

Appendix H
Marine Sediment
Geochemical
Assessment
Report

Marine Sediment Geochemical Assessment



Marine Sediment Geochemical Assessment

Client: Department of the Chief Minister and Cabinet, Northern Territory Government

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Executive Summary

The Northern Territory Government is intending to construct a new ship lift facility and marine industries precinct in Darwin to support the region's status as a growing logistics and marine services hub for northern Australia. The precinct, which is known as the Darwin Ship Lift Project (the 'Project'), will be situated approximately 6.5 km south-east of the Darwin Central Business District, on the East Arm Peninsula within Darwin Harbour, east of East Arm Wharf (EAW) and on the seaward side of Berrimah Road.

The Project is proposed to include a common user major vessel lifting, repair and maintenance facility, including both wet berth and dry berth vessel maintenance facilities and a western marine facility which includes additional quay line, berths and hardstand area. The facility is designed to accommodate the largest offshore patrol vessels currently being considered by Australian Navy, in addition to other vessels operated by the Australian Border Force (ABF), pearling and fishing fleets and other commercial industries.

Development of the Project will require dredging of a manoeuvring basin, berth areas and ship lift zone to provide safe water depths for the proposed vessel sizes and access to the deeper waters within East Arm. The precinct design will also include an area of land reclamation which will eventually form part of the hard stand area adjacent to the berths and ship lift. All dredged material will be either placed in the existing settlement ponds located adjacent to EAW or used as fill for reclamation at the Project site. No offshore disposal of dredged material is proposed.

To address the requirements of Commonwealth and the Northern Territory environmental approvals, a Sampling and Analysis Plan (SAP) was prepared, following the initial project design, by KBR in early 2020 for geochemical assessment of the dredge material to be removed from the Project dredging zones. Subsequent design changes made by the Northern Territory Government, resulted in AECOM updating the initial SAP to include the design changes. The SAP was prepared and subsequently updated by AECOM in accordance with guidance within the National Assessment Guidelines for Dredging (NAGD 2009). The SAP was implemented over a three-day sampling schedule on 27 to 29 July 2020, with sediment samples collected by vibrocoring.

A list of contaminants of potential concern was developed from a review of historical sediment quality data and the consideration of potential contaminant sources within the catchment of East Arm and the Elizabeth River. In accordance with this list, the samples were analysed at NATA-accredited laboratories for the following:

Contaminants of Potential Concern		Rationale for Analysis
Metals	Antimony (Sb)	Potentially found at ore export loading facilities
	Arsenic (As)	Known to be naturally high background levels
	Cadmium (Cd)	Common pollutant in port areas
	Chromium (Cr)	Elevated concentrations detected by URS (2009)
	Copper (Cu)	AIMS (2010) indicated the presence of elevated concentrations in port sediments
	Iron (Fe)	Exported from EAW
	Lead (Pb)	Common pollutant in port areas
	Manganese (Mn)	Exported from EAW
	Mercury (Hg)	Elevated concentrations detected by URS (2009)
	Nickel (Ni)	Elevated concentrations detected by URS (2009)
	Silver (Ag)	Common pollutant in port areas
	Zinc (Zn)	Common pollutant in port areas

Contaminants of Potential Concern		Rationale for Analysis
Hydrocarbons	Total polycyclic aromatic hydrocarbons (PAH)	Common pollutant in port areas
	Total recoverable hydrocarbons (TRH)	Common pollutant in port areas
Nutrients	Total nitrogen (N)	Palmerston wastewater treatment outfall located upstream, inputs from Elizabeth River and Hudson Creek catchments
	Total phosphorus (P)	
Organotins	Tributyltin (TBT)	No longer used as an antifoulant, but still potentially present in port environments
Radionuclides		Uranium (U) and thorium (Th) exported from EAW

In addition to the Contaminants of Potential Concern, the sediments were analysed for:

- Acid sulfate soil (ASS) potential (an important consideration for dredged sediments that are disposed into an onshore environment).
- Aluminium (useful for normalising elements, if required).
- Particle size distribution (potentially useful when assessing the distribution of contaminant concentrations across the dredging area).
- Total organic carbon (required for normalisation of concentrations of organic contaminants).

This report presents the data arising from the sediment geochemical investigation conducted in July 2020. Of note, the SAP included the sampling of sediments beneath the proposed reclamation area; at the time of SAP preparation it was considered that there may be a potential need to dredge beneath the future reclamation area prior to reclamation occurring. However, a further engineering assessment of the site concluded that dredging within the reclamation area would not be required. Hence, the analysis in this report is focussed upon only those samples collected from within the dredging footprint (though, for completeness, the full dataset is also presented).

Summary statistics from the analysis of the sediments for metals are:

Metal	SQG Low (NAGD 2009)	SQG High (NAGD 2009)	Min	Max	Mean	95%UCL ^a All sites	95%UCL ^a Dredging footprint only
Aluminium	NG	NG	1850	11500	7354.2	7802	7973
Iron	NG	NG	2950	75100	45563.3	48996	50261
Antimony	2	25	0.52	0.52	0.5	0.27	0.27
Arsenic	20	70	3.1	83.5	48.9	53.6	55.2
Cadmium	1.5	10	0.2	0.3	0.3	0.07	0.07
Chromium	80	370	3.6	89.2	34.8	38.7	40.5
Copper	65	270	1.2	54.5	7.3	13.1	13.4
Lead	50	220	5.7	50.8	12.4	17.6	15.9
Manganese	NG	NG	16	700	221.8	259	265
Nickel	21	52	1.3	58.4	7.7	13.2	14.0
Silver	1	4	0.1	0.6	0.2	0.09	0.09
Zinc	200	410	3.3	193	18.5	37.4	40.7
Mercury	0.15	1	0.01	0.05	0.0	0.0085	0.0086

Key

- a 95% UCL calculated using ProUCL. Data outputs are provided in Appendix E.
 NG No guideline
BOLD exceeds the NAGD (2009) Screening Level
BOLD exceeds the NAGD (2009) High Level

Arsenic concentrations were reported above the NAGD Screening Level of 20 mg/kg in nearly all samples. Concentrations in seven sediment samples (five surface samples and two deeper [>0.5 m bgl] samples) were reported above the High Level (70 mg/kg). The 95% UCL concentration (55.2 mg/kg) exceeds the Screening Level but is below the High Level. It should be noted that elevated concentrations of arsenic in Darwin Harbour sediments have previously been attributed to local geological influence, and bioavailable levels are low.

The 95% UCL concentrations of all other metals were below their respective Screening Levels, where available.

For the other analytes:

- TBT was reported above the Limit of Reporting (LOR) of 0.5 $\mu\text{gSn/kg}$ in one sample; this was from within the proposed reclamation area and therefore not in an area to be dredged. The surface sample at SL06 returned a concentration of 174.5 $\mu\text{gSn/kg}$ (normalised to 1% TOC) which is above the SQG High Level of 70 $\mu\text{gSn/kg}$. As no TBT was detected in the samples from within the dredging footprint, the 95% UCL concentration was below the Screening Level (9 $\mu\text{gSn/kg}$).
- Total Kjeldahl Nitrogen (TKN) and total nitrogen (as N) concentrations ranged from 90 mg/kg to 560 mg/kg with a 95% UCL of 311 mg/kg. The results indicate that nitrogen is present predominantly as organic nitrogen (TKN) with a minor inorganic component (nitrate + nitrite). Total phosphorus concentrations ranged from 134 mg/kg to 1290 mg/kg with a 95% UCL concentration of 753 mg/kg.
- Total petroleum hydrocarbons and total recoverable hydrocarbons were detected at very low levels in the majority of samples. All sample concentrations and the 95% UCL concentration were well below the NAGD and ANZG (2018) Screening Levels.
- Polycyclic aromatic hydrocarbons were detected above the LOR in only one sample (this was from within the proposed reclamation area and not being dredged), at concentrations that were well below the NAGD Screening Levels.
- Total radionuclide (gross alpha + gross beta) concentrations were well below the NAGD Screening Level.
- All sediments sampled were identified as having the potential to be acid generating (to varying degrees) if left in an oxygenated environment post-dredging. However, the samples also exhibited sufficient neutralising capacity for self-neutralisation to potentially occur within the EAW settlement ponds.

The key outcomes of the investigation were:

- Within the dredging footprint, no contaminants of potential anthropogenic origin were detected at levels above the criteria levels within the NAGD. That is, all contaminants of potential anthropogenic origin were present at concentrations at which, under the NAGD, toxic effects on organisms are not expected.
- As expected, arsenic concentrations typically exceeded the NAGD criteria levels. Previous studies have attributed elevated arsenic concentrations in Darwin Harbour sediments to local geological influence (e.g. weathering of bedrock in the catchment). Some of these studies have demonstrated that, in the natural marine environment, the arsenic has low bioavailability. That is, the arsenic is bound to the sediment in such a way that it will not readily enter the food chain.
- The sediments are classified as Potential Acid Sulfate Soils (PASS) and monitoring of tailwater within the EAW settlement ponds will need to be implemented to determine whether there is evidence of acid generation attributable to the placement of the dredged material.

1.0 Introduction

1.1 Project background

The Northern Territory Government (NTG) has identified the need for a new ship lift facility and marine industries precinct in Darwin to support the region's status as a growing logistics and marine services hub for northern Australia. In response to this need the NTG called for proposals from suitably qualified organisations to design and construct what is now known as the Darwin Ship Lift Project (the 'Project').

A development concept was originally prepared by Northern Ship Support Pty Ltd (NSS) in 2016. Following the Front End Engineering Design (FEED) process undertaken in 2018, the NTG identified areas where enhanced functionality and supporting marine facilities would provide additional benefit to the overall Project. This led to a number of post-FEED studies and updates to the development concept.

Based on the outcomes of the Post-FEED studies undertaken in 2019, the NTG now proposes to develop a common user major vessel lifting, repair and maintenance facility, including both wet berth and dry berth vessel maintenance facilities and a western marine facility which includes additional quay line, berths and hardstand (the 'Project').

The Project site is situated approximately 6.5 km south-east of the Darwin Central Business District (CBD), on the East Arm Peninsula within Darwin Harbour, east of East Arm Wharf (EAW) and on the seaward side of Berrimah Road (Figure 1). The ship lift and transfer system will consist of an approximately 103 m long ship lift with on-shore facilities for similarly sized vessels and will be able to accommodate vessels operated by Defence and Australian Border Force (ABF), pearling and fishing fleets and other commercial industries.

To enable construction of the proposed facility and provide safe all tide operational water depth to accommodate the proposed vessel sizes, dredging is required in the Project area.

In order to carry out a geochemical assessment of the marine sediments to inform the environmental assessment of the Project, a sampling and analysis plan (SAP) was prepared in accordance with the Northern Territory Environment Protection Authority (NT EPA) Guidelines for the Environmental Assessment of Marine Dredging in the Northern Territory (NT EPA 2013) and the National Assessment Guidelines for Dredging (Commonwealth of Australia 2009, hereafter 'the NAGD'). The SAP was prepared by KBR (2020) and updated by AECOM (2020) to reflect the most current design at that time.

The sediment sampling program which informs this geochemical assessment of the marine sediment of the Project area was implemented by AECOM in July 2020. This report presents the outcomes of the sediment geochemical assessment.

Of note, the SAP included the sampling of sediments beneath the proposed reclamation area; at the time of SAP preparation it was considered that there may be a potential need to dredge beneath the future reclamation area prior to reclamation occurring. However, a further engineering assessment of the site concluded that dredging within the reclamation area would not be required. Hence, the analysis in this report is focussed upon only those samples collected from within the dredging footprint (though, for completeness, the full dataset is also presented).

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<p>PROJECT ID 60633505 CREATED BY PJY APPROVED BY PYoung LAST MODIFIED 03 NOV 2020</p>	<p>AECOM www.aecom.com</p> <p>LEGEND — Darwin Ship Lift Project Footprint</p>	<p>Darwin Ship Lift Project Location</p>
<p>1:20,000 when printed at A4 DATUM GDA 1994, PROJECTION MGA ZONE 52</p>		<p>NORTHERN TERRITORY GOVERNMENT OF AUSTRALIA DARWIN SHIP LIFT PROJECT</p>
<p><small>Data sources: Source Data: Esri, Garmin, GeoEye, GeoEye, IGN, AerGRID, USDA, USGS, AeroGRID, IGN, and the GIS User Community Note: Data is based on information provided to and with the permission of the Northern Territory Land Information Authority (LIA) on 10/11/2010.</small></p>		<p>Figure 1</p>

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Figure 1 Project footprint and surrounding land uses

1.2 Project Approval Status

Aspects of both Commonwealth and NTG legislation are relevant to the location, construction and operation of the Project. For the original concept, a referral was made under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and a Notice of Intent (NOI) was submitted to the NT EPA to commence the Territory assessment process. The current status of each of process is outlined in the following sections.

1.2.1 EPBC Referral

On 24 April 2018, an EPBC Act Referral for the original Project FEED design was submitted to the Commonwealth Department of Environment and Energy (DoEE, now the Department of Agriculture, Water and the Environment [DAWE]). Following submission of the referral, on 25 September, DoEE issued its decision that the referred action was determined not to be a controlled action.

Following the FEED process, the NTG became the proponent of the Project, taking over from NSS and the overall design and scale of works proposed for the Project was amended to improve overall functionality and allow for the delivery of additional marine industry facilities. The NTG is now re-evaluating the implications of the Project in relation to matters concerning the EPBC Act and intends to submit an updated referral.

1.2.2 Notice of Intent

On 24 April 2018, an NOI for the original the Project was submitted to the NT EPA. Following submission, the NT EPA circulated the NOI to the relevant advisory bodies and compiled their comments. A response to the comments raised was prepared and provided to NT EPA on 22 August 2018.

The NT EPA considered all material provided and issued a Statement of Reasons (SoR) on 14 November 2018. The NT EPA decision outlined in the SoR notes that a formal Environmental Impact Statement (EIS) will be required.

During the preparation of the Terms of Reference (ToR), the NTG Project Team engaged with the NT EPA and informed them of proposed changes to the Project. The NT EPA determined that the changes could be addressed in the ToR and subsequent EIS without the need to resubmit a NOI.

1.3 Proposed Ship Lift Facility and Marine Industries Project

The Project includes a common user vessel lifting, repair and maintenance facility, including both wet berth and dry berth vessel maintenance facilities, in support of Darwin's position as a growing logistics and marine services hub for major industries within and around the Northern Territory region. The facility will enable maintenance and servicing of a range of vessels including:

- Australian Border Force vessels.
- Defence Offshore Patrol Vessels (OPVs).
- Pearling and fishing fleets.
- Tugs (including up to 6 m draft).
- Commercial vessels from the oil, gas and marine industries, and private vessels.

The ship lift and transfer system will consist of an approximately 103 m long ship lift with on-shore facilities for similarly sized vessels and will have the ability to accommodate the largest OPVs currently being considered by the Australian Navy. The Project will include the following elements:

- common user ship lift.
- wet berths for vessel mooring and maintenance.
- vessel transfer equipment including a self-propelled modular transporter (SPMT) system and SPMT garage.
- waterside infrastructure, including access channel, manoeuvring basin and all tide mooring.

- landside infrastructure, including a wash down area, hardstand and laydown areas, dry berths, blast and paint facility, internal roads, car parks and administrative offices.
- aids for navigation.

Figure 2 shows the overall conceptual design of the facility, including the extent of the existing access channel. The current concept plan involves a total works area of approximately 28 ha comprising the following:

- manoeuvring basin which covers approximately 2.0 ha
- ship lift and wet berth area covering approximately 5.1 ha
- outer wet berths area covering approximately 2.1 ha
- reclamation of approximately 14.6 ha
- land development of approximately 4.2 ha.

Dredging is required to establish the manoeuvring basin and the deep pocket area for the ship lift and adjacent wet berths along the western marine facility area. All dredged material will be used as fill for reclamation within the site or placed in the existing settlement ponds located adjacent to EAW. No offshore disposal of dredged material is proposed.

Dredged material that is placed on site will be pumped into, and/or placed within, a purpose-built material handling pond located in a portion of the Project area, within the area of reclamation. Bund walls will be progressively constructed to establish and progress the pond. This will ensure that all dredged material is handled within the site and will provide an appropriate means of holding solid material within the pond and managing the quality of waters discharged from the pond.

1.4 Proposed dredging

1.4.1 Overview of dredging

It is proposed that dredging will be undertaken in two stages:

- Early works dredging to remove unconsolidated sediments from the footprint to the required dredge depth or to the level of hard material using a small cutter suction dredge (CSD).
- Removal of remaining material to the required design depth using a backhoe dredge (BHD) or CSD as required to break and remove the harder consolidated material.

It is anticipated that the unconsolidated material that was subject to sampling for this geochemical assessment under the current SAP (AECOM 2020), with the exception of that material within the proposed reclamation area (which will remain in situ), will be removed as part of the early works dredging program and placed in the sedimentation ponds at EAW.

It is anticipated that material dredged as part of the second dredging campaign will be utilised on site to provide a foundation for areas to be reclaimed as part of the Project facility.

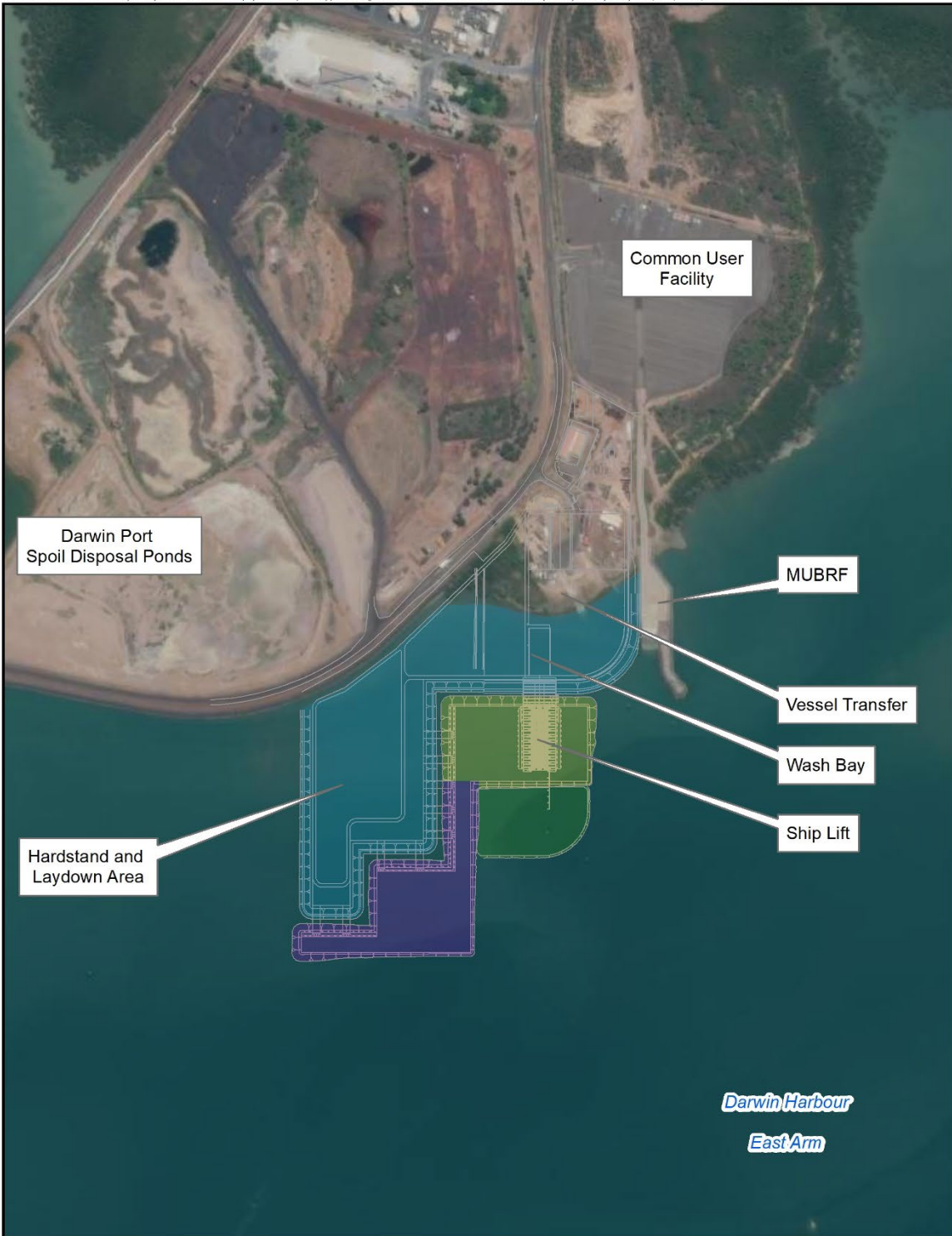
1.4.2 Dredging volumes

Dredging is required to achieve deeper access to the manoeuvring basin (-2.9 m relative to Lowest Astronomical Tide [LAT]) and the ship lift and wet berths area (-7.4 m LAT). Together these represent a dredge volume of approximately 476,700 m³. No dredging is required in the existing channel as it is already at or below the required depth. Of this volume, the unconsolidated material comprising marine sediments and unconsolidated residual sediments will be removed during the proposed early works dredging while the consolidated rock will be removed during a later dredging campaign.

The sediment types and stratigraphy of the site are well understood from the following information/data:

- site specific overwater geotechnical investigation results,
- marine seismic refraction and electrical resistivity tomography data, and
- geotechnical borehole data for the adjacent Multi User Barge Ramp Facility (MUBRF) and Marine Supply Base (MSB) projects.

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<p>PROJECT ID: 90933696 CREATED BY: PJY APPROVED BY: PYoung LAST MODIFIED: 03 NOV 2020</p> <p>AECOM www.aecom.com</p> <p>1:8,000 when printed at A4 DATUM: GDA 1984, PROJECTION: MGA ZONE 52</p> <p><small>Data sources: Source: Esri, Microsoft, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).</small></p>	<p>LEGEND — Darwin Ship Lift Project Footprint Proposed Stage 1 Dredging Footprint Zone</p> <ul style="list-style-type: none"> Reclamation Area Manoeuvring Area Shiplift & Berths 1, 2 and 3 Berths 4, 5 and 6 	<p>Proposed General Layout and Dredge Footprint</p> <p>NORTHERN TERRITORY GOVERNMENT OF AUSTRALIA DARWIN SHIP LIFT PROJECT</p> <p>Figure 2</p>
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Map Document: X:\609x609\33505\900_CAD_GIS\920_GIS\MXD\20200818_GeoChem\Report\60933506_Fig2_GeoChem Dredging and Layout_v1_A4P.mxd (peltor young)

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Figure 2 Proposed Project dredging footprint and general layout

The estimated dredge volumes associated with each dredging area are outlined in Table 1. Within the current SAP (AECOM 2020) the volume of unconsolidated sediment (upon which the sampling approach for the current geochemical assessment was based) within the overall dredge area was estimated to be 388,500 m³. Removing the need to dredge the unconsolidated material from within the proposed reclamation area has reduced the estimated volume to 238,500 m³.

Table 1 Estimated volumes of unconsolidated sediments to be dredged from the Project footprint.

Dredge Area	Average Dredge Level (m LAT)	Estimated volume of unconsolidated sediments (m ³)	Estimated volume of consolidated sediments (m ³)
Ship Lift and Wet Berths 1, 2 and 3	-7.4	116,400	112,600
Manoeuvring Basin	-2.9	36,400	2,600
Wet Berths 4, 5 and 6	-7.4	85,700	123,000
Total		238,500	238,200

1.4.3 Dredging methods

The dredging methods will be finalised during the construction procurement process and will be selected based on a range of factors including the characteristics of the material to be dredged, dredge depth and accuracy required, site conditions (including environmental factors and spatial extent of dredge area), logistics (vessel traffic and dredge manoeuvrability) and environmental considerations including potential noise and water quality impacts.

Early works dredging to remove unconsolidated sediments will be undertaken by a small CSD, with later dredging likely to be undertaken using a combination of CSD and/or BHD. The specific combination of these will depend on the outcome of detailed design and tender processes.

1.4.4 Reclamation and on-land material placement method

Unconsolidated material dredged as part of the early works dredging will be placed in the existing onshore settlement ponds at EAW. Dredged material will be pumped from the small CSD, via a floating pipeline directly into the ponds. Tailwater will then flow through the pond system before flowing from Pond E South, through the semi-permeable bund wall under the railway.

All material to be dredged during the second dredging campaign will be used to reclaim the area that will form the onshore laydown areas for the Project. This will be achieved by either placing the dredged material onshore using a BHD or by constructing a pond on the Project site into which dredged material can be placed.

1.5 Sediment geochemical investigation

It is understood that the dredging campaigns will be assessed with reference to the NT EPA's Guidelines for the Environmental Assessment of Marine Dredging in the Northern Territory (NT EPA 2013) and the NAGD.

The NAGD are used as a tool to guide the assessment process and provide a framework for assessing both dredging and dredged sediment disposal activities. The NAGD require that, where limited data exist or the data which do exist are out of date, sediment is to be analysed for a range of potential contaminants.

Results of sediment analysis are then compared with the sediment quality Screening Levels provided in Appendix A of the NAGD. These Screening Levels provide an indication of the suitability of the material for unconfined ocean disposal (and are therefore a conservative basis in this case, since ocean disposal is not proposed). The NAGD provide details on the approach required for assessing potential contaminants. Although unconfined ocean disposal is not proposed, the guidelines provide a suitable framework for considering the characteristics of the sediment to be disturbed during dredging and disposal.

The focus of the SAP and the sediment geochemical assessment is on Phases I and II as outlined in the NAGD, which involve a review of existing information on the proposed dredge material, the sampling and analysis of sediments from the dredge area, and the comparison of the analysis results with the Screening Levels in Appendix A of the NAGD.

The results of the geochemical assessment are detailed in Section 8.0. A discussion of the outcomes and results of the geochemical assessment in reference to Phases III–V of the NAGD is provided in Section 9.0.

1.6 Objectives

The objectives of this geochemical assessment are to:

- Characterise the sediments to be dredged during the proposed capital dredging.
- Assess the chemical characteristics of the sediments against criteria levels in the NAGD.
- Inform an assessment of the need for implementation of management and monitoring measures (specific to contaminants in, or acidification of, decant water in the reclamation area) during the dredging works.

2.0 Environmental Setting

2.1 Darwin Harbour

2.1.1 Overview

Darwin Harbour is a large estuary that experiences substantial tidal variation, with water quality varying with tide, weather, season and location.

Catchments draining to the harbour include the Elizabeth River, Blackmore River and Shoal Bay catchments and several smaller urban and rural catchments. The area covers over 3,200 km², of which approximately 65% is terrestrial and 35% is coastal and marine. Much of the region is undeveloped, with approximately 30% of the catchment being urban or rural land use (NT Department of Land Resource Management [DLRM] 2014).

The southern harbour area consists of East, West and Middle Arms which merge into a single unit, along with the smaller Woods Inlet, before opening into Beagle Gulf to the north.

The Elizabeth River flows into East Arm, while the Darwin and Blackmore rivers flow into Middle Arm. During the dry season (May to September) the estuary is typically well mixed, but freshwater inflow from rivers during the wet season can result in salinity-based water column stratification in the arms of the harbour (Drewry et al. 2010).

2.1.2 Bathymetry

The main channel of the Port of Darwin is between 15 m and 25 m deep, with a maximum depth of 36 m. The channel favours the eastern side of the harbour, with larger shallower areas occurring on the western side. Intertidal flats and shoals are typically more extensive on the western side of the harbour than on the eastern side. The channel continues into East Arm at water depths greater than 15 m below LAT. The bathymetry in this area of the harbour has largely been modified by dredging for the development of EAW and the INPEX Ichthys LNG plant export facilities.

The MUBRF channel is directly to the east of the Project (Figure 3), and largely follows the naturally deeper sections of the harbour where it connects with Bladin Point Channel (which leads to the Ichthys LNG plant). The MSB, located to the west of the Project, also connects with the Bladin Point Channel and is maintained to a depth of 7.7 m below LAT.

2.1.3 Hydrodynamics and sediment transport

The tidal range in Darwin Harbour is between 0 m (i.e. LAT) and approximately 8.2 m above LAT (Table 2). The mean spring tide range is approximately 5.6 m and the approximate mean neap tide range is 1.8 m. Tides within Darwin Harbour are predominantly semidiurnal, with a slight inequality between the successive tides during a single day.

Rigby et al. (2014) indicate that the wave climate in the region is dominated by locally generated waves, with little incident swell entering the harbour from the west, except under monsoonal cyclone or tropical low events. Between November and March, north-westerly winds blow over the uninterrupted fetch of the Timor Sea, increasing incident wave energy in Beagle Gulf and at the entrance to Darwin Harbour. Due to the alignment and narrow nature of the harbour entrance and the presence of the Tiwi Islands to the north, the interior of the harbour is sheltered from long period swell, and any swell that does enter the harbour is quickly dissipated by the generally shallow bathymetry and indented nature of the harbour shoreline.

The daily harbour inflow and outflow is approximately 216 million m³ on a spring tide and 71 million m³ on a neap tide. These flows represent 69% and 29% of water flows in Darwin Harbour respectively (Williams et al 2006). Tidal flows are strongest in the narrowest sections of the harbour, including sections of the East Arm channel.

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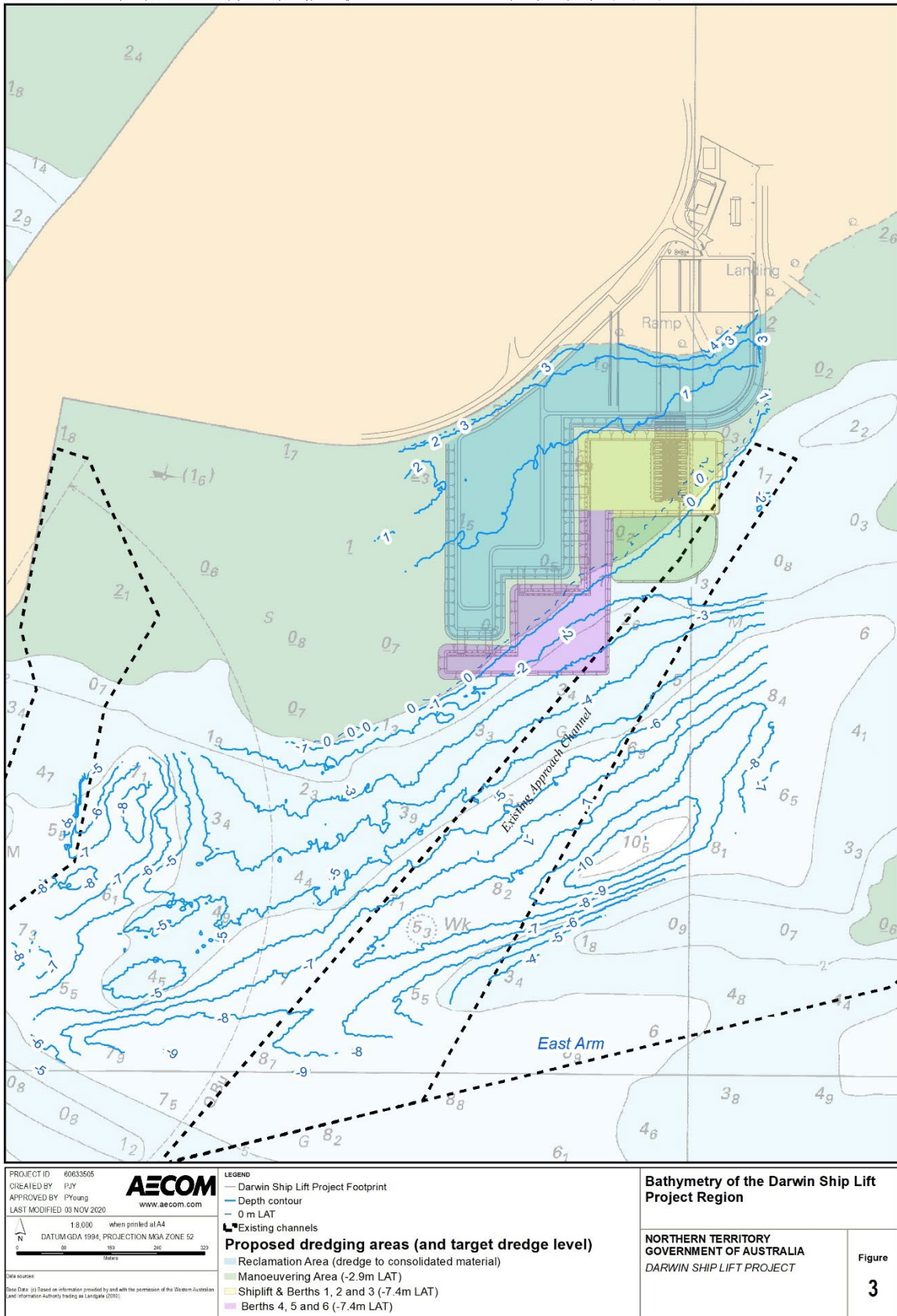


Figure 3 Project region bathymetry

Table 2 Darwin harbour tidal planes

Tidal Plane	Description	LAT (m)
HAT	Highest Astronomical Tide	8.2
MHWS	Mean High Water Springs	7.0
MHWN	Mean High Water Neaps	5.1
MSL	Mean Sea Level	4.24
AHD	Australian Height Datum	4.105
MLWN	Mean Low Water Neaps	3.3
MLWS	Mean Low Water Springs	1.4
LAT	Lowest Astronomical Tide	0.0

Modelling by Brinkman and Logan (2019) indicates that flood tidal current velocities within the harbour are generally higher than ebb tide velocities. Elevated tidal energy, particularly during spring tides, results in the regular resuspension of fine sediments from the seabed, leading to naturally high turbidity levels within the harbour. The suspended sediments are then carried into areas within the harbour where they are deposited but are not resuspended on ebb tides (Williams et al 2006, Brinkman & Logan 2019).

