

## **Airservices Australia**

Yulara Airport Groundwater sampling results for bore RN012065

August 2019

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## 1. Introduction

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.3 and the assumptions and qualifications contained throughout the Report.

## 1.1 Background

GHD was engaged by Airservices Australia (ASA) to sample groundwater from the existing groundwater bore RN012065, located within the Connellan Airport (the Site). The airport is located at 200 Coote Road (Lot 101, Town of Yulara) approximately 4.1 km northwest of Yulara Township, as shown in Figure 1, Appendix A. The groundwater bore RN012065 is located approximately 700 m northwest of the main Airport Terminal, or 95 m north of the airport Fire Station building, as shown in Figure 2, Appendix A.

### 1.2 Scope of works

The purpose of the groundwater sampling event was to provide an initial assessment of the potential for per and poly-fluoroalkyl substance (PFAS) impact to local groundwater quality. The following scope of works was undertaken:

- Gauging of the well using an oil-water interface probe to record depth to water and to assess whether light non-aqueous phase liquid (LNAPL) was present
- Sampling of groundwater, which was conducted via 'no-purge' HYDRAsleeve methods
- Analysis of the groundwater sample for PFAS content
- Comparison of field measurements and analytical results to applicable environmental guidelines
- Preparation of this letter report

### 1.3 Scope and limitations

This report has been prepared by GHD for Airservices Australia and may only be used and relied on by Airservices Australia for the purpose agreed between GHD and the Airservices Australia as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Airservices Australia arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described throughout this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Airservices Australia and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept

liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Site setting

#### 2.1 Climate and weather

Yulara is located within a semi-arid environment, with an average annual rainfall of 283 mm and with average high and low temperatures ranging from 38.5 °C (January) and 4.4 °C (July). (BOM, 2019; Yulara Airport, Station 015635). Annual rainfall is unpredictable though, as shown in Figure 2-1. Yulara is south of the Tropic of Capricorn and most rainfall received is generated from equatorial troughs moving south from the northern Australia wet season (November to April). As such, December is the wettest month on average (45.4 mm) and August the driest (5 mm).

The year to date rainfall total (to June 2019) measured at Yulara Airport was 20-mm, which is considerably below the average.



Figure 2-1 Annual rainfall over past decade (mm per calendar year, Yulara Airport)

### 2.2 Geology and hydrogeology

The Site is situated within the Amadeus Basin, which is composed of sediments dating to the Neoproterozoic and Palaeozoic era, overlain by Cainozoic deposits. The Cainozoic deposits are regionally important as they lie within a previous southeast / northwest oriented paleo-valley. The depth of this strata ranges from 27 to 140 metres below ground level (m,bgl) around the Yulara area. The Cainozoic strata are deposition products from the erosion of nearby highland areas and are comprised of sands, silts and clays. Borelogs from the area generally describe the lithology as a sequence of sand and clay layers with siltstone generally encountered at depths beyond 30 m.

The Cainozoic strata hosts some groundwater, but the main aquifer exists within the basement strata. In combination, these groundwater units represent the 'Dune Plains Aquifer', which flows northwards, towards the ephemeral salt lake, Lake Amadeus.

RN012065 was installed in 1979 to an approximate depth of 37.5 m and remains as the only registered bore within the airport (according to the NR Maps database). Water samples collected in 1979 showed the water was suitable for stock-watering but not for human consumption due to elevated total dissolved solids.

Six other monitoring or investigation bores exist within 2 km to the south and southeast of the Site, as listed below in Table 2-1. Although reported standing water levels occur around 12 and 14 m,bgl, the depth of initial water strike in these bores is generally deeper, typically between 18 and 30 m,bgl.

Bore Number	Bore Name	Purpose	Drilled Depth (m,bgl)	Water Level (m,bgl)
RN012065	Monitoring Bore – Yulara Airport	Monitoring	37.5	12.3
RN012074		Investigation	39	14.8
RN012075		Investigation	54	12.9
RN012076		Investigation	37.5	12.6
RN012081	Monitoring Bore – Yulara Dune Plains	Monitoring	93	14.6
RN012082		Investigation	53	0
RN012163	Replacement for RN012082	Investigation	63	14.2

## Table 2-1 Bores within 2-km of Yulara Airport (from NR Maps Water PortalDatabase)

### 2.3 Preliminary groundwater sensitivity assessment

The municipal potable-water supply to the Yulara Township is provided from a bore-field located approximately 9.5 km southwest of the Site, operated by Power Water Corporation. The location of this bore-field relative to the airport is shown in Figure 1, Appendix A.

Other regional features or activities with a potential to impact the local groundwater environment are also shown in Figure 1 and include the Yulara Wastewater treatment plant and the Yulara landfill.

The Australian Government Bureau of Meteorology (2019) provides mapping of Groundwater Dependent Ecosystems (GDE). For the Northern Territory, the mapping includes ecosystems that rely on the surface expression of groundwater such as rivers, wetlands and springs (aquatic ecosystems) and those that rely on subsurface groundwater including vegetation (terrestrial ecosystems). A search of the mapping database has indicated that no GDE, aquatic or terrestrial, lie within a 10 km radius of the Site.

## 3. Field investigations

### 3.1 Site observations

RN12065 is located approximately 340 m northeast of the former Fire Fighting Training Grounds, which contain a mock aircraft body on a concrete pad. The immediate surrounding areas are cleared and are not paved.

### 3.2 Methodology and results

RN012065 was gauged on 19 June 2019 using an oil/water interface probe to determine the depth to groundwater, the potential presence of light non-aqueous phase liquid and the total depth of the well. Calibration certificates are presented in Appendix B.

A HDPE HYDRASleeve was deployed using 'bailer-twine' composed of nylon fibres and was positioned near the mid-point of the well screen, at a depth of 25 m,bgl. The HYDRASleeve was recovered on 20 June 2019 and groundwater was sampled. The HDPE and nylon sampling materials used during the project, were selected to ensure no cross-contamination of PFAS from sampling materials/equipment.

