[NT]		105	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	10	<5	[NT]		105	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	10	44	[NT]		105	[NT]
Chloride	mg/L	1	INORG-081	[NT]	10	61	[NT]		97	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	10	19	[NT]		97	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	10	53	53	0	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-22
Date prepared	-			[NT]	11	01/11/2019	01/11/2019		[NT]	01/11/2019
Date analysed	-			[NT]	11	01/11/2019	01/11/2019		[NT]	01/11/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	14	[NT]		[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	4.8	[NT]		[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	3.1	[NT]		[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	33	[NT]		[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	41	40	2	[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	41	40	2	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	49	49	0	[NT]	92
Sulphate	mg/L	1	INORG-081	[NT]	11	17	17	0	[NT]	84
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	11	48	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-29
Date prepared	-			[NT]	22	01/11/2019	01/11/2019		[NT]	01/11/2019
Date analysed	-			[NT]	22	01/11/2019	01/11/2019		[NT]	01/11/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	22	69	68	1	[NT]	92
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	22	68	68	0	[NT]	97
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	22	200	200	0	[NT]	98
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	22	2300	2300	0	[NT]	85
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	22	130	130	0	[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	22	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	22	130	130	0	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	22	3600	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	22	490	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	22	1000	990	1	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	28	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	28	01/11/2019	01/11/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	28	52	52	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	28	7.3	7.3	0	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	28	13	13	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	28	230	230	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	28	110	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	28	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	28	110	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	28	390	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	28	71	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	28	180	190	5	[NT]	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-2
Date prepared	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Date analysed	-			01/11/2019	1	01/11/2019	01/11/2019		01/11/2019	01/11/2019
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	0.6	[NT]		102	106
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	0.6	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	96	97
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	95	97
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	103	114
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.26	0.26	0	96	94
Total Phosphorus	mg/L	0.01	INORG-060	<0.01	1	<0.01	<0.01	0	109	98
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	<0.005	<0.005	0	112	82
Soluble Nitrogen	mg/L	0.1	INORG-055	<0.1	1	0.6	[NT]		102	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-4
Date prepared	-			[NT]	3	01/11/2019	01/11/2019		[NT]	01/11/2019
Date analysed	-			[NT]	3	01/11/2019	01/11/2019		[NT]	01/11/2019
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	3	2.0	2.0	0	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	3	1.2	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	3	0.83	[NT]		[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	3	0.81	[NT]		[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	3	0.026	[NT]		[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	3	0.14	[NT]		[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	3	0.11	[NT]		[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	3	0.085	[NT]		[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	3	2.0	2.0	0	[NT]	103

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	11	01/11/2019	01/11/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	11	1.8	[NT]		[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	11	1.5	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	11	0.22	0.23	4	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	11	0.21	0.21	0	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	11	0.014	0.014	0	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	11	0.33	0.33	0	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	11	0.10	0.10	0	[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	11	1.1	[NT]		[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	12	01/11/2019	01/11/2019		[NT]	[NT]
Date analysed	-			[NT]	12	01/11/2019	01/11/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	12	1.6	1.5	6	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	12	1.3	[NT]		[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	12	0.28	[NT]		[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	12	0.26	[NT]		[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	12	0.015	[NT]		[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	12	<0.005	[NT]		[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	12	0.25	[NT]		[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	12	0.11	[NT]		[NT]	[NT]
Soluble Nitrogen	mg/L	0.1	INORG-055	[NT]	12	1.1	1.1	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-12
Date prepared	-			04/11/2019	8	04/11/2019	04/11/2019		04/11/2019	04/11/2019
Date analysed	-			04/11/2019	8	04/11/2019	04/11/2019		04/11/2019	04/11/2019
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	8	0.05	0.05	0	88	77
Antimony-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	101	102
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.005	0.005	0	97	100
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.024	0.024	0	101	101
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	8	<0.0005	<0.0005	0	103	110
Bismuth-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	101	83
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	8	0.07	0.07	0	112	117
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	8	<0.0001	<0.0001	0	98	103
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	94	92
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.002	0.002	0	95	93
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.009	0.009	0	99	97
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	8	0.65	0.65	0	102	#
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	102	99
Lithium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	8	0.0018	0.0018	0	110	114
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	8	0.080	0.079	1	94	91
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	8	<0.00005	[NT]		109	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	98	102
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.001	0.001	0	98	95
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	101	110
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	103	92
Thallium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	101	96
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	8	<0.0005	<0.0005	0	102	93
Tin-Dissolved	mg/L	0.001	METALS-022	<0.001	8	<0.001	<0.001	0	103	108
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	8	<0.0005	<0.0005	0	100	95
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.001	0.001	0	97	96
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	8	0.028	0.028	0	97	99

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	235372-16
Date prepared	-			[NT]	9	04/11/2019	04/11/2019		[NT]	04/11/2019
Date analysed	-			[NT]	9	04/11/2019	04/11/2019		[NT]	04/11/2019
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	9	0.05	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.005	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.017	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	9	0.06	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	9	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.002	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.0099	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	9	0.60	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	0.0014	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	9	0.055	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	9	<0.00005	<0.00005	0	[NT]	114
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.001	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.001	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	9	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	9	<0.0005	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.002	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	9	0.031	[NT]		[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	15	04/11/2019	04/11/2019		[NT]	[NT]
Date analysed	-			[NT]	15	04/11/2019	04/11/2019		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	15	0.03	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.004	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.017	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	15	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	15	0.05	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	15	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.001	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.008	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	15	0.31	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	15	0.0011	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	15	0.040	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	15	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.001	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.001	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	15	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	15	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	15	<0.0005	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	15	0.028	[NT]		[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	18	04/11/2019	04/11/2019		[NT]	[NT]
Date analysed	-			[NT]	18	04/11/2019	04/11/2019		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	18	0.03	0.03	0	[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.004	0.004	0	[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.022	0.022	0	[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	18	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	18	0.07	0.07	0	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	18	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.001	0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.009	0.009	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	18	0.32	0.32	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	18	0.0015	0.0015	0	[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	18	0.041	0.042	2	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	18	<0.00005	[NT]		[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.001	0.001	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.001	0.001	0	[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	18	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	18	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	18	<0.001	<0.001	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	18	0.033	0.033	0	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	235372-2
Date digested	-			04/11/2019	1	04/11/2019	04/11/2019		04/11/2019	04/11/2019
Date analysed	-			04/11/2019	1	04/11/2019	04/11/2019		04/11/2019	04/11/2019
Aluminium-Total	mg/L	0.01	METALS-022	<0.01	1	0.61	0.61	0	107	107
Antimony-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	112	111
Arsenic-Total	mg/L	0.001	METALS-022	<0.001	1	0.006	0.006	0	102	104
Barium-Total	mg/L	0.001	METALS-022	<0.001	1	0.031	0.031	0	104	113
Beryllium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	109	112
Bismuth-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	105	100
Boron-Total	mg/L	0.02	METALS-022	<0.02	1	0.07	0.06	15	114	114
Cadmium-Total	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	101	102
Chromium-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	0.001	0	100	99
Cobalt-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	0.001	0	99	96
Copper-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	<0.001	0	105	100
Iron-Total	mg/L	0.01	METALS-022	<0.01	1	6.0	6.1	2	107	121
Lead-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	99
Lithium-Total	mg/L	0.0005	METALS-022	<0.0005	1	0.0015	0.0014	7	111	110
Manganese-Total	mg/L	0.005	METALS-022	<0.005	1	0.032	0.031	3	102	100
Mercury-Total	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	<0.00005	0	108	102
Molybdenum-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	99	107
Nickel-Total	mg/L	0.001	METALS-022	<0.001	1	0.001	<0.001	0	103	98
Selenium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	104	104
Silver-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	104	99
Thallium-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	100	96
Thorium-Total	mg/L	0.0005	METALS-022	<0.0005	1	0.0007	0.0006	15	104	100
Tin-Total	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	101	106
Uranium-Total	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	102	103
Vanadium-Total	mg/L	0.001	METALS-022	<0.001	1	0.002	0.003	40	104	104
Zinc-Total	mg/L	0.001	METALS-022	<0.001	1	0.005	0.006	18	103	101

QUALITY CONTROL: Total Metals in water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date digested	-			[NT]	11	04/11/2019	04/11/2019		[NT]	[NT]
Date analysed	-			[NT]	11	04/11/2019	04/11/2019		[NT]	[NT]
Aluminium-Total	mg/L	0.01	METALS-022	[NT]	11	0.34	0.31	9	[NT]	[NT]
Antimony-Total	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]
Arsenic-Total	mg/L	0.001	METALS-022	[NT]	11	0.006	0.006	0	[NT]	[NT]
Barium-Total	mg/L	0.001	METALS-022	[NT]	11	0.021	0.021	0	[NT]	[NT]
Beryllium-Total	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Boron-Total	mg/L	0.02	METALS-022	[NT]	11	0.05	0.05	0	[NT]	[NT]
Cadmium-Total	mg/L	0.0001	METALS-022	[NT]	11	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	[NT]
Cobalt-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	[NT]
Copper-Total	mg/L	0.001	METALS-022	[NT]	11	0.016	0.015	6	[NT]	[NT]
Iron-Total	mg/L	0.01	METALS-022	[NT]	11	1.8	1.7	6	[NT]	[NT]
Lead-Total	mg/L	0.001	METALS-022	[NT]	11	0.007	0.006	15	[NT]	[NT]
Lithium-Total	mg/L	0.0005	METALS-022	[NT]	11	0.0015	0.0014	7	[NT]	[NT]
Manganese-Total	mg/L	0.005	METALS-022	[NT]	11	0.060	0.058	3	[NT]	[NT]
Mercury-Total	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.001	67	[NT]	[NT]
Nickel-Total	mg/L	0.001	METALS-022	[NT]	11	0.002	0.002	0	[NT]	[NT]
Selenium-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Silver-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thallium-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thorium-Total	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Total	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Uranium-Total	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Total	mg/L	0.001	METALS-022	[NT]	11	0.003	0.003	0	[NT]	[NT]
Zinc-Total	mg/L	0.001	METALS-022	[NT]	11	0.062	0.058	7	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Samples received in good order: No
Ferrous Iron bottles not supplied - not tested.
Did not receive QW-1

Percent recovery not available due to the analyte signal being much greater than the spike amount. An acceptable recovery was achieved for the LCS.

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr: Jasmine Rutherford	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensington, 6151, WA	**Date results required:** Or choose: standard / same day / 1 day / 2 day / 3 day standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format:** esdat / equis /
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

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Darwin Office - Envirolab Services
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Ph: 08 8967 1201 / darwin@envirolab.com.au

Sample information					Tests Required							Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Major Ions (Iron Balance)	Bromide	Nutrient Suite	Dissolved metals (26)	Dissolved Ferrous Iron	~~TSS~~	~~DOC/TOC/TC~~	Provide as much information about the sample as you can
1	MW01		16/07/19	water	X	X	X	X	X			Red f. Majada bottles have bee field filtered 0.45 µm
2	MW03		15/07/19	"	X	X	X	X	X			
3	MW04S		14/07/19	"	X	X	X	X	X			
4	MW04D		14/07/19	"	X	X	X	X	X			
5	MW05		"	"	X	X	X	X	X			
6	MW08S		15/07/19	"	X	X	X	X	X			
7	MW08D		"	"	X	X	X	X	X			
8	MW09S		"	"	X	X	X	X	X			
9	MW09D		"	"	X	X	X	X	X			
10	MW10		14/07/19	"	X	X	X	X	X			
11	MW12S		15/07/19	"	X	X	X	X	X			
12	MW12D		15/07/19	"	X	X	X	X	X			

☐ ***Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis***

Relinquished by (Company): DBCA	**Received by (Company):** MPL	***Lab Use Only***
Print Name: GAVAN McGRATH	**Print Name:** MC	**Job number:** 229816 **Cooling:** Ice / Ice pack / None
Date & Time: 16/7/19	**Date & Time:** 16-7-19 1650	**Temperature:** 11.5 **Security seal:** Intact / Broken / None
Signature: [signature]	**Signature:** [signature]	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**

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CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 424 344

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Client: Department of Biodiversity Conservation and Attractions	**Client Project Name / Number / Site etc (ie report title):** Ashfield Flats
Contact Person: Dr Gavan McGrath	
Project Mgr: Jasmine Rutherford	**PO No.:**
Sampler: Dr Gavan McGrath	**Envirolab Quote No. :** 19P132
Address: 17 Dick Perry Avenue, Kensignton, 6151, WA	**Date results required:** **Or choose: standard / same day / 1 day / 2 day / 3 day** standard
Phone: 08 9219 9447 **Mob:** 0458 559 765	**Additional report format: esdat / equis /**
Email: gavan.mcgrath@dbca.wa.gov.au	**Lab Comments:**

Sample information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Major Ions (Ion Balance)	Bromide	Nutrient Suite	Dissolved Metals	Dissolved Ferrous Iron											Provide as much information about the sample as you can
13	GW-1		16/7/19	water	X	X	X	X	X											
14	MW4		"	"	X	X	X	X	X		fg		16/7							

☐ *Please tick the box if observed settled sediment present in water samples is to be included in the extraction and/or analysis*

Relinquished by (Company): DBCA	**Received by (Company):** MPL	**Lab Use Only**	
Print Name: GAVAN McGRATH	**Print Name:** MC	**Job number:**	**Cooling: Ice / Ice pack / None**
Date & Time: 16/7/19	**Date & Time:** 16-7-19 1650	**Temperature:**	**Security seal: Intact / Broken / None**
Signature: [signature]	**Signature:** [signature]	**TAT Req - SAME day / 1 / 2 / 3 / 4 / STD**	

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CERTIFICATE OF ANALYSIS 229816

Client Details

Client	Dept of Biodiversity,Conservation and Attractions
Attention	Dr Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details

Your Reference	**Ashfield Flats**
Number of Samples	14 Waters
Date samples received	16/07/2019
Date completed instructions received	16/07/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	22/07/2019
Date of Issue	22/07/2019

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Results Approved By
Heram Halim, Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorganics							
Our Reference	UNITS	PQL	229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference			MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	17/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	17/07/2019	16/07/2019	16/07/2019	16/07/2019
Bromide	mg/L	0.5	<0.5	67	0.6	0.8	<0.5

Miscellaneous Inorganics							
Our Reference	UNITS	PQL	229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference			MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Bromide	mg/L	0.5	39	74	68	79	1.3

Miscellaneous Inorganics						
Our Reference	UNITS	PQL	229816-11	229816-12	229816-13	229816-14
Your Reference			MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Bromide	mg/L	0.5	38	27	<0.5	15

Ionic Balance							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	65	390	180	20	18
Potassium - Dissolved	mg/L	0.5	6.6	310	16	4.5	5.5
Magnesium - Dissolved	mg/L	0.5	28	1,700	72	29	35
Sodium - Dissolved	mg/L	0.5	140	11,000	280	150	140
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	220	3,500	650	160	120
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	220	3,500	650	160	120
Chloride	mg/L	1	190	20,000	270	260	190
Sulphate	mg/L	1	92	760	310	58	110
Ionic Balance	%		1.3	-1.5	0.64	-7.1	-0.48
Hardness as $CaCO_3$	mg/L	3	280	8,000	750	170	190

Ionic Balance							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	320	820	410	700	35
Potassium - Dissolved	mg/L	0.5	150	280	360	320	7.3
Magnesium - Dissolved	mg/L	0.5	840	2,000	1,600	1,900	45
Sodium - Dissolved	mg/L	0.5	6,600	13,000	12,000	13,000	200
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	110	340	1,100	210	130
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	110	340	1,100	210	130
Chloride	mg/L	1	12,000	23,000	21,000	25,000	390
Sulphate	mg/L	1	1,800	4,900	2,300	4,000	67
Ionic Balance	%		0.079	-0.040	0.80	-1.0	-2.6
Hardness as $CaCO_3$	mg/L	3	4,300	10,000	7,400	9,800	270

Ionic Balance						
Our Reference			229816-11	229816-12	229816-13	229816-14
Your Reference	UNITS	PQL	MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	380	110	63	120
Potassium - Dissolved	mg/L	0.5	110	160	7.0	97
Magnesium - Dissolved	mg/L	0.5	860	510	30	280
Sodium - Dissolved	mg/L	0.5	6,500	4,600	160	3,000
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	200	1,300	200	250
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	200	1,300	200	250
Chloride	mg/L	1	12,000	8,300	190	4,900
Sulphate	mg/L	1	1,900	540	97	920
Ionic Balance	%		-1.1	-3.5	4.0	-0.23
Hardness as $CaCO_3$	mg/L	3	4,500	2,400	280	1,400

Nutrients in Water							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Date analysed	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	4.6	170	6.7	0.5	0.6
Total Kjeldahl Nitrogen	mg/L	0.1	0.7	170	1.1	0.5	0.6
Nitrate as N	mg/L	0.005	3.9	<0.1	5.5	<0.1	<0.1
Nitrite as N	mg/L	0.005	<0.005	<0.1	0.069	<0.1	<0.1
NOx as N	mg/L	0.005	3.9	<0.1	5.5	<0.1	<0.1
Ammonia as N	mg/L	0.005	0.010	150	0.25	0.34	0.40
Phosphate as P	mg/L	0.005	0.008	4.6	<0.005	<0.1	<0.1
Total Phosphorus	mg/L	0.01	<0.01	4.6	<0.01	<0.01	<0.01
Organic N	mg/L	0.1	0.7	18	0.9	0.2	0.2

Nutrients in Water							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Date analysed	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	4.8	9.4	35	11	0.4
Total Kjeldahl Nitrogen	mg/L	0.1	4.8	9.4	35	11	0.4
Nitrate as N	mg/L	0.005	<0.1	<0.1	<0.005	<0.005	<0.1
Nitrite as N	mg/L	0.005	<0.1	<0.1	<0.005	<0.005	<0.1
NOx as N	mg/L	0.005	<0.1	<0.1	<0.005	<0.005	<0.1
Ammonia as N	mg/L	0.005	4.1	8.6	31	8.8	0.24
Phosphate as P	mg/L	0.005	<0.1	<0.25	1.2	0.26	<0.1
Total Phosphorus	mg/L	0.01	<0.01	<0.01	1.2	0.22	<0.01
Organic N	mg/L	0.1	0.7	0.7	4.2	2.0	0.2

Nutrients in Water						
Our Reference			229816-11	229816-12	229816-13	229816-14
Your Reference	UNITS	PQL	MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019
Date analysed	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	6.6	35	4.2	3.2
Total Kjeldahl Nitrogen	mg/L	0.1	6.6	35	0.7	3.2
Nitrate as N	mg/L	0.005	<0.1	<0.1	3.5	<0.1
Nitrite as N	mg/L	0.005	<0.1	<0.1	0.005	<0.1
NOx as N	mg/L	0.005	<0.1	<0.1	3.5	<0.1
Ammonia as N	mg/L	0.005	4.9	31	0.030	4.3
Phosphate as P	mg/L	0.005	<0.25	0.84	0.007	<0.1
Total Phosphorus	mg/L	0.01	0.01	1.5	<0.01	0.01
Organic N	mg/L	0.1	1.7	4.3	0.7	<0.1

Dissolved Metals in Water							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Iron (HCl preserved)	mg/L	0.02	0.06	<0.1	2.9	42	23
Ferrous Iron - Fe^{2+}	mg/L	0.05	0.07	<0.25	1.8	39	21
Ferric Iron - Fe^{3+}	mg/L	0.05	<0.05	<0.05	1.1	3.1	2.4
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.02	<0.01	<0.01	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.002	0.001	0.002	0.005
Barium-Dissolved	mg/L	0.001	0.071	0.49	0.077	0.11	0.28
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.09	4.5	0.2	0.03	0.03
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	0.003	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.003	<0.002	0.004	<0.001	0.007
Copper-Dissolved	mg/L	0.001	0.017	<0.002	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	0.08	<0.02	3.0	42	22
Lead-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	<0.0005	0.047	0.0008	0.0021	0.0008
Manganese-Dissolved	mg/L	0.005	0.11	<0.01	0.37	0.074	0.53
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.003	<0.002	0.005	<0.001	0.005
Nickel-Dissolved	mg/L	0.001	0.004	<0.002	0.003	0.001	0.002
Selenium-Dissolved	mg/L	0.001	<0.001	<0.002	0.005	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	0.0032	<0.001	0.049	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.002	0.011	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.21	0.003	0.005	0.001	0.002

Dissolved Metals in Water							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Iron (HCl preserved)	mg/L	0.02	59	77	<0.1	0.39	26
Ferrous Iron - Fe^{2+}	mg/L	0.05	58	74	<0.05	0.38	25
Ferric Iron - Fe^{3+}	mg/L	0.05	1.7	3.2	<0.05	<0.05	1.5
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.02	<0.02	0.13	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Barium-Dissolved	mg/L	0.001	0.055	0.063	0.066	0.11	0.14
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.001	<0.001	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Boron-Dissolved	mg/L	0.02	1.3	3.0	4.9	4.1	0.04
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	0.002	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	0.002	0.001
Copper-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Iron-Dissolved	mg/L	0.01	58	76	<0.02	0.41	27
Lead-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Lithium-Dissolved	mg/L	0.0005	0.050	0.022	0.096	0.17	0.0009
Manganese-Dissolved	mg/L	0.005	1.0	1.4	0.15	2.9	0.79
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	0.014	<0.002	<0.002	0.006
Nickel-Dissolved	mg/L	0.001	<0.001	0.004	<0.002	<0.002	0.002
Selenium-Dissolved	mg/L	0.001	0.003	0.007	0.006	0.007	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.001	<0.001	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	0.011	<0.001	<0.001	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.005	0.006	0.007	0.006	<0.001
Zinc-Dissolved	mg/L	0.001	0.011	0.005	0.002	0.007	0.007

Dissolved Metals in Water						
Our Reference	UNITS	PQL	229816-11	229816-12	229816-13	229816-14
Your Reference			MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019
Iron (HCl preserved)	mg/L	0.02	46	<0.04	0.1	14
Ferrous Iron - Fe^{2+}	mg/L	0.05	46	<0.25	0.09	14
Ferric Iron - Fe^{3+}	mg/L	0.05	<0.05	<0.05	<0.05	0.26
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	0.001
Barium-Dissolved	mg/L	0.001	0.10	0.048	0.071	0.074
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	2.5	4.2	0.09	2.7
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	0.001	0.002	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	0.003	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	<0.001	0.016	<0.001
Iron-Dissolved	mg/L	0.01	47	<0.01	0.13	14
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.081	0.043	<0.0005	0.018
Manganese-Dissolved	mg/L	0.005	8.4	0.039	0.11	0.71
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	0.003	0.005
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	0.004	0.001
Selenium-Dissolved	mg/L	0.001	0.005	0.006	0.001	0.004
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	0.0030	0.0007
Vanadium-Dissolved	mg/L	0.001	0.003	0.004	0.002	0.001
Zinc-Dissolved	mg/L	0.001	0.001	0.003	0.21	0.007

Method ID	Methodology Summary
INORG series	Determination of constituents in waters using colourimetric chemistry
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-060	Total Phosphorus by colourimetric analysis based on APHA latest edition 4500-P J.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-076	Ferrous Iron determination by colourimerically using APHA latest edition 3500-Fe B.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Metals in soil and water by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS. For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

Client Reference: Ashfield Flats

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-3
Date prepared	-			17/07/2019	1	16/07/2019	16/07/2019		17/07/2019	17/07/2019
Date analysed	-			17/07/2019	1	16/07/2019	16/07/2019		17/07/2019	17/07/2019
Bromide	mg/L	0.5	INORG-081	<0.5	1	<0.5	<0.5	0	102	72

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Bromide	mg/L	0.5	INORG-081	[NT]	11	38	38	0	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-3
Date prepared	-			16/07/2019	1	16/07/2019	16/07/2019		16/07/2019	16/07/2019
Date analysed	-			16/07/2019	1	16/07/2019	16/07/2019		16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	65	[NT]		98	71
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	6.6	[NT]		95	95
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	28	[NT]		97	91
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	140	[NT]		93	#
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	<5	1	220	220	0	100	[NT]
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	INORG-006	<5	1	<5	<5	0	100	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	<5	1	220	220	0	100	[NT]
Chloride	mg/L	1	INORG-081	<1	1	190	190	0	100	92
Sulphate	mg/L	1	INORG-081	<1	1	92	92	0	104	96
Hardness as $CaCO_3$	mg/L	3	METALS-008	<3	1	280	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	2	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	2	16/07/2019	16/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	390	390	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	310	310	0	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	1700	1700	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	11000	11000	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	2	3500	[NT]		[NT]	[NT]
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	INORG-006	[NT]	2	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	2	3500	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	2	20000	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	2	760	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	2	8000	7900	1	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	380	[NT]		[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	110	[NT]		[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	860	[NT]		[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	6500	[NT]		[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	200	200	0	[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	200	200	0	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	12000	12000	0	[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	11	1900	1900	0	[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	11	4500	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	12	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	12	16/07/2019	16/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	110	110	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	160	160	0	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	510	510	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	4600	4600	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	12	1300	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	12	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	12	1300	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	12	8300	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	12	540	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	12	2400	2400	0	[NT]	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-4
Date prepared	-			17/07/2019	1	17/07/2019	17/07/2019		17/07/2019	17/07/2019
Date analysed	-			17/07/2019	1	17/07/2019	17/07/2019		17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	4.6	4.6	0	106	103
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	0.7	0.7	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	3.9	3.9	0	104	103
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	107	128
NOx as N	mg/L	0.005	INORG-055	<0.005	1	3.9	3.9	0	104	103
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.010	0.009	11	100	105
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	0.008	0.008	0	105	85
Total Phosphorus	mg/L	0.01	INORG-060	<0.01	1	<0.01	<0.01	0	100	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	17/07/2019	17/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	17/07/2019	17/07/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	11	6.6	6.7	2	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	11	6.6	6.7	2	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	4.9	4.8	2	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	11	<0.25	<0.25	0	[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	11	0.01	0.01	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-5
Date prepared	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	22/07/2019
Date analysed	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	22/07/2019
Iron (HCl preserved)	mg/L	0.02	METALS-020	<0.02	1	0.06	[NT]		103	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	<0.05	1	0.07	0.05	33	95	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	1	<0.01	<0.01	0	100	98
Antimony-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	102	106
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	93	99
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.071	0.073	3	100	93
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	98	104
Bismuth-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	99	84
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	1	0.09	0.09	0	110	99
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	99	105
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	92	90
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.003	0.003	0	90	87
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.017	0.016	6	89	83
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	1	0.08	0.08	0	103	#
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	97	90
Lithium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	106	107
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	1	0.11	0.11	0	94	113
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	[NT]		114	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.003	0.003	0	98	104
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.004	0.004	0	90	85
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	95	101
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	97
Thallium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	100	94
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	99	95
Tin-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	101	100
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	0.0032	0.0033	3	99	94
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	96	97
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.21	0.20	5	92	92

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	5	19/07/2019	19/07/2019		[NT]	[NT]
Date analysed	-			[NT]	5	19/07/2019	19/07/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	5	23	24	4	[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	5	21	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	5	<0.01	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.005	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.28	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	5	0.03	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	5	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.007	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	5	22	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	0.0008	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	5	0.53	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	5	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.005	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.002	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.002	[NT]		[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	11	46	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	11	46	46	0	[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.10	0.099	1	[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	11	2.5	2.6	4	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	11	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	11	47	47	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	0.081	0.082	1	[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	11	8.4	8.1	4	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	[NT]		[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.005	0.005	0	[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.003	0.003	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Percent recovery not available due to the analyte signal being much greater than the spike amount. An acceptable recovery was achieved for the LCS.

Note: Some results have raised pqls. In these cases the sample's high TDS required the sample to be diluted prior to analysis.

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CERTIFICATE OF ANALYSIS 229816

Client Details

Client	Dept of Biodiversity,Conservation and Attractions
Attention	Dr Gavan McGrath
Address	Locked Bag 104, BENTLEY DELIVERY CEN, WA, 6983

Sample Details

Your Reference	**Ashfield Flats**
Number of Samples	14 Waters
Date samples received	16/07/2019
Date completed instructions received	16/07/2019

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	22/07/2019
Date of Issue	22/07/2019

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Results Approved By
Heram Halim, Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Miscellaneous Inorganics							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	17/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	17/07/2019	16/07/2019	16/07/2019	16/07/2019
Bromide	mg/L	0.5	<0.5	67	0.6	0.8	<0.5

Miscellaneous Inorganics							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Bromide	mg/L	0.5	39	74	68	79	1.3

Miscellaneous Inorganics						
Our Reference			229816-11	229816-12	229816-13	229816-14
Your Reference	UNITS	PQL	MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Bromide	mg/L	0.5	38	27	<0.5	15

Ionic Balance							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	65	390	180	20	18
Potassium - Dissolved	mg/L	0.5	6.6	310	16	4.5	5.5
Magnesium - Dissolved	mg/L	0.5	28	1,700	72	29	35
Sodium - Dissolved	mg/L	0.5	140	11,000	280	150	140
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	220	3,500	650	160	120
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	220	3,500	650	160	120
Chloride	mg/L	1	190	20,000	270	260	190
Sulphate	mg/L	1	92	760	310	58	110
Ionic Balance	%		1.3	-1.5	0.64	-7.1	-0.48
Hardness as $CaCO_3$	mg/L	3	280	8,000	750	170	190

Ionic Balance							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	320	820	410	700	35
Potassium - Dissolved	mg/L	0.5	150	280	360	320	7.3
Magnesium - Dissolved	mg/L	0.5	840	2,000	1,600	1,900	45
Sodium - Dissolved	mg/L	0.5	6,600	13,000	12,000	13,000	200
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	110	340	1,100	210	130
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	110	340	1,100	210	130
Chloride	mg/L	1	12,000	23,000	21,000	25,000	390
Sulphate	mg/L	1	1,800	4,900	2,300	4,000	67
Ionic Balance	%		0.079	-0.040	0.80	-1.0	-2.6
Hardness as $CaCO_3$	mg/L	3	4,300	10,000	7,400	9,800	270

Ionic Balance						
Our Reference			229816-11	229816-12	229816-13	229816-14
Your Reference	UNITS	PQL	MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Date analysed	-		16/07/2019	16/07/2019	16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	380	110	63	120
Potassium - Dissolved	mg/L	0.5	110	160	7.0	97
Magnesium - Dissolved	mg/L	0.5	860	510	30	280
Sodium - Dissolved	mg/L	0.5	6,500	4,600	160	3,000
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	200	1,300	200	250
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	<5	<5	<5	<5
Hydroxide OH^- as $CaCO_3$	mg/L	5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	5	200	1,300	200	250
Chloride	mg/L	1	12,000	8,300	190	4,900
Sulphate	mg/L	1	1,900	540	97	920
Ionic Balance	%		-1.1	-3.5	4.0	-0.23
Hardness as $CaCO_3$	mg/L	3	4,500	2,400	280	1,400

Nutrients in Water							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Date analysed	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	4.6	170	6.7	0.5	0.6
Total Kjeldahl Nitrogen	mg/L	0.1	0.7	170	1.1	0.5	0.6
Nitrate as N	mg/L	0.005	3.9	<0.1	5.5	<0.1	<0.1
Nitrite as N	mg/L	0.005	<0.005	<0.1	0.069	<0.1	<0.1
NOx as N	mg/L	0.005	3.9	<0.1	5.5	<0.1	<0.1
Ammonia as N	mg/L	0.005	0.010	150	0.25	0.34	0.40
Phosphate as P	mg/L	0.005	0.008	4.6	<0.005	<0.1	<0.1
Total Phosphorus	mg/L	0.01	<0.01	4.6	<0.01	<0.01	<0.01
Organic N	mg/L	0.1	0.7	18	0.9	0.2	0.2

Nutrients in Water							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Date analysed	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	4.8	9.4	35	11	0.4
Total Kjeldahl Nitrogen	mg/L	0.1	4.8	9.4	35	11	0.4
Nitrate as N	mg/L	0.005	<0.1	<0.1	<0.005	<0.005	<0.1
Nitrite as N	mg/L	0.005	<0.1	<0.1	<0.005	<0.005	<0.1
NOx as N	mg/L	0.005	<0.1	<0.1	<0.005	<0.005	<0.1
Ammonia as N	mg/L	0.005	4.1	8.6	31	8.8	0.24
Phosphate as P	mg/L	0.005	<0.1	<0.25	1.2	0.26	<0.1
Total Phosphorus	mg/L	0.01	<0.01	<0.01	1.2	0.22	<0.01
Organic N	mg/L	0.1	0.7	0.7	4.2	2.0	0.2

Nutrients in Water						
Our Reference			229816-11	229816-12	229816-13	229816-14
Your Reference	UNITS	PQL	MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019
Date analysed	-		17/07/2019	17/07/2019	17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	6.6	35	4.2	3.2
Total Kjeldahl Nitrogen	mg/L	0.1	6.6	35	0.7	3.2
Nitrate as N	mg/L	0.005	<0.1	<0.1	3.5	<0.1
Nitrite as N	mg/L	0.005	<0.1	<0.1	0.005	<0.1
NOx as N	mg/L	0.005	<0.1	<0.1	3.5	<0.1
Ammonia as N	mg/L	0.005	4.9	31	0.030	4.3
Phosphate as P	mg/L	0.005	<0.25	0.84	0.007	<0.1
Total Phosphorus	mg/L	0.01	0.01	1.5	<0.01	0.01
Organic N	mg/L	0.1	1.7	4.3	0.7	<0.1

Dissolved Metals in Water							
Our Reference			229816-1	229816-2	229816-3	229816-4	229816-5
Your Reference	UNITS	PQL	MW01	MW03	MW04S	MW04D	MW05
Date Sampled			16/07/2019	15/07/2019	14/07/2019	14/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Iron (HCl preserved)	mg/L	0.02	0.06	<0.1	2.9	42	23
Ferrous Iron - Fe^{2+}	mg/L	0.05	0.07	<0.25	1.8	39	21
Ferric Iron - Fe^{3+}	mg/L	0.05	<0.05	<0.05	1.1	3.1	2.4
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.02	<0.01	<0.01	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.002	0.001	0.002	0.005
Barium-Dissolved	mg/L	0.001	0.071	0.49	0.077	0.11	0.28
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	0.09	4.5	0.2	0.03	0.03
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0002	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	0.003	<0.001	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	0.003	<0.002	0.004	<0.001	0.007
Copper-Dissolved	mg/L	0.001	0.017	<0.002	<0.001	<0.001	<0.001
Iron-Dissolved	mg/L	0.01	0.08	<0.02	3.0	42	22
Lead-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	<0.0005	0.047	0.0008	0.0021	0.0008
Manganese-Dissolved	mg/L	0.005	0.11	<0.01	0.37	0.074	0.53
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	0.003	<0.002	0.005	<0.001	0.005
Nickel-Dissolved	mg/L	0.001	0.004	<0.002	0.003	0.001	0.002
Selenium-Dissolved	mg/L	0.001	<0.001	<0.002	0.005	<0.001	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	0.0032	<0.001	0.049	<0.0005	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.002	0.011	<0.001	<0.001	<0.001
Zinc-Dissolved	mg/L	0.001	0.21	0.003	0.005	0.001	0.002

Dissolved Metals in Water							
Our Reference			229816-6	229816-7	229816-8	229816-9	229816-10
Your Reference	UNITS	PQL	MW08S	MW08D	MW09S	MW09D	MW10
Date Sampled			15/07/2019	15/07/2019	15/07/2019	15/07/2019	14/07/2019
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019	19/07/2019
Iron (HCl preserved)	mg/L	0.02	59	77	<0.1	0.39	26
Ferrous Iron - Fe^{2+}	mg/L	0.05	58	74	<0.05	0.38	25
Ferric Iron - Fe^{3+}	mg/L	0.05	1.7	3.2	<0.05	<0.05	1.5
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.02	<0.02	0.13	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Barium-Dissolved	mg/L	0.001	0.055	0.063	0.066	0.11	0.14
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.001	<0.001	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Boron-Dissolved	mg/L	0.02	1.3	3.0	4.9	4.1	0.04
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0001
Chromium-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	0.002	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	0.002	0.001
Copper-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Iron-Dissolved	mg/L	0.01	58	76	<0.02	0.41	27
Lead-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Lithium-Dissolved	mg/L	0.0005	0.050	0.022	0.096	0.17	0.0009
Manganese-Dissolved	mg/L	0.005	1.0	1.4	0.15	2.9	0.79
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	0.014	<0.002	<0.002	0.006
Nickel-Dissolved	mg/L	0.001	<0.001	0.004	<0.002	<0.002	0.002
Selenium-Dissolved	mg/L	0.001	0.003	0.007	0.006	0.007	<0.001
Silver-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.001	<0.001	<0.001	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.002	<0.002	<0.002	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	0.011	<0.001	<0.001	<0.0005
Vanadium-Dissolved	mg/L	0.001	0.005	0.006	0.007	0.006	<0.001
Zinc-Dissolved	mg/L	0.001	0.011	0.005	0.002	0.007	0.007

Dissolved Metals in Water						
Our Reference	UNITS	PQL	229816-11	229816-12	229816-13	229816-14
Your Reference			MW12S	MW12D	QW-1	MW11
Date Sampled			15/07/2019	15/07/2019	16/07/2019	15/07/2019
Type of sample			Water	Water	Water	Water
Date prepared	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019
Date analysed	-		19/07/2019	19/07/2019	19/07/2019	19/07/2019
Iron (HCl preserved)	mg/L	0.02	46	<0.04	0.1	14
Ferrous Iron - Fe^{2+}	mg/L	0.05	46	<0.25	0.09	14
Ferric Iron - Fe^{3+}	mg/L	0.05	<0.05	<0.05	<0.05	0.26
Aluminium-Dissolved	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
Antimony-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Arsenic-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	0.001
Barium-Dissolved	mg/L	0.001	0.10	0.048	0.071	0.074
Beryllium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Boron-Dissolved	mg/L	0.02	2.5	4.2	0.09	2.7
Cadmium-Dissolved	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	0.001	0.001	0.002	<0.001	<0.001
Cobalt-Dissolved	mg/L	0.001	<0.001	<0.001	0.003	<0.001
Copper-Dissolved	mg/L	0.001	<0.001	<0.001	0.016	<0.001
Iron-Dissolved	mg/L	0.01	47	<0.01	0.13	14
Lead-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lithium-Dissolved	mg/L	0.0005	0.081	0.043	<0.0005	0.018
Manganese-Dissolved	mg/L	0.005	8.4	0.039	0.11	0.71
Mercury-Dissolved	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum-Dissolved	mg/L	0.001	<0.001	<0.001	0.003	0.005
Nickel-Dissolved	mg/L	0.001	<0.001	<0.001	0.004	0.001
Selenium-Dissolved	mg/L	0.001	0.005	0.006	0.001	0.004
Silver-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thallium-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Tin-Dissolved	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	0.0030	0.0007
Vanadium-Dissolved	mg/L	0.001	0.003	0.004	0.002	0.001
Zinc-Dissolved	mg/L	0.001	0.001	0.003	0.21	0.007

Method ID	Methodology Summary
INORG series	Determination of constituents in waters using colourimetric chemistry
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	NOx - determined colourimetrically. Soils are analysed from a water extract.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-060	Total Phosphorus by colourimetric analysis based on APHA latest edition 4500-P J.
INORG-062	TKN by calculation from Total Nitrogen and NOx using APHA methodology.
INORG-076	Ferrous Iron determination by colourimerically using APHA latest edition 3500-Fe B.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
INORG-110	Total Nitrogen by high temperature catalytic combustion with chemiluminescence detection. Dissolved/Total Carbon and Dissolved/Total Organic and Inorganic Carbon by high temperature catalytic combustion with NDIR
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Metals in soil and water by ICP-OES.
METALS-021	Determination of Mercury by Cold Vapour AAS. For urine samples total Mercury is determined, however, mercury in urine is almost entirely in the inorganic form (CDC).
METALS-022	Determination of various metals by ICP-MS.

Client Reference: Ashfield Flats

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-3
Date prepared	-			17/07/2019	1	16/07/2019	16/07/2019		17/07/2019	17/07/2019
Date analysed	-			17/07/2019	1	16/07/2019	16/07/2019		17/07/2019	17/07/2019
Bromide	mg/L	0.5	INORG-081	<0.5	1	<0.5	<0.5	0	102	72

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Bromide	mg/L	0.5	INORG-081	[NT]	11	38	38	0	[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-3
Date prepared	-			16/07/2019	1	16/07/2019	16/07/2019		16/07/2019	16/07/2019
Date analysed	-			16/07/2019	1	16/07/2019	16/07/2019		16/07/2019	16/07/2019
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	65	[NT]		98	71
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	6.6	[NT]		95	95
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	28	[NT]		97	91
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	140	[NT]		93	#
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	<5	1	220	220	0	100	[NT]
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	INORG-006	<5	1	<5	<5	0	100	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	<5	1	220	220	0	100	[NT]
Chloride	mg/L	1	INORG-081	<1	1	190	190	0	100	92
Sulphate	mg/L	1	INORG-081	<1	1	92	92	0	104	96
Hardness as $CaCO_3$	mg/L	3	METALS-008	<3	1	280	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	2	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	2	16/07/2019	16/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	390	390	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	310	310	0	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	1700	1700	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	2	11000	11000	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	2	3500	[NT]		[NT]	[NT]
Carbonate $CO_3{}^{2-}$ as $CaCO_3$	mg/L	5	INORG-006	[NT]	2	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	2	3500	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	2	20000	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	2	760	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	2	8000	7900	1	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	16/07/2019	16/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	380	[NT]		[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	110	[NT]		[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	860	[NT]		[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	6500	[NT]		[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	200	200	0	[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	11	200	200	0	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	12000	12000	0	[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	11	1900	1900	0	[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	11	4500	[NT]		[NT]	[NT]

QUALITY CONTROL: Ionic Balance					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	12	16/07/2019	16/07/2019		[NT]	[NT]
Date analysed	-			[NT]	12	16/07/2019	16/07/2019		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	110	110	0	[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	160	160	0	[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	510	510	0	[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	12	4600	4600	0	[NT]	[NT]
Bicarbonate HCO_3 as $CaCO_3$	mg/L	5	INORG-006	[NT]	12	1300	[NT]		[NT]	[NT]
Carbonate CO_3^{2-} as $CaCO_3$	mg/L	5	INORG-006	[NT]	12	<5	[NT]		[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	INORG-006	[NT]	12	1300	[NT]		[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	12	8300	[NT]		[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	12	540	[NT]		[NT]	[NT]
Hardness as $CaCO_3$	mg/L	3	METALS-008	[NT]	12	2400	2400	0	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-4
Date prepared	-			17/07/2019	1	17/07/2019	17/07/2019		17/07/2019	17/07/2019
Date analysed	-			17/07/2019	1	17/07/2019	17/07/2019		17/07/2019	17/07/2019
Total Nitrogen	mg/L	0.1	INORG-110	<0.1	1	4.6	4.6	0	106	103
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	<0.1	1	0.7	0.7	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	3.9	3.9	0	104	103
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	107	128
NOx as N	mg/L	0.005	INORG-055	<0.005	1	3.9	3.9	0	104	103
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	0.010	0.009	11	100	105
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	0.008	0.008	0	105	85
Total Phosphorus	mg/L	0.01	INORG-060	<0.01	1	<0.01	<0.01	0	100	[NT]

QUALITY CONTROL: Nutrients in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	17/07/2019	17/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	17/07/2019	17/07/2019		[NT]	[NT]
Total Nitrogen	mg/L	0.1	INORG-110	[NT]	11	6.6	6.7	2	[NT]	[NT]
Total Kjeldahl Nitrogen	mg/L	0.1	INORG-062	[NT]	11	6.6	6.7	2	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
NOx as N	mg/L	0.005	INORG-055	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	4.9	4.8	2	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	11	<0.25	<0.25	0	[NT]	[NT]
Total Phosphorus	mg/L	0.01	INORG-060	[NT]	11	0.01	0.01	0	[NT]	[NT]

Client Reference: Ashfield Flats

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	229816-5
Date prepared	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	22/07/2019
Date analysed	-			19/07/2019	1	19/07/2019	19/07/2019		19/07/2019	22/07/2019
Iron (HCl preserved)	mg/L	0.02	METALS-020	<0.02	1	0.06	[NT]		103	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	<0.05	1	0.07	0.05	33	95	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	<0.01	1	<0.01	<0.01	0	100	98
Antimony-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	102	106
Arsenic-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	93	99
Barium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.071	0.073	3	100	93
Beryllium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	98	104
Bismuth-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	99	84
Boron-Dissolved	mg/L	0.02	METALS-022	<0.02	1	0.09	0.09	0	110	99
Cadmium-Dissolved	mg/L	0.0001	METALS-022	<0.0001	1	<0.0001	<0.0001	0	99	105
Chromium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	92	90
Cobalt-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.003	0.003	0	90	87
Copper-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.017	0.016	6	89	83
Iron-Dissolved	mg/L	0.01	METALS-022	<0.01	1	0.08	0.08	0	103	#
Lead-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	97	90
Lithium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	106	107
Manganese-Dissolved	mg/L	0.005	METALS-022	<0.005	1	0.11	0.11	0	94	113
Mercury-Dissolved	mg/L	0.00005	METALS-021	<0.00005	1	<0.00005	[NT]		114	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.003	0.003	0	98	104
Nickel-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.004	0.004	0	90	85
Selenium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	95	101
Silver-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	103	97
Thallium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	100	94
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	<0.0005	0	99	95
Tin-Dissolved	mg/L	0.001	METALS-022	<0.001	1	<0.001	<0.001	0	101	100
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	0.0032	0.0033	3	99	94
Vanadium-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.002	0.002	0	96	97
Zinc-Dissolved	mg/L	0.001	METALS-022	<0.001	1	0.21	0.20	5	92	92

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	5	19/07/2019	19/07/2019		[NT]	[NT]
Date analysed	-			[NT]	5	19/07/2019	19/07/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	5	23	24	4	[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	5	21	[NT]		[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	5	<0.01	[NT]		[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.005	[NT]		[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.28	[NT]		[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	5	0.03	[NT]		[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	5	<0.0001	[NT]		[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.007	[NT]		[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	5	22	[NT]		[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	0.0008	[NT]		[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	5	0.53	[NT]		[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	5	<0.00005	<0.00005	0	[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.005	[NT]		[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.002	[NT]		[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	5	<0.0005	[NT]		[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	5	<0.001	[NT]		[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	5	0.002	[NT]		[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Date analysed	-			[NT]	11	19/07/2019	19/07/2019		[NT]	[NT]
Iron (HCl preserved)	mg/L	0.02	METALS-020	[NT]	11	46	[NT]		[NT]	[NT]
Ferrous Iron - Fe^{2+}	mg/L	0.05	INORG-076	[NT]	11	46	46	0	[NT]	[NT]
Aluminium-Dissolved	mg/L	0.01	METALS-022	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
Antimony-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Arsenic-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Barium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.10	0.099	1	[NT]	[NT]
Beryllium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Bismuth-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Boron-Dissolved	mg/L	0.02	METALS-022	[NT]	11	2.5	2.6	4	[NT]	[NT]
Cadmium-Dissolved	mg/L	0.0001	METALS-022	[NT]	11	<0.0001	<0.0001	0	[NT]	[NT]
Chromium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]
Cobalt-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Copper-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Iron-Dissolved	mg/L	0.01	METALS-022	[NT]	11	47	47	0	[NT]	[NT]
Lead-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Lithium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	0.081	0.082	1	[NT]	[NT]
Manganese-Dissolved	mg/L	0.005	METALS-022	[NT]	11	8.4	8.1	4	[NT]	[NT]
Mercury-Dissolved	mg/L	0.00005	METALS-021	[NT]	11	<0.00005	[NT]		[NT]	[NT]
Molybdenum-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Nickel-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Selenium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.005	0.005	0	[NT]	[NT]
Silver-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thallium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Tin-Dissolved	mg/L	0.001	METALS-022	[NT]	11	<0.001	<0.001	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	11	<0.0005	<0.0005	0	[NT]	[NT]
Vanadium-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.003	0.003	0	[NT]	[NT]
Zinc-Dissolved	mg/L	0.001	METALS-022	[NT]	11	0.001	0.001	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available).

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) a

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

Percent recovery not available due to the analyte signal being much greater than the spike amount. An acceptable recovery was achieved for the LCS.

Note: Some results have raised pqls. In these cases the sample's high TDS required the sample to be diluted prior to analysis.

ARL Group
Proudly Western Australian

ARL Analytical Reference Laboratory

ProMicro Science with Ethics

LABORATORY REPORT

Job Number:	19-04846
Revision:	00
Date:	18 April 2019

ADDRESS: **Department of Biodiversity Conservation & Attracti**
17 Dick Perry Avenue
Kensington WA

ATTENTION: Gavan McGrath

DATE RECEIVED: 29/03/2019

YOUR REFERENCE: Department of Biodiversity Conservation & Attractions

PURCHASE ORDER:

APPROVALS:

SSangster

Sean Sangster
Inorganics Supervisor

Sam Becker
Inorganics Manager

REPORT COMMENTS:

This report is issued by Analytical Reference Laboratory (WA) Pty Ltd. The report shall not be reproduced except in full without written approval from the laboratory.
Samples are analysed on an as received basis unless otherwise noted.
Metals in soils analysis was conducted on a dry weight basis.

METHOD REFERENCES:
Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561

Method ID	Method Description
ARL No. 401/403	Metals in Soil and Sediment by ICPOES/MS
ARL No. 406	Mercury by Cold Vapour Atomic Absorption Spectrophotometry
ARL No. 120	Filterable Reactive Phosphorus in Soil
ARL No. 304	Ammonia in Soil and Sediment by Discrete Analyser
ARL No. 314	NOx in Soil and Sediment by Discrete Analyser
ARL No. 312	Nitrite in Soil and Sediment by Discrete Analyser
ARL No. 118	Total Phosphorus and TKN in Soil and Biosolids

NATA
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Department of Biodiversity Conservation & Attracti   *LABORATORY REPORT*

Job No: 19-04846   *Revision: 00*   *Date: 18/04/19*

Metals in Soil and Sediment		**Sample No**	**19-04846-1**	**19-04846-2**	**19-04846-3**	**19-04846-4**	**19-04846-5**
		Sample Description	B03-0m	B03-0.4m	B03-0.8m	B03-1.8m	B03-2.8m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	16,000	25,000	28,000	12,000	12,000
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	1	mg/kg	28	45	47	21	25
Copper	1	mg/kg	21	22	22	11	14
Cobalt	1	mg/kg	6	4	6	7	8
Iron	1	mg/kg	30,000	55,000	56,000	31,000	35,000
Mercury	0.02	mg/kg	0.10	0.08	0.04	0.02	0.04
Nickel	1	mg/kg	10	11	9	8	9
Lead	1	mg/kg	27	29	24	11	13
Zinc	1	mg/kg	91	23	12	8	10

Metals in Soil and Sediment		**Sample No**	**19-04846-6**	**19-04846-7**	**19-04846-8**	**19-04846-9**	**19-04846-10**
		Sample Description	B01-0m	B01-0.7m	B01-1.5m	B01-2.5m	B01-3.5m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	2,300	1,900	3,000	2,200	3,400
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	1	mg/kg	12	14	8	7	5
Copper	1	mg/kg	2	83	2	1	1
Cobalt	1	mg/kg	<1	<1	<1	<1	<1
Iron	1	mg/kg	5,000	7,500	13,000	19,000	1,800
Mercury	0.02	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel	1	mg/kg	2	4	<1	<1	<1
Lead	1	mg/kg	11	17	6	16	2
Zinc	1	mg/kg	11	110	<1	<1	2

Metals in Soil and Sediment		**Sample No**	**19-04846-11**	**19-04846-12**	**19-04846-13**	**19-04846-14**	**19-04846-15**
		Sample Description	B04-0m	B04-0.25m	B04-0.5m	B08-2.5m	B12-0m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	5,100	10,000	4,000	14,000	23,000
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	1	mg/kg	15	24	11	38	49
Copper	1	mg/kg	16	13	4	17	34
Cobalt	1	mg/kg	2	2	<1	8	13
Iron	1	mg/kg	13,000	39,000	27,000	45,000	43,000
Mercury	0.02	mg/kg	0.02	0.02	<0.02	<0.02	0.05
Nickel	1	mg/kg	3	4	2	11	17
Lead	1	mg/kg	28	25	11	16	30
Zinc	1	mg/kg	27	10	2	11	43

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Department of Biodiversity Conservation & Attracti *LABORATORY REPORT*

Job No: 19-04846 *Revision: 00* *Date: 18/04/19*

Metals in Soil and Sediment		**Sample No**	**19-04846-16**	**19-04846-17**	**19-04846-18**	**19-04846-19**	**19-04846-20**
		Sample Description	B12-0.4m	B12-0.8m	B12-1.8m	B12-2.8m	B09-0m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	5,400	5,800	14,000	7,500	16,000
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	1	mg/kg	15	16	33	20	46
Copper	1	mg/kg	6	7	15	8	27
Cobalt	1	mg/kg	2	12	8	5	8
Iron	1	mg/kg	20,000	12,000	39,000	21,000	37,000
Mercury	0.02	mg/kg	<0.02	0.03	0.02	<0.02	0.04
Nickel	1	mg/kg	3	8	10	5	15
Lead	1	mg/kg	6	7	16	10	27
Zinc	1	mg/kg	2	4	10	5	35

Metals in Soil and Sediment		**Sample No**	**19-04846-21**	**19-04846-22**	**19-04846-23**	**19-04846-24**	**19-04846-25**
		Sample Description	B09-0.25m	B09-0.5m	B09-1.5m	B09-2.5m	B04-2.5m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	28,000	6,200	9,600	11,000	5,500
Arsenic	5	mg/kg	<5	<5	<5	11	<5
Cadmium	0.1	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1
Chromium	1	mg/kg	53	22	23	26	18
Copper	1	mg/kg	22	10	10	11	4
Cobalt	1	mg/kg	8	2	6	7	3
Iron	1	mg/kg	56,000	15,000	32,000	29,000	4,000
Mercury	0.02	mg/kg	0.02	<0.02	0.07	0.04	0.06
Nickel	1	mg/kg	13	3	7	8	3
Lead	1	mg/kg	28	3	12	14	12
Zinc	1	mg/kg	13	5	9	8	2

Metals in Soil and Sediment		**Sample No**	**19-04846-26**	**19-04846-27**	**19-04846-28**	**19-04846-29**	**19-04846-30**
		Sample Description	B04-1.5m	B10-0m	B10-1.4m	B10-3.0m	B10-4.8m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	2,300	4,000	4,200	6,500	4,500
Arsenic	5	mg/kg	<5	<5	<5	9	9
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	2.4	<0.1
Chromium	1	mg/kg	10	7	17	25	20
Copper	1	mg/kg	2	7	9	9	7
Cobalt	1	mg/kg	2	<1	3	1	6
Iron	1	mg/kg	11,000	9,200	12,000	42,000	10,000
Mercury	0.02	mg/kg	0.02	0.02	<0.02	0.02	<0.02
Nickel	1	mg/kg	2	1	4	4	7
Lead	1	mg/kg	9	47	15	11	12
Zinc	1	mg/kg	<1	20	20	3	2

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Metals in Soil and Sediment		Sample No	19-04846-31	19-04846-32	19-04846-33	19-04846-34	19-04846-35
		Sample Description	B11-0m	B11-0.4m	B11-0.8m	B11-1.8m	B11-2.8m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	35,000	3,900	10,000	20,000	4,400
Arsenic	5	mg/kg	<5	<5	<5	<5	7
Cadmium	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	1	mg/kg	45	13	40	42	17
Copper	1	mg/kg	25	5	20	22	6
Cobalt	1	mg/kg	6	<1	2	37	2
Iron	1	mg/kg	9,600	47,000	18,000	21,000	47,000
Mercury	0.02	mg/kg	0.03	<0.02	0.02	0.02	<0.02
Nickel	1	mg/kg	23	2	4	31	4
Lead	1	mg/kg	22	11	9	20	8
Zinc	1	mg/kg	21	3	5	12	2

Metals in Soil and Sediment		Sample No	19-04846-36	19-04846-37	19-04846-38	19-04846-39	19-04846-40
		Sample Description	B08-0m	B08-0.25m	B08-0.5m	B08-1.5m	B10-3.8m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Aluminium	1	mg/kg	5,800	3,700	7,900	14,000	6,700
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	0.3	<0.1	<0.1	<0.1	<0.1
Chromium	1	mg/kg	18	18	37	41	26
Copper	1	mg/kg	26	7	16	20	11
Cobalt	1	mg/kg	2	<1	1	16	12
Iron	1	mg/kg	15,000	11,000	36,000	49,000	13,000
Mercury	0.02	mg/kg	0.03	<0.02	<0.02	0.02	0.02
Nickel	1	mg/kg	6	1	3	18	6
Lead	1	mg/kg	57	5	38	39	29
Zinc	1	mg/kg	28	4	6	21	2

Nutrients in Soil		Sample No	19-04846-1	19-04846-2	19-04846-3	19-04846-4	19-04846-5
		Sample Description	B03-0m	B03-0.4m	B03-0.8m	B03-1.8m	B03-2.8m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	LOR	Units	Result	Result	Result	Result	Result
Filterable Reactive Phosphorus	1	mg/kg	<1	<1	<1	<1	<1
Ammonia-N	10	mg/kg	<10	60	80	50	90
Nitrate-N	1	mg/kg	21	3	3	2	2
NOx-N	1	mg/kg	21	3	3	2	2
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	3,300	2,800	2,300	1,600	2,900
Total Nitrogen	10	mg/kg	3,300	2,800	2,300	1,600	2,900
Total Phosphorus	1	mg/kg	640	610	390	53	87

Department of Biodiversity Conservation & Attracti *LABORATORY REPORT*
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Nutrients in Soil		**Sample No**	**19-04846-6**	**19-04846-7**	**19-04846-8**	**19-04846-9**	**19-04846-10**
		Sample Description	B01-0m	B01-0.7m	B01-1.5m	B01-2.5m	B01-3.5m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Filterable Reactive Phosphorus	1	mg/kg	1	<1	<1	<1	<1
Ammonia-N	10	mg/kg	<10	<10	<10	<10	<10
Nitrate-N	1	mg/kg	2	1	2	2	2
NOx-N	1	mg/kg	2	1	2	2	2
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	540	110	37	10	29
Total Nitrogen	10	mg/kg	540	110	39	12	31
Total Phosphorus	1	mg/kg	120	35	32	24	16

Nutrients in Soil		**Sample No**	**19-04846-11**	**19-04846-12**	**19-04846-13**	**19-04846-14**	**19-04846-15**
		Sample Description	B04-0m	B04-0.25m	B04-0.5m	B08-2.5m	B12-0m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Filterable Reactive Phosphorus	1	mg/kg	<1	<1	<1	<1	<1
Ammonia-N	10	mg/kg	<10	<10	<10	20	<10
Nitrate-N	1	mg/kg	34	16	3	1	9
NOx-N	1	mg/kg	34	16	3	1	9
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	2,100	900	150	970	4,900
Total Nitrogen	10	mg/kg	2,100	900	150	970	4,900
Total Phosphorus	1	mg/kg	220	150	37	63	430

Nutrients in Soil		**Sample No**	**19-04846-16**	**19-04846-17**	**19-04846-18**	**19-04846-19**	**19-04846-20**
		Sample Description	B12-0.4m	B12-0.8m	B12-1.8m	B12-2.8m	B09-0m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Filterable Reactive Phosphorus	1	mg/kg	<1	<1	<1	<1	<1
Ammonia-N	10	mg/kg	<10	20	50	30	20
Nitrate-N	1	mg/kg	2	1	1	1	1
NOx-N	1	mg/kg	2	1	1	1	1
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	320	240	1,200	150	4,200
Total Nitrogen	10	mg/kg	320	240	1,200	150	4,200
Total Phosphorus	1	mg/kg	120	34	92	45	330

Nutrients in Soil		**Sample No**	**19-04846-21**	**19-04846-22**	**19-04846-23**	**19-04846-24**	**19-04846-25**
		Sample Description	B09-0.25m	B09-0.5m	B09-1.5m	B09-2.5m	B04-2.5m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Filterable Reactive Phosphorus	1	mg/kg	<1	<1	<1	<1	<1
Ammonia-N	10	mg/kg	<10	<10	30	60	<10
Nitrate-N	1	mg/kg	1	1	1	2	1
NOx-N	1	mg/kg	1	1	1	2	1
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	1,200	110	880	1,100	40

Nutrients in Soil		**Sample No**	**19-04846-21**	**19-04846-22**	**19-04846-23**	**19-04846-24**	**19-04846-25**
		Sample Description	B09-0.25m	B09-0.5m	B09-1.5m	B09-2.5m	B04-2.5m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
Total Nitrogen	10	mg/kg	1,200	1,100	880	1,100	41
Total Phosphorus	1	mg/kg	280	48	89	92	40

Nutrients in Soil		**Sample No**	**19-04846-26**	**19-04846-27**	**19-04846-28**	**19-04846-29**	**19-04846-30**
		Sample Description	B04-1.5m	B10-0m	B10-1.4m	B10-3.0m	B10-4.8m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Filterable Reactive Phosphorus	1	mg/kg	<1	1	<1	<1	<1
Ammonia-N	10	mg/kg	<10	<10	<10	10	<10
Nitrate-N	1	mg/kg	1	5	4	<1	<1
NOx-N	1	mg/kg	1	5	4	<1	<1
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	28	440	340	310	44
Total Nitrogen	10	mg/kg	29	450	340	310	44
Total Phosphorus	1	mg/kg	39	140	88	45	69

Nutrients in Soil		**Sample No**	**19-04846-31**	**19-04846-32**	**19-04846-33**	**19-04846-34**	**19-04846-35**
		Sample Description	B11-0m	B11-0.4m	B11-0.8m	B11-1.8m	B11-2.8m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Filterable Reactive Phosphorus	1	mg/kg	<1	<1	<1	<1	<1
Ammonia-N	10	mg/kg	<10	<10	<10	20	<10
Nitrate-N	1	mg/kg	6	1	2	<1	<1
NOx-N	1	mg/kg	6	1	2	<1	<1
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	2,900	110	470	1,200	94
Total Nitrogen	10	mg/kg	2,900	110	470	1,200	94
Total Phosphorus	1	mg/kg	380	63	43	47	56

Nutrients in Soil		**Sample No**	**19-04846-36**	**19-04846-37**	**19-04846-38**	**19-04846-39**	**19-04846-40**
		Sample Description	B08-0m	B08-0.25m	B08-0.5m	B08-1.5m	B10-3.8m
		Sample Date	27/03/2019	27/03/2019	27/03/2019	27/03/2019	27/03/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Filterable Reactive Phosphorus	1	mg/kg	<1	<1	<1	<1	<1
Ammonia-N	10	mg/kg	<10	<10	<10	10	<10
Nitrate-N	1	mg/kg	<1	<1	<1	<1	<1
NOx-N	1	mg/kg	<1	<1	<1	<1	<1
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	940	150	380	1,100	74
Total Nitrogen	10	mg/kg	940	150	380	1,100	74
Total Phosphorus	1	mg/kg	280	36	32	88	21

Result Definitions
LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting
* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

Quality Control Report

Job Number: 19-04846

Date: 18/04/2019

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This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis

A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD

Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike

An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)

A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)

An in-house certified solution/mixture of the target analyte of known concentration.