It is noted that Baird (2019) found ebb tidal flows (measured between May and July 2019) at a site within the body of East Arm tended to be stronger than flood tidal flows, with peak current speeds of 0.6-0.7 m/s during spring tides and 0.2-0.25 m/s during neap tides. This suggests that the relative ebb/flood tidal flows within the main East Arm channel are contrary to those within the harbour in general. As the Project location is outside of the channel, the relative flows at the site are likely to be aligned with those within the harbour in general.

Brinkman and Logan (2019) consider that, during the wet season, there is a significant contribution of fine sediments to the harbour from terrestrial sources draining into the harbour via the reaches of West, Middle and East Arms. McKinnon et al. (2006) calculated that the annual total suspended sediment load transported to the harbour had increased by a factor of 1.3 compared to the pre-urbanisation load. Nawaz (2010) estimated that in the order of 80% of terrestrial sediment transported into the harbour was from channel erosion rather than from sheet erosion; the latter being a more likely source of contaminant inputs than the former.

Previous investigations within the harbour have demonstrated that complex circulation occurs near headlands and embayments that includes jets, eddies, separation points and stagnation zones. This may result in trapping of fine sediments at headlands and in embayments; modelling by Brinkman and Logan (2019) predicts that the nearshore portion of the Project footprint lies within an area of net sediment deposition, while net erosion is predicted in the portion further from shore.

2.1.4 Land use and pollutant loads

DLRM (2014) estimated that 30% of the land within the Darwin Harbour catchment was developed. About 13% of the developed area was subject to urban and other intensive land-uses in and around the cities of Darwin and Palmerston, including residential living, manufacturing, industry, roads, airport infrastructure and defence facilities. Skinner et al (2009) note that runoff from urban areas contain a disproportionately high pollutant load relative to that from non-urban areas. The remainder of the developed area comprised rural land-uses, including horticulture and agriculture. Non-polluting uses (e.g. remnant native vegetation, surface water supply, conservation areas) were considered by the Darwin Harbour Advisory Committee (DHAC 2003) to occupy the remaining 70% of the Darwin Harbour catchment.

The Elizabeth River has the second largest catchment of the rivers entering Darwin Harbour (the largest is the Blackmore River that enters Middle Arm [Padovan 2001]). Skinner et al (2009) estimated that 58% of the Elizabeth River catchment area comprised native vegetation with minimal disturbance, rural land use (such as irrigated crops and rural living) accounted for approximately 39% of the catchment area and only 2% was considered to support urban or industrial land uses. Undeveloped land (predominantly mangrove communities) fringes the river over a distance of some 25 km between the rural land use areas and East Arm; this has the potential to act as a buffer to reduce the amounts of pollutants reaching East Arm from sources in the upper catchment.

Some 3 km upstream of the Project location is Hudson Creek, which has a history of livestock export and light industrial uses and which receives inputs from the Darwin Correctional Centre's Sewage Treatment Plant (KBR 2020). It also includes rural and urban land; Skinner et al (2009) calculated that 50% of the catchment supported urban or industrial land uses.

Approximately 6 km upstream of the Project location, the Palmerston Wastewater Treatment Plant discharges treated effluent into Myrmidon Creek; this enters the Elizabeth River estuary at the head of East Arm. The mass loadings of the nutrients in the release from the Plant in 2005-06 were 40 tonnes of ammonia, 69 tonnes of Kjeldahl nitrogen and 18 tonnes of phosphorus (Power and Water Corporation 2006); it appears that no more recent data are publicly available. Skinner et al (2009) note that treated sewage effluent is the dominant anthropogenic point source of nutrients to Darwin Harbour. However, based upon the data of Butler et al (2013), Munksgaard et al (2018) considered that the water body in Darwin Harbour is generally nitrogen limited. Burford et al (2008) determined that the main input of nitrogen to the harbour was from the open ocean, while inputs from rivers and wastewater treatment plants entering the harbour were relatively minor.

Industrial, urban and rural land uses all represent sources of potential pollutants that may accumulate in the Project dredging area. The mean annual pollutant loads contributed to the harbour from the Elizabeth River, Hudson Creek and Myrmidon Creek catchments were estimated by Padovan (2001) based upon the 1995-96 and 1996-97 wet seasons, and by Skinner et al (2009) for the 2006-07 wet season; these estimates are presented in Table 3. A fourth catchment, Palmerston South, also discharges into the Elizabeth River, though the pollutant loads predicted by Padovan (2001) and Skinner et al (2009) were markedly lower than those from the Elizabeth River and Hudson Creek catchments.

Table 3 Estimated mean annual pollutant loads to East Arm from Elizabeth River and Hudson Creek

	Elizabeth River			Hudson Creek			Myrmidon Creek		
	1995-97	2006-07	Change	1995-97	2006-07	Change	1995-97	2006-07	Change
Nitrogen (t)	69	72	+3	15	14.4	-0.6	1.4	1.76	+0.36
Phosphorus (t)	3.5	3.56	+0.06	3	1.32	-1.78	0.1	0.15	+0.05
Arsenic (kg)	70	54	-16	40	14	-26	2.0	1.64	-0.36
Cadmium (kg)	14	18.6	+4.6	6	3.17	-2.83	0.2	0.4	+0.2
Chromium (kg)	156	202	+46	220	55.9	-164.1	3.0	6.51	+3.51
Copper (kg)	373	576	+203	189	308	+119	10.0	31.6	+21.6
Lead (kg)	132	428	+296	327	287	-40	2.0	33.2	+31.2
Nickel (kg)	138	98.8	-39.2	43	19.2	-23.8	2.0	2.35	+0.35
Zinc (kg)	1,638	2,300	+662	1,860	969	-891	12.0	108.0	+96.0

2.1.5 Distribution of contaminants

Environmental factors that may potentially affect the distribution of contaminants within Darwin Harbour, and hence could influence the concentrations of contaminants in the sediments of the Project dredging footprint, include:

- Strong tidal currents that readily mobilise seafloor sediments on flood and ebb tides, especially during spring tide periods.
- Eddies in water flows that enhance the settlement of sediments from the water column in certain areas (such as at the eastern end of EAW).
- Wind-driven water circulation that can redistribute large amounts of seafloor sediments, particularly during tropical storms and cyclones.

Each of these factors would primarily influence the distribution of fine sediment fractions, to which many metals are typically bound at higher densities (Batley 1995, Munksgaard & Parry 2002, Welch et al 2008).

Munksgaard et al (2018) noted that sediments provide time-integrated measures of net accumulation of contaminants at a location; these are independent of the seasonal and tidal variations in contaminant concentrations within the overlying water column.

2.2 Project Site

The Project site appears to have been vegetated by natural scrub and mangrove until 1927, when the Commonwealth of Australia acquired East Arm properties for the purpose of establishing a quarantine station, with associated facilities located to the north of the Project site (KBR 2020).

The Project site and its surrounds were used during World War II for a range of activities, with a flying boat base and the lugger maintenance section located within the area. The flying boat base comprised a number of components, including a large tarmac hardstand, hangar, workshop and stores with associated maritime infrastructure. The latter included a large concrete ramp enabling Catalinas to be taken in and out of the water (the RAAF Catalina Ramp), a concrete slipway with iron rails to serve the Marine Section vessels and a timber jetty (Cosmos 2015).

The flying boat base also included a range of offshore marine infrastructure, including permanent Catalina and vessel moorings comprised of at least 22 seaplane moorings, nine marine craft buoys, five lugger buoys, three warping and steadying buoys, three marker buoys, and one submarine buoy (Cosmos 2015).

Maintenance and repair activities, including refuelling, were largely conducted on the hardstand area at the base; however, some maintenance works such as engine tuning, minor repairs and supply activities were carried out on the Catalinas whilst they were on their moorings, under tow or taxiing (Cosmos 2015).

These activities both on land and over water would most likely have involved the storage and use of a range of oils, fuels, lubricants, paint, paint stripper and solvents, glues, insecticides and pesticides, degreasers, aircraft wash and polishes and acids both on the hardstand, and over water. Usage and spills of these chemicals may have resulted in their release into the surrounding environment (KBR 2020).

In the 1980s, the former RAAF Catalina Ramp was opened to the public by the NTG for use as a recreational boat ramp. The boat ramp became one of the most popular ramps in Darwin Harbour due to its length, which enabled small craft to easily access the harbour waters during most tidal phases. However, in 2005 the boat ramp was no longer required to support recreational boating as a new recreational boat ramp was constructed at East Arm, north of Catalina Island (KBR 2020).

Tributyltin (TBT) was widely used as a component of ship anti-fouling paints from the 1960s until 2008, when they were banned from use. Given the persistence of TBT within marine sediments (Furdeek et al 2016) there is the potential for it to be present within the Project dredging footprint.

At present, the site is currently used for a marine services business. It has a car park, site office and hardstand areas which are used to conduct marine services activities (including marine equipment and material hardstand/laydown), a works depot and marine workshop. Activities carried out on site, including the storage and maintenance of marine equipment, would likely involve the use of a range of hydrocarbons, oils and degreasers, and products associated with the maintenance, cleaning and wash down of marine equipment including buoys and vessels (KBR 2020).

2.3 East Arm Port

The Project site is immediately adjacent to East Arm Port and the associated EAW, which opened in 2000. The wharf has a continuous 775 m berth face, located parallel to the main shipping channel in East Arm, which incorporates a dry bulk materials handling facility (with a ship loader designed to load Panamax class vessels) and a liquids handling facility through which petroleum products and chemicals are imported.

East Arm Port occupies a land area of approximately 10 ha of sealed hardstand surface with 4,000 m² of undercover cargo handling facility, and a further 18 ha of bunded area for future reclamation. A single rail spur from the Australasia Railway runs over a 16 m wide railway causeway, linking to three rail lines to the wharf (including a 4 ha intermodal container terminal), with road access provided over the causeway from Berrimah Road (NTG 2011).

The primary role of East Arm Port is to facilitate the movement of goods via rail, road and shipping to international markets. EAW currently services vessels handling general cargoes, live cattle exports, dry bulk imports, containerised / break bulk and specialised heavy lift cargoes, plus offshore rig tender service vessels at the Marine Supply Base. It is utilised by oil and gas, mining, agriculture, horticulture, bulk minerals and construction industries (Darwin Port 2019).

The types and tonnages of cargo imported and exported from Darwin Port in 2018/2019 are detailed in Table 4 (Darwin Port 2020). Of note with reference to potential impacts on sediment quality are dry bulk exports (currently manganese, but included iron ore and copper concentrate until 2016), and chemical and petroleum imports. These have historically influenced the sediment quality in the EAW area, most notably after copper concentrate spills occurred while loading in 2010 (AIMS 2010).

Table 4 Trade through Darwin Port in 2018/2019

Commodity	Export tonnage	Import tonnage
Beverages	0	6,100
Building Materials	18	6,108
Chemicals	62	117,861
Dry Bulk	891,903	183,807
Livestock	159,584	0
Livestock Feed	24,500	0
Machinery & Equipment	3,085	10,243
Metal Products	1,426	25,967
Metal Waste	18,379	0
Motor Vehicles & Parts	0	12,060
Other	28,958	38,236
Paper	5,849	2,252
Petroleum Products	2,136	887,935
Polymers & Plastics	0	3,114
Rubber/Tyres/Tubes	0	6,106
Timber Products	0	622
Total	1,137,698	1,302,100

3.0 Basis for Assessment

3.1 Overview of guidelines

The framework for the assessment of the dredged materials from the Project has been developed based on the following guidelines:

- Guidelines for the Environmental Assessment of Marine Dredging in the Northern Territory (NT EPA 2013).
- The NAGD.
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).
- National Acid Sulfate Soils Guidance: National Acid Sulfate Soils Sampling and Identification Methods Manual, Canberra, Australia, (Sullivan, et al. 2018) Department of Agriculture and Water Resources.
- National Acid Sulfate Soils Guidance, Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management (Simpson et al 2018).

An overview of the key requirements of these guidelines, including identification of investigation levels, is provided in the following sections.

3.2 Guidelines for the Assessment of Marine Dredging in the Northern Territory

The Guidelines for the Assessment of Marine Dredging in the Northern Territory (NT EPA 2013) provides generic guidance on environmental assessment of dredging within the coastal waters (three nautical miles measured seaward from the territorial sea baseline) of the Northern Territory.

Within these guidelines is guidance which relates to the characterisation and assessment of the physical and chemical status of the sediments to be dredged, guidance which pertains to this geochemical assessment. This guidance has been directly adopted from the NAGD, which is addressed in the following section.

3.3 National Assessment Guidelines for Dredging

3.3.1 Decision framework

This report addresses the requirements set out in section 2.2.1 of the Project Terms of Reference document from the NT EPA. As outlined in the NAGD, the decision framework for assessing the quality of sediments and the suitability of the material for offshore disposal is based on five key steps (Figure 4):

1. Phase I – Evaluation of existing data.
2. Phase II – Sampling and analysis of sediments.
3. Phase III – Elutriate and bioavailability testing.
4. Phase IV – Toxicity and bioaccumulation testing.
5. Phase V – Weight of evidence assessment.

It must be noted that the decision framework pertains to offshore disposal of dredged material, whereas the sediments dredged from the Project footprint will be disposed onshore. Hence the assessment presented in this report is focussed upon the use of the NAGD framework to ascertain the contaminant status of the sediments to be dredged. Issues for consideration during the onshore disposal of the sediments are then addressed in Section 9.0.

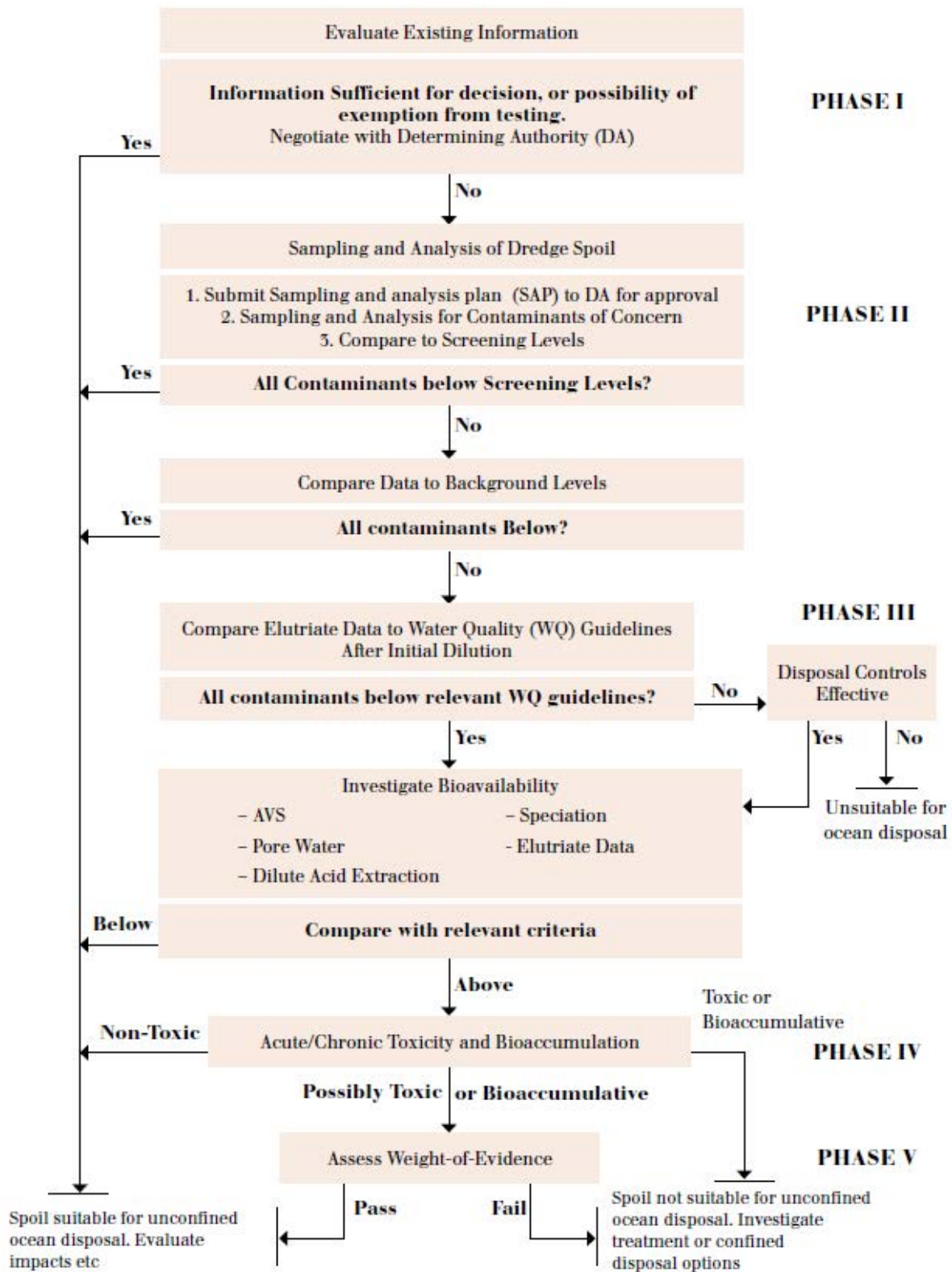


Figure 4 Decision tree for the assessment of the suitability of sediments for unconfined ocean disposal (NAGD 2009)

3.3.2 Criteria levels

For the purpose of this geochemical assessment, the criteria levels have been adopted from the Sediment Quality Guidelines (SQG) documented in Tables 2 and 4 of the NAGD.

A summary of the criteria levels is provided in Table 5.

Table 5 SQG values as listed in tables 2 and 4 of the NAGD.

Parameter	SQG Low (Screening Level)	SQG High (High Level)
Metals (mg/kg = ppm)		
Antimony (Sb)	2 mg/kg	25 mg/kg
Aluminium (Al)	NG	NG
Arsenic (As)	20 mg/kg	70 mg/kg
Cadmium (Cd)	1.5 mg/kg	10 mg/kg
Chromium (Cr)	80 mg/kg	370 mg/kg
Copper (Cu)	65 mg/kg	270 mg/kg
Iron (Fe)	NG	NG
Lead (Pb)	50 mg/kg	220 mg/kg
Manganese (Mn)	NG	NG
Mercury (Hg)	0.15 mg/kg	1 mg/kg
Nickel (Ni)	21 mg/kg	52 mg/kg
Silver (Ag)	1.0 mg/kg	3.7 mg/kg
Zinc (Zn)	200 mg/kg	410 mg/kg
Organics* (µg/kg = ppb)		
Total Polycyclic Aromatic Hydrocarbons (PAHs)	10,000 µg/kg	50,000 µg/kg
Total Recoverable Hydrocarbons (TRH)	550,000 µg/kg	NG
Total nitrogen	NG	NG
Total phosphorus	NG	NG
Tributyltin (TBT)	9 µg Sn/kg	70 µg Sn/kg
Radionuclides	35,000 Bq/kg	NG

* Normalised to 1% Total Organic Carbon (TOC)

NG = No Guideline

3.3.3 Data normalisation

Most natural and anthropogenic substances, including metals and organic contaminants, show a higher affinity to fine grained particulate matter than coarse fraction sediments, with organic matter and clay minerals generally exhibiting the strongest adsorption capacity for contaminants (OSPAR 2001).

Analysis of the whole sediment (as undertaken in this investigation) provides an indication of the distribution of contaminant concentrations in bedded sediments. If sediments within a given area are predominately fine grained, the influence of grain size distribution is of minor importance, however in areas where grain size varies considerably, the distribution of contaminants will be closely related to the distribution of fine grained sediments, obscuring the true spatial distribution of contaminants (Analysis and Monitoring of Priority Substances [AMPS] 2004).

Two different approaches are commonly used to correct for variable sediment composition:

- Contaminant concentrations may be normalised using components of the sediment that represent its affinity to bind contaminants (such as organic matter). Total Organic Carbon (TOC) is one of the most widely used 'normalisers' for organic contaminants.

- Isolation of the fine fraction sediments (<63 µm) by sieving for physical grain size normalisation, effectively removing the coarse grained particulates which display a lower affinity to bind anthropogenic contaminants.

The objective of using normalisation techniques is to reduce the variability between samples arising from differences in sediment properties, such as grain size distribution. However, it is noted that the correlation between contaminant and co-factor concentrations may be weak or absent in some areas (OSPAR 2009).

For organic contaminants, values were normalised to 1% TOC, as recommended in ANZG (2018) and the NAGD. If the sediment organic carbon content had been markedly higher than 1% in any samples, then following ANZECC (2000) the criteria levels could be relaxed owing to the presence of additional carbon binding sites, which would have acted to reduce the bioavailability of organic contaminants in those samples. As TOC was below 1% in all samples (see Section 8.2.2), normalisation of organic contaminant concentrations was undertaken as follows, with the normalised concentrations used in statistical calculations:

- Where TOC was less than 0.2%, the concentrations were multiplied by a factor of 5.
- Where TOC was between 0.2% and 1%, the concentrations were divided by TOC.

3.3.4 Calculation of the 95% upper confidence limit

In accordance with the guidance in the NAGD, the 95 per cent Upper Confidence Limit (95% UCL) is used to determine compliance with the Screening Levels. The United States Environmental Protection Agency (USEPA) has software (ProUCL) that can calculate 95% UCLs from data sets containing detect and non-detect observations. ProUCL calculates the most reliable 95% UCL value based on the specific distribution of data points within each data set, thereby accounting for normally distributed, gamma distributed and non-normally distributed data that are commonly encountered in environmental data.

For data sets that appear normally distributed, the Student's t-Test has been used to calculate each 95% UCL, while for data sets that did not appear normally distributed, the most conservative (highest) UCL available was used to calculate the 95% UCL.

Where concentrations are reported below the Limit of Reporting (LOR), a value of half the LOR is adopted for the purpose of statistical calculations.

3.4 Water quality guidelines

Management of water quality for natural and semi-natural water resources in Australia is guided by the ANZG (2018) which outlines the principles, objectives and philosophical basis underpinning the development and application of the guidelines. It also outlines the management framework recommended for applying the water quality guidelines to the natural and semi-natural marine and freshwater resources in Australia and New Zealand.

The guidelines provide a risk-based decision framework where possible, to help refine trigger values for application at local and/or regional scales.

In the event that elevated concentrations of contaminants of potential concern are reported in sediments, Phase III of the NAGD sediment investigation process requires elutriate testing to be completed to assess the potential impacts to water quality. Analytical results are compared against the relevant marine water quality trigger levels for 95% protection of species (ANZG 2018).

3.5 Acid Sulfate Soils guidelines

National Acid Sulfate Soils Guidelines (NASSG) were released in 2018 for uniform coverage of all the aspects of acid sulfate soils (ASS) assessment and management across the various state and territory jurisdictions. These guidelines should be used to supplement the existing local and regional guidance such as the Queensland ASS sampling guidelines (Ahern et al 1998) and Western Australian guidelines (DER 2015).

The National Acid Sulfate Soils Sampling and Identification Methods Manual (Sullivan et al 2018) provides the current best practice methodology for ASS investigations and sampling for management purposes. The purpose of this guidance is to provide technical and practical advice on the identification and sampling of ASS materials both prior to field investigations and when in the field. These guidelines also define the nature and extent of ASS and the amount of existing and potential acidity in order to determine appropriate management measures.

The 'Guidance for the Dredging of Acid Sulfate Soil Sediments and Associated Dredge Spoil Management' manual (Simpson et al 2018) describes a technical framework for evaluating the environmental acceptability of dredged material, management alternatives and means to minimise and manage potential impacts. It provides technical and procedural advice to avoid environmental harm from ASS encountered during dredging projects. It addresses both the risks posed during dredging operations and during disposal of dredged spoil materials.

Simpson et al (2018) also provide the action criteria which define the acidity levels beyond which ASS requires management, in conjunction with the volumes of disturbance involved (Table 6). As clay content tends to influence a soil's natural buffering capacity, the action criteria for smaller disturbances (≤ 1000 tonnes) are grouped into three broad texture categories – coarse, medium and fine. The action criteria for projects disturbing more than 1000 tonnes of soil are set at the lowest value, irrespective of texture. A detailed management plan may be required for these disturbances.

Table 6 Texture-based ASS Action Criteria

Type of material		Sum of existing and potential acidity			
Texture range (NCST, 2009)	Approximate clay content (%)	1-1000t material disturbed		>1000 t material disturbed	
		% S-equiv. (oven-dried basis)	Mol H+/t (oven-dried basis)	% S-equiv. (oven-dried basis)	Mol H+/t (oven-dried basis)
<i>Fine</i> Medium to heavy clays and silty clays	>40	0.1	62	0.03	18
<i>Medium</i> Sandy loams to light clays	5-40	0.06	36		
<i>Coarse</i> Sands to loamy sands and peats	<5	0.03	18		
<i>Draft action for poorly buffered sands – Coarse, sands, poorly buffered</i>	≤ 5	0.01	6	0.01	6

Soils with existing plus potential acidity below the action criteria may still be ASS but may not require management. Action criteria are based on the sum of existing plus potential acidity. This is usually calculated in units of percent-sulfur equivalents (e.g. s-TAA + s-SNAS + SCR in % S units) or equivalent acidity (e.g. TAA + a-SRAS + a-SPOS in mol H+/tonne units). The highest laboratory result(s) should always be used to decide if the relevant action criterion level has been met or exceeded; using the average or mean of a set of results is not appropriate or acceptable.

Based on the observed main lithology (sands with some silts and clays), and total potential volume of disturbance (>1000 t) the applicable ASS action criterion for this investigation are:

- sum of existing plus potential acidity (excluding acid neutralising capacity) of less than 18 mol H+/tonne (0.03 S%); and,

- a conservative neutralising capacity of more than 15 times (10 times more than the value given in NAASG) the sum of existing plus potential acidity, all measured in the same units (and using a minimum safety factor of 1.5).

A site-specific ASS risk matrix was also developed to highlight areas where sediments have the potential to produce acid if the materials are exposed to oxygen as a result of disposal onshore. The amount of Acid Neutralisation Capacity (ANC) present in each sample was assessed against the sum of existing and potential acidity in the sample to determine if the sample was classified as low risk or potential risk based on the site specific ASS criteria (Table 7).

The potential for samples to generate acidity was based on the most conservative assumption that less than 10,000 t of sediment would be removed from the vicinity of each of the sample sites. Samples that are classified as potential ASS risk based on the site-specific criteria will require management if disturbed or disposed of on land (Ahern et al 1998).

Table 7 Site Specific acid sulfate soils risk matrix adapted from Ahern et al (1998)

		Potential Acidity Risk (based on oxidisable sulfur content %S risk levels and treatment categories for less than 10,000 tonne of sediment [Ahern et al 1998])	
		Very High (≥0.03 and <0.06%S)	Extra High (>0.06 %S)
ANC Buffer Capacity (based on a %S equivalent)	Low (0 – 10 %S)	Potential risk	Potential risk
	Medium (10 – 30 %S)	Potential risk	Potential risk
	High (>30 %S)	Potential risk	Low risk

4.0 Background Data Review

4.1 Previous investigations

The NAGD state that existing chemical or toxicity data for the sediments of the area to be dredged have a maximum currency of five years, where there is no reason to believe that the contamination status has changed significantly, after which new data are required. The EAW area was subject to copper concentrate spills in 2010 (AIMS 2010), so in accordance with the guidelines, all data from 2010 and earlier are to be used for historical comparison only and cannot be used to characterise the current contaminant status of the sediments to be dredged.

Previous investigations that were conducted in the general vicinity of (though not within) the Project dredging footprint include the following:

- Radke et al (2020) Sediment Quality Assessment of East Arm.
- URS (2014) Multiuser Barge Facility Sediment Geochemical Investigation.
- Munksgaard et al (2013) Darwin Harbour Baseline Sediment Survey 2012.
- URS (2012) East Arm Wharf Dredging Sampling and Analysis Plan and report.
- AIMS (2010) Investigation of Copper Concentrate Loadout at East Arm Port: Water and Sediment Quality.
- URS (2009) Ichthys Gas Field Development Project: Nearshore Marine Water Quality and Sediment Study.
- Fortune (2006) The grainsize and heavy metal content of sediment in Darwin Harbour.

The findings of the previous investigations will assist in consideration of the potential sources of contaminants to the Project area. Selected findings (sediment quality exceedances only) from these studies are summarised in Table 8.

Table 8 Sediment sampling results from selected previous studies in the East Arm region near the Project area

Study	Analyte	Screening Level (mg/kg)	95% UCL	Comment
Radke et al 2020	Arsenic	20	Not calculated	NAGD High Level (70 mg/kg) exceeded in two samples (90.8 mg/kg and 110.4 mg/kg)
URS 2014	Arsenic	20	55	Bioavailability = low
URS 2012	Arsenic	20	42.2	Bioavailability = low
AIMS 2010	Arsenic	20	Not calculated	Screening Level exceeded at some sites near EAW
	Copper	270	Not calculated	Exceeded at some sites near EAW, bioavailability criteria exceeded at one site
URS 2009	Arsenic	20	37.2	Bioavailability = low
	Chromium	80	45.1	Screening Level exceeded at some sites near EAW
	Mercury	0.15	0.018	
	Nickel	21	5.9	
Fortune 2006	Arsenic	20	Not calculated	Screening Level exceeded at two sites near EAW

These studies found that although the NAGD Screening Levels were exceeded at some individual sites, the only 95% Upper Confidence Limit (UCL) levels to exceed a Screening Level (but not the NAGD 'High Level') were for arsenic in the surveys conducted by:

- URS (2009, 2012), in which elutriate testing showed that arsenic was present in a form with only low bioavailability.
- URS (2014), in which arsenic concentrations in all samples from the MUBRF site were above the Screening Level.

While arsenic has often been recorded within Darwin Harbour sediments at concentrations above the NAGD Screening Level (and above the High Level in the most recent survey [Radke et al (2020)], Fortune (2006) considered this to be a result of the local geology rather than due to anthropogenic inputs. This contention was supported by the results of the URS (2012) study, in which arsenic concentrations were typically higher in the sub-surface (>50 cm depth) sediments.

Munksgaard et al (2013) did not record any Screening Level exceedances in the general vicinity of the Project area, though they recorded Screening Level exceedances for arsenic, chromium and nickel in sediments in the upper reaches of Hudson Creek.

5.0 Contaminants of Potential Concern

Taking into consideration port activities, potential catchment inputs and data from previous sediment sampling programs in East Arm, Table 9 presents a list of contaminants which were considered could be present at elevated levels in the sediments within the Project dredging footprint. In addition to the listed contaminants, samples will also be tested for ASS potential to assist with assessing the risk associated with onshore placement of dredged material.

It should be noted that not all of the “typical sediment contaminants” listed in Table 1 of the NAGD appear in Table 9 and were subsequently tested for in the samples collected. Contaminants for which there are considered to be no significant sources of input to the Project dredging area (e.g. from imports or exports, or from the surrounding catchment) have been excluded from testing. For example, while organochlorine pesticides (mainly dieldrin) were detected in some samples of Darwin stormwater in the mid-1990s by Padovan (2001), these pesticides have been progressively phased out over the subsequent decades. Therefore, it is considered that the potential for organochlorine pesticides to be present in the sediments within the Project dredging footprint is sufficiently low to justify their exclusion from the contaminants list. It is also noted that pesticides were not included within the Darwin Harbour baseline sediment survey conducted by Munksgaard et al (2013) and are not included within the analytes for the sediment quality sub-program of the Darwin Harbour Integrated Marine Monitoring and Research Program (Brinkman & Logan 2019).

Table 9 Contaminants list for sampling in the Project dredging footprint

Analytical Parameter	Rationale for Analysis
Particle Size Distribution Analysis (PSD)	Standard sediment analysis tool.
Total Organic Carbon (TOC)	For normalisation of organics
Antimony	Potentially found at ore export loading facilities
Aluminium	Useful for normalising elements
Arsenic	Known to be naturally high background levels (Table 8)
Cadmium	Common pollutant in port areas
Chromium	Elevated concentrations detected by URS (2009)
Copper	AIMS (2010) indicated the presence of elevated concentrations in port sediments
Iron	Exported from EAW
Lead	Common pollutant in port areas
Manganese	Exported from EAW
Mercury	Elevated concentrations detected by URS (2009)
Nickel	Elevated concentrations detected by URS (2009)
Silver	Common pollutant in port areas
Zinc	Common pollutant in port areas
PAHs	Common pollutant in port areas
TRH	Common pollutant in port areas
Total nitrogen	Palmerston wastewater treatment outfall located upstream, inputs from Elizabeth River and Hudson Creek catchments
Total phosphorus	
TBT	No longer used as an antifoulant, but still potentially present in port environments.
Radionuclides	Uranium and thorium exported from EAW

6.0 Sampling and Analysis Plan

6.1 Overview

AECOM was commissioned by the NTG to update the SAP initially developed by KBR (2020) following project changes discussed in Section 1.0. The SAP was developed with reference to NAGD and the NT EPA's Guidelines for the Environmental Assessment of Marine Dredging in the Northern Territory (NT EPA 2013).

The purpose of the SAP is to describe the location and number of sediment samples, the sampling methodology, and the analyses proposed to assess the physical and chemical characteristics of the sediments to be dredged. The objectives of the SAP were to:

- Provide a brief summary of the proposed dredging operations relevant to the SAP.
- Identify potential contaminants of concern for inclusion in the testing of sediments based on potential contaminant sources and the results of previous testing.
- Identify procedures for the collection, handling, preservation and Quality Assurance/Quality Control (QA/QC) of sediment samples for analysis.
- Describe procedures for reporting on the data, results, and conclusions of the sediment sampling.