Sampling was performed in accordance with GHD SOP 1 Groundwater Well Sampling and QA/QC procedures. Samples were placed on ice and dispatched to the nominated NATA accredited laboratory (ALS) Field-measured physico-chemical parameters are shown in Table 3-1. The sample was noted as being clear, but contained small dark-coloured organic fragments and a slight organic matter odour.

Well ID	SWL (m bgl)	Depth (m bgl)	EC (µS/cm)	Temp (oC)	рН	DO %Sat	DO (mg/L)	Eh (mV)
RN12065	9.882	34.40	2563	25.5	8.34	22.6	1.75	-122.6

#### Table 3-1 Field water quality parameters

## 4. Analytical results

## 4.1 Quality assurance / quality control

One blind replicate sample was collected. The repeatability and precision of analytical results can be evaluated via the relative percentage difference (RPD) between a primary sample result (Co) and the field duplicate sample result (Cd), with the RPD calculated as follows:

$$RPD(\%) = \frac{\left|C_{o} - C_{d}\right|}{C_{o} + C_{d}} \times 200$$

 Where
 Co =
 Analyte concentration of the original sample

 Cd =
 Analyte concentration of the duplicate sample

An acceptance criteria of 30% relative percent difference (RPD) is adopted for field duplicates.

The results of the duplicate sample (QC01) collected are presented in comparison to the results of RN012065 in Table R 1 attached to the end of this report. Relative percentage differences between the primary and duplicate samples are within acceptable limits and provide some evidence of the reliability of the reported concentrations and in terms of the accuracy, precision and repeatability of the sampling and analytical procedures employed.

### 4.2 **PFAS** concentrations

Groundwater sampled from RN012065 contained low level PFAS concentrations, as shown in Table R 1 attached, with similar concentrations detected in the primary and duplicate samples. Original laboratory documents are presented in Appendix C. The 'Sum of PFAS' concentration reported was  $0.155 - 0.167 \mu g/L$  between the two samples.

The analytical results in Table R 1 are compared to generic Tier 1 water quality assessment criteria. Those groundwater assessment criteria are adopted from:

Heads of EPAs of Australia and New Zealand. 2018. PFAS National Environment Management Plan

- Aquatic Ecosystem freshwater guideline value: 95% Freshwater species protection slightly to moderately disturbed systems (Australian and New Zealand Guidelines for Fresh and Marine Water Quality – technical draft default guideline values)
- Health-based guidance values: Drinking Water (Australian Government Department of Health, 2017)

Given the regional site setting, these guidelines are considered highly conservative for assessing health or environmental risks posed by PFAS at this location. Shallow groundwater is not suitable for sensitive beneficial uses and due to the depth of groundwater regionally, no plausible exposure scenarios are presently posed in terms of groundwater risk to human health or (groundwater dependent) ecological receptors.

## 4.3 Conclusion

Groundwater is understood to regionally flow to the north. However, as discussed in Section 2 recharge can differ considerably on a year-to-year basis and might result in localised groundwater gradient development in response to artificial drawdown and/or recharge.

Other sources of PFAS impact in the Yulara region may include the Yulara Fire Station (213 Yulara Drive), the Yulara Waste Water Treatment Plant and the Yulara Landfill. These facilities are all located greater than 5 km south of the airport. Although not the responsibility of ASA, a more holistic assessment of potentially cumulative PFAS impacts to groundwater within the Yulara region may be warranted, given the semi-arid regional setting and the correspondingly higher importance of maintaining a dependable groundwater resource.

Table R 1 Groundwater analytical results



				Field ID	QC01	RN12065	
				Date	20/06/2019	20/06/2019	Relative
				Lab Report No.	ES1919430 20/06/2019 14:30	ES1919430 20/06/2019 14:30	Percentage Difference
				Sample Type	Field_D	Normal	
	Unit	EQL	PFAS NEMP 2018 Freshwater 95%	PFAS NEMP 2018 Health Drinking Water			
Perfluorobutane sulfonic acid (PFBS)	µg/L	0.002			0.016	0.021	27
Perfluoropentane sulfonic acid (PFPeS)	µg/L	0.002			0.003	0.003	0
Perfluorohexane sulfonic acid (PFHxS)	µg/L	0.002			0.011	0.012	9
Perfluoroheptane sulfonic acid (PFHpS)	µg/L	0.002			<0.002	<0.002	0
Perfluorooctane sulfonic acid (PFOS)	µg/L	0.002	0.13	0.07	0.032	0.036	12
Perfluorodecanesulfonic acid (PFDS)	µg/L	0.002			<0.002	<0.002	0
Perfluoro-n-hexadecanoic acid (PFHxDA)	µg/L	0.005			<0.005	<0.005	0
Perfluorobutanoic acid (PFBA)	µg/L	0.01			<0.01	<0.01	0
Perfluoropentanoic acid (PFPeA)	µg/L	0.002			0.009	0.007	25
Perfluorohexanoic acid (PFHxA)	µg/L	0.002			0.044	0.048	9
Perfluoroheptanoic acid (PFHpA)	µg/L	0.002			<0.002	<0.002	0
Perfluorooctanoic acid (PFOA)	µg/L	0.002	220	0.56	<0.002	<0.002	0
Perfluorononanoic acid (PFNA)	µg/L	0.002			<0.002	<0.002	0
Perfluorodecanoic acid (PFDA)	µg/L	0.002			<0.002	<0.002	0
Perfluoroundecanoic acid (PFUnDA)	µg/L	0.002			<0.002	<0.002	0
Perfluorododecanoic acid (PFDoDA)	µg/L	0.002			<0.002	<0.002	0
Perfluorotridecanoic acid (PFTrDA)	µg/L	0.002			<0.002	<0.002	0
Perfluorotetradecanoic acid (PFTeDA)	µg/L	0.005			<0.005	<0.005	0
Perfluorooctane sulfonamide (FOSA)	µg/L	0.002			<0.002	<0.002	0
N-Methyl perfluorooctane sulfonamide (MeFOSA)	µg/L	0.005			<0.005	<0.005	0
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	µg/L	0.005			<0.005	<0.005	0
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	µg/L	0.005			<0.005	<0.005	0
N-Methyl perfluorooctane sulfonamidoethanol (MEFOSE)	µg/L	0.005			<0.005	<0.005	0
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	µg/L	0.002			<0.002	<0.002	0
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	µg/L	0.002			<0.002	<0.002	0
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	µg/L	0.005			<0.005	<0.005	0
6:2 Fluorotelomer Sulfonate (6:2 FTS)	µg/L	0.005			0.040	0.040	0
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	µg/L	0.005			<0.005	<0.005	0
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	µg/L	0.005			<0.005	<0.005	0
PFAS (Sum of Total)	µg/L	0.002			0.155	0.167	7
Sum of PFHxS and PFOS	µg/L	0.002	0.13	0.07	0.043	0.048	11
PFAS (Sum of Total)(WA DER List)	µg/L	0.002			0.152	0.164	8