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Quality Control Report

Job Number: 19-04846
Date: 18/04/2019

Metals in Soil and Sediment

Holding Time Criteria	Date	
Extracted	4/04/2019	
Analysed	11/04/2019	
Duplicate Analysis (19-04846-22)	**RPD (%)**	**Limits (%)**
Aluminium	2	25
Arsenic	0	200
Cadmium	0	200
Chromium	9	25
Copper	10	50
Cobalt	0	200
Nickel	0	200
Lead	0	200
Zinc	22	200
Duplicate Analysis (19-04846-40)	**RPD (%)**	**Limits (%)**
Arsenic	0	200
Cadmium	0	200
Chromium	4	25
Copper	0	50
Cobalt	9	50
Iron	0	25
Nickel	0	50
Lead	0	25
Zinc	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Aluminium	<1	1
Arsenic	<5	5
Cadmium	<0.1	0.1
Chromium	<1	1
Copper	<1	1
Cobalt	<1	1
Iron	<1	1
Nickel	<1	1
Lead	<1	1
Zinc	<1	1
Matrix Spike (19-04846-22)	**Recovery (%)**	**Limits (%)**
Arsenic	100	80 - 120
Chromium	102	80 - 120
Copper	94	80 - 120
Cobalt	86	80 - 120
Nickel	96	80 - 120
Zinc	85	80 - 120
Matrix Spike (19-04846-40)	**Recovery (%)**	**Limits (%)**
Chromium	104	80 - 120

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Matrix Spike (19-04846-40)	Recovery (%)	Limits (%)
Copper	92	80 - 120
Nickel	92	80 - 120
Zinc	83	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Aluminium	97	80 - 120
Arsenic	94	80 - 120
Cadmium	82	80 - 120
Chromium	104	80 - 120
Copper	102	80 - 120
Cobalt	100	80 - 120
Iron	115	80 - 120
Nickel	106	80 - 120
Lead	104	80 - 120
Zinc	98	80 - 120

Mercury in Soils

Holding Time Criteria	Date	
Extracted	11/04/2019	
Analysed	12/04/2019	
Duplicate Analysis (19-04846-22)	**RPD (%)**	**Limits (%)**
Mercury	0	200
Duplicate Analysis (19-04846-40)	**RPD (%)**	**Limits (%)**
Mercury	200	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Mercury	<0.02	0.02
Matrix Spike (19-04846-22)	**Recovery (%)**	**Limits (%)**
Mercury	120	80 - 120
Matrix Spike (19-04846-40)	**Recovery (%)**	**Limits (%)**
Mercury	108	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Mercury	114	80 - 120

Total Phosphorus in Soil

Holding Time Criteria	Date	
Extracted	16/04/2019	
Analysed	17/04/2019	
Duplicate Analysis (19-04846-39)	**RPD (%)**	**Limits (%)**
Total Phosphorus	6	25
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Phosphorus	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Phosphorus	81	80 - 120

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Quality Control Report

Job Number: 19-04846

Date: 18/04/2019

TKN and TN in Soil

Holding Time Criteria	Date	
Extracted	17/04/2019	
Analysed	17/04/2019	
Duplicate Analysis (19-04846-39)	**RPD (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	0	25
Total Nitrogen	0	25
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Kjeldahl Nitrogen	<10	10
Total Nitrogen	<10	10
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	102	80 - 120
Total Nitrogen	102	80 - 120

Total Phosphorus in Soil

Holding Time Criteria	Date	
Extracted	12/04/2019	
Analysed	15/04/2019	
Duplicate Analysis (19-04846-18)	**RPD (%)**	**Limits (%)**
Total Phosphorus	3	25
Duplicate Analysis (19-04846-28)	**RPD (%)**	**Limits (%)**
Total Phosphorus	7	25
Duplicate Analysis (19-04846-38)	**RPD (%)**	**Limits (%)**
Total Phosphorus	25	25
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Phosphorus	<1	1
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Phosphorus	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Phosphorus	114	80 - 120
Total Phosphorus	107	80 - 120

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TKN and TN in Soil

Holding Time Criteria	Date	
Extracted	12/04/2019	
Analysed	16/04/2019	
Duplicate Analysis (19-04846-18)	**RPD (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	0	25
Total Nitrogen	0	25
Duplicate Analysis (19-04846-38)	**RPD (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	15	25
Total Nitrogen	15	25
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Kjeldahl Nitrogen	<10	10
Total Nitrogen	<10	10
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Kjeldahl Nitrogen	<10	10
Total Nitrogen	<10	10
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	102	80 - 120
Total Nitrogen	102	80 - 120
Total Kjeldahl Nitrogen	107	80 - 120
Total Nitrogen	107	80 - 120

Total Phosphorus in Soil

Holding Time Criteria	Date	
Extracted	11/04/2019	
Analysed	11/04/2019	
Duplicate Analysis (19-04846-2)	**RPD (%)**	**Limits (%)**
Total Phosphorus	2	25
Duplicate Analysis (19-04846-15)	**RPD (%)**	**Limits (%)**
Total Phosphorus	2	25
Duplicate Analysis (19-05425-1)	**RPD (%)**	**Limits (%)**
Total Phosphorus	7	50
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Phosphorus	<1	1
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Phosphorus	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Phosphorus	120	80 - 120
Total Phosphorus	120	80 - 120

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Quality Control Report

Job Number: 19-04846

Date: 18/04/2019

TKN and TN in Soil

Holding Time Criteria	Date	
Extracted	11/04/2019	
Analysed	12/04/2019	
Duplicate Analysis (19-04846-2)	**RPD (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	0	25
Total Nitrogen	0	25
Duplicate Analysis (19-04846-15)	**RPD (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	2	25
Total Nitrogen	2	25
Duplicate Analysis (19-05425-1)	**RPD (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	65	200
Total Nitrogen	65	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Kjeldahl Nitrogen	<10	10
Total Nitrogen	<10	10
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Kjeldahl Nitrogen	<10	10
Total Nitrogen	<10	10
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	98	80 - 120
Total Nitrogen	98	80 - 120
Total Kjeldahl Nitrogen	107	80 - 120
Total Nitrogen	107	80 - 120

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Quality Control Report

Job Number: 19-04846

Date: 18/04/2019

Ammonia in Soil

Holding Time Criteria	Date	
Extracted	8/04/2019	
Analysed	9/04/2019	
Duplicate Analysis (19-04846-3)	**RPD (%)**	**Limits (%)**
Ammonia-N	7	50
Duplicate Analysis (19-04846-12)	**RPD (%)**	**Limits (%)**
Ammonia-N	0	200
Duplicate Analysis (19-04846-23)	**RPD (%)**	**Limits (%)**
Ammonia-N	15	200
Duplicate Analysis (19-04846-32)	**RPD (%)**	**Limits (%)**
Ammonia-N	0	200
Duplicate Analysis (19-04992-2)	**RPD (%)**	**Limits (%)**
Ammonia-N	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Ammonia-N	<10	10
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Ammonia-N	<10	10
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Ammonia-N	<10	10
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Ammonia-N	93	80 - 120
Ammonia-N	91	80 - 120
Ammonia-N	94	80 - 120

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Quality Control Report

Job Number: 19-04846

Date: 18/04/2019

ARL Environmental and Analytical Laboratory

FRP in Soil

Holding Time Criteria	**Date**	
Extracted	9/04/2019	
Analysed	10/04/2019	
Duplicate Analysis (19-04846-1)	**RPD (%)**	**Limits (%)**
Filterable Reactive Phosphorus	0	200
Duplicate Analysis (19-04846-10)	**RPD (%)**	**Limits (%)**
Filterable Reactive Phosphorus	0	200
Duplicate Analysis (19-04846-21)	**RPD (%)**	**Limits (%)**
Filterable Reactive Phosphorus	0	200
Duplicate Analysis (19-04846-30)	**RPD (%)**	**Limits (%)**
Filterable Reactive Phosphorus	0	200
Duplicate Analysis (19-04992-4)	**RPD (%)**	**Limits (%)**
Filterable Reactive Phosphorus	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Filterable Reactive Phosphorus	<1	1
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Filterable Reactive Phosphorus	<1	1
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Filterable Reactive Phosphorus	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Filterable Reactive Phosphorus	97	80 - 120
Filterable Reactive Phosphorus	95	80 - 120
Filterable Reactive Phosphorus	97	80 - 120

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Quality Control Report

Job Number: 19-04846

Date: 18/04/2019

Ions in Soil

Holding Time Criteria	Date	
Extracted	8/04/2019	
Analysed	9/04/2019	
Duplicate Analysis (19-04846-1)	**RPD (%)**	**Limits (%)**
NOx-N	13	25
Nitrite-N	0	200
Duplicate Analysis (19-04846-10)	**RPD (%)**	**Limits (%)**
NOx-N	0	200
Nitrite-N	0	200
Duplicate Analysis (19-04846-21)	**RPD (%)**	**Limits (%)**
NOx-N	0	200
Nitrite-N	0	200
Duplicate Analysis (19-04846-30)	**RPD (%)**	**Limits (%)**
NOx-N	0	200
Nitrite-N	0	200
Duplicate Analysis (19-04992-4)	**RPD (%)**	**Limits (%)**
Nitrite-N	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
NOx-N	<1	1
Nitrite-N	<1	1
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
NOx-N	<1	1
Nitrite-N	<1	1
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Nitrite-N	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
NOx-N	106	80 - 120
Nitrite-N	85	80 - 120
NOx-N	107	80 - 120
Nitrite-N	85	80 - 120
Nitrite-N	85	80 - 120

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ARL
Analytical Reference Laboratory

CHAIN OF CUSTODY

46-48 Banksia Road WELSHPOOL WA 6106
Ph: +61 8 6253 4444 www.arlwa.com.au

Client: Dept Biodiversity Conservation	Date Results Required By: 18/04/2019	Purchase Order No: TBA
Contact Name: Gavan McGrath	(Please specify a time frame or number of working days)	ARL Quote No: DBCA 060319_REV1
Address: 17 Dick Perry Avenue Kensington	Email Reports To: gavan.mcgrath@dbca.wa.gov.au	LABORATORY USE ONLY Payment Method:
Phone No: 92199447 (0458559765)	Email Invoices To: as above.	Invoice No:
Fax No:		

Project Reference: Ashfield Flats Hydrological Study

Comments

ARL Job Number: 19-04846

Temperature of Samples: 12°

ANALYSIS REQUIRED

Lab #	Sample Description	Date Sampled	Sample Type	Total Containers	Full Nutrient Suite	Metals as per quote
1	B03 - 0m	27/03/19	Soil	1	X	X
2	B03 - 0.4m	"	"	1	X	X
3	B03 - 0.8m	"	"	1	X	X
4	B03 - 1.8m	"	"	1	X	X
5	B03 - 2.8m	"	"	1	X	X
6	B01 - 0m	"	"	1	X	X
7	B01 - 0.7m	"	"	1	X	X
8	B01 - 1.5m	"	"	1	X	X
9	B01 - 2.5m	"	"	1	X	X
10	B01 - 3.5m	"	"	1	X	X
11	B04 - 0m	"	"	1	X	X
12	B04 - 0.25m	"	"	1	X	X
13	B04 - 0.5m	"	"	1	X	X

Samples Relinquished By: Gavan McGrath On: 28/03/19 At: Signed: [signature]

Samples Received By: [signature] On: 29/03/19 At: 16:07 Signed: [signature]

ARL
Analytical Reference Laboratory

CHAIN OF CUSTODY

46-48 Banksia Road WELSHPOOL WA 6106
Ph: +61 8 6253 4444 www.arlwa.com.au

Client: Dept. Biodiversity Conservation	Date Results Required By: 18/04/2019	Purchase Order No: TBA	
Contact Name: Gawan McGrath	(Please specify a time frame or number of working days)	ARL Quote No: DBCA 060319_REV1	
Address: 17 Dick Perry Avenue Kensington	Email Reports To: gawan.mcgrath@dbca.wa.gov.au	LABORATORY USE ONLY	Payment Method:
Phone No: 92199447 (0458559765)	Email Invoices To: as above.	Invoice No:	
Fax No:			
Project Reference: Ashfield Flats Hydrological Study		ANALYSIS REQUIRED	

Comments

ARL Job Number: 1904846 — Temperature of Samples: 12°

Lab #	Sample Description	Date Sampled	Sample Type	Total Containers	Full Nutrient	Suite		Metals aspa	quote
14	B08 - 2.5 m	25/03/19	Soil	1	X			X	
15	B12 - 0 m	26/03/19	"	1	X			X	
16	B12 - 0.4 m	"	"	1	X			X	
17	B12 - 0.8 m	"	"	1	X			X	
18	B12 - 1.8 m	"	"	1	X			X	
19	B12 - 2.8 m	"	"	1	X			X	
20	B09 - 0 m	"	"	1	X			X	
21	B09 - 0.25 m	"	"	1	X			X	
22	B09 - 0.5 m	"	"	1	X			X	
23	B09 - 1.5 m	"	"	1	X			X	
24	B09 - 2.5 m	"	"	1	X			X	
25	B04 - 2.5 m	27/03/19	"	1	X			X	
26	B04 - 1.5 m	27/03/19	"	1	X			X	

Samples Relinquished By: Gawan McGrath On: 29/03/19 At: Signed: [signature]
Samples Received By: [signature] On: 29/03/19 At: 16:00 Signed: [signature]

ARL
Analytical Reference Laboratory

CHAIN OF CUSTODY

46-48 Banksia Road WELSHPOOL WA 6106
Ph: +61 8 6253 4444 www.arlwa.com.au

Client: Dept. Biodiversity Conservation	Date Results Required By: 18/04/2019	Purchase Order No: TBA
Contact Name: Gavan McGrath	(Please specify a time frame or number of working days)	ARL Quote No: DBCA 060319_REV1
Address: 17 Dick Perry Avenue Kensington	Email Reports To: gavan.mcgrath@dbca.wa.gov.au	LABORATORY USE ONLY Payment Method:
Phone No: 9219 9447 (0458559765)	Email Invoices To: gavan.mcgrath@dbca.wa.gov.au	Invoice No:
Fax No:		

Project Reference: Ashfield Flats Hydrological Study

Comments

ARL Job Number: 19-04846

Temperature of Samples:

ANALYSIS REQUIRED

Lab #	Sample Description	Date Sampled	Sample Type	Total Containers	Full Nutrient suite	metals as per quote
27	B10 - 0m	25/03/19	Soil	1	X	X
28	B10 - 1.4m	"	Soil	1	X	X
29	B10 - 3.0m	"	Soil	1	X	X
30	B10 - 4.8m	"	Soil	1	X	X
31	B11 - 0m	"	Soil	1	X	X
32	B11 - 0.4m	"	Soil	1	X	X
33	B11 - 0.8m	"	Soil	1	X	X
34	B11 - 1.8m	"	Soil	1	X	X
35	B11 - 2.8m	"	Soil	1	X	X
36	B08 - 0m	"	Soil	1	X	X
37	B08 - 0.25m	"	Soil	1	X	X
38	B08 - 0.5m	"	Soil	1	X	X
39	B08 - 1.5m	"	Soil	1	X	X

Samples Relinquished By: Gavan McGrath On: 29/03/19 At: Signed:

Samples Received By: On: 29/03/19 At: 16:00 Signed:

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DBCA 060319_REV1

Gavan McGrath
Department of Biodiversity Conservation and Attractions

6th March 2019

Analysis of Soil Samples

Analyte	Reporting Limit mg/kg	Holding Times	Price/Sample exc. GST	Sample Numbers	Accrued Price exc. GST	Sample Bottle Requirement
SPOCAS Suite	As per individual testing	24 Hours - Chilled; 6 weeks - frozen or dried; indefinite dried and inert atmosphere (AS4969.1)	$65.00	66	$4,290.00	Ziplock ASS Bag
Full Nutrient Suite (includes Ammonia-N, Nitrate-N, Nitrite-N, NOx N, TKN, TN, Reactive P, Total P)	10, 0.1, 0.1, 0.1, 10, 10, 1, 1	7 days (US EPA SW-846)	$64.00	66	$4,224.00	1 x 250mL Glass Soil Jar
Metals - Al, As, Cd, Cr, Cu, Co, Fe, Hg, Ni, Pb, Zn	1, 5, 0.1, 1, 1, 1, 1, 0.02, 1, 1, 1	6 months (NEPM), 28 Days for Hg (NEPM)	$30.00	66	$1,980.00	
	Total Price (Exc GST)				**$10,494.00**	

Analysis of Water Samples

Analyte	Reporting Limit mg/L	Holding Times	Price/Sample exc. GST	Sample Numbers	Accrued Price exc. GST	Sample Bottle Requirement
Major Ions (alkalinity, chloride, sulphate, nitrate, sodium, potassium, calcium, magnesium, hardness)	5 mg CaCO3/L, 5, 3, 0.01, 0.1, 0.1, 0.1, 0.1, 5 mg CaCO3/L	1 day (AS/NZS 5667.1:1998) - Due to Alkalinity	$42.00	92	$3,864.00	1 x 500mL Plastic, 1 x 125mL Plastic and 1 x 125mL Plastic Preserved
Bromide	0.1	1 month (AS/NZS 5667.1:1998)	$14.00	92	$1,288.00	
Full Nutrient Suite (includes Ammonia-N, Nitrate-N, Nitrite-N, NOx N, TKN, TN, Reactive P, Total P)	0.02, 0.01, 0.01, 0.01, 0.2, 0.2, 0.01, 0.01	2 days (APHA)	$58.00	92	$5,336.00	
Dissolved Metals - Al, As, Cd, Cr, Cu, Co, Fe, Hg, Ni, Pb, Zn	0.01, 0.001, 0.0001, 0.001, 0.001, 0.001, 0.01, 0.0001, 0.001, 0.001, 0.005	6 months (APHA), 1 month for Hg (AS/NZS 5667.1:1998)	$30.00	92	$2,760.00	
Ferrous Iron Ferric Iron	0.05	1 day (AS/NZS 5667.1:1998)	$15.00	92	$1,380.00	
	Total Price (Exc GST)				**$14,628.00**	

This quotation is valid until 30/06/2019
Please quote the above quotation number on COC with samples.

NHill

Natalie Hill | Key Account Manager | ARL Group
Phone. +61 8 6253 4444 | Mobile: +61 (0) 474 181 586
Email. nataliehill@arlgroup.com.au

ARL Analytical Reference Laboratory — ARL Group Proudly Western Australian — ProMicro Science with Ethics

LABORATORY REPORT

Job Number: 19-05282
Revision: 00
Date: 30 April 2019

ADDRESS: **Dept Biodiversity Conservation**
17 Dick Perry Ave
Kensington WA

ATTENTION: Gavan McGrath

DATE RECEIVED: 8/04/2019

YOUR REFERENCE: Dept Biodiversity Conservation

PURCHASE ORDER:

APPROVALS:

SSangster
Sean Sangster
Inorganics Supervisor

REPORT COMMENTS:

Samples are analysed on an as received basis unless otherwise noted.
Analysis was conducted on a dry weight basis.

METHOD REFERENCES:
Methods prefixed with "ARL" are covered under NATA Accreditation Number: 2377
Methods prefixed with "PM" are covered under NATA Accreditation Number: 2561

Method ID	Method Description
ARL No. 401/403	Metals in Soil and Sediment by ICPOES/MS
ARL No. 406	Mercury by Cold Vapour Atomic Absorption Spectrophotometry
ARL No. 304	Ammonia in Soil and Sediment by Discrete Analyser
ARL No. 314	NOx in Soil and Sediment by Discrete Analyser
ARL No. 312	Nitrite in Soil and Sediment by Discrete Analyser
ARL No. 120	Filterable Reactive Phosphorus in Soil
ARL No. 118	Total Phosphorus and TKN in Soil and Biosolids

NATA
WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025 - Testing

Dept Biodiversity Conservation
Job No: 19-05282

LABORATORY REPORT
Revision: 00

Date: 30/04/19

Metals in Soil and Sediment		Sample No	19-05282-1	19-05282-2	19-05282-3	19-05282-4	19-05282-5
		Sample Description	B05 - 0M	B05 - 0.4M	B05 - 0.9M	B05 - 1.9M	B05 - 2.9M
		Sample Date	1/04/2019	1/04/2019	1/04/2019	1/04/2019	1/04/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	9,900	23,000	7,000	1,000	2,800
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	0.7	<0.1	0.6	0.1	0.4
Chromium	1	mg/kg	19	46	22	5	9
Cobalt	1	mg/kg	8	3	<1	<1	6
Copper	1	mg/kg	13	17	7	1	2
Iron	1	mg/kg	35,000	48,000	5,200	780	3,900
Mercury	0.02	mg/kg	0.12	0.08	0.03	<0.02	0.03
Nickel	1	mg/kg	5	8	2	<1	2
Lead	1	mg/kg	22	20	6	4	6
Zinc	1	mg/kg	1,900	97	9	2	<1

Metals in Soil and Sediment		Sample No	19-05282-6	19-05282-7	19-05282-8	19-05282-9	19-05282-10
		Sample Description	B07 - 0M	B07 - 1.5M	B07 - 3.1M	B07 - 4.1M	B07 - 5.1M
		Sample Date	1/04/2019	1/04/2019	1/04/2019	1/04/2019	1/04/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	3,300	22,000	2,100	3,700	3,900
Arsenic	5	mg/kg	10	<5	<5	<5	<5
Cadmium	0.1	mg/kg	0.3	<0.1	0.4	0.7	0.3
Chromium	1	mg/kg	6	33	5	9	9
Cobalt	1	mg/kg	4	<1	<1	2	2
Copper	1	mg/kg	88	4	1	4	6
Iron	1	mg/kg	9,600	77,000	3,600	6,700	3,400
Mercury	0.02	mg/kg	0.10	0.08	<0.02	<0.02	<0.02
Nickel	1	mg/kg	2	2	<1	2	2
Lead	1	mg/kg	480	7	4	4	4
Zinc	1	mg/kg	120	2	<1	<1	2

Metals in Soil and Sediment		Sample No	19-05282-11	19-05282-12	19-05282-13	19-05282-14	19-05282-15
		Sample Description	B06 - 0M	B06 - 0.7M	B06 - 1.5M	B06 - 2.5M	B06 - 3.5M
		Sample Date	2/04/2019	2/04/2019	2/04/2019	2/04/2019	2/04/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	650	96	180	9,100	7,400
Arsenic	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	0.1	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1
Chromium	1	mg/kg	3	<1	<1	16	16
Cobalt	1	mg/kg	<1	<1	<1	<1	<1
Copper	1	mg/kg	5	<1	<1	<1	2
Iron	1	mg/kg	1,100	320	300	19,000	20,000
Mercury	0.02	mg/kg	<0.02	<0.02	<0.02	0.05	0.03
Nickel	1	mg/kg	<1	<1	<1	2	1
Lead	1	mg/kg	11	<1	<1	5	7
Zinc	1	mg/kg	21	<1	<1	<1	<1

Dept Biodiversity Conservation — *LABORATORY REPORT*

Job No: 19-05282 — *Revision: 00* — *Date: 30/04/19*

Metals in Soil and Sediment		**Sample No**	**19-05282-16**	**19-05282-17**	**19-05282-18**	**19-05282-19**
		Sample Description	B13 - 0M	B13 - 1.6M	B13 - 2.6M	B13 - 3.6M
		Sample Date	2/04/2019	2/04/2019	2/04/2019	2/04/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**
Aluminium	1	mg/kg	29,000	19,000	18,000	15,000
Arsenic	5	mg/kg	8	<5	<5	<5
Cadmium	0.1	mg/kg	0.5	<0.1	<0.1	<0.1
Chromium	1	mg/kg	44	34	46	41
Cobalt	1	mg/kg	12	4	17	8
Copper	1	mg/kg	230	25	23	20
Iron	1	mg/kg	47,000	23,000	38,000	35,000
Mercury	0.02	mg/kg	0.10	0.04	0.04	0.04
Nickel	1	mg/kg	20	9	18	11
Lead	1	mg/kg	130	11	18	14
Zinc	1	mg/kg	460	47	16	12

Nutrients in Soil		**Sample No**	**19-05282-1**	**19-05282-2**	**19-05282-3**	**19-05282-4**	**19-05282-5**
		Sample Description	B05 - 0M	B05 - 0.4M	B05 - 0.9M	B05 - 1.9M	B05 - 2.9M
		Sample Date	1/04/2019	1/04/2019	1/04/2019	1/04/2019	1/04/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Ammonia-N	10	mg/kg	70	<10	<10	<10	<10
Nitrate-N	1	mg/kg	110	65	1	<1	<1
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
NOx-N	1	mg/kg	110	65	1	<1	<1
Filterable Reactive Phosphorus	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	7,500	1,400	250	<10	<10
Total Nitrogen	10	mg/kg	7,600	1,500	250	<10	<10
Total Phosphorus	1	mg/kg	790	200	36	13	30

Nutrients in Soil		**Sample No**	**19-05282-6**	**19-05282-7**	**19-05282-8**	**19-05282-9**	**19-05282-10**
		Sample Description	B07 - 0M	B07 - 1.5M	B07 - 3.1M	B07 - 4.1M	B07 - 5.1M
		Sample Date	1/04/2019	1/04/2019	1/04/2019	1/04/2019	1/04/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Ammonia-N	10	mg/kg	<10	<10	<10	<10	<10
Nitrate-N	1	mg/kg	3	<1	<1	3	4
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
NOx-N	1	mg/kg	3	<1	<1	3	4
Filterable Reactive Phosphorus	1	mg/kg	<1	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	790	120	41	<10	<10
Total Nitrogen	10	mg/kg	790	120	41	<10	<10
Total Phosphorus	1	mg/kg	120	48	19	12	25

Nutrients in Soil		**Sample No**	**19-05282-11**	**19-05282-12**	**19-05282-13**	**19-05282-14**	**19-05282-15**
		Sample Description	B06 - 0M	B06 - 0.7M	B06 - 1.5M	B06 - 2.5M	B06 - 3.5M
		Sample Date	2/04/2019	2/04/2019	2/04/2019	2/04/2019	2/04/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Ammonia-N	10	mg/kg	<10	<10	<10	<10	<10
Nitrate-N	1	mg/kg	2	1	<1	<1	1

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Dept Biodiversity Conservation | *LABORATORY REPORT*

Job No: 19-05282 | *Revision: 00* | *Date: 30/04/19*

Nutrients in Soil		**Sample No**	**19-05282-11**	**19-05282-12**	**19-05282-13**	**19-05282-14**	**19-05282-15**
		Sample Description	B06 - 0M	B06 - 0.7M	B06 - 1.5M	B06 - 2.5M	B06 - 3.5M
		Sample Date	2/04/2019	2/04/2019	2/04/2019	2/04/2019	2/04/2019
Nitrite-N	1	mg/kg	<1	<1	<1	<1	<1
NOx-N	1	mg/kg	2	1	<1	<1	1
Filterable Reactive Phosphorus	1	mg/kg	2	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	4,300	<10	<10	<10	14
Total Nitrogen	10	mg/kg	4,300	<10	<10	<10	15
Total Phosphorus	1	mg/kg	270	15	14	20	25

Nutrients in Soil		**Sample No**	**19-05282-16**	**19-05282-17**	**19-05282-18**	**19-05282-19**
		Sample Description	B13 - 0M	B13 - 1.6M	B13 - 2.6M	B13 - 3.6M
		Sample Date	2/04/2019	2/04/2019	2/04/2019	2/04/2019
ANALYTE	**LOR**	**Units**	**Result**	**Result**	**Result**	**Result**
Ammonia-N	10	mg/kg	20	<10	20	40
Nitrate-N	1	mg/kg	11	3	<1	<1
Nitrite-N	1	mg/kg	<1	<1	<1	<1
NOx-N	1	mg/kg	11	3	<1	<1
Filterable Reactive Phosphorus	1	mg/kg	<1	<1	<1	<1
Total Kjeldahl Nitrogen	10	mg/kg	5,000	650	1,100	830
Total Nitrogen	10	mg/kg	5,000	650	1,100	830
Total Phosphorus	1	mg/kg	1,400	280	210	180

Result Definitions

LOR Limit of Reporting [NT] Not Tested [ND] Not Detected at indicated Limit of Reporting

* Denotes test not covered by NATA Accreditation

FOR MICROBIOLOGICAL TESTING - The data in this report may not be representative of a lot, batch or other samples and may not necessarily justify the acceptance or rejection of a lot or batch, a product recall or support legal proceedings. Tests are not routinely performed as duplicates unless specifically requested. Changes occur in the bacterial content of biological samples. Samples should be examined as soon as possible after collection, preferably within 6 hrs and must be stored at 4 degrees Celsius or below. Samples tested after 24 hrs cannot be regarded as satisfactory because of temperature abuse and variations.

Quality Control Report

Job Number: 19-05282
Date: 30/04/2019

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This Quality Control Report is issued in accordance with Section 18 of the ARL Quality Management Manual. All QC parameters are contained within the relevant ARL Method as indicated by the method reference, either on this report or the Laboratory Report.

Acceptance of Holding Times, Duplicate RPD, Spike, LCS and CRM Recoveries are determined at the time of analysis by the Signatory indicated on the Laboratory Report.

DEFINITIONS

Duplicate Analysis
A sample, chosen randomly by the analyst at the time of sample preparation, analysed in duplicate.

RPD
Relative Percent Difference is the absolute difference between the sample and a duplicate analysis compared to the average of the two analytical results. Acceptance Limits can be exceeded by matrix interference or when the result is less than 5 times the LOR.

Matrix Spike
An additional portion of sample to which known amounts of the target analytes are added before sample preparation. Acceptance Limits can be exceeded by matrix interference or when the target analytes are present in the sample.

Certified Reference Material (CRM)
A commercially available certified solution/mixture of the target analyte of known concentration.

Laboratory Control Sample (LCS)
An in-house certified solution/mixture of the target analyte of known concentration.

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Quality Control Report

Job Number: 19-05282

Date: 30/04/2019

Metals in Soil and Sediment

Holding Time Criteria	Date	
Extracted	23/04/2019	
Analysed	23/04/2019	
Duplicate Analysis (19-05282-19)	**RPD (%)**	**Limits (%)**
Arsenic	0	200
Chromium	2	25
Cobalt	12	50
Copper	0	25
Iron	0	25
Nickel	0	50
Lead	0	50
Zinc	0	50
Duplicate Analysis (19-05312-3)	**RPD (%)**	**Limits (%)**
Arsenic	0	200
Cobalt	0	200
Copper	0	50
Nickel	15	50
Lead	29	200
Zinc	1	25
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Aluminium	<1	1
Arsenic	<5	5
Cadmium	<0.1	0.1
Chromium	<1	1
Cobalt	<1	1
Copper	<1	1
Iron	<1	1
Nickel	<1	1
Lead	<1	1
Zinc	<1	1
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Aluminium	<1	1
Arsenic	<5	5
Cadmium	<0.1	0.1
Chromium	<1	1
Cobalt	<1	1
Copper	<1	1
Nickel	<1	1
Lead	<1	1
Zinc	<1	1
Matrix Spike (19-05282-19)	**Recovery (%)**	**Limits (%)**
Arsenic	88	80 - 120

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Quality Control Report

Job Number: 19-05282

Date: 30/04/2019

Matrix Spike (19-05282-19)	Recovery (%)	Limits (%)
Cadmium	81	80 - 120
Chromium	83	80 - 120
Copper	80	80 - 120
Lead	115	80 - 120
Zinc	84	80 - 120
Matrix Spike (19-05312-3)	**Recovery (%)**	**Limits (%)**
Arsenic	87	80 - 120
Copper	86	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Aluminium	100	80 - 120
Arsenic	99	80 - 120
Cadmium	99	80 - 120
Chromium	102	80 - 120
Cobalt	98	80 - 120
Copper	100	80 - 120
Iron	118	80 - 120
Nickel	107	80 - 120
Lead	108	80 - 120
Zinc	107	80 - 120
Aluminium	100	80 - 120
Arsenic	99	80 - 120
Cadmium	99	80 - 120
Chromium	101	80 - 120
Cobalt	102	80 - 120
Copper	114	80 - 120
Nickel	108	80 - 120
Lead	104	80 - 120

Mercury in Soils

Holding Time Criteria	Date	
Extracted	18/04/2019	
Analysed	23/04/2019	
Duplicate Analysis (19-05282-19)	**RPD (%)**	**Limits (%)**
Mercury	29	200
Duplicate Analysis (19-05312-3)	**RPD (%)**	**Limits (%)**
Mercury	29	50
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Mercury	<0.02	0.02
Matrix Spike (19-05282-19)	**Recovery (%)**	**Limits (%)**
Mercury	90	80 - 120
Matrix Spike (19-05312-3)	**Recovery (%)**	**Limits (%)**
Mercury	110	80 - 120
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Mercury	100	80 - 120

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Quality Control Report

Job Number: 19-05282

Date: 30/04/2019

ARL Environmental and Analytical Laboratory

Total Phosphorus in Soil

Holding Time Criteria	Date	
Extracted	23/04/2019	
Analysed	24/04/2019	
Duplicate Analysis (19-05282-1)	**RPD (%)**	**Limits (%)**
Total Phosphorus	1	25
Duplicate Analysis (19-05282-10)	**RPD (%)**	**Limits (%)**
Total Phosphorus	4	25
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Phosphorus	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Phosphorus	107	80 - 120

TKN and TN in Soil

Holding Time Criteria	Date	
Extracted	24/04/2019	
Analysed	23/04/2019	
Duplicate Analysis (19-05282-1)	**RPD (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	7	25
Total Nitrogen	7	25
Duplicate Analysis (19-05282-10)	**RPD (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	200	200
Total Nitrogen	200	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Total Kjeldahl Nitrogen	<10	10
Total Nitrogen	<10	10
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Total Kjeldahl Nitrogen	102	80 - 120
Total Nitrogen	102	80 - 120

FRP in Soil

Holding Time Criteria	Date	
Extracted	16/04/2019	
Analysed	16/04/2019	
Duplicate Analysis (19-05282-1)	**RPD (%)**	**Limits (%)**
Filterable Reactive Phosphorus	0	200
Duplicate Analysis (19-05282-11)	**RPD (%)**	**Limits (%)**
Filterable Reactive Phosphorus	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Filterable Reactive Phosphorus	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Filterable Reactive Phosphorus	104	80 - 120

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Quality Control Report

Job Number: 19-05282

Date: 30/04/2019

Environmental and Analytical Laboratory

Ammonia in Soil

Holding Time Criteria	Date	
Extracted	16/04/2019	
Analysed	17/04/2019	
Duplicate Analysis (19-05282-1)	**RPD (%)**	**Limits (%)**
Ammonia-N	2	50
Duplicate Analysis (19-05282-11)	**RPD (%)**	**Limits (%)**
Ammonia-N	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Ammonia-N	<10	10
Certified Reference Material	**Recovery (%)**	**Limits (%)**
Ammonia-N	99	80 - 120

Ions in Soil

Holding Time Criteria	Date	
Extracted	16/04/2019	
Analysed	16/04/2019	
Duplicate Analysis (19-05282-1)	**RPD (%)**	**Limits (%)**
Nitrite-N	0	200
NOx-N	10	25
Duplicate Analysis (19-05282-11)	**RPD (%)**	**Limits (%)**
Nitrite-N	0	200
NOx-N	0	200
Blank Analysis	**Result (mg/kg)**	**Limit (mg/kg)**
Nitrite-N	<1	1
NOx-N	<1	1
Certified Reference Material	**Recovery (%)**	**Limits (%)**
NOx-N	100	80 - 120
Nitrite-N	83	80 - 120

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CHAIN OF CUSTODY

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Client: Dept Biodiversity Conservation
Contact Name: Gavan McGrath
Address: 17 Dick Perry Avenue Kensington, WA
Phone No: 92199447 (0458559765)
Fax No:

Date Results Required By: 27/4/19
(Please specify a time frame or number of working days)
Email Reports To: gavan.mcgrath@dbca.wa.gov.au
Email Invoices To:

Purchase Order No:
ARL Quote No: DBCA 060319. REV1
LABORATORY USE ONLY
Payment Method:
Invoice No:

Project Reference: Ashfield Flats Hydrological Study
Comments

ARL Job Number: 19-05282
Temperature of Samples:

ANALYSIS REQUIRED

Lab #	Sample Description	Date Sampled	Sample Type	Total Containers
1	B05 - 0m	1/4/19	Soil	1
2	B05 - 0.4m	"	"	1
3	B05 - 0.9m	"	"	1
4	B05 - 1.9m	"	"	1
5	B05 - 2.9m	"	"	1
6	B07 - 0m	"	"	1
7	B07 - 1.5m	"	"	1
8	B07 - 3.1m	"	"	1
9	B07 - 4.1m	"	"	1
10	B07 - 5.1m	"	"	1
11	B06 - 0m	2/4/19	"	1
12	B06 - 0.7m	"	"	1
13	B06 - 1.5m	"	"	1

Samples Relinquished By: Gavan McGrath On: / / At: Signed: [signature]
Samples Received By: On: / / At: Signed:

ARL
Analytical Reference Laboratory

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46-48 Banksia Road WELSHPOOL WA 6106
Ph: +61 8 6253 4444 www.arlwa.com.au

Client: Dept Biodiversity Conservation	Date Results Required By: 27/4/19	Purchase Order No:
Contact Name: Gavan McGrath	(Please specify a time frame or number of working days)	ARL Quote No: DBCA 060319_REV1
Address: 17 Dick Perry Avenue Kensington, WA	Email Reports To: gavan.mcgrath@dbca.wa.gov.au	LABORATORY USE ONLY Payment Method:
Phone No: 92199447 (0458559765)	Email Invoices To:	Invoice No:
Fax No:		

Project Reference: Ashfield Flats Hydrological Study

Comments

ARL Job Number: 19-05282

Temperature of Samples:

ANALYSIS REQUIRED

Lab #	Sample Description	Date Sampled	Sample Type	Total Containers
14	B06 - 2.5 m	2/4/19	Soil	1
15	B06 - 3.5 m	"	"	1
16	B13 - 0 m	"	"	1
17	B13 - 1.6 m	"	"	1
18	B13 - 2.6 m	"	"	1
19	B13 - 3.6 m	"	"	1

Samples Relinquished By: Gavan McGrath On: 3 / 4 / 19 At: 08:45 Signed:

Samples Received By: On: / / At: Signed:

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DBCA 060319_REV1

Gavan McGrath
Department of Biodiversity Conservation and Attractions

6th March 2019

Analysis of Soil Samples

Analyte	Reporting Limit mg/kg	Holding Times	Price/Sample exc. GST	Sample Numbers	Accrued Price exc. GST	Sample Bottle Requirement
SPOCAS Suite	As per individual testing	24 Hours - Chilled; 6 weeks - frozen or dried; indefinite - dried and inert atmosphere (AS4969.1)	$65.00	66	$4,290.00	Ziplock ASS Bag
Full Nutrient Suite (includes Ammonia-N, Nitrate-N, Nitrite-N, NOx-N, TKN, TN, Reactive P, Total P)	10, 0.1, 0.1, 0.1, 10, 10, 1, 1	7 days (US EPA SW-846)	$64.00	66	$4,224.00	1 x 250mL Glass Soil Jar
Metals - Al, As, Cd, Cr, Cu, Co, Fe, Hg, Ni, Pb, Zn	1, 5, 0.1, 1, 1, 1, 1, 0.02, 1, 1, 1	6 months (NEPM), 28 Days for Hg (NEPM)	$30.00	66	$1,980.00	
	Total Price (Exc GST)				**$10,494.00**	

Analysis of Water Samples

Analyte	Reporting Limit mg/L	Holding Times	Price/Sample exc. GST	Sample Numbers	Accrued Price exc. GST	Sample Bottle Requirement
Major Ions (alkalinity, chloride, sulphate, nitrate, sodium, potassium, calcium, magnesium, hardness)	5 mg CaCO3/L, 5, 3, 0.01, 0.1, 0.1, 0.1, 0.1, 5 mg CaCO3/L	1 day (AS/NZS 5667.1:1998) - Due to Alkalinity	$42.00	92	$3,864.00	1 x 500mL Plastic, 1 x 125mL Plastic and 1 x 125mL Plastic Preserved
Bromide	0.1	1 month (AS/NZS 5667.1:1998)	$14.00	92	$1,288.00	
Full Nutrient Suite (includes Ammonia-N, Nitrate-N, Nitrite-N, NOx-N, TKN, TN, Reactive P, Total P)	0.02, 0.01, 0.01, 0.01, 0.2, 0.2, 0.01, 0.01	2 days (APHA)	$58.00	92	$5,336.00	
Dissolved Metals - Al, As, Cd, Cr, Cu, Co, Fe, Hg, Ni, Pb, Zn	0.01, 0.001, 0.0001, 0.001, 0.001, 0.001, 0.01, 0.0001, 0.001, 0.001, 0.005	6 months (APHA), 1 month for Hg (AS/NZS 5667.1:1998)	$30.00	92	$2,760.00	
Ferrous Iron Ferric Iron	0.05	1 day (AS/NZS 5667.1:1998)	$15.00	92	$1,380.00	
	Total Price (Exc GST)				**$14,628.00**	

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email: grzegorz.skrzypek@uwa.edu.au

Date: **19-Aug-19**

Client: Gavan McGrath <gavan.mcgrath@dbca.wa.gov.au>
Address: DBCA

Laboratory Report

Samples were analysed for δ^2H and δ^{18}O, using an Isotopic Liquid Water and Continuous Water Vapour Analyser Picarro 2130i

Notes:

1 All δ^2H and δ^{18}O values given in per mil [‰, VSMOW] according to delta notation, see e.g. Coplen 1996
2 Multi-points normalization used in order to reduce raw values to the international scale (Skrzypek 2013).
3 Normalization done basis on three laboratory standards, each repeated twice, calibrated against international standards provided by IAEA: VSMOW2, SLAP2 and GISP (Coplen 1996)
4 The external error for non-enriched water samples (one standard deviation): δ^{18}O ~0.10 ‰ δ^2H ~1.00 ‰.
5 Organic contaminations verified based on ChemCorrect algorithm
6 Technical details and used procedure can be found in the introduction of Skrzypek and Ford 2014.
7 Organic contaminations have been removed using MCM (MicroCombustionModule).

References:

Skrzypek G., 2013, Normalization procedures and reference material selection in stable HCNOS isotope analyses – an overview. Analytical and Bioanalytical Chemistry 405: 2815-2823.

Coplen T. B. 1996. New guidelines for reporting stable hydrogen, carbon, and oxygen isotope-ratio data. Geochimica et Cosmochimica Acta. 60, 3359

Skrzypek G., Ford D., 2014, Stable isotope analyses of saline water samples on a cavity ring-down spectroscopy instrument. Environmental Science & Technology 48: 2827-2834.

Lab ID	Sample Name	Date	Project	$\delta^{18}O$ VSMOW	$\delta^{2}H$ VSMOW	Comments
P-2859	MW-7	5/08/2019	DBCA/McGrath	**-4.00**	**-17.3**	
P-2860	CD-1	5/08/2019	DBCA/McGrath	**-3.70**	**-15.1**	
P-2861	CD-2	5/08/2019	DBCA/McGrath	**-3.63**	**-15.0**	
P-2862	CD-3	5/08/2019	DBCA/McGrath	**-3.63**	**-14.9**	
P-2863	CD-4	5/08/2019	DBCA/McGrath	**-3.60**	**-14.6**	
P-2864	CD-6	5/08/2019	DBCA/McGrath	**-3.63**	**-14.4**	
P-2865	CD-8	5/08/2019	DBCA/McGrath	**-3.42**	**-11.5**	
P-2866	CD-10	5/08/2019	DBCA/McGrath	**-3.34**	**-9.9**	
P-2867	CD-12	5/08/2019	DBCA/McGrath	**-3.28**	**-10.1**	
P-2868	CD-14	5/08/2019	DBCA/McGrath	**-3.28**	**-10.3**	
P-2869	CD-16	5/08/2019	DBCA/McGrath	**-3.30**	**-11.3**	
P-2870	CD-18	5/08/2019	DBCA/McGrath	**-3.33**	**-11.9**	
P-2871	CD-20	5/08/2019	DBCA/McGrath	**-3.33**	**-11.9**	
P-2872	CD-22	5/08/2019	DBCA/McGrath	**-3.38**	**-11.9**	
P-2878	CD-23	5/08/2019	DBCA/McGrath	**-3.19**	**-12.1**	
P-2879	CD-24	5/08/2019	DBCA/McGrath	**-3.25**	**-12.1**	
P-2880	CD-25	5/08/2019	DBCA/McGrath	**-3.26**	**-11.5**	
P-2881	CD-26	5/08/2019	DBCA/McGrath	**-3.45**	**-8.8**	
P-2882	CD-27	5/08/2019	DBCA/McGrath	**-3.31**	**-8.9**	
P-2883	CD-28	5/08/2019	DBCA/McGrath	**-3.37**	**-7.7**	
P-2884	CD-29	5/08/2019	DBCA/McGrath	**-3.71**	**-8.6**	
P-2885	CD-30	5/08/2019	DBCA/McGrath	**-3.87**	**-9.3**	
P-2886	P-1	5/08/2019	DBCA/McGrath	**-2.34**	**3.1**	
P-2887	P-2	5/08/2019	DBCA/McGrath	**-2.56**	**1.9**	
P-2888	P-3	5/08/2019	DBCA/McGrath	**-2.33**	**0.6**	
P-2889	P-4	5/08/2019	DBCA/McGrath	**-4.48**	**-11.3**	
P-2890	P-5	5/08/2019	DBCA/McGrath	**-5.03**	**-15.2**	
P-2891	P-6	5/08/2019	DBCA/McGrath	**-3.23**	**-5.3**	

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Laboratory Report

Samples were analysed for $\delta^{2}H$ and $\delta^{18}O$, using an Isotopic Liquid Water and Continuous Water Vapour Analyser Picarro 2130i

Notes:

1 All $\delta^{2}H$ and $\delta^{18}O$ values given in per mil [‰, VSMOW] according to delta notation, see e.g. Coplen 1996
2 Multi-points normalization used in order to reduce raw values to the international scale (Skrzypek 2013).
3 Normalization done basis on three laboratory standards, each repeated twice, calibrated against international standards provided by IAEA: VSMOW2, SLAP2 and GISP (Coplen 1996)
4 The external error for non-enriched water samples (one standard deviation): $\delta^{18}O$ ~0.10 ‰ $\delta^{2}H$ ~1.00 ‰.
5 Organic contaminations verified based on ChemCorrect algorithm
6 Technical details and used procedure can be found in the introduction of Skrzypek and Ford 2014.
7 Organic contaminations have been removed using MCM (MicroCombustionModule).

References:

Skrzypek G., 2013, Normalization procedures and reference material selection in stable HCNOS isotope analyses – an overview. Analytical and Bioanalytical Chemistry 405: 2815-2823.

Coplen T. B. 1996. New guidelines for reporting stable hydrogen, carbon, and oxygen isotope-ratio data. Geochimica et Cosmochimica Acta. 60, 3359

Skrzypek G., Ford D., 2014, Stable isotope analyses of saline water samples on a cavity ring-down spectroscopy instrument. Environmental Science & Technology 48: 2827-2834.

Lab ID	Sample Name	Date	Project	$\delta^{18}O$ VSMOW	$\delta^{2}H$ VSMOW	Comments
P-3961	SW05	28/10/2019	DBCA/McGrath	7.76	34.8	
P-3964	CD	28/10/2019	DBCA/McGrath	-3.42	-14.8	
P-3966	KD	28/10/2019	DBCA/McGrath	-4.18	-18.7	
P-3963	QW01	28/10/2019	DBCA/McGrath	-0.94	-4.3	
P-3957	SW01	29/10/2019	DBCA/McGrath	3.18	12.3	
P-3958	SW02	29/10/2019	DBCA/McGrath	0.18	0.3	
P-3959	SW03	28/10/2019	DBCA/McGrath	-2.92	-13.2	
P-3960	SW04	28/10/2019	DBCA/McGrath	1.96	8.7	
P-3962	SW08	29/10/2019	DBCA/McGrath	-0.95	-4.0	
P-3965	WC	28/10/2019	DBCA/McGrath	-3.97	-17.9	

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Address: DBCA

Laboratory Report

Samples were analysed for δ^2H and δ^{18}O, using an Isotopic Liquid Water and Continuous Water Vapour Analyser Picarro 2130i

Notes:

1 All δ^2H and δ^{18}O values given in per mil [‰, VSMOW] according to delta notation, see e.g. Coplen 1996
2 Multi-points normalization used in order to reduce raw values to the international scale (Skrzypek 2013).
3 Normalization done basis on three laboratory standards, each repeated twice, calibrated against international standards provided by IAEA: VSMOW2, SLAP2 and GISP (Coplen 1996)
4 The external error for non-enriched water samples (one standard deviation): δ^{18}O ~0.10 ‰ δ^2H ~1.00 ‰.
5 Organic contaminations verified based on ChemCorrect algorithm
6 Technical details and used procedure can be found in the introduction of Skrzypek and Ford 2014.
7 Organic contaminations have been removed using MCM (MicroCombustionModule).

References:

Skrzypek G., 2013, Normalization procedures and reference material selection in stable HCNOS isotope analyses – an overview. Analytical and Bioanalytical Chemistry 405: 2815-2823.

Coplen T. B. 1996. New guidelines for reporting stable hydrogen, carbon, and oxygen isotope-ratio data. Geochimica et Cosmochimica Acta. 60, 3359

Skrzypek G., Ford D., 2014, Stable isotope analyses of saline water samples on a cavity ring-down spectroscopy instrument. Environmental Science & Technology 48: 2827-2834.

Lab ID	Sample Name	Sample Date	Project	$\delta^{18}O$ VSMOW	$\delta^{2}H$ VSMOW	Comments
P-2740	CD	16/07/2019	DBCA/McGrath	**-3.92**	**-17.0**	
P-2739	KD	16/07/2019	DBCA/McGrath	**-4.13**	**-18.3**	
P-2741	WC	16/07/2019	DBCA/McGrath	**-4.04**	**-18.1**	
P-2736	MW6	17/07/2019	DBCA/McGrath	**-4.26**	**-19.3**	
P-2737	MW7	18/07/2019	DBCA/McGrath	**-4.03**	**-17.5**	
P-2764	MW01	16/07/2019	DBCA/McGrath	**-3.27**	**-14.4**	
P-2760	MW03	15/07/2019	DBCA/McGrath	**1.37**	**5.9**	
P-2754	MW05	14/07/2019	DBCA/McGrath	**-3.68**	**-15.8**	
P-2755	MW10	14/07/2019	DBCA/McGrath	**-3.13**	**-13.8**	
P-2761	MW11	15/07/2019	DBCA/McGrath	**-2.86**	**-14.5**	
P-2738	MW13	17/07/2019	DBCA/McGrath	**-2.91**	**-12.5**	
P-2735	QW-2	18/07/2019	DBCA/McGrath	**-4.06**	**-17.9**	
P-2742	SW02	16/07/2019	DBCA/McGrath	**-2.65**	**-11.2**	
P-2743	SW03	16/07/2019	DBCA/McGrath	**-3.69**	**-16.5**	
P-2744	SW04	16/07/2019	DBCA/McGrath	**-2.52**	**-10.2**	
P-2745	SW05	16/07/2019	DBCA/McGrath	**-2.09**	**-9.0**	
P-2751	SW06	16/07/2019	DBCA/McGrath	**-1.05**	**-4.9**	
P-2753	MW04D	14/07/2019	DBCA/McGrath	**-3.18**	**-13.7**	
P-2752	MW04S	14/07/2019	DBCA/McGrath	**-4.26**	**-19.5**	
P-2762	MW08D	15/07/2019	DBCA/McGrath	**-0.12**	**-3.1**	
P-2763	MW08S	15/07/2019	DBCA/McGrath	**-1.59**	**-7.7**	
P-2758	MW09D	15/07/2019	DBCA/McGrath	**-0.88**	**-6.7**	
P-2759	MW09S	15/07/2019	DBCA/McGrath	**2.53**	**11.3**	
P-2756	MW125	15/07/2019	DBCA/McGrath	**-2.67**	**-14.7**	
P-2757	MW12D	15/07/2019	DBCA/McGrath	**-1.86**	**-9.3**	

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Laboratory Report

Samples were analyzed for δ^{34}S, using an Automated Nitrogen Carbon Analyzer system consisting of a Sercon 20-22 mass spectrometer connected with an EA (SERCON, UK).

Notes:
1. All δ^{34}S values given in per mil [‰, VCDT] according to delta notation, see e.g. Skrzypek 2013
2. Multi-points normalization used in order to reduce raw values to the international scale (Skrzypek 2013)
Normalization done basis on international standards provided by IAEA: δ^{34}S - IAEA-S1, IAEA-S2, IAEA-S3 and NBS127
3. The external error of analyses (1 std dev), not more than: 0.4‰

References:
Skrzypek G., 2013, Normalization procedures and reference material selection in stable HCNOS isotope analyses – an overview. Analytical and Bioanalytical Chemistry 405: 2815-2823.
Coplen T. B. 1996. New guidelines for reporting stable hydrogen, carbon, and oxygen isotope-ratio data. Geochimica et Cosmochimica Acta. 60, 3359
Skrzypek G., Ford D., 2014, Stable isotope analyses of saline water samples on a cavity ring-down spectroscopy instrument. Environmental Science & Technology 48: 2827-2834.

Laboratory Report

Samples were analyzed for δ18O, using an TC/EA coupled with Delta XL Mass Spectrometer in continues flow mode (Thermo-Fisher Scientific)

Notes:
1. All values given in per mil [‰, VSMOW] according to delta notation, see e.g. Paul et al. 2007.
2. Multi-points normalization used in order to reduce raw values to the international scale (Paul et al.2007).
3. Normalization done basis on international standards provided by IAEA and NIST: IAEA-S1, IAEA-S2, IAEA-S3, NBS127 (Skrzypek and Sadler 2011).
4. The max external error of δ18O analyses is 0.4 ‰.

References:
Paul D., Skrzypek G. and Forizs I. 2007. Normalization of measured stable isotope composition to isotope reference scale – a review, *Rapid Communications in Mass*

Skrzypek G., Sadler R., 2011, A strategy for selection of reference materials in stable oxygen isotope analyses of solid materials. Rapid Commun. Mass Spectrom. 25: 1625-1630.

Sample Name	$\delta^{34}S$ (SO4) VCDT	$\delta^{18}O$ (SO4) VSMOW	Comments
CD	10.5	12.0	
KD	10.0	11.5	
MW01	10.5	9.4	
MW03	61.9	25.1	
MW04D	32.6	18.8	
MW04S	18.3	14.9	
MW05	14.6	15.7	
MW06	8.3	9.4	
MW07	11.8	14.0	
MW08D	14.5	17.8	
MW08S	15.5	18.4	
MW09D	19.6	18.5	
MW09S	33.0	24.1	
MW10	10.6	17.9	
MW11	3.1	17.0	
MW12D	41.0	23.1	
MW12S	23.3	18.0	
MW13	19.2	19.4	
QW02	9.8	14.9	
SW02	16.3	13.3	
SW03	8.5	13.2	
SW04	17.0	14.3	
SW05	14.2	14.5	
SW06	18.4	14.1	
WC	4.3	11.3	

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Laboratory Report

Samples were analysed for δ^2H and $\delta^{18}O$, using an Isotopic Liquid Water and Continuous Water Vapour Analyser Picarro 2130i

Notes:
1 All δ^2H and $\delta^{18}O$ values given in per mil [‰, VSMOW] according to delta notation, see e.g. Coplen 1996
2 Multi-points normalization used in order to reduce raw values to the international scale (Skrzypek 2013).
3 Normalization done basis on three laboratory standards, each repeated twice, calibrated against international standards provided by IAEA: VSMOW2, SLAP2 and GISP (Coplen 1996)
4 The external error for non-enriched water samples (one standard deviation): $\delta^{18}O$ ~0.10 ‰ δ^2H ~1.00 ‰.
5 Organic contaminations verified based on ChemCorrect algorithm
6 Technical details and used procedure can be found in the introduction of Skrzypek and Ford 2014.
7 Organic contaminations have been removed using MCM (MicroCombustionModule).

References:
Skrzypek G., 2013, Normalization procedures and reference material selection in stable HCNOS isotope analyses – an overview. Analytical and Bioanalytical Chemistry 405: 2815-2823.

Coplen T. B. 1996. New guidelines for reporting stable hydrogen, carbon, and oxygen isotope-ratio data. Geochimica et Cosmochimica Acta. 60, 3359

Skrzypek G., Ford D., 2014, Stable isotope analyses of saline water samples on a cavity ring-down spectroscopy instrument. Environmental Science & Technology 48: 2827-2834.

Lab ID	Sample Name		Project	$\delta^{18}O$ VSMOW	$\delta^{2}H$ VSMOW	Comments
P-4575	CD	20/12/2019	DBCA/McGrath	-3.09	-13.95	
P-4574	KD	20/12/2019	DBCA/McGrath	-4.09	-18.46	
P-4572	QW1	20/12/2019	DBCA/McGrath	-3.99	-18.65	
P-4576	SW01	20/12/2019	DBCA/McGrath	4.13	16.03	
P-4577	SW02	20/12/2019	DBCA/McGrath	3.91	15.60	
P-4578	SW03	20/12/2019	DBCA/McGrath	-0.31	-3.54	
P-4579	SW04	20/12/2019	DBCA/McGrath	4.79	18.21	
P-4580	SW08	20/12/2019	DBCA/McGrath	1.67	7.10	
P-4573	WC	20/12/2019	DBCA/McGrath	-3.80	-17.48	

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Laboratory Report

Samples were analysed for δ^2H and $\delta^{18}O$, using an Isotopic Liquid Water and Continuous Water Vapour Analyser Picarro 2130i

Notes:
1 All δ^2H and $\delta^{18}O$ values given in per mil [‰, VSMOW] according to delta notation, see e.g. Coplen 1996
2 Multi-points normalization used in order to reduce raw values to the international scale (Skrzypek 2013).
3 Normalization done basis on three laboratory standards, each repeated twice, calibrated against international standards provided by IAEA: VSMOW2, SLAP2 and GISP (Coplen 1996)
4 The external error for non-enriched water samples (one standard deviation): $\delta^{18}O$ ~0.10 ‰ δ^2H ~1.00 ‰.
5 Organic contaminations verified based on ChemCorrect algorithm
6 Technical details and used procedure can be found in the introduction of Skrzypek and Ford 2014.
7 Organic contaminations have been removed using MCM (MicroCombustionModule).

References:
Skrzypek G., 2013, Normalization procedures and reference material selection in stable HCNOS isotope analyses – an overview. Analytical and Bioanalytical Chemistry 405: 2815-2823.
Coplen T. B. 1996. New guidelines for reporting stable hydrogen, carbon, and oxygen isotope-ratio data. Geochimica et Cosmochimica Acta. 60, 3359
Skrzypek G., Ford D., 2014, Stable isotope analyses of saline water samples on a cavity ring-down spectroscopy instrument. Environmental Science & Technology 48: 2827-2834.

Lab ID	Sample Name	Date	Project	$\delta^{18}O$ VSMOW	$\delta^{2}H$ VSMOW	Comments
P-3588	CD01	4/10/2019	DBCA/McGrath	**-3.86**	**-16.56**	
P-3589	CD02	4/10/2019	DBCA/McGrath	**-3.68**	**-16.15**	
P-3590	CD03	4/10/2019	DBCA/McGrath	**-3.69**	**-16.33**	
P-3591	CD04	4/10/2019	DBCA/McGrath	**-3.88**	**-16.56**	
P-3592	CD05	4/10/2019	DBCA/McGrath	**-3.93**	**-17.06**	
P-3593	CD06	4/10/2019	DBCA/McGrath	**-3.98**	**-17.60**	
P-3594	CD07	4/10/2019	DBCA/McGrath	**-4.22**	**-20.49**	
P-3595	CD08	4/10/2019	DBCA/McGrath	**-4.26**	**-21.74**	
P-3596	CD09	4/10/2019	DBCA/McGrath	**-4.23**	**-23.31**	
P-3597	CD10	4/10/2019	DBCA/McGrath	**-4.41**	**-25.77**	
P-3598	CD11	4/10/2019	DBCA/McGrath	**-4.73**	**-28.99**	
P-3599	CD12	4/10/2019	DBCA/McGrath	**-4.50**	**-27.17**	
P-3600	CD13	4/10/2019	DBCA/McGrath	**-4.27**	**-24.40**	
P-3601	CD14	4/10/2019	DBCA/McGrath	**-4.12**	**-22.35**	
P-3607	CD15	4/10/2019	DBCA/McGrath	**-4.02**	**-22.03**	
P-3608	P01	4/10/2019	DBCA/McGrath	**-6.04**	**-40.57**	
P-3609	P02	4/10/2019	DBCA/McGrath	**-4.81**	**-28.51**	
P-3610	QW1	4/10/2019	DBCA/McGrath	**-4.23**	**-24.47**	
P-3611	MW7	4/10/2019	DBCA/McGrath	**-3.95**	**-16.97**	

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Laboratory Report

Samples were analysed for δ^2H and $\delta^{18}O$, using an Isotopic Liquid Water and Continuous Water Vapour Analyser Picarro 2130i

Notes:

1 All δ^2H and $\delta^{18}O$ values given in per mil [‰, VSMOW] according to delta notation, see e.g. Coplen 1996
2 Multi-points normalization used in order to reduce raw values to the international scale (Skrzypek 2013).
3 Normalization done basis on three laboratory standards, each repeated twice, calibrated against international standards provided by IAEA: VSMOW2, SLAP2 and GISP (Coplen 1996)
4 The external error for non-enriched water samples (one standard deviation): $\delta^{18}O$ ~0.10 ‰ δ^2H ~1.00 ‰.
5 Organic contaminations verified based on ChemCorrect algorithm
6 Technical details and used procedure can be found in the introduction of Skrzypek and Ford 2014.
7 Organic contaminations have been removed using MCM (MicroCombustionModule).

References:

Skrzypek G., 2013, Normalization procedures and reference material selection in stable HCNOS isotope analyses – an overview. Analytical and Bioanalytical Chemistry 405: 2815-2823.

Coplen T. B. 1996. New guidelines for reporting stable hydrogen, carbon, and oxygen isotope-ratio data. Geochimica et Cosmochimica Acta. 60, 3359

Skrzypek G., Ford D., 2014, Stable isotope analyses of saline water samples on a cavity ring-down spectroscopy instrument. Environmental Science & Technology 48: 2827-2834.

Lab ID	Sample Name	Date	Project	$\delta^{18}O$ VSMOW	$\delta^{2}H$ VSMOW	Comments
P-3088	CD-1	23/08/2019	DBCA/McGrath	-3.78	-16.7	
P-3089	CD-2	23/08/2019	DBCA/McGrath	-3.87	-17.0	
P-3090	CD-3	23/08/2019	DBCA/McGrath	-3.92	-16.9	
P-3091	CD-4	23/08/2019	DBCA/McGrath	-3.92	-16.7	
P-3092	CD-5	23/08/2019	DBCA/McGrath	-3.85	-16.3	
P-3093	CD-6	23/08/2019	DBCA/McGrath	-3.62	-14.5	
P-3094	CD-7	23/08/2019	DBCA/McGrath	-3.64	-14.4	
P-3095	CD-8	23/08/2019	DBCA/McGrath	-3.27	-8.2	
P-3096	CD-9	23/08/2019	DBCA/McGrath	-3.35	-10.4	
P-3097	CD-10	23/08/2019	DBCA/McGrath	-3.30	-8.3	
P-3103	CD-11	23/08/2019	DBCA/McGrath	-3.32	-9.0	
P-3104	CD-12	23/08/2019	DBCA/McGrath	-3.34	-8.4	
P-3105	CD-13	23/08/2019	DBCA/McGrath	-3.14	-8.3	
P-3106	CD-14	24/08/2019	DBCA/McGrath	-3.42	-10.8	
P-3107	CD-15	23/08/2019	DBCA/McGrath	-3.26	-8.8	
P-3108	CD-16	24/08/2019	DBCA/McGrath	-3.61	-12.2	
P-3109	CD-17	24/08/2019	DBCA/McGrath	-4.04	-16.0	
P-3110	CD-18	24/08/2019	DBCA/McGrath	-4.10	-16.2	
P-3111	CD-19	24/08/2019	DBCA/McGrath	-4.35	-18.8	
P-3112	CD-20	24/08/2019	DBCA/McGrath	-4.35	-18.3	
P-3113	CD-21	23/08/2019	DBCA/McGrath	-4.39	-18.9	
P-3114	CD-22	23/08/2019	DBCA/McGrath	-4.32	-18.6	
P-3115	CD-23	24/08/2019	DBCA/McGrath	-4.35	-18.8	
P-3116	CD-24	24/08/2019	DBCA/McGrath	-4.10	-18.1	
P-3117	CD-25	24/08/2019	DBCA/McGrath	-4.08	-17.1	
P-3123	CD-26	24/08/2019	DBCA/McGrath	-3.81	-16.5	
P-3124	CD-27	24/08/2019	DBCA/McGrath	-3.79	-15.4	
P-3125	CD-28	24/08/2019	DBCA/McGrath	-3.82	-15.4	
P-3126	CD-29	24/08/2019	DBCA/McGrath	-3.83	-15.3	
P-3087	MW7	23/08/2019	DBCA/McGrath	-3.94	-17.2	
P-3127	P1	24/08/2019	DBCA/McGrath	-3.54	-11.1	
P-3128	P2	24/08/2019	DBCA/McGrath	-3.32	-9.1	
P-3129	P3	24/08/2019	DBCA/McGrath	-4.62	-19.1	
P-3130	P4	24/08/2019	DBCA/McGrath	-5.21	-24.3	

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Laboratory Report

Samples were analysed for δ^2H and δ^{18}O, using an Isotopic Liquid Water and Continuous Water Vapour Analyser Picarro 2130i

Notes:

1 All δ^2H and δ^{18}O values given in per mil [‰, VSMOW] according to delta notation, see e.g. Coplen 1996
2 Multi-points normalization used in order to reduce raw values to the international scale (Skrzypek 2013).
3 Normalization done basis on three laboratory standards, each repeated twice, calibrated against international standards provided by IAEA: VSMOW2, SLAP2 and GISP (Coplen 1996)
4 The external error for non-enriched water samples (one standard deviation): δ^{18}O ~0.10 ‰ δ^2H ~1.00 ‰.
5 Organic contaminations verified based on ChemCorrect algorithm
6 Technical details and used procedure can be found in the introduction of Skrzypek and Ford 2014.
7 Organic contaminations have been removed using MCM (MicroCombustionModule).

References:

Skrzypek G., 2013, Normalization procedures and reference material selection in stable HCNOS isotope analyses – an overview. Analytical and Bioanalytical Chemistry 405: 2815-2823.

Coplen T. B. 1996. New guidelines for reporting stable hydrogen, carbon, and oxygen isotope-ratio data. Geochimica et Cosmochimica Acta. 60, 3359

Skrzypek G., Ford D., 2014, Stable isotope analyses of saline water samples on a cavity ring-down spectroscopy instrument. Environmental Science & Technology 48: 2827-2834.

Lab ID	Sample Name	Date	Project	$\delta^{18}O$ VSMOW	$\delta^{2}H$ VSMOW	Comments
P-4053	CD01	30/10/2019	DBCA/McGrath	-3.68	-16.01	
P-4054	CD02	30/10/2019	DBCA/McGrath	-3.68	-15.74	
P-4060	CD03	30/10/2019	DBCA/McGrath	-3.29	-15.51	
P-4061	CD04	30/10/2019	DBCA/McGrath	-3.60	-15.76	
P-4062	CD05	30/10/2019	DBCA/McGrath	-3.42	-15.29	
P-4063	CD06	30/10/2019	DBCA/McGrath	-2.52	-6.81	
P-4064	CD07	30/10/2019	DBCA/McGrath	-2.40	-7.57	
P-4065	CD08	30/10/2019	DBCA/McGrath	-1.91	-4.65	
P-4289	CD09	30/10/2019	DBCA/McGrath	-2.11	-3.21	
P-4290	CD10	30/10/2019	DBCA/McGrath	-2.13	-2.52	
P-4291	CD11	30/10/2019	DBCA/McGrath	-2.16	-2.62	
P-4334	CD12	30/10/2019	DBCA/McGrath	-2.12	-2.66	
P-4293	CD13	30/10/2019	DBCA/McGrath	-2.24	-3.18	
P-4294	CD14	30/10/2019	DBCA/McGrath	-2.28	-3.58	
P-4295	CD15	30/10/2019	DBCA/McGrath	-2.32	-4.03	
P-4296	CD16	30/10/2019	DBCA/McGrath	-2.41	-4.61	
P-4297	CD17	30/10/2019	DBCA/McGrath	-2.45	-5.12	
P-4298	CD18	30/10/2019	DBCA/McGrath	-2.50	-5.71	
P-4094	MW07	30/10/2019	DBCA/McGrath	-3.96	-16.51	
P-4092	P1	30/10/2019	DBCA/McGrath	-1.81	-1.75	
P-4093	P2	30/10/2019	DBCA/McGrath	-2.14	-1.22	

Appendix 2 Acid Sulphate Soils Assessment Report

ACID SULFATE SOILS DETAILED SITE ASSESSMENT

Ashfield Flats

EEC20088.001
Rev 0
03 September 2020

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Draft A	Internal review	SheBla	AlaFol	-	28/07/2020
Draft B	Client review	AlaFol	KurBla		29/07/2020
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Approval for issue

Alan Foley	AL Foley	3 September 2020

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Appendices

ABBREVIATIONS AND ACRONYMS

Abbreviation/acronym	Definition
~	Approximately
>	Greater than
≥	Greater than or equal to
<	Less than
≤	Less than or equal to
%	Per cent
%S	Percentage sulfur
µm	Micrometre
µS/cm	Micro Siemens per centimetre
ρsoil	Bulk density
AASS	Actual acid sulfate soils
AHD	Australian height datum
ANC	Acid neutralising capacity
ANZECC	Australian and New Zealand Environment and Conservation Council
AS/NZS	Australian Standard/New Zealand Standard
ASS	Acid sulfate soils
ASSDSA	Acid sulfate soils detailed site investigation
ASSDMP	Acid sulfate soils and dewatering management plan
AVS	Acid volatile sulfur
CF	Conversion factor
CRS	Chromium reducible sulfur
CCW	Conservation category wetland
DBCA	Department of Biodiversity, Conservation and Attractions
DMIRS	Department of Mines, Industry Regulation and Safety
DN	Diameter nominal
DO	Dissolved oxygen
DPLH	Department of Planning, Lands and Heritage
DSA	Detailed site assessment
DWER	Department of Water and Environmental Regulation
EC	Electrical conductivity
ENV	Effective neutralising value

Abbreviation/acronym	Definition
GDA	Geocentric datum of Australia
GDE	Groundwater dependent ecosystem
H^+/tonne	Hydrogen per tonne
ID	Identification
km	Kilometres
LIWG	Long-term irrigation water guidelines
LOR	Limit of reporting
LR	Liming rate
m	Metres
m^3	Cubic metres
m AHD	Metres Australian height datum
MBO	Monosulfidic black ooze
mbgl	Metres below ground level
mg/kg	Milligrams per kilogram
mm	Millimetres
mol H+/tonne	Moles of hydrogen per tonne
NASS	Non-acid sulfate soils
NATA	National Associated of Testing Authorities
PASS	Potential acid sulfate soils
pH_F	Field pH
pH_{FOX}	Field peroxide pH
pH_{KCl}	Potassium chloride pH
pH_{OX}	Peroxide oxidised pH
PSD	Particle size distribution
Pty Ltd	Proprietary limited
PVC	Polyvinyl chloride
QAQC	Quality assurance and quality control
Redox	Oxidation and reduction potential
RPD	Relative percentage difference
RPS	RPS Australia West Pty Ltd
S	Specific yield
SF	Safety factor
S_{NAS}	Net acid soluble sulfur

Abbreviation/acronym	Definition
S_{POS}	Peroxide oxidisable sulfur
SPOCAS	Suspension peroxide oxidation combined acidity and sulfur
TOC	Total organic carbon
TPA	Titratable peroxide acidity
TSS	Total suspended solids
TTA	Titratable total acidity
tonne/m^3	Tonne per cubic metre
the site	Ashfield Flats
UCL-95	Upper confidence level 95%
USEPA	United States Environmental Protection Agency
WA	Western Australia

EXECUTIVE SUMMARY

Background

The Department of Biodiversity, Conservation and Attractions (DBCA) has commissioned RPS Australia West Pty Ltd (RPS), to undertake an acid sulfate soils detailed site investigation (ASSDSA) for Ashfield Flats Reserve (the "site"). The ASSDSA will assist in an assessment of risk associated with potential future land management at the site. The site occupies numerous land parcels on the Swan River foreshore in Bassendean. Chapman Street and Kitchener Street drains bisect the site, which are Water Corporation open surface water drainage channels that discharge into the Swan River. Additionally, the site is classified as a bush forever site consisting of threatened ecological communities (TEC).