6.2 Sediment sampling locations

As indicated in Appendix D of the NAGD, "contaminants" will rarely penetrate far into the underlying, undisturbed geological materials". Based upon geophysical surveys undertaken across the dredging footprint, supplemented with limited geotechnical data from nearby investigations, the Project Engineer estimated that approximately 238,500 m³ of unconsolidated sediments will be dredged as part of the early works dredging campaign. The required number of sample locations, calculated in accordance with Appendix D of the NAGD, is 22. As indicated in Section 1.1, the SAP was prepared on the basis that dredging may be required within the proposed reclamation area. Hence, samples were collected from a total of 26 locations. As indicated in Section 1.1, the dredge footprint was revised after the geochemical survey, to no longer include the reclamation area.

The locations were selected by overlaying a 40 x 40m grid over the dredging area (to provide a total of 146 cells, more than the 130 cells [5 x 26 sample locations] needed to meet the requirements of Appendix D of the NAGD), then generating random numbers to determine the cells within which samples are to be collected. The locations sampled are shown in Figure 5 and coordinates (in geodetic datum GDA94, MGA zone 52) are presented in Appendix A. Several primary sample locations listed in Figure 7 of the SAP were not able to be sampled due to the hardness of the substrate, for each of these a backup location was sampled instead. In total 45 samples were collected (including triplicates and multiple depth horizons) from the 26 locations, 22 of which were within the new dredging footprint, which no longer includes the reclamation area.

6.3 Sampling Methodology

6.3.1 Sterilisation procedures

An area on the vessel was designated for sample handling prior to commencement of sampling operations. In the vicinity of the sampling area, potential contaminant sources (e.g. galvanised or oily surfaces) were covered or scrubbed with a decontamination solution or covered with a clean tarpaulin to reduce the potential for sample contamination.

Disposable nitrile gloves were worn by field personnel during sampling to minimise the potential for sample contamination by residues (e.g. hydrocarbons, sunscreen etc.). Nitrile gloves were changed between sample locations.

Decontaminated plastic and stainless steel spatulas were used where direct contact with the sediment sample was necessary (e.g. during splitting of the cores); stainless steel was used for samples to be analysed for organic compounds, and plastic for samples to be analysed for metals.

AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.



<p>PROJECT ID 60833505 CREATED BY PJY APPROVED BY PYoung LAST MODIFIED 03 NOV 2020</p> <p>AECOM www.aecom.com</p> <p>1:4,080 when printed at A4 DATUM GDA 1984, PROJECTION MGA ZONE 52</p> <p><small>Data sources: Source: Esri, DeLorme, GeoEye, Earthstar Geographics, CNR/SiA/Bruce D/B, URSI, AeroGRID, IGN, and the GIS User Community Base Data: S (Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).)</small></p>	<p>LEGEND</p> <ul style="list-style-type: none"> ● Sediment sample locations ■ Proposed dredging areas <ul style="list-style-type: none"> ■ Reclamation Area ■ Manoeuvring Area ■ Shiplift & Berths 1, 2 and 3 ■ Berths 4, 5 and 6 	<p>Sediment Sampling Locations</p> <p>NORTHERN TERRITORY GOVERNMENT OF AUSTRALIA DARWIN SHIP LIFT PROJECT</p> <p>Figure 5</p>
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Figure 5 Sediment sample locations

Smoking was not permitted in the vicinity of, or upwind from, the designated sample processing area. Sample processing was undertaken upwind of the engine exhaust outlets which were unable to be turned off for safety reasons.

The sediments in the proposed dredge footprint were sampled using a vibrocore, with samples retained in disposable plastic core liners within the coring tube. The plastic liner was replaced after each sampling attempt. Prior to the commencement of the survey all sampling equipment was cleaned and decontaminated using a Decon 90 solution. During sampling, equipment was cleaned and decontaminated between sites through cleaning in seawater and a rinse in Decon 90 solution.

6.3.2 Methodology overview

Vibrocore sampling was undertaken on board Bahgwan Marine's vessel the 'Welshman' from 27 to 29 July 2020. Seas Offshore Pty Ltd was subcontracted by AECOM to conduct the vibrocoring. A vibrocore was installed on the vessel, which was fitted with appropriate lifting equipment, power generation, deck space and adequate station-holding capability. The equipment was manned by suitably qualified and experienced personnel from Seas Offshore. The cores, with plastic liners, were driven into the seabed from the vessel, then recovered to the vessel where sub-sampling was undertaken by AECOM scientists.

6.3.3 Logging and sample management

The sediment logging and sub-sampling procedures undertaken by AECOM were as follows:

- The plastic core liners were cut longitudinally to allow the samples to be photographed, logged and sub-sampled.
- Core logging was undertaken in the field by experienced environmental professionals from AECOM. Log sheets were maintained, including a record of the nature of sediments throughout the core profile and observations of potential contamination such as odours or staining.
- A photographic log of the sediment cores was maintained.
- Composite sediment samples were collected from the following depth ranges:
 - 0 to 0.5 m.
 - 0.5 to 1 m.
 - Every half metre interval > 1 m.
- It is important to note that the thinnest layer that can be dredged reliably and handled selectively using equipment routinely available is approximately 0.5 m (NAGD 2009), so sub-sampling at smaller intervals along the core was considered to be redundant.
- Samples were placed in 250 mL laboratory supplied glass jars (for hydrocarbons, nutrients, radionuclides and TBT analyses) and plastic zip lock bags (for analysis of metals, ASS analyses and Particle Size Distribution [PSD]). The use of plastic, rather than glass, storage containers is recommended for metals, as metals tend to adsorb onto glass surfaces, potentially leading to underestimates of metal concentrations.
- Samples were labelled with a unique identifier, particular to that sample location and depth.
- All samples (plastic bags and jars) were placed inside labelled plastic zip lock bags for protection, stored and frozen at the earliest opportunity.
- Prior to transport to the project analytical laboratory samples were placed frozen in eskies with frozen ice bricks. Eskies were properly labelled and taped up to ensure safe transport of the samples.
- Samples were delivered, with accompanying Chain of Custody (CoC) forms, to Australian Laboratory Services (ALS) in Darwin from where they were forwarded, under appropriate CoC procedures and preservation conditions, to their National Association of Testing Authorities (NATA) accredited laboratory in Sydney.

6.4 Laboratory Analysis

Table 10 details the containers, holding times and analysing laboratories for each analyte tested.

Analysis of primary sediment samples was undertaken by ALS laboratories in Sydney, with Eurofins in Melbourne analysing inter-laboratory replicate samples for QA/QC purposes. The methods and analytical LOR's for the analyses are provided in Table 5; the latter were at or below the practical quantitation limits recommended in Table 1 of NAGD.

Table 10 Limits of reporting (LORs) and analytical methods

Analyte	LOR	Method	Container / sediment weight	Holding time	Analysing Laboratory
Basic Sediment Characteristics					
Moisture	1.0 %	In house	Teflon Lined 250 ml Glass Jar 10-50 g	Undetermined-extended storage if frozen)	ALS Sydney
TOC, OC and Inorganic Carbon	0.02%	LECO after acid treatment – EP005			
PSD	0.01 g/cm ³	Wet sieving and laser diffraction	2 x 500g plastic snap lock bag	No specific holding time – chilled to 4°C	ALS Sydney
Inorganic Compounds					
Total Metals and metalloids (mg/kg)					
Antimony	0.5mg/kg	USEPA 6020 USEPA 6010 (Al & Fe)	500 mL plastic snap lock bag– Unpreserved	6 months chilled to 4°C	ALS Sydney
Arsenic	0.5 mg/kg				
Aluminium	5.0 mg/kg				
Cadmium	0.1 mg/kg				
Chromium	0.5 mg/kg				
Copper	0.5 mg/kg				
Iron	100 mg/kg				
Lead	1.0 mg/kg				
Nickel	1.0 mg/kg				
Silver	0.1 mg/kg				
Zinc	0.5 mg/kg				
Manganese	10.0 mg/kg				
Mercury	0.01 mg/kg	APHA 3112 Hg-B		28 days	ALS Sydney
Organometallics					
TBT	0.5 µg Sn/kg	USEPA 8270D	250 mL glass jar	6 months	ALS Sydney
Organic compounds					
TPH	2 – 100 mg/kg	USEPA 8270D,	250 mL Soil Glass Jar – Unpreserved	14 days	ALS Sydney
PAH	0.004-0.005 mg/kg	USEPA 8270D		14 days	
BTEX and naphthalene (BTEXN)	200 mg/kg	USEPA 8260B		14 days	

Analyte	LOR	Method	Container / sediment weight	Holding time	Analysing Laboratory
Nutrients					
Total Nitrogen	20 mg/kg	NT-11 NT-11	Teflon Lined 250ml Glass Jar 50-200 g	6 months	ALS Sydney
Total Phosphorus	2 mg/kg			6 months	
Acid sulfate soils					
pH (F) pH (Fox) Reaction Rate	0.1 pH 0.1 pH 1	ALS EA037	Whirlpak 100-250 g	Lab in 24 hours and frozen as soon as possible	ALS Sydney
Chromium suite: Total actual acidity (TAA), and Acid Neutralising Capacity (ANC)	0.1 pH, 0.02 % pyrite S 0.005 % S 0.01 % CaCO ₃ , 0.01 % pyrite S	ALS EA033			
Radionuclides					
Sum gross alpha and beta	500 bq/kg	ISO9696 & ISO9697	Teflon Lined 250ml Glass Jar 50-200 g	6 months	ALS Sydney

6.5 Acid Sulfate Soils

6.5.1 Sampling Methodology

All samples were collected and logged according to the methodology presented in Section 6.3, and in accordance with the National ASS Guidance – Soil Sampling and Identification (Sullivan et al, 2018).

6.5.2 Sample analysis and indicative screening

Sample analysis for ASS was conducted as listed in Table 10.

Indicative screening tests (pH_f and pH_{fox}) for pH were conducted on all samples which involved shaking the soil samples with deionised water and peroxide, respectively, and noting the resultant pH of each sample. The pH_{fox} test simulates extreme acid-forming conditions. Based on the screening results from the laboratory, observed lithology and the potential for ASS to be present, further laboratory analysis (Chromium Reducible Sulfur Suite, CRS) were selected for select samples. The key decision rules around further analysis included:

- Typically, a field $pH_f < 4.0$ indicates actual acidity, and $pH_{fox} < 3.5$ indicates potential acid sulfate soils.
- A pH_{fox} value of at least one unit below pH_f may indicate acid generating material requiring further testing. The larger the difference (ΔpH) between the two values the more likely the material is potentially acidic. Also, the lower the pH_{fox} value the more likely the materials net acidity.
- If the $pH_{fox} < 3$, and the above condition applies, then it strongly indicates a PASS. The more the pH_{fox} drops below 3, the more positive the presence of sulphides.
- A pH_{fox} of 3-4 is less positive and laboratory analysis is required to confirm if sulfides are present.

- For pH_{fox} 4-5 the test is neither negative nor positive. However, further testing is required. Sulfides may be present either in small quantities and be poorly reactive or the sample may contain self-neutralising carbonate.
- For $\text{pH}_{\text{fox}} > 5$ and little or no drop in pH from the field value, little net acidification is indicated.

Laboratory analytical results were compared to the action criteria, to assess management requirements.

7.0 Quality Assurance and Quality Control

7.1 Field QA/QC

All fieldwork was conducted in general accordance with AECOM's Standard Field Operating Procedures and the protocols presented in the SAP, which were aimed at ensuring that all environmental samples were collected by a set of uniform and systematic methods in line with AECOM's Field Quality Management system. These are outlined in the following reference documents:

- Q4AN(EV)-002-PR1 - Field Quality Notes and Records
- Q4AN(EV)-007-PR1 - Chain of Custody (COC)
- Q4AN(EV)-301-PR1 - Shallow Sediment Sampling
- Q4AN(EV)-302-PR1 - Sediment Sampling – Vibrocore

Field QA/QC procedures followed during the sampling program included:

- Sampling was conducted by staff with appropriate experience and training.
- Field logs noting the outcomes of field activities, weather and site conditions at the time of sampling were recorded by AECOM.
- Decontamination procedures - including the use of new disposable gloves for the collection of each sample, thorough cleaning of the sampling equipment between each location and the use of dedicated sampling containers provided by the laboratory.
- Stainless steel equipment was used, where practicable, to minimise the risk of cross contamination of samples.
- Sample identification procedures - all sample containers were clearly labelled with a sample number, sample location, sample date and sampler's initials.
- All samples were held under appropriate storage conditions in the field until their transfer to ALS Darwin and forward transfer to other testing laboratories.
- CoC information requirements - a CoC form was completed and forwarded to the testing laboratory with each batch of samples collected.

7.1.1 Collection of field QA/QC samples

A summary of field QA/QC samples collected during the course of this sampling program is provided in Table 11.

Table 11 Field QA/QC sampling methods

Criterion	Comments
Field triplicate	Field triplicates, involving the collection of three core samples at the same location, were collected at two locations (SL05 and SL22). The samples were sent to ALS Sydney for analysis. Triplicate samples provide an indication of the variability of the physical and chemical characteristics of the sediment within a relatively small area.
Field splits	Two sites were selected to provide the field split samples. These were SL22 and SL23. At each of these sites, two samples were collected from the 0-0.5 m depth interval of the same core. One of the two samples was sent to the primary analysing laboratory, ALS Sydney, while the other sample was sent to Eurofins Melbourne. Split samples are inherently influenced by factors such as sampling techniques and sample media heterogeneity, so care was taken to ensure the split samples were taken from the same section of core, then placed into two sets of containers.

Criterion	Comments
Trip blanks	16 trip blank was sent to ALS Sydney for analysis. The trip blanks comprised of a jar filled with laboratory supplied acid washed sand which were present throughout the sampling procedure and transport of samples and were analysed as part of the sample batch. The trip blank sample remained unopened for the duration of the survey and thus provided an indication of contamination from volatile substances during sample transport and storage in the field, or during the laboratory analytical process.
Field blanks	No field blanks were effected during the sampling programme.
Rinsate blank	Rinsate blanks were prepared using the sampling equipment on the day following completion of the sampling. Three Rinsate blank samples (SLB01, SLRB02 and SLRB03) were sent to the laboratory for testing. The blank samples were analysed for a limited number of analytes to provide an indication of the thoroughness of decontamination of sampling equipment.
Inter-batch duplicate	All samples were sent as one batch following the completion of the three-day sampling survey; thus, an inter-batch duplicate sample was not necessary. When analysed, inter-batch duplicate results provide an indication of the analytical variation between batches.

7.1.2 Evaluation of field QA/QC

An evaluation of the field QA/QC procedures implemented during the course of this sampling program is provided in Appendix B and summarised in Table 12.

Table 12 Field QA/QC assessment

Criterion	Comments
QA/QC program includes replicate samples	<p>Field split and triplicate samples were both collected at more than 5% of locations. Relative percentage differences (RPD) and relative standard deviations RSD) across split samples and triplicate samples, respectively, were calculated as follows:</p> <ul style="list-style-type: none"> RPD = difference between the two concentrations, divided by the average of the two concentrations, multiplied by 100. RSD = standard deviation of the data set, divided by the average of the data set, multiplied by 100. <p>RPDs across split samples, and RSDs across triplicates samples, were evaluated in accordance with NAGD as follows:</p> <p>For split samples: Pass RPD <= 35% Pass-1 RPD > 35%, Analysis result < 10 times LOR Pass-2 RPD <= 50%, Analysis result > 10 times LOR and < 20 times LOR</p> <p>For triplicate samples: Pass RSD <= 50%</p> <p>RPD exceedances exist for several metals in the results reported by the primary and the secondary laboratory for the split samples. With the exception of arsenic, none of the results reported by the secondary laboratory were above the Screening Levels for any metal.</p> <p>RPD exceedances also exist for percentage TOC, total inorganic carbon, CRS and the BTEX surrogate (4-Bromofluorobenzene). For the purpose of normalising organic contaminants to 1% TOC, the TOC value which provided the most conservative (highest) concentration of a contaminant requiring normalisation was used when comparing against the NAGD Screening Levels.</p>

Criterion	Comments
	<p>It is likely these results can be attributed to the heterogeneity of the sediment, and difference in analytical methods and precision between the two laboratories. Conservatively, higher results have been used for data analysis.</p> <p>No RPD exceedances exist for TRH, TPH, BTEXN or nutrients (nitrogen and phosphorus) between results from the two laboratories.</p> <p>RSD exceedances do exist in comparisons of triplicate samples for several metals and the C10 - C36 Fraction (sum) of TPH and is likely as a result of sediment heterogeneity at the sampling site.</p>
All relevant media assessed	Sediments were collected at the nominated locations specified in the SAP to provide spatial coverage across the proposed dredging area. Where multiple core horizons were achieved, samples were collected and analysed from different depth profiles throughout the cores, to provide representative data throughout different sediment horizons.
Sample collection, handling and transportation procedures and field QA/QC plan	<p>Dedicated sampling equipment was used for the extraction and of sediment cores (i.e. disposable nitrile gloves, plastic spatulas).</p> <p>The vibrocore used in sample collection was cleaned with deionised water and Decon 90 prior to sampling. Disposable plastic core liners were used for sediment capture within the core tube and were replaced after each core attempt.</p> <p>Following extraction, samples were placed in dedicated sampling containers of appropriate composition provided by the laboratory. Sample jars were stored in a freezer unit on site prior to transport to the project analytical laboratory under CoC conditions.</p> <p>The collection, handling, storage and transport of the samples were undertaken in accordance with the procedures presented in the SAP, though the split samples forwarded to the secondary laboratory were noted to have not been chilled upon arrival.</p> <p>The CoC forms and the sample receipt notification identified the samples collected, the requested analytes and the date of collection.</p> <p>Logs of each sample were recorded.</p>
Trip Blanks	The results of trip blank sample analysis did not report any presence of analytes above LoR.
Rinsate samples	The results of the Rinsate samples analysis reported very low levels of aluminium, iron, antimony, chromium, copper, lead, magnesium and zinc indicating some minor contamination from the sampling equipment.

7.2 Laboratory QA/QC

The analysing laboratories, ALS and Eurofins, adopted their internal procedures and NATA accredited methods in accordance with their QA/QC systems.

7.2.1 Laboratory QA/QC procedures

Laboratory QA/QC procedures are summarised in Table 13.

Table 13 Laboratory QA/QC methods

Method	Comment	Acceptance limits
Laboratory duplicate sample	<p>The analytical laboratory collects duplicate sub samples from one sample submitted for analytical testing at a rate equivalent to one in twenty samples per analytical batch, or one sample per batch if less than twenty samples are analysed in a batch.</p> <p>A laboratory duplicate provides data on the analytical precision and reproducibility of the test result.</p>	Laboratory duplicate samples should return RPDs within the NEPM acceptance criteria of $\pm 30\%$.

Method	Comment	Acceptance limits
Matrix spike	<p>An authentic field sample was 'spiked' by adding an aliquot of known concentration of the target analyte(s) prior to sample extraction and analysis.</p> <p>A spike documents the effect of the sample matrix on the extraction and analytical techniques. Spiked samples are analysed for each batch where samples are analysed for organic chemicals of concern.</p>	Percent recovery is used to assess spike samples. Percent recovery should range from 70-130%.
Laboratory control spike	<p>A reference standard of known (certified) concentration was analysed along with a batch of samples.</p> <p>The certified reference standard or laboratory control spike provides an indication of the analytical accuracy and the precision of the test method and is used for inorganic analyses.</p>	Percent recovery is used to assess spike samples. The acceptable range for percent recovery varies depending on the analyte. Refer to Appendix C for recovery limits.
Surrogate standard / spike	<p>Organic compounds which are similar to the analyte of interest in terms of chemical composition, extractability, and chromatographic conditions (retention time), but which are not normally found in environmental samples.</p> <p>These surrogate compounds were 'spiked' into blanks, standards and samples submitted for organic analyses by gas-chromatographic techniques prior to sample extraction. Surrogate standard/spikes provide a means of checking that no gross errors have occurred during any stage of the test method leading to significant analyte loss.</p>	Percent recovery is used to assess spike samples. The acceptable range for percent recovery varies depending on the analyte. Refer to Appendix C for recovery limits.
Method blank	<p>Usually an organic or aqueous solution that is as free as possible of analytes of interest to which is added all the reagents, in the same volume, as used in the preparation and subsequent analysis of the samples.</p> <p>The reagent blank was carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis.</p> <p>The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample</p>	Method (laboratory) blanks should return analyte concentrations as 'below LOR'.

7.2.2 Evaluation of laboratory QA/QC results

An evaluation of the laboratory quality control procedures implemented during the course of this sampling program is provided Appendix B and summarised in Table 14. Laboratory QA/QC reports are also presented in Appendix C.

Table 14 Evaluation of laboratory QA/QC

Criterion	Comment
Appropriate methods used for sample analyses	<p>ALS (NATA Registration Number 825) Sydney was utilised as the primary analytical laboratory for all analyses undertaken. Eurofins Sydney and Melbourne analysing inter-laboratory duplicate samples for QA/QC purposes.</p> <p>All laboratory reports were NATA stamped and signed by a NATA Signatory.</p> <p>Statistical data presented in the laboratory QA/QC reports were considered adequate in demonstrating the precision and accuracy of the methods used to analyse field samples.</p>

Criterion	Comment
Appropriate LORs	All LORs were sufficiently low to enable assessment against adopted guideline criteria, where applicable. A number of LORs were raised during analysis due to possible sample heterogeneity however all LORs were still equal to, or below, NAGD limits.
Samples analysed within the appropriate holding times.	All samples were analysed within recommended holding times.
Laboratory QA/QC plan	Copies of signed CoC forms and laboratory QA/QC reports are presented in Appendix C. Laboratory duplicates, method blanks, laboratory control spikes, matrix spikes and surrogates were conducted by all laboratories.
QC Outliers	QC outliers are detailed in Appendix B. Four RPD exceedances were noted for duplicate pairs. The RPD exceedances are likely due to sample heterogeneity and in order to be conservative, the highest value has been adopted for interpretive use.
Overall Laboratory QA/QC	Laboratory duplicates, method blanks, laboratory control spikes, matrix spikes and surrogates were conducted by all laboratories for all batches analysed. QC outliers have been noted during the interpretation of data and with the limitations stated in Appendix B, the results are considered suitable for interpretive use.

8.0 Results

8.1 Field observations

Field observations made during sample logging are presented in Appendix D. In summary, the following points are noted (results presented are for the dredging footprint samples only [excluding those sample results collected within the reclamation footprint] unless state otherwise):

- The general sediment profile comprised silty mud and sand with abundant shell and/or coral fragments in the surface sediment. Clay and silt content increased with depth.
- Sediment was predominantly grey and reddish brown.
- Refusal of the vibrocore was met on hard red clay and bedrock, when encountered, generally comprised of weathered siltstone.

8.2 Concentrations of Contaminants of Potential Concern

8.2.1 Metals

Concentrations of metals in sediments are reported in Table A (attached). A summary of the range of analytical results and calculated 95% UCL concentrations is provided in Table 15. The table includes the NAGD Screening Levels and High Levels for all metals analysed, with the exception of aluminium, iron and manganese, for which no guidelines have been developed.

Table 15 Summary of analytical results - metal concentrations (mg/kg) in sediments

Metal	SQG Low (NAGD 2009)	SQG High (NAGD 2009)	Min	Max	Mean	95%UCL ^a All sites	95%UCL ^a Dredge footprint only (excl. reclamation area)
Aluminium	NG	NG	1850	11500	7354.2	7802	7973
Iron	NG	NG	2950	75100	45563.3	48996	50261
Antimony	2	25	0.52	0.52	0.5	0.27	0.27
Arsenic	20	70	3.1	83.5	48.9	53.6	55.2
Cadmium	1.5	10	0.2	0.3	0.3	0.07	0.07
Chromium	80	370	3.6	89.2	34.8	38.7	40.5
Copper	65	270	1.2	54.5	7.3	13.1	13.4
Lead	50	220	5.7	50.8	12.4	17.6	15.9
Manganese	NG	NG	16	700	221.8	259	265
Nickel	21	52	1.3	58.4	7.7	13.2	14.0
Silver	1	4	0.1	0.6	0.2	0.09	0.09
Zinc	200	410	3.3	193	18.5	37.4	40.7
Mercury	0.15	1	0.01	0.05	0.0	0.0085	0.0086

Key

^a 95% UCL calculated using ProUCL. Data outputs are provided in Appendix E.

NG No guideline

BOLD exceeds the NAGD (2009) Screening Level

BOLD exceeds the NAGD (2009) High Level

Key aspects of the data are:

- With the exception of arsenic, the 95% UCL concentrations for all metals are below their NAGD Screening Levels.
- The 95% UCL concentration of arsenic (55.2 mg/kg) exceeds the Screening Level (20 mg/kg) but is below the High Level (70 mg/kg). Arsenic concentrations in the majority of samples were reported above the Screening Level, with four shallow sediment samples (SL05B, SL05C, SL27 and SL31) collected from the 0.0-0.5 m bgl interval reporting concentrations above the High Level. A further two samples, collected respectively from the 0.5-1 m and 1-1.5 m bgl intervals of the same core (SL29), also reported concentrations above the High Level. Arsenic concentration

in the overlaying sample at location SL29 was reported just under the High Level. Arsenic is discussed further in Section 9.0 of this report.

- The concentration of chromium (89.2 mg/kg) was above the Screening Level (80 mg/kg) in the sample from the 0.5-1 m bgl interval at location SL28. All other chromium concentrations, and the 95% UCL concentration (40.5 mg/kg), were below the Screening Level.
- Nickel concentrations were below the Screening Level (21 mg/kg) in all samples with the exception of one sample from location SL21 which reported a concentration of 58.4 mg/kg in the 0.5-0.8 m bgl interval, which is also above the SQG High Level (52 mg/kg). The 95% UCL concentration for nickel (14.0 mg/kg) was below the Screening Level.
- With the exception of the concentrations of metals in sediment samples already mentioned, all other samples reported concentrations of metals below the respective NAGD Screening Levels (where Screening Levels exist).

8.2.2 Tributyltin (TBT) and Total Organic Carbon (TOC)

Table B (attached) presents the laboratory analytical results for TBT (normalised to 1% TOC) and TOC for all sites sampled. TBT was not detected (at an LOR of 0.5 µgSn/kg) in any of the samples from within the dredging footprint; therefore, the 95% UCL concentration was well below the Screening Level of 9 µgSn/kg.

TOC ranged from 0.05% at SL21 to 0.56% at SL28, within samples from the 0.5-0.8 m and 0-0.5 m bgl depth intervals, respectively.

8.2.3 Nutrients

Table B (attached) presents the laboratory analytical results for nutrients. Note that there are no NAGD Screening or High Levels for nutrients.

Nitrite + nitrate (as N) concentrations ranged from below the LOR of 0.1 mg/kg to 0.4 mg/kg, with the 95% UCL concentration reported as 0.15 mg/kg.

Total Kjeldahl Nitrogen (TKN) and total nitrogen (as N) concentrations ranged from 90 mg/kg at SL 21 (0.5-0.8 m bgl) to 560 mg/kg at SL13 (0.5-1 m bgl) with a 95% UCL of 311 mg/kg. The results indicate that nitrogen is present predominantly as organic nitrogen (TKN) with a minor inorganic component (nitrate + nitrite).

Total phosphorus concentrations ranged from 134 mg/kg at SL21 (0.5-0.8 m bgl) to 1290 mg/kg at SL05 (0-0.5 m bgl) with a 95% UCL concentration of 753 mg/kg.

8.2.4 Total Petroleum Hydrocarbons (TPH) and Total Recoverable Hydrocarbons (TRH)

Table C (attached) presents the laboratory analytical results for TPH (C₆-C₉//C₁₀-C₁₄/C₁₅-C₂₈/C₂₉-C₃₆) and TRH (C₆-C₁₀/ $>$ C₁₀-C₁₆/ $>$ C₁₆-C₃₄/ $>$ C₃₄-C₄₀). Where required, TPH and TRH results were normalised to 1% TOC as per Table 2 of NAGD.

TPH (C₁₅-C₂₈/C₂₉-C₃₆) and TRH ($>$ C₁₆-C₃₄/ $>$ C₃₄-C₄₀) were detected at low levels in all samples analysed. TPH and TRH concentrations for all other carbon fractions were below the respective LORs in all samples.

All concentrations of TPH were below the NAGD Screening Level of 550 mg/kg and the Screening Level of 280 mg/kg for TPH in sediments as listed in ANZG (2018). The highest concentration of TPH (52 mg/kg, C₁₅-C₂₈) was detected in the 0-0.5 bgl interval sample at location SL31. The highest TPH concentration for all TPH fractions combined was 80 mg/kg reported at location SL15 in the 0-0.5 m bgl interval sample.

The 95% UCL for TPH fraction C₁₅-C₂₈ (27.5 mg/kg) and all TPH fractions combined (45.8 mg/kg) was also below the NAGD and ANZG (2018) Screening Levels.

The highest concentration of TRH (69.6 mg/kg, $>$ C₁₆-C₃₄) was, as with TPH, also detected at location SL31 and also in the 0-0.5 m bgl interval sample. The highest TRH concentration for all TRH fractions was 87 mg/kg at location SL13 in the 0.5-1 m bgl interval sample. The 95% UCL for all TRH fractions combined was 47.1 mg/kg. A Screening Level does not exist for TRH in the NAGD or the ANZG (2018) guidelines.

A reanalysis of all samples for TPH and TRH following silica gel clean up reported concentrations below the LOR for all samples.

8.2.5 Polycyclic Aromatic Hydrocarbons (PAH)

Table D (attached) presents the laboratory analytical results for PAHs. No PAHs were detected in any of the samples from within the dredging footprint. Hence, the 95% UCL concentrations for all species of PAHs, and for total PAHs, were well below their respective Screening Levels.

8.2.6 Benzene, toluene, ethylbenzene, xylene, naphthalene

Table E (attached) presents the analytical results for BTEXN which were below the LORs in all samples from within the dredging footprint.

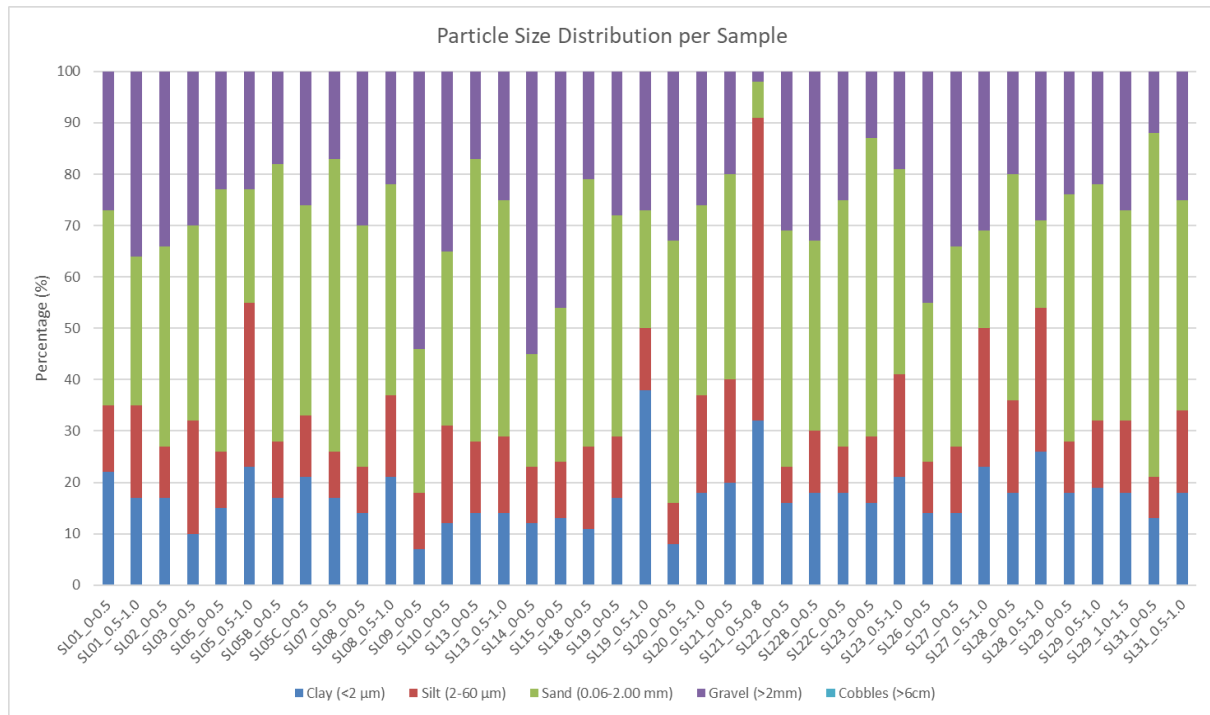
8.2.7 Radionuclides

Table F(attached) presents the results for the radionuclide analysis. Total gross alpha and beta levels in all samples, and the 95% UCL (1314 Bq/kg dry weight) were well below the Screening Level of 35,000 Bq/kg dry weight.

8.2.8 Particle Size Distribution (PSD)

The PSD of the sediment samples are presented in Figure 6 and in further detail in Table G (attached). Sand and gravel were reported as the primary components of all surface samples (0-0.5 m bgl) with silt and clay content generally increasing with depth. It should be noted that gravel may be misrepresented through the presence of shell or coral fragments being reported as gravel.

Figure 6 PSD depiction per sample



8.2.9 Acid Sulfate Soils

Table H (attached) presents the results of pHf and pHfox tests and analytical results for ASS analysis.