#### Environmental Standards

HEPA, January 2018, PFAS NEMP 2018 Freshwater 95%

HEPA, January 2018, PFAS NEMP 2018 Health Drinking Water

1

## Appendices

## Appendix A – Figures





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#### Data Disclaimer

©2019. Whilst every care has been taken to prepare this map, GHD makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind whether in contract, tor or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.





Airservices Australia Yulara Airport Groundwater Sampling (June 2019)

Project No. 43-32561 Revision No. 0 Date 3/07/2019

FIGURE 2

N:VAU \Brisbane\Projects\41\32561\GIS\Maps\MXD\4132561\_002\_YularaSiteLayout.mxd Print date: 03 Jul 2019 - 16:34

SITE LAYOUT Data source: GA - Roads, Places, Rail (2015); GHD - Yulara Aiport (2019); NTLIS: Groundwater Well (2015); Google Earth: Imagery (captured 18/06/2018, downloaded 03/07/2019). Created by: xlee Appendix B – Calibration certificates

#### Oil / Water Interface Meter

Instrument Interface Meter (60M) Serial No. 312446



Air-Met Scientific Pty Ltd 1300 137 067

ltem	Test	Pass	Comments
Battery	Compartment	1	
	Capacity	1	8.3 V
Probe	Cleaned/Decon.	1	
	Operation	1	
Connectors	Condition	$\checkmark$	
		1	
Tape Check	Cleaned	√	
	Checked for cuts	1	
Instrument Test	At surface level	1	
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## Certificate of Calibration

This is to certify that the above instrument has been cleaned and tested.

Calibrated by:

James Draper

Calibration date:

6/06/2019

Next calibration due:

5/08/2019

Instrument Y Serial No. 19

YSI Pro DSS 19D100844



## Air-Met Scientific Pty Ltd 1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
	Recharge OK?	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation	✓	
	(segments)		
Grill Filter	Condition	✓	
	Seal	✓	
РСВ	Condition	✓	
Connectors	Condition	✓	
Sensor	1. pH/ORP	✓	
	2. Turbidity	✓	
	3. Conductivity	✓	
	4. D.O	✓	
	5. Temp	✓	
	6. Depth	x	
Alarms	Beeper		
	Settings		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

## Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle	Instrument Reading
				Number	
1. EC		2.76mS		322349	2.75mS
2. Temp		17.5			18.0C
3. pH 4		pH 4.00		324985	pH 4.14
4. pH 7		pH 7.00		330737	pH 7.00
6. DO		0.0ppm		329994	0.0ppm
7. mV		231.8mV		324355/325421	231.8mV
8.Tubidity		ONTU		N/A	0.1NTU
9.Tubidity		100NTU		332244	100.3NTU
10.Tubidity		1000NTU		17L801628	9986NTU

Calibrated by:

James Draper

Calibration date: 11/06/2019

Next calibration due: 11/07/2019

Appendix C – Laboratory documentation

ALS	CHAIN OF CUSTODY ALS Laboratory: please tick →	DADELAIDE 21 Burma Ro Ph: 08 8359 0890 E: adela DBRISBANE 2 Byth Street Ph: 07 3243 7222 E; sampt DCI 405104 & Callera	oad Pooraka SA 5 ide@atsglobal.co Stafford QLD 405 es.brisbane@atsg	095 P n P 3 C 10bal.com P n D D 4650 L	IMACKAY 78 F h: 07 4944 017 MELBOURNÉ h: 03 8549 960 IUDGEE 1/29 S	Harbour Road Mack 77 E: mackay@alsgl 2-4 Weptall Road S, 6 E. samples.metbo Sydney Road Mudda	ay QLD 4740 obal.com pringvate VIC 0 urne@atsglobr re NSW 2850	3171 al.com	DNEWCA Ph: 02 40 DNOWRA 4 Ph: 02 4423 DPERTH 10	STLE 5/585 Ma  4 2500 E: samp /13 Geary Place 2063 E: nowrag ) Kod Way Maia	fland Road Mayfi eles.newcastře@a e North Nowra NS ⊇aisglobal.com ga_WA 6090	eld West NSW 2 Isglobal.com W 2541	304 EISYDNEY 277- Ph: 02 8784 855 CTOWNSVILLE 14 Ph: 07 4796 0600 8 EIWOLLONGONG	289 Woodpark Road Smithfield NSW 2164 5 E: samples syönsy@alsglobal.com 1-15 Desma Court Bohle OLD 4818 E: lownesville entrionmenta@alsglobal.com 99 Kenny Street Wollongong NSW 2500
		Ph: 07 7471 5600 E: gladst	one@alsglobal.co	m Ph	02 6372 6735	E mudgee.mail@al	sglobal.com	<u> </u>	Ph: 08 9209	7655 E: sample	s.perth@alsgloba	d com	Ph: 02 4225 3125	E: wollongong@alsglobal.com
CLIENT: GHD			TURNAR	OUND REQUIREMENTS : AT may be longer for some tests	Stan	ndard TAT (List	due date):					Custo	dy Seal Intact?	
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DRDER NUMBER:	PURCHASE	ORDER NO.:	COUNTR							34	5 6	7 Other	comment:	(45
ROJECT MANAGER:	: Kiara Crook	CONTACT	NODILE: 04	07 078 158		UISHED BY: /		F	ECEIVED BY	Sha	hila	RELINQUI	SHED BY:	RECEIVED BY:
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mail reports to (will de	lofault to PM if no other addresses are in	ted): kiara crook@ghd.co	n		20/6	liq	0800	2		10'0	SAM			
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								SIS REO	LIIRED includ	ing SUITES	/NB_Suite Co	les must he li	sted to attract suite pr	ice)
ALS USE ONLY	SAMPLE MATRIX: Soli	DETAILS d(S) Water(W)		CONTAINER INF	ORMATIO	N	Where	Metals are	required, specify T	iotal (unfiltered	bottle required) or	Dissolved (fiel	d filtered bottle required).	Additional Information
, LABID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVA (refer to codes beio	TIVE bw)	TOTAL BOTTLES	EP231X-LL							Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	RN12065	20/06/19		pros		1	<u> </u>				_			
2	QCOI	20/06/19	N	PFAS			<u> </u>	ļ				: 		
		Environment Sydney Work Order ES19	Reference <b>194</b> 3	o1										
		Telephone : + 61-2	-8784 8555	)										· · · ·
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Vater Container Codes: / = VOA Vial HCI Preserve	P = Unpreserved Plastic; N = Nitric Preserved ed; VB = VOA Vial Sodium Bisulphate Preserve	Plastic; ORC = Nitric Presen ed; VS = VOA Vial Sulfuric Pres	ved ORC; SH = served; AV = Ai	Sodium Hydroxide/Cd Preserved; freight Unpreserved Vial SG = Sui to Solie: B = Lingreserved Bas: Li =	S = Sodium	Hydroxide Prese ved Amber Glass	rved Plastic; ; H = HCl p tes; STT = S	AG = Arr	ber Glass Unpre Plastic; HS = H0 ium Thiosulfate P	served; AP - / Cl preserved S Preserved Bot	Airfreight Unpre peciation bottle	served Plastie ; SP = Sulfuri	c Preserved Plastic, 1	F = Formaldehγde Preserved Glass;