It is understood that prior investigations onsite have primarily arisen due to the site receiving poor quality groundwater and surface water from up-gradient areas. The drains were constructed in the 1960s to intersect and manage groundwater, as well as surface water. It is anticipated that the present land use will continue i.e. a mix of recreational park land and river flat wetland.

It is further understood that a previous study in the area found the highest reactive acid sulfate soils (ASS) material was in clayey to loamy soil at an elevation of <5m AHD, i.e. the proposed area of works along the Chapman Street drain and the greater Ashfield Flats. The investigation by Loos (2003) determined that ASS at Ashfield Flats is likely to occur in lenses or irregular layers.

The ASS investigation aimed to assess the extent and condition of ASS at the site and to assess risks associated with potential future land management at the site.

Scope and objectives

The principal objectives for the ASSDSA, to assist in planning for upgrade and reconstruction works, were to:

- Establish the extent and magnitude of ASS within soil and sediment of the site
- Determine the surface water quality (field parameters only) within Chapman Street Main Drain
- Establish the extent and magnitude of ASS and the presence of monosulfidic black ooze (MBOs) within sediments of Chapman Street Main Drain and wetlands.

Findings

Soils

Soils were categorised on site by an experienced field scientist by hand and visual observations based upon the bolus test and classified in general accordance with the field texture classes[1] detailed in the *Australian Soil and Land Survey Field Handbook* (MacDonald et al., 1998) and AS1726-2017 (Standards Australia, 2017). Soils were found to be predominately as a mixture of brown clayey sands, sandy clays, and sands, overlaying, grey clays to depth. Brown sands to ~1.5 mbgl were encountered toward the western boundary (S29-S31) with refusal upon encountering limestone occurring between 1.0-1.5 mbgl.

The net acidity of all soil types, with the exception of shallow soils along the western boundary, exceeded the relevant DWER action management criteria. Surficial soils along the western boundary, external to the wetland/vegetated areas do not require management with respect to ASS.

Based upon a review of the results for the site, with the exception of soils along the western boundary (outside the wetland/vegetated area), all onsite soils require management and lime-neutralisation should they be disturbed during construction. The extent of this area is presented in Figure E.

[1] Note, the soil descriptions have been consolidated for use in the development of future construction contractor documents

Sediment

Sediments along the drain consisted of black silts and silty sands, overlying dark grey clays. Sediments within the Chapman Street MD are identified as PASS (Figure E) and exceeded the relevant DWER action management criteria with minimal ANC present, and as such will require management and lime-neutralisation should these sediments be encountered during construction. Whilst sediments in the Kitchener Street MD were not sampled, in has been assumed that the sediments will also requirement management.

PASS was identified within sediment along the length of the Chapman Street MD. The PASS is predominantly in the form of pyrite although isolated pockets of potential MBOs were present in the drain (Figure E). Based upon the appreciable acid volatile sulfure (AVS) concentrations and visual observations, MBOs are potentially present in the drain from the right-angle bend (S7) in the northern portion of the site to end of the drain (S1). The analytical data corresponded to field observations, where black silty,and in some cases oozy, very fine grain sediments were encountered. Based on this assessment, the following has been concluded:

- Sediments at S05; classified as MBOs
- Sediments at S01, S03 and S07: indicative of potential MBOs (due to high moisture and higher AVS concentrations).

Where MBO/potential MBO sediments are disturbed during construction, they pose a potential risk to the environment via other processes (e.g. deoxygenation, nutrient cycling) and will require management to mitigate the risk to the environment during construction. RPS notes, that MBOs are transient in nature and may potentially be located in different areas at the time of construction.

Surface water

Surface water generally neutral (average of 6.9 pH units), an increase in salinity (EC) was observed as sampling locations approached the Swan River. Surface waters across the site were well oxygenated.

Recommendations

PASS are prominent across the majority of the site and therefore likely to be disturbed during construction works. In additional MBO/potential MBOs are present in the Chapman Street MD, and are assumed to be present in Kitchener Road MD. As such once detailed engineering design of proposed drainage works are completed, preparation of an Acid Sulfate Soils and Dewatering Management Plan (ASSDMP) will be required.

As part of preparation of an ASSDMP, a groundwater and surface water sampling program will be required to be completed across the site to established groundwater and surface quality, with respect to ASS parameters across the site. Groundwater and surface water samples should be analysed in line with the DWER (2015b) guidelines. The ASSDMP will outline the soil/sediment management measures; the groundwater, surface water (if required) and dewatering effluent monitoring measures; and the contingency management measures required to minimise any environmental impacts.

1 INTRODUCTION

1.1 Acid sulfate soils - definition

Acid Sulfate Soils (ASS) are formed naturally under waterlogged, iron and sulfate-rich conditions, being typical of coastal lowlands where the land has been subject to inundation by sea water. Such soils contain iron sulfide minerals (most commonly pyrite) or their oxidation products and remain stable under anaerobic conditions. Upon exposure to air, they may be oxidised, resulting in the formation of sulfuric acid and subsequent release of iron, aluminium and other heavy metals and nutrients from soils into surface water bodies and groundwater.

ASS as described above, are the most commonly occurring form of acid generating soils encountered in Western Australia (WA); however, a range of other acid generating soils that do not fit the traditional description of ASS may also be encountered during site investigations and can release a significant amount of acidity and/or iron when disturbed (DWER, 2015a).

Development of land containing ASS introduces a risk of environmental harm that requires management. Earthmoving and drainage works can result in exposure of these soils to oxidation either directly; or indirectly through the lowering of water tables. A Detailed Site Assessment (DSA) for ASS in general accordance with guidelines developed by the Department of Water and Environmental Regulation (DWER) can assist in:

- Identifying areas of ASS risk
- The design of projects to minimise disturbance of ASS
- Understanding potential onsite management requirements for ASS.

This report forms the ASSDSA for the construction of rerouting the Chapman Street Drain and remediation of the surrounding wetlands.

1.2 Background

The Department of Biodiversity, Conservation and Attractions (DBCA) has commissioned RPS Australia West Pty Ltd (RPS), to undertake an ASSDSA for Ashfield Flats Reserve (the “site”). The ASSDSA will assist in an assessment of risk associated with potential future land management at the site. The site occupies numerous land parcels on the Swan River foreshore in Bassendean. The is also bisected by the Chapman Street and Kitchener Street drains, which are Water Corporation open surface water drainage channels that discharge into the Swan River. The site is classified as a Bush Forever site containing threatened ecological communities (TECs).

It is understood that prior investigations onsite have primarily arisen due to the site receiving poor quality groundwater and surface water from up-gradient areas. The drains were constructed in the 1960s to intersect and manage groundwater, as well as surface water. It is anticipated that the present land use will continue i.e. a mix of recreational park land and river flat wetland.

It is further understood that a previous study in the area found the highest reactive ASS material was in clayey to loamy soil at an elevation of <5m AHD, i.e. the proposed area of works along the Chapman Street drain and the greater Ashfield Flats. The investigation by Loos (2003) determined that ASS at Ashfield Flats is likely to occur in lenses or irregular layers.

The ASS investigation aimed to assess the extent and condition of ASS at the site and to assess risks associated with potential future land management at the site.

To understand the potential ASS risks associated with disturbing in-situ sediments and soils, DBCA has engaged RPS to undertake a detailed soil and sediment sampling program across the site. The results of this program are presented herein.

1.3 Scope and objectives

The principal objectives for the ASSDSA, to assist in planning for future land management, were to:

- Establish the extent and magnitude of ASS within soil and sediment of the site.
- Determine the surface water quality (field parameters only) within Chapman Street Main Drain.

- Establish the extent and magnitude of ASS and the presence of monosulfidic black ooze (MBOs) within sediments of Chapman Street Main Drain.

1.4 Report format

The remainder of the report comprises the following sections:

Section 2 – Site Description: Details the relevant environmental characteristics of the site with respect to ASS management.

Section 3 – Soils: Assesses the presence and distribution of ASS within the vicinity of the site.

Section 4 – Sediments: Assesses the presence and distribution of ASS within the site.

Section 5 – Surface Water: Provides a baseline assessment of physical water quality in the Chapman Street Main Drain.

Section 6 – DSA Findings: Summarises the key findings of the DSA and recommendations for future works.

Section 7 – ASS Management and Approvals Process: Provides a brief summary of the proposed soil/sediment management protocols (based on current results) for the forthcoming construction works, and the need for appropriate management of Potential ASS (PASS).

1.5 Guidance literature

Preparation of this ASSDSA report was undertaken with reference to the following key guidance documents on acid sulfate soils and water quality:

- *Assessment and management of contaminated sites – Contaminated Sites Guidelines* (DWER, 2014).
- *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DWER, June 2015a).
- *Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes* (DWER, June 2015b).
- *Acid Sulfate Soils Laboratory Methods Guidelines* (McElnea, A.E. and Ahern, C.R. 2004).
- *Australian/New Zealand Standard 5667.1:1998, Water quality – Sampling. Part 1: Guidance on the design of sampling program, sampling techniques and the preservation and handling of sampling* (Standards Australia, 1998a).
- *Australian/New Zealand Standard 5667.6:1998. Water Quality – Sampling. Part 6: Guidance on sampling of rivers and streams* (Standards Australia, 1998c).
- *Australian/New Zealand Standard 5667.12:1998, Water Quality — Sampling. Part 12: Guidance on Sampling of Bottom Sediments* (Standards Australia, 1998e).
- *National Acid Sulfate Soils Guidance. Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management* (Water Quality Australia, June 2018a).
- *National Acid Sulfate Soils Guidance. Overview of management of monosulfidic black ooze (MBO) accumulations in waterways and wetland* (Water Quality Australia, June 2018b).

2 SITE DESCRIPTION

2.1 Site summary

A detailed site summary is provided in Table 1 below, with the site locality presented in Figure A.

Table 1: Site detail summary

Reference Name	Ashfield Flats			
Address	Lot	Plan	Street/Road	Suburb
	Provided in Appendix A			
Certificate of Title	Lot	Volume	Folio	Current Owners
	Provided in Appendix A			
Local Government Authority	Town of Bassendean			
Current Zoning	Local Scheme Reserves - Parks and Recreation and Public Purposes: Drainage Region Scheme Reserves (MRS) – Parks and Recreation (DPLH, 2020)			
Area Elevation	Area	Elevation		
	43.7 ha	1-12 mAHD*		
Site Location and Layout	Figure A			
Coordinates of the site GDA 94 Zone 50 (Figure A)	Reference Point	Easting	Northing	
	West	399,888	6,468,178	
	North	400,615	6,468,561	
	East	400,729	6,467,967	
	South	400,550	6,467,663	

*m AHD – metres Australian Height Datum

2.2 Geology, hydrogeology and hydrology

Table 2 presents a summary of the geology, hydrogeology and hydrology of the site.

Table 2: Geology, hydrogeology and hydrology summary

Element	Comments
Topography	The site is generally flat across the portion of the site that is wetlands (1 m AHD). To the west and northwest of the wetlands there is an escarpment which ranges from (3–12 m AHD). Elevation rises towards the northern portion of site where the Chapman St Drain enter the sites, ranging from 4 -5 m AHD. The topography data is from DWER and created from a LiDAR GRID dataset provided by Furgro Spatial in 2011. The data sets include 1 m contours only (DWER 2012) Topographical mapping for the site is presented in Figure B.
Regional Geology	Geological mapping (1:50,000[2]) from the Department of Mines, Industry Regulation and Safety (DMIRS) *GeoVIEW.WA* (DMIRS, 2020a) has identified that majority of the site is classified as SANDY SILT (Ms4), cream to pale brown alluvium clayey in part fine to medium-grained sand of alluvial origin. Additionally, along the north-western boundary a small portion is classified as SAND (S8), white to play grey at surface yellow at depth, fine to medium-grained moderately sorted subangular to subrounded minor heavy mineral of eolian origin. Geological mapping for the site is presented in Figure B.

[2] The estimated accuracy of the geological coverage is ±50 m (horizontal) (DMIRS, 2020b)

<table>
<tr><th>Element</th><th colspan="5">Comments</th></tr>
<tr><td rowspan="2">Acid Sulfate Soil Mapping</td><td colspan="5">Based on the DWER regional ASS risk mapping (www.nationalmap.gov.au), the majority of the site is classified as having “high to moderate risk of ASS occurring within 3 m of the natural soil surface”. Sections of the western boundary of the site are classified as having “moderate to low risk of ASS occurring within 3 m of natural soil surface but high to moderate risk of ASS beyond 3 m of natural soil surface” (DWER, 2020a).</td></tr>
<tr><td colspan="5">Regional ASS risk mapping is illustrated in Figure C.</td></tr>
<tr><td rowspan="5">Regional – Underlying Aquifer</td><td colspan="5">As presented in the DWER Water Register (DWER, 2020b), the site’s underlying aquifer is separated into three separate level aquifers as shown below:</td></tr>
<tr><td>Aquifer (Perth)</td><td colspan="4">Subarea</td></tr>
<tr><td>Perth – Superficial Swan</td><td colspan="4">Town of Bassendean</td></tr>
<tr><td>Perth – Leederville</td><td colspan="4">Perth North Confined</td></tr>
<tr><td>Perth – Yarragadee North</td><td colspan="4">Perth North Confined</td></tr>
<tr><td>Groundwater Depth and Flow</td><td colspan="5">According to the Perth Groundwater Map groundwater ranges from 0.0 - 5.5 mbgl, corresponding to approximately 1.0 – 7.0 mAHD. Groundwater generally flows south-west, towards the Swan River with the groundwater at it deepest point along Hardy Rd.</td></tr>
<tr><td rowspan="2">Groundwater Quality</td><td colspan="5">Based on the Perth Groundwater Map, salinity concentrations range from 500 -1,000 mg/L. This corresponds to a salinity classification of “marginal” as per Stream salinity status and trends in south-west Western Australia (DoE, 2005). Given nature of the site, i.e. “salt flat”, salinity concentrations onsite are potentially higher.</td></tr>
<tr><td colspan="5">Additionally, there is a low risk of iron staining across the site.</td></tr>
<tr><td rowspan="14">Wetlands</td><td colspan="5">Various wetlands are located within the site and immediately surrounding the site, details of each wetland are summarised below (DBCA, 2020a):
Wetland mapping is presented in Figure D</td></tr>
<tr><td>Unique Feature Identifier (UFI)</td><td>Wetland Name</td><td>Wetland Type</td><td>Management Category</td><td>Distance from Site</td></tr>
<tr><td>8576</td><td>unknown</td><td>Estuary-Peripheral</td><td>Conservation</td><td>On-site</td></tr>
<tr><td>15040</td><td>Ashfield Flats</td><td>Estuary-Peripheral</td><td>Multiple use</td><td>On-site</td></tr>
<tr><td>8565</td><td>Ashfield Flats</td><td>Estuary-Peripheral</td><td>Conservation</td><td>On-site</td></tr>
<tr><td>8575</td><td>Ashfield Flats</td><td>Estuary-Peripheral</td><td>Conservation</td><td>On-site</td></tr>
<tr><td>8574</td><td>Ashfield Flats</td><td>Estuary-Peripheral</td><td>Conservation</td><td>On-site</td></tr>
<tr><td>8571</td><td>Swan River Estuary</td><td>Estuary-Waterbody</td><td>Conservation</td><td>Immediately south and west of site</td></tr>
<tr><td>15957</td><td>South Garvey Park/ on Swan</td><td>Estuary-Peripheral</td><td>Conservation</td><td>~150 m south</td></tr>
<tr><td>13399</td><td>unknown</td><td>Floodplain</td><td>Conservation</td><td>~600 m north-east</td></tr>
<tr><td>9463</td><td>Swan River Flood plain, Great Eastern Hwy</td><td>Floodplain</td><td>Conservation</td><td>~500 m north-east</td></tr>
<tr><td>8732</td><td>Swan River Flood plain, Great Eastern Hwy</td><td>Estuary-peripheral</td><td>Conservation</td><td>~300 m east</td></tr>
<tr><td colspan="5">Wetland data is provided from DBCA-019 Geomorphic Wetlands Swan Coastal Plain mapping. (DBCA 2020a)</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Drainage</td><td colspan="5">The following drains are noted with respect to the site and investigation area:
• The Chapman Street main drain (MD), enters the site from the north-east and runs south-west, ~900 m, through the site to the Swan River. The Chapman Street MD drains water from the Bassendean light industrial area, ~1 km to the west the site (DWER, 2018).</td></tr>
</table>

Element	Comments
	• The Kitchener Road MD enters the western boundary and runs south-east for ~300 m prior to discharging to the Swan River. The Kitchener Road MD drains collects water from residential land located immediately west of the site. • A stormwater drain is located approximately 150 m to the north east of Kitchener Drain. The stormwater drain intercepts groundwater and discharges perennial flow to the wetland.

2.3 Protected areas

Table 3 provides details on environmentally sensitive or protected areas within the vicinity of the site.

Table 3: Sensitive and protected areas

Element	Comments
Wetlands	Refer to Table 2.
Bush Forever	The site is classified as a Bush Forever site, Ashfield Flats Bassendean/Ashfield, site number 214.
Groundwater Dependant Ecosystems	The Bureau of Meteorology Groundwater Dependent Ecosystems (GDE) Atlas (BoM, 2020) indicates that based upon a national assessment there is one terrestrial groundwater dependent ecosystem on site, unknown name with medium woodland, marri and river gum ecosystem type. Additionally, the following GDEs are located within 1 km radius from site: • Aquatic GDE; – Swan River, which is a connecter ecosystem type (high potential GDE), – Swan River Floodplain – Great Eastern Highway, which is a wetland flood plain ecosystem type (moderate to high potential GDE) – Garvey Parl which is a wetland sumpland type (moderate potential GDE). • Terrestrial GDE; – unknown name, wetland floodplain ecosystem type (high potential GDE) – unknown name with an ecosystem type of vegetation, medium woodland; marri and river gum (high potential GDE). • There are no subterranean GDEs identified within the vicinity of the site. The findings are presented in Appendix B.
Vegetation and Fauna	The majority of the site comprises remnant bushland. Eucalyptus and melaleuca woodland including typha wetland cover the western portion of site. The eastern portion of site comprises of a samphire salt flat community. A search of the online NatureMap database (DBCA, 2020b) was undertaken to identify conservation listed fauna and flora species that exist within the site and within vicinity of the site. The search identified a total of 183 species: • A total of four species are listed as protected under international agreement: *Actitis hypoleucos (Common Sandpiper), Hydroprogne caspia (Caspian Tern), Pandion cristatus (Osprey, Eastern Osprey) and Thalasseus bergii (Crested Tern)* • A total of five species are listed as threatened (TEC): *Calyptorhynchus banksii subsp. naso (*Forest Red-tailed Black Cockatoo*), Calyptorhynchus baudinii (*Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo*), Calyptorhynchus latirostris (*Carnaby's Cockatoo, White-tailed Short-billed Black, Cockatoo*), Calyptorhynchus sp. (*white-tailed black cockatoo*), Dasyurus geoffroii (*Chuditch, Western Quoll*).* • *Bolboschoenus fluviatilis* is listed as Priority 1; Species that are known from one or a few locations (generally five or less) which are potentially at risk. • A total of three species are listed as Priority 4; Classified as rare, near threatened and other species in need of monitoring. These include *Hydromys chrysogaster* (Water-rat, Rakali)*, Isoodon fuscivent*er *(*Quenda, southwestern brown bandicoot*)* and *Oxyura australis* (Blue-billed Duck) *Falco peregrinus (*Peregrine Falcon*)* is the only species listed as other specially protected fauna. • A total of 169 species are listed as non-conservation taxon. The findings are presented in Appendix C.
Surface Waters	Surface water from the site discharges via the Chapman Street and Kitchener Road MDs into the Swan River, which is a conservation category wetland (CCW) protected under the *Swan and Canning Rivers Management Act 2006.*

3 SOILS

3.1 Acid sulfate soil investigation

3.1.1 Scope of works

The ASSDSA for the site was undertaken from 17 and 23 June 2020 by RPS. The scope of work completed for the soil assessment included:

- A soil sampling program using hand augers and comprising visual/olfactory inspection and laboratory analysis of soil taken from 31 locations (S01 to S31), to a maximum sampling depth of 1.5 mbgl.
- Sampling was proposed to a maximum depth of 3 m at sites S29 to S31 however this could not be achieved due to refusal. Other sampling locations did not achieve the proposed depths due to either:
  - Refusal on clay
  - Soils below the water table not being retained in the hand auger.
- A total of 173 soil samples (including duplicates) were collected from the thirty-one locations. All samples were subjected to 'field measurements' of pH in water (pH_F) and field oxidised pH (pH_{FOX}), equivalent to one sample being field tested for every ~ 0.21 vertical metres investigated. This sampling frequency is in line with the minimum recommended frequency (0.25 m) detailed in DWER guidance (DWER, June 2015a), also discussed in Section 3.1.2.
- Comparison of field data results with applicable DWER indicator assessment criteria.
- Confirmatory laboratory analysis was performed on 42 of the 173 samples (including duplicates) via the Chromium Reducible Sulfur (CRS) suite with components of the Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) method, i.e. titratable peroxide acidity (TPA), to differentiate between sulfidic and organic and metal speciated acidity. The sampling frequency corresponded to approximately one sample tested per ~1.1 vertical metres of soil profile sampled and tested during the DSA, equivalent to approximately 45% the minimum recommended frequency detailed in DWER guidance (DWER, June 2015a).
- Modified tests for acid neutralising capacity ANC[3] (mod-ANC) were completed on one select soil samples to investigate "kinetically available" acid buffering capacity.

To assist in the design of any potential future land management at the site, the following additional analysis was undertaken on selected samples of different soil type and at various locations across site:

- Total organic carbon (TOC) – 25 samples in total.
- Electrical conductivity (EC) – 21 samples in total.
- Particle size distribution (PSD) – eight samples in total.

Soil sampling locations are provided in Figure C. Sampling logs are presented in Appendix D.

3.1.2 Sampling protocol

Sampling specific to the ASS investigation was conducted as follows:

- Soil samples were collected from 31 locations (S01 to S31) using a hand auger.
- At each location, samples were collected at 0.25 m intervals or change in lithology as per DWER guidance (DWER, June 2015a).
- Descriptions of the soil profile were logged.
- Samples were recovered in plastic zip-lock bags with air expelled and immediately sealed to minimise potential moisture loss and exposure to air.

---

[3] Samples are dried, uncrushed and sieved to 0.6 mm prior to analysis

- Soil samples were then stored in a clean esky cooler containing ice packs to abate potential sulfide oxidation during handling and transport to the laboratory.
- All samples remained chilled until delivery for analysis at the National Association of Testing Authority (NATA) registered laboratory, ALS Environmental.

3.1.3 Assessment criteria

Assessment criteria for ASS were adopted from the DWER guideline, *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DWER, June 2015a) and *Treatment and Management of Soil and Water in Acid Sulfate Soils Landscapes* (DWER, June 2015b).

Table 4 below presents the indicative pH assessment criteria for ASS field test results.

Table 4: DWER indicative pH assessment criteria for ASS

Field Test	AASS	PASS	Non-ASS (NASS)
pH_F	< 4	> 4	> 4
pH_{FOX}	< 4	< 4	> 4

Table 5 below presents the texture-based ASS action criteria for management. For excavation quantities of <1,000 tonnes ASS with ≥0.03 %S or ≥18 mol H+/tonne equivalent acidity a detailed management plan is required.

Table 5: DWER ASS management action criteria

Soil Type		Action criteria (<1,000 tonnes) Existing + Potential Acidity		Action criteria (>1,000 tonnes) Existing + Potential acidity	
Texture	Approx. clay content (%<0.002 mm)	Equivalent sulfur (%S)	Equivalent acidity (H+/tonne)	Equivalent sulfur (%S)	Equivalent acidity (H+/tonne)
Coarse texture (sands to loamy sands)	≤5	0.03	18	0.03	18
Medium texture (sandy loams to light clays)	5–40	0.06	36	0.03	18
Fine texture (medium to heavy clays and silty clays)	≥40	0.10	62	0.03	18

In addition, the following criteria will be applied to Bassendean Sands (Table 6) if encountered onsite.

Table 6: DWER ASS management action criteria: Bassendean sands

Soil Type	CRS (%S)	pH_{FOX}
Bassendean Sands	0.03	<3.0

3.1.4 Selection of samples for laboratory analysis

All samples collected were subjected to 'field measurements'; pH_F and pH_{FOX}. The 'field measurements' were undertaken to provide an indication of the presence of PASS, actual acid sulfate soils (AASS) or non-ASS (NASS), and were used as a screening tool to select samples to be subject to confirmatory laboratory ASS testing.

The sample selection rationale for confirmatory CRS and TPA laboratory assessment is summarised below:

- At each location, confirmatory laboratory analysis was conducted on horizons displaying pH_F and pH_{FOX} results indicative of AASS and or PASS, considering relevant DWER interpretative criteria (including pH changes on oxidation and reaction vigour).
- Across all locations, confirmatory laboratory analysis was conducted to assess all major soil-type associations encountered and ensure adequate characterisation of ASS behaviour in all prevailing lithologies.
- At specific locations selective confirmatory analysis on soils likely to undergo dewatering i.e. those at or close to the water table.
- Duplicate sampling was undertaken for Quality Assurance and Quality Control (QAQC) purposes; this was performed at a minimum rate of approximately one field duplicate per 20 primary samples.

TOC, EC and PSD were analysed on selected samples of different soil types and at various depths across the site, refer to Section 3.5.

3.2 Soil description

Soils were categorised on site by an experienced field scientist by hand and visual observations based upon the bolus test and classified in general accordance with the field texture classes[4] detailed in the *Australian Soil and Land Survey Field Handbook* (MacDonald et al., 1998) and AS1726-2017 (Standards Australia, 2017).

The general soil profile encountered during the soil sampling exercise across the site was:

- Mixture of brown clayey sand / sandy clay / sands, overlaying (~0.0 – 0.3 mbgl)
- Grey clay to depth, (~0.8 – 1.5 mbgl).

Brown sands to ~1.5 mbgl were encountered on the western boundary (S29-S31) with refusal upon encountering limestone between 1.0-1.5 mbgl.

Selected soil sampling locations that best represent the soil profiles encountered at site are presented in Plates 1 to 4 below. Soil profiles are presented with the first row of soil as 0.0 – 1.0 mbgl and the second row of soil as 1.0 -1.5 mbgl.

Plate 1: S20 soil profile

Plate 2: S17 soil profile

[4] Note, the soil descriptions have been consolidated for use in the development of future construction contractor documents

Plate 3: S3 soil profile

Plate 4: S7 soil profile

3.3 ASS findings

3.3.1 ASS inventory of testing

The inventory for ASS testing on the site (Table A at the rear of the document) shows that 31 locations were sampled and tested, with 173 field tests completed and 41 samples submitted for confirmatory laboratory testing.

Soil sampling logs and laboratory reporting are presented in Appendix D and Appendix E respectively.

3.3.2 Field pH parameters

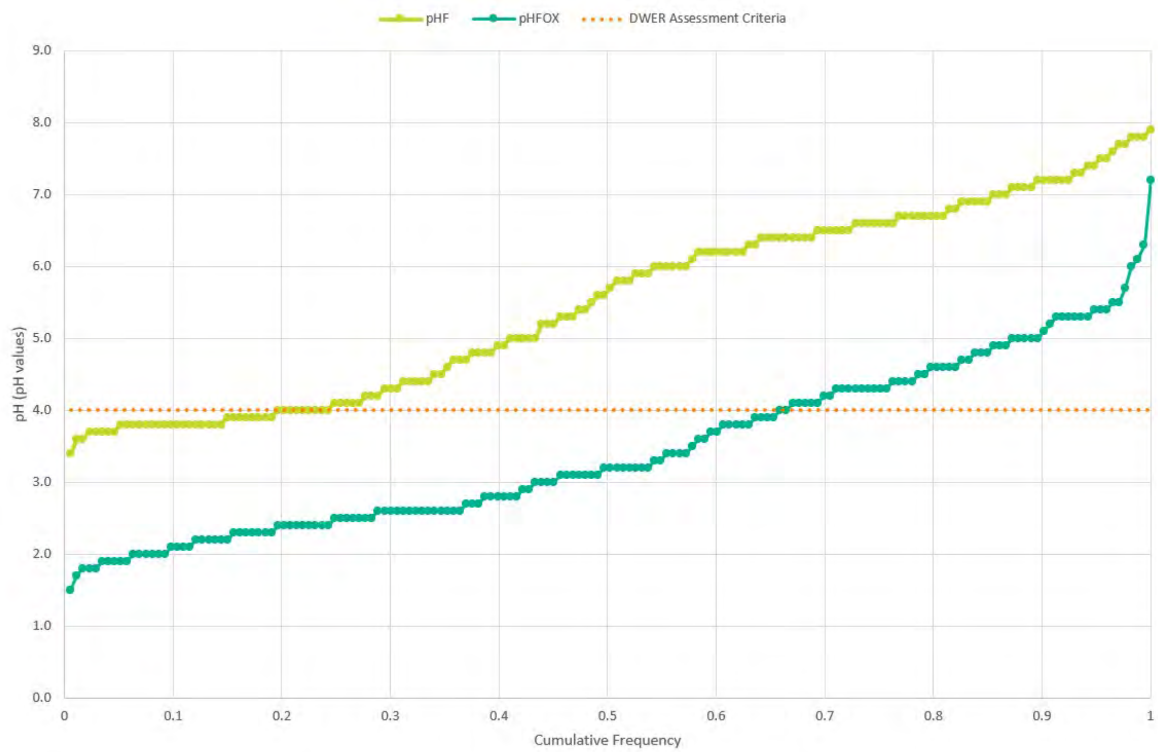
Field screening data is presented in Table B. Results from comparison of the field data with accepted DWER field assessment criteria (as outlined in Table 4) are presented in Table 7:

Table 7: Field data summary - soils

Indicative classification	Number of samples	Percentage of total samples
AASS (pH_F <4)	29	17%
PASS (pH_{FOX} <4)	86	50%
NASS (pH_F >4, pH_{FOX} >4)	54	33%

Graph 1 shows a cumulative frequency distribution of soil field pH (pH_F), and pH following soil oxidation with hydrogen peroxide (pH_{FOX}). The results show that the lowest reported pH_F prior to oxidation was 3.4, an indication that AASS are present within the soils tested.

Following oxidation (pH_{FOX}) some pH values decreased to as low as pH 1.5. This suggests that oxidisable sulfur (DWER, 2015a) is likely present in the corresponding samples (where pH_{FOX} <4).



Graph 1: Soil cumulative frequency distribution (pH_F and pH_{FOX})

3.3.3 Confirmatory assessment

Conclusions drawn from the ASS laboratory results (Table B) for the soils at the site are summarised as follows:

- A total of 34 samples (81%) from the 42 tested[5] were found to have net acidity (excluding ANC) concentrations exceeding the DWER ASS management action criteria of 0.03%S.
- The highest net acidity concentration (excluding ANC) and highest potential acidity (CRS) concentrations were 0.62%S and 0.59%S respectively (S11-S06).
- Titratable Actual Acidity (TAA) concentrations in a total of 25 samples (59%) exceeded the DWER ASS management action criteria (0.03%S), with a maximum of 0.17%S (S21-S02).
- Results from one sample (SZ7[6]) tested for net acid soluble sulfur (S_{NAS}) was below the limit of reporting (<0.005). This indicates that minimal sulfur is present as low solubility minerals.
- TPA concentrations exceeded the DWER ASS management criteria (0.03%S) in 23 samples (55%), with a maximum of 0.59%S (S11-S06). The majority of TPA present is in the form of organic or metal speciated acidity.
- Acid neutralising capacity (ANC) was present in seven samples analysed, with a maximum of 1.64%S (S01-S01). The majority of samples containing ANC were in the western portion of the site (S29-S31). In all cases the ANC was sufficient to buffer the acidity present.
- The mod-ANC conducted on S01-S01 (0.56%S) indicated that ~34% of the ANC was “kinetically” available which still exceeds the net acidity by 8-fold and thus sufficient to buffer all acidity present.

[5] Including duplicates

[6] A duplicate of S18-S02

- The calculated mean net acidity (excluding ANC) across all samples is 0.1%S, which exceeds the DWER action criteria of 0.03%S.

Table 8 below provides a summary of the analytical data obtained.

Table 8: ASS results summary - soil

Analyte	Unit	Management Criteria	Maximum Result*	Average Result	% of Samples Exceeded Criteria (No° Tested)
CRS	%S	>0.03	0.59	0.04	81% (42)
TAA	%S	>0.03	0.17	0.06	59% (42)
TPA	%S	>0.03	0.58	0.12	55% (42)
S_{NAS}	%S	>0.03	<0.02	<0.02	0% (1)
Net Acidity	%S	>0.03	0.62	0.10	79% (42)
pH_{KCl}	pH Units	Not Defined	4.4	5.7	---
pH_{OX}	pH Units	Not Defined	2.4	5.1	---
ANC	%S	Not Defined	1.64	0.47	---

* The minimum pH result has been reported, representing most acidic (maximum) sample

The data supports a conclusion that ASS is present within all soils across the site, except within shallow sands along the western boundary. All soils, with the exception of shallow soils along the western boundary will require active management if encountered during proposed earthworks onsite.

3.4 Quality control and quality assurance

To monitor the integrity of the sampling procedures, duplicate samples were recovered at a minimum rate of one in 20 and analysed by a NATA registered laboratory using NATA accredited methods (where possible). Soil quality assurance and quality results are presented in Table C, with a summary of the results presented below:

A total of 46 of 48 analytes tested (96%) had a Relative Percentage Difference (RPD) of <30%, and as such within the adopted acceptance criteria.

- Exceedances of the acceptance criteria has potentially occurred due to sample heterogeneity with the clayey soils which is common in soils containing various inclusions. All results have been used in the assessment, and as such the failures are not considered to be significant and/or affect the overall assessment.

Laboratory QAQC has been assessed, with all laboratory internal QAQC criteria being within the respective acceptance criteria.

3.5 Additional analysis

3.5.1 Overview

A summary of the results of the additional analysis is presented below with is presented in Tables D and E with laboratory reports presented in Appendix E.

3.5.2 Analytical results

3.5.2.1 Electrical conductivity

Soil electrical conductivity (EC) values ranged between 8 µS/cm (S31-S02) to 6,640 µS/cm (S27-S04). A mean and UCL95 of 2,656 and 3,510 µS/cm respectively were observed across the soils onsite.

Lower EC concentrations tended to be observed within the sandy profiles.

3.5.2.2 Total organic carbon

Total organic carbon (TOC) concentrations varied throughout the 25 soil samples analysed and ranged from <0.5% (several samples) to 23.5% (S20-S02) with a mean 3.3% and UCL95 of 5.3%.

The highest concentrations were observed within surficial soils, with concentrations tending to decrease with depth. The highest concentrations were also observed within the sandy clay soils onsite. As the analysis was spread across the site and all investigations depths, no specific spatial trends were identified.

Table 9 and Table 10 below presents a summary of the TOC results based upon the sample depth and soil type, respectively.

Table 9: TOC results summary - depth

Depth Interval (mbgl)	Number of Samples	TOC concentration (%)		
		Minimum	Mean	Maximum
0.0 0.3	8[1]	<0.5	7.1	23.5
0.3 - 0.6	6	<0.5	1.8	4.5
0.6 - 0.9	4	0.7	1.4	2.2
0.9 - 1.2	4[1]	<0.5	1.3	2.2
1.2 - 1.5	3	1.0	1.5	1.9

Where results are reported as <0.5%, the mean has been calculated used 0.5%. 1. Include a duplicate result

Table 10: TOC results summary – soil type

Soil type	Number of Samples	TOC concentration (%)		
		Minimum	Mean	Maximum
Clay	8	0.7	2.0	4.5
Sandy Clay	6[1]	0.8	6.0	23.5
Sand	2	<0.5	1.6	2.7
Clayey sand	8[1]	<0.5	1.6	4.9

Where results are reported as <0.5%, the mean has been calculated used 0.5%. 1. Include a duplicate result

3.5.2.3 PSD

Based upon the laboratory analysis, and with comparison with the particle sizes within AS1726-2017 (Standards Australia, 2017) and field observations only, the PSD analysis identified the following:

- Clay and silts are more prevalent in the central portion of the site, closer to the Chapman Street MD, with the sandy (0.06-2.00 mm) profile in areas of higher elevation.
  - The majority of particles (UCL95 of 59%) were <150 µm within the soils.
  - The soils are classified as silty and sandy clays
- Soils along the western boundary also contained gravels[7] up 17%. The soils were poorly graded sands and gravelly sands
- Sandy soils were located on the western boundary and higher in the soil profile. Clays/silts were more prevalent within the central (wetland) portion and around the Chapman Street MD and were encountered at all depths onsite.

[7] >2.36 mm fraction

3.6 Summary

Soils within the site are characterised predominately as a mixture of brown clayey sands, sandy clays, and sands, overlaying, grey clays to depth. Brown sands to ~1.5 mbgl were encountered toward the western boundary (S29-S31) with refusal upon encountering limestone occurring between 1.0-1.5 mbgl.

The net acidity of all soil types, with the exception of shallow soils along the western boundary, exceeded the relevant DWER action management criteria. Surficial soils along the western boundary, external to the wetland/vegetated areas do not require management with respect to ASS.

Based upon a review of the results for the site, with the exception of soils along the western boundary (outside the wetland/vegetated area), all onsite soils require management and lime-neutralisation should they be disturbed during construction. The extent of this area is presented in Figure E.

4 SEDIMENTS

4.1 Acid sulfate soils investigation

4.1.1 Scope of works

Sediment samples from the Chapman Street MD were collected from between 17 and 19 June 2020 by RPS. The scope of work completed for the sediment assessment included:

- A sediment sampling program was completed that comprised of visual/olfactory inspection and laboratory analysis of samples, taken from the Chapman Street MD at six locations[8] (S01, S03, S05, S07, S08 and S09, Figure C).
- Sampling extended to a maximum sampling depth of 0.4 mbgl.
- A total of 14 sediment samples were collected from the six locations. An additional sample was collected at S01 (DSA-S01) as two visually distinct materials were observed in the vicinity of S01.
- All samples were subject to 'field measurements' of pH in water (pH_F) and field oxidised pH (pH_{FOX}), equivalent to one sample being field tested for every ~0.1 vertical metres investigated. The sampling frequency exceeds the minimum recommended frequency detailed in DWER guidance (DWER, June 2015a).
- Comparison of field data results with applicable DWER indicator assessment criteria.
- Confirmatory laboratory analysis was performed on nine sediment samples via the CRS suite method with TPA (as per Section 3.1.1), corresponding to approximately one sample tested per ~0.15 vertical investigation.
- In addition to the above confirmatory analysis; eight select sediment samples where potential MBOs were observed, were analysed for acid volatile sulfur (AVS), a proxy for the identification of MBOs.
- Modified tests for ANC[9] were completed on three select soil samples to investigate "kinetically available" acid buffering capacity.
- Total Organic Carbon (TOC), moisture content and particle size distribution (PSD) analysis were completed on seven select samples.

Sediment sampling locations are provided in Figure C, with sampling logs presented in Appendix D and laboratory reports presented in Appendix E.

4.1.2 Sampling protocol

Sampling specific to the ASS investigation was conducted as follows:

- Sediment/soil samples were collected from six locations (S01, S03, S05, S07, S08 and S09) using a push tube sediment sampler.
- At each location, the sediment/soil profile was logged, and samples were collected at varying intervals dependant on the sediment/soil lithology at each location, ensuring that sediments were separated from underlying soils.
- Samples were recovered in glass jars or plastic zip-lock bags with air expelled and immediately sealed to minimise potential moisture loss and exposure to air.
- Samples were stored in a clean esky cooler containing ice packs or immediately frozen in dry ice (AVS samples) to abate potential sulfide oxidation during handling and transport to the office.

[8] To differentiate the drain sediments for the soils in the embankment, a "D" has been added to the start of the sample identifications.

[9] Analysis completed on a dried, uncrushed sample sieved to 0.6 mm prior to analysis

- All samples remained chilled, and samples for AVS analysis were frozen, until delivered for analysis at the National Association of Testing Authority (NATA) registered laboratory.

4.1.3 Assessment criteria

Assessment criteria for ASS are in line with those for the soils as per Section 3.1.3.

4.1.4 Selection of samples for laboratory analysis

As per the soil investigation all samples collected were subjected to 'field measurements'; pH_F and pH_{FOX} and were used as a screening tool to select samples to be subject to confirmatory laboratory ASS testing.

The sample selection rationale for confirmatory CRS and TPA laboratory assessment was as outlined for the soil assessment (Section 3.1.3).

Where visual evidence of potential MBOs were observed, samples were submitted for analysis of AVS.

4.2 Sediment description

As presented in Appendix D, the sediment lithology encountered during the sampling exercise, based upon the bolus test and classified in general accordance with the field texture classes[10] detailed in the *Australian Soil and Land Survey Field Handbook* (MacDonald et al., 1998), can be summaries as below:

- Black silt / silty sands, overlying,
- Dark grey clay.

A heavy organic layer was encountered at the surface of sampling location S09.

Potential MBOs, i.e. black silty material, were observed at the following locations:

- S01, S03, S05 and S07.

4.3 Sediment ASS findings

4.3.1 ASS inventory of testing

The inventory for sediment indicates that 14 samples were collected from six locations. All primary samples were submitted for field screening tests, with nine select samples submitted for confirmatory ASS testing, eight for AVS and three for modified tests for ANC.

Sediment sampling logs and laboratory reporting are presented in Appendix D and E respectively.

4.3.2 Field pH parameters

Field screening data is presented in Table F. Conclusions drawn from comparison of the field data with accepted DWER field assessment criteria (as outlined in Table 4) are presented in Table 9:

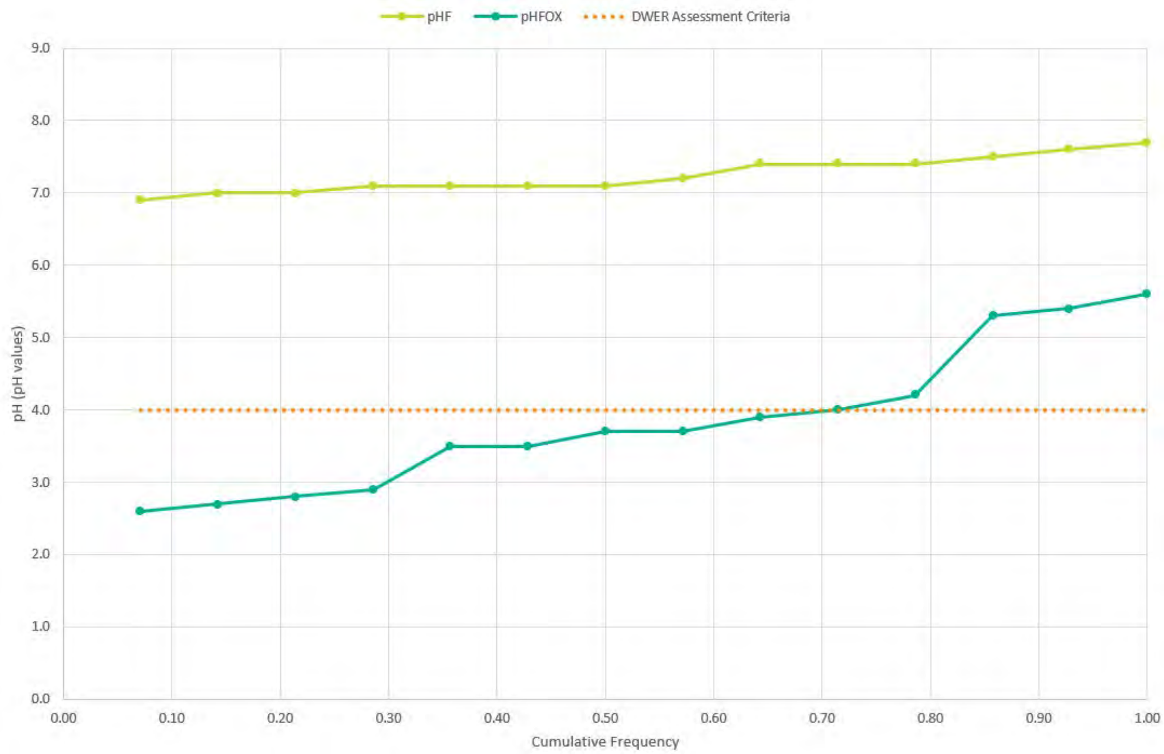
Table 11: Field data summary - sediments

Indicative classification	Number of samples	Percentage of total samples
AASS (pH_F <4)	0	0%
PASS (pH_{FOX} <4)	9	64%
NASS (pH_F >4, pH_{FOX} >4)	5	26%

[10] Note, the soil descriptions have been consolidated for use in the development of future construction contractor documents

Graph 2 shows a cumulative frequency distribution of sediment field pH (pH_F), and pH following oxidation with hydrogen peroxide (pH_{FOX}).

The results show that the lowest reported pH_F prior to oxidation was 6.9, an indication that AASS were not present within the soils tested. Following oxidation (pH_{FOX}) some pH values decreased to as low as pH 2.6. This suggests that oxidisable sulfur is present in the corresponding samples (where pH_{FOX} <4).



Graph 2: Sediment cumulative frequency distribution (pH_F and pH_{FOX})

4.3.3 Confirmatory assessment

Conclusions drawn from the ASS laboratory results (Table F) for the sediments are summarised as follows:

- All nine samples were found to have net acidity values[11] exceeding the DWER ASS management action criteria of 0.03%S.
- The highest net acidity[6] concentration was 3.51 %S and highest potential acidity (CRS) concentration was 3.48%S, identified at DS05-S01.
- A total of eight samples (89%) from the nine tested exceeded the CRS ASS management action criteria of 0.03%S. A mean CRS of 1.24%S was observed.
- All samples except DS5-S01 complied with the TAA DWER ASS management action criteria (0.03%S). DS5-S01 was reported at the DWER ASS criteria with a concentration of 0.03%S.
- TPA concentrations exceeded the DWER ASS management criteria (0.03%S) within six (66%) of the nine samples, with a maximum of 1.83%S (DS5-S01). The TPA is predominately present as inorganic sulfur species, i.e. CRS.
- AVS was present in all eight samples submitted for analysis. All eight samples tested exceeded the DWER ASS management action criteria of 0.03%S. A mean of 0.39%S was observed across the site,

[11] Excluding ANC

with a maximum of 0.99%S (DS5-S02). The ANC decreases with increasing distance from the Swan River.

- A total of five of the nine samples (55%) tested had observable ANC concentrations, with a maximum of 1.03%S (DS1-S01), a mean of 0.53%S. Only two of the samples containing ANC contained sufficient ANC to buffer the acidity present, however this does not take kinetic availability into consideration.
- The mod-ANC method was undertaken on three samples to determine the kinetic availability of the ANC (screened to 0.6 mm, with the <0.6 mm fraction assessed). A maximum of 1.18%S (DS1-S01) and a mean of 0.46%S. Only one sample (DS1-S01) contained sufficient mod-ANC to buffer the acidity present, taking kinetic availability into consideration.
- The calculated mean net acidity (excluding ANC) across all samples is 1.24%S, which exceeds the DWER action criteria of 0.03%S.

Table 10 below provides a summary of the analytical data obtained.

Table 12: ASS results summary - sediments

Analyte	Unit	Management Criteria	Maximum Result*	Average Result	% of Samples Exceeded Criteria (No° Tested)
CRS	%S	>0.03	3.48	1.24	88% (8)
TAA	%S	>0.03	0.03	<0.02	13% (8)
TPA	%S	>0.03	1.83	0.75	75% (8)
AVS	%S	>0.03	0.99	0.39	100% (8)
Net Acidity	%S	>0.03	3.51	1.24	100% (8)
pH_{KCl}	pH Units	Not Defined	5.9	6.6	---
pH_{OX}	pH Units	Not Defined	2.3	4.3	---
ANC	%S	Not Defined	1.0	0.53	---
Mod-ANC	%S	Not Defined	1.18	0.46	---

* The minimum pH result has been reported, representing most acidic (maximum) sample.

The data supports a conclusion that PASS is present within the sediments along the Chapman Street MD.

Based upon the appreciable AVS concentrations and visual observations, MBOs are potentially present in isolated locations in the drain. Sediments contain net acidity/CRS concentrations above the management action criteria., however there is insufficient ANC to buffer the acidity present for the majority of sediments assessed. As such the sediments within the Chapman Street MD, where disturbed during construction, will require management and lime-neutralisation to manage the risk of acidification.

4.4 Additional analysis

4.4.1 Overview and analysis program

A summary of the results of the additional analysis is provided below. Results are presented in Tables D and E with laboratory reports presented in Appendix E.

4.4.2 Analytical results

4.4.2.1 Electrical conductivity

Sediment EC values ranged between 196 µS/cm (DS9-S01) to 5,010 µS/cm (DS1A-S01). A mean of 2,432 µS/cm was observed across the sediments onsite.

4.4.2.2 Moisture content

Moisture content ranged from 43.9% (DS1-S02) to 74% (DS5-S02) with a mean of 60.1% observed.

4.4.2.3 Total organic carbon

Total organic carbon results varied throughout the six samples analysed and ranged from 4.0% (DS1-S02) to 10.2% (DS1A-S01) with a mean 6.6%.

4.4.2.4 PSD

The sediments within the MDs were a mixture of clay, silts and sands a based upon the laboratory analysis, and with comparison with the particle sizes within AS1726-2017 (Standards Australia, 2017):

- Sands (0.06-2.00 mm) tended to be the more dominant size fraction, especially in the upstream locations (DS07 and DS09).
- A percentage of gravels[12] were observed in the majority of samples, ranging between 1 and 10%.
- The majority of particles (UCL95 of 56%) were <150 µm within the sediments.

4.4.2.5 MBO indicators

The *National Acid Sulfate Soils Guidance. Overview of management of monosulfidic black ooze (MBO) accumulations in waterways and wetland* (Water Quality Australia, June 2018b) describe MBOs as *typically black gel-like materials (moisture contents often greater than 70% by weight), frequently "oily" appearance, enriched in AVS (≥0.01%S), high in organic matter (typically greater than 10% organic carbon) and can form thick (that is greater than 1 m) accumulations in waters within ASS landscapes*. MBOs are also identified in Western Australia to *often have a considerable acid neutralising capacity that can offset the acidity produced from oxidation of the sulfides in MBOs, but this self-neutralising capacity is not uniform* [across a spatial extent] (Water Quality Australia, June 2018a).

Based on the above definitions, sediments at the following locations are identified as MBOs:

- S05.

Sediments at the following locations are indicative of potential MBOs (due to high moisture and higher AVS concentrations):

- S01, S03 and S07.

The analytical data corresponds to field observations, where black oozy, very fine grain sediments were encountered.

These sediments pose a potential risk to the environment via:

- The potential release of contaminants, i.e. metals
- Deoxygenation of the water column
- Accelerated nutrient cycling causing algal blooms
- Release of noxious gases (i.e. hydrogen sulfide).

4.5 Sediment Summary

Sediments along the drain consisted of black silts and silty sands, overlying dark grey clays. Sediments within the Chapman Street MD are identified as PASS (Figure E) and exceeded the relevant DWER action management criteria with minimal ANC present, and as such will require management and lime-neutralisation

[12] >2.36 mm

should these sediments be encountered during construction. Whilst sediments in the Kitchener Street MD were not sampled, in has been assumed that the sediments will also requirement management.

PASS have been identified within sediment within the length of the Chapman Street MD. The PASS is predominantly in the form of pyrite although isolated pockets of potential MBOs were present in the drain (Figure E).Based upon the appreciable AVS concentrations and visual observations, potential MBOs are present in the drain from the right-angle bend (S7) in the northern portion of the site. The analytical data corresponded to field observations, where black silty,and in some cases oozy, very fine grain sediments were encountered. Based on this assessment, the following has been concluded: Based on this assessment, the following has been concluded:

- Sediments at S05; classified as MBOs
- Sediments at S01, S03 and S07: indicative of potential MBOs (due to high moisture and higher AVS concentrations).

Where MBO/potential MBO sediments are disturbed during construction, they pose a potential risk to the environment via other processes (e.g. deoxygenation, nutrient cycling) and will require management to mitigate the risk to the environment during construction. RPS notes, that MBOs are transient in nature and may potentially be located in different areas at the time of construction.

Examples of the potential MBOs that were encountered are detailed in Plate 5 to 8 below.

Plate 5: Identified MBO example 1 (DS7 at S07)

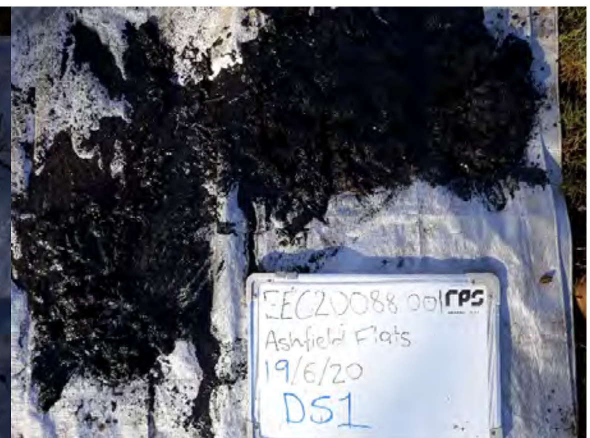


Plate 6: Identified MBO example 2 (DS1 at S01)

Plate 7: Identified MBO example 3 (DS3 at S03)

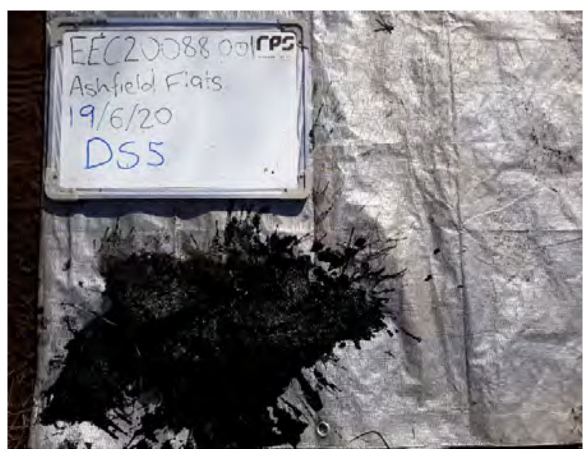


Plate 8: Identified MBO example 4 (DS5 at S05)

5 SURFACE WATER

5.1 Overview

During the sampling of drain sediments, physical parameters were monitored within the Chapman Street MD. Monitoring was undertaken using a calibrated water quality sampling and monitoring meter prior to sampling of sediments at each location (Figure C). Parameters recorded included the following:

- pH
- EC
- Redox
- Dissolved oxygen
- Temperature

Sampling was undertaken on two separate days, due to rainfall increasing the flow and volume of water in the drain and thus posing a safety risk to personnel onsite. Locations S08 and S09 were sampled on 17 June 2020 with locations S01-S09 sampled on the 19 June 2020.

Calibration records are presented in Appendix F.

5.2 Surface water quality findings

5.2.1 Observations

Water flowed in a south-west direction in the Chapman Street MD towards the Swan River and the volume and flow was noticed to significantly increase immediately flowing periods of rainfall.

5.2.2 Physical parameters and observations

A results of the field observations are provided in Table 11 below:

Table 13: Summary of surface water physical parameters

Location	pH (pH units)	EC (µS/cm)	Redox (mV)	Dissolved Oxygen (mg/L)	Temperature (°C)
S01	6.68	17,251	82	4.92	15.7
S02	6.84	4,524	111	6.47	16.6
S03	6.78	1,099	168	5.68	17.0
S04	6.81	582	166	4.09	16.6
S05	6.66	385	112	2.29	16.0
S06	6.76	415	97	2.22	15.4
S07	6.91	568	76	2.39	15.8
S08	7.31	135^	56	7.15	18.3
S09	7.27	951	105	6.34	17.6

^ Significant rainfall and increased flows in the drain occurred between the sampling at S09 and S08.

A summary of the data collected from the various physical parameters assessed is provided below:

- The pH was generally marginally acidic to marginally alkaline along the drain, with an average of 6.9 pH units, a minimum of 6.7 (S01 and S05) and a maximum of 7.3 (S08 and S09).
- Salinity ranged from ‘fresh’ (S08) to ‘saline’ (S01), based on the salinity classification system *Stream salinity status and trends in south-west Western Australia* (DoE, 2005). Salinity decreased with increasing distance from the Swan River.

- Other parameters were noted to be relatively consistent across the MD, such that no other discernible trends are noted.

5.3 Surface water summary

Surface water was marginally acidic to marginally alkaline (average of 6.9 pH units), an increase in salinity (EC) was observed as sampling locations approached the Swan River, and water was well oxygenated.

6 DSA FINDINGS AND RECOMMENDATIONS

6.1 Findings

6.1.1 Soils

Soils within the site are characterised predominately as a mixture of brown clayey sands, sandy clays, and sands, overlaying, grey clays to a depth of 1.5 mbgl, the maximum depth of the investigation. Brown sands to ~1.5 mbgl were encountered toward the western boundary (S29-S31) with refusal upon encountering limestone occurring between 1.0-1.5 mbgl.

The net acidity of all soil types, with the exception of shallow soils along the western boundary, exceeded the relevant DWER action management criteria. Surficial soils along the western boundary, external to the wetland/vegetated areas do not require management with respect to ASS.

Based upon a review of the results for the site, with the exception of soils along the western boundary (outside the wetland/vegetated area), all onsite soils require management and lime-neutralisation should they be disturbed during construction. The extent of this area is presented in Figure E.

6.1.2 Sediment

Sediments along the drain consisted of black silts and silty sands, overlying dark grey clays. Sediments within the Chapman Street MD are identified as PASS (Figure E) and exceeded the relevant DWER action management criteria with minimal ANC present, and as such will require management and lime-neutralisation should these sediments be encountered during construction. Whilst sediments in the Kitchener Street MD were not sampled, in has been assumed that the sediments will also requirement management.

PASS have been identified within sediment within the length of the Chapman Street MD. The PASS is predominantly in the form of pyrite although isolated pockets of potential MBOs were present in the drain (Figure E).Based upon the appreciable AVS concentrations and visual observations, potential MBOs are present in the drain from the right-angle bend (S7) in the northern portion of the site. The analytical data corresponded to field observations, where black silty,and in some cases oozy, very fine grain sediments were encountered. Based on this assessment, the following has been concluded: Based on this assessment, the following has been concluded:

- Sediments at S05; classified as MBOs
- Sediments at S01, S03 and S07: indicative of potential MBOs (due to high moisture and higher AVS concentrations).

Where MBO/potential MBO sediments are disturbed during construction, they pose a potential risk to the environment via other processes (e.g. deoxygenation, nutrient cycling) and will require management to mitigate the risk to the environment during construction. RPS notes, that MBOs are transient in nature and may potentially be located in different areas at the time of construction.

6.1.3 Surface water

Surface water was marginally acidic to marginally alkaline (average of 6.9 pH units), an increase in salinity (EC) was observed as sampling locations approached the Swan River, and water was well oxygenated.

6.2 Recommendations

PASS are prominent across the majority of the site and therefore likely to be disturbed during construction works. In additional MBO/potential MBOs are present in the Chapman Street MD, and are assumed to be present in Kitchener Road MD. As such once detailed engineering design of proposed drainage works are completed, preparation of an Acid Sulfate Soils and Dewatering Management Plan (ASSDMP) will be required.

As part of preparation of the ASSDMP, a groundwater and surface water sampling program will be required to be completed across the site to established groundwater and surface quality, with respect to ASS parameters. Groundwater and surface water samples should be analysed in line with the DWER (2015b) guidelines.

The ASSDMP will outline the soil/sediment management measures; the groundwater, surface water (if required) and dewatering effluent monitoring measures; and the contingency management measures required to minimise any environmental impacts.

Depending on the engineering design, some additional onsite soil investigations may potentially be required to:

- Cover the depth of excavation
- To confirm requiring liming rates for soils proposed to be disturbed.

Depending on the location of works onsite, additional groundwater bores may also be required to be installed, in the vicinity of proposed works, for during and post construction monitoring requirements.

7 ASS MANAGEMENT AND APPROVAL PROCESS

7.1 ASS approvals process

7.1.1 Regulatory authority

DWER is the regulatory authority that assess ASS development proposals and are required to be consulted regarding the following ASS items:

- Soil, sediment, surface water and groundwater management
- Endorsement of ASSDMP
- Issue groundwater dewatering licences, if required.

Additional consultation with the DBCA, specifically the rivers and estuaries division, may also be required, as land and any proposed drainage infrastructure discharges into the Swan River are managed by this authority.

7.1.2 Reporting requirements

RPS identifies a likely three stage approach required to the reporting of future excavation works:

1. Where ASS has been identified and is proposed to be disturbed a detailed management plan is required. An ASSDMP is generally prepared as a condition of development. For this project an ASSDMP would be prepared covering the full extent of the site works, i.e. excavation and or dewatering, where PASS is disturbed. Upon completion of engineering design some additional investigations may potentially be required to refine the ASS extent/liming rates for the site.
2. An ASS "Initial Closure Report" would be prepared by an environmental consultant and issued to the DWER (Contaminated Sites Branch)/DBCA at the cessation of construction works. The report would contain:
    - Management measures undertaken at the site and their effectiveness
    - Soil/sediment validation results, both field and laboratory testing as specified in the ASSDMP
    - Amount of neutralising agent used during construction
    - Discussion of potential human health and environmental risk, and any remediation required
    - Photographic record of the earthworks program
    - Results of the dewatering activities
    - Results of the dewatering, surface water (drain/Swan River) and groundwater monitoring.
3. A "Post-dewatering monitoring closure report" is typically prepared following 6–12 months of water (both surface and groundwater) quality data has been monitored, after completion of all dewatering activities. The water quality report is used to confirm that longer term ASS/dewatering effects have not impacted the shallow groundwater and surface water, of Swan River, and that the aquifer has recovered from any drawdown.

7.2 ASSDMP

7.2.1 Earthworks operating strategy

7.2.1.1 Soils

The ASSDMP for the site will provide a earthworks strategy. Below is a summary of the procedures and practices that would likely apply during earthworks for the site. These procedures and practices will be reviewed and revised upon receipt of detailed engineering design within the ASSDMP. The extent of identified PASS across the site is presented on Figure E.

The identified PASS lime-treatment rates, for indicative purposes, corresponds to the maximum net acidity[13] and excluding ANC for the different construction elements sections (Table 12). Additional assumptions include bulk density of 1.6 tonne/m^3, a safety factor of 2, and effective neutralising value (ENV) of 50%, per the following calculation. The liming rate will be updated based upon the liming material to be used, and validation test results. The lime material used onsite is recommended to have a particle size distribution of <1 mm.

Rates are calculated as follows:

$$LR = \%S * \rho_{soil} * CF * SF * (\frac{100}{ENV})$$

Where: LR = liming rate
%S = percentage sulfur
ρsoil = bulk density of soil (tonne/m^3) assumed at 1.6 tonne/m^3
CF = conversion factor (%S to kg pure $CaCO_3$/tonne) = 31.202
SF = safety factor of 2 as per DWER (2015) guidelines for high risk sites
ENV = effective neutralising value

Table 14: Indicative liming rates

Soils requiring management	Depth (mbgl)	Net acidity excluding ANC (%S)	Liming rate (kg aglime/m^3) (50% ENV)
All soils	0.00-1.25	0.21*	42
	1.25-1.50	0.62	214

*Mean and standard deviation net acidity concentration.

The treated material would be subject to validation testing, in accordance with DWER guidelines. Treated samples should have a pH_F ≥6.5 and pH_{FOX} ≥5.0. Around 25% of field validated samples will be subject to confirmatory testing, where the pH_{KCl} should be ≥6.5 and pH_{OX} ≥5.0, and excess ANC should be present.

The above liming rate may potentially be refined followed a review of the detailed engineering design and proposed construction methodology for the site.

7.2.1.2 Potential MBOs and sediment

Sediments within the Chapman Street MD are identified as PASS (Figure E) and exceeded the relevant DWER action management criteria and as such will require management and lime-neutralisation should these sediments be encountered during construction. Whilst sediments in the Kitchener Street MD were not sampled, in has been assumed that the sediments will also requirement management.

The liming rate for sediments in this area, based upon the aforementioned assumptions and a maximum net acidity (excluding ANC) of 3.5%S, is 350 kg aglime/m^3 (100% ENV) or 700 kg aglime/m^3 (50% ENV). The liming rate will be updated based upon the liming material to be used, and validation test results. The lime material used onsite is recommended to have a particle size distribution of <1 mm.

PASS have been identified within sediment within the length of the Chapman Street MD. The PASS is predominantly in the form of pyrite rather than as MBOs, although isolated pockets of potential MBOs were present in the drain (Figure E). The sediment containing minimal ANC and thus pose a potential risk to the environment if disturbed via other processes, i.e. potential release of contaminants, i.e. metals, deoxygenation of the water column and nutrient cycling causing algal blooms.

MBO/potential MBOs will require active management i.e. further lime neutralisation, where they are disturbed during construction, to minimise potential environmental risks and subsequent disposal to landfill will likely be recommended. Depending on the extent of removals, additional measures, e.g. silt curtains, will potentially be required to assist in mitigating risks to downgradient receptors. Therefore, the potential management of MBOs, is recommended to be discuss/workshopped with the DWER/DBCA, depending on the construction requirements and the extent of MBOs at the time of construction. RPS notes, that MBOs are transient in nature and may potentially be located in different areas at the time of construction than during this investigation however are likely to be present along the majority of the Chapman Street MD and potentially the Kitchener

[13] The mean plus one standard deviation net acidity has been used for the dark grey/black silty soils

Street MD (Figure E). Depending on the extent of works proposed for the drain an additional investigation may likely be required prior to disturbance of sediments within the drain.

7.2.2 Dewatering, groundwater and surface water operating strategies

The ASSDMP would also provide a dewatering, groundwater and surface water operating strategies. The strategies will detail monitoring practices, trigger levels for groundwater drawdown and water quality parameters (e.g. total acidity, pH, aluminium), for both groundwater and surface water, and appropriate treatment (i.e. settling basins, infiltration, liming).

These strategies will be adjusted for site specific purposes and incorporate the findings of the any future baseline groundwater/surface water monitoring.