The field observations (Section 8.1, Appendix D) include presence of abundant shell and/or coral in the surface sample (surface to 0.5m bgl) at all the sampling locations except for SL10 and SL18.

8.2.9.1 Indicative pH Screening results

The results of the indicative screening testing (pH_f and pH_{fox}) are presented in Table H (attached).

- The pH_f values ranged between 8.3 pH units and 9.2 pH units indicating absence of existing acidity.
- The pH_{fox} ranged between 6.2 and 8.2 pH units indicating absence of potential PASS at these locations and depths.
- The delta pH (difference between pH_f and pH_{fox}) ranged between 0.3 pH units and 2.7 pH units indicating weak to strong oxidation potential for these samples.
- All the samples exhibited a moderate reaction to peroxide.

As such, all samples were classified as soils with a limited net acidifying ability.

8.2.9.2 Chromium Reducible Sulfur (CRS) results

The indicative screening pH tests do not provide a quantitative measure of the amount of acid that has been or could be produced through oxidation. As such, CRS testing was conducted on 11 selected samples from within the dredging footprint to verify the existence and nature of acid sulfate soils.

The process for selecting the samples for CRS testing followed the guidance within the National ASS guidance (Sullivan et al, 2018). The samples were selected based on the individual pH_f , pH_{fox} , delta pH and observed lithologies in the field.

Table H presents the analytical results for the CRS testing. The data analysis is summarised below:

- No existing acidity (indicated by titratable actual acidity) was reported in any of the samples.
- However, all samples reported potential acidity (Chromium reducible sulfur %) ranging between 0.04%S and 0.23%S, indicating presence of PASS (i.e. un-oxidised sulfides) which could generate acidity upon oxidation.
- Hence, the sum of existing and potential acidity in all samples exceeded the action criterion of 0.03%S.
- All samples reported some acid neutralising capacity (ANC) ranging between 1.57 %S and 18.5%S. ANC is noted potentially due to the abundance of naturally occurring calcium carbonate such as crushed shells and coral skeletons as observed in the field. The ANC ranged between 19 and 231 times greater than the sum of existing and potential acidity concentrations; well within the adopted criterion of ANC being greater than 15 times the total acidity of samples.

Approximately 36% of the samples analysed during this investigation are classified as having low ANC buffer capacity (<10%S) with the remainder of the samples classified as having medium capacity (10-30%S). All samples reported concentrations of %S in the 'Very High' or 'Extra High' categories. All samples analysed during this investigation are therefore classified as a potential acidity risk as detailed in Table 16.

Table 16 Darwin EAW site specific acid sulfate soils risk matrix adopted from Ahern et al (1998)

		Potential Acidity Risk (based on oxidisable sulfur content %S risk levels and treatment categories for less than 10,000 tonne of sediment [Ahern et al 1998])	
		Very High (≥ 0.03 and $< 0.06\%S$)	Extra High ($> 0.06\%S$)
ANC Buffer Capacity (based on a %S equivalent)	Low (0 – 10 %S)	Potential risk	Potential risk
	Medium (10 – 30 %S)	Potential risk	Potential risk
	High ($> 30\%S$)	Low risk	Low risk

9.0 Discussion of Results

9.1 Key findings

A summary of the key findings of the investigation is provided in Table 17.

Table 17 Summary of key findings

Factor	Summary of results
Arsenic	Arsenic concentrations were reported above the NAGD Screening Level of 20 mg/kg in all except two samples. Concentrations in four shallow sediment samples, and a further two deeper sediment samples from another core, were reported above the High Value (70 mg/kg). The 95% UCL concentration (55.2 mg/kg) exceeds the Screening Level but is below the High Level.
Other metals	The 95% UCL concentrations of all other metals were below their respective Screening Levels, where available. Chromium was reported above its Screening Level in one sample. Nickel was reported above its SQQ High Level in one sample only, with no other samples reporting concentrations above the Screening Level.
TRH and TPH	The 95% UCL concentrations of all hydrocarbons were below the Screening Level. TPH and TRH were reported at low concentrations in the majority of samples.
Nutrients in sediments	Concentrations of nitrogen and phosphorous are considered sufficiently low to not pose a risk of eutrophication to harbour waters through their release, either at the dredge cutter head or in the reclamation area tailwater.
TBT	TBT was not detected in any of the samples from within the dredging footprint.
BTEXN	BTEXN concentrations were reported below the LOR across all samples.
PAH	PAHs were not detected in any of the samples from within the dredging footprint.
PSD	PSD analysis indicated sand and gravel as primary components in surface sediment samples (0-0.5 m bgl). The percentage of silt and clay increased with depth (>0.5 m bgl).
Acid Sulfate Soils	All sediments sampled were identified as having the potential to be acid generating (to varying degrees) if left in an oxygenated environment post-dredging. However, the samples exhibited sufficient neutralising capacity to potentially self-neutralise the dredged material within the dredge spoil ponds.
Radionuclides	The 95% UCL for total gross alpha and beta was well below the Screening level. Individual sample concentrations were also well below the Screening Level.

9.2 Potential issues

9.2.1 Arsenic

Elevated concentrations of arsenic in Darwin Harbour sediments have previously been attributed to local geological influence (e.g. natural weathering of bedrock in the catchment) and are not thought to be attributable to anthropogenic sources (Padovan 2003, Fortune 2006). Bioavailability testing using 1M HCl digest on eight samples of Darwin Harbour sediments collected by URS (2009) found that only a very small proportion was bioavailable; it was concluded that there would be a low risk of toxic effects from arsenic on the marine environment when the sediments were dredged.

Surveys conducted by URS at East Arm Wharf in 2012 and in 2014 at the MUBRF location directly adjacent to the Project site reported exceedances of the 95% UCL for arsenic during both surveys, while distribution of elevated arsenic concentrations above Screening Levels also included deeper horizons (>0.5 m bgl) during both surveys. Radke et al (2020) recently reported during the sediment quality assessment of East Arm, two samples with arsenic concentrations exceeding the SQG High Level of 70 mg/kg.

Given the findings from previous studies within the vicinity of the Project site, the distribution of arsenic during the current study within the sediment profile, especially elevated arsenic concentrations in deeper (>0.5 m) horizons exceeding SQG High level, supports the notion that the elevated levels are attributable to the local geology.

9.2.2 Potential Acid Sulfate Soils

The potential for sediments to generate acid were assessed against the Sullivan et al (2018), and Simpson et al (2018) guidelines. These guidelines supplement the existing local and regional guidance including Ahern et al (1998) and DER (2015).

All samples analysed during this investigation were identified as containing oxidisable sulfur. Due to high ANC values, the net acidity values were reported to be below the guideline criteria of 0.03%S. However, considering the potential that the sediment may be drained of seawater following disposal, there remains a potential risk of PASS oxidation and subsequent generation of acidity if dredged sediments are exposed to oxygen. In accordance with the guidelines, it is recommended that the Dredging and Dredge Spoil Placement Management Plan incorporates requirements for monitoring for evidence of acid generation within the dredged sediments.

The distribution of potentially acid producing sediments within the material to be dredged is not uniform across the site; however, these sediments reported sufficient neutralising capacity due to the presence of natural carbonates (e.g. calcareous sand, fine shell particles) and as such may not need further neutralisation. Additionally, during dredging and disposal on land, only the surface layer of the deposited sediments will be exposed to air and hence be potentially acid producing. As sediments are progressively buried as the dredging campaign progresses, they will again become anoxic and their potential to generate acid will decrease accordingly.

Oxidation of PASS can generate acid which can increase the solubility of heavy metals. Based on the analytical data, only arsenic has been reported higher than the adopted Screening Levels. These elevated arsenic levels may not be of high concern provided the PASS is not being exposed to oxidation by disposal of the dredged sediments in a non-acidic environment. However, there is the potential for acid to be generated if the dredged sediments are exposed to air once the tailwater has drained from the reclamation ponds. This acid could then mobilise the arsenic present in the sediments, leading to elevated arsenic concentrations in stormwater, if this subsequently accumulates within the ponds.

10.0 References

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Tables

Table A
Analytical results for metals in sediments
Marine Sediment Geochemical Assessment



Sample ID	Sample Date:	Aluminium	Iron	Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Silver	Zinc	Mercury
Unit		mg/kg												
Practical Quantitation Limit		50	50	0.5	1	0.1	1	1	1	10	1	0.1	1	0.01
Screening Level (NAGD 2009)		NG	NG	2	20	1.5	80	65	50	NG	21	1	200	0.15
SQG High (NAGD 2009)		NG	NG	25	70	10	370	270	220	NG	52	4	410	1
SL01_0-0.5	27/07/2020	7720	35600	<0.50	36.5	<0.1	26.6	4.4	9.6	137	5.5	<0.1	13.3	<0.01
SL01_0.5-1.0	27/07/2020	8140	43500	<0.50	25.2	<0.1	36.3	7.9	7.9	173	8	<0.1	12.4	0.01
SL02_0-0.5	29/07/2020	6580	39300	<0.50	49.6	<0.1	24.4	2.9	7.1	207	5.2	<0.1	9.4	<0.01
SL03_0-0.5	27/07/2020	5350	32400	<0.50	41.1	<0.1	29.9	3.1	6.7	253	4.6	<0.1	12.3	<0.01
SL05_0-0.5	29/07/2020	7010	51400	<0.50	64.8	<0.1	29.9	3.5	9.6	224	4.8	<0.1	9.6	<0.01
SL05_0.5-1.0	29/07/2020	9020	55900	<0.50	62.4	<0.1	34.5	5.3	8.5	254	6	<0.1	10.4	<0.01
SL05B_0-0.5	29/07/2020	7800	70100	0.52	75.8	<0.1	58.3	5.6	16.2	232	5.9	<0.1	12.6	<0.01
SL05C_0-0.5	29/07/2020	8430	56400	<0.50	79.1	<0.1	36.1	3.6	9.6	292	6.4	<0.1	12.7	<0.01
SL06_0-0.5	28/07/2020	3300	24400	<0.50	31.1	<0.1	15.4	5.1	8.6	127	4.8	<0.1	9.5	<0.01
SL07_0-0.5	29/07/2020	7220	44200	<0.50	63.7	<0.1	22.3	3.8	8.8	486	6.8	<0.1	14	<0.01
SL08_0-0.5	28/07/2020	7400	48000	<0.50	60.5	<0.1	26.5	3.8	9.9	218	5.6	0.1	11.2	<0.01
SL08_0.5-1.0	28/07/2020	8480	49400	<0.50	68.9	<0.1	26.1	3.8	9.5	317	5.8	<0.1	9.7	<0.01
SL09_0-0.5	28/07/2020	5160	40100	<0.50	22.8	0.2	26.5	21.6	5.7	189	10.2	0.6	16.9	0.05
SL10_0-0.5	27/07/2020	8140	42400	<0.50	49.4	<0.1	35.7	3.8	9.3	243	6.2	<0.1	15.6	<0.01
SL13_0-0.5	28/07/2020	7480	36800	<0.50	47.6	<0.1	24.2	3.1	9	237	5.4	<0.1	12.1	<0.01
SL13_0.5-1.0	28/07/2020	8930	63100	<0.50	57.4	<0.1	73.3	4.5	19.8	272	8	<0.1	16.6	<0.01
SL14_0-0.5	28/07/2020	7230	38600	<0.50	25.2	<0.1	39.7	8.3	8.8	91	5.4	<0.1	14.9	<0.01
SL15_0-0.5	28/07/2020	6900	42800	<0.50	38.5	<0.1	35.6	4.6	16.7	175	4.7	<0.1	11.7	<0.01
SL16_0-0.5	28/07/2020	7540	36200	<0.50	30.5	<0.1	28.9	7.3	9	124	5.7	<0.1	16.5	<0.01
SL16_0.5-1.0	28/07/2020	9180	68400	<0.50	35.2	<0.1	45.5	8.1	50.8	211	8.6	<0.1	13.6	<0.01
SL16_1.0-1.5	28/07/2020	7470	27700	<0.50	26.8	<0.1	23.8	24.9	8.3	149	15.3	<0.1	28.8	0.02
SL17_0-0.5	28/07/2020	6340	34200	<0.50	43.6	<0.1	20.3	3.6	13.1	181	5.3	<0.1	15.4	<0.01
SL18_0-0.5	28/07/2020	6390	28000	<0.50	33.4	<0.1	17.6	3.1	6.2	156	4.7	<0.1	13.4	<0.01
SL19_0-0.5	28/07/2020	8110	55100	<0.50	63.1	<0.1	59.3	4.4	12.1	221	5.8	<0.1	10.7	<0.01
SL19_0.5-1.0	29/07/2020	9060	50000	<0.50	49.2	<0.1	28.2	1.8	8.6	216	3.7	<0.1	8.1	<0.01
SL20_0-0.5	28/07/2020	4090	41600	<0.50	26	<0.1	59.6	13.1	14.2	72	4.8	<0.1	5.6	<0.01
SL20_0.5-1.0	29/07/2020	7640	47700	<0.50	55.8	<0.1	45.8	3.6	10.8	340	7	<0.1	15.6	<0.01
SL21_0-0.5	28/07/2020	7690	48400	<0.50	48	<0.1	33	22.3	27.2	186	18.3	<0.1	62	<0.01
SL21_0.5-0.8	28/07/2020	7020	26700	<0.50	11.5	<0.1	20.8	54.5	37	51	58.4	<0.1	193	<0.01
SL22_0-0.5	29/07/2020	8640	44500	<0.50	57.7	<0.1	30.7	3.5	7	229	6.9	<0.1	11.6	<0.01
SL22B_0-0.5	29/07/2020	1850	2950	<0.50	3.1	<0.1	3.6	1.2	<1.0	16	1.3	<0.1	3.3	<0.01
SL22C_0-0.5	29/07/2020	5450	37200	<0.50	42.4	<0.1	23	3.6	7.4	148	4	<0.1	8.5	<0.01
SL23_0-0.5	29/07/2020	7370	49600	<0.50	61	<0.1	43.5	3.4	9.3	244	5.2	<0.1	9.7	<0.01
SL23_0.5-1.0	29/07/2020	11500	49700	<0.50	40.7	<0.1	46.5	11.4	10.1	165	6	<0.1	11.9	<0.01
SL24_0-0.5	28/07/2020	3640	38700	<0.50	75.9	<0.1	20.8	2.4	12.7	371	5.8	<0.1	11.7	<0.01
SL26_0-0.5	28/07/2020	8370	62200	<0.50	55	<0.1	45.8	5.1	21.9	140	5	<0.1	8.3	<0.01
SL27_0-0.5	28/07/2020	7220	66000	<0.50	77.1	<0.1	47.5	6.5	15.8	226	5.6	<0.1	12.4	<0.01
SL27_0.5-1.0	28/07/2020	7750	51600	<0.50	44.8	<0.1	31.3	9.4	13.1	156	5.1	<0.1	6.8	<0.01
SL28_0-0.5	28/07/2020	8070	36400	<0.50	48.6	<0.1	31.7	4.2	7.2	189	5.8	0.1	12.1	<0.01
SL28_0.5-1.0	28/07/2020	10100	56000	<0.50	42.5	<0.1	89.2	10.3	14.5	136	5.6	0.1	10.1	<0.01
SL29_0-0.5	29/07/2020	7960	53200	<0.50	63.7	<0.1	41.4	5.9	8.2	239	5.7	<0.1	12.6	<0.01
SL29_0.5-1.0	29/07/2020	9660	75100	<0.50	83.5	<0.1	41.6	4.7	11.2	338	7.3	<0.1	10.1	<0.01
SL29_1.0-1.5	29/07/2020	8670	60500	<0.50	71.7	<0.1	41.6	4.6	10.1	222	6.2	<0.1	10.3	<0.01
SL31_0-0.5	29/07/2020	6020	54800	<0.50	75.2	<0.1	22.1	3	8.1	430	5.8	<0.1	13.3	<0.01
SL31_0.5-1.0	29/07/2020	7850	33500	<0.50	33	0.3	22.5	4.4	12.1	700	20	<0.1	70.8	0.01
Minimum	-	1850	2950	0.52	3.1	0.2	3.6	1.2	5.7	16	1.3	0.1	3.3	0.01
Maximum	-	11500	75100	0.52	83.5	0.3	89.2	54.5	50.8	700	58.4	0.6	193	0.05
Mean	-	7354	45563	1	49	0	35	7	12	222	8	0	18	0
SD	-	1767	13551	0	19	0	15	9	8	115	8	0	29	0
95%UCL ^a	-	7802	48996	0.267	53.59	0.0705	38.74	13.06	17.63	259.2	13.22	0.088	37.43	0.00847
<i>Dredge footprint only results (excl Reclamation area)</i>														
Minimum	-	1850	2950	0.52	3.1	0.2	3.6	1.2	5.7	16	1.3	0.1	3.3	0.01
Maximum	-	11500	75100	0.52	83.5	0.3	89.2	54.5	37	700	58.4	0.6	193	0.05
Mean	-	7525	46686	1	50	0.3	36	7	12	226	8	0.2	19	0.0
SD	-	1639	13070	0	19	0	16	9	6	118	9	0	31	0
95%UCL ^a	-	7973	50261	0.269	55.24	0.07	40.51	13.41	15.87	265	14.01	0.094	40.7	0.00855

Key
a 95% UCL calculated using ProUCL. Data outputs are provided in Appendix E.
NG No guideline
exceeds the NAGD (2009) Screening Level
exceeds the NAGD (2009) Screening Level

Table B
Analytical results for TOC, TBT and nutrients
Marine Sediment Geochemical Assessment



Site ID	Sample Date:	Total Organic Carbon %	Total Carbon	Total Inorganic Carbon	Tributyltin (TBT)	Nitrate, Nitrite, Nitrogen and Phosphorus			
						Nitrite + Nitrate as N (Sol.)	Total Kjeldahl Nitrogen as N	Total Nitrogen as N	Total Phosphorus as P
Unit		%	%	%	µgSn/kg	mg/kg	mg/kg	mg/kg	mg/kg
Limit of Reporting		0.2	0.2	0.2	0.5	0.1	20	20	2
Screening Level (NAGD 2009)		NG	NG	NG	9	NG	NG	NG	NG
SQG High (NAGD 2009)		NG	NG	NG	70	NG	NG	NG	NG
SL01_0-0.5	27/07/2020	0.4	6.15	5.75	<0.5	<0.1	420	420	583
SL01_0.5-1.0	27/07/2020	0.27	4.76	4.49	<0.5	<0.1	230	230	594
SL02_0-0.5	29/07/2020	0.36	6.36	6	<0.5	0.2	240	240	591
SL03_0-0.5	27/07/2020	0.13	1.74	1.61	<0.5	0.1	240	240	534
SL05_0-0.5	29/07/2020	0.35	5	4.65	<0.5	0.1	360	360	1290
SL05_0.5-1.0	29/07/2020	0.27	1.83	1.56	<0.5	0.2	280	280	539
SL05B_0-0.5	29/07/2020	0.34	4.68	4.34	<0.5	<0.1	310	310	860
SL05C_0-0.5	29/07/2020	0.51	4.65	4.14	<0.5	<0.1	350	350	1030
SL06_0-0.5	28/07/2020	0.14	2.04	1.9	174.5	<0.1	220	220	293
SL07_0-0.5	29/07/2020	0.29	7.13	6.84	<0.5	0.1	240	240	460
SL08_0-0.5	28/07/2020	0.28	6.41	6.13	<0.5	<0.1	370	370	978
SL08_0.5-1.0	28/07/2020	0.26	5.58	5.32	<0.5	0.1	270	270	1100
SL09_0-0.5	28/07/2020	0.11	1.67	1.56	<0.5	0.3	250	250	194
SL10_0-0.5	27/07/2020	0.19	3.72	3.53	<0.5	<0.1	300	300	591
SL13_0-0.5	28/07/2020	0.32	6.96	6.64	<0.5	0.1	320	320	703
SL13_0.5-1.0	28/07/2020	0.23	3.67	3.44	<0.5	<0.1	170	170	668
SL14_0-0.5	28/07/2020	0.26	2.62	2.36	<0.5	0.1	560	560	548
SL15_0-0.5	28/07/2020	0.2	2.29	2.09	<0.5	<0.1	420	420	668
SL16_0-0.5	28/07/2020	0.36	3.7	3.34	<0.5	0.4	330	330	490
SL16_0.5-1.0	28/07/2020	0.42	3.89	3.47	<0.5	0.1	500	500	524
SL16_1.0-1.5	28/07/2020	0.36	2.84	2.48	<0.5	<0.1	430	430	399
SL17_0-0.5	28/07/2020	0.21	4.7	4.49	<0.5	<0.1	310	310	493
SL18_0-0.5	28/07/2020	0.46	4.56	4.1	<0.5	<0.1	330	330	559
SL19_0-0.5	28/07/2020	0.36	4.67	4.31	<0.5	<0.1	340	340	994
SL20_0-0.5	28/07/2020	0.12	1.46	1.34	<0.5	<0.1	160	160	436
SL19_0.5-1.0	29/07/2020	0.26	5.38	5.12	<0.5	<0.1	250	250	760
SL20_0.5-1.0	29/07/2020	0.35	4.48	4.13	<0.5	<0.1	350	350	686
SL21_0-0.5	28/07/2020	0.22	2.69	2.47	<0.5	0.1	260	260	799
SL21_0.5-0.8	28/07/2020	0.05	0.21	0.16	<0.5	0.2	90	90	134
SL22_0-0.5	29/07/2020	0.3	7.16	6.86	<0.5	0.1	330	330	724
SL22B_0-0.5	29/07/2020	0.29	6.49	6.2	<0.5	0.2	300	300	555
SL22C_0-0.5	29/07/2020	0.26	6.32	6.06	<0.5	0.2	270	270	815
SL23_0-0.5	29/07/2020	0.34	2.85	2.51	<0.5	0.1	260	260	582
SL23_0.5-1.0	29/07/2020	0.41	6.08	5.67	<0.5	0.2	290	290	716
SL24_0-0.5	28/07/2020	0.15	6.54	6.39	<0.5	0.1	160	160	440
SL26_0-0.5	28/07/2020	0.22	4.57	4.35	<0.5	0.1	300	300	757
SL27_0-0.5	28/07/2020	0.36	3.75	3.39	<0.5	<0.1	440	440	1010
SL27_0.5-1.0	28/07/2020	0.18	0.98	0.8	<0.5	0.1	170	170	437
SL28_0-0.5	28/07/2020	0.56	5.14	4.58	<0.5	0.1	300	300	866
SL28_0.5-1.0	28/07/2020	0.18	0.78	0.6	<0.5	<0.1	270	270	556
SL29_0-0.5	29/07/2020	0.38	6.53	6.15	<0.5	<0.1	270	270	786
SL29_0.5-1.0	29/07/2020	0.32	4.31	3.99	<0.5	<0.1	250	250	970
SL29_1.0-1.5	29/07/2020	0.46	4.3	3.84	<0.5	<0.1	220	220	757
SL31_0-0.5	29/07/2020	0.23	6.8	6.57	<0.5	<0.1	270	270	649
SL31_0.5-1.0	29/07/2020	0.32	5.24	4.92	<0.5	<0.1	190	190	400
Minimum	-	0.05	0.21	0.16	<0.5	0.1	90	90	134
Maximum	-	0.56	7.16	6.86	174.5	0.4	560	560	1290
Mean	-	0	4	4	175	0	293	293	656
SD	-	0	2	2	0	0	90	90	234
95%UCL ^a	-	0.32	4.78	4.48	21	0.15	316	316	715
Dredge footprint only results (excl Reclamation area)									
Minimum	-	0.05	0.21	0.16	<0.5	0.1	90	90	134
Maximum	-	0.56	7.16	6.86	<0.5	0.3	560	560	1290
Mean	-	0.3	4	4	<0.5	0.1	288	288	689
SD	-	0	2	2	-	0	84	84	233
95%UCL ^a	-	0.322	4.885	4.577	<0.5	0.139	311.2	311.2	752.8

Key

a 95% UCL calculated using ProUCL. Data outputs are provided in Appendix E.

NG No guideline

exceeds the NAGD (2009) Screening Level

exceeds the NAGD (2009) Screening Level

Table C
Analytical results for TPH and TRH
Marine Sediment Geochemical AssessmentH



Site ID	Sample Date:	Total Petroleum Hydrocarbons (TPH)					Total Recoverable Hydrocarbons (TRH)						
		C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction	C10 - C36 Fraction (sum)	C6 - C10 Fraction	C6 - C10 Fraction minus BTEX (F1)	>C10 - C16 Fraction	>C16 - C34 Fraction	>C34 - C40 Fraction	>C10 - C40 Fraction (sum)	>C10 - C16 Fraction minus Naphthalene (F2)
Unit		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Limit of Reporting		3	3	3	5	3	3	3	3	3	5	3	3
Screening Level (ANZG 2018)		NG	NG	NG	NG	280	NG	NG	NG	NG	NG	NG	NG
SQG High (NAGD 2009)		NG	NG	NG	NG	550	NG	NG	NG	NG	NG	NG	NG
SL01_0-0.5	27/07/2020	<3	<3	30.0	20.0	50.0	<3	<3.0	<3	40.0	15.0	55.0	<3
SL01_0.5-1.0	27/07/2020	<3	<3	33.3	22.2	55.6	<3	<3.0	<3	48.1	9.3	48.1	<3
SL02_0-0.5	29/07/2020	<3	<3	16.7	16.7	33.3	<3	<3.0	<3	27.8	6.9	27.8	<3
SL03_0-0.5	27/07/2020	<3	<3	25.0	12.5	25.0	<3	<3.0	<3	35.0	19.2	35.0	<3
SL05_0-0.5	29/07/2020	<3	<3	17.1	17.1	34.3	<3	<3.0	<3	28.6	7.1	28.6	<3
SL05_0.5-1.0	29/07/2020	<3	<3	22.2	25.9	48.1	<3	<3.0	<3	37.0	18.5	55.6	<3
SL05B_0-0.5	29/07/2020	<3	<3	14.7	7.4	14.7	<3	<3.0	<3	26.5	7.4	26.5	<3
SL05C_0-0.5	29/07/2020	<3	<3	11.8	11.8	23.5	<3	<3.0	<3	19.6	4.9	19.6	<3
SL06_0-0.5	28/07/2020	<3	<3	25.0	12.5	25.0	<3	<3.0	<3	35.0	17.9	35.0	<3
SL07_0-0.5	29/07/2020	<3	<3	44.8	31.0	75.9	<3	<3.0	<3	65.5	17.2	82.8	<3
SL08_0-0.5	28/07/2020	<3	<3	35.7	21.4	57.1	<3	<3.0	<3	50.0	8.9	50.0	<3
SL08_0.5-1.0	28/07/2020	<3	<3	23.1	19.2	42.3	<3	<3.0	<3	38.5	9.6	38.5	<3
SL09_0-0.5	28/07/2020	<3	<3	40.0	25.0	65.0	<3	<3.0	<3	55.0	22.7	55.0	<3
SL10_0-0.5	27/07/2020	<3	<3	45.0	25.0	70.0	<3	<3.0	<3	60.0	13.2	60.0	<3
SL13_0-0.5	28/07/2020	<3	<3	4.7	4.7	4.7	<3	<3.0	<3	4.7	7.8	4.7	<3
SL13_0.5-1.0	28/07/2020	<3	<3	39.1	34.8	73.9	<3	<3.0	<3	60.9	26.1	87.0	<3
SL14_0-0.5	28/07/2020	<3	<3	34.6	30.8	65.4	<3	<3.0	<3	53.8	19.2	73.1	<3
SL15_0-0.5	28/07/2020	<3	<3	40.0	40.0	80.0	<3	<3.0	<3	65.0	12.5	65.0	<3
SL16_0-0.5	28/07/2020	<3	<3	36.1	36.1	72.2	<3	<3.0	<3	58.3	27.8	86.1	<3
SL16_0.5-1.0	28/07/2020	<3	<3	28.6	26.2	54.8	<3	<3.0	<3	45.2	23.8	69.0	<3
SL16_1.0-1.5	28/07/2020	<3	<3	33.3	22.2	55.6	<3	<3.0	<3	50.0	6.9	50.0	<3
SL17_0-0.5	28/07/2020	<3	<3	38.1	23.8	61.9	<3	<3.0	<3	57.1	11.9	57.1	<3
SL18_0-0.5	28/07/2020	<3	<3	21.7	19.6	41.3	<3	<3.0	<3	37.0	13.0	50.0	<3
SL19_0-0.5	28/07/2020	<3	<3	22.2	22.2	44.4	<3	<3.0	<3	36.1	16.7	52.8	<3
SL20_0-0.5	28/07/2020	<3	<3	20.0	12.5	20.0	<3	<3.0	<3	35.0	20.8	35.0	<3
SL19_0.5-1.0	29/07/2020	<3	<3	19.2	23.1	42.3	<3	<3.0	<3	38.5	9.6	38.5	<3
SL20_0.5-1.0	29/07/2020	<3	<3	22.9	25.7	48.6	<3	<3.0	<3	40.0	17.1	57.1	<3
SL21_0-0.5	28/07/2020	<3	<3	27.3	27.3	54.5	<3	<3.0	<3	45.5	11.4	45.5	<3
SL21_0.5-0.8	28/07/2020	<3	<3	20.0	12.5	20.0	<3	<3.0	<3	30.0	50.0	30.0	<3
SL22_0-0.5	29/07/2020	<3	<3	33.3	23.3	56.7	<3	<3.0	<3	50.0	8.3	50.0	<3
SL22B_0-0.5	29/07/2020	<3	<3	17.2	8.6	17.2	<3	<3.0	<3	31.0	8.6	31.0	<3
SL22C_0-0.5	29/07/2020	<3	<3	15.4	9.6	15.4	<3	<3.0	<3	26.9	9.6	26.9	<3
SL23_0-0.5	29/07/2020	<3	<3	23.5	20.6	44.1	<3	<3.0	<3	35.3	7.4	35.3	<3
SL23_0.5-1.0	29/07/2020	<3	<3	9.8	6.1	9.8	<3	<3.0	<3	17.1	6.1	17.1	<3
SL24_0-0.5	28/07/2020	<3	<3	35.0	12.5	35.0	<3	<3.0	<3	50.0	16.7	50.0	<3
SL26_0-0.5	28/07/2020	<3	<3	22.7	11.4	22.7	<3	<3.0	<3	36.4	11.4	36.4	<3
SL27_0-0.5	28/07/2020	<3	<3	30.6	19.4	50.0	<3	<3.0	<3	41.7	16.7	58.3	<3
SL27_0.5-1.0	28/07/2020	<3	<3	25.0	12.5	25.0	<3	<3.0	<3	35.0	13.9	35.0	<3
SL28_0-0.5	28/07/2020	<3	<3	7.1	8.9	16.1	<3	<3.0	<3	14.3	4.5	14.3	<3
SL28_0.5-1.0	28/07/2020	<3	<3	8.3	13.9	8.3	<3	<3.0	<3	25.0	13.9	25.0	<3
SL29_0-0.5	29/07/2020	<3	<3	21.1	15.8	36.8	<3	<3.0	<3	31.6	6.6	31.6	<3
SL29_0.5-1.0	29/07/2020	<3	<3	28.1	18.8	46.9	<3	<3.0	<3	40.6	7.8	40.6	<3
SL29_1.0-1.5	29/07/2020	<3	<3	8.7	15.2	23.9	<3	<3.0	<3	19.6	5.4	19.6	<3
SL31_0-0.5	29/07/2020	<3	<3	52.2	26.1	78.3	<3	<3.0	<3	69.6	10.9	69.6	<3
SL31_0.5-1.0	29/07/2020	<3	<3	18.8	7.8	18.8	<3	<3.0	<3	28.1	7.8	28.1	<3
Minimum	-	<3	<3	4.7	4.7	4.7	<3	<3	<3	4.7	4.5	4.7	<3
Maximum	-	<3	<3	52.2	40.0	80.0	<3	<3	<3	69.6	50.0	87.0	<3
Mean	-	<3	<3	26	19	41	<3	<3	<3	39	14	44	<3
SD	-	-	-	11	8	21	-	-	-	14	8	19	-
95%UCL ^a	-	<3	<3	28.3	21.2	46.7	<3	<3	<3	43.1	16	49	-
<i>Dredge footprint only results (excl Reclamation area)</i>													
Minimum	-	<3	<3	4.7	4.7	4.7	<3	<3	<3	4.7	4.5	4.7	<3
Maximum	-	<3	<3	52.2	40	80	<3	<3	<3	69.6	50	87.0	<3
Mean	-	<3	<3	24	19	40	<3	<3	<3	38	13	42	<3
SD	-	-	-	11	8	21	-	-	-	15	8	19	-
95%UCL ^a	-	<3	<3	27.48	20.85	45.75	<3	<3	<3	41.92	15.02	47.11	<3

Key
a 95% UCL calculated using ProUCL. Data outputs are provided in Appendix E.
NG No guideline
exceeds the NAGD (2009) Screening Level
exceeds the NAGD (2009) Screening Level