,



## SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	: ES1919430				
Client Contact Address	Client       : GHD PTY LTD         Contact       : MS KIARA CROOK         \ddress       : LEVEL 5 66 SMITH STREET         DARWIN NT, AUSTRALIA 0800		<ul> <li>Environmental Division Sydney</li> <li>Andrew Epps</li> <li>277-289 Woodpark Road Smithfield NSW Australia 2164</li> </ul>		
E-mail         : kiara.crook@ghd.com           Telephone         : +61 08 89820151           Facsimile         : +61 08 89821075		E-mail Telephone Facsimile	: andrev : +61 7 : +61-2-	w.epps@alsglobal.com 3552 8639 -8784 8500	
Project Order number C-O-C number Site Sampler	bject : 413256100 der number : O-C number : e : mpler : KIARA CROOK		: 1 of 2 : ES2018GHDSER0025 (EN/005/18) : NEPM 2013 B3 & ALS QC Standard		
Dates Date Samples Receiv Client Requested Due Date	ed : 21-Jun-2019 09:40 : 28-Jun-2019	Issue Date Scheduled Reporti	ng Date	: 24-Jun-2019 : <b>28-Jun-2019</b>	
Delivery Detail Mode of Delivery No. of coolers/boxes	S : Undefined : 1	Security Seal Temperature		: Not Available : 17.3'c - Ice present	

No. of samples received / analysed

: 2/2

#### **General Comments**

Receipt Detail

- 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 refer to the Proactive Holding Time Report table below which summarises breaches of
  recommended holding times that have occurred prior to samples/instructions being received at
  the laboratory. The absence of this summary table indicates that all samples have been received
  within the recommended holding times for the analysis requested.
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- 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 EP231X-LL component

#### Matrix: WATER

is provided, the laboratory and component	sampling date wi displayed in bra	ll be assumed by ckets without a	time 100 The 1
Matrix: WATER	Client sampling date / time	Client sample ID	WATER - EP2: PFAS - Full Su
ES1919430-001	20-Jun-2019 00:00	RN12065	✓
ES1919430-002	20-Jun-2019 00:00	QC01	✓

#### Proactive Holding Time Report

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

#### Requested Deliverables

ACCOUNTS PAYABLE (Hobart)		
- A4 - AU Tax Invoice (INV)	Email	ap-fss@ghd.com
Accounts Payable Australia		
- A4 - AU Tax Invoice (INV)	Email	accountspayableAU@ghd.com
GHD LAB REPORTS		
<ul> <li>*AU Certificate of Analysis - NATA (COA)</li> </ul>	Email	ghdlabreports@ghd.com
<ul> <li>*AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)</li> </ul>	Email	ghdlabreports@ghd.com
<ul> <li>*AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)</li> </ul>	Email	ghdlabreports@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	ghdlabreports@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	ghdlabreports@ghd.com
<ul> <li>Electronic SRN for ESdat (ESRN_ESDAT)</li> </ul>	Email	ghdlabreports@ghd.com
KIARA CROOK		
<ul> <li>*AU Certificate of Analysis - NATA (COA)</li> </ul>	Email	kiara.crook@ghd.com
<ul> <li>*AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)</li> </ul>	Email	kiara.crook@ghd.com
<ul> <li>*AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)</li> </ul>	Email	kiara.crook@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	kiara.crook@ghd.com
- A4 - AU Tax Invoice (INV)	Email	kiara.crook@ghd.com
- Chain of Custody (CoC) (COC)	Email	kiara.crook@ghd.com
- EDI Format - ENMRG (ENMRG)	Email	kiara.crook@ghd.com
- EDI Format - ESDAT (ESDAT)	Email	kiara.crook@ghd.com
<ul> <li>Electronic SRN for ESdat (ESRN_ESDAT)</li> </ul>	Email	kiara.crook@ghd.com

(29 analytes)



## **CERTIFICATE OF ANALYSIS**

Work Order	ES1919430	Page	: 1 of 5
Client	: GHD PTY LTD	Laboratory	Environmental Division Sydney
Contact	: MS KIARA CROOK	Contact	Andrew Epps
Address	ELVEL 5 66 SMITH STREET	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
	DARWIN NT, AUSTRALIA 0800		
Telephone	: +61 08 89820151	Telephone	: +61 7 3552 8639
Project	: 413256100	Date Samples Received	: 21-Jun-2019 09:40
Order number	:	Date Analysis Commenced	: 25-Jun-2019
C-O-C number	:	Issue Date	: 28-Jun-2019 11:07
Sampler	: KIARA CROOK		HALA NAIA
Site	:		
Quote number	: EN/005/18		
No. of samples received	: 2		Accredited for compliance with
No. of samples analysed	: 2		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.