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Tables

Table A
Acid Sulfate Soil Sampling Inventory

Definitions:

H to M - high to moderate risk of ASS occurrence within three metres of natural soil surface
M to L - moderate to low risk of ASS occurrence within three metres of natural soil surface with a high ot moderate risk beyond three metres of the natural soil surface
✓ (denotes Bassendean Sand samples having a pH_{FOX} <3), BS (Bassendean Sand), - (No Guideline), --- not tested, LOR (Limit of Reporting)

Notes:

This table utilises colour coding to aid data interpretation, avoid black and white reproduction
Units are as shown
Duplicate samples have been included in sample statistics.
Guideline values have beenadopted from *Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes* (DER 2015b)
Denotes sample exceeds DWER Action Criteria of 0.03 (%S) or 18 mol H^+ / tonne, for excavations of >1,000 tonnes

Location	Easting	Northing	DWER ASS Risk	Sampling Method	Sampling Depth (mbgl)	Analytes	Field Test Results					Laboratory Test Results						ASS Present?	Lithology Containing ASS
							Number of Field Tests	Non Acid Sulfate Soil	Potential Acid Sulfate Soil	Actual Acid Sulfate Soil	% Acid Sulfate Soil	Number of Laboratory Tests	TAA_{MAX}	TPA_{MAX}	CRS_{MAX}	Net Acidity $(SCR + S_{TAA})_{MAX}$	BS pH_{FOX} <3		
						Units	-	-	-	-	-	-	(%S)	(%S)	(%S)	(%S)	-		
Soils																			
S01	400,053	6,467,969	H to M	Hand auger	1.0		5	5	0	0	0%	2	<0.02	<0.02	0.067	0.07	×	Yes	CLAY/CLAYEY SAND: Brown
S02	400,126	6,468,041	H to M	Hand auger	1.5		7	2	5	0	71%	2	<0.02	0.19	0.201	0.21	×	Yes	CLAY/SANDY CLAY: Grey
S03	400,198	6,468,113	H to M	Hand auger	1.5		8	4	4	0	50%	1	0.04	0.27	0.037	0.07	×	Yes	CLAYEY SAND: Red/brown
S04	400,269	6,468,183	H to M	Hand auger	1.5		7	5	2	0	29%	1	<0.02	<0.02	0.024	0.04	×	Yes	CLAY: Dark grey
S05	400,342	6,468,255	H to M	Hand auger	0.8		3	2	1	0	33%	1	0.03	<0.02	0.031	0.06	×	Yes	CLAY: Dark grey
S06	400,414	6,468,326	H to M	Hand auger	1.3		7	0	3	0	43%	2	<0.02	<0.02	0.02	0.03	×	Yes	CLAYEY SAND: Brown
S07	400,495	6,468,311	H to M	Hand auger	1.5		7	0	7	0	100%	1	0.10	0.11	0.012	0.11	×	Yes	SANDY CLAY: Dark brown
S08	400,558	6,468,396	H to M	Hand auger	0.6		2	1	1	0	50%	1	0.04	<0.02	0.012	0.06	×	Yes	SILTY CLAY: Brown
S09	400,621	6,468,475	H to M	Hand auger	0.8		4	2	2	0	50%	2	0.07	<0.02	0.012	0.08	×	Yes	CLAYEY SAND: Red/brown; SANDY CLAY: Dark grey
S10	400,584	6,468,265	H to M	Hand auger	1.5		6	5	1	0	17%	2	<0.02	<0.02	0.01	<0.02	×	No	
S11	400,580	6,468,198	H to M	Hand auger	1.5		6	2	4	0	67%	2	0.06	0.58	0.59	0.62	×	Yes	CLAY/CLAYEY SAND: Grey
S12	400,529	6,468,111	H to M	Hand auger	1.5		6	0	6	0	100%	1	0.10	0.15	0.01	0.11	×	Yes	CLAY: Grey
S13	400,475	6,468,024	H to M	Hand auger	1.3		6	0	5	1	100%	1	0.04	0.01	0.01	0.04	×	Yes	SAND: Pale brown
S14	400,420	6,467,940	H to M	Hand auger	1.0		5	0	3	2	100%	1	0.03	<0.02	0.016	0.05	×	Yes	CLAYEY SAND: Grey
S15	400,364	6,467,866	H to M	Hand auger	1.5		9	0	3	6	100%	3	0.16	0.25	0.01	0.12	×	Yes	CLAY/SANDY CLAY: Grey
S16	400,329	6,467,814	H to M	Hand auger	1.5		8	0	7	1	100%	2	0.14	0.25	0.01	0.15	×	Yes	SANDY CLAY: Brown
S17	400,343	6,467,918	H to M	Hand auger	1.5		6	0	2	4	100%	1	0.06	0.11	0.006	0.07	×	Yes	SANDY CLAY: Grey
S18	400,254	6,467,943	H to M	Hand auger	1.5		7	0	4	3	100%	2	0.16	0.29	0.017	0.18	×	Yes	CLAY: Dark brown
S19	400,189	6,467,912	H to M	Hand auger	1.4		7	0	7	0	100%	1	0.13	0.20	0.006	0.13	×	Yes	CLAY: Brown
S20	400,466	6,467,916	H to M	Hand auger	1.5		7	0	3	4	100%	1	0.08	0.12	0.018	0.10	×	Yes	CLAYEY SAND: Grey
S21	400,550	6,467,904	H to M	Hand auger	1.0		4	0	3	1	100%	1	0.17	0.37	0.014	0.19	×	Yes	CLAY: Dark brown
S22	399,951	6,468,029	H to M	Hand auger	0.8		3	3	0	0	0%	1	<0.02	<0.02	0.014	0.02	×	No	
S23	400,017	6,468,078	H to M	Hand auger	1.0		4	0	2	2	100%	1	0.03	<0.02	0.011	0.04	×	Yes	CLAY: Brown
S24	400,034	6,468,169	H to M	Hand auger	1.0		5	3	2	0	40%	1	0.09	0.29	0.044	0.14	×	Yes	CLAY: Brown
S25	400,268	6,468,252	H to M	Hand auger	0.8		4	1	0	3	75%	2	0.16	0.17	0.011	0.17	×	Yes	SANDY CLAY: Brown, SILTY CLAY: Grey
S26	400,439	6,468,305	H to M	Hand auger	0.8		4	0	2	2	100%	1	0.07	0.01	0.005	0.07	×	Yes	CLAY: Grey
S27	400,381	6,468,181	H to M	Hand auger	0.8		5	0	5	0	100%	1	0.07	0.12	0.021	0.09	×	Yes	CLAY: Dark brown/grey

Location	Easting	Northing	DWER ASS Risk	Sampling Method	Sampling Depth (mbgl)	Analytes	Field Test Results					Laboratory Test Results						ASS Present?	Lithology Containing ASS
							Number of Field Tests	Non Acid Sulfate Soil	Potential Acid Sulfate Soil	Actual Acid Sulfate Soil	% Acid Sulfate Soil	Number of Laboratory Tests	TAA_{MAX}	TPA_{MAX}	CRS_{MAX}	Net Acidity ($SCR + S_{TAA}$) $_{MAX}$	BS pH_{FOX} <3		
						Units	-	-	-	-	-	-	(%S)	(%S)	(%S)	(%S)	-		
S28	400,216	6,468,063	H to M	Hand auger	1.0		5	3	2	0	40%	1	<0.02	<0.02	<0.005	<0.02	×	No	
S29	400,049	6,468,254	M to L	Hand auger	1.0		5	5	0	0	0%	1	<0.02	<0.02	0.008	<0.02	×	No	
S30	399,979	6,468,184	M to L	Hand auger	1.5		6	6	0	0	0%	1	<0.02	<0.02	0.008	<0.02	×	No	
S31	400,026	6,468,238	M to L	Hand auger	1.1		5	5	0	0	0%	1	<0.02	<0.02	0.006	<0.02	×	No	
				Totals/Max	**37**		**173**	**54**	**86**	**29**	**66%**	**42**	**0.17**	**0.580**	**0.59**	**0.62**			
Sediments																			
DS1	400,053	6,467,969	H to M	Push tube	0.15		3	2	1	0	33%	2	<0.02	1.53	1.96	1.96	×	Yes	SILTY SAND: Black
DS3	400,198	6,468,113	H to M	Push tube	0.20		2	0	2	0	100%	1	<0.02	0.85	1.25	1.25	×	Yes	CLAYEY SILT: Black
DS5	400,342	6,468,255	H to M	Push tube	0.10		2	0	2	0	100%	2	0.03	1.83	3.48	3.51	×	Yes	SILTY SAND: Black
DS7	400,495	6,468,311	H to M	Push tube	0.20		2	0	2	0	100%	1	<0.02	0.63	0.46	0.46	×	Yes	SILTY SAND: Black
DS8	400,558	6,468,396	H to M	Push tube	0.30		2	2	0	0	0%	1	<0.02	<0.02	0.02	0.03	×	No	
DS9	400,621	6,468,475	H to M	Push tube	0.40		3	1	2	0	67%	2	<0.02	0.25	0.22	0.23	×	Yes	ORGANIC MAT LAYER: Dark grey, CLAY: Dark grey
				Totals/Max	**1.35**		**14**	**5**	**9**	**0**	**64%**	**9**	**0.03**	**1.830**	**3.48**	**3.51**			

MAKING COMPLEX EASY

Table B
Acid Sulfate Soil Results

Definitions:

- (No Guideline), --- not tested, LOR (Limit of Reporting), mht (mol H+/tonne)

Notes:

This table utilises colour coding to aid data interpretation, avoid black and white reproduction
Units are as shown

Denotes less than LOR
Field test value indicative of AASS
Field test value indicative of PASS
Denotes sample exceeds DWER Action Criteria of 0.03 (%S) or 18 mol H^+ / tonne, for excavations of >1,000 tonnes
Denotes Bassendean Sand (BS) samples having a pH_{FOX}<3

Sample ID	Date	Interval (m)	Sample Description	Trigger	Field Tests				Acidity Trail						CRS		Retained Acidity		Net Acidity		ANC		
					pH_F	pH_{FOX}	pH Change	Reaction Vigour	pH_{KCl}	pH_{OX}	TAA	S_{TAA}	TPA	S_{TPA}	aSCR	SCR	aS_{NAS}	S_{NAS}	SCR + STAA	SCR + S_{TAA}	ANC	ANC	ANC (sieved to 0.6 mm)
				Units	pH	pH	pH	-	pH	pH	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	%S
				ASS	<4.0	<4.0	-	-	<4.0	<4.0	18	0.03	18	0.03	18	0.03	18	0.03	18	0.03	-	-	-
				LOR	0.1	0.1	0.1	-	0.1	0.1	2	0.02	2	0.02	10	0.005	10	0.02	10	0.02	10	0.01	0.01
S01-S01		0.0 - 0.1	CLAYEY SAND - Dark Brown MFG		7.2	5.3	1.9	Moderate	8.0	7.8	<2	<0.02	<2	<0.02	42	0.067	----	----	42	0.07	1,020	1.64	0.56
S01-S02		0.1 - 0.3	SANDY CLAY - Dark Brown. Fine grained		6.8	4.7	2.1	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S01-S03	22/06/2020	0.3 - 0.45			6.2	4.3	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S01-S04		0.45 - 0.75	CLAY - Dark brown, saturated		6.7	4.6	2.1	Strong	6.2	5.7	5	<0.02	<2	<0.02	26	0.042	----	----	31	0.05	----	----	---
S01-S05		0.75 - 1.0			6.6	4.4	2.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S02-S01		0.0 - 0.1	CLAYEY SAND - Red/brown. MFG		6.5	4.4	2.1	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S02-S02		0.1 - 0.4	CLAY - Dark grey. Fine grained saturated		6.9	4.9	2.0	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S02-S03		0.4 - 0.7			6.2	3.4	2.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S02-S04	23/06/2020	0.7 - 0.95			6.7	3.1	3.6	Strong	6.2	4.0	5	<0.02	119	0.19	125	0.201	----	----	131	0.21	----	----	---
S02-S05		0.95 - 1.1	SANDY CLAY - Dark grey, MFG, saturated		6.9	3.2	3.7	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S02-S06		1.1 - 1.4			6.9	3.1	3.8	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S02-S07		1.4-1.5			6.9	2.7	4.2	Strong	6.3	3.8	2	<0.02	97	0.16	84	0.134	----	----	86	0.14	----	----	---
S03-S01		0.0 - 0.1	CLAYEY SAND - Red/brown. MFG		6.3	3.8	2.5	Moderate	6.1	5.2	22	0.04	168	0.27	23	0.037	----	----	45	0.07	----	----	---
S03-S02		0.1 - 0.3	CLAY - Dark grey. Fine grained saturated		6.2	3.9	2.3	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S03-S03		0.3 - 0.5			6.2	4.3	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S03-S04	22/06/2020	0.5 - 0.75			6.2	3.8	2.4	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S03-S05		0.75 - 1.0	CLAY - Dark grey. Fine grained saturated		6.4	5.0	1.4	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S03-S06		1.0 - 1.25			6.7	4.2	2.5	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S03-S07		1.25 - 1.5			6.6	3.8	2.8	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SZ4		0.1 - 0.3	CLAY - Dark grey. Fine grained saturated		6.0	4.5	1.5	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S04-S01		0.0 - 0.1	CLAYEY SAND - Red/brown. MFG		6.5	4.0	2.5	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S04-S02		0.1 - 0.3	CLAY - Dark grey. Fine grained saturated		6.4	4.3	2.1	Moderate	5.9	7.2	8	<0.02	<2	<0.02	15	0.024	----	----	23	0.04	----	----	---
S04-S03		0.3 - 0.5			6.4	4.3	2.1	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S04-S04	22/06/2020	0.5 - 0.75			6.4	4.8	1.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S04-S05		0.75 - 1	CLAY - Grey. Fine grained saturated		6.7	4.3	2.4	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S04-S06		1 - 1.25			6.6	3.9	2.7	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S04-S07		1.25 - 1.5			6.4	3.1	3.3	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S05-S01		0.0 - 0.3	CLAYEY SAND - Brown. MFG		6.2	4.3	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S05-S02	19/06/2020	0.3 - 0.55	CLAY - Dark Grey. Fine grained		5.9	4.0	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S05-S03		0.55 - 0.8			6.5	3.5	3.0	Strong	5.6	5.3	17	0.03	2	<0.02	19	0.031	----	----	36	0.06	----	----	---

MAKING COMPLEX EASY

Sample ID	Date	Interval (m)	Sample Description	Trigger	Field Tests				Acidity Trail						CRS		Retained Acidity		Net Acidity		ANC		
					pH_F	pH_{FOX}	pH Change	Reaction Vigour	pH_{KCl}	pH_{OX}	TAA	S_{TAA}	TPA	S_{TPA}	aSCR	SCR	aS_{NAS}	S_{NAS}	SCR + STAA	SCR + S_{TAA}	ANC	ANC	ANC (sieved to 0.6 mm)
				Units	pH	pH	pH	-	pH	pH	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	%S
				ASS	<4.0	<4.0	-	-	<4.0	<4.0	18	0.03	18	0.03	18	0.03	18	0.03	18	0.03	-	-	-
				LOR	0.1	0.1	0.1	-	0.1	0.1	2	0.02	2	0.02	10	0.005	10	0.02	10	0.02	10	0.01	0.01
S06-S01	19/06/2020	0.0 - 0.3	CLAYEY SAND - Brown. MFG		6.4	3.4	3.0	Moderate	6.0	6.8	8	<0.02	<2	<0.02	<10	0.015	----	----	17	0.03	----	----	---
S06-S02		0.3 - 0.55	SANDY CLAY - Dark Brown. Fine grained		6.7	3.9	2.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-S03		0.55 - 0.7			7.5	5.4	2.1	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-S04		0.7 - 0.8	CLAYEY SAND - Grey. MFG		7.1	5.3	1.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-S05		0.8 - 0.95	CLAYEY SAND - Orange. MFG		7.4	5.0	2.4	Moderate	6.2	6.3	<2	<0.02	<2	<0.02	12	0.02	----	----	14	0.02	----	----	---
S06-S06		0.95 - 1.1			7.0	5.3	1.7	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-S07		1.1 - 1.3	SANDY CLAY - Grey, MFG		6.8	3.4	3.4	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S07-S01	19/06/2020	0.0 - 0.2	CLAYEY SAND - Dark Brown MFG		5.3	3.2	2.1	Extreme	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S07-S02		0.2 - 0.4			6.4	3.7	2.7	Extreme	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S07-S03		0.4 - 0.65	SANDY CLAY - Dark Brown. MFG		5.8	3.3	2.5	Extreme	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S07-S04		0.65 - 0.9			5.6	3.0	2.6	Moderate	5.0	4.7	61	0.10	69	0.11	<10	0.012	----	----	68	0.11	----	----	---
S07-S05		0.9 - 1.2	CLAYEY SAND - Grey. MFG		5.0	3.2	1.8	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S07-S06		1.2 - 1.5			5.7	3.2	2.5	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SZ3		0.9 - 1.2			5.0	3.2	1.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S08-S01	17/06/2020	0.0 - 0.3	SILTY CLAY - Brown. Fine grained		5.2	3.1	2.1	Moderate	5.7	5.7	27	0.04	<2	<0.02	<10	0.012	----	----	34	0.06	----	----	---
S08-S02		0.3 - 0.6	CLAY - Dark brown, wet		5.8	4.1	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S09-S01	17/06/2020	0.0 - 0.15	SILTY SAND - Brown. MFG		4.2	3.1	1.1	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S09-S02		0.15 - 0.3	CLAYEY SAND - Red/brown. MFG		4.8	2.8	2.0	Moderate	5.6	5.7	42	0.07	2	<0.02	<10	0.012	----	----	50	0.08	----	----	---
S09-S03		0.3 - 0.6	SANDY CLAY - Dark grey, fine, wet		6.0	4.6	1.4	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S09-S04		0.6 - 0.8	CLAY - Grey. Fine grained saturated		6.7	5.5	1.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S10-S01	18/06/2020	0.0 - 0.1	CLAYEY SAND - Brown. MFG		7.0	3.1	3.9	Moderate	6.6	5.8	<2	<0.02	<2	<0.02	<10	0.01	----	----	<10	<0.02	213	0.34	---
S10-S02		0.1-0.3	SANDY CLAY - Brown		7.2	4.1	3.1	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S10-S03		0.4 - 0.6	CLAY - Dark brown		6.7	4.5	2.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S10-S04		0.6 - 0.9	CLAY - Brown		7.7	6.0	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S10-S05		0.9 - 1.15	SANDY CLAY - Pale brown/orange		7.4	6.1	1.3	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S10-S06		1.15 - 1.5	SANDY CLAY - Dark Grey		7.8	7.2	0.6	Strong	6.6	7.3	<2	<0.02	<2	<0.02	<10	<0.005	----	----	<10	<0.02	136	0.22	---
S11-S01	18/06/2020	0.0 - 0.3	CLAY - Brown. Abundant organics		6.0	3.4	2.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S11-S02		0.3 - 0.5	CLAY - Grey. Fine grained saturated		5.3	3.0	2.3	Moderate	5.2	4.4	35	0.06	38	0.06	<10	<0.005	----	----	36	0.06	----	----	---
S11-S03		0.5 - 0.75			5.9	4.1	1.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S11-S04		0.75 - 1.0			6.5	4.6	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S11-S05		1.0 - 1.25	CLAYEY SAND - Grey. MFG		6.6	3.3	3.3	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S11-S06		1.25 - 1.50			6.7	1.7	5.0	Strong	5.8	2.4	17	0.03	364	0.58	368	0.59	----	----	385	0.62	----	----	---
S12-S01	18/06/2020	0.0 - 0.1	SILTY SAND - Dark brown. MFG		5.8	3.2	2.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S12-S02		0.1 - 0.6	CLAY - Brown, saturated		5.2	2.8	2.4	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S12-S03		0.6 - 0.75	CLAY - Grey. Fine grained saturated		5.2	3.2	2.0	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S12-S04		0.75 - 1.0			5.0	3.0	2.0	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S12-S05		1.0 - 1.25			4.7	2.3	2.4	Moderate	4.9	4.2	61	0.10	95	0.15	<10	0.01	----	----	67	0.11	----	----	---
S12-S06		1.25 - 1.5			4.6	2.4	2.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S13-S01	18/06/2020	0.0 - 0.1	CLAYEY SAND - Brown. MFG		4.8	2.6	2.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S13-S02		0.1 - 0.3	SANDY CLAY - Brown.		4.4	2.3	2.1	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S13-S03		0.3 - 0.55	CLAYEY SAND - Brown. Saturated		4.3	2.4	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S13-S04		0.55 - 0.8			4.1	1.9	2.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S13-S05		0.8 - 1	SAND - Pale brown. MFG. saturated		3.8	2.0	1.8	Slight	5.3	4.6	22	0.04	5	0.01	<10	0.010	----	----	28	0.04	----	----	---
S13-S06		1 - 1.3			4.0	2.2	1.8	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MAKING COMPLEX EASY

Sample ID	Date	Interval (m)	Sample Description	Trigger	Field Tests				Acidity Trail						CRS		Retained Acidity		Net Acidity		ANC		
					pH F	pH FOX	pH Change	Reaction Vigour	pH KCl	pH OX	TAA	S_{TAA}	TPA	S_{TPA}	aSCR	SCR	aS_{NAS}	S_{NAS}	SCR + STAA	SCR + S_{TAA}	ANC	ANC	ANC (sieved to 0.6 mm)
				Units	pH	pH	pH	-	pH	pH	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	%S
				ASS	<4.0	<4.0	-	-	<4.0	<4.0	18	0.03	18	0.03	18	0.03	18	0.03	18	0.03	-	-	-
				LOR	0.1	0.1	0.1	-	0.1	0.1	2	0.02	2	0.02	10	0.005	10	0.02	10	0.02	10	0.01	0.01
S14-S01	18/06/2020	0.0 - 0.2	SANDY CLAY - Dark brown		5.0	2.6	2.4	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S14-S02		0.2 - 0.4			4.9	2.4	2.5	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S14-S03		0.4 - 0.7	CLAY - Dark grey. Fine grained saturated		4.3	2.6	1.7	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S14-S04		0.7 - 0.85	CLAYEY SAND - Grey. MFG. Saturated		3.7	2.0	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S14-S05		0.85 - 1.0			3.7	2.2	1.5	Slight	5.3	4.9	19	0.03	<2	<0.02	10	0.016	----	----	29	0.05	----	----	---
S15-S01	23/06/2020	0.0 - 0.2	SANDY CLAY - Brown. Abundant organics		4.2	2.5	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S15-S02		0.2 - 0.4	CLAY - Grey. Fine grained saturated		3.9	2.3	1.6	Moderate	4.5	3.9	100	0.16	159	0.25	<10	0.01	----	----	107	0.17	----	----	---
S15-S03		0.4 - 0.6			3.9	2.4	1.5	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S15-S04		0.6 - 0.8	SANDY CLAY - Grey. MFG, saturated		4.0	2.4	1.6	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S15-S05		0.8 - 1.0			3.8	2.2	1.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S15-S06		1.0 - 1.25			3.8	2.0	1.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S15-S07		1.25 - 1.5			3.8	1.9	1.9	Moderate	4.9	4.0	46	0.07	75	0.12	<10	0.006	----	----	49	0.08	----	----	---
SZ8		0.0 - 0.2	SANDY CLAY - Brown. Abundant organics		4.2	2.6	1.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SZ9		1.25 - 1.5	SANDY CLAY - Grey. MFG, saturated		3.8	2.0	1.8	Slight	4.9	4.3	45	0.07	60	0.10	<10	<0.005	----	----	45	0.07	----	----	---
S16-S01	23/06/2020	0.0 - 0.25	SANDY CLAY - Brown. MFG		4.4	2.5	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S16-S02		0.25 - 0.5			3.8	2.2	1.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S16-S03		0.5 - 0.8			3.8	2.1	1.7	Moderate	4.7	3.9	87	0.14	138	0.22	<10	0.01	----	----	93	0.15	----	----	---
S16-S04		0.8 - 1.0	SANDY CLAY - Grey. MFG, saturated		3.7	2.6	1.1	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S16-S05		1.0 -1.20			3.7	2.0	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S16-S06		1.20 -1.4			3.9	2.3	1.6	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S16-S07		1.4 -1.5	CLAY - Grey. Fine grained saturated		3.8	2.2	1.6	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SZ10		0.5 - 0.8	SANDY CLAY - Brown. MFG		3.8	2.8	1.0	Strong	4.7	4.0	90	0.14	157	0.25	<10	0.007	----	----	94	0.15	----	----	---
S17-S01	23/06/2020	0.0 - 0.3	SANDY CLAY - Brown. Abundant organics		4.8	2.5	2.3	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S17-S02		0.3 - 0.6	CLAY - Grey. Moist		4.0	2.3	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S17-S03		0.6 - 0.8	SANDY CLAY - Grey. Saturated		3.8	2.5	1.3	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S17-S04		0.8 - 1.0			3.7	2.1	1.6	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S17-S05		1.0 -1.25			3.9	2.0	1.9	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S17-S06		1.25 - 1.5			3.8	1.8	2.0	Slight	4.9	4.0	38	0.06	68	0.11	<10	0.006	----	----	42	0.07	----	----	---
S18-S01	23/06/2020	0.0 - 0.25	CLAY - Dark brown		4.7	2.8	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S18-S02		0.25 - 0.5			4.4	2.4	2.0	Moderate	4.6	4.0	92	0.15	183	0.29	<10	<0.005	----	----	94	0.15	----	----	---
S18-S03		0.5 - 0.75	CLAYEY SAND - Brown/grey. Saturated		4.0	2.4	1.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S18-S04		0.75 - 1			3.8	1.9	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S18-S05		1 - 1.25	SANDY CLAYEY - Brown/grey. Saturated		3.8	1.8	2.0	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S18-S06		1.25 - 1.5	CLAY - Grey. Saturated		3.8	1.8	2.0	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SZ7		0.25 - 0.5	CLAY - Dark brown		4.1	2.5	1.6	Moderate	4.4	4.0	101	0.16	170	0.27	10	0.017	<10	<0.02	112	0.18	----	----	---
S19-S01	23/06/2020	0.0 - 0.25	CLAY - Brown		4.5	2.7	1.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S19-S02		0.25 - 0.5			4.0	2.3	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S19-S03		0.5 - 0.65	CLAY - Dark brown		4.1	2.6	1.5	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S19-S04		0.65 - 0.9	CLAY - Brown - some orange mottling		4.1	2.4	1.7	Moderate	4.6	4.4	80	0.13	123	0.20	<10	0.006	----	----	84	0.13	----	----	---
S19-S05		0.9 - 1	CLAY - Brown/grey		4.5	2.6	1.9	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S19-S06		1 - 1.1	CLAYEY SAND - Pale brown/orange. Saturated		4.7	3.0	1.7	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S19-S07		1.1 - 1.4	CLAYEY SAND - Brown/grey. Saturated		4.0	2.1	1.9	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MAKING COMPLEX EASY

Sample ID	Date	Interval (m)	Sample Description	Trigger	Field Tests				Acidity Trail						CRS		Retained Acidity		Net Acidity		ANC		
					pH_F	pH_{FOX}	pH Change	Reaction Vigour	pH_{KCl}	pH_{OX}	TAA	S_{TAA}	TPA	S_{TPA}	aSCR	SCR	aS_{NAS}	S_{NAS}	SCR + STAA	SCR + S_{TAA}	ANC	ANC	ANC (sieved to 0.6 mm)
				Units	pH	pH	pH	-	pH	pH	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	%S
				ASS	<4.0	<4.0	-	-	<4.0	<4.0	18	0.03	18	0.03	18	0.03	18	0.03	18	0.03	-	-	-
				LOR	0.1	0.1	0.1	-	0.1	0.1	2	0.02	2	0.02	10	0.005	10	0.02	10	0.02	10	0.01	0.01
S20-S01	18/06/2020	0.0 - 0.25	SANDY CLAY - Dark brown. Abundant organics		5.4	2.6	2.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S20-S02		0.25 - 0.5			4.0	2.5	1.5	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S20-S03		0.5 - 0.75	CLAYEY SAND - Grey. MFG. Saturated		3.9	2.6	1.3	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S20-S04		0.75 - 1.0			3.8	2.2	1.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S20-S05		1.0 - 1.25			3.6	1.9	1.7	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S20-S06		1.25 - 1.50			3.6	1.5	2.1	Strong	5.0	4.00	50	0.08	77	0.12	11	0.018	----	----	62	0.1	----	----	---
SZ2		0.0-0.25	SANDY CLAY - Dark brown. Abundant organics		4.8	2.6	2.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S21-S01	18/06/2020	0.0 - 0.15	SANDY CLAY - Dark brown		4.1	2.6	1.5	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S21-S02		0.15 - 0.65	CLAY - Dark brown. Saturated		3.8	2.4	1.4	Moderate	4.9	3.9	108	0.17	228	0.37	<10	0.014	----	----	117	0.190	----	----	---
S21-S03		0.65 - 0.9	CLAYEY SAND - Brown. saturated		4.0	2.6	1.4	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S21-S04		0.9 - 1	SAND - Pale brown. MFG. saturated		4.0	2.6	1.4	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S22-S01	22/06/2020	0.0 - 0.2	SANDY CLAY - Dark brown. MFG		6.5	4.4	2.1	Moderate	6.3	6.4	<2	<0.02	<2	<0.02	<10	0.014	----	----	10	0.020	----	----	---
S22-S02		0.2 - 0.5	CLAY - Dark brown		6.4	4.3	2.1	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S22-S03		0.5 - 0.8	SILTY CLAY - Grey. Fine grained		6.1	4.4	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S23-S01	17/06/2020	0.0 - 0.15	CLAYEY SAND - Brown. MFG. saturated, Abundant organics		6.2	4.1	2.1	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S23-S02		0.15 - 0.5	CLAY - Brown. Saturated		6.0	4.2	1.8	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S23-S03		0.5 - 0.75			6.0	3.9	2.1	Strong	6.0	5.8	18	0.03	<2	<0.02	<10	0.011	----	----	25	0.04	----	----	---
S23-S04		0.75 - 1.0			6.2	3.6	2.6	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S24-S01	17/06/2020	0.0 - 0.15	SAND - Brown. MFG. Abundant organics		7.5	5.3	2.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S24-S02		0.15 - 0.4	CLAY - Dark brown.		7.2	5.5	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S24-S03		0.4 - 0.7			6.6	3.7	2.9	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S24-S04		0.7 - 1.0	CLAY - Brown. Saturated		6.5	4.3	2.2	Strong	5.7	4.9	59	0.09	178	0.29	28	0.044	----	----	86	0.140	----	----	---
SZ1		0.4 - 0.7	CLAY - Dark brown.		6.6	3.8	2.8	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S25-S01	22/06/2020	0.0 - 0.3	CLAY - Brown. Saturated. Abundant organics		5.5	4.3	1.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S25-S02		0.3 - 0.4	SANDY CLAY - Brown. Saturated		3.9	2.8	1.1	Moderate	4.6	4.2	99	0.16	105	0.17	<10	0.011	----	----	106	0.17	----	----	---
S25-S03		0.4 - 0.6	CLAYEY SAND - Pale brown. Saturated		3.9	2.6	1.3	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S25-S04		0.6 - 0.8	SILTY CLAY - Grey. Saturated		3.4	1.9	1.5	Moderate	4.7	4.1	68	0.11	91	0.15	<10	0.007	----	----	73	0.12	----	----	---
S26-S01	22/06/2020	0.0 - 0.2	SILTY CLAY - Dark brown. Abundant organics		4.4	2.9	1.5	Extreme	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S26-S02		0.2 - 0.4	CLAY - Grey. moist		4.3	2.7	1.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S26-S03		0.4 - 0.6			3.9	2.3	1.6	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S26-S04		0.6 - 0.8	CLAY - Grey, saturated		3.8	2.1	1.7	Strong	5.1	4.2	44	0.07	65	0.10	<10	0.005	----	----	47	0.07	----	----	---
S27-S01	23/06/2020	0.0 - 0.2	CLAYEY SAND - Orange/yellow. MFG		6.6	3.8	2.8	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S27-S02		0.2 - 0.4	CLAY - Dark brown/grey		5.0	2.9	2.1	Moderate	5.1	4.7	42	0.07	77	0.12	13	0.021	----	----	56	0.09	----	----	---
S27-S03		0.4 - 0.6	CLAY - Dark grey, saturated		4.9	3.1	1.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S27-S04		0.6 - 0.8	CLAY - Grey, saturated		4.4	2.5	1.9	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
SZ5		0.0 - 0.2	CLAYEY SAND - Orange/yellow. MFG		5.3	3.6	1.7	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S28-S01	23/06/2020	0.0 - 0.3	CLAY - Brown. Saturated		5.6	2.8	2.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S28-S02		0.3 - 0.5	CLAY - Grey/brown. Saturated		5.9	4.7	1.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S28-S03		0.5 - 0.75	SANDY CLAY - Grey/brown. Saturated		6.0	4.9	1.1	Slight	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S28-S04		0.75 - 1.0			6.3	5.2	1.1	Strong	6.5	7.4	<2	<0.02	<2	<0.02	<10	<0.005	----	----	<10	<0.02	----	----	---
SZ6		0.0 - 0.3	CLAY - Brown. Saturated		5.4	3.2	2.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MAKING COMPLEX EASY

Sample ID	Date	Interval (m)	Sample Description	Trigger	Field Tests				Acidity Trail						CRS		Retained Acidity		Net Acidity		ANC		
					pH_F	pH_{FOX}	pH Change	Reaction Vigour	pH_{KCl}	pH_{OX}	TAA	S_{TAA}	TPA	S_{TPA}	aSCR	SCR	aS_{NAS}	S_{NAS}	SCR + STAA	SCR + S_{TAA}	ANC	ANC	ANC (sieved to 0.6 mm)
				Units	pH	pH	pH	-	pH	pH	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	%S
				ASS	<4.0	<4.0	-	-	<4.0	<4.0	18	0.03	18	0.03	18	0.03	18	0.03	18	0.03	-	-	-
				LOR	0.1	0.1	0.1	-	0.1	0.1	2	0.02	2	0.02	10	0.005	10	0.02	10	0.02	10	0.01	0.01
S29-S01	22/06/2020	0.0 - 0.25	SAND - Brown. MFG.		7.7	5.0	2.7	Moderate	8.5	7.0	<2	<0.02	<2	<0.02	<10	0.008	----	----	<10	<0.02	330	0.53	---
S29-S02		0.25 - 0.4			7.8	5.3	2.5	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S29-S03		0.4 - 0.6			7.9	5.4	2.5	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S29-S04		0.6 - 0.85			7.6	5.1	2.5	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S29-S05		0.85 - 1.0	CLAYEY SAND - Grey		7.2	5.0	2.2	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S30-S01	22/06/2020	0.0 - 0.25	SAND - Pale brown. MFG		6.4	4.1	2.3	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S30-S02		0.25 - 0.45	SAND - Brown		7.1	4.6	2.5	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S30-S03		0.45 - 0.7	SAND - Pale brown		7.8	6.3	1.5	Moderate	7.1	6.4	<2	<0.02	<2	<0.02	<10	0.008	----	----	<10	<0.02	43	0.07	---
S30-S04		0.7 - 1.0	CLAYEY SAND - Dark Brown MFG		7.3	5.3	2.0	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S30-S05		1.0 - 1.2			7.2	5.4	1.8	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S30-S06		1.2 - 1.5	SAND - Brown. MFG. Saturated		7.3	5.7	1.6	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S31-S01	22/06/2020	0.0 - 0.25	SAND - Brown. Abundant organics		6.9	4.6	2.3	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S31-S02		0.25 - 0.5	SAND - Pale brown. MFG		7.0	5.0	2.0	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S31-S03		0.5 - 0.75			7.1	4.8	2.3	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S31-S04		0.75 - 1.0			7.1	4.8	2.3	Moderate	6.8	6.0	<2	<0.02	<2	<0.02	<10	0.006	----	----	<10	<0.02	24	0.04	---
S31-S05		1.0 -1.1			7.2	4.9	2.3	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Table C
Acid Sulfate Soil Quality Control Results

Definitions:
- (No Guideline), --- not tested, LOR (Limit of Reporting), # (Not Calculated)

Notes:
This table utilises colour coding to aid data interpretation, avoid black and white reproduction
Denotes less than LOR
Denotes exceeds %RPD criteria

Sample ID	Sample Type	Date	Analyte	Field Tests		Acidity Trail						CRS		Retained Acidity		Net Acidity		ANC-E	
				pH_F	pH_{FOX}	pH_{KCl}	pH_{OX}	TAA	S_{TAA}	TPA	S_{TPA}	aSCR	SCR	aSNAS	SNAS	SCR + STAA	SCR + STAA	ANC	ANC
			Units	pH	pH	pH	pH	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S	mht	%S
			LOR	0.1	0.1	----	----	----	----	----	----	----	----	----	----	----	----	----	----
S24-S03	Primary	17/06/2020		6.6	3.7	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SZ1	Duplicate			6.6	3.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----
RPD (%)				0	3	----	----	----	----	----	----	----	----	----	----	----	----	----	----
S20-S01	Primary	18/06/2020		5.4	2.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SZ2	Duplicate			4.8	2.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----
RPD (%)				12	0	----	----	----	----	----	----	----	----	----	----	----	----	----	----
S07-S05	Primary	19/06/2020		5.0	3.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SZ3	Duplicate			5.0	3.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----
RPD (%)				0	0	----	----	----	----	----	----	----	----	----	----	----	----	----	----
S03-S02	Primary	22/06/2020		6.2	3.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SZ4	Duplicate			6	4.5	----	----	----	----	----	----	----	----	----	----	----	----	----	----
RPD (%)				3	14	----	----	----	----	----	----	----	----	----	----	----	----	----	----
S27-S01	Primary	23/06/2020		6.6	3.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SZ5	Duplicate			5.3	3.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----
RPD (%)				22	5	----	----	----	----	----	----	----	----	----	----	----	----	----	----
S28-S01	Primary	23/06/2020		5.6	2.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SZ6	Duplicate			5.4	3.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----
RPD (%)				4	13	----	----	----	----	----	----	----	----	----	----	----	----	----	----
S18-S02	Primary	23/06/2020		4.4	2.4	4.6	4	92	0.15	183	0.29	10	0.005	----	----	94	0.15	----	----
SZ7	Duplicate			4.1	2.5	4.4	4	101	0.16	170	0.27	10	0.017	<10	<0.02	112	0.18	----	----
RPD (%)				7	4	4	0	9	6	7	7	0	109	---	---	17	18	----	----
S15-S01	Primary	23/06/2020		4.2	2.5	----	----	----	----	----	----	----	----	----	----	----	----	----	----
SZ8	Duplicate			4.2	2.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----
RPD (%)				0	4	----	----	----	----	----	----	----	----	----	----	----	----	----	----
S15-S07	Primary	23/06/2020		3.8	1.9	4.9	4	46	0.07	75	0.12	10	0.006	----	----	49	0.08	----	----
SZ9	Duplicate			3.8	2	4.9	4.3	45	0.07	60	0.10	10	0.005	----	----	45	0.07	----	----
RPD (%)				0	5	0	7	2	0	22	22	0	18	----	----	9	13	----	----
S16-S03	Primary	23/06/2020		3.8	2.1	4.7	3.9	87	0.14	138	0.22	10	0.010	----	----	93	0.15	----	----
SZ10	Duplicate			3.8	2.8	4.7	4	90	0.14	157	0.25	10	0.007	----	----	94	0.15	----	----
RPD (%)				0	29	0	3	3	0	13	13	0	35	----	----	1	0	----	----

MAKING COMPLEX EASY

Table D
Analytical Results - Miscellaneous

Definitions:

LOR (Limits of Reporting),
ND denotes not detected. - denotes no guideline. --- denotes not tested. * Denotes duplicate concentration

Notes:

TOC and moiture content which are in %, with EC in µS/cm. Table uses colour coding for data interpretation.
denotes <LOR

Sample ID	Date Sampled	Interval (m)	Sample Description	Trigger	Miscellaneous		
					Total Organic Carbon	Electrical Conductivity	Moisture Content
				Units	%	µS/cm	%
				LOR	0.5	1	1
Soils							
S02-S06	23/06/2020	1.1 - 1.4	SANDY CLAY - Dark grey, MFG, saturated		1.9	2,300	--
S03-S01	22/06/2020	0.0 - 0.1	CLAYEY SAND - Red/brown. MFG		15	2,780	--
S04-S05	22/06/2020	0.75 - 1	CLAY - Grey. Fine grained saturated		0.7	2,880	--
S05-S01	19/06/2020	0.0 - 0.3	CLAYEY SAND - Brown. MFG		2.9	--	--
S06-S06	19/06/2020	0.95 - 1.1	CLAYEY SAND - Orange. MFG		2.0	--	--
S07-S05	19/06/2020	0.9 - 1.2	CLAYEY SAND - Grey. MFG		<0.5	--	--
S10-S03	18/06/2020	0.4 - 0.6	CLAY - Dark brown		2.0	146	--
S11-S06	18/06/2020	1.25 - 1.50	CLAYEY SAND - Grey. MFG		1.0	3,060	--
S13-S03	18/06/2020	0.3 - 0.55	CLAYEY SAND - Brown. Saturated		<0.5	1,970	--
S15-S01	23/06/2020	0.0 - 0.2	SANDY CLAY - Brown. Abundant organics		4.2	2,000	--
S16-S05	23/06/2020	1.0 -1.20	SANDY CLAY - Grey. MFG, saturated		2.2	2,980	--
S17-S02	23/06/2020	0.3 - 0.6	CLAY - Grey. Moist		2.2	2,050	--
S18-S06	23/06/2020	1.25 - 1.5	CLAY - Grey. Saturated		1.5	3,370	--
S19-S04	23/06/2020	0.65 - 0.9	CLAY - Brown - some orange mottling		1.8	2,690	--
S20-S01	18/06/2020	0.0 - 0.25	SANDY CLAY - Dark brown. Abundant organics		23.5	554	--
S22-S03	22/06/2020	0.5 - 0.75	CLAY - Brown. Saturated		0.8	7,720	--
S23-S01	17/06/2020	0.0 - 0.15	CLAYEY SAND - Brown. MFG. saturated, Abundant organics		4.9	4,120	--
S25-S03	22/06/2020	0.4 - 0.6	CLAYEY SAND - Pale brown. Saturated		<0.5	2,680	--
S26-S02	22/06/2020	0.2 - 0.4	CLAY - Grey. moist		4.5	1,850	--
S27-S04	23/06/2020	0.6 - 0.8	CLAY - Grey, saturated		2.2	6,640	--
S28-S04	23/06/2020	0.75 - 1.0	SANDY CLAY - Grey/brown. Saturated		0.8	5,060	--
S29-S01	22/06/2020	0.0 - 0.25	SAND - Brown. MFG.		2.7	220	--
S31-S02	22/06/2020	0.0 - 0.25	SAND - Brown. Abundant organics		<0.5	8	--
SZ2	18/06/2020	0.0-0.25	SANDY CLAY - Dark brown. Abundant organics		3.4	691	--
SZ3	19/06/2020	0.9 - 1.2	CLAYEY SAND - Grey. MFG		<0.5	--	--
				MEAN	3.3	2656	--
				MEDIAN	2.0	2680	--
				STDEV	5.1	1998	--
				COUNT	25	21	--
				95%UCL	5.3	3510	--
Sediments							
DS1A-S01	19/06/2020	0 - 0.1	SILTY SAND - Black. MFG. Abudant		10.2	5,010	61.4
DS1-S01	19/06/2020	0 - 0.1	SILTY SAND - Black. MFG. Abudant		4.8	3,230	49.2
DS1-S02	19/06/2020	0.1 - 0.15	SILTY SAND - Black. FG. Abudant organics		4.0	3,290	43.9
DS3-S01	19/06/2020	0 - 0.1	CLAYEY SILT - Black. Abudant organics		5.1	3,320	68.0
DS5-S02	19/06/2020	0.05 - 0.1	SILTY SAND - Black. MFG. Abundant organics		10.1	936	74.0
DS7-S01	19/06/2020		SILT - Black. Saturated. Abundant organics. Gel like. Hydrogen sulfide odour on disturbance		6.6	1,040	70.2
DS9-S01	17/06/2020	0 - 0.05	ORGANIC MATTER - Dark grey		5.4	196	53.7
				MEAN	6.6	2432	60.1
				MEDIAN	5.4	3230	61.4
				STDEV	2.5	1731	11.4
				COUNT	7	7	7
				95%UCL	8.5	3714	68.5

Table E
Analytical Results - Particle Size Distribution

Definitions:

LOR (Limits of Reporting)

Notes:

All values in %

deontes <LOR

Sample ID	Date Sampled	Interval (m)	PSD	Soil Classification					Particle Sizing											
				Clay (<2 µm)	Silt (2-60 µm)	Sand (0.06-2.00 mm)	Gravel (>2 mm)	Cobbles (>6 cm)	Grain Size +75 µm	Grain Size +150 µm	Grain Size +300 µm	Grain Size +425 µm	Grain Size +600 µm	Grain Size +1180 µm	Grain Size +2.36 mm	Grain Size +4.75 mm	Grain Size +9.5 mm	Grain Size +19.0 mm	Grain Size +37.5 mm	Grain Size +75.0 mm
			LOR	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Soils																				
S04-S05	22/06/2020	0.75 - 1		39	19	42	<1	<1	38	17	9	6	2	<1	<1	<1	<1	<1	<1	<1
S06-S03	19/06/2020	0.55 - 0.7		61	19	20	<1	<1	19	9	5	3	2	<1	<1	<1	<1	<1	<1	<1
S16-S05	23/06/2020	1.0 -1.20		22	27	51	<1	<1	49	24	5	1	<1	<1	<1	<1	<1	<1	<1	<1
S17-S02	23/06/2020	0.3 - 0.6		53	38	9	<1	<1	8	4	2	1	<1	<1	<1	<1	<1	<1	<1	<1
S26-S02	22/06/2020	0.2 - 0.4		38	37	23	2	<1	23	16	11	9	7	3	<1	<1	<1	<1	<1	<1
S27-S04	23/06/2020	0.6 - 0.8		6	62	32	<1	<1	27	11	5	3	2	<1	<1	<1	<1	<1	<1	<1
S29-S01	22/06/2020	0.0 - 0.25		5	2	74	19	<1	92	88	72	53	36	23	17	10	2	<1	<1	<1
S31-S02	22/06/2020	0.25 - 0.5		2	<1	98	<1	<1	98	96	77	38	10	<1	<1	<1	<1	<1	<1	<1
			MEAN	28	26	44	3	<1	44	33	23	14	7	3	2	1	<1	<1	<1	<1
			MEDIAN	30	23	37	<1	<1	33	17	7	5	2	<1	<1	<1	<1	<1	<1	<1
			STDEV	23	20	30	7	0	34	37	32	20	12	8	6	4	1	0	0	0
			COUNT	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
			95%UCL	44	40	64	7	<1	68	59	45	28	16	9	6	4	<1	<1	<1	<1
Sediments																				
DS1A-S01	19/06/2020	0 - 0.1		43	18	30	9	<1	38	34	30	25	20	14	7	5	3	<1	<1	<1
DS1-S01	19/06/2020	0 - 0.1		15	13	68	4	<1	71	66	55	34	15	7	3	1	<1	<1	<1	<1
DS1-S02	19/06/2020	0.1 - 0.15		22	11	56	11	<1	67	64	55	38	21	13	10	8	5	<1	<1	<1
DS3-S01	19/06/2020	0 - 0.1		39	31	27	3	<1	28	16	8	6	5	4	2	2	2	<1	<1	<1
DS5-S02	19/06/2020	0.05 - 0.1		39	30	30	1	<1	27	15	10	8	6	3	<1	<1	<1	<1	<1	<1
DS7-S01	19/06/2020			16	15	67	2	<1	69	58	49	34	12	5	1	1	<1	<1	<1	<1
DS9-S01	17/06/2020			25	18	56	1	<1	54	22	9	6	3	2	<1	<1	<1	<1	<1	<1
			MEAN	28	19	48	4	<1	51	39	31	22	12	7	3	2	1	<1	<1	<1
			MEDIAN	25	18	56	3	<1	54	34	30	25	12	5	2	1	<1	<1	<1	<1
			STDEV	12	8	18	4	0	19	23	22	14	7	5	4	3	2	0	0	0
			COUNT	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
			95%UCL	37	25	61	7	<1	65	56	47	32	17	10	6	5	3	0	<1	<1

Table F
Acid Sulfate Soil Results - Drain Sediments

Definitions:

- (No Guideline), --- not tested, LOR (Limit of Reporting), Reaction Vigour (L=Slight, M=Moderate, H=Strong, X=Extreme), mht (mol H+/tonne)

Notes:

This table utilises colour coding to aid data interpretation, avoid black and white reproduction
Units are as shown

- Denotes less than LOR
- Field test value indicative of AASS
- Field test value indicative of PASS
- Denotes sample exceeds DWER Action Criteria of 0.03 (%S) or 18 mol H^+ / tonne, for excavations of >1,000 tonnes
- Denotes Bassendean Sand (BS) samples having a pH_{FOX}<3

Sample ID	Date	Interval (m)	Sample Description	Trigger	Field Tests				Acidity Trail						AVS	CRS		Retained Acidity		Net Acidity		ANC		
					pH_F	pH_{FOX}	pH Change	Reaction Vigour	pH_{KCl}	pH_{OX}	TAA	S_{TAA}	TPA	S_{TPA}	S_{AVS}	aSCR	SCR	aS_{NAS}	S_{NAS}	SCR + STAA	SCR + S_{TAA}	ANC	ANC	ANC (sieved to 0.6 mm)
				Units	pH	pH	pH	-	pH	pH	mht	%S	mht	%S	%S	mht	%S	mht	%S	mht	%S	mht	%S	%S
				ASS	<4.0	<4.0	-	-	<4.0	<4.0	18	0.03	18	0.03	0.03	18	0.03	18	0.03	18	0.03	-	-	-
				LOR	0.1	0.1	0.1	-	0.1	0.1	2	0.02	2	0.02	0.001	10	0.005	10	0.02	10	0.02	10	0.01	0.01
DS1-S01	19/06/2020	0 - 0.1	SILTY SAND - Black. MFG. Abudant organics		7.7	4.2	3.5	Extreme	8.1	6.3	<2	<0.02	<2	<0.02	0.33	568	0.91	----	----	568	0.91	644	1.03	1.18
DS1-S02		0.1 - 0.15	SILTY SAND - Black. FG. Abudant organics		7.6	5.3	2.3	Extreme	---	---	---	---	---	---	0.21	---	---	---	---	---	---	---	---	---
DS1A-S01		0 - 0.1	SILTY SAND - Black. MFG. Abudant organics		7.5	3.5	4.0	Extreme	7.0	3.2	<2	<0.02	954	1.53	0.41	1220	1.96	----	----	1220	1.96	499	0.8	---
DS3-S01	19/06/2020	0 - 0.1	CLAYEY SILT - Black. Abudant organics		7.1	2.7	4.4	Extreme	6.5	3.4	<2	<0.02	529	0.85	0.42	780	1.25	----	----	780	1.25	261	0.42	---
DS3-S02		0.1 - 0.2			7.2	2.9	4.3	Extreme	---	---	---	---	---	---	0.32	---	---	---	---	---	---	---	---	---
DS5-S01	19/06/2020	0 - 0.05	SILTY SAND - Black. MFG. Abundant organics		7.4	3.7	3.7	Extreme	6.3	2.3	18	0.03	1140	1.83	---	2170	3.48	----	----	2190	3.51	----	----	---
DS5-S02		0.05 - 0.1			7.4	3.9	3.5	Extreme	6.3	2.4	13	0.02	980	1.57	0.99	1740	2.80	----	----	1760	2.82	----	----	---
DS7-S01	19/06/2020	0.0-0.1	SILT - Black. Saturated. Abundant organics. Gel like. Hydrogen sulfide odour on		7.0	2.6	4.4	Extreme	6.8	5.0	<2	<0.02	392	0.63	0.36	284	0.455	----	----	284	0.46	167	0.27	0.15
DS7-S02		0.1-0.2	CLAYEY SAND - Dark grey. Saturated		7.1	2.8	4.3	Extreme	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
DS8-S01	17/06/2020	0 - 0.15	SANDY CLAY - Brown. MFG. Saturated		7.1	5.6	1.5	Moderate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
DS8-S02		0.15 - 0.3			7.1	5.4	1.7	Moderate	5.9	5.6	9	<0.02	<2	<0.02	---	10	0.017	----	----	19	0.03	----	----	---
DS9-S01	17/06/2020	0 - 0.05	ORGANIC MAT LAYER - Dark grey		6.9	3.5	3.4	Extreme	6.3	4.1	9	<0.02	154	0.25	---	135	0.216	----	----	144	0.23	----	----	---
DS9-S02		0.05-0.2	CLAY - Dark grey		7.4	4.0	3.4	Strong	5.7	6.5	19	0.03	<2	<0.02	0.11	18	0.029	----	----	37	0.06	19	0.03	0.05
DS9-S03		0.2-0.4			7.0	3.7	3.3	Strong	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

MAKING
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Figures

Figure A

Site location and layout

Job Number: C20088.001
Doc Number: 001
Date: 07.07.20
Scale: 1:4,000 @ A3
Created by: MA

Source: Cadastre - Landgate, 2020 Orthophoto - Landgate, Jan 2020

Document Path: G:\Jobs\C_Jobs\C20088 - DBCA Ashfield Flats ASS\Figures C20088-001\EEC20088-001_G_001_FigA Site Location and Layout_200707.mxd

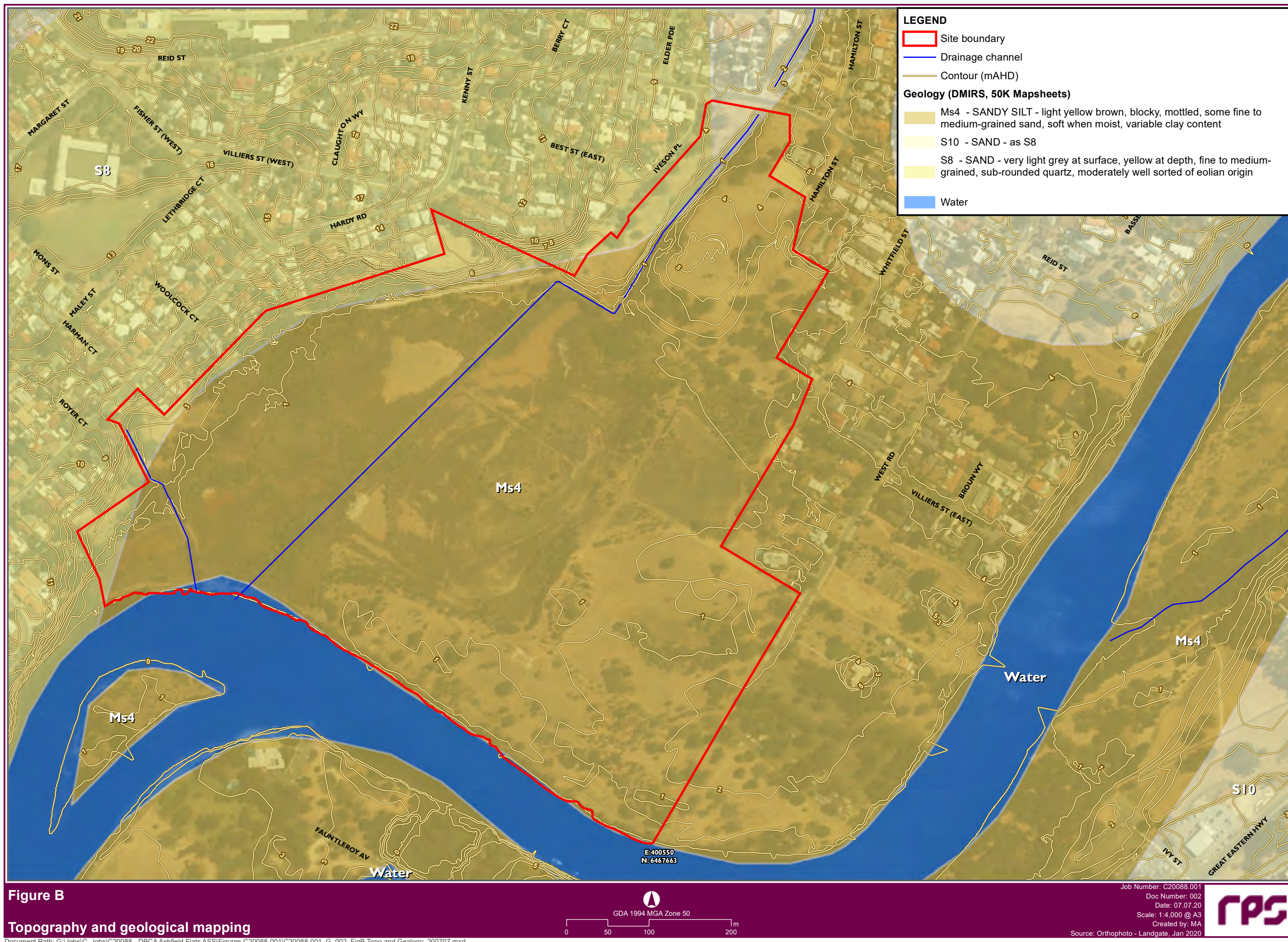

Figure B

Topography and geological mapping

Job Number: C20088.001
Doc Number: 002
Date: 07.07.20
Scale: 1:4,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, Jan 2020

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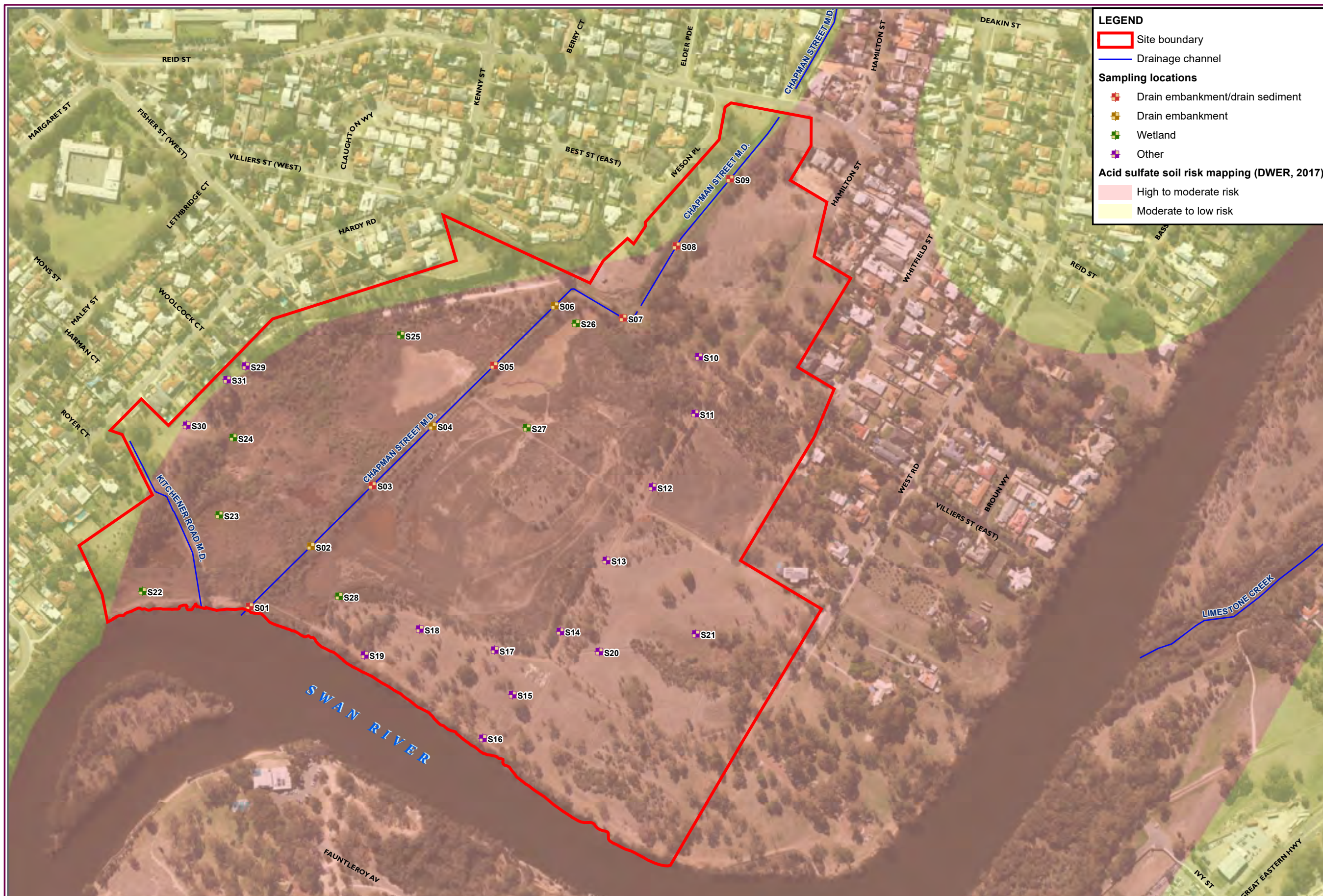

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Figure C

Acid sulfate soils risk mapping and soil/sediment sampling locations

GDA 1994 MGA Zone 50

0 50 100 200 m

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Doc Number: 002
Date: 07.07.20
Scale: 1:4,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, Jan 2020

Document Path: G:\Jobs\C_Jobs\C20088 - DBCA Ashfield Flats ASS\Figures C20088-001\C20088-001_G_003_FigC ASS mapping and Sampling_200707.mxd

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Figure D

Surface water, drainage and wetland mapping

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Doc Number: 004
Date: 07.07.20
Scale: 1:4,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, Jan 2020

Document Path: G:\Jobs\C_Jobs\C20088 - DBCA Ashfield Flats ASS\Figures C20088-001\C20088-001_G_004_FigD SW Drainage and Wetlands_200707.mxd

Soils Requiring Management	Depth (mbgl)	Net acidity excluding ANC (%S)	Liming rate (kg aglime/m3) (50% ENV)
All soils	0.0-1.0	0.21	42
	1.0-1.5	0.62	214
Drain sediments	0.00-0.5	3.51	700

Figure E

Extent of PASS identified onsite

Job Number: C20088.001
Doc Number: 005
Date: 28.07.20
Scale: 1:4,000 @ A3
Created by: MA
Source: Orthophoto - Landgate, Jan 2020

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Figure F

Total organic carbon

Job Number: C20088.001
Doc Number: 006
Date: 21.08.20
Scale: 1:3,500 @ A3
Created by: RL
Source: Orthophoto - Landgate, Jan 2020

Document Path: G:\Jobs\C_Jobs\C20088 - DBCA Ashfield Flats ASS\Figures C20088-001\C20088-001_G_006_FigF Total Organic Carbon_200821.mxd

Appendix A
Site lot details

APPENDIX A: SITE LOT DETAILS

The following table presents the lot details and certificates of title for the site.