Table D
Analytical results for PAHs
Marine Sediment Geochemical Assessment

Site ID	Sample Date:	Polycyclic Aromatic Hydrocarbons																				
		Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(e)pyrene	Benzo(a)pyrene	Perylene	Benzo(g,h,i)perylene	Dibenz(a,h)anthracene	Indeno(1,2,3-cd)pyrene	Coronene	Sum of PAHs
Unit		µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Limit of Reporting		5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4
Screening Level (ANZG 2018)		NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	10000
SOG High (NAGD 2009)		NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	50000
SL01 0-0.5	27/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
SL01 0.5-1.0	27/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL02 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL03 0-0.5	27/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL05 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL05 0.5-1.0	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL05B 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL05C 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL06 0-0.5	28/07/2020	<5	60	<4	<4	<4	75	<4	90	75	30	35	35	<4	<4	30	<4	20	<4	<4	<5	450
SL07 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL08 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL08 0.5-1.0	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL09 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL10 0-0.5	27/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL13 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL13 0.5-1.0	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL14 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL15 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL16 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL16 0.5-1.0	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL16 1.0-1.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL17 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL18 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL19 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL20 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL19 0.5-1.0	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL20 0.5-1.0	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL21 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL21 0.5-0.8	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL22 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL22B 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL22C 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL23 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL23 0.5-1.0	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL24 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL26 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL27 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL27 0.5-1.0	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL28 0-0.5	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL28 0.5-1.0	28/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL29 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL29 0.5-1.0	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL29 1.0-1.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL31 0-0.5	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
SL31 0.5-1.0	29/07/2020	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
Minimum		0	60	0	0	0	75	0	90	75	30	35	35	0	0	30	0	20	0	0	0	450
Maximum		0	60	0	0	0	75	0	90	75	30	35	35	0	0	30	0	20	0	0	0	450
Mean		-	60	-	-	-	75	-	90	75	30	35	35	-	-	30	-	20	-	-	-	450
SD		-	0	-	-	-	0	-	0	0	0	0	0	-	-	0	-	0	-	-	-	0
95%UCL ^a		<5	6.1	<4	<4	<4	10.7	<4	12.5	10.7	3.8	4.1	4.1	<4	<4	3.8	<4	3.1	<4	<4	<5	55.4
Dredge footprint only results (excl Reclamation area)																						
Minimum		<5	<5	<4	<4																	

Table E
Analytical results for BTEX
Marine Sediment Geochemical Assessment



Site ID	Sample Date:	BTEXN							
		Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	Total Xylenes	Sum of BTEX	Naphthalene
Unit		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Limit of Reporting		0.2	0.2	0.2	0.2	0.2	0.5	0.2	0.2
Screening Level (ANZG 2018)		NG	NG	NG	NG	NG	NG	NG	NG
SQG High (NAGD 2009)		NG	NG	NG	NG	NG	NG	NG	NG
SL01_0-0.5	27/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL01_0.5-1.0	27/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL02_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL03_0-0.5	27/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL05_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL05_0.5-1.0	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL05B_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL05C_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL06_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL07_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL08_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL08_0.5-1.0	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL09_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL10_0-0.5	27/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL13_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL13_0.5-1.0	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL14_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL15_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL16_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL16_0.5-1.0	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL16_1.0-1.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL17_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL18_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL19_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL20_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL19_0.5-1.0	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL20_0.5-1.0	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL21_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL21_0.5-0.8	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL22_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL22B_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL22C_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL23_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL23_0.5-1.0	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL24_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL26_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL27_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL27_0.5-1.0	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL28_0-0.5	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL28_0.5-1.0	28/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL29_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL29_0.5-1.0	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL29_1.0-1.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL31_0-0.5	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SL31_0.5-1.0	29/07/2020	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
Minimum	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
Maximum	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
Mean	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SD	-	-	-	-	-	-	-	-	-
95%UCL ^a	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
Dredge footprint only results (excl Reclamation area)									
Minimum	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
Maximum	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
Mean	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2
SD	-	-	-	-	-	-	-	-	-
95%UCL ^a	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2

Key

- a 95% UCL calculated using ProUCL. Data outputs are provided in Appendix E.
- NG No guideline
- exceeds the NAGD (2009) Screening Level
- exceeds the NAGD (2009) Screening Level

Table F
Analytical results for radionuclides
Marine Sediment Geochemical Assessment



Site ID	Sample Date:	Radionuclides		
		Gross alpha	Gross beta	Total Gross Alpha & Beta
Unit		Bq/kg DW	Bq/kg DW	Bq/kg DW
Limit of Reporting		500	500	500
Screening Level (ANZG 2018)		NG	NG	35000
SQG High (NAGD 2009)		NG	NG	NG
SL01_0-0.5	27/07/2020	<500	<500	<500
SL01_0.5-1.0	27/07/2020	1030	<500	1030
SL02_0-0.5	29/07/2020	560	<500	560
SL03_0-0.5	27/07/2020	970	<500	970
SL05_0-0.5	29/07/2020	780	<500	780
SL05_0.5-1.0	29/07/2020	770	910	1680
SL05B_0-0.5	29/07/2020	740	<500	740
SL05C_0-0.5	29/07/2020	590	<500	590
SL06_0-0.5	28/07/2020	<500	<500	<500
SL07_0-0.5	29/07/2020	<500	<500	<500
SL08_0-0.5	28/07/2020	550	<500	550
SL08_0.5-1.0	28/07/2020	890	<500	890
SL09_0-0.5	28/07/2020	1010	590	1600
SL10_0-0.5	27/07/2020	1190	<500	1190
SL13_0-0.5	28/07/2020	580	<500	580
SL13_0.5-1.0	28/07/2020	1110	530	1640
SL14_0-0.5	28/07/2020	1320	610	1930
SL15_0-0.5	28/07/2020	1130	640	1770
SL16_0-0.5	28/07/2020	700	510	1210
SL16_0.5-1.0	28/07/2020	780	550	1330
SL16_1.0-1.5	28/07/2020	1020	800	1820
SL17_0-0.5	28/07/2020	590	<500	590
SL18_0-0.5	28/07/2020	690	<500	690
SL19_0-0.5	28/07/2020	980	<500	980
SL20_0-0.5	28/07/2020	1260	880	2140
SL19_0.5-1.0	29/07/2020	1010	630	1640
SL20_0.5-1.0	29/07/2020	780	<500	780
SL21_0-0.5	28/07/2020	850	680	1530
SL21_0.5-0.8	28/07/2020	910	900	1810
SL22_0-0.5	29/07/2020	<500	<500	<500
SL22B_0-0.5	29/07/2020	520	<500	520
SL22C_0-0.5	29/07/2020	710	<500	710
SL23_0-0.5	29/07/2020	580	<500	580
SL23_0.5-1.0	29/07/2020	1300	790	2090
SL24_0-0.5	28/07/2020	620	<500	620
SL26_0-0.5	28/07/2020	1040	560	1600
SL27_0-0.5	28/07/2020	800	520	1320
SL27_0.5-1.0	28/07/2020	1360	840	2200
SL28_0-0.5	28/07/2020	560	<500	560
SL28_0.5-1.0	28/07/2020	1420	870	2290
SL29_0-0.5	29/07/2020	550	<500	550
SL29_0.5-1.0	29/07/2020	1000	<500	1000
SL29_1.0-1.5	29/07/2020	880	510	1390
SL31_0-0.5	29/07/2020	550	<500	550
SL31_0.5-1.0	29/07/2020	650	570	1220
Minimum	-	520	510	520
Maximum	-	1420	910	2290
Mean	-	862	678	1176
SD	-	258	148	554
95%UCL ^a	-	883	583	1255

Dredge footprint only results (excl Reclamation area)

Minimum	-	520	510	520
Maximum	-	1420	910	2290
Mean	-	878	689	1185
SD	-	262	145	558
95%UCL ^a	-	912.6	596.5	1314

Key

- a 95% UCL calculated using ProUCL. Data outputs are provided in Appendix E.
- NG No guideline
- exceeds the NAGD (2009) Screening Level
- exceeds the NAGD (2009) Screening Level

Table G
Analytical results for PSD
Marine Sediment Geochemical Assessment



Sample Name	Particle Sizing												Soil Classification based on Particle Size				
	+75µm	+150µm	+300µm	+425µm	+600µm	+1180µm	+2.36mm	+4.75mm	+9.5mm	+19.0mm	+37.5mm	+75.0mm	Clay (<2 µm)	Silt (2-60 µm)	Sand (0.06-2.00 mm)	Gravel (>2mm)	Cobbles (>6cm)
Unit	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Limit of reporting	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SL01_0-0.5	62	60	57	53	47	35	24	13	<1	<1	<1	<1	22	13	38	27	<1
SL01_0.5-1.0	65	63	60	57	52	44	33	19	3	<1	<1	<1	17	18	29	36	<1
SL02_0-0.5	71	67	62	58	53	42	30	22	12	<1	<1	<1	17	10	39	34	<1
SL03_0-0.5	66	57	47	43	40	35	28	20	10	<1	<1	<1	10	22	38	30	<1
SL05_0-0.5	70	66	59	53	46	34	19	3	<1	<1	<1	<1	15	11	51	23	<1
SL05_0.5-1.0	43	38	35	32	30	26	21	11	5	<1	<1	<1	23	32	22	23	<1
SL05B_0-0.5	65	62	54	47	41	27	14	3	<1	<1	<1	<1	17	11	54	18	<1
SL05C_0-0.5	65	61	55	49	44	33	23	11	5	<1	<1	<1	21	12	41	26	<1
SL06_0-0.5	82	79	74	68	59	46	33	19	11	<1	<1	<1	12	4	47	37	<1
SL07_0-0.5	72	68	60	53	44	26	13	6	<1	<1	<1	<1	17	9	57	17	<1
SL08_0-0.5	75	73	69	63	56	40	26	13	5	<1	<1	<1	14	9	47	30	<1
SL08_0.5-1.0	63	60	54	48	41	30	19	10	5	<1	<1	<1	21	16	41	22	<1
SL09_0-0.5	80	77	74	71	68	60	51	39	22	<1	<1	<1	7	11	28	54	<1
SL10_0-0.5	67	62	55	51	48	42	32	20	6	<1	<1	<1	12	19	34	35	<1
SL13_0-0.5	72	66	57	50	42	25	13	8	2	<1	<1	<1	14	14	55	17	<1
SL13_0.5-1.0	68	62	54	49	44	34	21	10	4	<1	<1	<1	14	15	46	25	<1
SL14_0-0.5	75	73	71	69	67	61	53	37	19	<1	<1	<1	12	11	22	55	<1
SL15_0-0.5	74	72	69	66	61	52	44	30	17	<1	<1	<1	13	11	30	46	<1
SL16_0-0.5	65	64	60	56	50	39	29	16	4	<1	<1	<1	16	18	34	32	<1
SL16_0.5-1.0	56	55	53	49	45	37	32	26	13	<1	<1	<1	15	26	25	34	<1
SL16_1.0-1.5	24	23	21	20	18	15	8	3	<1	<1	<1	<1	10	64	13	13	<1
SL17_0-0.5	69	66	62	56	49	35	25	18	13	<1	<1	<1	16	13	43	28	<1
SL18_0-0.5	73	64	46	40	36	28	18	8	<1	<1	<1	<1	11	16	52	21	<1
SL19_0-0.5	67	64	57	52	46	35	25	12	4	<1	<1	<1	17	12	43	28	<1
SL19_0.5-1.0	45	41	38	37	35	32	25	13	<1	<1	<1	<1	38	12	23	27	<1
SL20_0-0.5	80	75	64	58	52	41	30	20	13	<1	<1	<1	8	8	51	33	<1
SL20_0.5-1.0	61	56	46	41	36	29	24	18	9	<1	<1	<1	18	19	37	26	<1
SL21_0-0.5	59	53	45	40	35	28	17	5	<1	<1	<1	<1	20	20	40	20	<1
SL21_0.5-0.8	7	4	3	3	2	2	1	<1	<1	<1	<1	<1	32	59	7	2	<1
SL22_0-0.5	74	71	66	60	54	40	26	18	6	<1	<1	<1	16	7	46	31	<1
SL22B_0-0.5	69	66	62	58	53	41	29	21	6	<1	<1	<1	18	12	37	33	<1
SL22C_0-0.5	71	68	61	56	49	34	20	11	2	<1	<1	<1	18	9	48	25	<1
SL23_0-0.5	66	57	46	39	32	20	10	4	<1	<1	<1	<1	16	13	58	13	<1
SL23_0.5-1.0	54	46	40	37	33	26	16	3	<1	<1	<1	<1	21	20	40	19	<1
SL24_0-0.5	67	65	60	54	48	37	27	13	2	<1	<1	<1	1	32	37	30	<1
SL26_0-0.5	74	73	69	65	61	53	42	24	5	<1	<1	<1	14	10	31	45	<1
SL27_0-0.5	73	71	65	58	52	42	30	11	<1	<1	<1	<1	14	13	39	34	<1
SL27_0.5-1.0	47	44	41	39	38	35	29	20	5	<1	<1	<1	23	27	19	31	<1
SL28_0-0.5	64	60	53	48	42	30	16	5	<1	<1	<1	<1	18	18	44	20	<1
SL28_0.5-1.0	45	42	39	38	37	34	26	12	3	<1	<1	<1	26	28	17	29	<1
SL29_0-0.5	68	64	59	54	47	32	20	11	4	<1	<1	<1	18	10	48	24	<1
SL29_0.5-1.0	63	58	52	47	41	31	18	7	4	<1	<1	<1	19	13	46	22	<1
SL29_1.0-1.5	64	59	53	48	44	35	24	12	5	<1	<1	<1	18	14	41	27	<1
SL31_0-0.5	78	74	64	55	44	23	7	2	<1	<1	<1	<1	13	8	67	12	<1
SL31_0.5-1.0	65	62	58	53	46	32	23	17	6	<1	<1	<1	18	16	41	25	<1
Average	64.07	60.24	54.42	49.80	44.62	34.62	24.40	14.30	7.28	<1	<1	<1	16.67	17.00	38.80	27.53	<1
<i>Dredge footprint only results (excl Reclamation area)</i>																	
Average	65	60	54	50	45	35	24	14	7	<1	<1	<1	17	16	40	27	<1

Table H
Analytical results for acid sulfate soils
Marine Sediment Geochemical Assessment

Site ID	Sample Date:	Ass Field Screening Analysis			Actual Acidity			Potential Acidity		Acid Neutralising Capacity			ANC 5 times higher than CRS	ANC % > Sum of existing and potential acidity	ANC Fineness Factor	Net Acidity (sulfur units)	Net Acidity (acidity units)	Acid Base Accounting			
		pH (F)	pH (Fox)	Reaction Rate	pH KCl (23A)	Titratable Actual Acidity (23F)	sulfidic - Titratable Actual Acidity (s-23F)	Chromium Reducible Sulfur (22B)	acidity - Chromium Reducible Sulfur (a-22B)	Acid Neutralising Capacity (19A2)	acidity - Acid Neutralising Capacity (a-19A2)	sulfidic - Acid Neutralising Capacity (s-19A2)						Net Acidity excluding ANC (sulfur units)	Net Acidity excluding ANC (acidity units)	Liming Rate	Net Acidity excluding ANC (sulfur units)
Unit		pH Unit	pH Unit		pH Unit	mole H+ / t	% pyrite S	% S	mole H+ / t	% CaCO3	mole H+ / t	% pyrite S		%S		% S	mole H+ / t	kg CaCO3/t	% S	mole H+ / t	kg CaCO3/t
Limit of Reporting		0.1	0.1	1	0.1	2	0.02	0.005	10	0.01	10	0.01			0.5	0.02	10	1	0.02	10	1
SL01_0-0.5	27/07/2020	8.8	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL01_0.5-1.0	27/07/2020	8.7	6.3	2	9.1	<2	<0.02	0.175	109	38.1	7610	12.2	Pass	70	1.5	<0.02	<10	<1	0.18	109	8
SL02_0-0.5	29/07/2020	8.7	6.4	2	9.2	<2	<0.02	0.093	58	46.8	9360	15	Pass	161	1.5	<0.02	<10	<1	0.09	58	4
SL03_0-0.5	27/07/2020	8.7	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL05_0-0.5	29/07/2020	8.7	6.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL05_0.5-1.0	29/07/2020	8.8	6.3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL05B_0-0.5	29/07/2020	8.7	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL05C_0-0.5	29/07/2020	8.7	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL06_0-0.5	28/07/2020	8.6	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL07_0-0.5	29/07/2020	8.6	6.8	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL08_0-0.5	28/07/2020	8.7	6.4	2	9.2	<2	<0.02	0.086	54	46.9	9380	15	Pass	174	1.5	<0.02	<10	<1	0.09	54	4
SL08_0.5-1.0	28/07/2020	8.8	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL09_0-0.5	28/07/2020	8.6	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL10_0-0.5	27/07/2020	8.7	6.4	2	9.1	<2	<0.02	0.04	25	28.8	5750	9.22	Pass	231	1.5	<0.02	<10	<1	0.04	25	2
SL13_0-0.5	28/07/2020	8.8	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL13_0.5-1.0	28/07/2020	8.7	6.6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL14_0-0.5	28/07/2020	8.7	6.4	2	9	<2	<0.02	0.049	30	19.4	3870	6.2	Pass	127	1.5	<0.02	<10	<1	0.05	30	2
SL15_0-0.5	28/07/2020	8.7	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL16_0-0.5	28/07/2020	8.7	6.3	2	9.1	<2	<0.02	0.072	45	28.1	5620	9	Pass	125	1.5	<0.02	<10	<1	0.07	45	3
SL16_0.5-1.0	28/07/2020	8.7	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL16_1.0-1.5	28/07/2020	8.7	6.3	2	9	<2	<0.02	0.13	81	26.2	5240	8.4	Pass	65	1.5	<0.02	<10	<1	0.13	81	6
SL17_0-0.5	28/07/2020	8.6	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL18_0-0.5	28/07/2020	8.9	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL19_0-0.5	28/07/2020	8.7	6.4	2	9.1	<2	<0.02	0.137	85	34.3	6860	11	Pass	80	1.5	<0.02	<10	<1	0.14	85	6
SL20_0-0.5	28/07/2020	8.6	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL19_0.5-1.0	29/07/2020	8.8	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL20_0.5-1.0	29/07/2020	8.7	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL21_0-0.5	28/07/2020	8.9	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL21_0.5-0.8	28/07/2020	9.2	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL22_0-0.5	29/07/2020	8.8	6.4	2	9.3	<2	<0.02	0.119	74	57.6	11500	18.5	Pass	155	1.5	<0.02	<10	<1	0.12	74	6
SL22B_0-0.5	29/07/2020	8.6	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL22C_0-0.5	29/07/2020	8.7	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL23_0-0.5	29/07/2020	8.6	6.2	2	9.2	<2	<0.02	0.121	75	45.6	9120	14.6	Pass	121	1.5	<0.02	<10	<1	0.12	75	6
SL23_0.5-1.0	29/07/2020	8.8	6.3	2	8.9	<2	<0.02	0.229	143	20.1	4010	6.43	Pass	28	1.5	<0.02	<10	<1	0.23	143	11
SL24_0-0.5	28/07/2020	8.5	8.2	3	9.4	<2	<0.02	0.017	11	56.8	11400	18.2	Pass	1071	1.5	<0.02	<10	<1	<0.02	11	<1
SL26_0-0.5	28/07/2020	8.8	6.4	2	9.1	<2	<0.02	0.066	42	40.4	8070	12.9	Pass	195	1.5	<0.02	<10	<1	0.07	42	3
SL27_0-0.5	28/07/2020	8.8	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL27_0.5-1.0	28/07/2020	8.5	6.4	2	8.9	<2	<0.02	0.084	52	4.91	982	1.57	Pass	19	1.5	<0.02	<10	<1	0.08	52	4
SL28_0-0.5	28/07/2020	8.9	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL28_0.5-1.0	28/07/2020	8.3	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL29_0-0.5	29/07/2020	8.6	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL29_0.5-1.0	29/07/2020	8.7	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL29_1.0-1.5	29/07/2020	8.6	6.4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL31_0-0.5	29/07/2020	8.5	6.7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SL31_0.5-1.0	29/07/2020	8.7	6.5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Minimum	-	8.3	6.2	2	8.9	<2	<0.02	0.017	11	4.91	982	1.57	-	19	1.5	<0.02	<10	<1	0.04	11	2
Maximum	-	9.2	8.2	3	9.4	<2	<0.02	0.229	143	57.6	11500	18.5	-	1071	1.5	<0.02	<10	<1	0.23	143	11
Mean	-	9	6	2	9	<2	<0.02	0.10	63	35	7055	11	-	187	1.5	<0.02	<10	<1	0	63	5
SD	-	0	0	0	0	0	0	0.06	35	15	3017	5	-	262	-	0	0	0	0	35	3
95%UCL	-	8.791	6.649	2.119	9.181	<2	<0.02	0.128	79.65	42.42	8483	13.59	-	335.1	-	<0.02	<10	<1	0.129	79.65	5.97
<i>Dredge footprint only results (excl Reclamation area)</i>																					
Minimum	-	8.3	6.2	2	8.9	<2	0	0.04	25	4.91	982	1.57	-	18.69047619	1.5	<0.02	<10	<1	0.04	25	2
Maximum	-	9.2	6.8	2	9.3	<2	0	0.229	143	57.6	11500	18.5	-	230.5	1.5	<0.02	<10	<1	0.23	143	11
Mean	-	8.7	6	2	<0.5	<2	<0.02	0	68	35	6956	11	-	124	1.5	<0.02	<10	<1	0	68	5
SD	-	0	0	0	0	0	0	0	33	15	2923	5	-	65	-	0	0	0	0	33	3
95%UCL ^a	-	8.751	6.459	2	9.169	<2	<3	0.14	87	43.19	8631	13.84	-	161	-	<0.02	<10	<1	0.141	87	6.566

Appendix A

Sample Location Coordinates

Appendix A Sample Location Coordinates

Site_ID	Latitude	Lat_DD	Longitude	Lon_DD
SL01	12°29'28.3"	-12.4912	130°53'55.2"	130.8987
SL02	12°29'33.5"	-12.4926	130°53'52.6"	130.8979
SL03	12.29'36.1"	-12.4934	130.53'51.3"	130.8976
SL04	12°29'27.1"	-12.4909	130°53'55.2"	130.8987
SL05A	12°29'31.0"	-12.4919	130°53'57.9"	130.8994
SL05B	12°29'31.0"	-12.4919	130°53'58.0"	130.8994
SL05C	12°29'30.9"	-12.4919	130°53'58.0"	130.8994
SL06	12°29'21.6"	-12.4893	130°53'58"	130.8994
SL07	12°29'37.5"	-12.4938	130°53'47.3"	130.8965
SL08	12°29'28.6"	-12.4913	130°53'57.9"	130.8994
SL09	12°29'24.5"	-12.4901	130°53'57.8"	130.8994
SL10	12.49338	-12.4934	130.8983	130.8983
SL11	12°29'22.9"	-12.4897	130°53'54.1"	130.8984
SL12	12°29'23.5"	-12.4899	130°54'00.8"	130.9002
SL13	12°29'34.8"	-12.493	130°53'51.2"	130.8976
SL14	12°29'25.7"	-12.4905	130°53'55.2"	130.8987
SL15	12°29'26.9"	-12.4908	130°53'58.0"	130.8994
SL16	12°29'21.5"	-12.4893	130°54'03.5"	130.901
SL17	12°29'28.2"	-12.4912	130°53'52.6"	130.8979
SL18	12°29'34.9"	-12.493	130°53'55.4"	130.8987
SL19	12°29'29.6"	-12.4916	130°54'00.5"	130.9001
SL19A	12°29'29.5"	-12.4915	130°54'00.7"	130.9002
SL20	12°29'36.4"	-12.4934	130°53'50.0"	130.8972
SL21	12°29'37.4"	-12.4937	130°53'51.3"	130.8976
SL22A	12°29'30.9"	-12.4919	130°53'55.1"	130.8986
SL22B	12°29'30.9"	-12.4919	130°53'55.1"	130.8986
SL22C	12°29'30.9"	-12.4919	130°53'55.1"	130.8986
SL23	12°29'32.3"	-12.4923	130°53'58.1"	130.8995
SL24	12°29'32.4"	-12.4923	130°53'48.7"	130.8969
SL25	12°29'25.8"	-12.4905	130°53'48.6"	130.8968
SL26	12°29'27.1"	-12.4909	130°54'00.1"	130.9
SL27	12°29'29.5"	-12.4915	130°53'59.2"	130.8998
SL28	12°29'31.0"	-12.4919	130°53'59.3"	130.8998
SL29	12°29'30.8"	-12.4919	130°53'56.7"	130.8991
SL31	12°29'35"	-12.4931	130°53'50"	130.8972

Appendix B

Data Validation Report

DATA VALIDATION REPORT				
Project number:	60633505	Validation by:	Cam Evangelho	Date: 20/08/2020
Client:	Northern Territory Department of Trade, Business and Innovation			
Site:	Darwin Ship Lift and Marine Industries Facility			
Matrix type:	Soil	Data verified by:	Marthin Slabber	Date: 26/08/2020
Primary samples:	31			
Laboratory:	ALS, Eurofins			
Lab reference:	ES2026249, 736637	Project Manager:	Karen Telford	
Field Quality Assurance and Quality Control				
Sampling personnel	Sampling was completed from the 27 th -29 th of July 2020 by suitably qualified and experienced personnel, with field operations supplemented by geotechnical staff from the contractor.			
Sampling Methodology	Samples were collected using vibrocore, with the cores (and liners) being driven into the seabed from the vessel, then recovered to the vessel.			
Sample Handling & Preservation	Sediment samples were placed in 250 ml laboratory supplied glass jars (for hydrocarbons and TBT analyses) and plastic whirlpak bags (for metals, PSD and acid sulphate soils analyses). The use of plastic, rather than glass, storage containers for metals was used as metals tend to adsorb onto glass surfaces, potentially leading to underestimates of metal concentrations. All samples were stored on ice or refrigerated in the field and frozen at the earliest opportunity, and subsequently delivered to a NATA accredited laboratory for analysis.			
Decontamination Procedure	Sampling equipment were decontaminated between sites by cleaning with a decontamination solution (Decon 90). Following decontamination equipment was rinsed in seawater prior to use at the next site.			
Chain of Custody (COC)	COC documents completed by Will Riddell.			
Analysis Request	Laboratory analysis request and sample receipt notification reviewed and approved by Peter Young.			
Field Blank	Field blank samples were not collected during this survey.			
Rinsate Blank	Rinsate blank samples were collected on the first day following field sampling.			
Trip Blank	Trip blanks were included at frequency of one per esky (16 in total). Concentrations were not detected above the LOR for all analytes tested.			
Frequency of field QC	Inter-laboratory duplicates were collected at a frequency of one in twenty primary samples (one of each per GME). Intra-laboratory duplicates were not collected.			

Handling and preservation	Primary sediment samples were received preserved and chilled at the laboratory. Inter-laboratory duplicate samples were adequately packed preserved but not chilled. Sample receipt temperatures were as below:									
	<table border="1"> <thead> <tr> <th>Lab Report Number</th> <th>Receipt Temp (°C)</th> <th>Comments</th> </tr> </thead> <tbody> <tr> <td>ES2026249</td> <td>4.6</td> <td>Ice bricks present</td> </tr> <tr> <td>736637</td> <td>-</td> <td>Evidence to chill not evident</td> </tr> </tbody> </table>	Lab Report Number	Receipt Temp (°C)	Comments	ES2026249	4.6	Ice bricks present	736637	-	Evidence to chill not evident
	Lab Report Number	Receipt Temp (°C)	Comments							
	ES2026249	4.6	Ice bricks present							
736637	-	Evidence to chill not evident								
All samples were received at the laboratory in appropriate sample containers.										
Laboratory QA/QC										
Tests requested/reported	Samples were analysed and reported as requested on the COC.									
Holding time compliance	<p>Samples were extracted and analysed within recommended holding times with the exception of the following:</p> <ul style="list-style-type: none"> Holding time exceedance of 1 day: SL03_0.5, SL01_0-0.5, SL01_0.5-1.0, SL10_0-0.5, SL05B_0-0.5, LS22B_0-0.5 Holding time exceedance of 2 days: SL28_0-0.5, SL28_0.5-1.0 									
Laboratory Accreditation	The primary laboratory analysis was conducted by ALS Environmental Pty Ltd (Sydney) a National Association of Testing Authorities (NATA) accredited laboratory. The inter-laboratory duplicate sample was analysed at Eurofins (Melbourne), also a NATA accredited laboratory.									
Frequency of laboratory QC	<p>The laboratory reported a sufficient frequency of quality control samples to assess whether the results have been reported to an acceptable accuracy and precision with the exception of:</p> <ul style="list-style-type: none"> EP1903303 – Organotin Analysis for matrix spikes EP1911026 – Organotin Analysis for laboratory duplicates 									
Method Blank	Method blank concentrations were not detected above the LOR for all analytes tested.									
Laboratory duplicate RPDs	<p>Laboratory duplicate Relative Percentage Differences (RPD) were within control limits with the exception of the following:</p> <ul style="list-style-type: none"> SL23_0.5-1.0: Total Kjeldalh Nitrogen (168%) – RPD exceeds LOR based limits SL23_0.5-1.0: Total Phosphorous as P (156%) – RPD exceeds LOR based limits SL08_0-0.5: Total Phosphorous as P (37%) – RPD exceeds LOR based limits SL29_1.0-1.5: Total Phosphorous as P (40.6%) – RPD exceeds LOR based limits 									
Laboratory control spike recovery	<p>Laboratory Control Spikes (LCS) recoveries were within control limits with the exception of the following:</p> <ul style="list-style-type: none"> QC-MRG2-31966530: Total Phosphorous as P – Recovery greater than upper control limit. ES2026249—029: Total Phosphorous as P – MS recovery not determined, background level greater than or equal to 4x spike level. ES2026249—036: Total Phosphorous as P – MS recovery not determined, background level greater than or equal to 4x spike level. 									
Matrix spike recovery	All AECOM Matrix Spike (MS) recoveries (where reported) were within control limits with the exception of Organotin Analysis, which was reported under the LOR.									
Surrogate spike recovery	Surrogate spike recoveries were within control limits.									

QA/QC Data Evaluation	
Comparison of Field Observations and Laboratory Results	No anomalous results between field observations and analysis results were noted.
Data transcription	A random 10% check of the laboratory results identified no anomalies within the electronic data, the laboratory reports, and tables generated by AECOM.
Limits of reporting	LORs were sufficiently low to enable assessment against adopted guideline criteria with the exception of the following. Refer to report table for analyte LOR's.
Field intra-laboratory duplicate RPDs	Field intra-laboratory duplicates were not collected.
Field inter-laboratory duplicate RPDs	Field inter-laboratory duplicate RPDs were reported within $\leq 35\%$ with the exception of iron, arsenic, chromium, copper, lead, nickel, TOC and total inorganic carbon. All results, with the exception of arsenic, were below the respective Screening Levels and do not affect the risk profile of the site and were within the same order of magnitude. This apparent lack of precision is likely attributable to the heterogeneous nature of the sediment.
Field triplicate RSDs	Field triplicate RSDs were reported within the RSDs of ≤ 50 with the exception of aluminium, iron, arsenic, chromium, copper, lead, manganese, nickel and zinc. This apparent lack of precision is likely attributable to the heterogeneous nature of the sediment.

Appendix C

Chain of Custody
Documentation and
Laboratory Reports

CERTIFICATE OF ANALYSIS

Work Order : ES2026249 Amendment : (Preliminary Report) Client : AECOM Australia Pty Ltd Contact : PETER YOUNG Address : GPO BOX 3175 DARWIN NT, AUSTRALIA 0801 Telephone : 6432 2000 Project : 60566025 Darwin Sediment Sampling Order number : 60566025 C-O-C number : ---- Sampler : Will Riddell Site : ---- Quote number : EP/036/20 V4 No. of samples received : 65 No. of samples analysed : 65	Page : 1 of 43 Laboratory : Environmental Division Sydney Contact : Brenda Hong Address : 277-289 Woodpark Road Smithfield NSW Australia 2164 Telephone : +61 2 8784 8555 Date Samples Received : 31-Jul-2020 08:44 Date Analysis Commenced : 04-Aug-2020 Issue Date : 27-Aug-2020 16:16
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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
- 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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Edwandy Fadjjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Minh Wills	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Morgan Lennox		Brisbane Organics, Stafford, QLD

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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.

This report contains preliminary authorised results. The report may contain semi-quantitative results. Any result presented in this preliminary report may be subject to change in the final report.

- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP080-SD: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP132B-SD : Positive PAH result for sample #ES2026249_47 is confirmed by re-extraction and re-analysis.
- EK061G/EK067G: Poor duplicate precision for TKN and TP due to sample heterogeneity.
- 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.
- Radiological work undertaken by ALS Laboratory Group (Ceska Lipa) under CAI accreditation No. L1163. Report No. \$\$. NATA and CAI accreditations' are both recognised under ILAC.