Position

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Franco Lentini

Accreditation Category

Sydney Organics, Smithfield, NSW

Page	: 2 of 5
Work Order	: ES1919430
Client	: GHD PTY LTD
Project	413256100



#### **General Comments**

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

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

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

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

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

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

Key: CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

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Work Order	ES1919430
Client	: GHD PTY LTD
Project	: 413256100



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)		Clie	ent sample ID	RN12065	QC01					
	Cl	ient sampliı	ng date / time	20-Jun-2019 00:00	20-Jun-2019 00:00					
Compound	CAS Number	LOR	Unit	ES1919430-001	ES1919430-002					
				Result	Result					
EP231A: Perfluoroalkyl Sulfonic Acids										
Perfluorobutane sulfonic acid	375-73-5	0.002	µg/L	0.021	0.016					
(PFBS)										
Perfluoropentane sulfonic acid	2706-91-4	0.002	µg/L	0.003	0.003					
(PFPeS)										
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	µg/L	0.012	0.011					
Perfluoroheptane sulfonic acid	375-92-8	0.002	µg/L	<0.002	<0.002					
(PFHpS)										
Perfluorooctane sulfonic acid	1763-23-1	0.002	µg/L	0.036	0.032					
(PFOS)										
Perfluorodecane sulfonic acid	335-77-3	0.002	µg/L	<0.002	<0.002					
(PFDS)										
EP231B: Perfluoroalkyl Carboxylic Ac	ids									
Perfluorobutanoic acid (PFBA)	375-22-4	0.01	µg/L	<0.01	<0.01					
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	µg/L	0.007	0.009					
Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	µg/L	0.048	0.044					
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	µg/L	<0.002	<0.002					
Perfluorooctanoic acid (PFOA)	335-67-1	0.002	µg/L	<0.002	<0.002					
Perfluorononanoic acid (PFNA)	375-95-1	0.002	µg/L	<0.002	<0.002					
Perfluorodecanoic acid (PFDA)	335-76-2	0.002	µg/L	<0.002	<0.002					
Perfluoroundecanoic acid	2058-94-8	0.002	µg/L	<0.002	<0.002					
(PFUnDA)										
Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	µg/L	<0.002	<0.002					
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	µg/L	<0.002	<0.002					
Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.005	µg/L	<0.005	<0.005					
Perfluorohexadecanoic acid	67905-19-5	0.005	µg/L	<0.005	<0.005					
(PFHxDA)										
EP231C: Perfluoroalkyl Sulfonamides										
Perfluorooctane sulfonamide	754-91-6	0.002	µg/L	<0.002	<0.002					
(FOSA)										
N-Methyl perfluorooctane	31506-32-8	0.005	µg/L	<0.005	<0.005					
					1	I		1		

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Work Order	: ES1919430
Client	: GHD PTY LTD
Project	: 413256100



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)		Clie	ent sample ID	RN12065	QC01	 	
	Cl	ient samplii	ng date / time	20-Jun-2019 00:00	20-Jun-2019 00:00	 	
Compound	CAS Number	LOR	Unit	ES1919430-001	ES1919430-002	 	
				Result	Result	 	
EP231C: Perfluoroalkyl Sulfonamide	es - Continued						
N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.005	µg/L	<0.005	<0.005	 	
N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.005	µg/L	<0.005	<0.005	 	
N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.005	µg/L	<0.005	<0.005	 	
N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.002	µg/L	<0.002	<0.002	 	
N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.002	µg/L	<0.002	<0.002	 	
EP231D: (n:2) Fluorotelomer Sulfon	ic Acids						
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.005	µg/L	<0.005	<0.005	 	
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.005	µg/L	0.040	0.040	 	
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.005	µg/L	<0.005	<0.005	 	
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.005	µg/L	<0.005	<0.005	 	
EP231P: PFAS Sums							
Sum of PFAS		0.002	µg/L	0.167	0.155	 	
Sum of PFHxS and PFOS	355-46-4/1763-23- 1	0.002	µg/L	0.048	0.043	 	
Sum of PFAS (WA DER List)		0.002	µg/L	0.164	0.152	 	
EP231S: PFAS Surrogate							
13C4-PFOS		0.002	%	82.7	91.9	 	
13C8-PFOA		0.002	%	110	109	 	

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Work Order	: ES1919430
Client	: GHD PTY LTD
Project	: 413256100



## Surrogate Control Limits

Sub-Matrix: WATER	Recovery Limits (%)			
Compound	CAS Number	Low	High	
EP231S: PFAS Surrogate				
13C4-PFOS		60	120	
13C8-PFOA		60	120	



## **QUALITY CONTROL REPORT**

Work Order	: ES1919430	Page	: 1 of 7	
Client		Laboratory	: Environmental Division	Sydney
Contact	: MS KIARA CROOK	Contact	: Andrew Epps	
Address	LEVEL 5 66 SMITH STREET	Address	: 277-289 Woodpark Roa	ad Smithfield NSW Australia 2164
Telephone	: +61 08 89820151	Telephone	: +61 7 3552 8639	
Project	: 413256100	Date Samples Received	: 21-Jun-2019	SWIIII A
Order number	:	Date Analysis Commenced	: 25-Jun-2019	
C-O-C number	:	Issue Date	: 28-Jun-2019	
Sampler	: KIARA CROOK			HAC-MRA NAIA
Site	:			
Quote number	: EN/005/18			Approximation No. 025
No. of samples received	: 2			Accredited for compliance with
No. of samples analysed	: 2			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