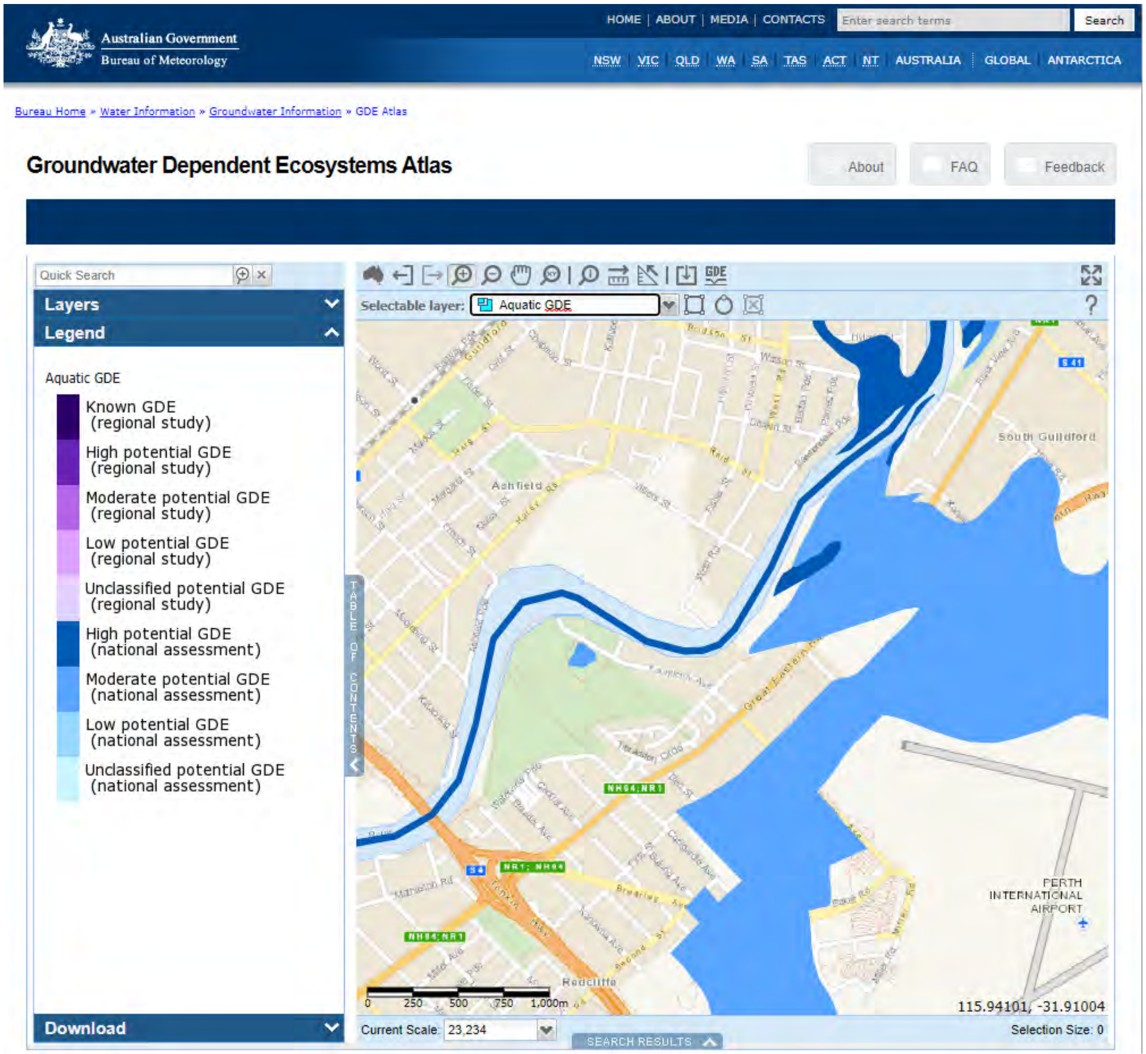
Table A.1: Site lot details

Reference Name	Ashfield Flats			
Address	Lot	Plan	Street/Road	Suburb
	8111	415024	No address	
	272	2789		
	273	2789		
	P Road Land ID Number 3440620			
	11	90002	Hamilton	Bassendean
	280	2789		
	279	2789		
	278	2789		
	277	2789		
	276	2789		
	4744	39632	Whitfield	Bassendean
	274	2789	Hamilton	Bassendean
	P Road Land ID Number 3440690			
	P Road Land ID Number 3440691			
	63	8007		
	64	8007		
	65	8007		
	66	8007		
	67	8007	No address	
	68	8007		
	69	8007		
	616	3712	Hamilton	Bassendean
	617	3712		
	301	40483	No address	
	P Road Land ID Number 3440617			
	P Road Land ID Number 3440616			
	9	70256	Kitchener	Bassendean
	P Road Land ID Number 3440678		No address	
	12074	80439	Iveson	Bassendean
	110	80439		
	108	80439		
	33	42566	No address	
	111	80439		
	821	40943	Villiers	Bassendean
	12	64959	Hardy	Bassendean

	3	64389		No address	
	667	3767			
	668	3767			
	50	34948			
	34	8362			
	P Road Land ID Number 3879327				
	1092	4989		Ashfield Parade	Ashfield
	4690	161897			
	1094	4989			
	1095				
	1096				
	1097				
Certificate of Title	**Lot**	**Volume**	**Folio**	**Current Owners**	
	8111	2976	919	Town of Bassendean	
	272	1927	936		
	273	1910	772	Shire of Bassendean	
	P Road Land ID Number 3440620			Town of Bassendean	
	11	2061	888		
	280	262	40A		
	279	264	143A		
	278	264	142A		
	277	1814	714		
	276	1814	714		
	4744	LR3126	621	State of Western Australia	
	274	1014	968	Town of Bassendean	
	P Road Land ID Number 3440690				
	P Road Land ID Number 3440691				
	63	1755	666	Town of Bassendean	
	64	1755	666		
	65	1755	666		
	66	1108	906		
	67	1320	314		
	68	1320	313		
	69	1755	666		
	616	1286	213	WA Planning Commission	
	617	1286	213		

	301	2573	898	Western Australia Planning Commission
	P Road Land ID Number 3440617			
	P Road Land ID Number 3440616			
	9	2090	582	Water Corporation
	P Road Land ID Number 3440678			
	12074	3104	546	State of Western Australia
	110	1927	944	Water Corporation
	108	1927	942	Town of Bassendean
	33	1893	89	Water Corporation
	111	1927	945	Water Corporation
	821	2584	600	Western Australia Planning Commission
	12	1655	476	Town of Bassendean
	3	1639	409	
	667	1546	914	
	668	1546	914	
	50	84	146A	Water Corporation
	34	1546	913	
	P Road Land ID Number 3879327			
	1092	1266	585	Robert Alan Deering
	4690	1126	528	Western Australia Planning Commission
	1094	1071	576	Metropolitan Region Planning Authority
	1095	1071	576	
	1096	1071	576	
	1097	1106	862	Town of Bassendean

Appendix B
Groundwater dependent ecosystems search results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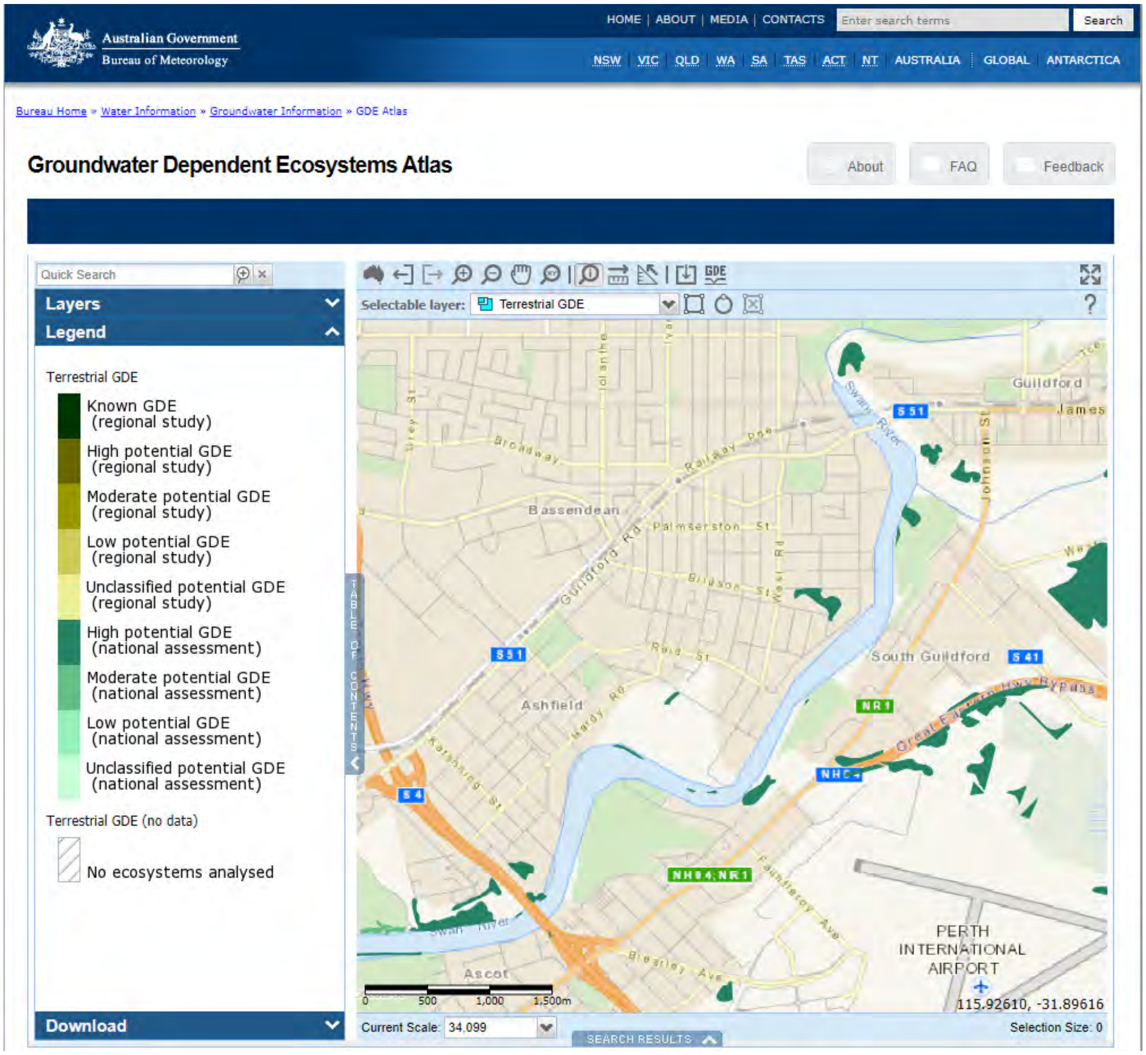
Aquatic GDE
Known GDE (regional study)
High potential GDE (regional study)
Moderate potential GDE (regional study)
Low potential GDE (regional study)
Unclassified potential GDE (regional study)
High potential GDE (national assessment)
Moderate potential GDE (national assessment)
Low potential GDE (national assessment)
Unclassified potential GDE (national assessment)
Download
Selectable layer:
Aquatic GDE
South Guildford
Ashfield
PERTH INTERNATIONAL AIRPORT
Redcliffe
0 250 500 750 1,000m
115.94101, -31.91004
Current Scale: 23,234
SEARCH RESULTS
Selection Size: 0



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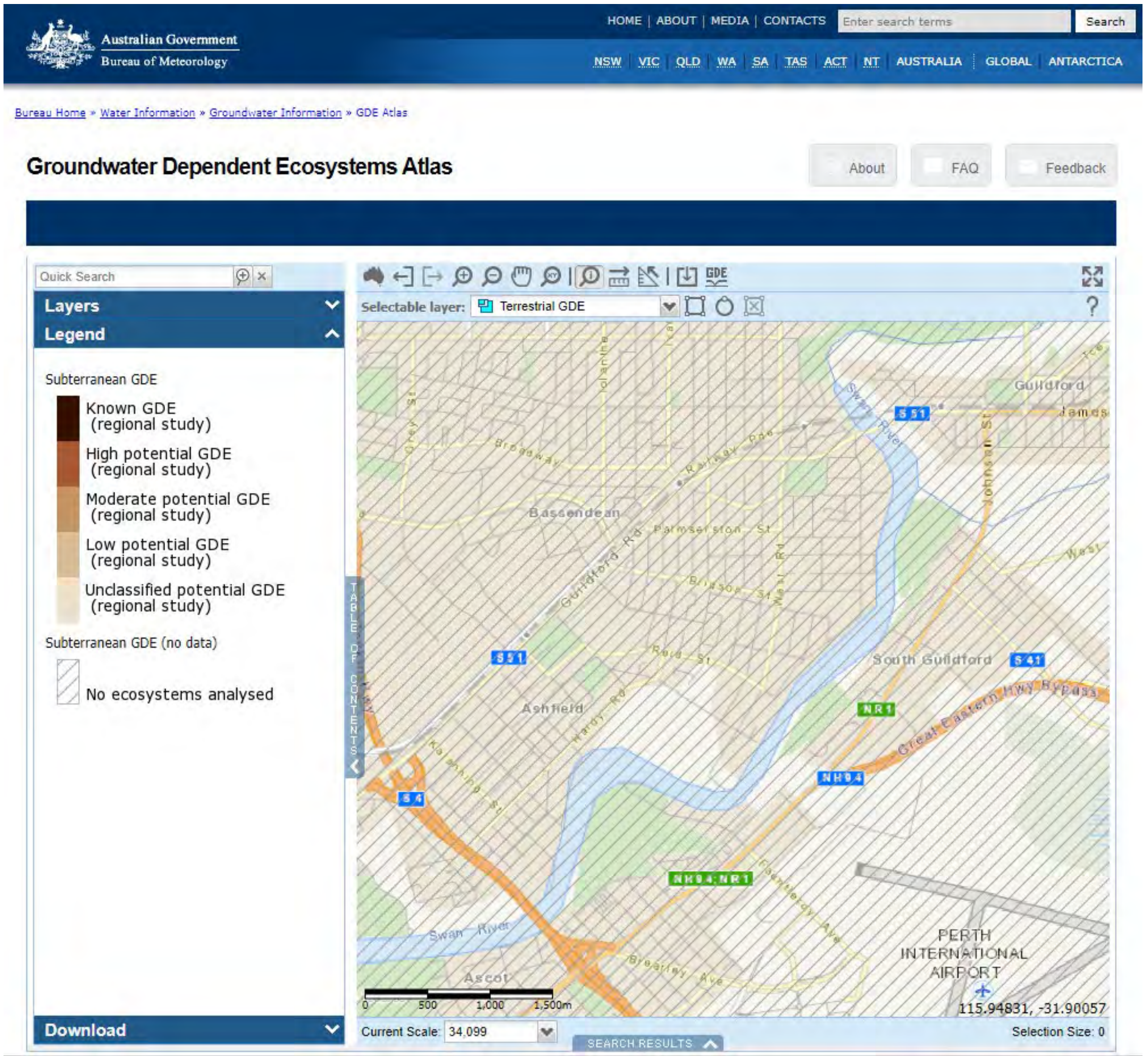
Terrestrial GDE
Known GDE (regional study)
High potential GDE (regional study)
Moderate potential GDE (regional study)
Low potential GDE (regional study)
Unclassified potential GDE (regional study)
High potential GDE (national assessment)
Moderate potential GDE (national assessment)
Low potential GDE (national assessment)
Unclassified potential GDE (national assessment)
Terrestrial GDE (no data)
No ecosystems analysed
Download
Selectable layer: Terrestrial GDE
Guildford
Bassendean
Palmerston St
South Guildford
Ashfield
Ascot
PERTH INTERNATIONAL AIRPORT
Swan River
0 500 1,000 1,500m
115.92610, -31.89616
Current Scale: 34,099
SEARCH RESULTS
Selection Size: 0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Legend
Subterranean GDE
Known GDE (regional study)
High potential GDE (regional study)
Moderate potential GDE (regional study)
Low potential GDE (regional study)
Unclassified potential GDE (regional study)
Subterranean GDE (no data)
No ecosystems analysed
Download
Selectable layer: Terrestrial GDE
Guildford
Bassendean
South Guildford
Ashfield
Swan River
Ascot
PERTH INTERNATIONAL AIRPORT
Great Eastern Hwy Bypass
0 500 1,000 1,500m
115.94831, -31.90057
Current Scale: 34,099
SEARCH RESULTS
Selection Size: 0

Appendix C
NatureMap search results

NatureMap
Mapping Western Australia's biodiversity

map

Printed by Guest user on 10/6/2020

Query details : Current Names Only=Yes; Core Datasets Only=Yes; Method='By Circle'; Centre=115° 56' 50'' E,31° 55' 09'' S; Buffer=2km;

Search Results

Selected

- Selected Species

All Results

- Default
- Confirmed
- Corrected
- Reported

Reference Layers

Major WA Towns

Major WA Towns

Major WA Towns

State Borders

Department of Biodiversity, Conservation and Attractions
NatureMap is a collaborative project of the Department of Biodiversity, Conservation and Attractions, Western Australia, and the Western Australian Museum.

NatureMap Species Report

Created By Guest user on 09/06/2020

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 56' 50'' E,31° 55' 09'' S
Buffer 2km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24262	*Acanthiza inornata (Western Thornbill)*			
4.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
5.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
6.	25536	*Accipiter fasciatus (Brown Goshawk)*			
7.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
8.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
9.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
10.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
11.	2648	*Alternanthera denticulata (Lesser Joyweed)*			
12.	13267	*Amyema linophylla subsp. linophylla*			
13.	24310	*Anas castanea (Chestnut Teal)*			
14.	24311	*Anas clypeata (Northern Shoveler)*			Y
15.	24312	*Anas gracilis (Grey Teal)*			
16.	24313	*Anas platyrhynchos (Mallard)*			
17.		*Anas platyrhynchos subsp. domesticus*			
18.	24315	*Anas rhynchotis (Australasian Shoveler)*			
19.	24316	*Anas superciliosa (Pacific Black Duck)*			
20.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
21.		*Anser anser*			
22.	24561	*Anthochaera carunculata (Red Wattlebird)*			
23.	12040	*Apium prostratum subsp. prostratum var. prostratum (Sea Celery)*			
24.	41324	*Ardea modesta (great egret, white egret)*			
25.	24340	*Ardea novaehollandiae (White-faced Heron)*			
26.	24341	*Ardea pacifica (White-necked Heron)*			
27.	226	*Arundo donax (Giant Reed)*	Y		
28.	20283	*Astartea scoparia (Common Astartea)*			
29.	44679	*Auranticarpa rhombifolia*	Y		Y
30.	233	*Avena barbata (Bearded Oat)*	Y		
31.	24318	*Aythya australis (Hardhead)*			
32.		*Badumna insignis*			
33.	32315	*Barbula calycina*			
34.		*Barnardius zonarius*			
35.	24319	*Biziura lobata (Musk Duck)*			
36.	48689	*Bolboschoenus fluviatilis*		P1	
37.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
38.	25716	*Cacatua sanguinea (Little Corella)*			
39.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
40.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
41.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
42.	1276	*Caesia micrantha (Pale Grass Lily)*			
43.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
44.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)*		T	
45.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo, White-tailed Long-billed Black Cockatoo)*		T	
46.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)*		T	
47.	48400	*Calyptorhynchus sp. (white-tailed black cockatoo)*		T	
48.	32338	*Campylopus introflexus*	Y		
49.		*Carassius auratus*			
50.	18321	*Casuarina glauca*	Y		
51.	1742	*Casuarina obesa (Swamp Sheoak, Kuli)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
52.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
53.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
54.	24980	*Christinus marmoratus (Marbled Gecko)*			
55.		*Chroicocephalus novaehollandiae*			
56.	24288	*Circus approximans (Swamp Harrier)*			
57.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
58.	24399	*Columba livia (Domestic Pigeon)*	Y		
59.	6347	*Conostephium minus (Pink-tipped Pearl flower)*			
60.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
61.	25592	*Corvus coronoides (Australian Raven)*			
62.	25595	*Cracticus tibicen (Australian Magpie)*			
63.	25596	*Cracticus torquatus (Grey Butcherbird)*			
64.	24322	*Cygnus atratus (Black Swan)*			
65.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
66.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
67.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
68.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
69.		*Egretta novaehollandiae*			
70.		*Elanus axillaris*			
71.	25250	*Elapognathus coronatus (Crowned Snake)*			
72.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
73.		*Eolophus roseicapillus*			
74.	6132	*Epilobium ciliatum*	Y		
75.	6133	*Epilobium hirtigerum (Hairy Willow Herb)*			
76.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
77.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
78.	25623	*Falco longipennis (Australian Hobby)*			
79.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
80.	20216	*Ficinia nodosa (Knotted Club Rush)*			
81.	25727	*Fulica atra (Eurasian Coot)*			
82.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
83.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
84.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
85.	20505	*Gastrolobium celsianum*			
86.	25530	*Gerygone fusca (Western Gerygone)*			
87.	24443	*Grallina cyanoleuca (Magpie-lark)*			
88.	24295	*Haliastur sphenurus (Whistling Kite)*			
89.	1526	*Hesperantha falcata*	Y		
90.	25734	*Himantopus himantopus (Black-winged Stilt)*			
91.	24491	*Hirundo neoxena (Welcome Swallow)*			
92.	24215	*Hydromys chrysogaster (Water-rat, Rakali)*		P4	
93.	48587	*Hydroprogne caspia (Caspian Tern)*		IA	
94.		*Hypoblemum sp.*			Y
95.	6620	*Ipomoea cairica (Coast Morning Glory)*	Y		
96.	6630	*Ipomoea indica (Morning Glory)*	Y		
97.	48588	*Isoodon fusciventer (Quenda, southwestern brown bandicoot)*		P4	
98.	1185	*Juncus kraussii (Sea Rush)*			
99.	1188	*Juncus pallidus (Pale Rush)*			
100.	6733	*Lantana camara (Common Lantana)*	Y		
101.		*Latrodectus hasselti*			
102.	11911	*Laxmannia ramosa subsp. ramosa*			
103.	25005	*Lialis burtonis*			
104.	25661	*Lichmera indistincta (Brown Honeyeater)*			
105.		*Lophoictinia isura*			
106.	2396	*Lysiana casuarinae*			
107.	25654	*Malurus splendens (Splendid Fairy-wren)*			
108.	25758	*Megalurus gramineus (Little Grassbird)*			
109.	5987	*Melaleuca viminea (Mohan)*			
110.	24598	*Merops ornatus (Rainbow Bee-eater)*			
111.		*Microcarbo melanoleucos*			
112.		*Missulena granulosa*			
113.	6970	*Nicandra physalodes (Apple of Peru)*	Y		
114.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
115.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
116.		*Oecobius navus*			
117.		*Opopaea sp.*			Y
118.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
119.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
120.	48591	*Pandion cristatus (Osprey, Eastern Osprey)*		IA	
121.		*Papillogobius punctatus*			

NatureMap
Mapping Western Australia's biodiversity

	Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area[1]
122.	3618	*Paraserianthes lophantha (Albizia)*			
123.	25253	*Parasuta gouldii*			
124.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
125.	25682	*Pardalotus striatus (Striated Pardalote)*			
126.	25687	*Passer domesticus (House Sparrow)*	Y		
127.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
128.	48060	*Petrochelidon ariel (Fairy Martin)*			
129.	48061	*Petrochelidon nigricans (Tree Martin)*			
130.	48066	*Petroica boodang (Scarlet Robin)*			
131.	24659	*Petroica goodenovii (Red-capped Robin)*			
132.	2299	*Petrophile linearis (Pixie Mops)*			
133.	25697	*Phalacrocorax carbo (Great Cormorant)*			
134.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
135.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
136.	25699	*Phalacrocorax varius (Pied Cormorant)*			
137.	24409	*Phaps chalcoptera (Common Bronzewing)*			
138.	18529	*Philotheca spicata (Pepper and Salt)*			
139.	1478	*Phlebocarya ciliata*			
140.	48071	*Phylidonyris niger (White-cheeked Honeyeater)*			
141.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
142.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
143.	25720	*Platycercus icterotis (Western Rosella)*			
144.	24680	*Podiceps cristatus subsp. australis (Great Crested Grebe)*			
145.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
146.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
147.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
148.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
149.	48675	*Pterostylis atrosanguinea*			
150.	1698	*Pterostylis vittata (Banded Greenhood)*			
151.		*Purpureicephalus spurius*			
152.	48096	*Rhipidura albiscapa (Grey Fantail)*			
153.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
154.	20063	*Salix babylonica*	Y		
155.	48834	*Schinus terebinthifolia*	Y		
156.		*Scytodes thoracica*			
157.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
158.		*Smeringopus natalensis*			
159.		*Smeringopus natalensis?*			Y
160.	30948	*Smicrornis brevirostris (Weebill)*			
161.	617	*Sorghum halepense (Johnson Grass)*	Y		
162.		*Steatoda grossa*			
163.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
164.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
165.	2639	*Suaeda australis (Seablite)*			
166.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
167.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
168.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
169.	33236	*Tecticornia halocnemoides (Shrubby Samphire)*			
170.	33319	*Tecticornia indica subsp. bidens*			
171.	31718	*Tecticornia lepidosperma*			
172.	48597	*Thalasseus bergii (Crested Tern)*		IA	
173.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
174.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
175.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
176.	24158	*Trichosurus vulpecula subsp. vulpecula (Common Brushtail Possum)*			
177.	17763	*Trifolium campestre var. campestre (Hop Clover)*	Y		
178.		*Urodacus novaehollandiae*			
179.	24386	*Vanellus tricolor (Banded Lapwing)*			
180.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
181.	8257	*Vellereophyton dealbatum (White Cudweed)*	Y		
182.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			
183.		*unknown unknown*			Y

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D
Soil/sediment sampling logs

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Light Rain	**Time:**	1:00 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	
Sampling area:	Drain embankment/Drain sediment	**Total depth (mbgl):**	1 (poor recovery at 0.8)	**Depth to water (mbgl):**	~0.05
Sampling location:	S01	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	22.6.20	**Fill thickness (m):**			

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.1	**CLAYEY SAND**	Dark Brown	Medium Fine Grain	Moist	Some	Low plasticity	Natural	Roots	S01-S01	0 - 0.1	7.2	5.3	Moderate	0.07
0.1 - 0.45	**SANDY CLAY**	Dark Brown	Fine Grain	Saturated	None	Intermediate plasticity	Natural	Softer at depth and some orange mottling from 0.3 mbgl	S01-S02	0.1 - 0.3	6.8	4.7	Moderate	---
									S01-S03	0.3 - 0.45	6.2	4.3	Moderate	---
0.45 - 1	**CLAY**	Dark Brown	Fine Grain	Saturated	None	Soft	Natural	Grey/Dark brown colouring	S01-S04	0.45 - 0.75	6.7	4.6	Strong	0.05
									S01-S05	0.75 - 1	6.6	4.4	Moderate	---
19.6.20 - 15:10														
Drain sediment														
0 - 0.1	**SILTY SAND**	Black	Medium Fine Grain	Saturated	Abundant	Very Soft	Natural	Possibly MBO - sampled from base of drain - approx 0.3 m below water	DS1_S01	0 - 0.1	7.7	4.2	Extreme	0.91
0.1 - 0.15	**SILTY CLAY**	Black	Fine Grain	Saturated	Abundant	Very Soft	Natural		DS1_S02	0.1 - 0.15	7.6	5.3	Extreme	---
									DS1A_S01	0 - 0.1	7.5	3.5	Extreme	1.96

Additional details / comments:

Legend	
	Inferred actual acid sulfate soil (AASS)
	Inferred potential acid sulfate soil (PASS)
	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Sunny	**Time:**	9:00 AM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	—
Sampling area:	Drain embankment	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	~ 0.1
Sampling location:	S02	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	23.06.2020	**Fill thickness (m):**	—-		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.1	**CLAYEY SAND**	Red/brown	Medium Fine Grain	Moist	Some	Soft	Natural	Roots	S02-S01	0.0-0.1	6.5	4.4	Moderate	---
0.1 - 0.95	**CLAY**	Dark Grey	Fine Grain	Saturated	Trace	Intermediate plasticity	Natural	Trace orange/yellow mottling - roots to 0.3 mbgl. Becoming softer after 0.95 mbgl	S02-S02	0.1-0.4	6.9	4.9	Moderate	---
0.95 - 1.5	**SANDY CLAY**	Dark Grey	Medium Fine Grain	Saturated	None	Low plasticity	Natural		S02-S03	0.4-0.7	6.2	3.4	Moderate	---
									S02-S04	0.7-0.95	6.7	3.1	Strong	0.21
									S02-S05	0.95-1.1	6.9	3.2	Strong	---
									S02-S06	1.1-1.4	6.9	3.1	Strong	---
									S02-S07	1.4-1.5	6.9	2.7	Strong	0.14

Additional details / comments:

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(green)	Inferred potential acid sulfate soil (PASS)
(yellow)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Light Rain	**Time:**	3:00 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	SZ4 @ S02
Sampling area:	Drain embankment/Drain sediment	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	~0.1
Sampling location:	S03	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date		**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.1	**CLAYEY SAND**	Red/brown	Medium Fine Grain	Moist	Some	Soft	Natural	Roots	S03-S01	0 - 0.1	6.3	3.8	Moderate	0.07
0.1 - 0.75	**CLAY**	Dark Grey	Fine Grain	Moist	Trace	Intermediate plasticity	Natural	Trace orange mottling - roots to 0.3	S03-S02	0.1 - 0.3	6.2	3.9	Moderate	---
									S03-S03	0.3 - 0.5	6.2	4.3	Moderate	---
									S03-S04	0.5 - 0.75	6.2	3.8	Moderate	---
0.75 - 1.5	**CLAY**	Grey	Fine Grain	Saturated	None	Soft	Natural	Some yellow/orange mottling - poor recovery from 1.0 mbgl	S03-S05	0.75 - 1	6.4	5.0	Strong	---
									S03-S06	1 - 1.25	6.7	4.2	Strong	---
									S03-S07	1.25 - 1.5	6.6	3.8	Strong	---
14:20 - 19.6.20														
Drain sediment														
0 - 0.2	**CLAYEY SILT**	Black	Very Fine Grain	Saturated	Abundant	Very Soft	Natural	Predominantly silt with some clay, possibly from bank wall - collected from side of bank at approx 0.5 mbgl - some H2S odour, but mostly organic - potential MBO	DS3_S01	0 - 0.1	7.1	2.7	Extreme	1.25
								Clay not sampled - black silty material only	DS3_S02	0.1 - 0.2	7.2	2.9	Extreme	---

Additional details / comments:	Legend	
		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Light Rain	**Time:**	2:00 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Drain embankment	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	~0.75
Sampling location:	S04	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	22.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.1	CLAYEY SAND	Red/brown	Medium Fine Grain	Moist	Some	Soft	Natural	Roots	S04-S01	0 - 0.1	6.5	4.0	Moderate	---
0.1 - 0.75	CLAY	Dark Grey	Fine Grain	Moist	Trace	Intermediate plasticity	Natural	Trace orange mottling - roots to 0.3	S04-S02	0.1 - 0.3	6.4	4.3	Moderate	0.04
									S04-S03	0.3 - 0.5	6.4	4.3	Moderate	---
									S04-S04	0.5 - 0.75	6.4	4.8	Moderate	---
0.75 - 1.5	CLAY	Grey	Fine Grain	Saturated	None	Soft	Natural	Some yellow/orange mottling - poor recovery from 1.1	S04-S05	0.75 - 1	6.7	4.3	Strong	---
									S04-S06	1 - 1.25	6.6	3.9	Strong	---
									S04-S07	1.25 - 1.5	6.4	3.1	Strong	---

Additional details / comments:

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(green)	Inferred potential acid sulfate soil (PASS)
(yellow)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Light Rain	**Time:**	12:00 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	
Sampling area:	Drain embankment/Drain sediment	**Total depth (mbgl):**	0.8	**Depth to water (mbgl):**	0.2
Sampling location:	S05	**Refusal (Y/N):**	Y	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	19.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.3	**CLAYEY SAND**	Brown	Medium Fine Grain	Moist	None	Soft	Natural	Some orange/red mottling	S05-S01	0 - 0.3	6.2	4.3	Moderate	---
0.3 - 0.8	**CLAY**	Dark Brown	Fine Grain	Saturated	None	Intermediate plasticity	Natural	Slight dark grey colouring	S05-S02	0.3 - 0.55	5.9	4.0	Moderate	---
									S05-S03	0.55 - 0.8	6.5	3.5	Strong	0.06
Drain Sediment														
0 - 0.1	**SILTY SAND**	Black	Medium Fine Grain	Saturated	Abundant	Very Soft	Natural	Gel-like consistency - potential MBO - sample taken from approx 0.4 mbgl on side of bank	DS5_S01	0 - 0.05	7.4	3.7	Extreme	3.51
								PSD, AVS, TOC taken at DS5_S02	DS5_S02	0.05 - 0.1	7.4	3.9	Extreme	2.82

Additional details / comments:	Legend	
		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Light Rain	**Time:**	10:45 AM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Drain embankment	**Total depth (mbgl):**	1.3	**Depth to water (mbgl):**	~0.5
Sampling location:	S06	**Refusal (Y/N):**	Y	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	19.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.3	**CLAYEY SAND**	Brown	Medium Fine Grain	Moist	Trace	Firm	Natural	Trace orange mottling - roots	S06-S01	0 - 0.3	6.4	3.4	Moderate	0.03
0.3 - 0.7	**SANDY CLAY**	Dark Brown	Fine Grain	Moist	None	Intermediate plasticity	Natural	Hard clay	S06-S02	0.3 - 0.55	6.7	3.9	Moderate	---
									S06-S03	0.55 - 0.7	7.5	5.4	Moderate	---
0.7 - 0.8	**CLAYEY SAND**	Grey	Medium Fine Grain	Moist	None	Intermediate plasticity	Natural	Orange mottling	S06-S04	0.7 - 0.8	7.1	5.3	Moderate	---
0.8 - 1.1	**CLAYEY SAND**	Orange	Medium Fine Grain	Saturated	None	Soft	Natural	Some grey sand - trace gravels	S06-S05	0.8 - 0.95	7.4	5.0	Moderate	0.02
									S06-S06	0.95 - 1.1	7.0	5.3	Slight	---
1.1 - 1.3	**SANDY CLAY**	Grey	Medium Fine Grain	Saturated	None	Low plasticity	Natural		S06-S07	1.1 - 1.3	6.8	3.4	Strong	---

Additional details / comments:

Legend

	Inferred actual acid sulfate soil (AASS)
	Inferred potential acid sulfate soil (PASS)
	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Sunny	**Time:**	8:30 AM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	SZ-3 @ S05
Sampling area:	Drain embankment/Drain sediment	**Total depth (mbgl):**	2 (no recovery after 1.5)	**Depth to water (mbgl):**	0.4
Sampling location:	S07	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	19.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.4	**CLAYEY SAND**	Dark Brown	Medium Fine Grain	Moist	Some	Low plasticity	Natural	Some orange mottling from approx 0.25m	S07-S01	0- 0.2	5.3	3.2	Extreme	---
									S07-S02	0.2 - 0.4	6.4	3.7	Extreme	---
0.4 - 0.9	**SANDY CLAY**	Dark Brown	Medium Fine Grain	Saturated	Trace	Intermediate plasticity	Natural	Roots - some lower plasticity soil in profile (more sand)	S07-S03	0.4 - 0.65	5.8	3.3	Extreme	---
									S07-S04	0.65 - 0.9	5.6	3.0	Moderate	0.11
0.9 - 1.5	**CLAYEY SAND**	Grey	Medium Fine Grain	Saturated	None	Low plasticity	Natural	Orange mottling from 0.9 - 1.4 mbgl	S07-S05	0.9 - 1.2	5.0	3.2	Strong	---
									S07-S06	1.2 - 1.5	5.7	3.2	Strong	---
Drain Sediment														
0.0-0.1	**CLAYEY SAND**	Dark Grey	Medium Fine Grain	Saturated	Some	Soft	Natural	Collected from bottom of drain - refusal at clay layer	DS7-S01	0.0-0.1	7.0	2.6	Extreme	0.46
0.1-0.2	**SILT**	Black	Fine Grain	Saturated	Abundant	Very Soft	Natural	Gel-like consistency - some H2S and organic odour, particularly from disturbance when sampling -potential MBO - collected from drain bank at approx 0.4 mbgl	DS7-S02	0.1-0.2	7.1	2.8	Extreme	---

Additional details / comments:	Legend	
Ceramtic tile noted in surrounding area-potential fill soils		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Heavy Rain	**Time:**	3:00 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Drain embankment	**Total depth (mbgl):**	0.6	**Depth to water (mbgl):**	---
Sampling location:	S08	**Refusal (Y/N):**	Y	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	17.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.3	**SILTY CLAY**	Brown	Fine Grain	Moist	Trace	Low plasticity	Disturbed		S08-S01	0 - 0.3	5.2	3.1	Moderate	0.06
0.3 - 0.6	**CLAY**	Dark Brown	Fine Grain	Wet	Trace	Intermediate plasticity	Natural		S08-S02	0.3 - 0.6	5.8	4.1	Moderate	---
0 - 0.3	**SANDY CLAY**	Brown	Medium Fine Grain	Saturated	Some	Intermediate plasticity	Natural	Yellow/orange sand throughout - thick organic mat layer to 0.05	DS8_S01	0 - 0.15	7.1	5.6	Moderate	---
									DS8_S02	0.15 - 0.3	7.1	5.4	Moderate	0.03

Additional details / comments:	**Legend**	
		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Heavy Rain	**Time:**	1:30
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Drain embankment/Drain sediment	**Total depth (mbgl):**	0.8	**Depth to water (mbgl):**	0.5
Sampling location:	S09	**Refusal (Y/N):**	Y	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	17.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.15	**SILTY SAND**	Brown	Medium Fine Grain	Dry	Trace	Soft	Disturbed		S09-S01	0.0 - 0.15	4.2	3.1	Strong	---
0.15 - 0.3	**CLAYEY SAND**	Red/brown	Medium Fine Grain	Dry	Trace	Firm	Disturbed		S09-S02	0.15 - 0.3	4.8	2.8	Moderate	0.08
0.3 - 0.6	**SANDY CLAY**	Dark Grey	Fine Grain	Wet	None	Intermediate plasticity	Natural		S09-S03	0.3 - 0.6	6.0	4.6	Moderate	0.03
0.6 - 0.8	**CLAY**	Grey	Fine Grain	Saturated	None	Intermediate plasticity	Natural		S09-S04	0.6 - 0.8	6.7	5.5	Moderate	---
Sediment														
0 - 0.05	**Organic material layer**	Dark Grey		Saturated	Abundant		Natural	Strong organic odour throughout profile	S01	0.0-0.05	6.9	3.5	Extreme	0.23
0.05 - 0.4	**Clay**	Dark Grey	Medium Fine Grain	Saturated	Trace	Intermediate plasticity	Natural		S02	0.05-0.2	7.4	4.0	Strong	0.03
									S03	0.2-0.4	7.0	3.7	Strong	---

Additional details / comments:

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(green)	Inferred potential acid sulfate soil (PASS)
(yellow)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Light Rain	**Time:**	8:30
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	0.9
Sampling location:	S10	**Refusal (Y/N):**	Y	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	18.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.1	**CLAYEY SAND**	Brown	Medium Fine Grain	Moist	Trace	Soft	Natural	Some grass roots	S10-S01	0 - 0.1	7.0	3.1	Moderate	<0.02
0.1 - 0.4	**SANDY CLAY**	Brown	Medium Fine Grain	Moist	None	Low plasticity	Natural	P.brown/red sand throughout - brown clays	S10-S02	0.1 - 0.4	7.2	4.1	Moderate	---
0.4 - 0.6	**CLAY**	Dark Brown	Fine Grain	Moist	None	Intermediate plasticity	Natural		S10-S03	0.4 - 0.6	6.7	4.5	Moderate	---
0.6 - 0.9	**CLAY**	Brown	Fine Grain	Wet	None	Intermediate plasticity	Natural		S10-S04	0.6 - 0.9	7.7	6.0	Moderate	---
0.9 - 1.15	**SANDY CLAY**	P.Brown/ orange	Medium Fine Grain	Saturated	Trace	Low plasticity	Natural	Trace roots	S10-S05	0.9 - 1.15	7.4	6.1	Slight	---
1.15 - 1.5	**SANDY CLAY**	Dark Grey	Medium Fine Grain	Saturated	None	Intermediate plasticity	Natural	Discoloured by P.brown sand in hole (fallback) - some orange mottling	S10-S06	1.15 - 1.5	7.8	7.2	Strong	<0.02

Additional details / comments:

Legend

- Inferred actual acid sulfate soil (AASS)
- Inferred potential acid sulfate soil (PASS)
- Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Light Rain	**Time:**	11:00 AM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	~0.3
Sampling location:	S11	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	18/06/2020	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.3	**CLAY**	Brown	Fine Grain	Saturated	Abundant	Low plasticity	Natural		S11-S01	0.0 - 0.3	6.0	3.4	Moderate	---
0.3 - 1.0	**CLAY**	Grey	Fine Grain	Saturated	Trace	Intermediate plasticity	Natural	trace gravels, orange mottling throughout, mottling abundant at 0.3 - 0.5 mbgl	S11-S02	0.3 - 0.5	5.3	3.0	Moderate	0.06
									S11-S03	0.5 - 0.75	5.9	4.1	Moderate	---
									S11-S04	0.75 - 1.0	6.5	4.6	Moderate	---
1.0 -1.5	**CLAYEY SAND**	Grey	Medium Fine Grain	Saturated	None	Soft	Natural		S11-S05	1.0 - 1.25	6.6	3.3	Strong	---
									S11-S06	1.25 - 1.50	6.7	1.7	Strong	0.62

Additional details / comments:

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(dark green)	Inferred potential acid sulfate soil (PASS)
(yellow)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Heavy Rain	**Time:**	10:15
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	0.3
Sampling location:	S12	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	18/06/2020	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.1	**SILTY SAND**	Dark Brown	Medium Fine Grain	Wet	Some	Soft	Natural	Roots	S12-S01	0 - 0.1	5.8	3.2	Moderate	---
0.1 - 0.6	**CLAY**	Brown	Fine Grain	Saturated	Trace	Intermediate plasticity	Natural	Trace roots	S12-S02	0.1 - 0.6	5.2	2.8	Moderate	---
0.6 - 1.5	**CLAY**	Grey	Fine Grain	Saturated	None	Low plasticity	Natural	Trace orange sand, more sand, compaction and poor recovery from 0.6 - 1mbgl	S12-S03	0.6 - 0.75	5.2	3.2	Moderate	---
									S12-S04	0.75 - 1.0	5.0	3.0	Moderate	---
									S12-S05	1.0 - 1.25	4.7	2.3	Moderate	0.11
									S12-S06	1.25 - 1.5	4.6	2.4	Moderate	---

Additional details / comments:

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(green)	Inferred potential acid sulfate soil (PASS)
(yellow)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Light Rain	**Time:**	3:10
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	0.3
Sampling location:	S13	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	18.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.1	**CLAYEY SAND**	Brown	Medium Fine Grain	Moist	Trace	Soft	Natural	Roots	S13-S01	0 - 0.1	4.8	2.6	Moderate	---
0.1 - 0.3	**SANDY CLAY**	Brown	Medium Fine Grain	Wet	None	Low plasticity	Natural		S13-S02	0.1 - 0.3	4.4	2.3	Moderate	---
0.3 - 0.8	**CLAYEY SAND**	Brown	Medium Fine Grain	Saturated	None	Soft	Natural	Orange mottling from 0.5 - 1.0 mbgl	S13-S03	0.3 - 0.55	4.3	2.4	Moderate	---
									S13-S04	0.55 - 0.8	4.1	1.9	Moderate	---
0.8 - 1.5	**SAND**	Pale Brown	Medium Fine Grain	Saturated	None	Soft	Natural	Poor recovery from 1 - 1.5 mbgl due to saturation - no recovery from 1.3 mbgl	S13-S05	0.8 - 1	3.8	2.0	Slight	0.04
									S13-S06	1 - 1.3	4.0	2.2	Slight	---

Additional details / comments:	**Legend**	
		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Light Rain	**Time:**	4:05
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	0.3
Sampling location:	S14	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	18.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.4	**SANDY CLAY**	Dark Brown	Medium Fine Grain	Moist	Some	Soft	Natural	Roots	S14-S01	0.0 - 0.2	5.0	2.6	Moderate	---
									S14-S02	0.2 - 0.4	4.9	2.4	Strong	---
0.4 - 0.7	**CLAY**	Dark Grey	Fine Grain	Saturated	None	High plasticity	Natural	Some orange mottling	S14-S03	0.4 - 0.7	4.3	2.6	Slight	---
0.7 - 1.0	**CLAYEY SAND**	Grey	Medium Fine Grain	Saturated	None	Soft	Natural	Abundant orange mottling. No recovery after 1 mbgl	S14-S04	0.7 - 0.85	3.7	2.0	Moderate	---
									S14-S05	0.85 - 1.0	3.7	2.2	Slight	0.05

Additional details / comments:

Legend

(green)	Inferred actual acid sulfate soil (AASS)
(orange)	Inferred potential acid sulfate soil (PASS)
(blue)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	1:00 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	SZ8 @ S15-S01. SZ9 @ S15-S07
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	~0.4
Sampling location:	S15	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	23/06/2020	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.2	**SANDY CLAY**	Brown	Fine Grain	Moist	Abundant	Low plasticity	Natural		S15-S01	0.0 - 0.2	4.2	2.5	Moderate	---
0.2 - 0.6	**CLAY**	Grey	Fine Grain	Moist	Trace	Intermediate plasticity	Natural	Trace orange mottling	S15-S02	0.2 - 0.4	3.9	2.3	Moderate	0.17
									S15-S03	0.4 - 0.6	3.9	2.4	Moderate	---
0.6 - 1.5	**SANDY CLAY**	Grey	Medium Fine Grain	Saturated	None	Low plasticity	Natural	Moist from 0.6 - 1.0 mbgl, saturated 1.0 -1.5 mbgl. Yellow mottling	S15-S04	0.6 - 0.8	4.0	2.4	Slight	---
									S15-S05	0.8 - 1.0	3.8	2.2	Moderate	---
									S15-S06	1.0 - 1.25	3.8	2.0	Moderate	---
									S15-S07	1.25 - 1.5	3.8	1.9	Moderate	0.08

Additional details / comments:

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(green)	Inferred potential acid sulfate soil (PASS)
(yellow)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	2:30 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	SZ10 @ S16-S03
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	
Sampling location:	S16	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	23/06/2020	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.8	**SANDY CLAY**	Brown	Medium Fine Grain	Moist	Some	Low plasticity	Natural	soft texture	S16-S01	0.0 - 0.25	4.4	2.5	Moderate	---
									S16-S02	0.25 - 0.5	3.8	2.2	Moderate	---
									S16-S03	0.5 - 0.8	3.8	2.1	Moderate	0.15
0.8 - 1.4	**SANDY CLAY**	Grey	Medium Fine Grain	Saturated	None	Low plasticity	Natural	very soft texture	S16-S04	0.8 - 1.0	3.7	2.6	Strong	---
									S16-S05	1.0 -1.20	3.7	2.0	Moderate	---
									S16-S06	1.20 -1.4	3.9	2.3	Strong	---
1.4 - 1.5	**CLAY**	Grey	Fine Grain	Saturated	None	Intermediate plasticity	Natural		S16-S07	1.4 -1.5	3.8	2.2	Slight	---

Additional details / comments:

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(green)	Inferred potential acid sulfate soil (PASS)
(yellow)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	12:15 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	~0.4
Sampling location:	S17	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	23/06/2020	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.3	SANDY CLAY	Brown	Fine Grain	Moist	Abundant	Low plasticity	Natural		S17-S01	0.0 - 0.3	4.8	2.5	Moderate	---
0.3 - 0.6	CLAY	Grey	Fine Grain	Moist	Trace	Intermediate plasticity	Natural	trace orange mottling	S17-S02	0.3 - 0.6	4.0	2.3	Moderate	---
0.6 - 1.5	SANDY CLAY	Grey	Fine Grain	Saturated	None	Low plasticity	Natural	yellow mottling increasing with depth	S17-S03	0.6 - 0.8	3.8	2.5	Moderate	---
									S17-S04	0.8 - 1.0	3.7	2.1	Slight	---
									S17-S05	1.0 -1.25	3.9	2.0	Slight	---
									S17-S06	1.25 - 1.5	3.8	1.8	Slight	0.07

Additional details / comments:	Legend	
	(teal)	Inferred actual acid sulfate soil (AASS)
	(dark green)	Inferred potential acid sulfate soil (PASS)
	(orange)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	1:50
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	SZ-7 @ S18_S02
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	0.4
Sampling location:	S18	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	23.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.5	**CLAY**	Dark Brown	Fine Grain	Moist	Trace	Friable	Natural	Saturated from 0.4 mbgl - slight organic layer to 0.05 mbgl	S18_S01	0 - 0.25	4.7	2.8	Moderate	---
									S18_S02	0.25 - 0.5	4.4	2.4	Moderate	0.15
0.5 - 1.0	**CLAYEY SAND**	Brown/grey	Medium Fine Grain	Saturated	Trace	Soft	Natural	Some orange mottling - roots	S18_S03	0.5 - 0.75	4.0	2.4	Moderate	---
									S18_S04	0.75 - 1.0	3.8	1.9	Moderate	---
1.0 - 1.25	**SANDY CLAY**	Brown/grey	Medium Fine Grain	Saturated	None	Low plasticity	Natural	Trace orange and yellow mottling	S18_S05	1.0 - 1.25	3.8	1.8	Moderate	---
1.25 - 1.5	**CLAY**	Grey	Fine Grain	Saturated	None	Soft	Natural		S18_S06	1.25 - 1.5	3.8	1.8	Moderate	---

Additional details / comments:

Poor sample recovery after 1.0 mbgl

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(green)	Inferred potential acid sulfate soil (PASS)
(orange)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	12:20
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	~0.9
Sampling location:	S19	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	23.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.5	**CLAY**	Brown	Fine Grain	Dry	Trace	Friable	Natural	Roots - moist from 0.3	S19-S01	0 - 0.25	4.5	2.7	Moderate	---
									S19-S02	0.25 - 0.5	4.0	2.3	Moderate	---
0.5 - 0.65	**CLAY**	Dark Brown	Fine Grain	Moist	None	Intermediate plasticity	Natural	Slightly crumbly (friable)	S19-S03	0.5 - 0.65	4.1	2.6	Strong	---
0.65 - 0.9	**CLAY**	Brown	Fine Grain	Moist	None	Intermediate plasticity	Natural	Some orange mottling - jar taken	S19-S04	0.65 - 0.9	4.1	2.4	Moderate	0.13
0.9 - 1.0	**CLAY**	Brown/grey	Fine Grain	Moist	None	Intermediate plasticity	Natural	Trace orange mottling and trace sand	S19-S05	0.9 - 1	4.5	2.6	Slight	---
1.0 - 1.1	**CLAYEY SAND**	Pale Brown/orange	Medium Fine Grain	Saturated	None	Soft	Natural	Trace orange mottling	S19-S06	1 - 1.1	4.7	3.0	Slight	---
1.1 - 1.4	**CLAYEY SAND**	Brown/grey	Medium Fine Grain	Saturated	None	Soft	Natural	Trace orange mottling	S19-S07	1.1 - 1.4	4.0	2.1	Slight	---

Additional details / comments:	Legend	
No sample recovery after 1.4 mbgl		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	1:00 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	SZ2@S01
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	~0.5
Sampling location:	S20	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	18/06/2020	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.5	**SANDY CLAY**	Dark Brown	Medium Fine Grain	Wet	Abundant	Low plasticity	Natural	organic matter abundant 0.0 - 0.1 mbgl	S20-S01	0.0 - 0.25	5.4	2.6	Moderate	---
									S20-S02	0.25 - 0.5	4.0	2.5	Moderate	---
0.5 - 1.5	**CLAYEY SAND**	Grey	Medium Fine Grain	Saturated	None	Soft	Natural	trace orange/yellow mottling	S20-S03	0.5 - 0.75	3.9	2.6	Moderate	---
									S20-S04	0.75 - 1.0	3.8	2.2	Moderate	---
									S20-S05	1.0 - 1.25	3.6	1.9	Slight	---
									S20-S06	1.25 - 1.50	3.6	1.5	Strong	0.1

Additional details / comments:

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(green)	Inferred potential acid sulfate soil (PASS)
(yellow)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	1:30 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1	**Depth to water (mbgl):**	0.3
Sampling location:	S21	**Refusal (Y/N):**	Y	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	18.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.15	**SANDY CLAY**	Dark Brown	Medium Fine Grain	Wet	Some	Low plasticity	Natural	Roots	S21-S01	0 - 0.15	4.1	2.6	Strong	---
0.15 - 0.65	**CLAY**	Dark Brown	Fine Grain	Saturated	Trace	Intermediate plasticity	Natural	Roots	S21-S02	0.15 - 0.65	3.8	2.4	Moderate	0.19
0.65 - 0.9	**CLAYEY SAND**	Brown	Medium Fine Grain	Saturated	None	Soft	Natural	Some orange mottling	S21-S03	0.65 - 0.9	4.0	2.6	Moderate	---
0.9 - 1.0	**SAND**	Pale Brown	Medium Fine Grain	Saturated	None	Soft	Natural	Some orange mottling	S21-S04	0.9 - 1.0	4.0	2.6	Moderate	---

Additional details / comments:

Legend

Teal	Inferred actual acid sulfate soil (AASS)
Green	Inferred potential acid sulfate soil (PASS)
Yellow	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	9:40
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1	**Depth to water (mbgl):**	0.3
Sampling location:	S22	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	Y		
Date	22.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.2	**SANDY CLAY**	Dark Brown	Medium Fine Grain	Moist	Some	Low plasticity	Natural	Roots - trace orange mottling	S22-S01	0 - 0.2	6.5	4.4	Moderate	0.02
0.2 - 0.5	**CLAY**	Dark Brown	Fine Grain	Wet	Trace	Intermediate plasticity	Natural	Roots - trace orange mottling	S22-S02	0.2 - 0.5	6.4	4.3	Moderate	---
0.5 - 0.8	**SILTY CLAY**	Grey	Fine Grain	Saturated	None	Intermediate plasticity	Natural	Very soft - some orange mottling	S22-S03	0.5 - 0.8	6.1	4.4	Moderate	---

Additional details / comments:	**Legend**	
No sample recovery after 0.8 mbgl		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	Weather:		Time:	10:45
Site name:	Ashfield Flats	Sampling method:	Hand Auger	QAQC samples:	---
Sampling area:	Other	Total depth (mbgl):	1	Depth to water (mbgl):	0
Sampling location:	S23	Refusal (Y/N):	N	Easting / northing:	400026 6467997
Scientist(s)	S.Blakiston & M.Emeny	Fill present (Y/N):	N		
Date	17/06/2020	Fill thickness (m):	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.15	CLAYEY SAND	Brown	Medium Fine Grain	Saturated	Abundant	Intermediate plasticity	Natural		S23-S01	0 - 0.15	6.2	4.1	Strong	---
0.15 - 1.0	CLAY	Brown	Fine Grain	Saturated	Some	High plasticity	Natural	Roots from 0.15 to 0.3 mbgl	S23-S02	0.15 - 0.5	6.0	4.2	Strong	---
									S23-S03	0.5 - 0.75	6.0	3.9	Strong	0.04
									S23-S04	0.75 - 1.0	6.2	3.6	Strong	---

Additional details / comments:

Legend

- Inferred actual acid sulfate soil (AASS)
- Inferred potential acid sulfate soil (PASS)
- Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**	Sunny	**Time:**	9AM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	SZ-1 @ S03
Sampling area:	Other	**Total depth (mbgl):**	1.0	**Depth to water (mbgl):**	~0.3
Sampling location:	S24	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	17/06/2020	**Fill thickness (m):**	—		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.15	**SAND**	Brown	Medium Fine Grain	Moist	Abundant	Soft	Natural		S24-S01	0.0-0.15	7.5	5.3	Moderate	---
0.15 - 0.7	**CLAY**	Dark Brown	Fine Grain	Wet	Some	Intermediate plasticity	Natural	Trace sand	S24-S02	0.15-0.4	7.2	5.5	Moderate	---
									S24-S03	0.4-0.7	6.6	3.7	Strong	---
0.7 - 1.00	**CLAY**	Brown	Fine Grain	Saturated	Some	Low plasticity	Natural	Organic odour	S24-S04	0.7-1.0	6.5	4.3	Strong	0.14

Additional details / comments:	Legend	
		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	8:30
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.0	**Depth to water (mbgl):**	0.1
Sampling location:	S25	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	22.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.3	**CLAY**	Brown	Fine Grain	Saturated	Abundant	Soft	Natural	Predominantly organics in top 0.1 m	S25-S01	0 - 0.3	5.5	4.3	Moderate	---
0.3 - 0.4	**SANDY CLAY**	Brown	Medium Fine Grain	Saturated	Trace	Intermediate plasticity	Natural	Roots - some orange mottling	S25-S02	0.3 - 0.4	3.9	2.8	Moderate	0.17
0.4 - 0.6	**CLAYEY SAND**	Pale Brown	Medium Fine Grain	Saturated	None	Low plasticity	Natural	Orange/yellow sand with some brown clay	S25-S03	0.4 - 0.6	3.9	2.6	Moderate	---
0.6 - 0.8	**SILTY CLAY**	Grey	Fine Grain	Saturated	None	Intermediate plasticity	Natural	Fine, soft clay with trace yellow sand	S25-S04	0.6 - 0.8	3.4	1.9	Moderate	0.12

Additional details / comments:

No sample recovery after 0.8 mbgl

Legend

(teal)	Inferred actual acid sulfate soil (AASS)
(green)	Inferred potential acid sulfate soil (PASS)
(yellow)	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	9:00 AM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.0	**Depth to water (mbgl):**	~0.3
Sampling location:	S26	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	22/06/2020	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.2	**SILTY CLAY**	Dark Brown	Medium Fine Grain	Moist	Abundant	Intermediate plasticity	Natural	soft texture	S26-S01	0.0 - 0.2	4.4	2.9	Extreme	---
0.2 - 0.6	**CLAY**	Grey	Fine Grain	Moist	Some	Intermediate plasticity	Natural	soft texture	S26-S02	0.2 - 0.4	4.3	2.7	Moderate	---
0.6 - 0.8	**CLAY**	Grey	Fine Grain	Saturated	Trace	Intermediate plasticity	Natural	very soft texture	S26-S03	0.4 - 0.6	3.9	2.3	Strong	---
									S26-S04	0.6 - 0.8	3.8	2.1	Strong	0.07

Additional details / comments:	Legend	
No sample recovery after 0.8 mbgl		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	10:00
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	SZ-5 @ S27_S01
Sampling area:	Other	**Total depth (mbgl):**	1.0	**Depth to water (mbgl):**	0.1
Sampling location:	S27	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	23.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0 - 0.2	**CLAYEY SAND**	Orange/Yellow	Medium Fine Grain	Wet	Trace	Low plasticity	Natural	Fine organic layer on top to 0.05 m	S27-S01	0.0 - 0.2	6.6	3.8	Strong	---
0.2 - 0.4	**CLAY**	Dark Brown/Grey	Fine Grain	Wet	None	Intermediate plasticity	Natural		S27-S02	0.2 - 0.4	5.0	2.9	Moderate	0.09
0.4 - 0.6	**CLAY**	Dark Grey	Fine Grain	Saturated	Trace	Intermediate plasticity	Natural	Some orange mottling	S27-S03	0.4 - 0.6	4.9	3.1	Moderate	---
0.6 - 0.8	**CLAY**	Grey	Fine Grain	Saturated	None	Intermediate plasticity	Natural	Abundant red mottling - red parts are soft	S27-S04	0.6 - 0.8	4.4	2.5	Moderate	---

Additional details / comments:

No sample recovery after 0.8 mbgl

Legend

- Inferred actual acid sulfate soil (AASS)
- Inferred potential acid sulfate soil (PASS)
- Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	11:10
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	SZ-6 @ S28_S01
Sampling area:	Other	**Total depth (mbgl):**	1.0	**Depth to water (mbgl):**	0.1
Sampling location:	S28	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	N		
Date	23.6.20	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.3	**CLAY**	Brown	Fine Grain	Saturated	Some	Intermediate plasticity	Natural	Fine organic layer to 0.05 mbgl - roots and sheoak needles	S28-S01	0.0 - 0.3	5.6	2.8	Moderate	---
0.3 - 0.5	**CLAY**	Grey/brown	Fine Grain	Saturated	None	Intermediate plasticity	Natural	Some orange mottling	S28-S02	0.3 - 0.5	5.9	4.7	Moderate	---
0.5 - 1.0	**SANDY CLAY**	Grey/brown	Medium Fine Grain	Saturated	None	Soft	Natural		S28-S03	0.5 - 0.75	6.0	4.9	Slight	---
									S28-S04	0.75 - 1.0	6.3	5.2	Strong	<0.02

Additional details / comments:

Poor sample recovery after 0.5 mbgl

Legend

- Inferred actual acid sulfate soil (AASS)
- Inferred potential acid sulfate soil (PASS)
- Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	10:00 AM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.0	**Depth to water (mbgl):**	---
Sampling location:	S29	**Refusal (Y/N):**	Y	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	Y		
Date	22/06/2020	**Fill thickness (m):**	1.0		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.85	**SAND**	Brown	Medium Fine Grain	Dry	Some	Firm	Disturbed	Pale grey clay peds at 0.6 - 0.85 mbgl. Dry at 0.0 - 0.6 mbgl and moist from 0.6 - 0.85 mbgl. Abundant organic matter 0.0 - 0.1 mbgl	S29-S01	0.0 - 0.25	7.7	5.0	Moderate	<0.02
									S29-S02	0.25 - 0.4	7.8	5.3	Moderate	---
									S29-S03	0.4 - 0.6	7.9	5.4	Moderate	---
									S29-S04	0.6 - 0.85	7.6	5.1	Moderate	---
0.85 - 1.0	**CLAYEY SAND**	Grey	Medium Fine Grain	Moist	None	Firm	Disturbed		S29-S05	0.85 - 1.0	7.2	5.0	Moderate	---

Additional details / comments:

Legend

	Inferred actual acid sulfate soil (AASS)
	Inferred potential acid sulfate soil (PASS)
	Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	10:50
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.5	**Depth to water (mbgl):**	1.4
Sampling location:	S30	**Refusal (Y/N):**	N	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	Y		
Date	22.6.20	**Fill thickness (m):**	~1.2		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.25	**SAND**	Pale Brown	Medium Fine Grain	Dry	Trace	Soft	Fill	DI water added for better recovery - roots	S30-S01	0.0 - 0.25	6.4	4.1	Moderate	---
0.25 - 0.45	**SAND**	Brown	Medium Fine Grain	Dry	None	Soft	Fill	DI water added for better recovery - some grey sand	S30-S02	0.25 - 0.45	7.1	4.6	Moderate	---
0.45 - 0.7	**SAND**	Pale Brown	Medium Fine Grain	Moist	None	Soft	Fill	Some yellow sand throughout	S30-S03	0.45 - 0.7	7.8	6.3	Moderate	<0.02
0.7 - 1.2	**CLAYEY SAND**	Dark Brown	Medium Fine Grain	Moist	None	Low plasticity	Natural	some orange mottling	S30-S04	0.7 - 1.0	7.3	5.3	Moderate	---
									S30-S05	1.0 - 1.2	7.2	5.4	Moderate	---
1.2 - 1.5	**SAND**	Brown	Medium Fine Grain	Saturated	None	Soft	Natural	Saturated from 1.4mbgl - poor recovery after 1.5mbgl	S30-S06	1.2 - 1.5	7.3	5.7	Moderate	---

Additional details / comments:	Legend	
Asbestos containing material observed at surface		Inferred actual acid sulfate soil (AASS)
		Inferred potential acid sulfate soil (PASS)
		Value exceeds DWER action criteria of 0.03% S

SOIL/SEDIMENT PROFILE LOG

Project number:	EEC20088.001	**Weather:**		**Time:**	12:00 PM
Site name:	Ashfield Flats	**Sampling method:**	Hand Auger	**QAQC samples:**	---
Sampling area:	Other	**Total depth (mbgl):**	1.1	**Depth to water (mbgl):**	---
Sampling location:	S31	**Refusal (Y/N):**	Y	**Easting / northing:**	
Scientist(s)	S.Blakiston & M.Emeny	**Fill present (Y/N):**	Y		
Date	22/06/2020	**Fill thickness (m):**	---		

Soil depth (m)	Soil description								Sample I.D.	Interval (m)	pH_F	pH_{FOX}	Vigour	Net acidity (%S)
	Type	Colour	Texture	Moisture	Organics	Consistency	Origin	Other						
0.0 - 0.25	**SAND**	Brown	Medium Fine Grain	Dry	Abundant	Firm	Disturbed		S31-S01	0.0 - 0.25	6.9	4.6	Moderate	---
0.25 - 1.1	**SAND**	Pale Brown	Medium Fine Grain	Dry	Trace	Firm	Disturbed	construction and demolition waste (limestone, concrete) becoming more abundant with depth. Black cobbles at 0.6 mbgl	S31-S02	0.25 - 0.5	7.0	5.0	Moderate	---
									S31-S03	0.5 - 0.75	7.1	4.8	Moderate	---
									S31-S04	0.75 - 1.0	7.1	4.8	Moderate	<0.02
									S31-S05	1.0 - 1.1	7.2	4.9	Moderate	---

Additional details / comments:

Legend

	Inferred actual acid sulfate soil (AASS)
	Inferred potential acid sulfate soil (PASS)
	Value exceeds DWER action criteria of 0.03% S

Appendix E
Laboratory documentation

CERTIFICATE OF ANALYSIS

Work Order	: **EP2006307**	Page	: 1 of 6
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: Shenae Blakiston	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 18-Jun-2020 10:30
Order number	: ----	Date Analysis Commenced	: 19-Jun-2020
C-O-C number	: ----	Issue Date	: 30-Jun-2020 11:08
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 20		
No. of samples analysed	: 20		

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*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth Inorganics, Wangara, WA
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

- AVS conducted by ALS Brisbane, NATA Site No. 818.
- PSD conducted by ALS Newcastle, NATA accreditation no. 825, site no 1656.
- EA150H: Soil particle density results fell outside the scope of AS1289.3.6.3. Results should be scrutinised accordingly.
- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S08-S01	S08-S02	DS08-S01	DS08-S02	S09-S01
			Client sampling date / time	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006307-001	EP2006307-002	EP2006307-003	EP2006307-004	EP2006307-005
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	5.2	5.8	7.1	7.1	4.2
pH (Fox)	----	0.1	pH Unit	3.1	4.1	5.6	5.4	3.1
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Moderate	Strong

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S09-S02	S09-S03	S09-S04	S23-S01	S23-S02
			Client sampling date / time	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006307-006	EP2006307-007	EP2006307-008	EP2006307-009	EP2006307-010
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	4120	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.8	6.0	6.7	6.2	6.0
pH (Fox)	----	0.1	pH Unit	2.8	4.6	5.5	4.1	4.2
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Strong	Strong
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	----	8.4	----
Total Organic Carbon	----	0.5	%	----	----	----	4.9	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S23-S03	S23-S04	S24-S01	S24-S02	S24-S03
			Client sampling date / time	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006307-011	EP2006307-012	EP2006307-013	EP2006307-014	EP2006307-015
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.0**	**6.2**	**7.5**	**7.2**	**6.6**
pH (Fox)	----	0.1	pH Unit	**3.9**	**3.6**	**5.3**	**5.5**	**3.7**
Reaction Rate	----	1	-	**Strong**	**Strong**	**Moderate**	**Moderate**	**Strong**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		S24-S04	SZ-1	DS9-S01-	DS9-S02	DS9-S03
		Client sampling date / time		17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006307-016	EP2006307-017	EP2006307-018	EP2006307-019	EP2006307-020
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	196	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	6.5	6.6	----	7.4	7.0
pH (Fox)	----	0.1	pH Unit	4.3	3.8	----	4.0	3.7
Reaction Rate	----	1	-	Strong	Strong	----	Strong	Strong
EA038: Acid Volatlile Sulfur								
Acid Volatile Sulfur	----	0.001	%	----	----	0.114	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	----	----	53.7	----	----
EA150: Particle Sizing								
+75µm	----	1	%	----	----	54	----	----
+150µm	----	1	%	----	----	22	----	----
+300µm	----	1	%	----	----	9	----	----
+425µm	----	1	%	----	----	6	----	----
+600µm	----	1	%	----	----	3	----	----
+1180µm	----	1	%	----	----	2	----	----
+2.36mm	----	1	%	----	----	<1	----	----
+4.75mm	----	1	%	----	----	<1	----	----
+9.5mm	----	1	%	----	----	<1	----	----
+19.0mm	----	1	%	----	----	<1	----	----
+37.5mm	----	1	%	----	----	<1	----	----
+75.0mm	----	1	%	----	----	<1	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	25	----	----
Silt (2-60 µm)	----	1	%	----	----	18	----	----
Sand (0.06-2.00 mm)	----	1	%	----	----	56	----	----
Gravel (>2mm)	----	1	%	----	----	1	----	----
Cobbles (>6cm)	----	1	%	----	----	<1	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	----	----	2.36	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	9.4	----	----
Total Organic Carbon	----	0.5	%	----	----	5.4	----	----

QUALITY CONTROL REPORT

Work Order	: **EP2006307**	Page	: 1 of 3
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: Shenae Blakiston	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 18-Jun-2020
Order number	: ----	Date Analysis Commenced	: 19-Jun-2020
C-O-C number	: ----	Issue Date	: 30-Jun-2020
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 20		
No. of samples analysed	: 20		

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*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth Inorganics, Wangara, WA
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 (%)
EA010: Conductivity (1:5) (QC Lot: 3093544)									
EP2006307-009	S23-S01	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	4120	4600	10.9	0% - 20%
EP2006309-071	Anonymous	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	35	36	2.89	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3097255)									
EP2006307-001	S08-S01	EA037: pH (F)	----	0.1	pH Unit	5.2	5.3	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.1	3.0	0.00	0% - 20%
EP2006307-010	S23-S02	EA037: pH (F)	----	0.1	pH Unit	6.0	6.0	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	4.2	4.3	3.08	0% - 20%
EA038: Acid Volatlile Sulfur (QC Lot: 3102022)									
EP2006307-018	DS9-S01-	EA038: Acid Volatile Sulfur	----	0.001	%	0.114	0.114	0.00	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 3093410)									
EP2006307-018	DS9-S01-	EA055: Moisture Content	----	0.1	%	53.7	57.0	5.85	0% - 20%
EP004: Organic Matter (QC Lot: 3093393)									
EP2006307-009	S23-S01	EP004: Organic Matter	----	0.5	%	8.4	8.4	0.00	0% - 50%
		EP004: Total Organic Carbon	----	0.5	%	4.9	4.9	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 Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA010: Conductivity (1:5) (QCLot: 3093544)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	24800 µS/cm	102	93.6	106
EA038: Acid Volatlile Sulfur (QCLot: 3102022)								
EA038: Acid Volatile Sulfur	----	0.001	%	<0.001	0.044 %	102	87.0	107
EP004: Organic Matter (QCLot: 3093393)								
EP004: Organic Matter	----	0.5	%	<0.5	2.3 %	99.1	70.0	120
				<0.5	85 %	85.1	70.0	120
EP004: Total Organic Carbon	----	0.5	%	<0.5	----	----	----	----

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.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2006307**	Page	: 1 of 5
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: Shenae Blakiston	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 18-Jun-2020
Site	: Ashfield Flats	Issue Date	: 30-Jun-2020
Sampler	: Matt Emeny, Shenae Blakiston	No. of samples received	: 20
Order number	: ----	No. of samples analysed	: 20

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: **SOIL**

Method	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EP004: Organic Matter						
Snap Lock Bag						
S23-S01	26-Jun-2020	24-Jun-2020	2	----	----	----

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		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010: Conductivity (1:5)								
Snap Lock Bag (EA010)								
S23-S01		**17-Jun-2020**	**23-Jun-2020**	24-Jun-2020	✓	**23-Jun-2020**	21-Jul-2020	✓
Soil Glass Jar - Unpreserved (EA010)								
DS9-S01-		**17-Jun-2020**	**23-Jun-2020**	24-Jun-2020	✓	**23-Jun-2020**	21-Jul-2020	✓
EA037: Ass Field Screening Analysis								
Snap Lock Bag - frozen (EA037)								
S08-S01,	S08-S02,	**17-Jun-2020**	**19-Jun-2020**	14-Dec-2020	✓	**19-Jun-2020**	14-Dec-2020	✓
DS08-S01,	DS08-S02,							
S09-S01,	S09-S02,							
S09-S03,	S09-S04,							
S23-S01,	S23-S02,							
S23-S03,	S23-S04,							
S24-S01,	S24-S02,							
S24-S03,	S24-S04,							
SZ-1,	DS9-S02,							
DS9-S03								
EA038: Acid Volatlile Sulfur								
Snap Lock Bag - frozen (EA038)								
DS9-S01-		**17-Jun-2020**	**----**	----	----	**25-Jun-2020**	17-Jun-2021	✓
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
DS9-S01-		**17-Jun-2020**	**----**	----	----	**22-Jun-2020**	01-Jul-2020	✓

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
EA150: Particle Sizing							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) DS9-S01-	**17-Jun-2020**	**----**	----	----	**30-Jun-2020**	14-Dec-2020	✓
EA150: Soil Classification based on Particle Size							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) DS9-S01-	**17-Jun-2020**	**----**	----	----	**30-Jun-2020**	14-Dec-2020	✓
EA152: Soil Particle Density							
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152) DS9-S01-	**17-Jun-2020**	**----**	----	----	**30-Jun-2020**	14-Dec-2020	✓
EP004: Organic Matter							
Snap Lock Bag (EP004) S23-S01	**17-Jun-2020**	**26-Jun-2020**	24-Jun-2020	×	**26-Jun-2020**	24-Jul-2020	✓
Soil Glass Jar - Unpreserved (EP004) DS9-S01-	**17-Jun-2020**	**26-Jun-2020**	15-Jul-2020	✓	**26-Jun-2020**	15-Jul-2020	✓

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)							
Acid Volatile Sulfur	EA038	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
ASS Field Screening Analysis	EA037	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acid Volatile Sulfur	EA038	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	10	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Acid Volatile Sulfur	EA038	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	10	**10.00**	**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
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3)
ASS Field Screening Analysis	EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.
Acid Volatile Sulfur	EA038	SOIL	In house: Referenced to Sullivan et al (1998). The AVS method converts reduced inorganic Sulfur to H2S by way of a cold 12MHCl acid digest; the evolved H2S is trapped in a Zinc Acetate solution as ZnS which is quantified by iodometric titration.
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 6.1 and Table 1 (14 day holding time).
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003
Soil Particle Density	EA152	SOIL	Soil Particle Density by AS 1289.3.5.1-2006 : Methods of testing soils for engineering purposes - Soil classification tests - Determination of the soil particle density of a soil - Standard method
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3).