(Preliminary Report)

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL23_0.5-1.0	SL05C_0-0.5	SL23_0-0.5	SL31_0-0.5	SL31_0.5-1.0
Client sampling date / time				29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00
Compound	CAS Number	LOR	Unit	ES2026249-001	ES2026249-002	ES2026249-003	ES2026249-004	ES2026249-005	
				Result	Result	Result	Result	Result	
EA037: Ass Field Screening Analysis									
∅ pH (F)	----	0.1	pH Unit	8.6	8.7	8.8	8.5	8.7	
∅ pH (Fox)	----	0.1	pH Unit	6.2	6.5	6.3	6.7	6.5	
∅ Reaction Rate	----	1	-	2	2	2	2	2	
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%	33.9	33.8	33.8	37.6	39.2	
EA150: Particle Sizing									
+75µm	----	1	%	54	65	66	78	65	
+150µm	----	1	%	46	61	57	74	62	
+300µm	----	1	%	40	55	46	64	58	
+425µm	----	1	%	37	49	39	55	53	
+600µm	----	1	%	33	44	32	44	46	
+1180µm	----	1	%	26	33	20	23	32	
+2.36mm	----	1	%	16	23	10	7	23	
+4.75mm	----	1	%	3	11	4	2	17	
+9.5mm	----	1	%	<1	5	<1	<1	6	
+19.0mm	----	1	%	<1	<1	<1	<1	<1	
+37.5mm	----	1	%	<1	<1	<1	<1	<1	
+75.0mm	----	1	%	<1	<1	<1	<1	<1	
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%	21	21	16	13	18	
Silt (2-60 µm)	----	1	%	20	12	13	8	16	
Sand (0.06-2.00 mm)	----	1	%	40	41	58	67	41	
Gravel (>2mm)	----	1	%	19	26	13	12	25	
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1	
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.73	2.74	2.72	2.81	2.75	
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg	11500	8430	7370	6020	7850	
Iron	7439-89-6	50	mg/kg	49700	56400	49600	54800	33500	
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Arsenic	7440-38-2	1.00	mg/kg	40.7	79.1	61.0	75.2	33.0	
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	0.3	
Chromium	7440-47-3	1.0	mg/kg	46.5	36.1	43.5	22.1	22.5	

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL23_0.5-1.0	SL05C_0-0.5	SL23_0-0.5	SL31_0-0.5	SL31_0.5-1.0
Client sampling date / time				29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-001	ES2026249-002	ES2026249-003	ES2026249-004	ES2026249-005	
				Result	Result	Result	Result	Result	
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Copper	7440-50-8	1.0	mg/kg	11.4	3.6	3.4	3.0	4.4	
Lead	7439-92-1	1.0	mg/kg	10.1	9.6	9.3	8.1	12.1	
Manganese	7439-96-5	10	mg/kg	165	292	244	430	700	
Nickel	7440-02-0	1.0	mg/kg	6.0	6.4	5.2	5.8	20.0	
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Zinc	7440-66-6	1.0	mg/kg	11.9	12.7	9.7	13.3	70.8	
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.1	<0.1	0.2	<0.1	<0.1	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg	260	350	290	270	190	
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg	260	350	290	270	190	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg	582	1030	716	649	400	
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%	0.34	0.51	0.41	0.23	0.32	
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%	2.85	4.65	6.08	6.80	5.24	
EP003TIC: Total inorganic Carbon (TIC) in Soil									
Total Inorganic Carbon	----	0.02	%	2.51	4.14	5.67	6.57	4.92	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
>C16 - C34 Fraction	----	3	mg/kg	7	10	12	16	9	
>C34 - C40 Fraction	----	5	mg/kg	<5	<5	<5	<5	<5	
>C10 - C40 Fraction (sum)	----	3	mg/kg	7	10	12	16	9	
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<3	<3	<3	<3	<3	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C10 - C14 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C15 - C28 Fraction	----	3	mg/kg	4	6	8	12	6	
C29 - C36 Fraction	----	5	mg/kg	<5	6	7	6	<5	

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Analytical Results

Table with columns for Client sample ID, Client sampling date / time, Compound, CAS Number, LOR, Unit, and results for various sample IDs (SL23_0.5-1.0, SL05C_0-0.5, SL23_0-0.5, SL31_0-0.5, SL31_0.5-1.0). Rows include sections for Total Petroleum Hydrocarbons, Total Recoverable Hydrocarbons, BTEXN, Organotin Compounds, and Polynuclear Aromatic Hydrocarbons.

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Project : 60566025 Darwin Sediment Sampling



Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL23_0.5-1.0	SL05C_0-0.5	SL23_0-0.5	SL31_0-0.5	SL31_0.5-1.0
Client sampling date / time				29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-001	ES2026249-002	ES2026249-003	ES2026249-004	ES2026249-005	
				Result	Result	Result	Result	Result	
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	<4	<4	<4	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	<4	<4	<4	
Coronene	191-07-1	5	µg/kg	<5	<5	<5	<5	<5	
^ Sum of PAHs	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	5	5	5	5	5	
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	10	10	10	10	10	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	86.7	93.3	99.8	92.3	112	
Toluene-D8	2037-26-5	0.2	%	96.2	102	108	102	118	
4-Bromofluorobenzene	460-00-4	0.2	%	93.0	93.5	97.0	92.6	106	
EP090S: Organotin Surrogate									
Tripopyltin	----	0.5	%	80.3	103	86.0	102	78.6	
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%	90.1	72.7	84.8	69.2	83.4	
Anthracene-d10	1719-06-8	10	%	116	90.6	112	89.3	100	
4-Terphenyl-d14	1718-51-0	10	%	121	105	119	105	119	

(Preliminary Report)

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Project : 60566025 Darwin Sediment Sampling



Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID				
Client sampling date / time				SL05_0-0.5	SL05_0.5-1.0	SL29_0-0.5	SL29_0.5-1.0	SL29_1.0-1.5
Compound	CAS Number	LOR	Unit	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00
				ES2026249-008	ES2026249-009	ES2026249-010	ES2026249-011	ES2026249-012
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
ø pH (F)	----	0.1	pH Unit	8.7	8.8	8.6	8.7	8.6
ø pH (Fox)	----	0.1	pH Unit	6.3	6.3	6.4	6.5	6.4
ø Reaction Rate	----	1	-	2	2	2	2	2
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	31.8	26.4	40.1	32.8	31.5
EA150: Particle Sizing								
+75µm	----	1	%	70	43	68	63	64
+150µm	----	1	%	66	38	64	58	59
+300µm	----	1	%	59	35	59	52	53
+425µm	----	1	%	53	32	54	47	48
+600µm	----	1	%	46	30	47	41	44
+1180µm	----	1	%	34	26	32	31	35
+2.36mm	----	1	%	19	21	20	18	24
+4.75mm	----	1	%	3	11	11	7	12
+9.5mm	----	1	%	<1	5	4	4	5
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	15	23	18	19	18
Silt (2-60 µm)	----	1	%	11	32	10	13	14
Sand (0.06-2.00 mm)	----	1	%	51	22	48	46	41
Gravel (>2mm)	----	1	%	23	23	24	22	27
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.74	2.73	2.67	2.77	2.72
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	7010	9020	7960	9660	8670
Iron	7439-89-6	50	mg/kg	51400	55900	53200	75100	60500
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	64.8	62.4	63.7	83.5	71.7
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	29.9	34.5	41.4	41.6	41.6

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Analytical Results

Table with columns for Client sample ID, Compound, CAS Number, LOR, Unit, and results for various sample IDs (SL05_0-0.5, SL05_0.5-1.0, SL29_0-0.5, SL29_0.5-1.0, SL29_1.0-1.5). Rows include sections for Total Metals in Sediments, Total Recoverable Mercury, Nitrite plus Nitrate as N, Total Kjeldahl Nitrogen, Total Nitrogen as N, Total Phosphorus as P, Total Organic Carbon, Total Carbon, Total inorganic Carbon, Total Recoverable Hydrocarbons, and Total Petroleum Hydrocarbons.

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Analytical Results

Table with columns for Client sample ID, sampling date, and various compound results across five sample IDs (SL05_0-0.5, SL05_0.5-1.0, SL29_0-0.5, SL29_0.5-1.0, SL29_1.0-1.5). Rows include Total Petroleum Hydrocarbons, Total Recoverable Hydrocarbons, BTEXN, Organotin Compounds, and Polynuclear Aromatic Hydrocarbons.

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL05_0-0.5	SL05_0.5-1.0	SL29_0-0.5	SL29_0.5-1.0	SL29_1.0-1.5
Client sampling date / time				29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-008	ES2026249-009	ES2026249-010	ES2026249-011	ES2026249-012	
				Result	Result	Result	Result	Result	
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	<4	<4	<4	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	<4	<4	<4	
Coronene	191-07-1	5	µg/kg	<5	<5	<5	<5	<5	
^ Sum of PAHs	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	5	5	5	5	5	
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	10	10	10	10	10	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	102	76.5	99.9	94.2	108	
Toluene-D8	2037-26-5	0.2	%	112	83.1	108	104	116	
4-Bromofluorobenzene	460-00-4	0.2	%	104	85.1	98.2	100	114	
EP090S: Organotin Surrogate									
Tripopyltin	----	0.5	%	70.1	93.5	85.8	101	38.9	
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%	87.8	76.4	79.4	74.4	93.0	
Anthracene-d10	1719-06-8	10	%	104	77.6	86.2	76.5	115	
4-Terphenyl-d14	1718-51-0	10	%	120	96.7	123	113	120	

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL22_0-0.5	SL20_0-0.5	SL20_0.5-1.0	SL07_0-0.5	SL02_0-0.5
Client sampling date / time					29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00
Compound	CAS Number	LOR	Unit	ES2026249-013	ES2026249-014	ES2026249-015	ES2026249-016	ES2026249-017	
				Result	Result	Result	Result	Result	
EA037: Ass Field Screening Analysis									
∅ pH (F)	----	0.1	pH Unit	8.8	8.8	8.7	8.6	8.7	
∅ pH (Fox)	----	0.1	pH Unit	6.4	6.4	6.5	6.8	6.4	
∅ Reaction Rate	----	1	-	2	2	2	2	2	
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%	42.7	30.0	34.3	39.0	38.0	
EA150: Particle Sizing									
+75µm	----	1	%	74	80	61	72	71	
+150µm	----	1	%	71	75	56	68	67	
+300µm	----	1	%	66	64	46	60	62	
+425µm	----	1	%	60	58	41	53	58	
+600µm	----	1	%	54	52	36	44	53	
+1180µm	----	1	%	40	41	29	26	42	
+2.36mm	----	1	%	26	30	24	13	30	
+4.75mm	----	1	%	18	20	18	6	22	
+9.5mm	----	1	%	6	13	9	<1	12	
+19.0mm	----	1	%	<1	<1	<1	<1	<1	
+37.5mm	----	1	%	<1	<1	<1	<1	<1	
+75.0mm	----	1	%	<1	<1	<1	<1	<1	
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%	16	8	18	17	17	
Silt (2-60 µm)	----	1	%	7	8	19	9	10	
Sand (0.06-2.00 mm)	----	1	%	46	51	37	57	39	
Gravel (>2mm)	----	1	%	31	33	26	17	34	
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1	
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.74	2.79	2.68	2.68	2.68	
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg	8640	4090	7640	7220	6580	
Iron	7439-89-6	50	mg/kg	44500	41600	47700	44200	39300	
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Arsenic	7440-38-2	1.00	mg/kg	57.7	49.2	55.8	63.7	49.6	
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Chromium	7440-47-3	1.0	mg/kg	30.7	28.2	45.8	22.3	24.4	

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Analytical Results

Table with columns for Sub-Matrix (SEDIMENT), Client sample ID, and various sample IDs (SL22_0-0.5, SL20_0-0.5, SL20_0.5-1.0, SL07_0-0.5, SL02_0-0.5). Rows include compound names (Copper, Lead, Manganese, Nickel, Silver, Zinc), CAS numbers, LOR, and units, along with analytical results for various methods like ICPMS, FIMS, and Discrete Analyser.

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Analytical Results

Table with columns: Sub-Matrix: SEDIMENT (Matrix: SOIL), Client sample ID, SL22_0-0.5, SL20_0-0.5, SL20_0.5-1.0, SL07_0-0.5, SL02_0-0.5. Rows include various hydrocarbon fractions (e.g., >C10 - C16 Fraction, C6 - C9 Fraction) and organotin compounds (Tributyltin).

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL22_0-0.5	SL20_0-0.5	SL20_0.5-1.0	SL07_0-0.5	SL02_0-0.5
Client sampling date / time					29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00
Compound	CAS Number	LOR	Unit	ES2026249-013	ES2026249-014	ES2026249-015	ES2026249-016	ES2026249-017	
				Result	Result	Result	Result	Result	
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Fluoranthene	206-44-0	4	µg/kg	<4	<4	<4	----	<4	
Pyrene	129-00-0	4	µg/kg	<4	<4	<4	----	<4	
Benzo(a)anthracene	56-55-3	4	µg/kg	<4	<4	<4	----	<4	
Chrysene	218-01-9	4	µg/kg	<4	<4	<4	----	<4	
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	<4	----	<4	
Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	<4	----	<4	
Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	<4	----	<4	
Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	<4	----	<4	
Perylene	198-55-0	4	µg/kg	<4	<4	<4	----	<4	
Benzo(g,h,i)perylene	191-24-2	4	µg/kg	<4	<4	<4	----	<4	
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	<4	----	<4	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	<4	----	<4	
Coronene	191-07-1	5	µg/kg	<5	<5	<5	----	<5	
^ Sum of PAHs	----	4	µg/kg	<4	<4	<4	----	<4	
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	<4	----	<4	
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	5	5	5	----	5	
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	10	10	10	----	10	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	106	106	108	99.9	94.2	
Toluene-D8	2037-26-5	0.2	%	115	115	119	107	99.2	
4-Bromofluorobenzene	460-00-4	0.2	%	102	104	105	96.2	91.5	
EP090S: Organotin Surrogate									
Tripropyltin	----	0.5	%	88.1	97.4	87.7	109	81.9	
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%	82.1	79.3	74.7	----	78.9	
Anthracene-d10	1719-06-8	10	%	102	97.6	90.7	----	101	
4-Terphenyl-d14	1718-51-0	10	%	118	112	102	----	115	

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL26_0-0.5	SL19_0-0.5	SL19_0.5-1.0	SL15_0-0.5	SL14_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-018	ES2026249-019	ES2026249-020	ES2026249-026	ES2026249-027	
				Result	Result	Result	Result	Result	
EA037: Ass Field Screening Analysis									
∅ pH (F)	----	0.1	pH Unit	8.8	8.7	8.6	8.7	8.7	
∅ pH (Fox)	----	0.1	pH Unit	6.4	6.4	6.4	6.4	6.4	
∅ Reaction Rate	----	1	-	2	2	2	2	2	
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%	33.5	31.0	19.1	30.0	37.4	
EA150: Particle Sizing									
+75µm	----	1	%	74	67	45	74	75	
+150µm	----	1	%	73	64	41	72	73	
+300µm	----	1	%	69	57	38	69	71	
+425µm	----	1	%	65	52	37	66	69	
+600µm	----	1	%	61	46	35	61	67	
+1180µm	----	1	%	53	35	32	52	61	
+2.36mm	----	1	%	42	25	25	44	53	
+4.75mm	----	1	%	24	12	13	30	37	
+9.5mm	----	1	%	5	4	<1	17	19	
+19.0mm	----	1	%	<1	<1	<1	<1	<1	
+37.5mm	----	1	%	<1	<1	<1	<1	<1	
+75.0mm	----	1	%	<1	<1	<1	<1	<1	
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%	14	17	38	13	12	
Silt (2-60 µm)	----	1	%	10	12	12	11	11	
Sand (0.06-2.00 mm)	----	1	%	31	43	23	30	22	
Gravel (>2mm)	----	1	%	45	28	27	46	55	
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1	
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.72	2.70	2.73	2.71	2.77	
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg	8370	8110	9060	6900	7230	
Iron	7439-89-6	50	mg/kg	62200	55100	50000	42800	38600	
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Arsenic	7440-38-2	1.00	mg/kg	55.0	63.1	26.0	38.5	25.2	
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Chromium	7440-47-3	1.0	mg/kg	45.8	59.3	59.6	35.6	39.7	

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL26_0-0.5	SL19_0-0.5	SL19_0.5-1.0	SL15_0-0.5	SL14_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-018	ES2026249-019	ES2026249-020	ES2026249-026	ES2026249-027	
				Result	Result	Result	Result	Result	
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Copper	7440-50-8	1.0	mg/kg	5.1	4.4	13.1	4.6	8.3	
Lead	7439-92-1	1.0	mg/kg	21.9	12.1	14.2	16.7	8.8	
Manganese	7439-96-5	10	mg/kg	140	221	72	175	91	
Nickel	7440-02-0	1.0	mg/kg	5.0	5.8	4.8	4.7	5.4	
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Zinc	7440-66-6	1.0	mg/kg	8.3	10.7	5.6	11.7	14.9	
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.1	<0.1	<0.1	<0.1	0.1	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg	300	340	160	420	560	
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg	300	340	160	420	560	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg	757	994	436	668	548	
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%	0.22	0.36	0.12	0.20	0.26	
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%	4.57	4.67	1.46	2.29	2.62	
EP003TIC: Total inorganic Carbon (TIC) in Soil									
Total Inorganic Carbon	----	0.02	%	4.35	4.31	1.34	2.09	2.36	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
>C16 - C34 Fraction	----	3	mg/kg	8	13	7	13	14	
>C34 - C40 Fraction	----	5	mg/kg	<5	6	<5	<5	5	
>C10 - C40 Fraction (sum)	----	3	mg/kg	8	19	7	13	19	
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<3	<3	<3	<3	<3	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C10 - C14 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C15 - C28 Fraction	----	3	mg/kg	5	8	4	8	9	
C29 - C36 Fraction	----	5	mg/kg	<5	8	<5	8	8	

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Analytical Results

Table with columns: Sub-Matrix: SEDIMENT (Matrix: SOIL), Client sample ID, SL26_0-0.5, SL19_0-0.5, SL19_0.5-1.0, SL15_0-0.5, SL14_0-0.5. Rows include various hydrocarbon fractions (C10, C6-C10, BTEX, Xylenes, Naphthalene) and organotin compounds (Tributyltin) with their respective concentrations and units.

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL26_0-0.5	SL19_0-0.5	SL19_0.5-1.0	SL15_0-0.5	SL14_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-018	ES2026249-019	ES2026249-020	ES2026249-026	ES2026249-027	
				Result	Result	Result	Result	Result	
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	<4	<4	<4	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	<4	<4	<4	
Coronene	191-07-1	5	µg/kg	<5	<5	<5	<5	<5	
^ Sum of PAHs	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	5	5	5	5	5	
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	10	10	10	10	10	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	102	87.3	90.8	77.7	95.4	
Toluene-D8	2037-26-5	0.2	%	105	91.7	104	82.4	98.3	
4-Bromofluorobenzene	460-00-4	0.2	%	115	95.2	101	92.4	101	
EP090S: Organotin Surrogate									
Tripopyltin	----	0.5	%	54.2	81.8	65.4	89.9	81.6	
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%	80.5	74.8	84.0	75.0	94.0	
Anthracene-d10	1719-06-8	10	%	81.0	88.0	107	80.7	117	
4-Terphenyl-d14	1718-51-0	10	%	117	101	106	116	107	

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID				
Client sampling date / time				SL09_0-0.5	SL08_0-0.5	SL08_0.5-1.0	SL03_0-0.5	SL01_0-0.5
Compound	CAS Number	LOR	Unit	ES2026249-028	ES2026249-029	ES2026249-030	ES2026249-031	ES2026249-032
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
Ø pH (F)	----	0.1	pH Unit	8.6	8.7	8.8	8.7	8.8
Ø pH (Fox)	----	0.1	pH Unit	6.4	6.4	6.4	6.4	6.4
Ø Reaction Rate	----	1	-	2	2	2	2	2
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	31.4	33.7	39.2	29.7	39.0
EA150: Particle Sizing								
+75µm	----	1	%	80	75	63	66	62
+150µm	----	1	%	77	73	60	57	60
+300µm	----	1	%	74	69	54	47	57
+425µm	----	1	%	71	63	48	43	53
+600µm	----	1	%	68	56	41	40	47
+1180µm	----	1	%	60	40	30	35	35
+2.36mm	----	1	%	51	26	19	28	24
+4.75mm	----	1	%	39	13	10	20	13
+9.5mm	----	1	%	22	5	5	10	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Clay (<2 µm)	----	1	%	7	14	21	10	22
Silt (2-60 µm)	----	1	%	11	9	16	22	13
Sand (0.06-2.00 mm)	----	1	%	28	47	41	38	38
Gravel (>2mm)	----	1	%	54	30	22	30	27
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.72	2.58	2.64	2.61	2.53
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	5160	7400	8480	5350	7720
Iron	7439-89-6	50	mg/kg	40100	48000	49400	32400	35600
EG020-SD: Total Metals in Sediments by ICPMS								
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	7440-38-2	1.00	mg/kg	22.8	60.5	68.9	41.1	36.5
Cadmium	7440-43-9	0.1	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1
Chromium	7440-47-3	1.0	mg/kg	26.5	26.5	26.1	29.9	26.6

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL09_0-0.5	SL08_0-0.5	SL08_0.5-1.0	SL03_0-0.5	SL01_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	27-Jul-2020 00:00	27-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-028	ES2026249-029	ES2026249-030	ES2026249-031	ES2026249-032	
				Result	Result	Result	Result	Result	
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Copper	7440-50-8	1.0	mg/kg	21.6	3.8	3.8	3.1	4.4	
Lead	7439-92-1	1.0	mg/kg	5.7	9.9	9.5	6.7	9.6	
Manganese	7439-96-5	10	mg/kg	189	218	317	253	137	
Nickel	7440-02-0	1.0	mg/kg	10.2	5.6	5.8	4.6	5.5	
Silver	7440-22-4	0.1	mg/kg	0.6	0.1	<0.1	<0.1	<0.1	
Zinc	7440-66-6	1.0	mg/kg	16.9	11.2	9.7	12.3	13.3	
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg	0.05	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.3	<0.1	0.1	0.1	<0.1	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg	250	370	270	240	420	
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg	250	370	270	240	420	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg	194	978	1100	534	583	
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%	0.11	0.28	0.26	0.13	0.40	
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%	1.67	6.41	5.58	1.74	6.15	
EP003TIC: Total inorganic Carbon (TIC) in Soil									
Total Inorganic Carbon	----	0.02	%	1.56	6.13	5.32	1.61	5.75	
EP080/071: Total Petroleum Hydrocarbons (silica gel cleanup)									
C10 - C14 Fraction	----	3	mg/kg	----	----	----	----	<3	
C15 - C28 Fraction	----	3	mg/kg	----	----	----	----	<3	
C29 - C36 Fraction	----	5	mg/kg	----	----	----	----	<5	
^ C10 - C36 Fraction (sum)	----	3	mg/kg	----	----	----	----	<3	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
>C16 - C34 Fraction	----	3	mg/kg	11	14	10	7	16	
>C34 - C40 Fraction	----	5	mg/kg	<5	<5	<5	<5	6	
>C10 - C40 Fraction (sum)	----	3	mg/kg	11	14	10	7	22	
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<3	<3	<3	<3	<3	

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Analytical Results

Table with columns for Client sample ID, sampling date, and various hydrocarbon fractions (e.g., >C10 - C16 Fraction, C6 - C10 Fraction). Rows include sub-matrix details, compound lists, and results for different sample IDs (SL09_0-0.5, SL08_0-0.5, etc.).

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Analytical Results

Table with columns: Sub-Matrix: SEDIMENT (Matrix: SOIL), Client sample ID, Client sampling date / time, Compound, CAS Number, LOR, Unit, and results for samples SL09_0-0.5, SL08_0-0.5, SL08_0.5-1.0, SL03_0-0.5, and SL01_0-0.5. Includes sections for EP132B: Polynuclear Aromatic Hydrocarbons - Continued, EP080-SD: TPH(V)/BTEX Surrogates, EP090S: Organotin Surrogate, and EP132T: Base/Neutral Extractable Surrogates.

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL01_0.5-1.0	SL10_0-0.5	SL27_0-0.5	SL27_0.5-1.0	SL17_0-0.5
Client sampling date / time				27-Jul-2020 00:00	27-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-033	ES2026249-034	ES2026249-035	ES2026249-036	ES2026249-037	
				Result	Result	Result	Result	Result	
EA037: Ass Field Screening Analysis									
∅ pH (F)	----	0.1	pH Unit	8.7	8.7	8.8	8.5	8.6	
∅ pH (Fox)	----	0.1	pH Unit	6.3	6.4	6.4	6.4	6.4	
∅ Reaction Rate	----	1	-	2	2	2	2	2	
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%	27.3	30.1	32.4	19.9	31.4	
EA150: Particle Sizing									
+75µm	----	1	%	65	67	73	47	69	
+150µm	----	1	%	63	62	71	44	66	
+300µm	----	1	%	60	55	65	41	62	
+425µm	----	1	%	57	51	58	39	56	
+600µm	----	1	%	52	48	52	38	49	
+1180µm	----	1	%	44	42	42	35	35	
+2.36mm	----	1	%	33	32	30	29	25	
+4.75mm	----	1	%	19	20	11	20	18	
+9.5mm	----	1	%	3	6	<1	5	13	
+19.0mm	----	1	%	<1	<1	<1	<1	<1	
+37.5mm	----	1	%	<1	<1	<1	<1	<1	
+75.0mm	----	1	%	<1	<1	<1	<1	<1	
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%	17	12	14	23	16	
Silt (2-60 µm)	----	1	%	18	19	13	27	13	
Sand (0.06-2.00 mm)	----	1	%	29	34	39	19	43	
Gravel (>2mm)	----	1	%	36	35	34	31	28	
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1	
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.61	2.51	2.53	2.63	2.55	
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg	8140	8140	7220	7750	6340	
Iron	7439-89-6	50	mg/kg	43500	42400	66000	51600	34200	
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Arsenic	7440-38-2	1.00	mg/kg	25.2	49.4	77.1	44.8	43.6	
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Chromium	7440-47-3	1.0	mg/kg	36.3	35.7	47.5	31.3	20.3	

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL01_0.5-1.0	SL10_0-0.5	SL27_0-0.5	SL27_0.5-1.0	SL17_0-0.5
Client sampling date / time					27-Jul-2020 00:00	27-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00
Compound	CAS Number	LOR	Unit	ES2026249-033	ES2026249-034	ES2026249-035	ES2026249-036	ES2026249-037	
				Result	Result	Result	Result	Result	
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Copper	7440-50-8	1.0	mg/kg	7.9	3.8	6.5	9.4	3.6	
Lead	7439-92-1	1.0	mg/kg	7.9	9.3	15.8	13.1	13.1	
Manganese	7439-96-5	10	mg/kg	173	243	226	156	181	
Nickel	7440-02-0	1.0	mg/kg	8.0	6.2	5.6	5.1	5.3	
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Zinc	7440-66-6	1.0	mg/kg	12.4	15.6	12.4	6.8	15.4	
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg	0.01	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg	230	300	440	170	310	
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg	230	300	440	170	310	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg	594	591	1010	437	493	
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%	0.27	0.19	0.36	0.18	0.21	
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%	4.76	3.72	3.75	0.98	4.70	
EP003TIC: Total inorganic Carbon (TIC) in Soil									
Total Inorganic Carbon	----	0.02	%	4.49	3.53	3.39	0.80	4.49	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
>C16 - C34 Fraction	----	3	mg/kg	13	12	15	7	12	
>C34 - C40 Fraction	----	5	mg/kg	<5	<5	6	<5	<5	
>C10 - C40 Fraction (sum)	----	3	mg/kg	13	12	21	7	12	
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<3	<3	<3	<3	<3	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C10 - C14 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C15 - C28 Fraction	----	3	mg/kg	9	9	11	5	8	
C29 - C36 Fraction	----	5	mg/kg	6	5	7	<5	5	

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL01_0.5-1.0	SL10_0-0.5	SL27_0-0.5	SL27_0.5-1.0	SL17_0-0.5		
Client sampling date / time				27-Jul-2020 00:00	27-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00			
Compound	CAS Number	LOR	Unit	ES2026249-033	ES2026249-034	ES2026249-035	ES2026249-036	ES2026249-037			
				Result	Result	Result	Result	Result			
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons - Continued											
^ C10 - C36 Fraction (sum)				----	3	mg/kg	15	14	18	5	13
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons											
C6 - C10 Fraction				C6_C10	3	mg/kg	<3	<3	<3	<3	<3
C6 - C10 Fraction minus BTEX (F1)				C6_C10-BTEX	3.0	mg/kg	<3.0	<3.0	<3.0	<3.0	<3.0
EP080-SD: BTEXN											
Benzene				71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene				108-88-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Ethylbenzene				100-41-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
meta- & para-Xylene				108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
ortho-Xylene				95-47-6	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes				----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX				----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Naphthalene				91-20-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
EP090: Organotin Compounds											
Tributyltin				56573-85-4	0.5	µgSn/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP132B: Polynuclear Aromatic Hydrocarbons											
Naphthalene				91-20-3	5	µg/kg	<5	<5	<5	<5	<5
2-Methylnaphthalene				91-57-6	5	µg/kg	<5	<5	<5	<5	<5
Acenaphthylene				208-96-8	4	µg/kg	<4	<4	<4	<4	<4
Acenaphthene				83-32-9	4	µg/kg	<4	<4	<4	<4	<4
Fluorene				86-73-7	4	µg/kg	<4	<4	<4	<4	<4
Phenanthrene				85-01-8	4	µg/kg	<4	<4	<4	<4	<4
Anthracene				120-12-7	4	µg/kg	<4	<4	<4	<4	<4
Fluoranthene				206-44-0	4	µg/kg	<4	<4	<4	<4	<4
Pyrene				129-00-0	4	µg/kg	<4	<4	<4	<4	<4
Benz(a)anthracene				56-55-3	4	µg/kg	<4	<4	<4	<4	<4
Chrysene				218-01-9	4	µg/kg	<4	<4	<4	<4	<4
Benzo(b+j)fluoranthene				205-99-2 205-82-3	4	µg/kg	<4	<4	<4	<4	<4
Benzo(k)fluoranthene				207-08-9	4	µg/kg	<4	<4	<4	<4	<4
Benzo(e)pyrene				192-97-2	4	µg/kg	<4	<4	<4	<4	<4
Benzo(a)pyrene				50-32-8	4	µg/kg	<4	<4	<4	<4	<4
Perylene				198-55-0	4	µg/kg	<4	<4	<4	<4	<4
Benzo(g,h,i)perylene				191-24-2	4	µg/kg	<4	<4	<4	<4	<4

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL01_0.5-1.0	SL10_0-0.5	SL27_0-0.5	SL27_0.5-1.0	SL17_0-0.5
Client sampling date / time				27-Jul-2020 00:00	27-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-033	ES2026249-034	ES2026249-035	ES2026249-036	ES2026249-037	
				Result	Result	Result	Result	Result	
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	<4	<4	<4	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	<4	<4	<4	
Coronene	191-07-1	5	µg/kg	<5	<5	<5	<5	<5	
^ Sum of PAHs	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	5	5	5	5	5	
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	10	10	10	10	10	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	79.1	84.3	95.8	86.0	96.7	
Toluene-D8	2037-26-5	0.2	%	99.7	105	95.1	86.5	96.3	
4-Bromofluorobenzene	460-00-4	0.2	%	108	113	102	97.3	99.3	
EP090S: Organotin Surrogate									
Tripopyltin	----	0.5	%	83.8	90.5	91.0	94.5	93.8	
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%	94.1	83.4	99.9	105	88.4	
Anthracene-d10	1719-06-8	10	%	86.6	87.4	89.3	111	100	
4-Terphenyl-d14	1718-51-0	10	%	117	115	110	115	111	

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL16_1.0-1.5	SL16_0.5-1.0	SL16_0-0.5	SL13_0.5-1.0	SL13_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-038	ES2026249-039	ES2026249-040	ES2026249-041	ES2026249-042	
				Result	Result	Result	Result	Result	
EA037: Ass Field Screening Analysis									
∅ pH (F)	----	0.1	pH Unit	8.7	8.7	8.7	8.7	8.8	
∅ pH (Fox)	----	0.1	pH Unit	6.3	6.4	6.3	6.6	6.5	
∅ Reaction Rate	----	1	-	2	2	2	2	2	
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%	32.6	38.4	36.0	30.8	39.1	
EA150: Particle Sizing									
+75µm	----	1	%	24	56	65	68	72	
+150µm	----	1	%	23	55	64	62	66	
+300µm	----	1	%	21	53	60	54	57	
+425µm	----	1	%	20	49	56	49	50	
+600µm	----	1	%	18	45	50	44	42	
+1180µm	----	1	%	15	37	39	34	25	
+2.36mm	----	1	%	12	32	29	21	13	
+4.75mm	----	1	%	8	26	16	10	8	
+9.5mm	----	1	%	3	13	4	4	2	
+19.0mm	----	1	%	<1	<1	<1	<1	<1	
+37.5mm	----	1	%	<1	<1	<1	<1	<1	
+75.0mm	----	1	%	<1	<1	<1	<1	<1	
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%	10	15	16	14	14	
Silt (2-60 µm)	----	1	%	64	26	18	15	14	
Sand (0.06-2.00 mm)	----	1	%	13	25	34	46	55	
Gravel (>2mm)	----	1	%	13	34	32	25	17	
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1	
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.50	2.35	2.48	2.66	2.63	
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg	7470	9180	7540	8930	7480	
Iron	7439-89-6	50	mg/kg	27700	68400	36200	63100	36800	
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Arsenic	7440-38-2	1.00	mg/kg	26.8	35.2	30.5	57.4	47.6	
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Chromium	7440-47-3	1.0	mg/kg	23.8	45.5	28.9	73.3	24.2	

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Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL16_1.0-1.5	SL16_0.5-1.0	SL16_0-0.5	SL13_0.5-1.0	SL13_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-038	ES2026249-039	ES2026249-040	ES2026249-041	ES2026249-042	
				Result	Result	Result	Result	Result	
EG020-SD: Total Metals in Sediments by ICPMS - Continued									
Copper	7440-50-8	1.0	mg/kg	24.9	8.1	7.3	4.5	3.1	
Lead	7439-92-1	1.0	mg/kg	8.3	50.8	9.0	19.8	9.0	
Manganese	7439-96-5	10	mg/kg	149	211	124	272	237	
Nickel	7440-02-0	1.0	mg/kg	15.3	8.6	5.7	8.0	5.4	
Silver	7440-22-4	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Zinc	7440-66-6	1.0	mg/kg	28.8	13.6	16.5	16.6	12.1	
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg	0.02	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	0.1	0.4	<0.1	0.1	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg	430	500	330	170	320	
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg	430	500	330	170	320	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg	399	524	490	668	703	
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%	0.36	0.42	0.36	0.23	0.32	
EP003TC: Total Carbon (TC) in Soil									
Total Carbon	TC	0.02	%	2.84	3.89	3.70	3.67	6.96	
EP003TIC: Total inorganic Carbon (TIC) in Soil									
Total Inorganic Carbon	----	0.02	%	2.48	3.47	3.34	3.44	6.64	
EP080/071: Total Petroleum Hydrocarbons (silica gel cleanup)									
C10 - C14 Fraction	----	3	mg/kg	----	----	<3	----	----	
C15 - C28 Fraction	----	3	mg/kg	----	----	<3	----	----	
C29 - C36 Fraction	----	5	mg/kg	----	----	<5	----	----	
^ C10 - C36 Fraction (sum)	----	3	mg/kg	----	----	<3	----	----	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
>C10 - C16 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
>C16 - C34 Fraction	----	3	mg/kg	18	19	21	14	<3	
>C34 - C40 Fraction	----	5	mg/kg	<5	10	10	6	<5	
>C10 - C40 Fraction (sum)	----	3	mg/kg	18	29	31	20	<3	
>C10 - C16 Fraction minus Naphthalene (F2)	----	3	mg/kg	<3	<3	<3	<3	<3	

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Table with columns for Client sample ID, Client sampling date / time, Compound, CAS Number, LOR, Unit, and results for various sample IDs (SL16_1.0-1.5, SL16_0.5-1.0, SL16_0-0.5, SL13_0.5-1.0, SL13_0-0.5). Rows include sections for Total Recoverable Hydrocarbons (NEPM 2013 Fractions), Total Petroleum Hydrocarbons, Total Recoverable Hydrocarbons (minus BTEX), BTEXN, Organotin Compounds, and Polynuclear Aromatic Hydrocarbons.