Position

• 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

Franco Lentini

Accreditation Category

Sydney Organics, Smithfield, NSW

Page	: 2 of 7
Work Order	: ES1919430
Client	: GHD PTY LTD
Project	: 413256100



#### **General Comments**

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

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

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

Key: Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot

- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- RPD = Relative Percentage Difference
- # = Indicates failed QC

#### Laboratory Duplicate (DUP) Report

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

Sub-Matrix: WATER					Laboratory Duplicate (DUP) Report				
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP231A: Perfluoroalkyl Sulfonic Acids (QC Lot: 2424635)									
ES1919201-001	Anonymous	EP231X-LL: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.002	μg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	µg/L	0.028	0.032	10.7	0% - 50%
		EP231X-LL: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.002	µg/L	<0.002	<0.002	0.00	No Limit
	EP231X-LL: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.002	µg/L	0.042	0.041	0.00	0% - 20%	
		EP231X-LL: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.002	µg/L	<0.002	<0.002	0.00	No Limit
ES1919244-055	Anonymous	EP231X-LL: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	µg/L	0.007	0.007	0.00	No Limit
		EP231X-LL: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.002	µg/L	0.004	0.004	0.00	No Limit
		EP231X-LL: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.002	µg/L	<0.002	<0.002	0.00	No Limit
EP231B: Perfluoroa	kyl Carboxylic Acids(	QC Lot: 2424635)							
ES1919201-001	Anonymous	EP231X-LL: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	µg/L	0.004	0.004	0.00	No Limit
		EP231X-LL: Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	µg/L	0.008	0.009	21.4	No Limit

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Work Order	: ES1919430
Client	: GHD PTY LTD
Project	: 413256100



Sub-Matrix: WATER			[	Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP231B: Perfluoroall	cyl Carboxylic Acids (QC Lo	ot: 2424635) - continued							
ES1919201-001	Anonymous	EP231X-LL: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	µg/L	0.002	0.003	0.00	No Limit
		EP231X-LL: Perfluorooctanoic acid (PFOA)	335-67-1	0.002	µg/L	<0.002	0.002	0.00	No Limit
		EP231X-LL: Perfluorononanoic acid (PFNA)	375-95-1	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorodecanoic acid (PFDA)	335-76-2	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorotetradecanoic acid	376-06-7	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		EP231X-LL: Perfluorohexadecanoic acid (PFHxDA)	67905-19-5	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		EP231X-LL: Perfluorobutanoic acid (PFBA)	375-22-4	0.01	µg/L	<0.01	<0.01	0.00	No Limit
ES1919244-055	Anonymous	EP231X-LL: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorooctanoic acid (PFOA)	335-67-1	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorononanoic acid (PFNA)	375-95-1	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorodecanoic acid (PFDA)	335-76-2	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		EP231X-LL: Perfluorohexadecanoic acid (PFHxDA)	67905-19-5	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		EP231X-LL: Perfluorobutanoic acid (PFBA)	375-22-4	0.01	µg/L	<0.01	<0.01	0.00	No Limit
EP231C: Perfluoroalk	vl Sulfonamides (QC Lot: 2	424635)							
ES1919201-001	Anonymous	EP231X-LL: Perfluorooctane sulfonamide (EOSA)	754-91-6	0.002	ua/L	< 0.002	< 0.002	0.00	No Limit
		EP231X-LL: N-Methyl perfluorooctane sulfonamidoacetic acid (MeEOSAA)	2355-31-9	0.002	μg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtEOSAA)	2991-50-6	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		EP231X-LL: N-Methyl perfluorooctane sulfonamide (MeEQSA)	31506-32-8	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		EP231X-LL: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		EP231X-LL: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.005	µg/L	<0.005	<0.005	0.00	No Limit
ES1919244-055	Anonymous	EP231X-LL: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.002	µg/L	<0.002	<0.002	0.00	No Limit

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Work Order	: ES1919430
Client	: GHD PTY LTD
Project	: 413256100



Sub-Matrix: WATER				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP231C: Perfluoroal	kyl Sulfonamides (QC Lot: 2	2424635) - continued							
ES1919244-055	Anonymous	EP231X-LL: N-Methyl perfluorooctane	2355-31-9	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		sulfonamidoacetic acid (MeFOSAA)							
		EP231X-LL: N-Ethyl perfluorooctane	2991-50-6	0.002	µg/L	<0.002	<0.002	0.00	No Limit
		sulfonamidoacetic acid (EtFOSAA)							
		EP231X-LL: N-Methyl perfluorooctane	31506-32-8	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		sulfonamide (MeFOSA)							
		EP231X-LL: N-Ethyl perfluorooctane sulfonamide	4151-50-2	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		(EtFOSA)							
		EP231X-LL: N-Methyl perfluorooctane	24448-09-7	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		sulfonamidoethanol (MeFOSE)							
		EP231X-LL: N-Ethyl perfluorooctane	1691-99-2	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		sulfonamidoethanol (EtFOSE)							
EP231D: (n:2) Fluore	otelomer Sulfonic Acids (Q0	C Lot: 2424635)							
ES1919201-001	Anonymous	EP231X-LL: 4:2 Fluorotelomer sulfonic acid (4:2	757124-72-4	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		FTS)							
		EP231X-LL: 6:2 Fluorotelomer sulfonic acid (6:2	27619-97-2	0.005	µg/L	0.050	0.056	12.0	0% - 50%
		FTS)							
		EP231X-LL: 8:2 Fluorotelomer sulfonic acid (8:2	39108-34-4	0.005	μg/L	<0.005	<0.005	0.00	No Limit
		FTS)							
		EP231X-LL: 10:2 Fluorotelomer sulfonic acid	120226-60-0	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		(10:2 FTS)							
ES1919244-055	Anonymous	EP231X-LL: 4:2 Fluorotelomer sulfonic acid (4:2	757124-72-4	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		FTS)							
		EP231X-LL: 6:2 Fluorotelomer sulfonic acid (6:2	27619-97-2	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		FTS)							
		EP231X-LL: 8:2 Fluorotelomer sulfonic acid (8:2	39108-34-4	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		FTS)							
		EP231X-LL: 10:2 Fluorotelomer sulfonic acid	120226-60-0	0.005	µg/L	<0.005	<0.005	0.00	No Limit
		(10:2 FTS)							