Preparation Methods	Method	Matrix	Method Descriptions
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.
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3) (Method 105)

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EP2006307**

Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: Shenae Blakiston	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: shenae.blakiston@rpsgroup.com.au	E-mail	: Lauren.biagioni@alsglobal.com
Telephone	: ----	Telephone	: 08 9406 1307
Facsimile	: ----	Facsimile	: +61-8-9406 1399
Project	: EEC20088.001	Page	: 1 of 3
Order number	: ----	Quote number	: EP2020AQUTER0006 (EP/446/20)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Ashfield Flats		
Sampler	: Matt Emeny, Shenae Blakiston		

Dates

Date Samples Received	: 18-Jun-2020 10:30	Issue Date	: 18-Jun-2020
Client Requested Due Date	: 30-Jun-2020	Scheduled Reporting Date	: **30-Jun-2020**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Not Available
No. of coolers/boxes	: 1	Temperature	: -1.8 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 20 / 20

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
- AVS conducted by ALS Brisbane, NATA Site No. 818.
- PSD conducted by ALS Newcastle, NATA accreditation no. 825, site no 1656.
- 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 (Samples.Perth@alsglobal.com)
- Analytical work for this work order will be conducted at ALS Environmental Perth.
- **PSD analysis will be conducted by ALS Environmental, Newcastle, NATA accreditation no. 825, Site No. 1656.**
- Please direct any turnaround / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **AVS analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818.**
- **pH analysis should be conducted within 6 hours of sampling.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

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: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA010 (solids): Electrical Conductivity (1:5)	SOIL - EA037 ASS Field Screening Analysis	SOIL - EA038 Acid Volatile Sulfur	SOIL - EA055-103 Moisture Content	SOIL - EA150H/EA152 Particle Sizing with Hydrometer + Soil Particle	SOIL - EP004 (Carbon) Organic Matter & Total Organic Carbon (Calc.)
EP2006307-001	17-Jun-2020 00:00	S08-S01		✓				
EP2006307-002	17-Jun-2020 00:00	S08-S02		✓				
EP2006307-003	17-Jun-2020 00:00	DS08-S01		✓				
EP2006307-004	17-Jun-2020 00:00	DS08-S02		✓				
EP2006307-005	17-Jun-2020 00:00	S09-S01		✓				
EP2006307-006	17-Jun-2020 00:00	S09-S02		✓				
EP2006307-007	17-Jun-2020 00:00	S09-S03		✓				
EP2006307-008	17-Jun-2020 00:00	S09-S04		✓				
EP2006307-009	17-Jun-2020 00:00	S23-S01	✓	✓				✓
EP2006307-010	17-Jun-2020 00:00	S23-S02		✓				
EP2006307-011	17-Jun-2020 00:00	S23-S03		✓				
EP2006307-012	17-Jun-2020 00:00	S23-S04		✓				
EP2006307-013	17-Jun-2020 00:00	S24-S01		✓				
EP2006307-014	17-Jun-2020 00:00	S24-S02		✓				
EP2006307-015	17-Jun-2020 00:00	S24-S03		✓				
EP2006307-016	17-Jun-2020 00:00	S24-S04		✓				
EP2006307-017	17-Jun-2020 00:00	SZ-1		✓				
EP2006307-018	17-Jun-2020 00:00	DS9-S01-	✓		✓	✓	✓	✓
EP2006307-019	17-Jun-2020 00:00	DS9-S02		✓				
EP2006307-020	17-Jun-2020 00:00	DS9-S03		✓				

Proactive Holding Time Report

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

Requested Deliverables

ACCOUNTS PAYABLE		
- A4 - AU Tax Invoice (INV)	Email	West.AccountsPayable@rpsgroup.com.au
ALAN FOLEY		
- *AU Certificate of Analysis - NATA (COA)	Email	Alan.Foley@rpsgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	Alan.Foley@rpsgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	Alan.Foley@rpsgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	Alan.Foley@rpsgroup.com.au
- Attachment - Report (SUBCO)	Email	Alan.Foley@rpsgroup.com.au
- Chain of Custody (CoC) (COC)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - ENMRG (ENMRG)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - XTab (XTAB)	Email	Alan.Foley@rpsgroup.com.au
Shenae Blakiston		
- *AU Certificate of Analysis - NATA (COA)	Email	shenae.blakiston@rpsgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	shenae.blakiston@rpsgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	shenae.blakiston@rpsgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	shenae.blakiston@rpsgroup.com.au
- Attachment - Report (SUBCO)	Email	shenae.blakiston@rpsgroup.com.au
- Chain of Custody (CoC) (COC)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - ENMRG (ENMRG)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - XTab (XTAB)	Email	shenae.blakiston@rpsgroup.com.au

CHAIN OF COUSTODY

Site:	Ashfield Flats	
Project reference:	EEC20088.001	
Scientist(s)	Shenae Blakiston & Matt Emeny	
Sample type(s):	Soil	
Report to:	Alan Foley & Shenae Blakiston	
Invoice to:	west.accountspayable@rpsgroup.com	

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Page number: 1
Turnaround time: Standard
Quote number: EP/446/20

Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
S08-S01	1	17/06/2020	1	x					
S08-S02	2	17/06/2020	1	x					
DS8-S01	3	17/06/2020	1	x					
DS8-S02	4	17/06/2020	1	x					
S09-S01	5	17/06/2020	4	x	x	x	x	x	1x green bag labelled frozen for AVS
S09-S02	6	17/06/2020	1	x					
S09-S03	7	17/06/2020	1	x					
S09-S04	8	17/06/2020	1	x					
S23-S01	9	17/06/2020	2	x	x	x			
S23-S02	10	17/06/2020	1	x					
S23-S03	11	17/06/2020	1	x					
S23-S04	12	17/06/2020	1	x					
S24-S01	13	17/06/2020	1	x					
S24-S02	14	17/06/2020	1	x					
S24-S03	15	17/06/2020	1	x					
S24-S04	16	17/06/2020	1	x					
SZ-1	17	17/06/2020	1	x					
Total number of bottles/bags/jars			21						

Environmental Division
Perth
Work Order Reference
EP2006307

Telephone : + 61-8-9406 1301

Primary destination:	ALS	**Received by:**	MO	**Secondary destination:**		**Received by:**	
Relinquished by:	Alan Foley	**Organisation:**	als	**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**	18/06/2020	**Organisation:**		**Date:**	
Date:	18/06/2020	**Time:**	1030	**Date:**		**Time:**	
Time:	8:15:00 AM			**Time:**			

Certificate of Analysis

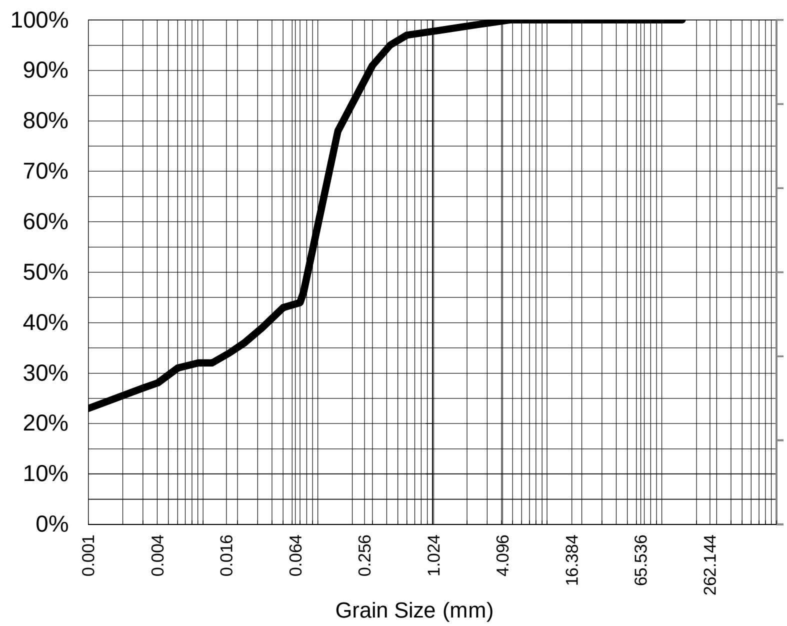
ALS Laboratory Group Pty Ltd
5/585 Maitland Road
Mayfield West, NSW 2304
pH 02 4014 2500
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	Shenae Blakiston	**DATE REPORTED:**	30-Jun-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	18-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006307-018 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	DS9-S01\u00ad

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	99%
1.18	98%
0.600	97%
0.425	95%
0.300	91%
0.150	78%
0.075	46%
Particle Size (microns)	
50	43%
33	39%
23	36%
17	34%
12	32%
9	32%
6	31%
4	28%
1	23%

Median Particle Size (mm)*	0.084

Analysis Notes

Samples analysed as received.
**** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results***

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	26-Jun-20
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES, VEG	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.36 (2.45)*		

NATA Accreditation: 825 Site: Newcastle
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced, except in full.

Aleksandar Vujkovic
Laboratory Supervisor
Authorised Signatory

CERTIFICATE OF ANALYSIS

Work Order	: **EP2006357**	Page	: 1 of 11
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: Shenae Blakiston	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 19-Jun-2020 15:30
Order number	: ----	Date Analysis Commenced	: 23-Jun-2020
C-O-C number	: ----	Issue Date	: 26-Jun-2020 17:12
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 41		
No. of samples analysed	: 41		

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*
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S10-S01	S10-S02	S10-S03	S10-S04	S10-S05
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006357-001	EP2006357-002	EP2006357-003	EP2006357-004	EP2006357-005
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	146	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	7.0	7.2	6.7	7.7	7.4
pH (Fox)	----	0.1	pH Unit	3.1	4.1	4.5	6.0	6.1
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Moderate	Slight
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	3.5	----	----
Total Organic Carbon	----	0.5	%	----	----	2.0	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S10-S06	S11-S01	S11-S02	S11-S03	S11-S04
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006357-006	EP2006357-007	EP2006357-008	EP2006357-009	EP2006357-010
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	7.8	6.0	5.3	5.9	6.5
pH (Fox)	----	0.1	pH Unit	7.2	3.4	3.0	4.1	4.6
Reaction Rate	----	1	-	Strong	Moderate	Moderate	Moderate	Moderate

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S11-S05	S11-S06	S12-S01	S12-S02	S12-S03
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006357-011	EP2006357-012	EP2006357-013	EP2006357-014	EP2006357-015
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**----**	**3060**	**----**	**----**	**----**
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.6**	**6.7**	**5.8**	**5.2**	**5.2**
pH (Fox)	----	0.1	pH Unit	**3.3**	**1.7**	**3.2**	**2.8**	**3.2**
Reaction Rate	----	1	-	**Strong**	**Strong**	**Moderate**	**Moderate**	**Moderate**
EP004: Organic Matter								
Organic Matter	----	0.5	%	**----**	**1.8**	**----**	**----**	**----**
Total Organic Carbon	----	0.5	%	**----**	**1.0**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S12-S04	S12-S05	S12-S06	S13-S01	S13-S02
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006357-016	EP2006357-017	EP2006357-018	EP2006357-019	EP2006357-020
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**5.0**	**4.7**	**4.6**	**4.8**	**4.4**
pH (Fox)	----	0.1	pH Unit	**3.0**	**2.3**	**2.4**	**2.6**	**2.3**
Reaction Rate	----	1	-	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S13-S03	S13-S04	S13-S05	S13-S06	S14-S01
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006357-021	EP2006357-022	EP2006357-023	EP2006357-024	EP2006357-025
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	1970	----	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.3	4.1	3.8	4.0	5.0
pH (Fox)	----	0.1	pH Unit	2.4	1.9	2.0	2.2	2.6
Reaction Rate	----	1	-	Moderate	Moderate	Slight	Slight	Moderate
EP004: Organic Matter								
Organic Matter	----	0.5	%	0.7	----	----	----	----
Total Organic Carbon	----	0.5	%	<0.5	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S14-S02	S14-S03	S14-S04	S14-S05	S20-S01
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006357-026	EP2006357-027	EP2006357-028	EP2006357-029	EP2006357-030
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	----	554
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.9	4.3	3.7	3.7	5.4
pH (Fox)	----	0.1	pH Unit	2.4	2.6	2.0	2.2	2.6
Reaction Rate	----	1	-	Strong	Slight	Moderate	Slight	Moderate
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	----	----	40.5
Total Organic Carbon	----	0.5	%	----	----	----	----	23.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S20-S02	S20-S03	S20-S04	S20-S05	S20-S06
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006357-031	EP2006357-032	EP2006357-033	EP2006357-034	EP2006357-035
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.0	3.9	3.8	3.6	3.6
pH (Fox)	----	0.1	pH Unit	2.5	2.6	2.2	1.9	1.5
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Slight	Strong

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S21-S01	S21-S02	S21-S03	S21-S04	SZ2
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006357-036	EP2006357-037	EP2006357-038	EP2006357-039	EP2006357-040
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	----	691
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.1	3.8	4.0	4.0	4.8
pH (Fox)	----	0.1	pH Unit	2.6	2.4	2.6	2.6	2.9
Reaction Rate	----	1	-	Strong	Moderate	Moderate	Moderate	Strong
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	----	----	5.8
Total Organic Carbon	----	0.5	%	----	----	----	----	3.4

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S10-S07	----	----	----	----
			Client sampling date / time	18-Jun-2020 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EP2006357-041	--------	--------	--------	--------
				Result	----	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	7.4	----	----	----	----
pH (Fox)	----	0.1	pH Unit	7.4	----	----	----	----
Reaction Rate	----	1	-	Strong	----	----	----	----

QUALITY CONTROL REPORT

Work Order	: **EP2006357**	Page	: 1 of 3
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: Shenae Blakiston	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 19-Jun-2020
Order number	: ----	Date Analysis Commenced	: 23-Jun-2020
C-O-C number	: ----	Issue Date	: 26-Jun-2020
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 41		
No. of samples analysed	: 41		

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*
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 (%)*
EA010: Conductivity (1:5) (QC Lot: 3093544)									
EP2006307-009	Anonymous	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	4120	4600	10.9	0% - 20%
EP2006309-071	Anonymous	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	35	36	2.89	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3102175)									
EP2006357-001	S10-S01	EA037: pH (F)	----	0.1	pH Unit	7.0	7.0	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.1	3.0	0.00	0% - 20%
EP2006357-010	S11-S04	EA037: pH (F)	----	0.1	pH Unit	6.5	6.6	1.53	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	4.6	4.6	0.00	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3102176)									
EP2006357-021	S13-S03	EA037: pH (F)	----	0.1	pH Unit	4.3	4.2	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	2.4	2.4	0.00	0% - 20%
EP2006357-030	S20-S01	EA037: pH (F)	----	0.1	pH Unit	5.4	5.4	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	2.6	2.6	0.00	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3102177)									
EP2006357-041	S10-S07	EA037: pH (F)	----	0.1	pH Unit	7.4	7.3	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	7.4	7.3	0.00	0% - 20%
EP004: Organic Matter (QC Lot: 3093393)									
EP2006307-009	Anonymous	EP004: Organic Matter	----	0.5	%	8.4	8.4	0.00	0% - 50%
		EP004: Total Organic Carbon	----	0.5	%	4.9	4.9	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 Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA010: Conductivity (1:5) (QCLot: 3093544)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	24800 µS/cm	102	93.6	106
EP004: Organic Matter (QCLot: 3093393)								
EP004: Organic Matter	----	0.5	%	<0.5	2.3 %	99.1	70.0	120
				<0.5	85 %	85.1	70.0	120
EP004: Total Organic Carbon	----	0.5	%	<0.5	----	----	----	----

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.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2006357**	Page	
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: Shenae Blakiston	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 19-Jun-2020
Site	: Ashfield Flats	Issue Date	: 26-Jun-2020
Sampler	: Matt Emeny, Shenae Blakiston	No. of samples received	: 41
Order number	: ----	No. of samples analysed	: 41

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

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

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

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		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010: Conductivity (1:5)								
Soil Glass Jar - Unpreserved (EA010)								
S10-S03,	S11-S06,	**18-Jun-2020**	**23-Jun-2020**	25-Jun-2020	✓	**23-Jun-2020**	21-Jul-2020	✓
S13-S03,	S20-S01,							
SZ2								
EA037: Ass Field Screening Analysis								
Snap Lock Bag - frozen on receipt at ALS (EA037)								
S10-S01,	S10-S02,	**18-Jun-2020**	**25-Jun-2020**	15-Dec-2020	✓	**26-Jun-2020**	15-Dec-2020	✓
S10-S03,	S10-S04,							
S10-S05,	S10-S06,							
S11-S01,	S11-S02,							
S11-S03,	S11-S04,							
S11-S05,	S11-S06,							
S12-S01,	S12-S02,							
S12-S03,	S12-S04,							
S12-S05,	S12-S06,							
S13-S01,	S13-S02,							
S13-S03,	S13-S04,							
S13-S05,	S13-S06,							
S14-S01,	S14-S02,							
S14-S03,	S14-S04,							
S14-S05,	S20-S01,							
S20-S02,	S20-S03,							
S20-S04,	S20-S05,							
S20-S06,	S21-S01,							
S21-S02,	S21-S03,							
S21-S04,	SZ2,							
S10-S07								

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
EP004: Organic Matter								
Soil Glass Jar - Unpreserved (EP004)								
S10-S03, S13-S03, SZ2	S11-S06, S20-S01,	**18-Jun-2020**	**26-Jun-2020**	16-Jul-2020	✓	**26-Jun-2020**	16-Jul-2020	✓

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)							
ASS Field Screening Analysis	EA037	5	41	**12.20**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Electrical Conductivity (1:5)	EA010	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	10	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Electrical Conductivity (1:5)	EA010	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	10	**10.00**	**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
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3)
ASS Field Screening Analysis	EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3).

Preparation Methods	Method	Matrix	Method Descriptions
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.
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3) (Method 105)

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EP2006357**

Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: Shenae Blakiston	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: shenae.blakiston@rpsgroup.com.au	E-mail	: Lauren.biagioni@alsglobal.com
Telephone	: ----	Telephone	: 08 9406 1307
Facsimile	: ----	Facsimile	: +61-8-9406 1399
Project	: EEC20088.001	Page	: 1 of 3
Order number	: ----	Quote number	: EP2020AQUTER0006 (EP/446/20)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Ashfield Flats		
Sampler	: Matt Emeny, Shenae Blakiston		

Dates

Date Samples Received	: 19-Jun-2020 15:30	Issue Date	: 19-Jun-2020
Client Requested Due Date	: 26-Jun-2020	Scheduled Reporting Date	: **26-Jun-2020**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Not Available
No. of coolers/boxes	: 2	Temperature	: 9.7 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 41 / 41

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 (Samples.Perth@alsglobal.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.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

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: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA010 (solids): Electrical Conductivity (1:5)	SOIL - EA037 ASS Field Screening Analysis	SOIL - EP004 (Carbon) Organic Matter & Total Organic Carbon (Calc.)
EP2006357-001	18-Jun-2020 00:00	S10-S01		✓	
EP2006357-002	18-Jun-2020 00:00	S10-S02		✓	
EP2006357-003	18-Jun-2020 00:00	S10-S03	✓	✓	✓
EP2006357-004	18-Jun-2020 00:00	S10-S04		✓	
EP2006357-005	18-Jun-2020 00:00	S10-S05		✓	
EP2006357-006	18-Jun-2020 00:00	S10-S06		✓	
EP2006357-007	18-Jun-2020 00:00	S11-S01		✓	
EP2006357-008	18-Jun-2020 00:00	S11-S02		✓	
EP2006357-009	18-Jun-2020 00:00	S11-S03		✓	
EP2006357-010	18-Jun-2020 00:00	S11-S04		✓	
EP2006357-011	18-Jun-2020 00:00	S11-S05		✓	
EP2006357-012	18-Jun-2020 00:00	S11-S06	✓	✓	✓
EP2006357-013	18-Jun-2020 00:00	S12-S01		✓	
EP2006357-014	18-Jun-2020 00:00	S12-S02		✓	
EP2006357-015	18-Jun-2020 00:00	S12-S03		✓	
EP2006357-016	18-Jun-2020 00:00	S12-S04		✓	
EP2006357-017	18-Jun-2020 00:00	S12-S05		✓	
EP2006357-018	18-Jun-2020 00:00	S12-S06		✓	
EP2006357-019	18-Jun-2020 00:00	S13-S01		✓	
EP2006357-020	18-Jun-2020 00:00	S13-S02		✓	
EP2006357-021	18-Jun-2020 00:00	S13-S03	✓	✓	✓
EP2006357-022	18-Jun-2020 00:00	S13-S04		✓	
EP2006357-023	18-Jun-2020 00:00	S13-S05		✓	
EP2006357-024	18-Jun-2020 00:00	S13-S06		✓	
EP2006357-025	18-Jun-2020 00:00	S14-S01		✓	
EP2006357-026	18-Jun-2020 00:00	S14-S02		✓	
EP2006357-027	18-Jun-2020 00:00	S14-S03		✓	
EP2006357-028	18-Jun-2020 00:00	S14-S04		✓	
EP2006357-029	18-Jun-2020 00:00	S14-S05		✓	
EP2006357-030	18-Jun-2020 00:00	S20-S01	✓	✓	✓
EP2006357-031	18-Jun-2020 00:00	S20-S02		✓	
EP2006357-032	18-Jun-2020 00:00	S20-S03		✓	
EP2006357-033	18-Jun-2020 00:00	S20-S04		✓	
EP2006357-034	18-Jun-2020 00:00	S20-S05		✓	
EP2006357-035	18-Jun-2020 00:00	S20-S06		✓	

			SOIL - EA010 (solids): Electrical Conductivity (1:5)	SOIL - EA037 ASS Field Screening Analysis	SOIL - EP004 (Carbon) Organic Matter & Total Organic Carbon (Calc.)
EP2006357-036	18-Jun-2020 00:00	S21-S01		✓	
EP2006357-037	18-Jun-2020 00:00	S21-S02		✓	
EP2006357-038	18-Jun-2020 00:00	S21-S03		✓	
EP2006357-039	18-Jun-2020 00:00	S21-S04		✓	
EP2006357-040	18-Jun-2020 00:00	SZ2	✓	✓	✓
EP2006357-041	18-Jun-2020 00:00	S10-S07		✓	

Proactive Holding Time Report

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

Requested Deliverables

ACCOUNTS PAYABLE

- A4 - AU Tax Invoice (INV)	Email	West.AccountsPayable@rpsgroup.com.au

ALAN FOLEY

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

Shenae Blakiston

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

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 3
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

Analytical suites

Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)
S10-S01	1	18/06/2020	1	x				
S10-S02	2	18/06/2020	1	x				
S10-S03	3	18/06/2020	2	x	x	x		
S10-S04	4	18/06/2020	1	x				
S10-S05	5	18/06/2020	1	x				
S10-S06	6	18/06/2020	1	x				
S11-S01	7	18/06/2020	1	x				
S11-S02	8	18/06/2020	1	x				
S11-S03	9	18/06/2020	1	x				
S11-S04	10	18/06/2020	1	x				
S11-S05	11	18/06/2020	1	x				
S11-S06	12	18/06/2020	2	x	x	x		
S12-S01	13	18/06/2020	1	x				
S12-S02	14	18/06/2020	1	x				
S12-S03	15	18/06/2020	1	x				
S12-S04	16	18/06/2020	1	x				
S12-S05	17	18/06/2020	1	x				
Total number of bottles/bags/jars			19					

Environmental Division
Perth
Work Order Reference
EP2006357

Telephone : + 61-8-9406 1301

Primary destination:	ALS	Received by:	SP	Secondary destination:		Received by:	
Relinquished by:	Alan Foley	Organisation:	ALS	Relinquished by:		Organisation:	
Organisation:	RPS	Date:	~~[illegible]~~ 19.6.2020	Organisation:		Date:	
Date:	19/06/2020	Time:	1530	Date:		Time:	
Time:	8:15:00 AM			Time:			

CHAIN OF CUSTODY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	2 of 3
Turnaround time:	Standard
Quote number:	EP/446/20

Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
S12-S06	18	18/06/2020	1	x					
S13-S01	19	18/06/2020	1	x					
S13-S02	20	18/06/2020	1	x					
S13-S03	21	18/06/2020	2	x	x	x			
S13-S04	22	18/06/2020	1	x					
S13-S05	23	18/06/2020	1	x					
S13-S06	24	18/06/2020	1	x					
S14-S01	25	18/06/2020	1	x					
S14-S02	26	18/06/2020	1	x					
S14-S03	27	18/06/2020	1	x					
S14-S04	28	18/06/2020	1	x					
S14-S05	29	18/06/2020	1	x					
S14-S06	SNR	18/06/2020	1	x					
S20-S01	30	18/06/2020	2	x	x	x			
S20-S02	31	18/06/2020	1	x					
S20-S03	32	18/06/2020	1	x					
S20-S04	33	18/06/2020	1	x					
Total number of bottles/bags/jars			19						

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Alan Foley	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	19/06/2020	Time:		Date:		Time:	
Time:	8:15:00 AM			Time:			

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Page number:	3 of 3
Turnaround time:	Standard
Quote number:	EP/446/20

Analytical suites

Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
S20-S05 34	18/06/2020	1	x					
S20-S06 35	18/06/2020	1	x					
S21-S01 36	18/06/2020	1	x					
S21-S02 37	18/06/2020	1	x					
S21-S03 38	18/06/2020	1	x					
S21-S04 39	18/06/2020	1	x					
SZ2 40	18/06/2020	2	x	x	x			
Total number of bottles/bags/jars		8						

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Alan Foley	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	19/06/2020	Time:		Date:		Time:	
Time:	8:15:00 AM			Time:			

CERTIFICATE OF ANALYSIS

Work Order	: **EP2006383**	Page	: 1 of 8
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 22-Jun-2020 11:05
Order number	: ----	Date Analysis Commenced	: 25-Jun-2020
C-O-C number	: ----	Issue Date	: 01-Jul-2020 13:55
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 26		
No. of samples analysed	: 26		

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*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Inorganics, Stafford, QLD
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

- EA038 conducted by ALS Brisbane, NATA Site No. 818.
- EA150H/EA152 conducted by ALS Newcastle, NATA accreditation no. 825, site no 1656.
- EA150H: Soil particle density results fell outside the scope of AS1289.3.6.3. Results should be scrutinised accordingly.
- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	DS1-S01	DS1-S02	DS1A-S01	DS3-S01	DS3-S02
			Client sampling date / time	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006383-001	EP2006383-002	EP2006383-003	EP2006383-004	EP2006383-005
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	3230	3290	5010	3320	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	7.7	7.6	7.5	7.1	7.2
pH (Fox)	----	0.1	pH Unit	4.2	5.3	3.5	2.7	2.9
Reaction Rate	----	1	-	Extreme	Extreme	Extreme	Extreme	Extreme
EA038: Acid Volatlile Sulfur								
Acid Volatile Sulfur	----	0.001	%	0.328	0.210	0.412	0.423	0.321
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	49.2	43.9	61.4	68.0	63.4
EA150: Particle Sizing								
+75µm	----	1	%	71	67	38	28	----
+150µm	----	1	%	66	64	34	16	----
+300µm	----	1	%	55	55	30	8	----
+425µm	----	1	%	34	38	25	6	----
+600µm	----	1	%	15	21	20	5	----
+1180µm	----	1	%	7	13	14	4	----
+2.36mm	----	1	%	3	10	7	2	----
+4.75mm	----	1	%	1	8	5	2	----
+9.5mm	----	1	%	<1	5	3	2	----
+19.0mm	----	1	%	<1	<1	<1	<1	----
+37.5mm	----	1	%	<1	<1	<1	<1	----
+75.0mm	----	1	%	<1	<1	<1	<1	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	15	22	43	39	----
Silt (2-60 µm)	----	1	%	13	11	18	31	----
Sand (0.06-2.00 mm)	----	1	%	68	56	30	27	----
Gravel (>2mm)	----	1	%	4	11	9	3	----
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.41	2.47	2.02	2.30	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	8.3	6.8	17.5	8.8	----
Total Organic Carbon	----	0.5	%	4.8	4.0	10.2	5.1	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S05-S01	S05-S02	S05-S03	DS5-S01	DS5-S02
			Client sampling date / time	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006383-006	EP2006383-007	EP2006383-008	EP2006383-009	EP2006383-010
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	5320	----	----	----	936
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	6.2	5.9	6.5	7.4	7.4
pH (Fox)	----	0.1	pH Unit	4.3	4.0	3.5	3.7	3.9
Reaction Rate	----	1	-	Moderate	Moderate	Strong	Extreme	Extreme
EA038: Acid Volatlile Sulfur								
Acid Volatile Sulfur	----	0.001	%	----	----	----	----	0.986
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	----	----	----	----	74.0
EA150: Particle Sizing								
+75µm	----	1	%	----	----	----	----	27
+150µm	----	1	%	----	----	----	----	15
+300µm	----	1	%	----	----	----	----	10
+425µm	----	1	%	----	----	----	----	8
+600µm	----	1	%	----	----	----	----	6
+1180µm	----	1	%	----	----	----	----	3
+2.36mm	----	1	%	----	----	----	----	<1
+4.75mm	----	1	%	----	----	----	----	<1
+9.5mm	----	1	%	----	----	----	----	<1
+19.0mm	----	1	%	----	----	----	----	<1
+37.5mm	----	1	%	----	----	----	----	<1
+75.0mm	----	1	%	----	----	----	----	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	----	----	39
Silt (2-60 µm)	----	1	%	----	----	----	----	30
Sand (0.06-2.00 mm)	----	1	%	----	----	----	----	30
Gravel (>2mm)	----	1	%	----	----	----	----	1
Cobbles (>6cm)	----	1	%	----	----	----	----	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	----	----	----	----	2.06
EP004: Organic Matter								
Organic Matter	----	0.5	%	5.0	----	----	----	17.4
Total Organic Carbon	----	0.5	%	2.9	----	----	----	10.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S06-S01	S06-S02	S06-S03	S06-S04	S06-S05
			Client sampling date / time	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006383-011	EP2006383-012	EP2006383-013	EP2006383-014	EP2006383-015
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	6.4	6.7	7.5	7.1	7.4
pH (Fox)	----	0.1	pH Unit	3.4	3.9	5.4	5.3	5.0
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Moderate	Moderate
EA150: Particle Sizing								
+75µm	----	1	%	----	----	19	----	----
+150µm	----	1	%	----	----	9	----	----
+300µm	----	1	%	----	----	5	----	----
+425µm	----	1	%	----	----	3	----	----
+600µm	----	1	%	----	----	2	----	----
+1180µm	----	1	%	----	----	<1	----	----
+2.36mm	----	1	%	----	----	<1	----	----
+4.75mm	----	1	%	----	----	<1	----	----
+9.5mm	----	1	%	----	----	<1	----	----
+19.0mm	----	1	%	----	----	<1	----	----
+37.5mm	----	1	%	----	----	<1	----	----
+75.0mm	----	1	%	----	----	<1	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	61	----	----
Silt (2-60 µm)	----	1	%	----	----	19	----	----
Sand (0.06-2.00 mm)	----	1	%	----	----	20	----	----
Gravel (>2mm)	----	1	%	----	----	<1	----	----
Cobbles (>6cm)	----	1	%	----	----	<1	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	----	----	2.41	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S06-S06	S06-S07	S07-S01	S07-S02	S07-S03
			Client sampling date / time	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006383-016	EP2006383-017	EP2006383-018	EP2006383-019	EP2006383-020
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	381	----	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	7.0	6.8	5.3	6.4	5.8
pH (Fox)	----	0.1	pH Unit	5.3	3.4	3.2	3.7	3.3
Reaction Rate	----	1	-	Slight	Strong	Extreme	Extreme	Extreme
EP004: Organic Matter								
Organic Matter	----	0.5	%	3.4	----	----	----	----
Total Organic Carbon	----	0.5	%	2.0	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		S07-S04	S07-S05	S07-S06	DS7-S01	DS7-S02
		Client sampling date / time		19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006383-021	EP2006383-022	EP2006383-023	EP2006383-024	EP2006383-025
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	1070	----	1040	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	5.6	5.0	5.7	7.0	7.1
pH (Fox)	----	0.1	pH Unit	3.0	3.2	3.2	2.6	2.8
Reaction Rate	----	1	-	Moderate	Strong	Strong	Extreme	Extreme
EA038: Acid Volatlile Sulfur								
Acid Volatile Sulfur	----	0.001	%	----	----	----	0.362	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	----	----	----	70.2	----
EA150: Particle Sizing								
+75µm	----	1	%	----	----	----	69	----
+150µm	----	1	%	----	----	----	58	----
+300µm	----	1	%	----	----	----	49	----
+425µm	----	1	%	----	----	----	34	----
+600µm	----	1	%	----	----	----	12	----
+1180µm	----	1	%	----	----	----	5	----
+2.36mm	----	1	%	----	----	----	1	----
+4.75mm	----	1	%	----	----	----	1	----
+9.5mm	----	1	%	----	----	----	<1	----
+19.0mm	----	1	%	----	----	----	<1	----
+37.5mm	----	1	%	----	----	----	<1	----
+75.0mm	----	1	%	----	----	----	<1	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	----	16	----
Silt (2-60 µm)	----	1	%	----	----	----	15	----
Sand (0.06-2.00 mm)	----	1	%	----	----	----	67	----
Gravel (>2mm)	----	1	%	----	----	----	2	----
Cobbles (>6cm)	----	1	%	----	----	----	<1	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	----	----	----	2.22	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	<0.5	----	11.4	----
Total Organic Carbon	----	0.5	%	----	<0.5	----	6.6	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	SZ3	----	----	----	----
			Client sampling date / time	19-Jun-2020 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EP2006383-026	--------	--------	--------	--------
				Result	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1120**	----	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**5.0**	----	----	----	----
pH (Fox)	----	0.1	pH Unit	**3.2**	----	----	----	----
Reaction Rate	----	1	-	**Moderate**	----	----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	<0.5	----	----	----	----
Total Organic Carbon	----	0.5	%	<0.5	----	----	----	----

Environmental

QUALITY CONTROL REPORT

Work Order	: **EP2006383**	Page	: 1 of 3
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 22-Jun-2020
Order number	: ----	Date Analysis Commenced	: 25-Jun-2020
C-O-C number	: ----	Issue Date	: 01-Jul-2020
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 26		
No. of samples analysed	: 26		

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*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Inorganics, Stafford, QLD
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 (%)*
EA010: Conductivity (1:5) (QC Lot: 3099095)									
EP2006383-001	DS1-S01	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	3230	3360	3.98	0% - 20%
EP2006383-026	SZ3	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	1120	1100	2.00	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3107578)									
EP2006383-001	DS1-S01	EA037: pH (F)	----	0.1	pH Unit	7.7	7.8	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	4.2	4.2	0.00	0% - 20%
EP2006383-010	DS5-S02	EA037: pH (F)	----	0.1	pH Unit	7.4	7.4	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.9	3.8	0.00	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3107579)									
EP2006383-021	S07-S04	EA037: pH (F)	----	0.1	pH Unit	5.6	5.6	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.0	3.1	0.00	0% - 20%
EA038: Acid Volatlile Sulfur (QC Lot: 3110743)									
EP2006383-001	DS1-S01	EA038: Acid Volatile Sulfur	----	0.001	%	0.328	0.294	10.9	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 3100715)									
EP2006383-001	DS1-S01	EA055: Moisture Content	----	0.1	%	49.2	50.2	1.91	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 3103135)									
EP2006383-005	DS3-S02	EA055: Moisture Content	----	0.1	%	63.4	63.5	0.174	0% - 20%
EP004: Organic Matter (QC Lot: 3100682)									
EP2006383-001	DS1-S01	EP004: Organic Matter	----	0.5	%	8.3	8.3	0.00	0% - 50%
		EP004: Total Organic Carbon	----	0.5	%	4.8	4.8	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 Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA010: Conductivity (1:5) (QCLot: 3099095)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	24800 µS/cm	104	93.6	106
EA038: Acid Volatlile Sulfur (QCLot: 3110743)								
EA038: Acid Volatile Sulfur	----	0.001	%	<0.001	0.044 %	99.3	87.0	107
EP004: Organic Matter (QCLot: 3100682)								
EP004: Organic Matter	----	0.5	%	<0.5	2.3 %	86.5	70.0	120
				<0.5	85 %	89.8	70.0	120
EP004: Total Organic Carbon	----	0.5	%	<0.5	----	----	----	----

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.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2006383**	Page	: 1 of 5
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 22-Jun-2020
Site	: Ashfield Flats	Issue Date	: 01-Jul-2020
Sampler	: Matt Emeny, Shenae Blakiston	No. of samples received	: 26
Order number	: ----	No. of samples analysed	: 26

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

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

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

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		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010: Conductivity (1:5)								
Soil Glass Jar - Unpreserved (EA010)								
DS1-S01,	DS1-S02,	**19-Jun-2020**	**25-Jun-2020**	26-Jun-2020	✓	**25-Jun-2020**	23-Jul-2020	✓
DS1A-S01,	DS3-S01,							
S05-S01,	DS5-S02,							
S06-S06,	S07-S05,							
DS7-S01,	SZ3							
EA037: Ass Field Screening Analysis								
Snap Lock Bag - frozen (EA037)								
DS1-S01,	DS1-S02,	**19-Jun-2020**	**26-Jun-2020**	16-Dec-2020	✓	**26-Jun-2020**	16-Dec-2020	✓
DS1A-S01,	DS3-S01,							
DS3-S02,	S05-S01,							
S05-S02,	S05-S03,							
DS5-S01,	DS5-S02,							
S06-S01,	S06-S02,							
S06-S03,	S06-S04,							
S06-S05,	S06-S06,							
S06-S07,	S07-S01,							
S07-S02,	S07-S03,							
S07-S04,	S07-S05,							
S07-S06,	DS7-S01,							
DS7-S02,	SZ3							
EA038: Acid Volatlile Sulfur								
Snap Lock Bag - frozen (EA038)								
DS1-S01,	DS1-S02,	**19-Jun-2020**	**----**	----	----	**30-Jun-2020**	19-Jun-2021	✓
DS1A-S01,	DS3-S01,							
DS3-S02,	DS5-S02,							
DS7-S01								

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
EA055: Moisture Content (Dried @ 105-110°C)								
Snap Lock Bag - frozen (EA055)								
DS3-S02		**19-Jun-2020**	**----**	----	----	**26-Jun-2020**	03-Jul-2020	✓
Soil Glass Jar - Unpreserved (EA055)								
DS1-S01,	DS1-S02,	**19-Jun-2020**	**----**	----	----	**25-Jun-2020**	03-Jul-2020	✓
DS1A-S01,	DS3-S01,							
DS5-S02,	DS7-S01							
EA150: Particle Sizing								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)								
DS1-S01,	DS1-S02,	**19-Jun-2020**	**----**	----	----	**30-Jun-2020**	16-Dec-2020	✓
DS1A-S01,	DS3-S01,							
DS5-S02,	S06-S03,							
DS7-S01								
EA150: Soil Classification based on Particle Size								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)								
DS1-S01,	DS1-S02,	**19-Jun-2020**	**----**	----	----	**30-Jun-2020**	16-Dec-2020	✓
DS1A-S01,	DS3-S01,							
DS5-S02,	S06-S03,							
DS7-S01								
EA152: Soil Particle Density								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152)								
DS1-S01,	DS1-S02,	**19-Jun-2020**	**----**	----	----	**30-Jun-2020**	16-Dec-2020	✓
DS1A-S01,	DS3-S01,							
DS5-S02,	S06-S03,							
DS7-S01								
EP004: Organic Matter								
Soil Glass Jar - Unpreserved (EP004)								
DS1-S01,	DS1-S02,	**19-Jun-2020**	**30-Jun-2020**	17-Jul-2020	✓	**30-Jun-2020**	17-Jul-2020	✓
DS1A-S01,	DS3-S01,							
S05-S01,	DS5-S02,							
S06-S06,	S07-S05,							
DS7-S01,	SZ3							

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)							
Acid Volatile Sulfur	EA038	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
ASS Field Screening Analysis	EA037	3	26	**11.54**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acid Volatile Sulfur	EA038	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	10	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Acid Volatile Sulfur	EA038	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	10	**10.00**	**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
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3)
ASS Field Screening Analysis	EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.
Acid Volatile Sulfur	EA038	SOIL	In house: Referenced to Sullivan et al (1998). The AVS method converts reduced inorganic Sulfur to H2S by way of a cold 12MHCl acid digest; the evolved H2S is trapped in a Zinc Acetate solution as ZnS which is quantified by iodometric titration.
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 6.1 and Table 1 (14 day holding time).
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003
Soil Particle Density	EA152	SOIL	Soil Particle Density by AS 1289.3.5.1-2006 : Methods of testing soils for engineering purposes - Soil classification tests - Determination of the soil particle density of a soil - Standard method
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3).

Preparation Methods	Method	Matrix	Method Descriptions
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.
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3) (Method 105)

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EP2006383**

Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: Alan.Foley@rpsgroup.com.au	E-mail	: Lauren.biagioni@alsglobal.com
Telephone	: ----	Telephone	: 08 9406 1307
Facsimile	: ----	Facsimile	: +61-8-9406 1399
Project	: EEC20088.001	Page	: 1 of 3
Order number	: ----	Quote number	: EP2020AQUTER0006 (EP/446/20)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Ashfield Flats		
Sampler	: Matt Emeny, Shenae Blakiston		

Dates

Date Samples Received	: 22-Jun-2020 11:05	Issue Date	: 22-Jun-2020
Client Requested Due Date	: 02-Jul-2020	Scheduled Reporting Date	: **02-Jul-2020**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Not Available
No. of coolers/boxes	: 2	Temperature	: 5.4/-2.5 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 26 / 26

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
- EA038 conducted by ALS Brisbane, NATA Site No. 818.
- EA150H/EA152 conducted by ALS Newcastle, NATA accreditation no. 825, site no 1656.
- 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 (Samples.Perth@alsglobal.com)
- Analytical work for this work order will be conducted at ALS Environmental Perth.
- **EA150H/EA152 analysis will be conducted by ALS Environmental, Newcastle, NATA accreditation no. 825, Site No. 1656.**
- Please direct any turnaround / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **EA038 analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818.**
- **pH analysis should be conducted within 6 hours of sampling.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

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: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA010 (solids): Electrical Conductivity (1:5)	SOIL - EA037 ASS Field Screening Analysis	SOIL - EA038 Acid Volatile Sulfur	SOIL - EA055-103 Moisture Content	SOIL - EA150H/EA152 Particle Sizing with Hydrometer + Soil Particle	SOIL - EP004 (Carbon) Organic Matter & Total Organic Carbon (Calc.)
EP2006383-001	19-Jun-2020 00:00	DS1-S01	✓	✓	✓	✓	✓	✓
EP2006383-002	19-Jun-2020 00:00	DS1-S02	✓	✓	✓	✓	✓	✓
EP2006383-003	19-Jun-2020 00:00	DS1A-S01	✓	✓	✓	✓	✓	✓
EP2006383-004	19-Jun-2020 00:00	DS3-S01	✓	✓	✓	✓	✓	✓
EP2006383-005	19-Jun-2020 00:00	DS3-S02		✓	✓	✓		
EP2006383-006	19-Jun-2020 00:00	S05-S01	✓	✓				✓
EP2006383-007	19-Jun-2020 00:00	S05-S02		✓				
EP2006383-008	19-Jun-2020 00:00	S05-S03		✓				
EP2006383-009	19-Jun-2020 00:00	DS5-S01		✓				
EP2006383-010	19-Jun-2020 00:00	DS5-S02	✓	✓	✓	✓	✓	✓
EP2006383-011	19-Jun-2020 00:00	S06-S01		✓				
EP2006383-012	19-Jun-2020 00:00	S06-S02		✓				
EP2006383-013	19-Jun-2020 00:00	S06-S03		✓			✓	
EP2006383-014	19-Jun-2020 00:00	S06-S04		✓				
EP2006383-015	19-Jun-2020 00:00	S06-S05		✓				
EP2006383-016	19-Jun-2020 00:00	S06-S06	✓	✓				✓
EP2006383-017	19-Jun-2020 00:00	S06-S07		✓				
EP2006383-018	19-Jun-2020 00:00	S07-S01		✓				
EP2006383-019	19-Jun-2020 00:00	S07-S02		✓				
EP2006383-020	19-Jun-2020 00:00	S07-S03		✓				
EP2006383-021	19-Jun-2020 00:00	S07-S04		✓				
EP2006383-022	19-Jun-2020 00:00	S07-S05	✓	✓				✓
EP2006383-023	19-Jun-2020 00:00	S07-S06		✓				
EP2006383-024	19-Jun-2020 00:00	DS7-S01	✓	✓	✓	✓	✓	✓
EP2006383-025	19-Jun-2020 00:00	DS7-S02		✓				
EP2006383-026	19-Jun-2020 00:00	SZ3	✓	✓				✓

Proactive Holding Time Report

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

Requested Deliverables

ACCOUNTS PAYABLE		
- A4 - AU Tax Invoice (INV)	Email	West.AccountsPayable@rpsgroup.com.au
ALAN FOLEY		
- *AU Certificate of Analysis - NATA (COA)	Email	Alan.Foley@rpsgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	Alan.Foley@rpsgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	Alan.Foley@rpsgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	Alan.Foley@rpsgroup.com.au
- Attachment - Report (SUBCO)	Email	Alan.Foley@rpsgroup.com.au
- Chain of Custody (CoC) (COC)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - ENMRG (ENMRG)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - XTab (XTAB)	Email	Alan.Foley@rpsgroup.com.au
Shenae Blakiston		
- *AU Certificate of Analysis - NATA (COA)	Email	shenae.blakiston@rpsgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	shenae.blakiston@rpsgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	shenae.blakiston@rpsgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	shenae.blakiston@rpsgroup.com.au
- Attachment - Report (SUBCO)	Email	shenae.blakiston@rpsgroup.com.au
- Chain of Custody (CoC) (COC)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - ENMRG (ENMRG)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - XTab (XTAB)	Email	shenae.blakiston@rpsgroup.com.au

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 2
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

	Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)
1	DS1-S01	19/06/2020	4	x	x	x	x	x
2	DS1-S02	19/06/2020	4	x	x	x	x	x
3	DS1A-S01	19/06/2020	4	x	x	x	x	x
4	DS3-S01	19/06/2020	4	x	x	x	x	x
5	DS3-S02	19/06/2020	1 (2)	x				
6	S05-S01	19/06/2020	3 (2)	x	x	x		
7	S05-S02	19/06/2020	1	x				
8	S05-S03	19/06/2020	1	x				
9	DS5-S01	19/06/2020	4 (1)	x	x	x	x	x
10	DS5-S02	19/06/2020	1 (4)	x				
11	S06-S01	19/06/2020	1	x				
12	S06-S02	19/06/2020	1	x				
13	S06-S03	19/06/2020	2	x			x	
14	S06-S04	19/06/2020	1	x				
15	S06-S05	19/06/2020	1	x				
16	S06-S06	19/06/2020	3	x	x	x		
17	S06-S07	19/06/2020	1	x				
	Total number of bottles/bags/jars		37					

Primary destination:	ALS	**Received by:**	MO	**Secondary destination:**		**Received by:**	
Relinquished by:	Alan Foley	**Organisation:**	ALS	**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**	22-6-2020	**Organisation:**		**Date:**	
Date:	22/06/2020	**Time:**	11.05	**Date:**		**Time:**	
Time:	8:45:00 AM			**Time:**			

Environmental Division
Perth
Work Order Reference
EP2006383

Telephone : + 61-8-9406 1301

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Page number:	2 of 2
Turnaround time:	Standard
Quote number:	EP/446/20

Analytical suites

	Sample I.D.	**Date collected**	**Number of jars / bottles / bags**	**ASS Field Screening (EA037)**	**Electrical Conductivity (EA010)**	**Organic Matter & TOC (EP004)**	**PSD & Soil Particle Density (EA150H/EA152)**	**Acid Volatile Sulfur (EA038)**	**Remarks**
18	S07-S01	19/06/2020	1	x					
19	S07-S02	19/06/2020	1	x					
20	S07-S03	19/06/2020	1	x					
21	S07-S04	19/06/2020	1	x					
22	S07-S05	19/06/2020	2	x	x	x			
23	S07-S06	19/06/2020	1	x					
24	DS7-S01	19/06/2020	4	x	x	x	x	x	
25	DS7-S02	19/06/2020	1	x					
26	SZ3	19/06/2020	2	x	x	x			

Total number of bottles/bags/jars 14

Primary destination:	ALS	**Received by:**	MO	**Secondary destination:**		**Received by:**	
Relinquished by:	Alan Foley	**Organisation:**	AW	**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**	22-6-2020	**Organisation:**		**Date:**	
Date:	22/06/2020	**Time:**	11:05	**Date:**		**Time:**	
Time:	8:45:00 AM			**Time:**			

Certificate of Analysis

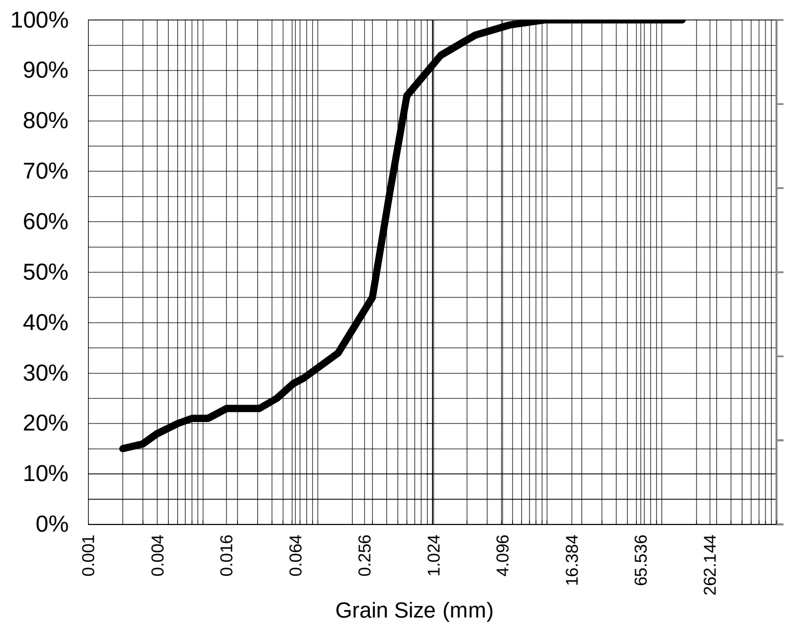
ALS Laboratory Group Pty Ltd
5/585 Maitland Road
Mayfield West, NSW 2304
pH 02 4014 2500
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	30-Jun-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	22-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006383-001 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	DS1-S01

Particle Size Distribution



Particle Size (mm)	% Passing
9.50	100%
4.75	99%
2.36	97%
1.18	93%
0.600	85%
0.425	66%
0.300	45%
0.150	34%
0.075	29%
Particle Size (microns)	
44	25%
31	23%
22	23%
16	23%
11	21%
8	21%
6	20%
4	18%
2	15%

Median Particle Size (mm)*	0.330

Analysis Notes

Samples analysed as received.
**** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results***

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Jun-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES,VEG

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.41 (2.45)*

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WORLD RECOGNISED ACCREDITATION

Aleksandar Vujkovic
Laboratory Supervisor
Authorised Signatory

Certificate of Analysis

ALS Laboratory Group Pty Ltd
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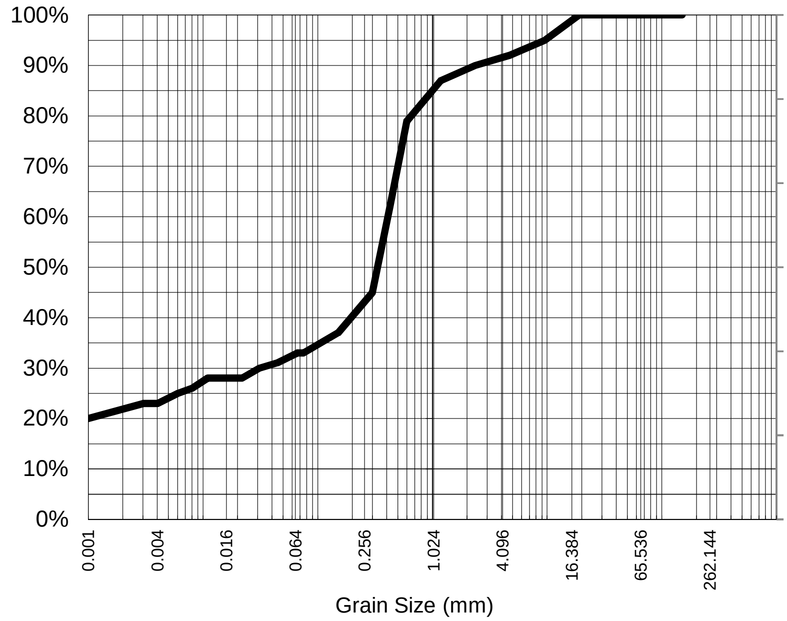
Mayfield West, NSW 2304
pH 02 4014 2500
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	30-Jun-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	22-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006383-002 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	DS1-S02

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	95%
4.75	92%
2.36	90%
1.18	87%
0.600	79%
0.425	62%
0.300	45%
0.150	37%
0.075	33%
Particle Size (microns)	
44	31%
31	30%
22	28%
16	28%
11	28%
8	26%
6	25%
4	23%
1	20%

Median Particle Size (mm)*	0.337

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	26-Jun-20
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	SAND, FINES,VEG	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.47		

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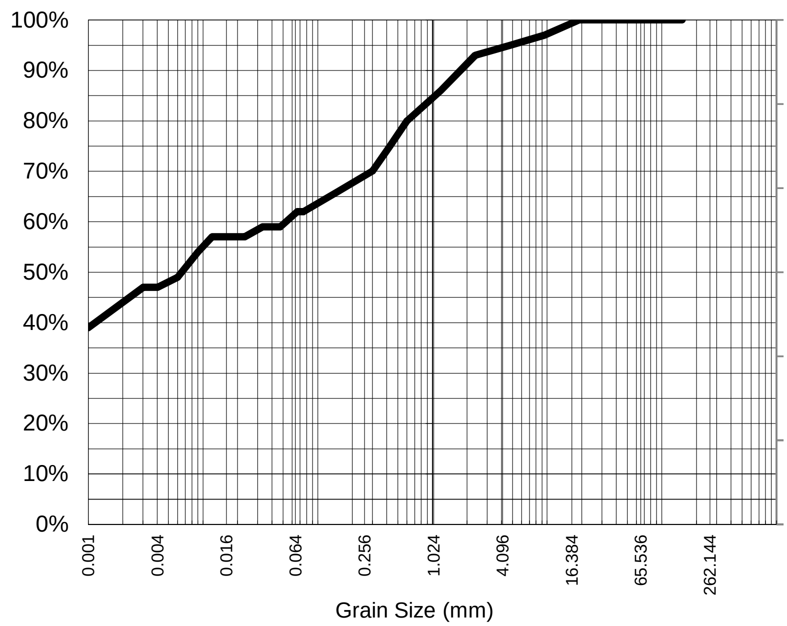
Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	30-Jun-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	22-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006383-003 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	DS1A-S01

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	97%
4.75	95%
2.36	93%
1.18	86%
0.600	80%
0.425	75%
0.300	70%
0.150	66%
0.075	62%
Particle Size (microns)	
47	59%
33	59%
23	57%
17	57%
12	57%
9	54%
6	49%
4	47%
1	39%

Median Particle Size (mm)*	0.007

Analysis Notes

Samples analysed as received.

**** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results***

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Jun-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: FINES, SAND, VEG

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.02 (2.45)*

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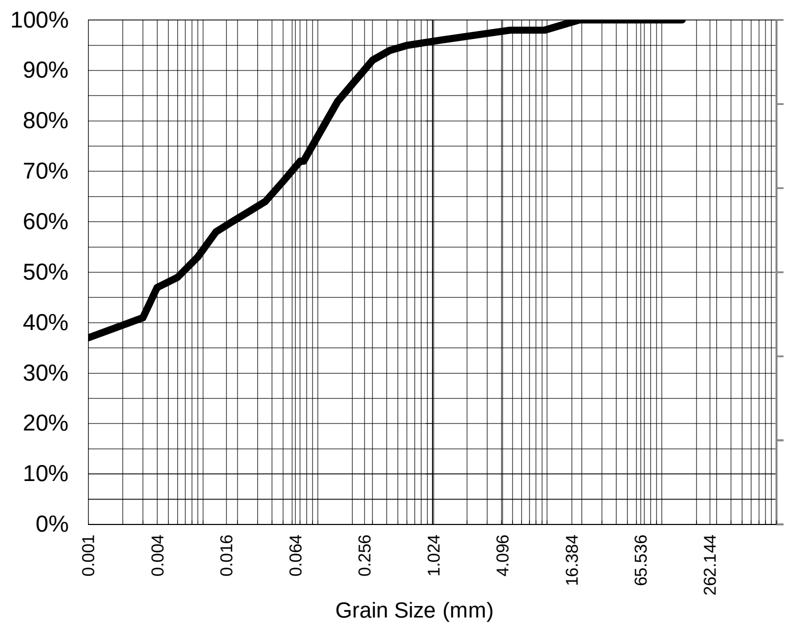
ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	30-Jun-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	22-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006383-004 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	DS3-S01

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	98%
4.75	98%
2.36	97%
1.18	96%
0.600	95%
0.425	94%
0.300	92%
0.150	84%
0.075	72%
Particle Size (microns)	
50	68%
35	64%
25	62%
18	60%
13	58%
9	53%
6	49%
4	47%
1	37%

Median Particle Size (mm)*	0.007

Analysis Notes

Samples analysed as received.

**** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results***

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Jun-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: FINES, SAND, VEG

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.3 (2.45)*

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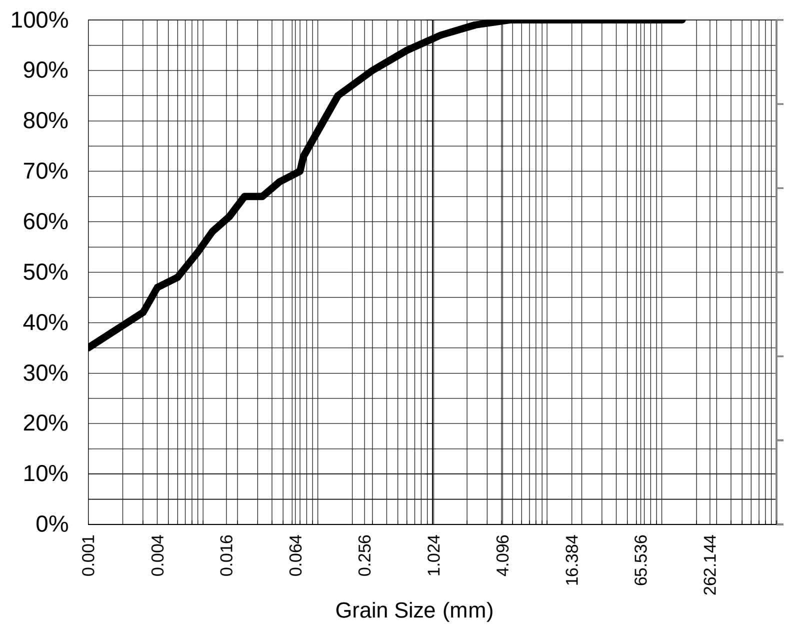
ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	30-Jun-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	22-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006383-010 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	DS5-S02

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	99%
1.18	97%
0.600	94%
0.425	92%
0.300	90%
0.150	85%
0.075	73%
Particle Size (microns)	
47	68%
33	65%
23	65%
17	61%
12	58%
9	54%
6	49%
4	47%
1	35%

Median Particle Size (mm)*	0.007

Analysis Notes

Samples analysed as received.

**** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results***

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	26-Jun-20
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	FINES, SAND, VEG	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.06 (2.45)*		

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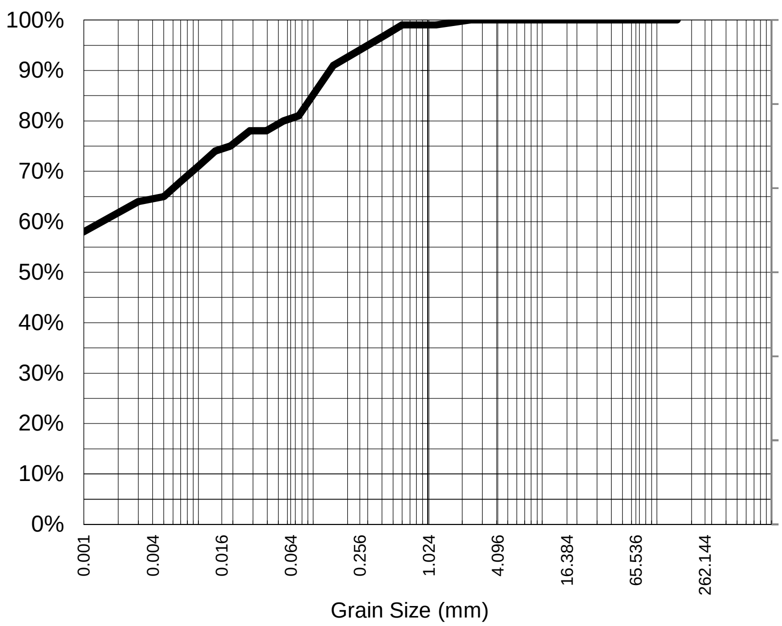
Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	30-Jun-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	22-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006383-013 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	S06-S03

Particle Size Distribution



Particle Size (mm)	% Passing
2.36	100%
1.18	99%
0.600	99%
0.425	97%
0.300	95%
0.150	91%
0.075	81%
Particle Size (microns)	
55	80%
39	78%
28	78%
19	75%
14	74%
10	71%
7	68%
5	65%
1	58%

Median Particle Size (mm)*	<0.007

Analysis Notes

Samples analysed as received.

**** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results***

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Jun-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: FINES, SAND, VEG

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.41 (2.45)*

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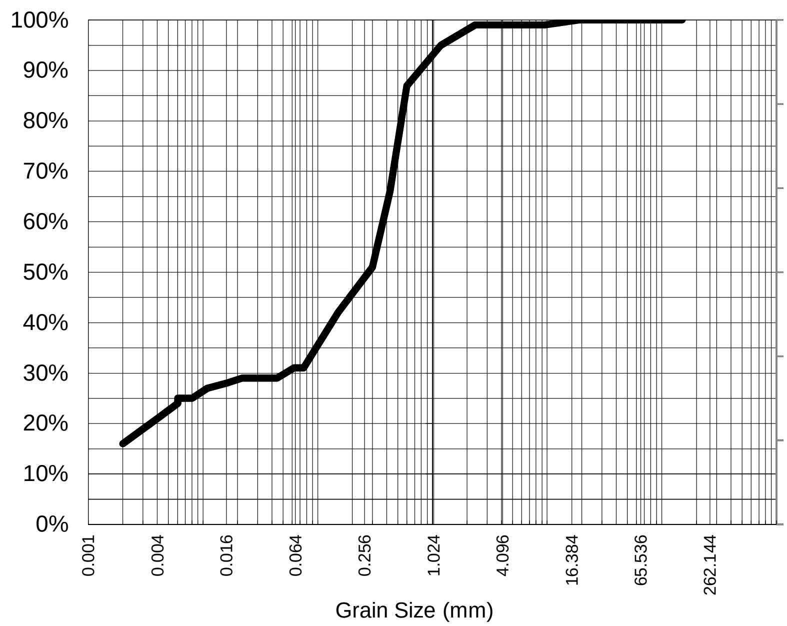
Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	30-Jun-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	22-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006383-024 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	DS7-S01

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	99%
4.75	99%
2.36	99%
1.18	95%
0.600	87%
0.425	66%
0.300	51%
0.150	42%
0.075	31%
Particle Size (microns)	
44	29%
31	29%
22	29%
16	28%
11	27%
8	25%
6	25%
6	24%
2	16%

Median Particle Size (mm)*	0.283

Analysis Notes

Samples analysed as received.