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Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL16_1.0-1.5	SL16_0.5-1.0	SL16_0-0.5	SL13_0.5-1.0	SL13_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-038	ES2026249-039	ES2026249-040	ES2026249-041	ES2026249-042	
				Result	Result	Result	Result	Result	
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Fluoranthene	206-44-0	4	µg/kg	<4	<4	----	<4	<4	
Pyrene	129-00-0	4	µg/kg	<4	<4	----	<4	<4	
Benzo(a)anthracene	56-55-3	4	µg/kg	<4	<4	----	<4	<4	
Chrysene	218-01-9	4	µg/kg	<4	<4	----	<4	<4	
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	----	<4	<4	
Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	----	<4	<4	
Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	----	<4	<4	
Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	----	<4	<4	
Perylene	198-55-0	4	µg/kg	<4	<4	----	<4	<4	
Benzo(g,h,i)perylene	191-24-2	4	µg/kg	<4	<4	----	<4	<4	
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	----	<4	<4	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	----	<4	<4	
Coronene	191-07-1	5	µg/kg	<5	<5	----	<5	<5	
^ Sum of PAHs	----	4	µg/kg	<4	<4	----	<4	<4	
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	----	<4	<4	
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	5	5	----	5	5	
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	10	10	----	10	10	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	90.4	96.5	87.1	84.7	97.4	
Toluene-D8	2037-26-5	0.2	%	96.6	101	92.4	85.4	101	
4-Bromofluorobenzene	460-00-4	0.2	%	101	106	104	98.5	105	
EP090S: Organotin Surrogate									
Tripopyltin	----	0.5	%	96.6	87.9	71.0	95.9	72.0	
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%	72.7	73.4	----	81.6	85.7	
Anthracene-d10	1719-06-8	10	%	76.3	86.1	----	76.8	84.7	
4-Terphenyl-d14	1718-51-0	10	%	119	105	----	100	109	

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL21_0-0.5	SL21_0.5-0.8	SL18_0-0.5	SL24_0-0.5	SL06_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-043	ES2026249-044	ES2026249-045	ES2026249-046	ES2026249-047	
				Result	Result	Result	Result	Result	
EA037: Ass Field Screening Analysis									
∅ pH (F)	----	0.1	pH Unit	8.9	9.2	8.9	8.5	8.6	
∅ pH (Fox)	----	0.1	pH Unit	6.5	6.5	6.5	8.2	6.5	
∅ Reaction Rate	----	1	-	2	2	2	3	2	
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%	32.3	25.1	35.6	29.6	27.4	
EA150: Particle Sizing									
+75µm	----	1	%	59	7	73	67	82	
+150µm	----	1	%	53	4	64	65	79	
+300µm	----	1	%	45	3	46	60	74	
+425µm	----	1	%	40	3	40	54	68	
+600µm	----	1	%	35	2	36	48	59	
+1180µm	----	1	%	28	2	28	37	46	
+2.36mm	----	1	%	17	1	18	27	33	
+4.75mm	----	1	%	5	<1	8	13	19	
+9.5mm	----	1	%	<1	<1	<1	2	11	
+19.0mm	----	1	%	<1	<1	<1	<1	<1	
+37.5mm	----	1	%	<1	<1	<1	<1	<1	
+75.0mm	----	1	%	<1	<1	<1	<1	<1	
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%	20	32	11	1	12	
Silt (2-60 µm)	----	1	%	20	59	16	32	4	
Sand (0.06-2.00 mm)	----	1	%	40	7	52	37	47	
Gravel (>2mm)	----	1	%	20	2	21	30	37	
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1	
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.59	2.38	2.64	2.60	2.67	
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg	7690	7020	6390	3640	3300	
Iron	7439-89-6	50	mg/kg	48400	26700	28000	38700	24400	
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Arsenic	7440-38-2	1.00	mg/kg	48.0	11.5	33.4	75.9	31.1	
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Chromium	7440-47-3	1.0	mg/kg	33.0	20.8	17.6	20.8	15.4	

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Table with columns for Client sample ID, Client sampling date / time, Compound, CAS Number, LOR, Unit, and results for various sample IDs (SL21_0-0.5, SL21_0.5-0.8, SL18_0-0.5, SL24_0-0.5, SL06_0-0.5). Rows include sections for Total Metals in Sediments, Total Recoverable Mercury, Nitrite plus Nitrate as N, Total Kjeldahl Nitrogen, Total Nitrogen as N, Total Phosphorus as P, Total Organic Carbon, Total Carbon, Total inorganic Carbon, and Total Petroleum Hydrocarbons.

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Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL21_0-0.5	SL21_0.5-0.8	SL18_0-0.5	SL24_0-0.5	SL06_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-043	ES2026249-044	ES2026249-045	ES2026249-046	ES2026249-047	
				Result	Result	Result	Result	Result	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 fractions (silica gel cleanup)									
>C10 - C16 Fraction	----	3	mg/kg	----	----	<3	----	----	
>C16 - C34 Fraction	----	3	mg/kg	----	----	<3	----	----	
>C34 - C40 Fraction	----	5	mg/kg	----	----	<5	----	----	
^ >C10 - C40 Fraction (sum)	----	3	mg/kg	----	----	<3	----	----	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C10 - C14 Fraction	----	3	mg/kg	<3	<3	<3	<3	<3	
C15 - C28 Fraction	----	3	mg/kg	6	4	10	7	5	
C29 - C36 Fraction	----	5	mg/kg	6	<5	9	<5	<5	
^ C10 - C36 Fraction (sum)	----	3	mg/kg	12	4	19	7	5	
EP080-SD / EP071-SD: Total Recoverable Hydrocarbons									
C6 - C10 Fraction	C6_C10	3	mg/kg	<3	<3	<3	<3	<3	
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	3.0	mg/kg	<3.0	<3.0	<3.0	<3.0	<3.0	
EP080-SD: BTEXN									
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
Toluene	108-88-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
Ethylbenzene	100-41-4	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
meta- & para-Xylene	108-38-3 106-42-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
ortho-Xylene	95-47-6	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
^ Total Xylenes	----	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	
^ Sum of BTEX	----	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
Naphthalene	91-20-3	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	
EP090: Organotin Compounds									
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	<0.5	<0.5	34.9	
EP132B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	5	µg/kg	<5	<5	----	<5	<5	
2-Methylnaphthalene	91-57-6	5	µg/kg	<5	<5	----	<5	12	
Acenaphthylene	208-96-8	4	µg/kg	<4	<4	----	<4	<4	
Acenaphthene	83-32-9	4	µg/kg	<4	<4	----	<4	<4	
Fluorene	86-73-7	4	µg/kg	<4	<4	----	<4	<4	
Phenanthrene	85-01-8	4	µg/kg	<4	<4	----	<4	15	
Anthracene	120-12-7	4	µg/kg	<4	<4	----	<4	<4	

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Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL21_0-0.5	SL21_0.5-0.8	SL18_0-0.5	SL24_0-0.5	SL06_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-043	ES2026249-044	ES2026249-045	ES2026249-046	ES2026249-047	
				Result	Result	Result	Result	Result	
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Fluoranthene	206-44-0	4	µg/kg	<4	<4	----	<4	18	
Pyrene	129-00-0	4	µg/kg	<4	<4	----	<4	15	
Benzo(a)anthracene	56-55-3	4	µg/kg	<4	<4	----	<4	6	
Chrysene	218-01-9	4	µg/kg	<4	<4	----	<4	7	
Benzo(b+j)fluoranthene	205-99-2 205-82-3	4	µg/kg	<4	<4	----	<4	7	
Benzo(k)fluoranthene	207-08-9	4	µg/kg	<4	<4	----	<4	<4	
Benzo(e)pyrene	192-97-2	4	µg/kg	<4	<4	----	<4	<4	
Benzo(a)pyrene	50-32-8	4	µg/kg	<4	<4	----	<4	6	
Perylene	198-55-0	4	µg/kg	<4	<4	----	<4	<4	
Benzo(g,h,i)perylene	191-24-2	4	µg/kg	<4	<4	----	<4	4	
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	----	<4	<4	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	----	<4	<4	
Coronene	191-07-1	5	µg/kg	<5	<5	----	<5	<5	
^ Sum of PAHs	----	4	µg/kg	<4	<4	----	<4	90	
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	----	<4	7	
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	5	5	----	5	10	
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	10	10	----	10	12	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	98.4	91.4	99.5	84.4	89.2	
Toluene-D8	2037-26-5	0.2	%	105	91.8	100	104	98.5	
4-Bromofluorobenzene	460-00-4	0.2	%	109	98.8	97.3	93.3	88.9	
EP090S: Organotin Surrogate									
Tripopyltin	----	0.5	%	81.3	81.5	94.8	55.7	56.0	
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%	61.3	92.7	----	83.7	75.1	
Anthracene-d10	1719-06-8	10	%	73.9	89.4	----	89.1	76.6	
4-Terphenyl-d14	1718-51-0	10	%	92.6	122	----	118	99.1	

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Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL28_0.5-1.0	SL28_0-0.5	SL05B_0-0.5	LS22B_0-0.5	SL22C_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	30-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-048	ES2026249-049	ES2026249-050	ES2026249-051	ES2026249-052	
				Result	Result	Result	Result	Result	
EA037: Ass Field Screening Analysis									
ø pH (F)	----	0.1	pH Unit	8.3	8.9	8.7	8.6	8.7	
ø pH (Fox)	----	0.1	pH Unit	6.4	6.4	6.5	6.4	6.4	
ø Reaction Rate	----	1	-	2	2	2	2	2	
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%	29.4	38.1	31.0	46.6	41.4	
EA150: Particle Sizing									
+75µm	----	1	%	45	64	65	69	71	
+150µm	----	1	%	42	60	62	66	68	
+300µm	----	1	%	39	53	54	62	61	
+425µm	----	1	%	38	48	47	58	56	
+600µm	----	1	%	37	42	41	53	49	
+1180µm	----	1	%	34	30	27	41	34	
+2.36mm	----	1	%	26	16	14	29	20	
+4.75mm	----	1	%	12	5	3	21	11	
+9.5mm	----	1	%	3	<1	<1	6	2	
+19.0mm	----	1	%	<1	<1	<1	<1	<1	
+37.5mm	----	1	%	<1	<1	<1	<1	<1	
+75.0mm	----	1	%	<1	<1	<1	<1	<1	
EA150: Soil Classification based on Particle Size									
Clay (<2 µm)	----	1	%	26	18	17	18	18	
Silt (2-60 µm)	----	1	%	28	18	11	12	9	
Sand (0.06-2.00 mm)	----	1	%	17	44	54	37	48	
Gravel (>2mm)	----	1	%	29	20	18	33	25	
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1	
EA152: Soil Particle Density									
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.74	2.63	2.64	2.64	2.59	
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES									
Aluminium	7429-90-5	50	mg/kg	10100	8070	7800	1850	5450	
Iron	7439-89-6	50	mg/kg	56000	36400	70100	2950	37200	
EG020-SD: Total Metals in Sediments by ICPMS									
Antimony	7440-36-0	0.50	mg/kg	<0.50	<0.50	0.52	<0.50	<0.50	
Arsenic	7440-38-2	1.00	mg/kg	42.5	48.6	75.8	3.10	42.4	
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	
Chromium	7440-47-3	1.0	mg/kg	89.2	31.7	58.3	3.6	23.0	

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Analytical Results

Table with columns for Sub-Matrix (SEDIMENT), Client sample ID, and various sample IDs (SL28_0.5-1.0, SL28_0-0.5, SL05B_0-0.5, LS22B_0-0.5, SL22C_0-0.5). Rows include compound names (Copper, Lead, Manganese, Nickel, Silver, Zinc), test methods (EG020-SD, EG035T, EK059G, EK061G, EK062, EK067G, EP003, EP003TC, EP003TIC, EP080/071, EP080-SD/EP071-SD), and results in mg/kg or %.

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Client : AECOM Australia Pty Ltd
Project : 60566025 Darwin Sediment Sampling



Analytical Results

Table with columns for Client sample ID, Client sampling date / time, Compound, CAS Number, LOR, Unit, and results for various sample IDs (SL28, SL05B, LS22B, SL22C). Includes sections for Total Petroleum Hydrocarbons, Total Recoverable Hydrocarbons, BTEXN, Organotin Compounds, and Polynuclear Aromatic Hydrocarbons.

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Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)				Client sample ID	SL28_0.5-1.0	SL28_0-0.5	SL05B_0-0.5	LS22B_0-0.5	SL22C_0-0.5
Client sampling date / time				28-Jul-2020 00:00	28-Jul-2020 00:00	29-Jul-2020 00:00	29-Jul-2020 00:00	30-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-048	ES2026249-049	ES2026249-050	ES2026249-051	ES2026249-052	
				Result	Result	Result	Result	Result	
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Dibenz(a,h)anthracene	53-70-3	4	µg/kg	<4	<4	<4	<4	<4	
Indeno(1.2.3.cd)pyrene	193-39-5	4	µg/kg	<4	<4	<4	<4	<4	
Coronene	191-07-1	5	µg/kg	<5	<5	<5	<5	<5	
^ Sum of PAHs	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (zero)	----	4	µg/kg	<4	<4	<4	<4	<4	
^ Benzo(a)pyrene TEQ (half LOR)	----	4	µg/kg	5	5	5	5	5	
^ Benzo(a)pyrene TEQ (LOR)	----	4	µg/kg	10	10	10	10	10	
EP080-SD: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.2	%	96.1	81.4	94.0	84.6	85.9	
Toluene-D8	2037-26-5	0.2	%	105	88.5	104	92.6	90.5	
4-Bromofluorobenzene	460-00-4	0.2	%	96.7	83.0	92.4	89.6	109	
EP090S: Organotin Surrogate									
Tripopyltin	----	0.5	%	115	96.3	101	118	85.0	
EP132T: Base/Neutral Extractable Surrogates									
2-Fluorobiphenyl	321-60-8	10	%	84.6	76.6	88.7	78.8	76.6	
Anthracene-d10	1719-06-8	10	%	83.7	81.4	95.8	78.4	96.0	
4-Terphenyl-d14	1718-51-0	10	%	109	105	105	101	114	

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Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SLRB03	SLFB03	SLRB01	SLFB01	SLRB02
Client sampling date / time				29-Jul-2020 00:00	29-Jul-2020 00:00	27-Jul-2020 00:00	27-Jul-2020 00:00	28-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2026249-006	ES2026249-007	ES2026249-021	ES2026249-022	ES2026249-023	
				Result	Result	Result	Result	Result	
EG020T: Total Metals by ICP-MS									
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	

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Analytical Results

Table with columns for Client sample ID, SLFB02, SLTB01 TRIP BLANK, SLTB01 TRIP BLANK 1, SLTB01 TRIP BLANK 2, and SLTB01 TRIP BLANK 3. Rows include various chemical analyses such as EG020T: Total Metals by ICP-MS, EP080/071: Total Petroleum Hydrocarbons, EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions, EP080: BTEXN, and EP080S: TPH(V)/BTEX Surrogates.

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Analytical Results

Table with columns for Client sample ID, SLTB01 TRIP BLANK 4-8, and various chemical compounds like EP080/071: Total Petroleum Hydrocarbons, EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions, EP080: BTEXN, and EP080S: TPH(V)/BTEX Surrogates.

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Analytical Results

Table with columns for Client sample ID, SLTB01 TRIP BLANK 9-13, Client sampling date / time, Compound, CAS Number, LOR, Unit, and Result. Rows include EP080/071: Total Petroleum Hydrocarbons, EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions, EP080: BTEXN, and EP080S: TPH(V)/BTEX Surrogates.



Surrogate Control Limits

Sub-Matrix: SEDIMENT		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP080-SD: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	67	137
Toluene-D8	2037-26-5	74	134
4-Bromofluorobenzene	460-00-4	73	137
EP090S: Organotin Surrogate			
Tripropyltin	----	35	130
EP132T: Base/Neutral Extractable Surrogates			
2-Fluorobiphenyl	321-60-8	55	135
Anthracene-d10	1719-06-8	70	136
4-Terphenyl-d14	1718-51-0	57	127

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

QUALITY CONTROL REPORT

Work Order	: ES2026249	Page	: 1 of 25
Amendment	: (Preliminary Report)		
Client	: AECOM Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: PETER YOUNG	Contact	: Brenda Hong
Address	: GPO BOX 3175 DARWIN NT, AUSTRALIA 0801	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: 6432 2000	Telephone	: +61 2 8784 8555
Project	: 60566025 Darwin Sediment Sampling	Date Samples Received	: 31-Jul-2020
Order number	: 60566025	Date Analysis Commenced	: 04-Aug-2020
C-O-C number	: ----	Issue Date	: 27-Aug-2020
Sampler	: Will Riddell		
Site	: ----		
Quote number	: EP/036/20 V4		
No. of samples received	: 65		
No. of samples analysed	: 65		



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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW
Minh Wills	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Morgan Lennox		Brisbane Organics, Stafford, QLD

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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 (%)
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QC Lot: 3191128)									
ES2026249-001	SL23_0.5-1.0	EG005-SD: Aluminium	7429-90-5	50	mg/kg	11500	11200	3.23	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	49700	57400	14.3	0% - 20%
ES2026249-013	SL22_0-0.5	EG005-SD: Aluminium	7429-90-5	50	mg/kg	8640	9130	5.58	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	44500	44500	0.136	0% - 20%
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QC Lot: 3191130)									
ES2026249-028	SL09_0-0.5	EG005-SD: Aluminium	7429-90-5	50	mg/kg	5160	5070	1.76	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	40100	37400	6.95	0% - 20%
ES2026249-038	SL16_1.0-1.5	EG005-SD: Aluminium	7429-90-5	50	mg/kg	7470	6260	17.7	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	27700	28500	2.94	0% - 20%
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QC Lot: 3196155)									
ES2026249-048	SL28_0.5-1.0	EG005-SD: Aluminium	7429-90-5	50	mg/kg	10100	8420	18.4	0% - 20%
		EG005-SD: Iron	7439-89-6	50	mg/kg	56000	48600	14.2	0% - 20%
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QC Lot: 3191126)									
ES2026249-001	SL23_0.5-1.0	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
ES2026249-013	SL22_0-0.5	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QC Lot: 3191131)									
ES2026249-028	SL09_0-0.5	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	0.05	0.04	0.00	No Limit
ES2026249-038	SL16_1.0-1.5	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	0.02	0.01	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QC Lot: 3196156)									
ES2026249-048	SL28_0.5-1.0	EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	0.00	No Limit
EA037: Ass Field Screening Analysis (QC Lot: 3183450)									
EB2020446-001	Anonymous	EA037: pH (F)	----	0.1	pH Unit	5.6	5.5	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	3.6	3.7	0.00	0% - 20%
ES2026249-011	SL29_0.5-1.0	EA037: pH (F)	----	0.1	pH Unit	8.7	8.9	1.48	0% - 20%

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Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, LOR, Unit, Original Result, Duplicate Result, RPD (%), Recovery Limits (%). Rows include EA037: Ass Field Screening Analysis (pH) and EA055: Moisture Content (Dried @ 105-110°C) and EG020-SD: Total Metals in Sediments by ICPMS.

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Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, LOR, Unit, Original Result, Duplicate Result, RPD (%), Recovery Limits (%). Rows include various sediment samples (e.g., EG020-SD, EK059G) and their corresponding metal analysis results.

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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 (%)
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3196152)									
ES2026249-008	SL05_0-0.5	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.1	<0.1	0.00	No Limit
ES2026249-027	SL14_0-0.5	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.1	<0.1	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 3196153)									
ES2026249-038	SL16_1.0-1.5	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
ES2026249-047	SL06_0-0.5	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3194488)									
ES2026249-001	SL23_0.5-1.0	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	260	# 20	168	0% - 50%
ES2026249-012	SL29_1.0-1.5	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	220	210	6.60	0% - 50%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3194490)									
ES2026249-029	SL08_0-0.5	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	370	330	11.7	0% - 50%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 3196653)									
ES2026249-036	SL27_0.5-1.0	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	170	140	18.2	No Limit
ES2026249-045	SL18_0-0.5	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	330	280	15.2	0% - 50%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3194487)									
ES2026249-001	SL23_0.5-1.0	EK067G: Total Phosphorus as P	----	2	mg/kg	582	# 73	156	0% - 20%
ES2026249-012	SL29_1.0-1.5	EK067G: Total Phosphorus as P	----	2	mg/kg	757	# 1140	40.6	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3194489)									
ES2026249-029	SL08_0-0.5	EK067G: Total Phosphorus as P	----	2	mg/kg	978	# 673	37.0	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 3196654)									
ES2026249-036	SL27_0.5-1.0	EK067G: Total Phosphorus as P	----	2	mg/kg	437	509	15.1	0% - 20%
ES2026249-045	SL18_0-0.5	EK067G: Total Phosphorus as P	----	2	mg/kg	559	490	13.0	0% - 20%
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 3194732)									
ES2026249-001	SL23_0.5-1.0	EP003: Total Organic Carbon	----	0.02	%	0.34	0.32	7.38	0% - 50%
ES2026249-013	SL22_0-0.5	EP003: Total Organic Carbon	----	0.02	%	0.30	0.32	5.82	0% - 50%
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 3194734)									
ES2026249-028	SL09_0-0.5	EP003: Total Organic Carbon	----	0.02	%	0.11	0.12	0.00	No Limit
ES2026249-038	SL16_1.0-1.5	EP003: Total Organic Carbon	----	0.02	%	0.36	0.37	4.90	0% - 50%
EP003: Total Organic Carbon (TOC) in Soil (QC Lot: 3194736)									
ES2026249-048	SL28_0.5-1.0	EP003: Total Organic Carbon	----	0.02	%	0.18	0.16	9.72	No Limit
EP003TC: Total Carbon (TC) in Soil (QC Lot: 3194733)									
ES2026249-001	SL23_0.5-1.0	EP003TC: Total Carbon	TC	0.02	%	2.85	2.90	1.68	0% - 20%
ES2026249-013	SL22_0-0.5	EP003TC: Total Carbon	TC	0.02	%	7.16	7.17	0.00	0% - 20%
EP003TC: Total Carbon (TC) in Soil (QC Lot: 3194735)									
ES2026249-028	SL09_0-0.5	EP003TC: Total Carbon	TC	0.02	%	1.67	1.67	0.00	0% - 20%
ES2026249-038	SL16_1.0-1.5	EP003TC: Total Carbon	TC	0.02	%	2.84	2.78	2.41	0% - 20%
EP003TC: Total Carbon (TC) in Soil (QC Lot: 3194737)									
ES2026249-048	SL28_0.5-1.0	EP003TC: Total Carbon	TC	0.02	%	0.78	0.79	0.00	0% - 20%

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Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, LOR, Unit, Original Result, Duplicate Result, RPD (%), Recovery Limits (%). Rows include various hydrocarbon fraction analyses (e.g., EP071-SD: C10 - C14 Fraction) and total petroleum hydrocarbon reports for different QC lots (3174628, 3174629, 3174630, 3188261, 3188285, 3188293, 3196306).

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Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, LOR, Unit, Original Result, Duplicate Result, RPD (%), Recovery Limits (%). Rows include various hydrocarbon and BTEXN analysis results for different sample IDs and methods.

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Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, LOR, Unit, Original Result, Duplicate Result, RPD (%), Recovery Limits (%). Rows include EP080-SD: BTEXN (QC Lot: 3188293), EP080-SD: BTEXN (QC Lot: 3196306), EP090: Organotin Compounds (QC Lot: 3179116), EP090: Organotin Compounds (QC Lot: 3179117), and EP132B: Polynuclear Aromatic Hydrocarbons (QC Lot: 3204904).

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Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, LOR, Unit, Original Result, Duplicate Result, RPD (%), Recovery Limits (%). Rows include sub-matrix SOIL and various polynuclear aromatic hydrocarbons (PAHs) such as Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Naphthalene, etc.

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Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, LOR, Unit, Original Result, Duplicate Result, RPD (%), Recovery Limits (%). Rows include sub-matrix SOIL and various polynuclear aromatic hydrocarbons (PAHs) such as Benzo(k)fluoranthene, Benzo(e)pyrene, etc.

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Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, LOR, Unit, Original Result, Duplicate Result, RPD (%), Recovery Limits (%). Includes sub-matrices for SOIL (Polynuclear Aromatic Hydrocarbons) and WATER (Total Metals by ICP-MS).

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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 (%)	
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3177095)										
ES2026359-040	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit	
ES2026359-041	Anonymous	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.00	No Limit	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3177095)										
ES2026359-040	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit	
ES2026359-041	Anonymous	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.00	No Limit	
EP080: BTEXN (QC Lot: 3177095)										
ES2026359-040	Anonymous	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit	
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit	
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit	
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.00	No Limit	
			106-42-3							
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit	
ES2026359-041	Anonymous	EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit	
		EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.00	No Limit	
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.00	No Limit	
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.00	No Limit	
		EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	<2	0.00	No Limit	
			106-42-3							
	EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.00	No Limit		
	EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.00	No Limit		

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Client : AECOM Australia Pty Ltd
Project : 60566025 Darwin Sediment Sampling

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			
				Result	Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit			LCS	Low	High
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QCLot: 3191128)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	13267 mg/kg	119	88.2	136
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	27922 mg/kg	105	70.0	109
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QCLot: 3191130)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	13267 mg/kg	118	88.2	136
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	27922 mg/kg	106	70.0	109
EG005(ED093)-SD: Total Metals in Sediments by ICP-AES (QCLot: 3196155)								
EG005-SD: Aluminium	7429-90-5	50	mg/kg	<50	13267 mg/kg	125	88.2	136
EG005-SD: Iron	7439-89-6	50	mg/kg	<50	27922 mg/kg	109	70.0	109
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 3191126)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	0.0847 mg/kg	85.0	72.0	116
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 3191131)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	0.0847 mg/kg	93.3	72.0	116
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 3196156)								
EG035T-LL: Mercury	7439-97-6	0.01	mg/kg	<0.01	0.0847 mg/kg	93.9	72.0	116
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 3191127)								
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	----	----	----	----
EG020-SD: Arsenic	7440-38-2	1	mg/kg	<1.00	98 mg/kg	115	80.0	139
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	0.74 mg/kg	111	83.0	127
EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	15.4 mg/kg	118	73.0	130
EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	48 mg/kg	107	76.0	130
EG020-SD: Lead	7439-92-1	1	mg/kg	<1.0	50 mg/kg	122	74.0	130
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	482 mg/kg	121	76.0	130
EG020-SD: Nickel	7440-02-0	1	mg/kg	<1.0	12.4 mg/kg	117	83.0	130
EG020-SD: Silver	7440-22-4	0.1	mg/kg	<0.1	----	----	----	----
EG020-SD: Zinc	7440-66-6	1	mg/kg	<1.0	115 mg/kg	113	82.0	137
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 3191129)								
EG020-SD: Antimony	7440-36-0	0.5	mg/kg	<0.50	----	----	----	----
EG020-SD: Arsenic	7440-38-2	1	mg/kg	<1.00	98 mg/kg	114	80.0	139
EG020-SD: Cadmium	7440-43-9	0.1	mg/kg	<0.1	0.74 mg/kg	116	83.0	127
EG020-SD: Chromium	7440-47-3	1	mg/kg	<1.0	15.4 mg/kg	115	73.0	130
EG020-SD: Copper	7440-50-8	1	mg/kg	<1.0	48 mg/kg	102	76.0	130
EG020-SD: Lead	7439-92-1	1	mg/kg	<1.0	50 mg/kg	130	74.0	130
EG020-SD: Manganese	7439-96-5	10	mg/kg	<10	482 mg/kg	114	76.0	130

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Sub-Matrix: SOIL

Table with columns: Method/Compound, CAS Number, LOR, Unit, Method Blank (MB) Report Result, Laboratory Control Spike (LCS) Report Spike Concentration, Spike Recovery (%), and Recovery Limits (%). Rows include various metal analyses (Nickel, Silver, Zinc, Antimony, Arsenic, Cadmium, Chromium, Copper, Lead, Manganese) and nitrogen/phosphorus analyses.

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Project : 60566025 Darwin Sediment Sampling



Sub-Matrix: SOIL

Table with columns: Method/Compound, CAS Number, LOR, Unit, Method Blank (MB) Report Result, Laboratory Control Spike (LCS) Report Spike Concentration, Spike Recovery (%), Recovery Limits (%). Rows include various chemical analyses like Total Phosphorus as P, Total Organic Carbon (TOC), Total Carbon (TC), and Total Petroleum Hydrocarbons.

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Sub-Matrix: SOIL

Table with columns: Method/Compound, CAS Number, LOR, Unit, Method Blank (MB) Report Result, Laboratory Control Spike (LCS) Report Spike Concentration, Spike Recovery (%), Recovery Limits (%). Rows include various hydrocarbon fractions (EP071-SD, EP080-SD) and BTEXN compounds.

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Sub-Matrix: SOIL

Table with columns: Method/Compound, CAS Number, LOR, Unit, Method Blank (MB) Report Result, Laboratory Control Spike (LCS) Report Spike Concentration, Spike Recovery (%), and Recovery Limits (%). Rows include various chemical compounds like BTEXN, Organotin Compounds, and Polynuclear Aromatic Hydrocarbons.

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Sub-Matrix: SOIL

Table with columns: Method/Compound, CAS Number, LOR, Unit, Method Blank (MB) Report Result, Laboratory Control Spike (LCS) Report Spike Concentration, Spike Recovery (%), and Recovery Limits (%). It contains three sections of data for Polynuclear Aromatic Hydrocarbons (PAHs) under QCLot 3204904, QCLot 3204911, and QCLot 3204935.

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Sub-Matrix: SOIL

Table with columns: Method/Compound, CAS Number, LOR, Unit, Method Blank (MB) Report Result, Laboratory Control Spike (LCS) Report Spike Concentration, Spike Recovery (%), Recovery Limits (%). Includes sub-section EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 3204935) - continued.

Sub-Matrix: WATER

Table with columns: Method/Compound, CAS Number, LOR, Unit, Method Blank (MB) Report Result, Laboratory Control Spike (LCS) Report Spike Concentration, Spike Recovery (%), Recovery Limits (%). Includes sub-section EG020T: Total Metals by ICP-MS (QCLot: 3177565) and EP080/071: Total Petroleum Hydrocarbons (QCLot: 3177095).

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Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report				
					Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3177095) - continued									
EP080: C6 - C9 Fraction	----	20	µg/L	<20	260 µg/L	91.1	75.0	127	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3177095)									
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	310 µg/L	91.9	75.0	127	
EP080: BTEXN (QCLot: 3177095)									
EP080: Benzene	71-43-2	1	µg/L	<1	10 µg/L	81.5	70.0	122	
EP080: Toluene	108-88-3	2	µg/L	<2	10 µg/L	96.4	69.0	123	
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	10 µg/L	94.4	70.0	120	
EP080: meta- & para-Xylene	108-38-3	2	µg/L	<2	10 µg/L	92.7	69.0	121	
	106-42-3								
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	10 µg/L	94.8	72.0	122	
EP080: Naphthalene	91-20-3	5	µg/L	<5	10 µg/L	81.3	70.0	120	

Matrix Spike (MS) Report

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

Sub-Matrix: SOIL

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery(%) MS	Low	High
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 3191126)							
ES2026249-001	SL23_0.5-1.0	EG035T-LL: Mercury	7439-97-6	0.05 mg/kg	102	70.0	130
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 3191131)							
ES2026249-028	SL09_0-0.5	EG035T-LL: Mercury	7439-97-6	0.05 mg/kg	120	70.0	130
EG035T: Total Recoverable Mercury by FIMS (Low Level) (QCLot: 3196156)							
ES2026249-048	SL28_0.5-1.0	EG035T-LL: Mercury	7439-97-6	0.05 mg/kg	102	70.0	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 3191127)							
ES2026249-002	SL05C_0-0.5	EG020-SD: Arsenic	7440-38-2	50 mg/kg	75.7	70.0	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	92.7	70.0	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	107	70.0	130
		EG020-SD: Copper	7440-50-8	250 mg/kg	108	70.0	130
		EG020-SD: Lead	7439-92-1	250 mg/kg	97.8	70.0	130
		EG020-SD: Nickel	7440-02-0	50 mg/kg	94.5	70.0	130
		EG020-SD: Zinc	7440-66-6	250 mg/kg	90.0	70.0	130
EG020-SD: Total Metals in Sediments by ICPMS (QCLot: 3191129)							
ES2026249-029	SL08_0-0.5	EG020-SD: Arsenic	7440-38-2	50 mg/kg	80.8	70.0	130
		EG020-SD: Cadmium	7440-43-9	50 mg/kg	90.9	70.0	130
		EG020-SD: Chromium	7440-47-3	50 mg/kg	86.0	70.0	130

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Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, Concentration, Spike Recovery(%), Recovery Limits (%). Rows include various sediment samples and their corresponding metal and nutrient concentrations.