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

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

Sub-Matrix: WATER				Method Blank (MB)	Laboratory Control Spike (LCS) Report			
				Report	Spike	Spike Recovery (%)	Recovery	Limits (%)
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 2424635	5)							
EP231X-LL: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.002	μg/L	<0.002	0.05 µg/L	91.2	50	130
EP231X-LL: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.002	μg/L	<0.002	0.05 µg/L	93.6	50	130
EP231X-LL: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.002	μg/L	<0.002	0.05 µg/L	87.2	50	130
EP231X-LL: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.002	μg/L	<0.002	0.05 µg/L	97.4	50	130
EP231X-LL: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.002	μg/L	<0.002	0.05 µg/L	90.2	50	130
EP231X-LL: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.002	μg/L	<0.002	0.05 µg/L	87.6	40	130
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 2424	635)							
EP231X-LL: Perfluorobutanoic acid (PFBA)	375-22-4	0.01	μg/L	<0.01	0.25 μg/L	63.1	50	130
EP231X-LL: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.002	μg/L	<0.002	0.05 µg/L	98.2	50	130
EP231X-LL: Perfluorohexanoic acid (PFHxA)	307-24-4	0.002	μg/L	<0.002	0.05 µg/L	107	50	130
EP231X-LL: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.002	μg/L	<0.002	0.05 μg/L	80.4	50	130
EP231X-LL: Perfluorooctanoic acid (PFOA)	335-67-1	0.002	μg/L	<0.002	0.05 µg/L	105	50	130
EP231X-LL: Perfluorononanoic acid (PFNA)	375-95-1	0.002	μg/L	<0.002	0.05 µg/L	94.8	50	130
EP231X-LL: Perfluorodecanoic acid (PFDA)	335-76-2	0.002	μg/L	<0.002	0.05 µg/L	94.2	50	130
EP231X-LL: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.002	μg/L	<0.002	0.05 µg/L	104	40	130
EP231X-LL: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.002	μg/L	<0.002	0.05 µg/L	118	40	130
EP231X-LL: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.002	μg/L	<0.002	0.05 µg/L	92.4	40	130
EP231X-LL: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.005	μg/L	<0.005	0.125 µg/L	106	40	130
EP231X-LL: Perfluorohexadecanoic acid (PFHxDA)	67905-19-5	0.005	μg/L	<0.005	0.05 µg/L	57.0	50	130
EP231C: Perfluoroalkyl Sulfonamides (QCLot: 2424635)	)							
EP231X-LL: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.002	μg/L	<0.002	0.05 µg/L	70.6	40	130
EP231X-LL: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.005	µg/L	<0.005	0.125 μg/L	68.9	40	130
EP231X-LL: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.005	μg/L	<0.005	0.125 µg/L	87.7	40	130
EP231X-LL: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.005	µg/L	<0.005	0.125 μg/L	91.2	50	130
EP231X-LL: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	1691-99-2	0.005	µg/L	<0.005	0.125 μg/L	79.5	40	130
EP231X-LL: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	2355-31-9	0.002	µg/L	<0.002	0.05 μg/L	101	50	130
EP231X-LL: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.002	µg/L	<0.002	0.05 µg/L	113	40	130
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 24	124635)							
EP231X-LL: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.005	µg/L	<0.005	0.05 µg/L	92.6	50	130

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Sub-Matrix: WATER	Method Blank (MB)	Laboratory Control Spike (LCS) Report						
	Report	Spike	Spike Recovery (%)	Recovery Limits (%)				
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot:	2424635) - continu	ed						
EP231X-LL: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.005	µg/L	<0.005	0.05 µg/L	99.0	50	130
EP231X-LL: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.005	µg/L	<0.005	0.05 µg/L	83.8	50	130
EP231X-LL: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.005	µg/L	<0.005	0.05 µg/L	116	50	130

### Matrix Spike (MS) Report

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

Sub-Matrix: WATER				Ма	atrix Spike (MS) Report		
				Spike	SpikeRecovery(%)	Recovery L	imits (%)
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP231A: Perfluoro	alkyl Sulfonic Acids (QCLot: 2424635)						
ES1919201-002	Anonymous	EP231X-LL: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.05 µg/L	74.4	50	130
		EP231X-LL: Perfluoropentane sulfonic acid (PFPeS)	2706-91-4	0.05 µg/L	78.2	50	130
		EP231X-LL: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.05 µg/L	61.6	50	130
		EP231X-LL: Perfluoroheptane sulfonic acid (PFHpS)	375-92-8	0.05 µg/L	87.8	50	130
		EP231X-LL: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.05 µg/L	81.4	50	130
		EP231X-LL: Perfluorodecane sulfonic acid (PFDS)	335-77-3	0.05 µg/L	56.8	30	130
EP231B: Perfluoro	oalkyl Carboxylic Acids (QCLot: 2424635)						
ES1919201-002	Anonymous	EP231X-LL: Perfluorobutanoic acid (PFBA)	375-22-4	0.25 µg/L	81.2	30	130
		EP231X-LL: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.05 µg/L	82.4	50	130
		EP231X-LL: Perfluorohexanoic acid (PFHxA)	307-24-4	0.05 µg/L	103	50	130
		EP231X-LL: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.05 µg/L	78.6	50	130
		EP231X-LL: Perfluorooctanoic acid (PFOA)	335-67-1	0.05 µg/L	93.6	50	130
		EP231X-LL: Perfluorononanoic acid (PFNA)	375-95-1	0.05 µg/L	84.8	50	130
		EP231X-LL: Perfluorodecanoic acid (PFDA)	335-76-2	0.05 µg/L	67.8	50	130
		EP231X-LL: Perfluoroundecanoic acid (PFUnDA)	2058-94-8	0.05 µg/L	68.6	30	130
		EP231X-LL: Perfluorododecanoic acid (PFDoDA)	307-55-1	0.05 µg/L	68.6	30	130
		EP231X-LL: Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.05 µg/L	41.2	30	130
		EP231X-LL: Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.125 µg/L	46.6	30	130
		EP231X-LL: Perfluorohexadecanoic acid (PFHxDA)	67905-19-5	0.05 µg/L	117	30	130
EP231C: Perfluoro	alkyl Sulfonamides (QCLot: 2424635)						
ES1919201-002	Anonymous	EP231X-LL: Perfluorooctane sulfonamide (FOSA)	754-91-6	0.05 µg/L	68.2	30	130
		EP231X-LL: N-Methyl perfluorooctane sulfonamide (MeFOSA)	31506-32-8	0.125 µg/L	65.9	30	130
		EP231X-LL: N-Ethyl perfluorooctane sulfonamide (EtFOSA)	4151-50-2	0.125 µg/L	56.6	30	130