**** Soil Particle Density results fell outside the scope of AS 1289.3.6.3. Typical sediment SPD values used for calculations and consequently, NATA endorsement does not apply to hydrometer results***

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 26-Jun-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: SAND, FINES,VEG

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.22 (2.45)*

NATA Accreditation: 825 Site: Newcastle
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Aleksandar Vujkovic
Laboratory Supervisor
Authorised Signatory

Template Version PKV8.0 180919

CERTIFICATE OF ANALYSIS

Work Order	: **EP2006459**	Page	: 1 of 12
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 23-Jun-2020 13:30
Order number	: ----	Date Analysis Commenced	: 26-Jun-2020
C-O-C number	: ----	Issue Date	: 01-Jul-2020 13:57
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 47		
No. of samples analysed	: 47		

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*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

- PSD conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S29-S01	S29-S02	S29-S03	S29-S04	S29-S05
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006459-001	EP2006459-002	EP2006459-003	EP2006459-004	EP2006459-005
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	220	----	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	7.7	7.8	7.9	7.6	7.2
pH (Fox)	----	0.1	pH Unit	5.0	5.3	5.4	5.1	5.0
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Moderate	Moderate
EA150: Particle Sizing								
+75µm	----	1	%	92	----	----	----	----
+150µm	----	1	%	88	----	----	----	----
+300µm	----	1	%	72	----	----	----	----
+425µm	----	1	%	53	----	----	----	----
+600µm	----	1	%	36	----	----	----	----
+1180µm	----	1	%	23	----	----	----	----
+2.36mm	----	1	%	17	----	----	----	----
+4.75mm	----	1	%	10	----	----	----	----
+9.5mm	----	1	%	2	----	----	----	----
+19.0mm	----	1	%	<1	----	----	----	----
+37.5mm	----	1	%	<1	----	----	----	----
+75.0mm	----	1	%	<1	----	----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	5	----	----	----	----
Silt (2-60 µm)	----	1	%	2	----	----	----	----
Sand (0.06-2.00 mm)	----	1	%	74	----	----	----	----
Gravel (>2mm)	----	1	%	19	----	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.53	----	----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	4.6	----	----	----	----
Total Organic Carbon	----	0.5	%	2.7	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S31-S01	S31-S02	S31-S03	S31-S04	S31-S05
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006459-006	EP2006459-007	EP2006459-008	EP2006459-009	EP2006459-010
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	8	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	6.9	7.0	7.1	7.1	7.2
pH (Fox)	----	0.1	pH Unit	4.6	5.0	4.8	4.8	4.9
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Moderate	Moderate
EA150: Particle Sizing								
+75µm	----	1	%	----	98	----	----	----
+150µm	----	1	%	----	96	----	----	----
+300µm	----	1	%	----	77	----	----	----
+425µm	----	1	%	----	38	----	----	----
+600µm	----	1	%	----	10	----	----	----
+1180µm	----	1	%	----	<1	----	----	----
+2.36mm	----	1	%	----	<1	----	----	----
+4.75mm	----	1	%	----	<1	----	----	----
+9.5mm	----	1	%	----	<1	----	----	----
+19.0mm	----	1	%	----	<1	----	----	----
+37.5mm	----	1	%	----	<1	----	----	----
+75.0mm	----	1	%	----	<1	----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	2	----	----	----
Silt (2-60 µm)	----	1	%	----	<1	----	----	----
Sand (0.06-2.00 mm)	----	1	%	----	98	----	----	----
Gravel (>2mm)	----	1	%	----	<1	----	----	----
Cobbles (>6cm)	----	1	%	----	<1	----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	----	2.62	----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	0.8	----	----	----
Total Organic Carbon	----	0.5	%	----	<0.5	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S26-S01	S26-S02	S26-S03	S26-S04	S25-S01
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006459-011	EP2006459-012	EP2006459-013	EP2006459-014	EP2006459-015
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	1850	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.4	4.3	3.9	3.8	5.5
pH (Fox)	----	0.1	pH Unit	2.9	2.7	2.3	2.1	4.3
Reaction Rate	----	1	-	Extreme	Moderate	Strong	Strong	Moderate
EA150: Particle Sizing								
+75µm	----	1	%	----	23	----	----	----
+150µm	----	1	%	----	16	----	----	----
+300µm	----	1	%	----	11	----	----	----
+425µm	----	1	%	----	9	----	----	----
+600µm	----	1	%	----	7	----	----	----
+1180µm	----	1	%	----	3	----	----	----
+2.36mm	----	1	%	----	<1	----	----	----
+4.75mm	----	1	%	----	<1	----	----	----
+9.5mm	----	1	%	----	<1	----	----	----
+19.0mm	----	1	%	----	<1	----	----	----
+37.5mm	----	1	%	----	<1	----	----	----
+75.0mm	----	1	%	----	<1	----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	38	----	----	----
Silt (2-60 µm)	----	1	%	----	37	----	----	----
Sand (0.06-2.00 mm)	----	1	%	----	23	----	----	----
Gravel (>2mm)	----	1	%	----	2	----	----	----
Cobbles (>6cm)	----	1	%	----	<1	----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	----	2.53	----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	7.7	----	----	----
Total Organic Carbon	----	0.5	%	----	4.5	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S25-S02	S25-S03	S25-S04	S22-S01	S22-S02
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006459-016	EP2006459-017	EP2006459-018	EP2006459-019	EP2006459-020
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	2680	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	3.9	3.9	3.4	6.5	6.4
pH (Fox)	----	0.1	pH Unit	2.8	2.6	1.9	4.4	4.3
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Moderate	Moderate
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	<0.5	----	----	----
Total Organic Carbon	----	0.5	%	----	<0.5	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		S22-S03	S01-S01	S01-S02	S01-S03	S01-S04
		Client sampling date / time		22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006459-021	EP2006459-022	EP2006459-023	EP2006459-024	EP2006459-025
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**7720**	----	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.1**	**7.2**	**6.8**	**6.2**	**6.7**
pH (Fox)	----	0.1	pH Unit	**4.4**	**5.3**	**4.7**	**4.3**	**4.6**
Reaction Rate	----	1	-	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Strong**
EP004: Organic Matter								
Organic Matter	----	0.5	%	**1.5**	----	----	----	----
Total Organic Carbon	----	0.5	%	**0.8**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S01-S05	S30-S01	S30-S02	S30-S03	S30-S04
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006459-026	EP2006459-027	EP2006459-028	EP2006459-029	EP2006459-030
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.6**	**6.4**	**7.1**	**7.8**	**7.3**
pH (Fox)	----	0.1	pH Unit	**4.4**	**4.1**	**4.6**	**6.3**	**5.3**
Reaction Rate	----	1	-	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S30-S05	S30-S06	S04-S01	S04-S02	S04-S03
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006459-031	EP2006459-032	EP2006459-033	EP2006459-034	EP2006459-035
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	7.2	7.3	6.5	6.4	6.4
pH (Fox)	----	0.1	pH Unit	5.4	5.7	4.0	4.3	4.3
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Moderate	Moderate

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID		S04-S04	S04-S05	S04-S06	S04-S07	S03-S01
		Client sampling date / time		22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006459-036	EP2006459-037	EP2006459-038	EP2006459-039	EP2006459-040
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	2880	----	----	2780
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	6.4	6.7	6.6	6.4	6.3
pH (Fox)	----	0.1	pH Unit	4.8	4.3	3.9	3.1	3.8
Reaction Rate	----	1	-	Moderate	Strong	Strong	Strong	Moderate
EA150: Particle Sizing								
+75µm	----	1	%	----	38	----	----	----
+150µm	----	1	%	----	17	----	----	----
+300µm	----	1	%	----	9	----	----	----
+425µm	----	1	%	----	6	----	----	----
+600µm	----	1	%	----	2	----	----	----
+1180µm	----	1	%	----	<1	----	----	----
+2.36mm	----	1	%	----	<1	----	----	----
+4.75mm	----	1	%	----	<1	----	----	----
+9.5mm	----	1	%	----	<1	----	----	----
+19.0mm	----	1	%	----	<1	----	----	----
+37.5mm	----	1	%	----	<1	----	----	----
+75.0mm	----	1	%	----	<1	----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	39	----	----	----
Silt (2-60 µm)	----	1	%	----	19	----	----	----
Sand (0.06-2.00 mm)	----	1	%	----	42	----	----	----
Gravel (>2mm)	----	1	%	----	<1	----	----	----
Cobbles (>6cm)	----	1	%	----	<1	----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	----	2.62	----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	1.2	----	----	25.8
Total Organic Carbon	----	0.5	%	----	0.7	----	----	15.0

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S03-S02	S03-S03	S03-S04	S03-S05	S03-S06
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006459-041	EP2006459-042	EP2006459-043	EP2006459-044	EP2006459-045
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.2**	**6.2**	**6.2**	**6.4**	**6.7**
pH (Fox)	----	0.1	pH Unit	**3.9**	**4.3**	**3.8**	**5.0**	**4.2**
Reaction Rate	----	1	-	**Moderate**	**Moderate**	**Moderate**	**Strong**	**Strong**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S03-S07	SZ4	----	----	----
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EP2006459-046	EP2006459-047	--------	--------	--------
				Result	Result	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	6.6	6.0	----	----	----
pH (Fox)	----	0.1	pH Unit	3.8	4.5	----	----	----
Reaction Rate	----	1	-	Strong	Strong	----	----	----

QUALITY CONTROL REPORT

Work Order	: **EP2006459**	Page	: 1 of 3
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 23-Jun-2020
Order number	: ----	Date Analysis Commenced	: 26-Jun-2020
C-O-C number	: ----	Issue Date	: 01-Jul-2020
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 47		
No. of samples analysed	: 47		

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*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 (%)
EA010: Conductivity (1:5) (QC Lot: 3100884)									
EP2006459-001	S29-S01	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	220	240	8.78	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3107573)									
EP2006459-001	S29-S01	EA037: pH (F)	----	0.1	pH Unit	7.7	7.7	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.0	5.0	0.00	0% - 20%
EP2006459-010	S31-S05	EA037: pH (F)	----	0.1	pH Unit	7.2	7.2	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	4.9	4.8	0.00	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3107574)									
EP2006459-021	S22-S03	EA037: pH (F)	----	0.1	pH Unit	6.1	6.2	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	4.4	4.5	3.16	0% - 20%
EP2006459-030	S30-S04	EA037: pH (F)	----	0.1	pH Unit	7.3	7.4	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	5.3	5.3	0.00	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3107575)									
EP2006459-041	S03-S02	EA037: pH (F)	----	0.1	pH Unit	6.2	6.1	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.9	3.7	3.67	0% - 20%
EP004: Organic Matter (QC Lot: 3100687)									
EP2006459-001	S29-S01	EP004: Organic Matter	----	0.5	%	4.6	4.6	0.00	No Limit
		EP004: Total Organic Carbon	----	0.5	%	2.7	2.7	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 Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA010: Conductivity (1:5) (QCLot: 3100884)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	24800 µS/cm	102	93.6	106
EP004: Organic Matter (QCLot: 3100687)								
EP004: Organic Matter	----	0.5	%	<0.5	2.3 %	109	70.0	120
				<0.5	85 %	83.9	70.0	120
EP004: Total Organic Carbon	----	0.5	%	<0.5	----	----	----	----

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.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2006459**	Page	: 1 of 5
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 23-Jun-2020
Site	: Ashfield Flats	Issue Date	: 01-Jul-2020
Sampler	: Matt Emeny, Shenae Blakiston	No. of samples received	: 47
Order number	: ----	No. of samples analysed	: 47

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

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

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

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
EA010: Conductivity (1:5)							
Soil Glass Jar - Unpreserved (EA010) S29-S01, S31-S02, S26-S02, S25-S03, S22-S03, S04-S05, S03-S01	**22-Jun-2020**	**26-Jun-2020**	29-Jun-2020	✓	**26-Jun-2020**	24-Jul-2020	✓
EA037: Ass Field Screening Analysis							
Snap Lock Bag - frozen (EA037) S29-S01, S29-S02, S29-S03, S29-S04, S29-S05, S31-S01, S31-S02, S31-S03, S31-S04, S31-S05, S26-S01, S26-S02, S26-S03, S26-S04, S25-S01, S25-S02, S25-S03, S25-S04, S22-S01, S22-S02, S22-S03, S01-S01, S01-S02, S01-S03, S01-S04, S01-S05, S30-S01, S30-S02, S30-S03, S30-S04, S30-S05, S30-S06, S04-S01, S04-S02, S04-S03, S04-S04, S04-S05, S04-S06, S04-S07, S03-S01, S03-S02, S03-S03, S03-S04, S03-S05, S03-S06, S03-S07, SZ4	**22-Jun-2020**	**26-Jun-2020**	19-Dec-2020	✓	**26-Jun-2020**	19-Dec-2020	✓

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA150: Particle Sizing								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)								
S29-S01, S26-S02,	S31-S02, S04-S05	**22-Jun-2020**	**----**	----	----	**01-Jul-2020**	19-Dec-2020	✓
EA150: Soil Classification based on Particle Size								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)								
S29-S01, S26-S02,	S31-S02, S04-S05	**22-Jun-2020**	**----**	----	----	**01-Jul-2020**	19-Dec-2020	✓
EA152: Soil Particle Density								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152)								
S29-S01, S26-S02,	S31-S02, S04-S05	**22-Jun-2020**	**----**	----	----	**01-Jul-2020**	19-Dec-2020	✓
EP004: Organic Matter								
Soil Glass Jar - Unpreserved (EP004)								
S29-S01, S26-S02, S22-S03, S03-S01	S31-S02, S25-S03, S04-S05,	**22-Jun-2020**	**29-Jun-2020**	20-Jul-2020	✓	**29-Jun-2020**	20-Jul-2020	✓

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)							
ASS Field Screening Analysis	EA037	5	47	**10.64**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Electrical Conductivity (1:5)	EA010	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	7	**28.57**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Electrical Conductivity (1:5)	EA010	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	7	**14.29**	**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
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3)
ASS Field Screening Analysis	EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003
Soil Particle Density	EA152	SOIL	Soil Particle Density by AS 1289.3.5.1-2006 : Methods of testing soils for engineering purposes - Soil classification tests - Determination of the soil particle density of a soil - Standard method
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3).

Preparation Methods	Method	Matrix	Method Descriptions
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.
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3) (Method 105)

Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	: **EP2006459**		
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: Alan.Foley@rpsgroup.com.au	E-mail	: Lauren.biagioni@alsglobal.com
Telephone	: ----	Telephone	: 08 9406 1307
Facsimile	: ----	Facsimile	: +61-8-9406 1399
Project	: EEC20088.001	Page	: 1 of 3
Order number	: ----	Quote number	: EP2020AQUTER0006 (EP/446/20)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Ashfield Flats		
Sampler	: Matt Emeny, Shenae Blakiston		

Dates

Date Samples Received	: 23-Jun-2020 13:30	Issue Date	: 23-Jun-2020
Client Requested Due Date	: 02-Jul-2020	Scheduled Reporting Date	: **02-Jul-2020**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 2	Temperature	: 0.0 - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 47 / 47

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
- PSD conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- 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 (Samples.Perth@alsglobal.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.
- **PSD 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.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

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: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA010 (solids): Electrical Conductivity (1:5)	SOIL - EA037 ASS Field Screening Analysis	SOIL - EA150H/EA152 Particle Sizing with Hydrometer + Soil Particle	SOIL - EP004 (Carbon) Organic Matter & Total Organic Carbon (Calc.)
EP2006459-001	22-Jun-2020 00:00	S29-S01	✓	✓	✓	✓
EP2006459-002	22-Jun-2020 00:00	S29-S02		✓		
EP2006459-003	22-Jun-2020 00:00	S29-S03		✓		
EP2006459-004	22-Jun-2020 00:00	S29-S04		✓		
EP2006459-005	22-Jun-2020 00:00	S29-S05		✓		
EP2006459-006	22-Jun-2020 00:00	S31-S01		✓		
EP2006459-007	22-Jun-2020 00:00	S31-S02	✓	✓	✓	✓
EP2006459-008	22-Jun-2020 00:00	S31-S03		✓		
EP2006459-009	22-Jun-2020 00:00	S31-S04		✓		
EP2006459-010	22-Jun-2020 00:00	S31-S05		✓		
EP2006459-011	22-Jun-2020 00:00	S26-S01		✓		
EP2006459-012	22-Jun-2020 00:00	S26-S02	✓	✓	✓	✓
EP2006459-013	22-Jun-2020 00:00	S26-S03		✓		
EP2006459-014	22-Jun-2020 00:00	S26-S04		✓		
EP2006459-015	22-Jun-2020 00:00	S25-S01		✓		
EP2006459-016	22-Jun-2020 00:00	S25-S02		✓		
EP2006459-017	22-Jun-2020 00:00	S25-S03	✓	✓		✓
EP2006459-018	22-Jun-2020 00:00	S25-S04		✓		
EP2006459-019	22-Jun-2020 00:00	S22-S01		✓		
EP2006459-020	22-Jun-2020 00:00	S22-S02		✓		
EP2006459-021	22-Jun-2020 00:00	S22-S03	✓	✓		✓
EP2006459-022	22-Jun-2020 00:00	S01-S01		✓		
EP2006459-023	22-Jun-2020 00:00	S01-S02		✓		
EP2006459-024	22-Jun-2020 00:00	S01-S03		✓		
EP2006459-025	22-Jun-2020 00:00	S01-S04		✓		
EP2006459-026	22-Jun-2020 00:00	S01-S05		✓		
EP2006459-027	22-Jun-2020 00:00	S30-S01		✓		
EP2006459-028	22-Jun-2020 00:00	S30-S02		✓		
EP2006459-029	22-Jun-2020 00:00	S30-S03		✓		
EP2006459-030	22-Jun-2020 00:00	S30-S04		✓		
EP2006459-031	22-Jun-2020 00:00	S30-S05		✓		
EP2006459-032	22-Jun-2020 00:00	S30-S06		✓		
EP2006459-033	22-Jun-2020 00:00	S04-S01		✓		
EP2006459-034	22-Jun-2020 00:00	S04-S02		✓		
EP2006459-035	22-Jun-2020 00:00	S04-S03		✓		

			SOIL - EA010 (solids): Electrical Conductivity (1:5)	SOIL - EA037 ASS Field Screening Analysis	SOIL - EA150H/EA152 Particle Sizing with Hydrometer + Soil Particle	SOIL - EP004 (Carbon) Organic Matter & Total Organic Carbon (Calc.)
EP2006459-036	22-Jun-2020 00:00	S04-S04		✓		
EP2006459-037	22-Jun-2020 00:00	S04-S05	✓	✓	✓	✓
EP2006459-038	22-Jun-2020 00:00	S04-S06		✓		
EP2006459-039	22-Jun-2020 00:00	S04-S07		✓		
EP2006459-040	22-Jun-2020 00:00	S03-S01	✓	✓		✓
EP2006459-041	22-Jun-2020 00:00	S03-S02		✓		
EP2006459-042	22-Jun-2020 00:00	S03-S03		✓		
EP2006459-043	22-Jun-2020 00:00	S03-S04		✓		
EP2006459-044	22-Jun-2020 00:00	S03-S05		✓		
EP2006459-045	22-Jun-2020 00:00	S03-S06		✓		
EP2006459-046	22-Jun-2020 00:00	S03-S07		✓		
EP2006459-047	22-Jun-2020 00:00	SZ4		✓		

Proactive Holding Time Report

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

Requested Deliverables

ACCOUNTS PAYABLE		
- A4 - AU Tax Invoice (INV)	Email	West.AccountsPayable@rpsgroup.com.au
ALAN FOLEY		
- *AU Certificate of Analysis - NATA (COA)	Email	Alan.Foley@rpsgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	Alan.Foley@rpsgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	Alan.Foley@rpsgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	Alan.Foley@rpsgroup.com.au
- Attachment - Report (SUBCO)	Email	Alan.Foley@rpsgroup.com.au
- Chain of Custody (CoC) (COC)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - ENMRG (ENMRG)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - XTab (XTAB)	Email	Alan.Foley@rpsgroup.com.au
Shenae Blakiston		
- *AU Certificate of Analysis - NATA (COA)	Email	shenae.blakiston@rpsgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	shenae.blakiston@rpsgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	shenae.blakiston@rpsgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	shenae.blakiston@rpsgroup.com.au
- Attachment - Report (SUBCO)	Email	shenae.blakiston@rpsgroup.com.au
- Chain of Custody (CoC) (COC)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - ENMRG (ENMRG)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - XTab (XTAB)	Email	shenae.blakiston@rpsgroup.com.au

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 3
Turnaround time:	Standard
Quote number:	EP/446/20

Analytical suites

Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
S29-S01	1	22/06/2020	3	x	x	x	x		
S29-S02	2	22/06/2020	1	x					
S29-S03	3	22/06/2020	1	x					
S29-S04	4	22/06/2020	1	x					
S29-S05	5	22/06/2020	1	x					
S31-S01	6	22/06/2020	1	x					
S31-S02	7	22/06/2020	3	x	x	x	x		
S31-S03	8	22/06/2020	1	x					
S31-S04	9	22/06/2020	1	x					
S31-S05	10	22/06/2020	1	x					
S26-S01	11	22/06/2020	1	x					
S26-S02	12	22/06/2020	3	x	x	x	x		
S26-S03	13	22/06/2020	1	x					
S26-S04	14	22/06/2020	1	x					
S25-S01	15	22/06/2020	1	x					
S25-S02	16	22/06/2020	1	x					
S25-S03	17	22/06/2020	2	x	x	x			
Total number of bottles/bags/jars			24						

Environmental Division
Perth
Work Order Reference
EP2006459

Telephone : + 61-8-9406 1301

Primary destination:	ALS	**Received by:**	Louise K	**Secondary destination:**		**Received by:**	
Relinquished by:	Kurt Blackman	**Organisation:**	ALS	**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**	23/6/2020	**Organisation:**		**Date:**	
Date:	23/06/2020	**Time:**	1330	**Date:**		**Time:**	
Time:	9:00am			**Time:**			

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	2 of 3
Turnaround time:	Standard
Quote number:	EP/446/20

Analytical suites

Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
S25-S04 18	22/06/2020	1	x					
S22-S01 19	22/06/2020	1	x					
S22-S02 20	22/06/2020	1	x					
S22-S03 21	22/06/2020	2	x	x	x			
S01-S01 22	22/06/2020	1	x					
S01-S02 23	22/06/2020	1	x					
S01-S03 24	22/06/2020	1	x					
S01-S04 25	22/06/2020	1	x					
S01-S05 26	22/06/2020	1	x					
S30-S01 27	22/06/2020	1	x					
S30-S02 28	22/06/2020	1	x					
S30-S03 29	22/06/2020	1	x					
S30-S04 30	22/06/2020	1	x					
S30-S05 31	22/06/2020	1	x					
S30-S06 32	22/06/2020	1	x					
S04-S01 33	22/06/2020	1	x					
S04-S02 34	22/06/2020	1	x					
Total number of bottles/bags/jars		18						

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Kurt Blackman	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	23/06/2020	Time:		Date:		Time:	
Time:	9:00am			Time:			

CHAIN OF CUSTODY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com
Page number:	3 of 3
Turnaround time:	Standard
Quote number:	EP/446/20

Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
S04-S03 35	22/06/2020	1	x					
S04-S04 36	22/06/2020	1	x					
S04-S05 37	22/06/2020	3	x	x	x	x		
S04-S06 38	22/06/2020	1	x					
S04-S07 39	22/06/2020	1	x					
S03-S01 40	22/06/2020	2	x	x	x			
S03-S02 41	22/06/2020	1	x					
S03-S03 42	22/06/2020	1	x					
S03-S04 43	22/06/2020	1	x					
S03-S05 44	22/06/2020	1	x					
S03-S06 45	22/06/2020	1	x					
S03-S07 46	22/06/2020	1	x					
SZ4 47	22/06/2020	1	x					
Total number of bottles/bags/jars		16						

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Kurt Blackman	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	23/06/2020	Time:		Date:		Time:	
Time:	9:00am			Time:			

Certificate of Analysis

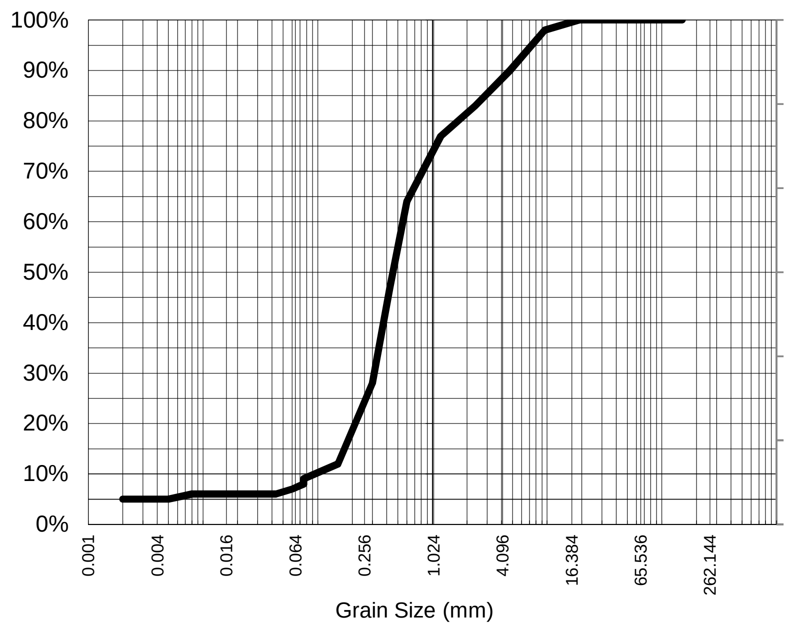
ALS Laboratory Group Pty Ltd
5/585 Maitland Road
Mayfield West, NSW 2304
pH 02 4014 2500
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	1-Jul-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	23-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006459-001 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	S29-S01

Particle Size Distribution



Particle Size (mm)	% Passing
19.0	100%
9.50	98%
4.75	90%
2.36	83%
1.18	77%
0.600	64%
0.425	47%
0.300	28%
0.150	12%
0.075	9%
Particle Size (microns)	
60	7%
43	6%
30	6%
21	6%
16	6%
11	6%
8	6%
5	5%
2	5%

Median Particle Size (mm)*	0.456

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments: AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly

Analysed: 29-Jun-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: CLAY/SAND/SOIL

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.53

NATA Accreditation: 825 Site: Newcastle
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NATA
WORLD RECOGNISED ACCREDITATION

Aleksandar Vujkovic
Laboratory Supervisor
Authorised Signatory

Certificate of Analysis

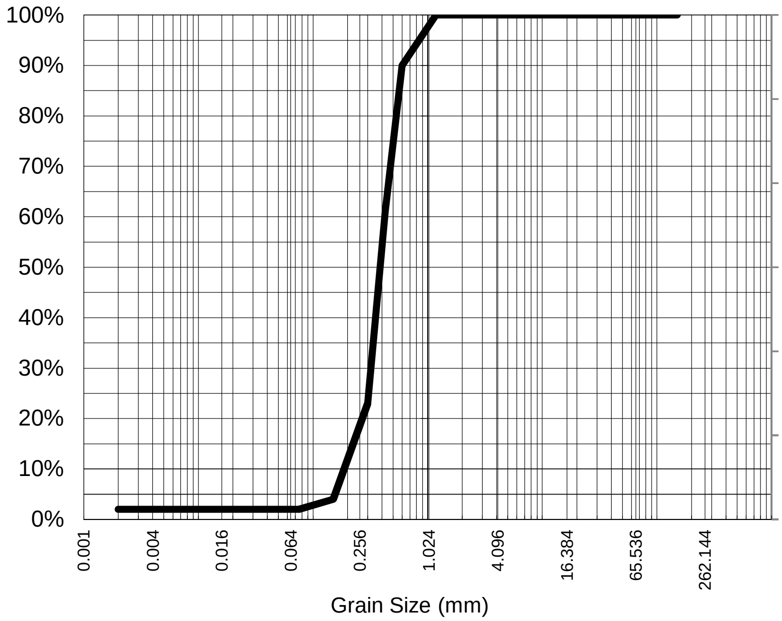
ALS Laboratory Group Pty Ltd
5/585 Maitland Road
Mayfield West, NSW 2304
pH 02 4014 2500
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	1-Jul-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	23-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006459-007 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	S31-S02

Particle Size Distribution



Particle Size (mm)	% Passing
1.18	100%
0.600	90%
0.425	61%
0.300	23%
0.150	4%
0.075	2%
Particle Size (microns)	
58	2%
41	2%
29	2%
21	2%
15	2%
11	2%
8	2%
5	2%
2	2%

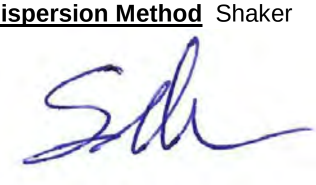
Median Particle Size (mm)*	0.389

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:	AS1289.3.6.3 states that hydrometer analysis is not applicable for samples containing <10% fines (<75um). Results should be assessed accordingly	**Analysed:**	29-Jun-20
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	CLAY/SAND/SOIL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.62		



Aleksandar Vujkovic
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Authorised Signatory

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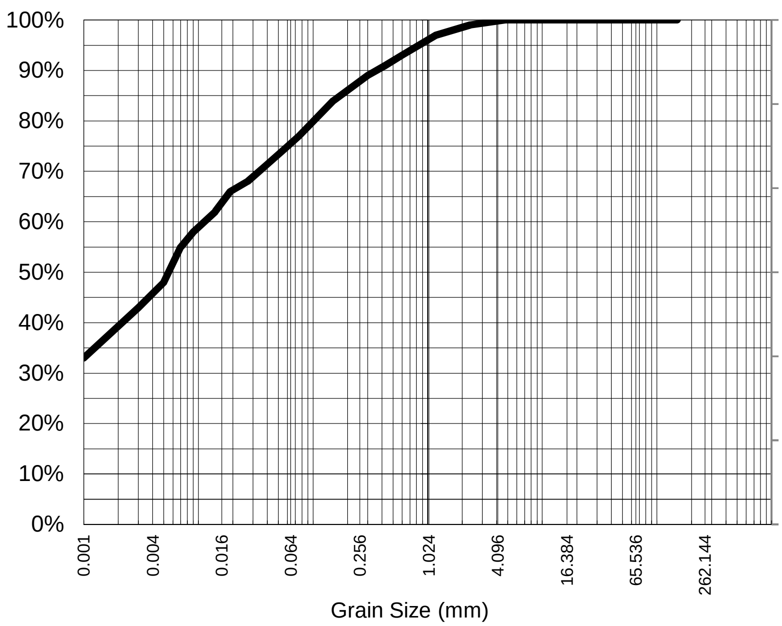
ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	1-Jul-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	23-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006459-012 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	S26-S02

Particle Size Distribution



Particle Size (mm)	% Passing
4.75	100%
2.36	99%
1.18	97%
0.600	93%
0.425	91%
0.300	89%
0.150	84%
0.075	77%
Particle Size (microns)	
54	74%
38	71%
27	68%
19	66%
14	62%
9	58%
7	55%
5	48%
1	33%

Median Particle Size (mm)*	<0.007

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 29-Jun-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: CLAY/SAND/SOIL

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.53

NATA Accreditation: 825 Site: Newcastle
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Aleksandar Vujkovic
Laboratory Supervisor
Authorised Signatory

Certificate of Analysis

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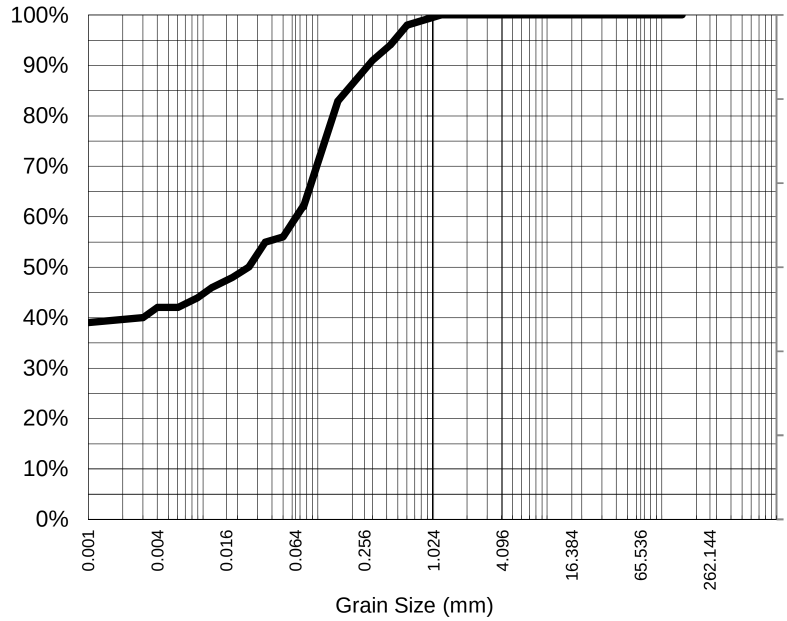
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	1-Jul-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	23-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006459-037 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	S04-S05

Particle Size Distribution



Particle Size (mm)	% Passing
1.18	100%
0.600	98%
0.425	94%
0.300	91%
0.150	83%
0.075	62%
Particle Size (microns)	
50	56%
35	55%
25	50%
18	48%
12	46%
9	44%
6	42%
4	42%
1	39%

Median Particle Size (mm)*	0.025

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	29-Jun-20
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	CLAY/SAND/SOIL	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.62		

Aleksandar Vujkovic
Laboratory Supervisor
Authorised Signatory

CERTIFICATE OF ANALYSIS

Work Order	: **EP2006510**	Page	: 1 of 13
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 24-Jun-2020 15:22
Order number	: ----	Date Analysis Commenced	: 30-Jun-2020
C-O-C number	: ----	Issue Date	: 03-Jul-2020 09:49
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 54		
No. of samples analysed	: 54		

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*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

- PSD conducted by ALS Sydney, NATA accreditation no. 825, site no 10911.
- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S02-S01	S02-S02	S02-S03	S02-S04	S02-S05
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-001	EP2006510-002	EP2006510-003	EP2006510-004	EP2006510-005
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.5**	**6.9**	**6.2**	**6.7**	**6.9**
pH (Fox)	----	0.1	pH Unit	**4.4**	**4.9**	**3.4**	**3.1**	**3.2**
Reaction Rate	----	1	-	**Moderate**	**Moderate**	**Moderate**	**Strong**	**Strong**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S02-S06	S02-S07	S27-S01	S27-S02	S27-S03
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-006	EP2006510-007	EP2006510-008	EP2006510-009	EP2006510-010
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**2300**	----	----	----	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.9**	**6.9**	**6.6**	**5.0**	**4.9**
pH (Fox)	----	0.1	pH Unit	**3.1**	**2.7**	**3.8**	**2.9**	**3.1**
Reaction Rate	----	1	-	**Strong**	**Strong**	**Strong**	**Moderate**	**Moderate**
EP004: Organic Matter								
Organic Matter	----	0.5	%	**3.3**	----	----	----	----
Total Organic Carbon	----	0.5	%	**1.9**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S27-S04	S28-S01	S28-S02	S28-S03	S28-S04
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-011	EP2006510-012	EP2006510-013	EP2006510-014	EP2006510-015
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	6640	----	----	----	5060
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.4	5.6	5.9	6.0	6.3
pH (Fox)	----	0.1	pH Unit	2.5	2.8	4.7	4.9	5.2
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Slight	Strong
EA150: Particle Sizing								
+75µm	----	1	%	27	----	----	----	----
+150µm	----	1	%	11	----	----	----	----
+300µm	----	1	%	5	----	----	----	----
+425µm	----	1	%	3	----	----	----	----
+600µm	----	1	%	2	----	----	----	----
+1180µm	----	1	%	<1	----	----	----	----
+2.36mm	----	1	%	<1	----	----	----	----
+4.75mm	----	1	%	<1	----	----	----	----
+9.5mm	----	1	%	<1	----	----	----	----
+19.0mm	----	1	%	<1	----	----	----	----
+37.5mm	----	1	%	<1	----	----	----	----
+75.0mm	----	1	%	<1	----	----	----	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	6	----	----	----	----
Silt (2-60 µm)	----	1	%	62	----	----	----	----
Sand (0.06-2.00 mm)	----	1	%	32	----	----	----	----
Gravel (>2mm)	----	1	%	<1	----	----	----	----
Cobbles (>6cm)	----	1	%	<1	----	----	----	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.51	----	----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	3.8	----	----	----	1.3
Total Organic Carbon	----	0.5	%	2.2	----	----	----	0.8

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S19-S01	S19-S02	S19-S03	S19-S04	S19-S05
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-016	EP2006510-017	EP2006510-018	EP2006510-019	EP2006510-020
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	2690	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.5	4.0	4.1	4.1	4.5
pH (Fox)	----	0.1	pH Unit	2.7	2.3	2.6	2.4	2.6
Reaction Rate	----	1	-	Moderate	Moderate	Strong	Moderate	Slight
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	----	3.1	----
Total Organic Carbon	----	0.5	%	----	----	----	1.8	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S19-S06	S19-S07	S18-S01	S18-S02	S18-S03
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-021	EP2006510-022	EP2006510-023	EP2006510-024	EP2006510-025
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.7	4.0	4.7	4.4	4.0
pH (Fox)	----	0.1	pH Unit	3.0	2.1	2.8	2.4	2.4
Reaction Rate	----	1	-	Slight	Slight	Moderate	Moderate	Moderate

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S18-S04	S18-S05	S18-S06	S15-S01	S15-S02
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-026	EP2006510-027	EP2006510-028	EP2006510-029	EP2006510-030
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	3370	2000	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	3.8	3.8	3.8	4.2	3.9
pH (Fox)	----	0.1	pH Unit	1.9	1.8	1.8	2.5	2.3
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Moderate	Moderate
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	2.6	7.2	----
Total Organic Carbon	----	0.5	%	----	----	1.5	4.2	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S15-S03	S15-S04	S15-S05	S15-S06	S15-S07
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-031	EP2006510-032	EP2006510-033	EP2006510-034	EP2006510-035
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**3.9**	**4.0**	**3.8**	**3.8**	**3.8**
pH (Fox)	----	0.1	pH Unit	**2.4**	**2.4**	**2.2**	**2.0**	**1.9**
Reaction Rate	----	1	-	**Moderate**	**Slight**	**Moderate**	**Moderate**	**Moderate**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S16-S01	S16-S02	S16-S03	S16-S04	S16-S05
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-036	EP2006510-037	EP2006510-038	EP2006510-039	EP2006510-040
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	----	2980
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.4	3.8	3.8	3.7	3.7
pH (Fox)	----	0.1	pH Unit	2.5	2.2	2.1	2.6	2.0
Reaction Rate	----	1	-	Moderate	Moderate	Moderate	Strong	Moderate
EA150: Particle Sizing								
+75µm	----	1	%	----	----	----	----	49
+150µm	----	1	%	----	----	----	----	24
+300µm	----	1	%	----	----	----	----	5
+425µm	----	1	%	----	----	----	----	1
+600µm	----	1	%	----	----	----	----	<1
+1180µm	----	1	%	----	----	----	----	<1
+2.36mm	----	1	%	----	----	----	----	<1
+4.75mm	----	1	%	----	----	----	----	<1
+9.5mm	----	1	%	----	----	----	----	<1
+19.0mm	----	1	%	----	----	----	----	<1
+37.5mm	----	1	%	----	----	----	----	<1
+75.0mm	----	1	%	----	----	----	----	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	----	----	22
Silt (2-60 µm)	----	1	%	----	----	----	----	27
Sand (0.06-2.00 mm)	----	1	%	----	----	----	----	51
Gravel (>2mm)	----	1	%	----	----	----	----	<1
Cobbles (>6cm)	----	1	%	----	----	----	----	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	----	----	----	----	2.49
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	----	----	3.9
Total Organic Carbon	----	0.5	%	----	----	----	----	2.2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S16-S06	S16-S07	S17-S01	S17-S02	S17-S03
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-041	EP2006510-042	EP2006510-043	EP2006510-044	EP2006510-045
				Result	Result	Result	Result	Result
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	2050	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	3.9	3.8	4.8	4.0	3.8
pH (Fox)	----	0.1	pH Unit	2.3	2.2	2.5	2.3	2.5
Reaction Rate	----	1	-	Strong	Slight	Moderate	Moderate	Moderate
EA150: Particle Sizing								
+75µm	----	1	%	----	----	----	8	----
+150µm	----	1	%	----	----	----	4	----
+300µm	----	1	%	----	----	----	2	----
+425µm	----	1	%	----	----	----	1	----
+600µm	----	1	%	----	----	----	<1	----
+1180µm	----	1	%	----	----	----	<1	----
+2.36mm	----	1	%	----	----	----	<1	----
+4.75mm	----	1	%	----	----	----	<1	----
+9.5mm	----	1	%	----	----	----	<1	----
+19.0mm	----	1	%	----	----	----	<1	----
+37.5mm	----	1	%	----	----	----	<1	----
+75.0mm	----	1	%	----	----	----	<1	----
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	----	----	----	53	----
Silt (2-60 µm)	----	1	%	----	----	----	38	----
Sand (0.06-2.00 mm)	----	1	%	----	----	----	9	----
Gravel (>2mm)	----	1	%	----	----	----	<1	----
Cobbles (>6cm)	----	1	%	----	----	----	<1	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	----	----	----	2.46	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	----	----	----	3.8	----
Total Organic Carbon	----	0.5	%	----	----	----	2.2	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S17-S04	S17-S05	S17-S06	SZ5	SZ6
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006510-046	EP2006510-047	EP2006510-048	EP2006510-049	EP2006510-050
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	3.7	3.9	3.8	5.3	5.4
pH (Fox)	----	0.1	pH Unit	2.1	2.0	1.8	3.6	3.2
Reaction Rate	----	1	-	Slight	Slight	Slight	Moderate	Moderate

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	SZ7	SZ8	SZ9	SZ10	----
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	----
Compound	CAS Number	LOR	Unit	EP2006510-051	EP2006510-052	EP2006510-053	EP2006510-054	--------
				Result	Result	Result	Result	----
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	4.1	4.2	3.8	3.8	----
pH (Fox)	----	0.1	pH Unit	2.5	2.6	2.0	2.8	----
Reaction Rate	----	1	-	Moderate	Moderate	Slight	Strong	----

Environmental

QUALITY CONTROL REPORT

Work Order	: **EP2006510**	Page	: 1 of 3
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 24-Jun-2020
Order number	: ----	Date Analysis Commenced	: 30-Jun-2020
C-O-C number	: ----	Issue Date	: 03-Jul-2020
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 54		
No. of samples analysed	: 54		

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*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 (%)
EA010: Conductivity (1:5) (QC Lot: 3103315)									
EP2006510-040	S16-S05	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	2980	3050	2.35	0% - 20%
EP2006475-006	Anonymous	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	30100	29600	1.80	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3115557)									
EP2006510-001	S02-S01	EA037: pH (F)	----	0.1	pH Unit	6.5	6.7	1.97	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	4.4	4.2	4.41	0% - 20%
EP2006510-010	S27-S03	EA037: pH (F)	----	0.1	pH Unit	4.9	5.0	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.1	3.1	0.00	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3115558)									
EP2006510-021	S19-S06	EA037: pH (F)	----	0.1	pH Unit	4.7	4.8	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.0	3.2	3.55	0% - 20%
EP2006510-030	S15-S02	EA037: pH (F)	----	0.1	pH Unit	3.9	4.0	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	2.3	2.2	0.00	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 3115559)									
EP2006510-041	S16-S06	EA037: pH (F)	----	0.1	pH Unit	3.9	3.8	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	2.3	2.3	0.00	0% - 20%
EP2006510-050	SZ6	EA037: pH (F)	----	0.1	pH Unit	5.4	5.4	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.2	3.3	3.97	0% - 20%
EP004: Organic Matter (QC Lot: 3100689)									
EP2006510-006	S02-S06	EP004: Organic Matter	----	0.5	%	3.3	3.3	0.00	No Limit
		EP004: Total Organic Carbon	----	0.5	%	1.9	1.9	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 Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	*CAS Number*	*LOR*	*Unit*	*Result*	*Concentration*	*LCS*	*Low*	*High*
EA010: Conductivity (1:5) (QCLot: 3103315)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	24800 µS/cm	102	93.6	106
EP004: Organic Matter (QCLot: 3100689)								
EP004: Organic Matter	----	0.5	%	<0.5	2.3 %	86.5	70.0	120
				<0.5	85 %	89.8	70.0	120
EP004: Total Organic Carbon	----	0.5	%	<0.5	----	----	----	----

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.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2006510**	Page	: 1 of 6
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 24-Jun-2020
Site	: Ashfield Flats	Issue Date	: 03-Jul-2020
Sampler	: Matt Emeny, Shenae Blakiston	No. of samples received	: 54
Order number	: ----	No. of samples analysed	: 54

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

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

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

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		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010: Conductivity (1:5)								
Soil Glass Jar - Unpreserved (EA010)								
S02-S06,	S27-S04,	**23-Jun-2020**	**30-Jun-2020**	30-Jun-2020	✓	**30-Jun-2020**	28-Jul-2020	✓
S28-S04,	S19-S04,							
S18-S06,	S15-S01,							
S16-S05,	S17-S02							
EA037: Ass Field Screening Analysis								
Snap Lock Bag - frozen (EA037)								

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
EA037: Ass Field Screening Analysis - Continued								
S02-S01,	S02-S02,	**23-Jun-2020**	**01-Jul-2020**	20-Dec-2020	✓	**01-Jul-2020**	20-Dec-2020	✓
S02-S03,	S02-S04,							
S02-S05,	S02-S06,							
S02-S07,	S27-S01,							
S27-S02,	S27-S03,							
S27-S04,	S28-S01,							
S28-S02,	S28-S03,							
S28-S04,	S19-S01,							
S19-S02,	S19-S03,							
S19-S04,	S19-S05,							
S19-S06,	S19-S07,							
S18-S01,	S18-S02,							
S18-S03,	S18-S04,							
S18-S05,	S18-S06,							
S15-S01,	S15-S02,							
S15-S03,	S15-S04,							
S15-S05,	S15-S06,							
S15-S07,	S16-S01,							
S16-S02,	S16-S03,							
S16-S04,	S16-S05,							
S16-S06,	S16-S07,							
S17-S01,	S17-S02,							
S17-S03,	S17-S04,							
S17-S05,	S17-S06,							
SZ5,	SZ6,							
SZ7,	SZ8,							
SZ9,	SZ10							
EA150: Particle Sizing								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)								
S27-S04,	S16-S05,	**23-Jun-2020**	**----**	----	----	**03-Jul-2020**	20-Dec-2020	✓
S17-S02								
EA150: Soil Classification based on Particle Size								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H)								
S27-S04,	S16-S05,	**23-Jun-2020**	**----**	----	----	**03-Jul-2020**	20-Dec-2020	✓
S17-S02								
EA152: Soil Particle Density								
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152)								
S27-S04,	S16-S05,	**23-Jun-2020**	**----**	----	----	**03-Jul-2020**	20-Dec-2020	✓
S17-S02								

Matrix: **SOIL**

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

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP004: Organic Matter								
Soil Glass Jar - Unpreserved (EP004)								
S02-S06,	S27-S04,	**23-Jun-2020**	**30-Jun-2020**	21-Jul-2020	✓	**30-Jun-2020**	21-Jul-2020	✓
S28-S04,	S19-S04,							
S18-S06,	S15-S01,							
S16-S05,	S17-S02							

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)							
ASS Field Screening Analysis	EA037	6	54	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Electrical Conductivity (1:5)	EA010	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Electrical Conductivity (1:5)	EA010	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	2	8	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Electrical Conductivity (1:5)	EA010	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	8	**12.50**	**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*
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3)
ASS Field Screening Analysis	EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3 - 2003
Soil Particle Density	EA152	SOIL	Soil Particle Density by AS 1289.3.5.1-2006 : Methods of testing soils for engineering purposes - Soil classification tests - Determination of the soil particle density of a soil - Standard method
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3).

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
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.
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1 - 1997. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM (2013) Schedule B(3) (Method 105)

CHAIN OF CUSTODY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 4
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)
S02-S01 1	23/06/2020		x				
S02-S02 2	23/06/2020		x				
S02-S03 3	23/06/2020		x				
S02-S04 4	23/06/2020		x				
S02-S05 5	23/06/2020		x				
S02-S06 6	23/06/2020		x	x	x		
S02-S07 7	23/06/2020		x				
S27-S01 8	23/06/2020		x				
S27-S02 9	23/06/2020		x				
S27-S03 10	23/06/2020		x				
S27-S04 11	23/06/2020		x	x	x	x	
S28-S01 12	23/06/2020		x				
S28-S02 13	23/06/2020		x				
S28-S03 14	23/06/2020		x				
S28-S04 15	23/06/2020		x	x	x		
S19-S01 16	23/06/2020		x				
S19-S02 17	23/06/2020		x				
Total number of bottles/bags/jars							

Environmental Division
Perth
Work Order Reference
EP2006510

Telephone : + 61-8-9406 1301

Primary destination:	ALS	Received by:	Louise K
Relinquished by:	Shenae Blakiston	Organisation:	ALS
Organisation:	RPS	Date:	24/6/2020
Date:	23/06/2020	Time:	15:22
Time:	11:00am		

Secondary destination:		Received by:	
Relinquished by:		Organisation:	
Organisation:		Date:	
Date:		Time:	
Time:			

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	2 of 4
Turnaround time:	Standard
Quote number:	EP/446/20

Analytical suites

Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
S19-S03 18	23/06/2020		x					
S19-S04 19	23/06/2020		x	x	x			
S19-S05 20	23/06/2020		x					
S19-S06 21	23/06/2020		x					
S19-S07 22	23/06/2020		x					
S18-S01 23	23/06/2020		x					
S18-S02 24	23/06/2020		x					
S18-S03 25	23/06/2020		x					
S18-S04 26	23/06/2020		x					
S18-S05 27	23/06/2020		x					
S18-S06 28	23/06/2020		x	x	x			
S15-S01 29	23/06/2020		x	x	x			
S15-S02 30	23/06/2020		x					
S15-S03 31	23/06/2020		x					
S15-S04 32	23/06/2020		x					
S15-S05 33	23/06/2020		x					
S15-S06 34	23/06/2020		x					
Total number of bottles/bags/jars								

Primary destination:	ALS	**Received by:**		**Secondary destination:**		**Received by:**	
Relinquished by:	Shenae Blakiston	**Organisation:**		**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**		**Organisation:**		**Date:**	
Date:	23/06/2020	**Time:**		**Date:**		**Time:**	
Time:	11:00am			**Time:**			

CHAIN OF COUSTODY

rps MAKING COMPLEX EASY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	3 of 4
Turnaround time:	Standard
Quote number:	EP/446/20

Analytical suites

Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)
S15-S07 35	23/06/2020		x				
S16-S01 36	23/06/2020		x				
S16-S02 37	23/06/2020		x				
S16-S03 38	23/06/2020		x				
S16-S04 39	23/06/2020		x				
S16-S05 40	23/06/2020		x	x	x	x	
S16-S06 41	23/06/2020		x				
S16-S07 42	23/06/2020		x				
S17-S01 43	23/06/2020		x				
S17-S02 44	23/06/2020		x	x	x	x	
S17-S03 45	23/06/2020		x				
S17-S04 46	23/06/2020		x				
S17-S05 47	23/06/2020		x				
S17-S06 48	23/06/2020						
SZ5 49	23/06/2020						
SZ6 50	23/06/2020						
SZ7 51	23/06/2020						
Total number of bottles/bags/jars							

Primary destination:	ALS	Received by:	
Relinquished by:	Shenae Blakiston	Organisation:	
Organisation:	RPS	Date:	
Date:	23/06/2020	Time:	
Time:	11:00am		

Secondary destination:	
Relinquished by:	
Organisation:	
Date:	
Time:	

Received by:	
Organisation:	
Date:	
Time:	

CHAIN OF COUSTODY

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Page number:	4 of 4
Turnaround time:	Standard
Quote number:	EP/446/20

Analytical suites

Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
SZ8 52	23/06/2020	1	x					
SZ9 53	23/06/2020	1	x					
SZ10 54	23/06/2020	1	x					

Total number of bottles/bags/jars 3

Primary destination:	ALS	**Received by:**		**Secondary destination:**		**Received by:**	
Relinquished by:	Shenae Blakiston	**Organisation:**		**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**		**Organisation:**		**Date:**	
Date:	23/06/2020	**Time:**		**Date:**		**Time:**	
Time:	11:00am			**Time:**			

Certificate of Analysis

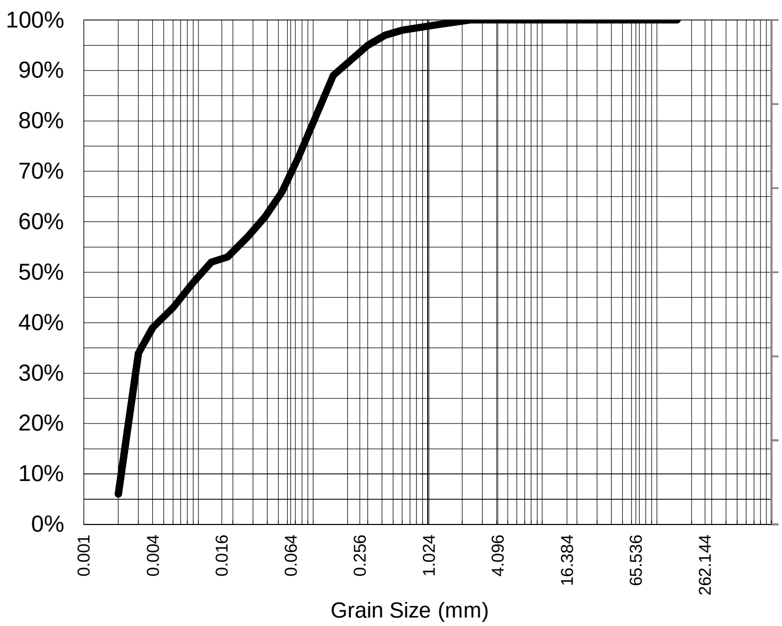
ALS Laboratory Group Pty Ltd
5/585 Maitland Road
Mayfield West, NSW 2304
pH 02 4014 2500
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	3-Jul-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	24-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006510-011 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	S27-S04

Particle Size Distribution



Particle Size (mm)	% Passing
2.36	100%
1.18	99%
0.600	98%
0.425	97%
0.300	95%
0.150	89%
0.075	73%
Particle Size (microns)	
54	66%
38	61%
27	57%
18	53%
13	52%
9	48%
6	43%
4	39%
2	6%

Median Particle Size (mm)*	0.011

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:		**Analysed:**	1-Jul-20
Loss on Pretreatment	NA	**Limit of Reporting:**	1%
Sample Description:	CLAY	**Dispersion Method**	Shaker
Test Method:	AS1289.3.6.2/AS1289.3.6.3		
Soil Particle Density (<2.36mm)	2.51		

NATA Accreditation: 825 Site: Newcastle
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Aleksandar Vujkovic
Laboratory Supervisor
Authorised Signatory

Certificate of Analysis

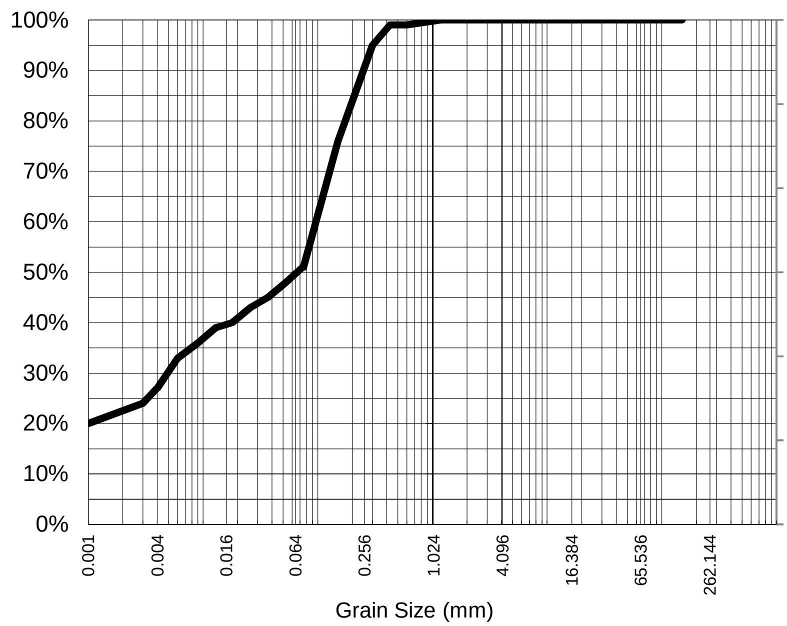
ALS Laboratory Group Pty Ltd
5/585 Maitland Road
Mayfield West, NSW 2304
pH 02 4014 2500
fax 02 4968 0349
samples.newcastle@alsenviro.com

ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	3-Jul-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	24-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006510-040 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	S16-S05

Particle Size Distribution



Particle Size (mm)	% Passing
1.18	100%
0.600	99%
0.425	99%
0.300	95%
0.150	76%
0.075	51%
Particle Size (microns)	
53	48%
37	45%
26	43%
18	40%
13	39%
9	36%
6	33%
4	27%
1	20%

Median Particle Size (mm)*	0.067

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 1-Jul-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: CLAY

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.49

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Aleksandar Vujkovic
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Authorised Signatory

Certificate of Analysis

ALS Laboratory Group Pty Ltd
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Mayfield West, NSW 2304
pH 02 4014 2500
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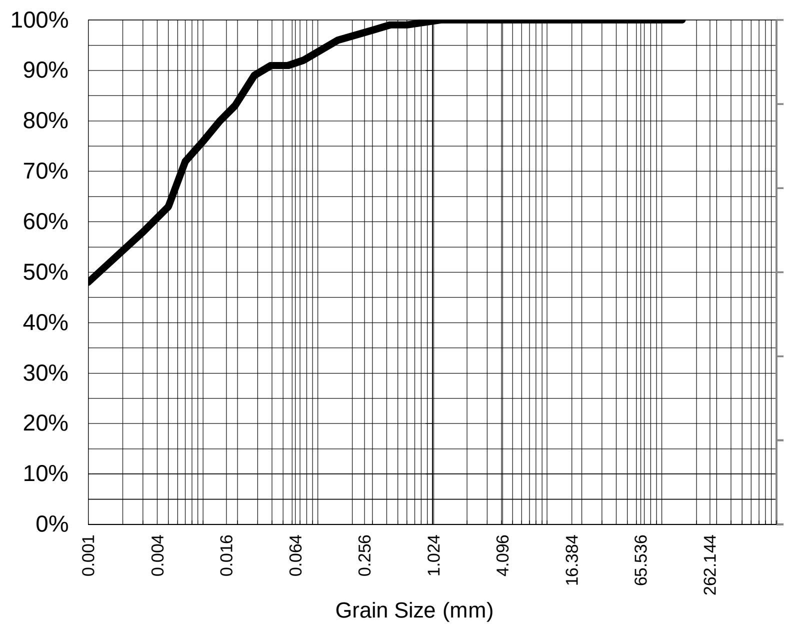
ALS Environmental

Newcastle, NSW

CLIENT:	ALAN FOLEY	**DATE REPORTED:**	3-Jul-2020
COMPANY:	RPS Australia West Pty Ltd	**DATE RECEIVED:**	24-Jun-2020
ADDRESS:	PO Box 170 West Perth WA	**REPORT NO:**	EP2006510-044 / PSD
PROJECT:	EEC20088.001	**SAMPLE ID:**	S17-S02

Particle Size Distribution



Particle Size (mm)	% Passing
1.18	100%
0.600	99%
0.425	99%
0.300	98%
0.150	96%
0.075	92%
Particle Size (microns)	
55	91%
39	91%
28	89%
19	83%
14	80%
10	76%
7	72%
5	63%
1	48%

Median Particle Size (mm)*	<0.007

Analysis Notes

Samples analysed as received.

Median Particle Size is not covered under the current scope of ALS's NATA accreditation.

Sample Comments:

Analysed: 1-Jul-20

Loss on Pretreatment NA

Limit of Reporting: 1%

Sample Description: CLAY

Dispersion Method Shaker

Test Method: AS1289.3.6.2/AS1289.3.6.3

Soil Particle Density (<2.36mm) 2.46

NATA Accreditation: 825 Site: Newcastle
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WORLD RECOGNISED ACCREDITATION

Aleksandar Vujkovic
Laboratory Supervisor
Authorised Signatory

CERTIFICATE OF ANALYSIS

Work Order	: **EP2006921**	Page	: 1 of 12
Amendment	: **1**		
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 19-Jun-2020 15:30
Order number	: ----	Date Analysis Commenced	: 06-Jul-2020
C-O-C number	: ----	Issue Date	: 24-Jul-2020 09:39
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 50		
No. of samples analysed	: 50		

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*
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

- ASS: EA033 (CRS Suite): Retained Acidity not required because pH KCl greater than or equal to 4.5
- Amendment (24/07/2020): This report has been amended as a result of misinterpretation of sample identification numbers (IDs). All analysis results are as per the previous report
- ASS: EA033 (CRS Suite): ANC not required for various samples because pH KCl less than 6.5
- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	DS9-S01	S08-S01	S09-S02	S23-S03	S24-S04
			Client sampling date / time	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00
				EP2006921-001	EP2006921-002	EP2006921-003	EP2006921-004	EP2006921-005
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	4.1	5.7	5.7	5.8	4.9
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	154	<2	2	<2	178
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	6.3	5.7	5.6	6.0	5.7
Titratable Actual Acidity (23F)	----	2	mole H+ / t	9	27	42	18	59
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	0.04	0.07	0.03	0.09
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.216	0.012	0.012	0.011	0.044
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	135	<10	<10	<10	28
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.23	0.06	0.08	0.04	0.14
Net Acidity (acidity units)	----	10	mole H+ / t	144	34	50	25	86
Liming Rate	----	1	kg CaCO3/t	11	3	4	2	6
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.23	0.06	0.08	0.04	0.14
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	144	34	50	25	86
Liming Rate excluding ANC	----	1	kg CaCO3/t	11	3	4	2	6
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	6.9	----	----	----	----
pH (Fox)	----	0.1	pH Unit	3.5	----	----	----	----
Reaction Rate	----	1	-	Extreme	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S10-S01	S10-S06	S11-S02	S11-S06	S12-S05
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006921-006	EP2006921-007	EP2006921-008	EP2006921-009	EP2006921-010
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	5.8	7.3	4.4	2.4	4.2
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	38	364	95
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	6.6	6.6	5.2	5.8	4.9
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	35	17	61
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.06	0.03	0.10
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.010	<0.005	<0.005	0.590	0.010
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	368	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	1.07	0.68	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	213	136	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.34	0.22	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.06	0.62	0.11
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	36	385	67
Liming Rate	----	1	kg CaCO3/t	<1	<1	3	29	5
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.06	0.62	0.11
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	36	385	67
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	3	29	5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S13-S05	S14-S05	S20-S06	S21-S02	DS1A-S01
			Client sampling date / time	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	19-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006921-011	EP2006921-012	EP2006921-013	EP2006921-014	EP2006921-015
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	4.6	4.9	4.0	3.9	3.2
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	5	<2	77	228	954
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	5.3	5.3	5.0	4.9	7.0
Titratable Actual Acidity (23F)	----	2	mole H+ / t	22	19	50	108	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.04	0.03	0.08	0.17	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.010	0.016	0.018	0.014	1.96
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	10	11	<10	1220
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	----	----	----	2.50
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	----	----	----	499
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	----	----	----	0.80
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.04	0.05	0.10	0.19	1.42
Net Acidity (acidity units)	----	10	mole H+ / t	28	29	62	117	888
Liming Rate	----	1	kg CaCO3/t	2	2	5	9	67
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.04	0.05	0.10	0.19	1.96
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	28	29	62	117	1220
Liming Rate excluding ANC	----	1	kg CaCO3/t	2	2	5	9	92

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	DS1-S01	DS3-S01	DS5-S01	DS5-S02	DS7-S01
			Client sampling date / time	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006921-016	EP2006921-017	EP2006921-018	EP2006921-019	EP2006921-020
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	6.3	3.4	2.3	2.4	5.0
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	529	1140	980	392
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	8.1	6.5	6.3	6.3	6.8
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	18	13	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.03	0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.910	1.25	3.48	2.80	0.455
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	568	780	2170	1740	284
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	3.22	1.31	----	----	0.83
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	644	261	----	----	167
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	1.03	0.42	----	----	0.27
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.22	0.97	3.51	2.82	0.28
Net Acidity (acidity units)	----	10	mole H+ / t	138	606	2190	1760	173
Liming Rate	----	1	kg CaCO3/t	10	45	164	132	13
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.91	1.25	3.51	2.82	0.46
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	568	780	2190	1760	284
Liming Rate excluding ANC	----	1	kg CaCO3/t	43	59	164	132	21

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	DS8-S02	S09-S03	S05-S03	S06-S01	S06-S05
			Client sampling date / time	17-Jun-2020 00:00	17-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00	19-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006921-021	EP2006921-022	EP2006921-023	EP2006921-024	EP2006921-025
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	5.6	6.6	5.3	6.8	6.3
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	2	<2	<2
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	5.9	6.7	5.6	6.0	6.2
Titratable Actual Acidity (23F)	----	2	mole H+ / t	9	<2	17	8	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.03	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.017	0.032	0.031	0.015	0.020
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	10	20	19	<10	12
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	0.36	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	71	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	0.11	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.03	<0.02	0.06	0.03	0.02
Net Acidity (acidity units)	----	10	mole H+ / t	19	<10	36	17	14
Liming Rate	----	1	kg CaCO3/t	1	<1	3	1	1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.03	0.03	0.06	0.03	0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	19	20	36	17	14
Liming Rate excluding ANC	----	1	kg CaCO3/t	1	2	3	1	1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S07-S04	S01-S01	S01-S04	S03-S01	S04-S02
			Client sampling date / time	19-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006921-026	EP2006921-027	EP2006921-028	EP2006921-029	EP2006921-030
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	**4.7**	**7.8**	**5.7**	**5.2**	**7.2**
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	**69**	<2	<2	**168**	<2
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**5.0**	**8.0**	**6.2**	**6.1**	**5.9**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**61**	<2	**5**	**22**	**8**
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	**0.10**	<0.02	<0.02	**0.04**	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.012**	**0.067**	**0.042**	**0.037**	**0.024**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	**42**	**26**	**23**	**15**
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	**5.12**	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	**1020**	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	**1.64**	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	**0.11**	<0.02	**0.05**	**0.07**	**0.04**
Net Acidity (acidity units)	----	10	mole H+ / t	**68**	<10	**31**	**45**	**23**
Liming Rate	----	1	kg CaCO3/t	**5**	<1	**2**	**3**	**2**
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.11**	**0.07**	**0.05**	**0.07**	**0.04**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**68**	**42**	**31**	**45**	**23**
Liming Rate excluding ANC	----	1	kg CaCO3/t	**5**	**3**	**2**	**3**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S22-S01	S25-S02	S25-S04	S26-S04	S29-S01
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00	22-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006921-031	EP2006921-032	EP2006921-033	EP2006921-034	EP2006921-035
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	6.4	4.2	4.1	4.2	7.0
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	105	91	65	<2
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	6.3	4.6	4.7	5.1	8.5
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	99	68	44	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	0.16	0.11	0.07	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.014	0.011	0.007	0.005	0.008
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	----	----	----	----	1.65
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	----	----	----	----	330
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	----	----	----	----	0.53
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.02	0.17	0.12	0.07	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	10	106	73	47	<10
Liming Rate	----	1	kg CaCO3/t	1	8	5	4	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.02	0.17	0.12	0.07	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	10	106	73	47	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	1	8	5	4	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S30-S03	S31-S04	S02-S04	S02-S07	S15-S02
			Client sampling date / time	22-Jun-2020 00:00	22-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006921-036	EP2006921-037	EP2006921-038	EP2006921-039	EP2006921-040
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	6.4	6.0	4.0	3.8	3.9
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	119	97	159
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	7.1	6.8	6.2	6.3	4.5
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	5	2	100
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	0.16
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.008	0.006	0.201	0.134	0.010
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	125	84	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.21	0.12	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	43	24	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.07	0.04	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.21	0.14	0.17
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	131	86	107
Liming Rate	----	1	kg CaCO3/t	<1	<1	10	6	8
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.21	0.14	0.17
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	131	86	107
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	10	6	8

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S15-S07	S16-S03	S17-S06	S18-S02	S19-S04
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006921-041	EP2006921-042	EP2006921-043	EP2006921-044	EP2006921-045
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	4.0	3.9	4.0	4.0	4.4
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	75	138	68	183	123
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	4.9	4.7	4.9	4.6	4.6
Titratable Actual Acidity (23F)	----	2	mole H+ / t	46	87	38	92	80
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.07	0.14	0.06	0.15	0.13
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.006	0.010	0.006	<0.005	0.006
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.08	0.15	0.07	0.15	0.13
Net Acidity (acidity units)	----	10	mole H+ / t	49	93	42	94	84
Liming Rate	----	1	kg CaCO3/t	4	7	3	7	6
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.08	0.15	0.07	0.15	0.13
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	49	93	42	94	84
Liming Rate excluding ANC	----	1	kg CaCO3/t	4	7	3	7	6

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	S27-S02	S28-S04	SZ10	SZ7	SZ9
			Client sampling date / time	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00	23-Jun-2020 00:00
Compound	CAS Number	LOR	Unit	EP2006921-046	EP2006921-047	EP2006921-048	EP2006921-049	EP2006921-050
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	4.7	7.4	4.0	4.0	4.3
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	77	<2	157	170	60
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	5.1	6.5	4.7	4.4	4.9
Titratable Actual Acidity (23F)	----	2	mole H+ / t	42	<2	90	101	45
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.07	<0.02	0.14	0.16	0.07
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.021	<0.005	0.007	0.017	<0.005
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	13	<10	<10	10	<10
EA033-D: Retained Acidity								
Net Acid Soluble Sulfur (20Je)	----	0.02	% S	----	----	----	<0.02	----
acidity - Net Acid Soluble Sulfur (a-20J)	----	10	mole H+ / t	----	----	----	<10	----
sulfidic - Net Acid Soluble Sulfur (s-20J)	----	0.02	% pyrite S	----	----	----	<0.02	----
KCl Extractable Sulfur (23Ce)	----	0.02	% S	----	----	----	0.07	----
HCl Extractable Sulfur (20Be)	----	0.02	% S	----	----	----	0.07	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	----	0.02	% S	0.09	<0.02	0.15	0.18	0.07
Net Acidity (acidity units)	----	10	mole H+ / t	56	<10	94	112	45
Liming Rate	----	1	kg CaCO3/t	4	<1	7	8	3
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.09	<0.02	0.15	0.18	0.07
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	56	<10	94	112	45
Liming Rate excluding ANC	----	1	kg CaCO3/t	4	<1	7	8	3

Environmental

QUALITY CONTROL REPORT

Work Order	: **EP2006921**	Page	: 1 of 6
Amendment	: **1**		
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 19-Jun-2020
Order number	: ----	Date Analysis Commenced	: 06-Jul-2020
C-O-C number	: ----	Issue Date	: 24-Jul-2020
Sampler	: Matt Emeny, Shenae Blakiston		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 50		
No. of samples analysed	: 50		

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*
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 (%)
EA029-A: pH Measurements (QC Lot: 3124181)									
EP2006921-001	DS9-S01	EA029-TPA: pH OX (23B)	----	0.1	pH Unit	4.1	4.1	0.00	0% - 20%
EP2006921-011	S13-S05	EA029-TPA: pH OX (23B)	----	0.1	pH Unit	4.6	4.6	0.00	0% - 20%
EA029-A: pH Measurements (QC Lot: 3124182)									
EP2006921-021	DS8-S02	EA029-TPA: pH OX (23B)	----	0.1	pH Unit	5.6	5.7	2.13	0% - 20%
EP2006921-031	S22-S01	EA029-TPA: pH OX (23B)	----	0.1	pH Unit	6.4	6.4	0.00	0% - 20%
EA029-A: pH Measurements (QC Lot: 3124184)									
EP2006921-041	S15-S07	EA029-TPA: pH OX (23B)	----	0.1	pH Unit	4.0	4.0	0.00	0% - 20%
EA029-B: Acidity Trail (QC Lot: 3124181)									
EP2006921-001	DS9-S01	EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	154	154	0.00	0% - 20%
EP2006921-011	S13-S05	EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	5	5	0.00	No Limit
EA029-B: Acidity Trail (QC Lot: 3124182)									
EP2006921-021	DS8-S02	EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	0.00	No Limit
EP2006921-031	S22-S01	EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	0.00	No Limit
EA029-B: Acidity Trail (QC Lot: 3124184)									
EP2006921-041	S15-S07	EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	75	75	0.00	0% - 20%
EA033-A: Actual Acidity (QC Lot: 3124180)									
EP2006921-001	DS9-S01	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	9	9	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	6.3	6.4	0.00	0% - 20%
EP2006921-011	S13-S05	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.04	0.04	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	22	22	0.00	0% - 50%
		EA033: pH KCl (23A)	----	0.1	pH Unit	5.3	5.3	0.00	0% - 20%
EA033-A: Actual Acidity (QC Lot: 3124183)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EA033-A: Actual Acidity (QC Lot: 3124183) - continued									
EP2006921-021	DS8-S02	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	9	9	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	5.9	5.9	0.00	0% - 20%
EP2006921-031	S22-S01	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	6.3	6.3	0.00	0% - 20%
EA033-A: Actual Acidity (QC Lot: 3124185)									
EP2006921-041	S15-S07	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.07	0.07	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	46	46	0.00	0% - 20%
		EA033: pH KCl (23A)	----	0.1	pH Unit	4.9	4.9	0.00	0% - 20%
EA033-B: Potential Acidity (QC Lot: 3124180)									
EP2006921-001	DS9-S01	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.216	0.216	0.00	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	135	135	0.00	0% - 50%
EP2006921-011	S13-S05	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.010	0.009	10.5	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA033-B: Potential Acidity (QC Lot: 3124183)									
EP2006921-021	DS8-S02	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.017	0.016	6.06	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	10	10	0.00	No Limit
EP2006921-031	S22-S01	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.014	0.015	6.90	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA033-B: Potential Acidity (QC Lot: 3124185)									
EP2006921-041	S15-S07	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.006	0.006	0.00	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.00	No Limit
EA033-E: Acid Base Accounting (QC Lot: 3124180)									
EP2006921-001	DS9-S01	EA033: Net Acidity (sulfur units)	----	0.02	% S	0.23	0.23	0.00	0% - 50%
		EA033: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.23	0.23	0.00	0% - 50%
		EA033: Liming Rate	----	1	kg CaCO3/t	11	11	0.00	0% - 50%
		EA033: Liming Rate excluding ANC	----	1	kg CaCO3/t	11	11	0.00	0% - 50%
		EA033: Net Acidity (acidity units)	----	10	mole H+ / t	144	144	0.00	0% - 50%
		EA033: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	144	144	0.00	0% - 50%
EP2006921-011	S13-S05	EA033: Net Acidity (sulfur units)	----	0.02	% S	0.04	0.04	0.00	No Limit
		EA033: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.04	0.04	0.00	No Limit
		EA033: Liming Rate	----	1	kg CaCO3/t	2	2	0.00	No Limit
		EA033: Liming Rate excluding ANC	----	1	kg CaCO3/t	2	2	0.00	No Limit
		EA033: Net Acidity (acidity units)	----	10	mole H+ / t	28	27	3.64	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
				Laboratory Duplicate (DUP) Report					
EA033-E: Acid Base Accounting (QC Lot: 3124180) - continued									
EP2006921-011	S13-S05	EA033: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	28	27	3.64	No Limit
EA033-E: Acid Base Accounting (QC Lot: 3124183)									
EP2006921-021	DS8-S02	EA033: Net Acidity (sulfur units)	----	0.02	% S	0.03	0.03	0.00	No Limit
		EA033: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.03	0.03	0.00	No Limit
		EA033: Liming Rate	----	1	kg CaCO3/t	1	1	0.00	No Limit
		EA033: Liming Rate excluding ANC	----	1	kg CaCO3/t	1	1	0.00	No Limit
		EA033: Net Acidity (acidity units)	----	10	mole H+ / t	19	19	0.00	No Limit
		EA033: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	19	19	0.00	No Limit
EP2006921-031	S22-S01	EA033: Net Acidity (sulfur units)	----	0.02	% S	0.02	0.02	0.00	No Limit
		EA033: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.02	0.02	0.00	No Limit
		EA033: Liming Rate	----	1	kg CaCO3/t	1	1	0.00	No Limit
		EA033: Liming Rate excluding ANC	----	1	kg CaCO3/t	1	1	0.00	No Limit
		EA033: Net Acidity (acidity units)	----	10	mole H+ / t	10	12	18.2	No Limit
		EA033: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	10	12	18.2	No Limit
EA033-E: Acid Base Accounting (QC Lot: 3124185)									
EP2006921-041	S15-S07	EA033: Net Acidity (sulfur units)	----	0.02	% S	0.08	0.08	0.00	No Limit
		EA033: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.08	0.08	0.00	No Limit
		EA033: Liming Rate	----	1	kg CaCO3/t	4	4	0.00	No Limit
		EA033: Liming Rate excluding ANC	----	1	kg CaCO3/t	4	4	0.00	No Limit
		EA033: Net Acidity (acidity units)	----	10	mole H+ / t	49	50	2.02	No Limit
		EA033: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	49	50	2.02	No Limit
EA037: Ass Field Screening Analysis (QC Lot: 3124176)									
EP2006921-001	DS9-S01	EA037: pH (F)	----	0.1	pH Unit	6.9	6.8	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.5	3.5	0.00	0% - 20%

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 Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA029-B: Acidity Trail (QCLot: 3124181)								
EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	----	----	----	----
EA029-B: Acidity Trail (QCLot: 3124182)								
EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	----	----	----	----
EA029-B: Acidity Trail (QCLot: 3124184)								
EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	----	----	----	----
EA033-A: Actual Acidity (QCLot: 3124180)								
EA033: pH KCl (23A)	----	0.1	pH Unit	<0.1	----	----	----	----
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	22.26 mole H+ / t	104	79.4	110
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-A: Actual Acidity (QCLot: 3124183)								
EA033: pH KCl (23A)	----	0.1	pH Unit	<0.1	----	----	----	----
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	22.26 mole H+ / t	110	79.4	110
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-A: Actual Acidity (QCLot: 3124185)								
EA033: pH KCl (23A)	----	0.1	pH Unit	<0.1	----	----	----	----
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	22.26 mole H+ / t	97.4	79.4	110
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity (QCLot: 3124180)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.202 % S	88.6	84.6	110
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-B: Potential Acidity (QCLot: 3124183)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.202 % S	90.1	84.6	110
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-B: Potential Acidity (QCLot: 3124185)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.202 % S	92.1	84.6	110
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 3124183)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	4.9 % CaCO3	102	98.1	108
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
EA033-E: Acid Base Accounting (QCLot: 3124180)								
EA033: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA033: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----

Sub-Matrix: **SOIL**

				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
EA033-E: Acid Base Accounting (QCLot: 3124180) - continued								
EA033: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
EA033-E: Acid Base Accounting (QCLot: 3124183)								
EA033: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA033: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA033: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
EA033-E: Acid Base Accounting (QCLot: 3124185)								
EA033: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA033: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA033: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----

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.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2006921**	Page	: 1 of 10
Amendment	: **1**		
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 19-Jun-2020
Site	: Ashfield Flats	Issue Date	: 24-Jul-2020
Sampler	: Matt Emeny, Shenae Blakiston	No. of samples received	: 50
Order number	: ----	No. of samples analysed	: 50

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: **SOIL**

Method	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA037: Ass Field Screening Analysis						
Snap Lock Bag						
DS9-S01	06-Jul-2020	18-Jun-2020	**18**	07-Jul-2020	18-Jun-2020	**19**

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		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-A: pH Measurements								
80* dried soil (EA029-TPA)								
DS9-S01,	S08-S01,	**17-Jun-2020**	**08-Jul-2020**	17-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S09-S02,	S23-S03,							
S24-S04,	DS8-S02,							
S09-S03								
80* dried soil (EA029-TPA)								
S10-S01,	S10-S06,	**18-Jun-2020**	**08-Jul-2020**	18-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S11-S02,	S11-S06,							
S12-S05,	S13-S05,							
S14-S05,	S20-S06,							
S21-S02								
80* dried soil (EA029-TPA)								
DS1A-S01,	DS1-S01,	**19-Jun-2020**	**08-Jul-2020**	19-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
DS3-S01,	DS5-S01,							
DS5-S02,	DS7-S01,							
S05-S03,	S06-S01,							
S06-S05,	S07-S04							
80* dried soil (EA029-TPA)								
S01-S01,	S01-S04,	**22-Jun-2020**	**08-Jul-2020**	22-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S03-S01,	S04-S02,							
S22-S01,	S25-S02,							
S25-S04,	S26-S04,							
S29-S01,	S30-S03,							
S31-S04								

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
EA029-A: pH Measurements - Continued								
80* dried soil (EA029-TPA)								
S02-S04,	S02-S07,	**23-Jun-2020**	**08-Jul-2020**	23-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S15-S02,	S15-S07,							
S16-S03,	S17-S06,							
S18-S02,	S19-S04,							
S27-S02,	S28-S04,							
SZ10,	SZ7,							
SZ9								
EA029-B: Acidity Trail								
80* dried soil (EA029-TPA)								
DS9-S01,	S08-S01,	**17-Jun-2020**	**08-Jul-2020**	17-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S09-S02,	S23-S03,							
S24-S04,	DS8-S02,							
S09-S03								
80* dried soil (EA029-TPA)								
S10-S01,	S10-S06,	**18-Jun-2020**	**08-Jul-2020**	18-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S11-S02,	S11-S06,							
S12-S05,	S13-S05,							
S14-S05,	S20-S06,							
S21-S02								
80* dried soil (EA029-TPA)								
DS1A-S01,	DS1-S01,	**19-Jun-2020**	**08-Jul-2020**	19-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
DS3-S01,	DS5-S01,							
DS5-S02,	DS7-S01,							
S05-S03,	S06-S01,							
S06-S05,	S07-S04							
80* dried soil (EA029-TPA)								
S01-S01,	S01-S04,	**22-Jun-2020**	**08-Jul-2020**	22-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S03-S01,	S04-S02,							
S22-S01,	S25-S02,							
S25-S04,	S26-S04,							
S29-S01,	S30-S03,							
S31-S04								
80* dried soil (EA029-TPA)								
S02-S04,	S02-S07,	**23-Jun-2020**	**08-Jul-2020**	23-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S15-S02,	S15-S07,							
S16-S03,	S17-S06,							
S18-S02,	S19-S04,							
S27-S02,	S28-S04,							
SZ10,	SZ7,							
SZ9								

Matrix: **SOIL**

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

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-A: Actual Acidity								
80* dried soil (EA033)								
DS9-S01,	S08-S01,	**17-Jun-2020**	**08-Jul-2020**	17-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S09-S02,	S23-S03,							
S24-S04,	DS8-S02,							
S09-S03								
80* dried soil (EA033)								
S10-S01,	S10-S06,	**18-Jun-2020**	**08-Jul-2020**	18-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S11-S02,	S11-S06,							
S12-S05,	S13-S05,							
S14-S05,	S20-S06,							
S21-S02								
80* dried soil (EA033)								
DS1A-S01,	DS1-S01,	**19-Jun-2020**	**08-Jul-2020**	19-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
DS3-S01,	DS5-S01,							
DS5-S02,	DS7-S01,							
S05-S03,	S06-S01,							
S06-S05,	S07-S04							
80* dried soil (EA033)								
S01-S01,	S01-S04,	**22-Jun-2020**	**08-Jul-2020**	22-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S03-S01,	S04-S02,							
S22-S01,	S25-S02,							
S25-S04,	S26-S04,							
S29-S01,	S30-S03,							
S31-S04								
80* dried soil (EA033)								
S02-S04,	S02-S07,	**23-Jun-2020**	**08-Jul-2020**	23-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S15-S02,	S15-S07,							
S16-S03,	S17-S06,							
S18-S02,	S19-S04,							
S27-S02,	S28-S04,							
SZ10,	SZ7,							
SZ9								

Matrix: **SOIL**

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

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-B: Potential Acidity								
80° dried soil (EA033)								
DS9-S01,	S08-S01,	**17-Jun-2020**	**08-Jul-2020**	17-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S09-S02,	S23-S03,							
S24-S04,	DS8-S02,							
S09-S03								
80° dried soil (EA033)								
S10-S01,	S10-S06,	**18-Jun-2020**	**08-Jul-2020**	18-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S11-S02,	S11-S06,							
S12-S05,	S13-S05,							
S14-S05,	S20-S06,							
S21-S02								
80° dried soil (EA033)								
DS1A-S01,	DS1-S01,	**19-Jun-2020**	**08-Jul-2020**	19-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
DS3-S01,	DS5-S01,							
DS5-S02,	DS7-S01,							
S05-S03,	S06-S01,							
S06-S05,	S07-S04							
80° dried soil (EA033)								
S01-S01,	S01-S04,	**22-Jun-2020**	**08-Jul-2020**	22-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S03-S01,	S04-S02,							
S22-S01,	S25-S02,							
S25-S04,	S26-S04,							
S29-S01,	S30-S03,							
S31-S04								
80° dried soil (EA033)								
S02-S04,	S02-S07,	**23-Jun-2020**	**08-Jul-2020**	23-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S15-S02,	S15-S07,							
S16-S03,	S17-S06,							
S18-S02,	S19-S04,							
S27-S02,	S28-S04,							
SZ10,	SZ7,							
SZ9								

Matrix: **SOIL**

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

Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-C: Acid Neutralising Capacity								
80* dried soil (EA033)								
DS9-S01,	S08-S01,	**17-Jun-2020**	**08-Jul-2020**	17-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S09-S02,	S23-S03,							
S24-S04,	DS8-S02,							
S09-S03								
80* dried soil (EA033)								
S10-S01,	S10-S06,	**18-Jun-2020**	**08-Jul-2020**	18-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S11-S02,	S11-S06,							
S12-S05,	S13-S05,							
S14-S05,	S20-S06,							
S21-S02								
80* dried soil (EA033)								
DS1A-S01,	DS1-S01,	**19-Jun-2020**	**08-Jul-2020**	19-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
DS3-S01,	DS5-S01,							
DS5-S02,	DS7-S01,							
S05-S03,	S06-S01,							
S06-S05,	S07-S04							
80* dried soil (EA033)								
S01-S01,	S01-S04,	**22-Jun-2020**	**08-Jul-2020**	22-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S03-S01,	S04-S02,							
S22-S01,	S25-S02,							
S25-S04,	S26-S04,							
S29-S01,	S30-S03,							
S31-S04								
80* dried soil (EA033)								
S02-S04,	S02-S07,	**23-Jun-2020**	**08-Jul-2020**	23-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S15-S02,	S15-S07,							
S16-S03,	S17-S06,							
S18-S02,	S19-S04,							
S27-S02,	S28-S04,							
SZ10,	SZ7,							
SZ9								

Matrix: **SOIL**

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

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA033-D: Retained Acidity								
80* dried soil (EA033)								
DS9-S01, S09-S02, S24-S04, S09-S03	S08-S01, S23-S03, DS8-S02,	**17-Jun-2020**	**08-Jul-2020**	17-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
80* dried soil (EA033)								
S10-S01, S11-S02, S12-S05, S14-S05, S21-S02	S10-S06, S11-S06, S13-S05, S20-S06,	**18-Jun-2020**	**08-Jul-2020**	18-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
80* dried soil (EA033)								
DS1A-S01, DS3-S01, DS5-S02, S05-S03, S06-S05,	DS1-S01, DS5-S01, DS7-S01, S06-S01, S07-S04	**19-Jun-2020**	**08-Jul-2020**	19-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
80* dried soil (EA033)								
S01-S01, S03-S01, S22-S01, S25-S04, S29-S01, S31-S04	S01-S04, S04-S02, S25-S02, S26-S04, S30-S03,	**22-Jun-2020**	**08-Jul-2020**	22-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
80* dried soil (EA033)								
S02-S04, S15-S02, S16-S03, S18-S02, S27-S02, SZ10, SZ9	S02-S07, S15-S07, S17-S06, S19-S04, S28-S04, SZ7,	**23-Jun-2020**	**08-Jul-2020**	23-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓

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
EA033-E: Acid Base Accounting								
80* dried soil (EA033)								
DS9-S01,	S08-S01,	**17-Jun-2020**	**08-Jul-2020**	17-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S09-S02,	S23-S03,							
S24-S04,	DS8-S02,							
S09-S03								
80* dried soil (EA033)								
S10-S01,	S10-S06,	**18-Jun-2020**	**08-Jul-2020**	18-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S11-S02,	S11-S06,							
S12-S05,	S13-S05,							
S14-S05,	S20-S06,							
S21-S02								
80* dried soil (EA033)								
DS1A-S01,	DS1-S01,	**19-Jun-2020**	**08-Jul-2020**	19-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
DS3-S01,	DS5-S01,							
DS5-S02,	DS7-S01,							
S05-S03,	S06-S01,							
S06-S05,	S07-S04							
80* dried soil (EA033)								
S01-S01,	S01-S04,	**22-Jun-2020**	**08-Jul-2020**	22-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S03-S01,	S04-S02,							
S22-S01,	S25-S02,							
S25-S04,	S26-S04,							
S29-S01,	S30-S03,							
S31-S04								
80* dried soil (EA033)								
S02-S04,	S02-S07,	**23-Jun-2020**	**08-Jul-2020**	23-Jun-2021	✓	**10-Jul-2020**	06-Oct-2020	✓
S15-S02,	S15-S07,							
S16-S03,	S17-S06,							
S18-S02,	S19-S04,							
S27-S02,	S28-S04,							
SZ10,	SZ7,							
SZ9								
EA037: Ass Field Screening Analysis								
Snap Lock Bag (EA037)								
DS9-S01		**17-Jun-2020**	**06-Jul-2020**	18-Jun-2020	×	**07-Jul-2020**	18-Jun-2020	×

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)							
ASS Field Screening Analysis	EA037	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	5	50	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029-TPA	5	50	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Suite for Acid Sulphate Soils	EA033	3	50	**6.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	3	50	**6.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029-TPA	3	50	**6.00**	**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
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029-TPA	SOIL	In house: Referenced to Ahern et al 2004 - a suspension peroxide oxidation method following the 'sulfur trail' by determining the level of 1M KCL extractable sulfur and the sulfur level after oxidation of soil sulphides. The 'acidity trail' is followed by measurement of TAA, TPA and TSA. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
ASS Field Screening Analysis	EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.

Preparation Methods	Method	Matrix	Method Descriptions
Drying only	EN020D	SOIL	In house
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	:	**EP2006921**			
Amendment	:	**1**			
Client	:	**RPS Australia West Pty Ltd**	Laboratory	:	Environmental Division Perth
Contact	:	ALAN FOLEY	Contact	:	Lauren Biagioni
Address	:	PO BOX 170 WEST PERTH WA 6872	Address	:	26 Rigali Way Wangara WA Australia 6065
E-mail	:	Alan.Foley@rpsgroup.com.au	E-mail	:	Lauren.biagioni@alsglobal.com
Telephone	:	----	Telephone	:	08 9406 1307
Facsimile	:	----	Facsimile	:	+61-8-9406 1399
Project	:	EEC20088.001	Page	:	1 of 4
Order number	:	----	Quote number	:	EP2020AQUTER0006 (EP/446/20)
C-O-C number	:	----	QC Level	:	NEPM 2013 B3 & ALS QC Standard
Site	:	Ashfield Flats			
Sampler	:	Matt Emeny, Shenae Blakiston			

Dates

Date Samples Received	:	19-Jun-2020 15:30	Issue Date	:	24-Jul-2020
Client Requested Due Date	:	15-Jul-2020	Scheduled Reporting Date	:	**15-Jul-2020**

Delivery Details

Mode of Delivery	:	Samples On Hand	Security Seal	:	Not Available
No. of coolers/boxes	:	----	Temperature	:	----
Receipt Detail	:		No. of samples received / analysed	:	50 / 50

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 (Samples.Perth@alsglobal.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.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

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: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA029b TPA TPA	SOIL - EA033-WA WA - Chromium Suite for Acid Sulphate Soils	SOIL - EA037 ASS Field Screening Analysis
EP2006921-001	17-Jun-2020 00:00	DS9-S01	✓	✓	✓
EP2006921-002	17-Jun-2020 00:00	S08-S01	✓	✓	
EP2006921-003	17-Jun-2020 00:00	S09-S02	✓	✓	
EP2006921-004	17-Jun-2020 00:00	S23-S03	✓	✓	
EP2006921-005	17-Jun-2020 00:00	S24-S04	✓	✓	
EP2006921-006	18-Jun-2020 00:00	S10-S01	✓	✓	
EP2006921-007	18-Jun-2020 00:00	S10-S06	✓	✓	
EP2006921-008	18-Jun-2020 00:00	S11-S02	✓	✓	
EP2006921-009	18-Jun-2020 00:00	S11-S06	✓	✓	
EP2006921-010	18-Jun-2020 00:00	S12-S05	✓	✓	
EP2006921-011	18-Jun-2020 00:00	S13-S05	✓	✓	
EP2006921-012	18-Jun-2020 00:00	S14-S05	✓	✓	
EP2006921-013	18-Jun-2020 00:00	S20-S06	✓	✓	
EP2006921-014	18-Jun-2020 00:00	S21-S02	✓	✓	
EP2006921-015	19-Jun-2020 00:00	DS1A-S01	✓	✓	
EP2006921-016	19-Jun-2020 00:00	DS1-S01	✓	✓	
EP2006921-017	19-Jun-2020 00:00	DS3-S01	✓	✓	
EP2006921-018	19-Jun-2020 00:00	DS5-S01	✓	✓	
EP2006921-019	19-Jun-2020 00:00	DS5-S02	✓	✓	
EP2006921-020	19-Jun-2020 00:00	DS7-S01	✓	✓	
EP2006921-021	17-Jun-2020 00:00	DS8-S02	✓	✓	
EP2006921-022	17-Jun-2020 00:00	S09-S03	✓	✓	
EP2006921-023	19-Jun-2020 00:00	S05-S03	✓	✓	
EP2006921-024	19-Jun-2020 00:00	S06-S01	✓	✓	
EP2006921-025	19-Jun-2020 00:00	S06-S05	✓	✓	
EP2006921-026	19-Jun-2020 00:00	S07-S04	✓	✓	
EP2006921-027	22-Jun-2020 00:00	S01-S01	✓	✓	
EP2006921-028	22-Jun-2020 00:00	S01-S04	✓	✓	
EP2006921-029	22-Jun-2020 00:00	S03-S01	✓	✓	
EP2006921-030	22-Jun-2020 00:00	S04-S02	✓	✓	
EP2006921-031	22-Jun-2020 00:00	S22-S01	✓	✓	
EP2006921-032	22-Jun-2020 00:00	S25-S02	✓	✓	
EP2006921-033	22-Jun-2020 00:00	S25-S04	✓	✓	
EP2006921-034	22-Jun-2020 00:00	S26-S04	✓	✓	
EP2006921-035	22-Jun-2020 00:00	S29-S01	✓	✓	

			SOIL - EA029b TPA TPA	SOIL - EA033-WA WA - Chromium Suite for Acid Sulphate Soils	SOIL - EA037 ASS Field Screening Analysis
EP2006921-036	22-Jun-2020 00:00	S30-S03	✓	✓	
EP2006921-037	22-Jun-2020 00:00	S31-S04	✓	✓	
EP2006921-038	23-Jun-2020 00:00	S02-S04	✓	✓	
EP2006921-039	23-Jun-2020 00:00	S02-S07	✓	✓	
EP2006921-040	23-Jun-2020 00:00	S15-S02	✓	✓	
EP2006921-041	23-Jun-2020 00:00	S15-S07	✓	✓	
EP2006921-042	23-Jun-2020 00:00	S16-S03	✓	✓	
EP2006921-043	23-Jun-2020 00:00	S17-S06	✓	✓	
EP2006921-044	23-Jun-2020 00:00	S18-S02	✓	✓	
EP2006921-045	23-Jun-2020 00:00	S19-S04	✓	✓	
EP2006921-046	23-Jun-2020 00:00	S27-S02	✓	✓	
EP2006921-047	23-Jun-2020 00:00	S28-S04	✓	✓	
EP2006921-048	23-Jun-2020 00:00	SZ10	✓	✓	
EP2006921-049	23-Jun-2020 00:00	SZ7	✓	✓	
EP2006921-050	23-Jun-2020 00:00	SZ9	✓	✓	

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: **SOIL**

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
EA037: ASS Field Screening Analysis							
DS9-S01	Snap Lock Bag	18-Jun-2020	18-Jun-2020	19-Jun-2020	×	02-Jul-2020	×

Requested Deliverables

ACCOUNTS PAYABLE		
- A4 - AU Tax Invoice (INV)	Email	West.AccountsPayable@rpsgroup.com.au
ALAN FOLEY		
- *AU Certificate of Analysis - NATA (COA)	Email	Alan.Foley@rpsgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	Alan.Foley@rpsgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	Alan.Foley@rpsgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	Alan.Foley@rpsgroup.com.au
- A4 - AU Tax Invoice (INV)	Email	Alan.Foley@rpsgroup.com.au
- Chain of Custody (CoC) (COC)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - ENMRG (ENMRG)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	Alan.Foley@rpsgroup.com.au
- EDI Format - XTab (XTAB)	Email	Alan.Foley@rpsgroup.com.au
Shenae Blakiston		
- *AU Certificate of Analysis - NATA (COA)	Email	shenae.blakiston@rpsgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	shenae.blakiston@rpsgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	shenae.blakiston@rpsgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	shenae.blakiston@rpsgroup.com.au
- Chain of Custody (CoC) (COC)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - ENMRG (ENMRG)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	shenae.blakiston@rpsgroup.com.au
- EDI Format - XTab (XTAB)	Email	shenae.blakiston@rpsgroup.com.au

Natalie Duncan

From: Alan Foley <Alan.Foley@rpsgroup.com.au>
Sent: Thursday, 2 July 2020 2:11 PM
To: Samples Perth
Cc: Lauren Biagioni; Shenae Blakiston
Subject: [EXTERNAL] - Rebatch EP2006307, 6357, 6383, 6459, 6510

Follow Up Flag: Follow up
Flag Status: Completed

Categories: Rebatch

CAUTION: This email originated from outside of ALS. Do not click links or open attachments unless you recognize the sender and are sure content is relevant to you.

Good afternoon

Can I please get the below samples rebatched from the above jobs. Quote: EP-446-20

	Sample	job #	pH Field +Fox	CRS suite +TPA
1	DS9-S01	6307	✓	✓
2	S08-S01	6307		✓
3	S09-S02	6307		✓
4	S23-S03	6307		✓
5	S24-S04	6307		✓
6	S10-S01	6357		✓
7	S10-S06	6357		✓
8	S11-S02	6357		✓
9	S11-S06	6357		✓
10	S12-S05	6357		✓
11	S13-S05	6357		✓
12	S14-S05	6357		✓
13	S20-S06	6357		✓
14	S21-S02	6357		✓
15	DS1A-S01	6383		✓
16	DS1-S01	6383		✓
17	DS3-S01	6383		✓
18	DS5-S01	6383		✓
19	DS5-S02	6383		✓
20	DS7-S01	6383		✓
21 -	DS8-S02	~~6383~~ 6307		✓
22 -	DS9-S02	~~6383~~ 6307.		✓
23	S05-S03	6383		✓
24	S06-S01	6383		✓
25	S06-S05	6383		✓
26	S07-S04	6383		✓
27	S01-S01	6459		✓
28	S01-S04	6459		✓
29	S03-S01	6459		✓

Environmental Division
Perth
Work Order Reference
EP2006921

Telephone : + 61-8-9406 1301

30	S04-S02	6459		✓
31	S22-S01	6459		✓
32	S25-S02	6459		✓
33	S25-S04	6459		✓
34	S26-S04	6459		✓
35	S29-S01	6459		✓
36	S30-S03	6459		✓
37	S31-S04	6459		✓
38	S02-S04	6510		✓
39	S02-S07	6510		✓
40	S15-S02	6510		✓
41	S15-S07	6510		✓
42	S16-S03	6510		✓
43	S17-S06	6510		✓
44	S18-S02	6510		✓
45	S19-S04	6510		✓
46	S27-S02	6510		✓
47	S28-S04	6510		✓
48	SZ10	6510		✓
49	SZ7	6510		✓
50	SZ9	6510		✓

Regards

Alan

Alan Foley
Principal Scientist - Contamination and Acid Sulfate Soils
RPS | Australia Asia Pacific
Level 2, 27-31 Troode Street
West Perth WA 6005, Australia
T +61 8 9211 1111
D +61 9288 0836 **M** +61 457 554 432
E alan.foley@rpsgroup.com.au

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In response to COVID-19, RPS has adapted the way we work to ensure we remain connected with you and our colleagues, and continue to deliver good work.

We recognise that the months ahead will pose challenges for many of our clients and partners. We're here to help in any way we can. While COVID-19 might separate us physically in the short term, please know that we're here, we're with you and we're stronger together.

If you need support or would like to discuss your forward looking priorities, please get in touch. You can continue to contact me in the usual ways via phone and email, or we can set up a virtual meeting.

CHAIN OF COUSTODY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1
Turnaround time:	Standard
Quote number:	EP/446/20

Analytical suites

	Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
2	S08-S01	1	17/06/2020	1	x					
	S08-S02	2	17/06/2020	1	x					
	DS8-S01	3	17/06/2020	1	x					
21	DS8-S02	4	17/06/2020	1	x					
	S09-S01	5	17/06/2020	4	x	x	x	x	x	1x green bag labelled frozen for AVS
22	S09-S02	6	17/06/2020	1	x					
	S09-S03	7	17/06/2020	1	x					
	S09-S04	8	17/06/2020	1	x					
	S23-S01	9	17/06/2020	2	x	x	x			
	S23-S02	10	17/06/2020	1	x					
4	S23-S03	11	17/06/2020	1	x					
	S23-S04	12	17/06/2020	1	x					
	S24-S01	13	17/06/2020	1	x					
	S24-S02	14	17/06/2020	1	x					
5	S24-S03	15	17/06/2020	1	x					
	S24-S04	16	17/06/2020	1	x					
	SZ-1	17	17/06/2020	1	x					
	Total number of bottles/bags/jars			21						

Environmental Division
Perth
Work Order Reference
EP2006307

Primary destination:	ALS	Received by:	MO	Secondary destination:		Received by:	
Relinquished by:	Alan Foley	Organisation:	als	Relinquished by:		Organisation:	
Organisation:	RPS	Date:	18/06/2020	Organisation:		Date:	
Date:	18/06/2020	Time:	1030	Date:		Time:	
Time:	8:15:00 AM			Time:			

1 18. DS9-S01
3 19. DS9-S02
20. DS9-S03

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CHAIN OF COUNTY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site: Ashfield Flats
Project reference: EEC20088.001
Scientist(s) Shenae Blakiston & Matt Emeny
Sample type(s): Soil
Report to: Alan Foley & Shenae Blakiston
Invoice to: west.accountspayable@rpsgroup.com

Page number: 1 of 3
Turnaround time: Standard
Quote number: EP/446/20

Environmental Division
Perth
Work Order Reference
EP2006357

	Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA033)	Remarks
(6)	S10-S01 1	18/06/2020	1	x					
	S10-S02 2	18/06/2020	1	x					
	S10-S03 3	18/06/2020	2	x	x	x			
	S10-S04 4	18/06/2020	1	x					
	S10-S05 5	18/06/2020	1	x					
(7)	S10-S06 6	18/06/2020	1	x					
	S11-S01 7	18/06/2020	1	x					
(8)	S11-S02 8	18/06/2020	1	x					
	S11-S03 9	18/06/2020	1	x					
	S11-S04 10	18/06/2020	1	x					
	S11-S05 11	18/06/2020	1	x					
(9)	S11-S06 12	18/06/2020	2	x	x	x			
	S12-S01 13	18/06/2020	1	x					
	S12-S02 14	18/06/2020	1	x					
	S12-S03 15	18/06/2020	1	x					
	S12-S04 16	18/06/2020	1	x					
(10)	S12-S05 17	18/06/2020	1	x					
	Total number of bottles/bags/jars		19						

Primary destination: ALS
Relinquished by: Alan Foley
Organisation: RPS
Date: 19/06/2020
Time: 8:15:00 AM

Received by: SP
Organisation: ALS
Date: ~~[illegible]~~ 19.6.2020
Time: 1530

Secondary destination:
Relinquished by:
Organisation:
Date:
Time:

Received by:
Organisation:
Date:
Time:

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	2 of 3
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150N/EA152)	Acid Volatile Sulfur (EA038)	Remarks
S12-S06 18	18/06/2020	1	x					
S13-S01 19	18/06/2020	1	x					
S13-S02 20	18/06/2020	1	x					
S13-S03 21	18/06/2020	2	x	x	x			
S13-S04 22	18/06/2020	1	x					
11 S13-S05 23	18/06/2020	1	x					
S13-S06 24	18/06/2020	1	x					
S14-S01 25	18/06/2020	1	x					
S14-S02 26	18/06/2020	1	x					
S14-S03 27	18/06/2020	1	x					
S14-S04 28	18/06/2020	1	x					
12 S14-S05 29	18/06/2020	1	x					
S14-S06 SNR	18/06/2020	1	x					
S20-S01 30	18/08/2020	2	x	x	x			
S20-S02 31	18/06/2020	1	x					
S20-S03 32	18/06/2020	1	x					
S20-S04 33	18/06/2020	1	x					
Total number of bottles/bags/jars		19						

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Alan Foley	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	19/06/2020	Time:		Date:		Time:	
Time:	8:15:00 AM			Time:			

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	3 of 3
Turnaround time:	Standard
Quote number:	EP/446/20

	Sample I.D.	Date collected	Number of jars / bottles / bags	Analytical suites: ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA033)	Remarks
	S20-S05 34	18/06/2020	1	x					
13	S20-S06 35	18/06/2020	1	x					
	S21-S01 36	18/06/2020	1	x					
14	S21-S02 37	18/06/2020	1	x					
	S21-S03 38	18/06/2020	1	x					
	S21-S04 39	18/06/2020	1	x					
	SZ2 40	18/06/2020	2	x	x	x			

Total number of bottles/bags/jars 8

Primary destination:	ALS	**Received by:**		**Secondary destination:**		**Received by:**	
Relinquished by:	Alan Foley	**Organisation:**		**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**		**Organisation:**		**Date:**	
Date:	19/06/2020	**Time:**		**Date:**		**Time:**	
Time:	8:15:00 AM			**Time:**			

CHAIN OF CUSTODY

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Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 2
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

Environmental Division
Perth
Work Order Reference
EP2006383

Telephone . . . . . .

		Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)
(16)	1	DS1-S01	19/06/2020	4	x	x	x	x	x
	2	DS1-S02	19/06/2020	4	x	x	x	x	x
(19)	3	DS1A-S01	19/06/2020	4	x	x	x	x	x
(17)	4	DS3-S01	19/06/2020	4	x	x	x	x	x
	5	DS3-S02	19/06/2020	1 (2)	x				
	6	S05-S01	19/06/2020	3 (2)	x	x	x		
	7	S05-S02	19/06/2020	1	x				
(23)	8	S05-S03	19/06/2020	1	x				
(18)	9	DS5-S01	19/06/2020	4 (1)	x	x	x	x	x
(19)	10	DS5-S02	19/06/2020	1 (4)	x				
(24)	11	S06-S01	19/06/2020	1	x				
	12	S06-S02	19/06/2020	1	x				
	13	S06-S03	19/06/2020	2	x			x	
	14	S06-S04	19/06/2020	1	x				
(25)	15	S06-S05	19/06/2020	1	x				
	16	S06-S06	19/06/2020	3	x	x	x		
	17	S06-S07	19/06/2020	1	x				
		Total number of bottles/bags/jars		37					

Primary destination:	ALS	Received by:	MO	Secondary destination:		Received by:	
Relinquished by:	Alan Foley	Organisation:	ALS	Relinquished by:		Organisation:	
Organisation:	RPS	Date:	22-6-2020	Organisation:		Date:	
Date:	22/06/2020	Time:	11:05	Date:		Time:	
Time:	8:45:00 AM			Time:			

CHAIN OF COPY

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Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	2 of 2
Turnaround time:	Standard
Quote number:	EP/446/20

	Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
18	S07-S01	19/06/2020	1	x					
19	S07-S02	19/06/2020	1	x					
(26) 20	S07-S03	19/06/2020	1	x					
21	S07-S04	19/06/2020	1	x					
22	S07-S05	19/06/2020	2	x	x	x			
23	S07-S06	19/06/2020	1	x					
(2) 24	DS7-S01	19/06/2020	4	x	x	x	x	x	
25	DS7-S02	19/06/2020	1	x					
26	SZ3	19/06/2020	2	x	x	x			

Total number of bottles/bags/jars 14

Primary destination:	ALS	**Received by:**	MO	**Secondary destination:**		**Received by:**	
Relinquished by:	Alan Foley	**Organisation:**	ALS	**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**	22-6-2020	**Organisation:**		**Date:**	
Date:	22/06/2020	**Time:**	11:05	**Date:**		**Time:**	
Time:	8:45:00 AM			**Time:**			

CHAIN OF COUSTODY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 3
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

Environmental Division
Perth
Work Order Reference
EP2006459

Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)
S29-S01	1	22/06/2020	3	x	x	x	x	
S29-S02	2	22/06/2020	1	x				
S29-S03	3	22/06/2020	1	x				
S29-S04	4	22/06/2020	1	x				
S29-S05	5	22/06/2020	1	x				
S31-S01	6	22/06/2020	1	x				
S31-S02	7	22/06/2020	3	x	x	x	x	
S31-S03	8	22/06/2020	1	x				
S31-S04	9	22/06/2020	1	x				
S31-S05	10	22/06/2020	1	x				
S26-S01	11	22/06/2020	1	x				
S26-S02	12	22/06/2020	3	x	x	x	x	
S26-S03	13	22/06/2020	1	x				
S26-S04	14	22/06/2020	1	x				
S25-S01	15	22/06/2020	1	x				
S25-S02	16	22/06/2020	1	x				
S25-S03	17	22/06/2020	2	x	x	x		
Total number of bottles/bags/jars			24					

Primary destination:	ALS	Received by:	Louise K	Secondary destination:		Received by:	
Relinquished by:	Kurt Blackman	Organisation:	ALS	Relinquished by:		Organisation:	
Organisation:	RPS	Date:	23/6/2020	Organisation:		Date:	
Date:	23/06/2020	Time:	1330	Date:		Time:	
Time:	9:00am			Time:			

CHAIN OF CUSTODY

rps MAKING COMPLEX EASY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	2 of 3
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

	Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150/EA152)	Acid Volatile Sulfur (EA038)
33	S25-S04 18	22/06/2020	1	x				
3[illegible]	S22-S01 19	22/06/2020	1	x				
	S22-S02 20	22/06/2020	1	x				
	S22-S03 21	22/06/2020	2	x	x	x		
27	S01-S01 22	22/06/2020	1	x				
	S01-S02 23	22/06/2020	1	x				
	S01-S03 24	22/06/2020	1	x				
28	S01-S04 25	22/06/2020	1	x				
	S01-S05 26	22/06/2020	1	x				
	S30-S01 27	22/06/2020	1	x				
	S30-S02 28	22/06/2020	1	x				
26	S30-S03 29	22/06/2020	1	x				
	S30-S04 30	22/06/2020	1	x				
	S30-S05 31	22/06/2020	1	x				
	S30-S06 32	22/06/2020	1	x				
	S04-S01 33	22/06/2020	1	x				
30	S04-S02 34	22/06/2020	1	x				
	Total number of bottles/bags/jars		18					

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Kurt Blackman	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	23/06/2020	Time:		Date:		Time:	
Time:	9:00am			Time:			

CHAIN OF CUSTODY

rps

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	3 of 3
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

(24)

Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)
S04-S03	35	22/06/2020	1	x				
S04-S04	36	22/06/2020	1	x				
S04-S05	37	22/06/2020	3	x	x	x	x	
S04-S06	38	22/06/2020	1	x				
S04-S07	39	22/06/2020	1	x				
S03-S01	40	22/06/2020	2	x	x	x		
S03-S02	41	22/06/2020	1	x				
S03-S03	42	22/06/2020	1	x				
S03-S04	43	22/06/2020	1	x				
S03-S05	44	22/06/2020	1	x				
S03-S06	45	22/06/2020	1	x				
S03-S07	46	22/06/2020	1	x				
SZ4	47	22/06/2020	1	x				
Total number of bottles/bags/jars			16					

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Kurt Blackman	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	23/06/2020	Time:		Date:		Time:	
Time:	9:00am			Time:			

CHAIN OF CUSTODY

rps

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 4
Turnaround time:	Standard
Quote number:	EP/446/20

	Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
	S02-S01	1	23/06/2020		x					
	S02-S02	2	23/06/2020		x					
38	S02-S03	3	23/06/2020		x					
	S02-S04	4	23/06/2020		x					
	S02-S05	5	23/06/2020		x					
	S02-S06	6	23/06/2020		x	x	x			
34	S02-S07	7	23/06/2020		x					
	S27-S01	8	23/06/2020		x					
46	S27-S02	9	23/06/2020		x					
	S27-S03	10	23/06/2020		x					
	S27-S04	11	23/06/2020		x	x	x	x		
	S28-S01	12	23/06/2020		x					
	S28-S02	13	23/06/2020		x					
	S28-S03	14	23/06/2020		x					
47	S28-S04	15	23/06/2020		x	x	x			
	S19-S01	16	23/06/2020		x					
	S19-S02	17	23/06/2020		x					
	Total number of bottles/bags/jars									

Environmental Division
Perth
Work Order Reference
EP2006510

Telephone : +61-8-9406 1301

Primary destination:	ALS	**Received by:**	Louise K	**Secondary destination:**		**Received by:**	
Relinquished by:	Shenae Blakiston	**Organisation:**	ALS	**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**	24/6/2020	**Organisation:**		**Date:**	
Date:	23/06/2020	**Time:**	15:22	**Date:**		**Time:**	
Time:	11:00am			**Time:**			

CHAIN OF CUSTODY

rps

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	2 of 4
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

Analytical suites

	Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)
	S19-S03	18	23/06/2020		x				
45	S19-S04	19	23/06/2020		x	x	x		
	S19-S05	20	23/06/2020		x				
	S19-S06	21	23/06/2020		x				
	S19-S07	22	23/06/2020		x				
	S18-S01	23	23/06/2020		x				
44	S18-S02	24	23/06/2020		x				
	S18-S03	25	23/06/2020		x				
	S18-S04	26	23/06/2020		x				
	S18-S05	27	23/06/2020		x				
	S18-S06	28	23/06/2020		x	x	x		
	S15-S01	29	23/06/2020		x	x	x		
40	S15-S02	30	23/06/2020		x				
	S15-S03	31	23/06/2020		x				
	S15-S04	32	23/06/2020		x				
	S15-S05	33	23/06/2020		x				
	S15-S06	34	23/06/2020		x				
	Total number of bottles/bags/jars								

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Shenae Blakiston	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	23/06/2020	Time:		Date:		Time:	
Time:	11:00am			Time:			

CHAIN OF CUSTODY

rps

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	3 of 4
Turnaround time:	Standard
Quote number:	EP/446/20

	Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA03B)	Remarks
41	S15-S07 35	23/06/2020		x					
	S16-S01 36	23/06/2020		x					
42	S16-S02 37	23/06/2020		x					
	S16-S03 38	23/06/2020		x					
	S16-S04 39	23/06/2020		x					
	S16-S05 40	23/06/2020		x	x	x	x		
	S16-S06 41	23/06/2020		x					
	S16-S07 42	23/06/2020		x					
	S17-S01 43	23/06/2020		x					
	S17-S02 44	23/06/2020		x	x	x	x		
	S17-S03 45	23/06/2020		x					
	S17-S04 46	23/06/2020		x					
	S17-S05 47	23/06/2020		x					
43	S17-S06 48	23/06/2020							
	SZ5 49	23/06/2020							
	SZ6 50	23/06/2020							
44	SZ7 51	23/06/2020							
	Total number of bottles/bags/jars								

Primary destination:	ALS	**Received by:**		**Secondary destination:**		**Received by:**	
Relinquished by:	Shenae Blakiston	**Organisation:**		**Relinquished by:**		**Organisation:**	
Organisation:	RPS	**Date:**		**Organisation:**		**Date:**	
Date:	23/06/2020	**Time:**		**Date:**		**Time:**	
Time:	11:00am			**Time:**			

CHAIN OF COUSTODY

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Page number:	4 of 4
Turnaround time:	Standard
Quote number:	EP/446/20

Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)	Remarks
SZ3	52	23/06/2020	1	x					
(50) SZ9	53	23/06/2020	1	x					
(47) SZ10	54	23/06/2020	1	x					

Total number of bottles/bags/jars: 3

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Shenae Blakiston	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	23/06/2020	Time:		Date:		Time:	
Time:	11:00am			Time:			

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EP2007504**	Page	: 1 of 3
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 18-Jun-2020 10:30
Order number	: ----	Date Analysis Commenced	: 27-Jul-2020
C-O-C number	: ----	Issue Date	: 28-Jul-2020 16:40
Sampler	: ----		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 5		
No. of samples analysed	: 5		

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*
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

- ALS is not NATA accredited for the analysis of EA033-C-ANC on an unpulverised sample (Samples 1-4).
- ASS: EA033 (CRS Suite): Retained Acidity not required for sample #5 because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	DS1-S01	DS7-S01	DS9-S02	S01-S01	DS9-S02
Client sampling date / time				19-Jun-2020 00:00	20-Jul-2020 00:00	17-Jun-2020 00:00	22-Jun-2020 00:00	17-Jun-2020 00:00
				EP2007504-001	EP2007504-002	EP2007504-003	EP2007504-004	EP2007504-005
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH OX (23B)	----	0.1	pH Unit	----	----	----	----	6.5
EA029-B: Acidity Trail								
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	----	----	<2
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	----	----	----	----	5.7
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	----	----	19
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	----	----	----	----	0.03
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	----	----	----	----	0.029
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	----	----	----	----	18
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	3.69	0.47	0.17	1.73	0.09
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	736	94	33	346	19
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	1.18	0.15	0.05	0.56	0.03
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	----	----	1.5
Net Acidity (sulfur units)	----	0.02	% S	----	----	----	----	0.06
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	----	----	37
Liming Rate	----	1	kg CaCO3/t	----	----	----	----	3
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	----	----	0.06
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	----	----	37
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	----	----	3

Environmental

QUALITY CONTROL REPORT

Work Order	: **EP2007504**	Page	: 1 of 4
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 18-Jun-2020
Order number	: ----	Date Analysis Commenced	: 27-Jul-2020
C-O-C number	: ----	Issue Date	: 28-Jul-2020
Sampler	: ----		
Site	: Ashfield Flats		
Quote number	: EP/446/20		
No. of samples received	: 5		
No. of samples analysed	: 5		

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*
Daniel Fisher	Inorganics Analyst	Perth ASS, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 (%)
EA029-A: pH Measurements (QC Lot: 3163477)									
EP2007504-005	DS9-S02	EA029-TPA: pH OX (23B)	----	0.1	pH Unit	6.5	6.6	0.00	0% - 20%
EA029-B: Acidity Trail (QC Lot: 3163477)									
EP2007504-005	DS9-S02	EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	0.00	No Limit
EA033-A: Actual Acidity (QC Lot: 3163476)									
EP2007504-005	DS9-S02	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.03	0.03	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	19	19	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	5.7	5.8	2.78	0% - 20%
EA033-B: Potential Acidity (QC Lot: 3163476)									
EP2007504-005	DS9-S02	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.029	0.027	7.14	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	18	17	0.00	No Limit
EA033-C: Acid Neutralising Capacity (QC Lot: 3154071)									
EP2007504-001	DS1-S01	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	3.69	3.71	0.540	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	1.18	1.19	0.844	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	736	741	0.696	0% - 20%
EA033-C: Acid Neutralising Capacity (QC Lot: 3163476)									
EP2007504-005	DS9-S02	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.09	<0.01	160	No Limit
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.03	<0.01	100	No Limit
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	19	<10	62.0	No Limit
EA033-E: Acid Base Accounting (QC Lot: 3163476)									

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 (%)
EA033-E: Acid Base Accounting (QC Lot: 3163476) - continued									
EP2007504-005	DS9-S02	EA033: Net Acidity (sulfur units)	----	0.02	% S	0.06	0.06	0.00	No Limit
		EA033: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.06	0.06	0.00	No Limit
		EA033: Liming Rate	----	1	kg CaCO3/t	3	3	0.00	No Limit
		EA033: Liming Rate excluding ANC	----	1	kg CaCO3/t	3	3	0.00	No Limit
		EA033: Net Acidity (acidity units)	----	10	mole H+ / t	37	36	2.74	No Limit
		EA033: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	37	36	2.74	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 Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA029-B: Acidity Trail (QCLot: 3163477)								
EA029-TPA: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	----	----	----	----
EA033-A: Actual Acidity (QCLot: 3163476)								
EA033: pH KCl (23A)	----	0.1	pH Unit	<0.1	----	----	----	----
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	22.26 mole H+ / t	85.1	79.4	110
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity (QCLot: 3163476)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.202 % S	93.6	84.6	110
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 3154071)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	4.9 % CaCO3	102	98.1	108
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 3163476)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	4.9 % CaCO3	102	98.1	108
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
EA033-E: Acid Base Accounting (QCLot: 3163476)								
EA033: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA033: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA033: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----

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.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2007504**	Page	: 1 of 4
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Telephone	: 08 9406 1307
Project	: EEC20088.001	Date Samples Received	: 18-Jun-2020
Site	: Ashfield Flats	Issue Date	: 28-Jul-2020
Sampler	: ----	No. of samples received	: 5
Order number	: ----	No. of samples analysed	: 5

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

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

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

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	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-A: pH Measurements							
Snap Lock Bag - frozen on receipt at ALS (EA029-TPA) DS9-S02	**17-Jun-2020**	**27-Jul-2020**	17-Jun-2021	✓	**28-Jul-2020**	25-Oct-2020	✓
EA029-B: Acidity Trail							
Snap Lock Bag - frozen on receipt at ALS (EA029-TPA) DS9-S02	**17-Jun-2020**	**27-Jul-2020**	17-Jun-2021	✓	**28-Jul-2020**	25-Oct-2020	✓
EA033-A: Actual Acidity							
Snap Lock Bag - frozen on receipt at ALS (EA033) DS9-S02	**17-Jun-2020**	**27-Jul-2020**	17-Jun-2021	✓	**28-Jul-2020**	25-Oct-2020	✓
EA033-B: Potential Acidity							
Snap Lock Bag - frozen on receipt at ALS (EA033) DS9-S02	**17-Jun-2020**	**27-Jul-2020**	17-Jun-2021	✓	**28-Jul-2020**	25-Oct-2020	✓
EA033-C: Acid Neutralising Capacity							
Snap Lock Bag - frozen on receipt at ALS (EA033) DS9-S02, DS9-S02	**17-Jun-2020**	**27-Jul-2020**	17-Jun-2021	✓	**28-Jul-2020**	25-Oct-2020	✓
Snap Lock Bag - frozen on receipt at ALS (EA033) DS1-S01	**19-Jun-2020**	**27-Jul-2020**	19-Jun-2021	✓	**28-Jul-2020**	25-Oct-2020	✓
Snap Lock Bag - frozen on receipt at ALS (EA033) DS7-S01	**20-Jul-2020**	**27-Jul-2020**	20-Jul-2021	✓	**28-Jul-2020**	25-Oct-2020	✓
Snap Lock Bag - frozen on receipt at ALS (EA033) S01-S01	**22-Jun-2020**	**27-Jul-2020**	22-Jun-2021	✓	**28-Jul-2020**	25-Oct-2020	✓
EA033-D: Retained Acidity							
Snap Lock Bag - frozen on receipt at ALS (EA033) DS9-S02	**17-Jun-2020**	**27-Jul-2020**	17-Jun-2021	✓	**28-Jul-2020**	25-Oct-2020	✓
EA033-E: Acid Base Accounting							
Snap Lock Bag - frozen on receipt at ALS (EA033) DS9-S02	**17-Jun-2020**	**27-Jul-2020**	17-Jun-2021	✓	**28-Jul-2020**	25-Oct-2020	✓

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)							
Chromium Suite for Acid Sulphate Soils	EA033	2	5	**40.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029-TPA	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Suite for Acid Sulphate Soils	EA033	2	5	**40.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	2	5	**40.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029-TPA	1	1	**100.00**	**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*
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029-TPA	SOIL	In house: Referenced to Ahern et al 2004 - a suspension peroxide oxidation method following the 'sulfur trail' by determining the level of 1M KCL extractable sulfur and the sulfur level after oxidation of soil sulphides. The 'acidity trail' is followed by measurement of TAA, TPA and TSA. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	: **EP2007504**		
Client	: **RPS Australia West Pty Ltd**	Laboratory	: Environmental Division Perth
Contact	: ALAN FOLEY	Contact	: Lauren Biagioni
Address	: PO BOX 170 WEST PERTH WA 6872	Address	: 26 Rigali Way Wangara WA Australia 6065
E-mail	: Alan.Foley@rpsgroup.com.au	E-mail	: Lauren.biagioni@alsglobal.com
Telephone	: ----	Telephone	: 08 9406 1307
Facsimile	: ----	Facsimile	: +61-8-9406 1399
Project	: EEC20088.001	Page	: 1 of 2
Order number	: ----	Quote number	: EP2020AQUTER0006 (EP/446/20)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Ashfield Flats		
Sampler	:		

Dates

Date Samples Received	: 18-Jun-2020 10:30	Issue Date	: 24-Jul-2020
Client Requested Due Date	: 28-Jul-2020	Scheduled Reporting Date	: **28-Jul-2020**

Delivery Details

Mode of Delivery	: Samples On Hand	Security Seal	: Not Available
No. of coolers/boxes	: ----	Temperature	: ----
Receipt Detail	:	No. of samples received / analysed	: 5 / 5

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 (Samples.Perth@alsglobal.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.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.

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: **SOIL**

Laboratory sample ID	*Client sampling date / time*	*Client sample ID*	SOIL - EA029b TPA TPA	SOIL - EA033-C ANC ANC only from Chromium Suite Method	SOIL - EA033-WA WA - Chromium Suite for Acid Sulphate Soils
EP2007504-001	19-Jun-2020 00:00	DS1-S01		✓	
EP2007504-002	20-Jul-2020 00:00	DS7-S01		✓	
EP2007504-003	17-Jun-2020 00:00	DS9-S02		✓	
EP2007504-004	22-Jun-2020 00:00	S01-S01		✓	
EP2007504-005	17-Jun-2020 00:00	DS9-S02	✓		✓

Proactive Holding Time Report

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

Requested Deliverables

ACCOUNTS PAYABLE

- A4 - AU Tax Invoice (INV)	Email	West.AccountsPayable@rpsgroup.com.au

ALAN FOLEY

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

Shenae Blakiston

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

Natalie Duncan

From:	Alan Foley <Alan.Foley@rpsgroup.com.au>
Sent:	Thursday, 16 July 2020 1:24 PM
To:	Samples Perth
Cc:	Shenae Blakiston; Lauren Biagioni
Subject:	[EXTERNAL] - RE: RESULTS & EDD & INVOICE for ALS Workorder : EP2006921 | Overall Description: Ex EP2006307; EP2006357; EP2006383; EP2006459; EP2006510

CAUTION: This email originated from outside of ALS. Do not click links or open attachments unless you recognize the sender and are sure content is relevant to you.

Good afternoon

Can I please get the following samples analysed for the mod-acid neutralising capacity (ANC) per quote EP/446/20, uncrushed sample sieved to 0.6 mm (EA033 method)

1 DS1-S01
2 DS7-S01
3 DS9-S02
4 S01-S01

Environmental Division
Perth
Work Order Reference
EP2007504

Telephone : + 61-8-9406 1301

Regards

Alan

Alan Foley
Principal Scientist - Contamination and Acid Sulfate Soils
RPS | Australia Asia Pacific
M +61 457 554 432
E alan.foley@rpsgroup.com.au

From: angel-no-reply@alsglobal.com <angel-no-reply@alsglobal.com>
Sent: Wednesday, 15 July 2020 7:10 PM
To: Alan Foley <Alan.Foley@rpsgroup.com.au>
Subject: RESULTS & EDD & INVOICE for ALS Workorder : EP2006921 | Overall Description: Ex EP2006307; EP2006357; EP2006383; EP2006459; EP2006510

CAUTION: This email originated from outside of RPS.

Deliverables for ALS Workorder EP2006921

Project: EEC20088.001

CHAIN OF CUSTODY

1

RPS
Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site: Ashfield Flats
Project reference: EEC20088.001
Scientist(s): Shenae Blakiston & Matt Emeny
Sample type(s): Soil
Report to: Alan Foley & Shenae Blakiston
Invoice to: west.accountspayable@rpsgroup.com

Page number: 1
Turnaround time: Standard
Quote number: EP/446/20

	Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150/EA152)	Acid Volatile Sulfur (EA033)	Remarks
2	S08-S01	1	17/06/2020	1	x					
	S08-S02	2	17/06/2020	1	x					
	DS8-S01	3	17/06/2020	1	x					
21	DS8-S02	4	17/06/2020	1	x					
	S09-S01	5	17/06/2020	4	x	x	x	x	x	1x green bag labelled frozen for AVS
22	S09-S02	6	17/06/2020	1	x					
	S09-S03	7	17/06/2020	1	x					
	S09-S04	8	17/06/2020	1	x					
	S23-S01	9	17/06/2020	2	x	x	x			
	S23-S02	10	17/06/2020	1	x					
4	S23-S03	11	17/06/2020	1	x					
	S23-S04	12	17/06/2020	1	x					
	S24-S01	13	17/06/2020	1	x					
	S24-S02	14	17/06/2020	1	x					
	S24-S03	15	17/06/2020	1	x					
5	S24-S04	16	17/06/2020	1	x					
	SZ-1	17	17/06/2020	1	x					
	Total number of bottles/bags/jars			21						

Environmental Division
Perth
Work Order Reference
EP2006307

Primary destination: ALS
Relinquished by: Alan Foley
Organisation: RPS
Date: 18/06/2020
Time: 8:15:00 AM

Received by: MO
Organisation: als
Date: 18/06/2020
Time: 630

Secondary destination:
Relinquished by:
Organisation:
Date:
Time:

Received by:
Organisation:
Date:
Time:

1 18. DS9-S01
3 19. DS9-S02
20. DS9-S03

CHAIN OF CUSTODY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 3
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks:	

Analytical suites

	Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150H/EA152)	Acid Volatile Sulfur (EA038)
6	S10-S01 1	18/06/2020	1	x				
	S10-S02 2	18/06/2020	1	x				
	S10-S03 3	18/06/2020	2	x	x	x		
	S10-S04 4	18/06/2020	1	x				
7	S10-S05 5	18/06/2020	1	x				
	S10-S06 6	18/06/2020	1	x				
	S11-S01 7	18/06/2020	1	x				
8	S11-S02 8	18/06/2020	1	x				
	S11-S03 9	18/06/2020	1	x				
	S11-S04 10	18/06/2020	1	x				
	S11-S05 11	18/06/2020	1	x				
9	S11-S06 12	18/06/2020	2	x	x	x		
	S12-S01 13	18/06/2020	1	x				
	S12-S02 14	18/06/2020	1	x				
	S12-S03 15	18/06/2020	1	x				
	S12-S04 16	18/06/2020	1	x				
10	S12-S05 17	18/06/2020	1	x				
	Total number of bottles/bags/jars		19					

Environmental Division
Perth
Work Order Reference
EP2006357

Primary destination: ALS		Received by:	SP	Secondary destination:	Received by:
Relinquished by:	Alan Foley	Organisation:	ALS	Relinquished by:	Organisation:
Organisation:	RPS	Date:	~~1530~~ 19.6.2020	Organisation:	Date:
Date:	19/06/2020	Time:	1530	Date:	Time:
Time:	8:15:00 AM			Time:	

CHAIN OF CUSTODY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	2 of 3
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks	

Analytical suites

Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle density [illegible]	Acid Volatile Sulfide [illegible]
S12-S06 18	18/06/2020	1	x				
S13-S01 19	18/06/2020	1	x				
S13-S02 20	18/06/2020	1	x				
S13-S03 21	18/06/2020	2	x	x	x		
S13-S04 22	18/06/2020	1	x				
(11) S13-S05 23	18/06/2020	1	x				
S13-S06 24	18/06/2020	1	x				
S14-S01 25	18/06/2020	1	x				
S14-S02 26	18/06/2020	1	x				
S14-S03 27	18/06/2020	1	x				
S14-S04 28	18/06/2020	1	x				
(12) S14-S05 29	18/06/2020	1	x				
S14-S06 SNR	18/06/2020	1	x				
S20-S01 30	18/06/2020	2	x	x	x		
S20-S02 31	18/06/2020	1	x				
S20-S03 32	18/06/2020	1	x				
S20-S04 33	18/06/2020	1	x				
Total number of bottles/bags/jars		19					

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Alan Foley	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	19/06/2020	Time:		Date:		Time:	
Time:	8:15:00 AM			Time:			

CHAIN OF CUSTODY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 2
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks:	

		Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Soil Particle Density (EA150/EA152)	Acid Volatile Sulfur (EA033)
16	1	DS1-S01	19/06/2020	4	x	x	x	x	x
	2	DS1-S02	19/06/2020	4	x	x	x	x	x
13	3	DS1A-S01	19/06/2020	4	x	x	x	x	x
	4	DS3-S01	19/06/2020	4	x	x	x	x	x
17	5	DS3-S02	19/06/2020	1 (2)	x				
	6	S05-S01	19/06/2020	3 (2)	x	x	x		
	7	S05-S02	19/06/2020	1	x				
23	8	S05-S03	19/06/2020	1	x				
18	9	DS5-S01	19/06/2020	4 (1)	x	x	x	x	x
19	10	DS5-S02	19/06/2020	1 (4)	x				
	11	S06-S01	19/06/2020	1	x				
24	12	S06-S02	19/06/2020	1	x				
	13	S06-S03	19/06/2020	2	x			x	
	14	S06-S04	19/06/2020	1	x				
25	15	S06-S05	19/08/2020	1	x				
	16	S06-S06	19/06/2020	3	x	x	x		
	17	S06-S07	19/06/2020	1	x				
		Total number of bottles/bags/jars		37					

Environmental Division
Perth
Work Order Reference
EP2006383

Telephone :

Primary destination:	ALS	**Received by:**	MO	**Secondary destination:**	
Relinquished by:	Alan Foley	**Organisation:**	ALS	**Relinquished by:**	
Organisation:	RPS	**Date:**	22-6-2020	**Organisation:**	
Date:	22/06/2020	**Time:**	11:05	**Date:**	
Time:	8:45:00 AM			**Time:**	

Received by:	
Organisation:	
Date:	
Time:	

![RPS]

CHAIN OF CUSTODY

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emeny
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	1 of 3
Turnaround time:	Standard
Quote number:	EP/446/20
Remarks:	

	Sample I.D.	Date collected	Number of jars / bottles / bags	ASS Field screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EK004)	PSD & Soil particle density (EA150H/EA152)	Acid Volatile Sulfide (EA033)
35 27	S29-S01 1	22/06/2020	3	x	x	x	x	
	S29-S02 2	22/06/2020	1	x				
	S29-S03 3	22/06/2020	1	x				
	S29-S04 4	22/06/2020	1	x				
	S29-S05 5	22/06/2020	1	x				
	S31-S01 6	22/06/2020	1	x				
	S31-S02 7	22/06/2020	3	x	x	x	x	
	S31-S03 8	22/06/2020	1	x				
33	S31-S04 9	22/06/2020	1	x				
	S31-S05 10	22/06/2020	1	x				
	S26-S01 11	22/06/2020	1	x				
	S26-S02 12	22/06/2020	3	x	x	x	x	
	S26-S03 13	22/06/2020	1	x				
34	S26-S04 14	22/06/2020	1	x				
	S25-S01 15	22/06/2020	1	x				
32	S25-S02 16	22/06/2020	1	x				
	S25-S03 17	22/06/2020	2	x	x	x		
	Total number of bottles/bags/jars		24					

Environmental Division
Perth
Work Order Reference
EP2006459

Primary destination:	ALS	Received by:	Louise K	Secondary destination:		Received by:	
Relinquished by:	Kurt Blackman	Organisation:	ALS	Relinquished by:		Organisation:	
Organisation:	RPS	Date:	23/6/2020	Organisation:		Date:	
Date:	23/06/2020	Time:	1330	Date:		Time:	
Time:	9:00am			Time:			

CHAIN OF CUSTODY

RPS

Level 2, 27-31 Troode Street
West Perth WA 6005
Tel: (618) 9211 1111
Fax: (618) 9211 1122

Site:	Ashfield Flats
Project reference:	EEC20088.001
Scientist(s)	Shenae Blakiston & Matt Emery
Sample type(s):	Soil
Report to:	Alan Foley & Shenae Blakiston
Invoice to:	west.accountspayable@rpsgroup.com

Page number:	2 of 3
Turnaround time:	Standard
Quote number:	EP/448/20
Remarks	

	Sample I.D.		Date collected	Number of jars / bottles / bags	ASS Field Screening (EA037)	Electrical Conductivity (EA010)	Organic Matter & TOC (EP004)	PSD & Particle Density (EA150/EA152)	ACH Volatile Sulfur (EA033)	Remarks
33	S25-S04	18	22/06/2020	1	x					
34	S22-S01	19	22/06/2020	1	x					
	S22-S02	20	22/06/2020	1	x					
	S22-S03	21	22/06/2020	2	x	x	x			
27	S01-S01	22	22/06/2020	1	x					
	S01-S02	23	22/06/2020	1	x					
	S01-S03	24	22/06/2020	1	x					
28	S01-S04	25	22/06/2020	1	x					
	S01-S05	26	22/06/2020	1	x					
	S30-S01	27	22/06/2020	1	x					
	S30-S02	28	22/06/2020	1	x					
31	S30-S03	29	22/06/2020	1	x					
	S30-S04	30	22/06/2020	1	x					
	S30-S05	31	22/06/2020	1	x					
	S30-S06	32	22/06/2020	1	x					
	S04-S01	33	22/06/2020	1	x					
30	S04-S02	34	22/06/2020	1	x					
	Total number of bottles/bags/jars			18						

Primary destination:	ALS	Received by:		Secondary destination:		Received by:	
Relinquished by:	Kurt Blackman	Organisation:		Relinquished by:		Organisation:	
Organisation:	RPS	Date:		Organisation:		Date:	
Date:	23/06/2020	Time:		Date:		Time:	
Time:	9:00am			Time:			

Appendix F
Calibration log

MULTI-PARAMETER METER CALIBRATION RECORD

Project number: EEC 20088.001

Site location: Ashfield

Date	pH 7		pH 4		EC buffer µs/cm		Temp. °C		D.O. ppm		Redox		Scientist
	Pre-cal	Post-cal	Pre-cal	Post-cal	Pre-cal	Post-cal	Pre-cal	Post-cal	Zero	Air	Temp. °C	Measurement	
17/6/20	6.98	7.00	4.07	4.00	1438	1413			0.9	8.40			
19/6/20	6.95	7.00	4.12	4.00	1379	1413			0	8.62			

Multi-parameter meter details	Solution	Batch / lot	Expiry date	Zobell B solution, for Ag/AgCl saturated KCl electrode				Calibration notes:
Manufacturer: Xylem	pH 4 buffer	—	—	T °C	mV	T °C	mV	
Model number: YSI pro	pH 7 buffer	—	—	5	273	20	240	
Serial number:	EC buffer	345200	Nov 19	10	262	25	229	
	Zobell B			15	251	30	218	