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Sub-Matrix: WATER				Matrix Spike (MS) Report				
				Spike	SpikeRecovery(%)	Recovery L	imits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High	
EP231C: Perfluoro	alkyl Sulfonamides (QCLot: 2424635) - continued							
ES1919201-002	Anonymous	EP231X-LL: N-Methyl perfluorooctane sulfonamidoethanol (MeFOSE)	24448-09-7	0.125 µg/L	72.5	30	130	
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	0.125 μg/L	72.7	30	130		
		EP231X-LL: N-Methyl perfluorooctane sulfonamidoacetic acid (MeFOSAA)	0.05 µg/L	69.0	30	130		
		EP231X-LL: N-Ethyl perfluorooctane sulfonamidoacetic acid (EtFOSAA)	2991-50-6	0.05 µg/L	57.2	30	130	
EP231D: (n:2) Fluc	protelomer Sulfonic Acids (QCLot: 2424635)							
ES1919201-002	Anonymous	EP231X-LL: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.05 µg/L	73.4	50	130	
		EP231X-LL: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.05 µg/L	91.6	50	130	
		EP231X-LL: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.05 µg/L	73.4	50	130	
		EP231X-LL: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.05 µg/L	82.6	50	130	



QA/QC Compliance Assessment to assist with Quality Review							
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Client	: GHD PTY LTD	Laboratory	: Environmental Division Sydney				
Contact	: MS KIARA CROOK	Telephone	: +61 7 3552 8639				
Project	: 413256100	Date Samples Received	: 21-Jun-2019				
Site	:	Issue Date	: 28-Jun-2019				
Sampler	: KIARA CROOK	No. of samples received	: 2				
Order number	:	No. of samples analysed	: 2				

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.

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

#### **Outliers : Analysis Holding Time Compliance**

• NO Analysis Holding Time Outliers exist.

#### **Outliers : Frequency of Quality Control Samples**

• <u>NO</u> Quality Control Sample Frequency Outliers exist.

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#### 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.

Evaluation:	<b>x</b> :	= Holding	time	breach;	~	=	Within	holding	time.
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Matrix: WATER					Evaluation	: × = Holding time	breach ; 🗸 = Withi	n 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
EP231A: Perfluoroalkyl Sulfonic Acids								
HDPE (no PTFE) (EP231X-LL) RN12065,	QC01	20-Jun-2019	25-Jun-2019	17-Dec-2019	~	25-Jun-2019	17-Dec-2019	✓
EP231B: Perfluoroalkyl Carboxylic Acids								
HDPE (no PTFE) (EP231X-LL) RN12065,	QC01	20-Jun-2019	25-Jun-2019	17-Dec-2019	1	25-Jun-2019	17-Dec-2019	~
EP231C: Perfluoroalkyl Sulfonamides								
HDPE (no PTFE) (EP231X-LL) RN12065,	QC01	20-Jun-2019	25-Jun-2019	17-Dec-2019	1	25-Jun-2019	17-Dec-2019	✓
EP231D: (n:2) Fluorotelomer Sulfonic Acid	ls							
HDPE (no PTFE) (EP231X-LL) RN12065,	QC01	20-Jun-2019	25-Jun-2019	17-Dec-2019	1	25-Jun-2019	17-Dec-2019	~
EP231P: PFAS Sums								
HDPE (no PTFE) (EP231X-LL) RN12065,	QC01	20-Jun-2019	25-Jun-2019	17-Dec-2019	1	25-Jun-2019	17-Dec-2019	✓

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## **Quality Control Parameter Frequency Compliance**

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

Matrix: WATER Evaluation: * = Quality Control frequency not within specification ; 🗸 = Quality Control frequency within sp							not within specification ; $\checkmark$ = Quality Control frequency within specification.
Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	00	Reaular	Actual	Jal Expected Evaluation		
Laboratory Duplicates (DUP)							
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	2	14	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard

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## **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
Per- and Polyfluoroalkyl Substances (PFAS by LCMSMS	EP231X-LL	WATER	In-house: Analysis of fresh and saline waters by solid phase extraction followed by LC-Electrospray-MS-MS, Negative Mode using MRM. Where commercially available, isotopically labelled analogues of the target analytes are used as internal standards for quantification. Where a labelled analogue is not commercially available, the internal standard with similar chemistry and the closest retention time to the target is used for quantification. The DQO for internal standard response is 50-150% of that established at initial calibration. PFOS is quantified using a certified, traceable standard consisting of linear and branched PFOS isomers. This method complies with the quality control definitions as stated in QSM 5.1. Data is reviewed in line with the DQOs as stated in QSM5.1
Preparation Methods	Method	Matrix	Method Descriptions
SPE preparation for LL and saline PFCs	EP231-SPE	WATER	In house

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**Document Status** 

Revision	Author	Reviewer		Approved for Issue			
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