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Sub-Matrix: SOIL

Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, Concentration, Spike Recovery(%), Recovery Limits (%). Rows include various sample IDs and compounds like Total Petroleum Hydrocarbons, Benzene, Toluene, Ethylbenzene, and meta- & para-Xylene.

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Sub-Matrix: SOIL

Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, Concentration, Spike Recovery(%), Recovery Limits (%). Rows include various chemical analyses such as EP080-SD: BTEXN, EP090: Organotin Compounds, and EP132B: Polynuclear Aromatic Hydrocarbons.

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Sub-Matrix: SOIL

Table with columns: Laboratory sample ID, Client sample ID, Method: Compound, CAS Number, Concentration, Spike Recovery(%), Recovery Limits (%). Contains two main sections: EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 3204911) and EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 3204935).

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Sub-Matrix: SOIL

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 3204935) - continued							
ES2026249-052	SL22C_0-0.5	EP132B-SD: Dibenz(a,h)anthracene	53-70-3	25 µg/kg	85.2	70.0	130
		EP132B-SD: Indeno(1.2.3.cd)pyrene	193-39-5	25 µg/kg	90.8	70.0	130
		EP132B-SD: Coronene	191-07-1	25 µg/kg	92.4	70.0	130

Sub-Matrix: WATER

				Matrix Spike (MS) Report				
				Spike	SpikeRecovery(%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High	
EG020T: Total Metals by ICP-MS (QCLot: 3177566)								
ES2026249-007	SLFB03	EG020A-T: Arsenic	7440-38-2	1 mg/L	92.7	70.0	130	
		EG020A-T: Cadmium	7440-43-9	0.25 mg/L	96.4	70.0	130	
		EG020A-T: Chromium	7440-47-3	1 mg/L	121	70.0	130	
		EG020A-T: Copper	7440-50-8	1 mg/L	130	70.0	130	
		EG020A-T: Lead	7439-92-1	1 mg/L	128	70.0	130	
		EG020A-T: Manganese	7439-96-5	1 mg/L	94.9	70.0	130	
		EG020A-T: Nickel	7440-02-0	1 mg/L	92.8	70.0	130	
		EG020A-T: Zinc	7440-66-6	1 mg/L	95.0	70.0	130	
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3177095)								
ES2026359-040	Anonymous	EP080: C6 - C9 Fraction	----	325 µg/L	101	70.0	130	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3177095)								
ES2026359-040	Anonymous	EP080: C6 - C10 Fraction	C6_C10	375 µg/L	97.0	70.0	130	
EP080: BTEXN (QCLot: 3177095)								
ES2026359-040	Anonymous	EP080: Benzene	71-43-2	25 µg/L	93.6	70.0	130	
		EP080: Toluene	108-88-3	25 µg/L	110	70.0	130	
		EP080: Ethylbenzene	100-41-4	25 µg/L	110	70.0	130	
		EP080: meta- & para-Xylene	108-38-3	25 µg/L	110	70.0	130	
			106-42-3					
		EP080: ortho-Xylene	95-47-6	25 µg/L	109	70.0	130	
EP080: Naphthalene	91-20-3	25 µg/L	98.9	70.0	130			

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES2026249	Page	: 1 of 29
Amendment	: (Preliminary Report)		
Client	: AECOM Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: PETER YOUNG	Telephone	: +61 2 8784 8555
Project	: 60566025 Darwin Sediment Sampling	Date Samples Received	: 31-Jul-2020
Site	: ----	Issue Date	: 27-Aug-2020
Sampler	: Will Riddell	No. of samples received	: 65
Order number	: 60566025	No. of samples analysed	: 65

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

Outliers : Analysis Holding Time Compliance

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

Outliers : Frequency of Quality Control Samples

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

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Client : AECOM Australia Pty Ltd
Project : 60566025 Darwin Sediment Sampling

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Duplicate (DUP) RPDs							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	ES2026249--001	SL23_0.5-1.0	Total Kjeldahl Nitrogen as N	----	168 %	0% - 50%	RPD exceeds LOR based limits
EK067G: Total Phosphorus as P by Discrete Analyser	ES2026249--001	SL23_0.5-1.0	Total Phosphorus as P	----	156 %	0% - 20%	RPD exceeds LOR based limits
EK067G: Total Phosphorus as P by Discrete Analyser	ES2026249--029	SL08_0-0.5	Total Phosphorus as P	----	37.0 %	0% - 20%	RPD exceeds LOR based limits
EK067G: Total Phosphorus as P by Discrete Analyser	ES2026249--012	SL29_1.0-1.5	Total Phosphorus as P	----	40.6 %	0% - 20%	RPD exceeds LOR based limits
Laboratory Control Spike (LCS) Recoveries							
EK067G: Total Phosphorus as P by Discrete Analyser	QC-MRG2-31966530	----	Total Phosphorus as P	----	110 %	76.0-108%	Recovery greater than upper control limit
Matrix Spike (MS) Recoveries							
EK067G: Total Phosphorus as P by Discrete Analyser	ES2026249--029	SL08_0-0.5	Total Phosphorus as P	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EK067G: Total Phosphorus as P by Discrete Analyser	ES2026249--036	SL27_0.5-1.0	Total Phosphorus as P	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method	Container / Client Sample ID(s)	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue	
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved	SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	----	----	----	11-Aug-2020	10-Aug-2020	1
Soil Glass Jar - Unpreserved	SL28_0.5-1.0,	SL28_0-0.5	----	----	----	13-Aug-2020	11-Aug-2020	2
Soil Glass Jar - Unpreserved	SL05B_0-0.5,	LS22B_0-0.5	----	----	----	13-Aug-2020	12-Aug-2020	1
EP080/071: Total Petroleum Hydrocarbons (silica gel cleanup)								
Soil Glass Jar - Unpreserved	SL01_0-0.5		18-Aug-2020	10-Aug-2020	8	----	----	----
Soil Glass Jar - Unpreserved	SL16_0-0.5,	SL18_0-0.5	18-Aug-2020	11-Aug-2020	7	----	----	----
Soil Glass Jar - Unpreserved	SL07_0-0.5		18-Aug-2020	12-Aug-2020	6	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 fractions (silica gel cleanup)								
Soil Glass Jar - Unpreserved	SL01_0-0.5		18-Aug-2020	10-Aug-2020	8	----	----	----

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Matrix: **SOIL**

Method Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 fractions (silica gel cleanup) - Analysis						
Soil Glass Jar - Unpreserved SL16_0-0.5, SL18_0-0.5	18-Aug-2020	11-Aug-2020	7	----	----	----
Soil Glass Jar - Unpreserved SL07_0-0.5	18-Aug-2020	12-Aug-2020	6	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons						
Soil Glass Jar - Unpreserved SL03_0-0.5, SL10_0-0.5, SL01_0.5-1.0,	18-Aug-2020	10-Aug-2020	8	----	----	----
Soil Glass Jar - Unpreserved SL26_0-0.5, SL19_0.5-1.0, SL14_0-0.5, SL19_0-0.5, SL15_0-0.5, SL09_0-0.5	18-Aug-2020	11-Aug-2020	7	----	----	----
Soil Glass Jar - Unpreserved SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0.5-1.0, SL13_0-0.5, SL21_0.5-0.8, SL06_0-0.5, SL28_0-0.5, SL08_0.5-1.0, SL27_0.5-1.0, SL16_1.0-1.5, SL13_0.5-1.0, SL21_0-0.5, SL24_0-0.5, SL28_0.5-1.0,	18-Aug-2020	11-Aug-2020	7	----	----	----
Soil Glass Jar - Unpreserved SL23_0.5-1.0, SL23_0-0.5, SL31_0.5-1.0, SL05_0.5-1.0, SL29_0.5-1.0, SL22_0-0.5, SL20_0.5-1.0, SL05C_0-0.5, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL02_0-0.5	18-Aug-2020	12-Aug-2020	6	----	----	----
Soil Glass Jar - Unpreserved SL05B_0-0.5, LS22B_0-0.5	18-Aug-2020	12-Aug-2020	6	----	----	----
Soil Glass Jar - Unpreserved SL22C_0-0.5	18-Aug-2020	13-Aug-2020	5	----	----	----

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
Organotin Analysis	4	46	8.70	10.00	NEPM 2013 B3 & ALS QC Standard

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 Client : AECOM Australia Pty Ltd
 Project : 60566025 Darwin Sediment Sampling

Matrix: SOIL

Quality Control Sample Type Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP) - Continued					
TPH Semivolatile Fraction following Silica Gel Cleanup	0	4	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
Organotin Analysis	2	46	4.35	5.00	NEPM 2013 B3 & ALS QC Standard
TPH Semivolatile Fraction following Silica Gel Cleanup	0	4	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

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

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

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

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

Matrix: 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								
Snap Lock Bag - frozen (EA037) SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	07-Aug-2020	23-Jan-2021	✓	07-Aug-2020	23-Jan-2021	✓
Snap Lock Bag - frozen (EA037) SL26_0-0.5, SL19_0.5-1.0, SL14_0-0.5, SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0.5-1.0, SL13_0.5-1.0, SL21_0-0.5, SL18_0-0.5, SL06_0-0.5,	SL19_0-0.5, SL15_0-0.5, SL09_0-0.5, SL08_0.5-1.0, SL27_0.5-1.0, SL16_1.0-1.5, SL16_0-0.5, SL13_0-0.5, SL21_0.5-0.8, SL24_0-0.5, SL28_0-0.5	28-Jul-2020	07-Aug-2020	24-Jan-2021	✓	07-Aug-2020	24-Jan-2021	✓
Snap Lock Bag - frozen (EA037) SL28_0.5-1.0		28-Jul-2020	12-Aug-2020	24-Jan-2021	✓	12-Aug-2020	24-Jan-2021	✓
Snap Lock Bag - frozen (EA037) SL23_0.5-1.0, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL07_0-0.5,	SL23_0-0.5, SL31_0.5-1.0, SL05_0.5-1.0, SL29_0.5-1.0, SL22_0-0.5, SL20_0.5-1.0, SL02_0-0.5	29-Jul-2020	07-Aug-2020	25-Jan-2021	✓	07-Aug-2020	25-Jan-2021	✓

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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								
Snap Lock Bag - frozen (EA037) SL05C_0-0.5, LS22B_0-0.5	SL05B_0-0.5,	29-Jul-2020	12-Aug-2020	25-Jan-2021	✓	12-Aug-2020	25-Jan-2021	✓
Snap Lock Bag - frozen (EA037) SL22C_0-0.5		30-Jul-2020	12-Aug-2020	26-Jan-2021	✓	12-Aug-2020	26-Jan-2021	✓
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055) SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	----	----	----	11-Aug-2020	10-Aug-2020	*
Soil Glass Jar - Unpreserved (EA055) SL26_0-0.5, SL19_0.5-1.0, SL14_0-0.5, SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0.5-1.0, SL13_0.5-1.0, SL21_0-0.5, SL18_0-0.5, SL06_0-0.5	SL19_0-0.5, SL15_0-0.5, SL09_0-0.5, SL08_0.5-1.0, SL27_0.5-1.0, SL16_1.0-1.5, SL16_0-0.5, SL13_0-0.5, SL21_0.5-0.8, SL24_0-0.5,	28-Jul-2020	----	----	----	11-Aug-2020	11-Aug-2020	✓
Soil Glass Jar - Unpreserved (EA055) SL28_0.5-1.0,	SL28_0-0.5	28-Jul-2020	----	----	----	13-Aug-2020	11-Aug-2020	*
Soil Glass Jar - Unpreserved (EA055) SL23_0.5-1.0, SL23_0-0.5, SL31_0.5-1.0, SL05_0.5-1.0, SL29_0.5-1.0, SL22_0-0.5, SL20_0.5-1.0, SL02_0-0.5	SL05C_0-0.5, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL07_0-0.5,	29-Jul-2020	----	----	----	11-Aug-2020	12-Aug-2020	✓
Soil Glass Jar - Unpreserved (EA055) SL05B_0-0.5,	LS22B_0-0.5	29-Jul-2020	----	----	----	13-Aug-2020	12-Aug-2020	*
Soil Glass Jar - Unpreserved (EA055) SL22C_0-0.5		30-Jul-2020	----	----	----	13-Aug-2020	13-Aug-2020	✓

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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 (EA150H) SL05C_0-0.5, LS22B_0-0.5	SL05B_0-0.5,	29-Jul-2020	----	----	----	14-Aug-2020	25-Jan-2021	✓
Snap Lock Bag (EA150H) SL22C_0-0.5		30-Jul-2020	----	----	----	14-Aug-2020	26-Jan-2021	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	----	----	----	14-Aug-2020	23-Jan-2021	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) SL26_0-0.5, SL19_0.5-1.0, SL14_0-0.5, SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0.5-1.0, SL13_0.5-1.0, SL21_0-0.5, SL18_0-0.5, SL06_0-0.5, SL28_0-0.5	SL19_0-0.5, SL15_0-0.5, SL09_0-0.5, SL08_0.5-1.0, SL27_0.5-1.0, SL16_1.0-1.5, SL16_0-0.5, SL13_0-0.5, SL21_0.5-0.8, SL24_0-0.5, SL28_0.5-1.0,	28-Jul-2020	----	----	----	14-Aug-2020	24-Jan-2021	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) SL23_0.5-1.0, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL07_0-0.5,	SL23_0-0.5, SL31_0.5-1.0, SL05_0.5-1.0, SL29_0.5-1.0, SL22_0-0.5, SL20_0.5-1.0, SL02_0-0.5	29-Jul-2020	----	----	----	14-Aug-2020	25-Jan-2021	✓

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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: Soil Classification based on Particle Size								
Snap Lock Bag (EA150H) SL05C_0-0.5, LS22B_0-0.5	SL05B_0-0.5,	29-Jul-2020	----	----	----	14-Aug-2020	25-Jan-2021	✓
Snap Lock Bag (EA150H) SL22C_0-0.5		30-Jul-2020	----	----	----	14-Aug-2020	26-Jan-2021	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	----	----	----	14-Aug-2020	23-Jan-2021	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) SL26_0-0.5, SL19_0.5-1.0, SL14_0-0.5, SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0.5-1.0, SL13_0.5-1.0, SL21_0-0.5, SL18_0-0.5, SL06_0-0.5, SL28_0-0.5	SL19_0-0.5, SL15_0-0.5, SL09_0-0.5, SL08_0.5-1.0, SL27_0.5-1.0, SL16_1.0-1.5, SL16_0-0.5, SL13_0-0.5, SL21_0.5-0.8, SL24_0-0.5, SL28_0.5-1.0,	28-Jul-2020	----	----	----	14-Aug-2020	24-Jan-2021	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA150H) SL23_0.5-1.0, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL07_0-0.5,	SL23_0-0.5, SL31_0.5-1.0, SL05_0.5-1.0, SL29_0.5-1.0, SL22_0-0.5, SL20_0.5-1.0, SL02_0-0.5	29-Jul-2020	----	----	----	14-Aug-2020	25-Jan-2021	✓

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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	
EA152: Soil Particle Density								
Snap Lock Bag (EA152) SL05C_0-0.5, LS22B_0-0.5	SL05B_0-0.5,	29-Jul-2020	----	----	----	14-Aug-2020	25-Jan-2021	✓
Snap Lock Bag (EA152) SL22C_0-0.5		30-Jul-2020	----	----	----	14-Aug-2020	26-Jan-2021	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152) SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	----	----	----	14-Aug-2020	23-Jan-2021	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152) SL26_0-0.5, SL19_0.5-1.0, SL14_0-0.5, SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0.5-1.0, SL13_0.5-1.0, SL21_0-0.5, SL18_0-0.5, SL06_0-0.5, SL28_0-0.5	SL19_0-0.5, SL15_0-0.5, SL09_0-0.5, SL08_0.5-1.0, SL27_0.5-1.0, SL16_1.0-1.5, SL16_0-0.5, SL13_0-0.5, SL21_0.5-0.8, SL24_0-0.5, SL28_0.5-1.0,	28-Jul-2020	----	----	----	14-Aug-2020	24-Jan-2021	✓
Snap Lock Bag - Friable Asbestos/PSD Bag (EA152) SL23_0.5-1.0, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL07_0-0.5,	SL23_0-0.5, SL31_0.5-1.0, SL05_0.5-1.0, SL29_0.5-1.0, SL22_0-0.5, SL20_0.5-1.0, SL02_0-0.5	29-Jul-2020	----	----	----	14-Aug-2020	25-Jan-2021	✓

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Matrix: SOIL

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include various soil samples like SL03_0-0.5, SL01_0-0.5, SL19_0-0.5, etc., with their respective dates and evaluation status.

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Matrix: SOIL

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include various soil samples like SL03_0-0.5, SL01_0-0.5, SL19_0-0.5, etc., with their respective dates and evaluation status.

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Matrix: SOIL

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include various soil glass jar samples (e.g., SL03_0-0.5, SL01_0-0.5, SL19_0-0.5, etc.) with their respective dates and evaluation status.

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Matrix: SOIL

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser and various Soil Glass Jar - Unpreserved (EK059G) samples.

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include various soil samples like SL03_0-0.5, SL01_0-1.0, etc., with their respective dates and evaluation status.

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Matrix: SOIL

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include various soil samples like SL03_0-0.5, SL01_0-1.0, etc., with their respective dates and evaluation status.

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Matrix: SOIL

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

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EP003: Total Organic Carbon (TOC) in Soil								
Snap Lock Bag - frozen (EP003) SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	12-Aug-2020	23-Jan-2021	✓	12-Aug-2020	23-Jan-2021	✓
Snap Lock Bag - frozen (EP003) SL26_0-0.5, SL19_0.5-1.0, SL14_0-0.5, SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0.5-1.0, SL13_0.5-1.0, SL21_0-0.5, SL18_0-0.5, SL06_0-0.5, SL28_0-0.5	SL19_0-0.5, SL15_0-0.5, SL09_0-0.5, SL08_0.5-1.0, SL27_0.5-1.0, SL16_1.0-1.5, SL16_0-0.5, SL13_0-0.5, SL21_0.5-0.8, SL24_0-0.5, SL28_0.5-1.0,	28-Jul-2020	12-Aug-2020	24-Jan-2021	✓	12-Aug-2020	24-Jan-2021	✓
Snap Lock Bag - frozen (EP003) SL23_0.5-1.0, SL23_0-0.5, SL31_0.5-1.0, SL05_0.5-1.0, SL29_0.5-1.0, SL22_0-0.5, SL20_0.5-1.0, SL02_0-0.5, LS22B_0-0.5	SL05C_0-0.5, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL07_0-0.5, SL05B_0-0.5,	29-Jul-2020	12-Aug-2020	25-Jan-2021	✓	12-Aug-2020	25-Jan-2021	✓
Snap Lock Bag - frozen (EP003) SL22C_0-0.5		30-Jul-2020	12-Aug-2020	26-Jan-2021	✓	12-Aug-2020	26-Jan-2021	✓

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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	
EP003TC: Total Carbon (TC) in Soil								
Snap Lock Bag - frozen (EP003TC) SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	12-Aug-2020	23-Jan-2021	✔	12-Aug-2020	23-Jan-2021	✔
Snap Lock Bag - frozen (EP003TC) SL26_0-0.5, SL19_0.5-1.0, SL14_0-0.5, SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0.5-1.0, SL13_0.5-1.0, SL21_0-0.5, SL18_0-0.5, SL06_0-0.5, SL28_0-0.5	SL19_0-0.5, SL15_0-0.5, SL09_0-0.5, SL08_0.5-1.0, SL27_0.5-1.0, SL16_1.0-1.5, SL16_0-0.5, SL13_0-0.5, SL21_0.5-0.8, SL24_0-0.5, SL28_0.5-1.0,	28-Jul-2020	12-Aug-2020	24-Jan-2021	✔	12-Aug-2020	24-Jan-2021	✔
Snap Lock Bag - frozen (EP003TC) SL23_0.5-1.0, SL23_0-0.5, SL31_0.5-1.0, SL05_0.5-1.0, SL29_0.5-1.0, SL22_0-0.5, SL20_0.5-1.0, SL02_0-0.5, LS22B_0-0.5	SL05C_0-0.5, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL07_0-0.5, SL05B_0-0.5,	29-Jul-2020	12-Aug-2020	25-Jan-2021	✔	12-Aug-2020	25-Jan-2021	✔
Snap Lock Bag - frozen (EP003TC) SL22C_0-0.5		30-Jul-2020	12-Aug-2020	26-Jan-2021	✔	12-Aug-2020	26-Jan-2021	✔
EP080/071: Total Petroleum Hydrocarbons (silica gel cleanup)								
Soil Glass Jar - Unpreserved (EP071-SDSG) SL01_0-0.5		27-Jul-2020	18-Aug-2020	10-Aug-2020	✘	19-Aug-2020	27-Sep-2020	✔
Soil Glass Jar - Unpreserved (EP071-SDSG) SL16_0-0.5,	SL18_0-0.5	28-Jul-2020	18-Aug-2020	11-Aug-2020	✘	19-Aug-2020	27-Sep-2020	✔
Soil Glass Jar - Unpreserved (EP071-SDSG) SL07_0-0.5		29-Jul-2020	18-Aug-2020	12-Aug-2020	✘	19-Aug-2020	27-Sep-2020	✔

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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	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
Soil Glass Jar - Unpreserved (EP071-SD)								
SL03_0-0.5, SL01_0-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	10-Aug-2020	10-Aug-2020	✔	11-Aug-2020	19-Sep-2020	✔
Soil Glass Jar - Unpreserved (EP071-SD)								
SL26_0-0.5, SL19_0-1.0, SL14_0-0.5, SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0-1.0, SL13_0-1.0, SL21_0-0.5, SL18_0-0.5, SL06_0-0.5	SL19_0-0.5, SL15_0-0.5, SL09_0-0.5, SL08_0-1.0, SL27_0-1.0, SL16_1.0-1.5, SL16_0-0.5, SL13_0-0.5, SL21_0-0.5-0.8, SL24_0-0.5,	28-Jul-2020	10-Aug-2020	11-Aug-2020	✔	11-Aug-2020	19-Sep-2020	✔
Soil Glass Jar - Unpreserved (EP071-SD)								
SL28_0-1.0,	SL28_0-0.5	28-Jul-2020	10-Aug-2020	11-Aug-2020	✔	12-Aug-2020	19-Sep-2020	✔
Soil Glass Jar - Unpreserved (EP071-SD)								
SL23_0-1.0, SL23_0-0.5, SL31_0-1.0, SL05_0-1.0, SL29_0-1.0, SL22_0-0.5, SL20_0-1.0, SL02_0-0.5	SL05C_0-0.5, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL07_0-0.5,	29-Jul-2020	10-Aug-2020	12-Aug-2020	✔	11-Aug-2020	19-Sep-2020	✔
Soil Glass Jar - Unpreserved (EP071-SD)								
SL05B_0-0.5,	LS22B_0-0.5	29-Jul-2020	10-Aug-2020	12-Aug-2020	✔	12-Aug-2020	19-Sep-2020	✔
Soil Glass Jar - Unpreserved (EP071-SD)								
SL22C_0-0.5		30-Jul-2020	10-Aug-2020	13-Aug-2020	✔	12-Aug-2020	19-Sep-2020	✔
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 fractions (silica gel cleanup)								
Soil Glass Jar - Unpreserved (EP071-SDSG)								
SL01_0-0.5		27-Jul-2020	18-Aug-2020	10-Aug-2020	✘	19-Aug-2020	27-Sep-2020	✔
Soil Glass Jar - Unpreserved (EP071-SDSG)								
SL16_0-0.5,	SL18_0-0.5	28-Jul-2020	18-Aug-2020	11-Aug-2020	✘	19-Aug-2020	27-Sep-2020	✔
Soil Glass Jar - Unpreserved (EP071-SDSG)								
SL07_0-0.5		29-Jul-2020	18-Aug-2020	12-Aug-2020	✘	19-Aug-2020	27-Sep-2020	✔

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 Client : AECOM Australia Pty Ltd
 Project : 60566025 Darwin Sediment Sampling

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	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
Soil Glass Jar - Unpreserved (EP080-SD) SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	10-Aug-2020	10-Aug-2020	✓	10-Aug-2020	10-Aug-2020	✓
Soil Glass Jar - Unpreserved (EP071-SD) SL03_0-0.5, SL01_0.5-1.0,	SL01_0-0.5, SL10_0-0.5	27-Jul-2020	10-Aug-2020	10-Aug-2020	✓	11-Aug-2020	19-Sep-2020	✓
Soil Glass Jar - Unpreserved (EP080-SD) SL26_0-0.5, SL19_0.5-1.0, SL14_0-0.5, SL08_0-0.5, SL27_0-0.5, SL17_0-0.5, SL16_0.5-1.0, SL13_0.5-1.0, SL21_0-0.5, SL18_0-0.5, SL06_0-0.5, SL28_0-0.5	SL19_0-0.5, SL15_0-0.5, SL09_0-0.5, SL08_0.5-1.0, SL27_0.5-1.0, SL16_1.0-1.5, SL16_0-0.5, SL13_0-0.5, SL21_0.5-0.8, SL24_0-0.5, SL28_0.5-1.0,	28-Jul-2020	10-Aug-2020	11-Aug-2020	✓	11-Aug-2020	11-Aug-2020	✓
Soil Glass Jar - Unpreserved (EP071-SD) SL28_0.5-1.0,	SL28_0-0.5	28-Jul-2020	10-Aug-2020	11-Aug-2020	✓	12-Aug-2020	19-Sep-2020	✓
Soil Glass Jar - Unpreserved (EP080-SD) SL23_0.5-1.0, SL23_0-0.5, SL31_0.5-1.0, SL05_0.5-1.0, SL29_0.5-1.0, SL22_0-0.5, SL20_0.5-1.0, SL02_0-0.5, LS22B_0-0.5	SL05C_0-0.5, SL31_0-0.5, SL05_0-0.5, SL29_0-0.5, SL29_1.0-1.5, SL20_0-0.5, SL07_0-0.5, SL05B_0-0.5,	29-Jul-2020	10-Aug-2020	12-Aug-2020	✓	11-Aug-2020	12-Aug-2020	✓
Soil Glass Jar - Unpreserved (EP071-SD) SL05B_0-0.5,	LS22B_0-0.5	29-Jul-2020	10-Aug-2020	12-Aug-2020	✓	12-Aug-2020	19-Sep-2020	✓
Soil Glass Jar - Unpreserved (EP071-SD) SL22C_0-0.5		30-Jul-2020	10-Aug-2020	13-Aug-2020	✓	12-Aug-2020	19-Sep-2020	✓
Soil Glass Jar - Unpreserved (EP080-SD) SL22C_0-0.5		30-Jul-2020	13-Aug-2020	13-Aug-2020	✓	13-Aug-2020	13-Aug-2020	✓

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Matrix: SOIL

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include EP080-SD / EP071-SD: Total Recoverable Hydrocarbons for various soil samples.

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Matrix: SOIL

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include EP080-SD: BTEXN, Soil Glass Jar - Unpreserved (EP080-SD) for various sample IDs and dates.

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Matrix: SOIL

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include EP090: Organotin Compounds and various Soil Glass Jar - Unpreserved (EP090) samples with their respective dates and evaluation status.

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include EP132B: Polynuclear Aromatic Hydrocarbons and various Soil Glass Jar - Unpreserved (EP132B-SD) samples.

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

Table with columns: Method, Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include EG020T: Total Metals by ICP-MS and Clear Plastic Bottle - Unspecified; Lab-acidified (EG020B-T) samples.

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Matrix: WATER

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

Table with columns: Method, Container / Client Sample ID(s), Sample Date, Extraction / Preparation (Date extracted, Due for extraction, Evaluation), Analysis (Date analysed, Due for analysis, Evaluation). Rows include EP080/071: Total Petroleum Hydrocarbons, EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions, and EP080: BTEXN.

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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: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Reaular	Actual	Expected	Evaluation	
Analytical Methods							
Laboratory Duplicates (DUP)							
ASS Field Screening Analysis	EA037	7	63	11.11	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	5	45	11.11	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	6	45	13.33	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	4	46	8.70	10.00	✖	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	5	41	12.20	10.00	✔	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	5	47	10.64	9.52	✔	NEPM 2013 B3 & ALS QC Standard
Total Carbon	EP003TC	5	45	11.11	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	5	45	11.11	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	5	45	11.11	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	5	45	11.11	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	5	45	11.11	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	5	46	10.87	10.00	✔	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	5	45	11.11	10.00	✔	NEPM 2013 B3 & ALS QC Standard
TPH Semivolatile Fraction following Silica Gel Cleanup	EP071-SDSG	0	4	0.00	10.00	✖	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	6	45	13.33	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	3	45	6.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	3	46	6.52	5.00	✔	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	3	41	7.32	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TKN as N By Discrete Analyser	EK061G	9	47	19.15	14.29	✔	NEPM 2013 B3 & ALS QC Standard
Total Carbon	EP003TC	3	45	6.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Fe and Al in Sediments by ICPAES	EG005-SD	3	45	6.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS (Low Level)	EG035T-LL	3	45	6.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals in Sediments by ICPMS	EG020-SD	3	45	6.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP003	6	45	13.33	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus By Discrete Analyser	EK067G	9	46	19.57	15.00	✔	NEPM 2013 B3 & ALS QC Standard
TPH - Semivolatile Fraction	EP071-SD	3	45	6.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TPH Semivolatile Fraction following Silica Gel Cleanup	EP071-SDSG	1	4	25.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX in Sediments	EP080-SD	4	45	8.89	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	3	45	6.67	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Organotin Analysis	EP090	3	46	6.52	5.00	✔	NEPM 2013 B3 & ALS QC Standard
PAHs in Sediments by GCMS(SIM)	EP132B-SD	3	41	7.32	5.00	✔	NEPM 2013 B3 & ALS QC Standard

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Matrix: SOIL Evaluation: * = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Table with 8 columns: Quality Control Sample Type, Method, Count (QC, Regular), Rate (%) (Actual, Expected), Evaluation, and Quality Control Specification. Rows include Analytical Methods (Method Blanks), Matrix Spikes, and various sediment analysis methods.

Matrix: WATER Evaluation: * = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Table with 8 columns: Quality Control Sample Type, Method, Count (QC, Regular), Rate (%) (Actual, Expected), Evaluation, and Quality Control Specification. Rows include Laboratory Duplicates, Laboratory Control Samples, Method Blanks, and Matrix Spikes for water samples.

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Matrix: **WATER** Evaluation: * = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
Matrix Spikes (MS) - Continued							
TRH Volatiles/BTEX	EP080	1	20	5.00	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
ASS Field Screening Analysis	* EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines. As received samples are tested for pH field and pH fox and assessed for a reaction rating.
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 Schedule B(3).
Particle Size Analysis by Hydrometer	EA150H	SOIL	Particle Size Analysis by Hydrometer according to AS1289.3.6.3
Soil Particle Density	EA152	SOIL	Soil Particle Density by AS 1289.3.5.1: Methods of testing soils for engineering purposes - Soil classification tests - Determination of the soil particle density of a soil - Standard method
Gross Alpha and Beta activity in solids	EA250	SOIL	In house: Referenced to ISO 9697 / CSN 757611. Determination of Gross Alpha and Beta activity in soil and sediment by Thick Source method. An appropriate mass of sample is dried and pulverised prior to direct activity counting. (If required, Potassium may be determined separately and results corrected accordingly for 40K.) Analysis is performed by ALS (Czech Republic) who hold technical accreditation #1163 for Gross alpha and beta activity under CAI. CAI are a European accreditation body, equivalent to NATA in Australia and recognised internationally by NATA under ILAC.
Total Fe and Al in Sediments by ICPAES	EG005-SD	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3). LORs per NODG
Total Metals in Sediments by ICPMS	EG020-SD	SOIL	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector. Analyte list and LORs per NODG.
Total Mercury by FIMS (Low Level)	EG035T-LL	SOIL	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl ₂)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Nitrite and Nitrate as N (NO _x)- Soluble by Discrete Analyser	EK059G	SOIL	In house: Thermo Scientific Method D08727 and NEMI (National Environmental Method Index) Method ID: 9171. This method covers the determination of total oxidised nitrogen (NO _x -N) and nitrate (NO ₃ -N) by calculation, Combined oxidised Nitrogen (NO ₂ +NO ₃) in a water extract is determined by direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	In house: Referenced to APHA 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NO _x) By Discrete Analyser	EK062G	SOIL	In house: Referenced to APHA 4500 Norg/NO ₃ - Total Nitrogen is determined as the sum of TKN and Oxidised Nitrogen, each determined separately as N.
Total Phosphorus By Discrete Analyser	EK067G	SOIL	In house: Referenced to APHA 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.

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Analytical Methods	Method	Matrix	Method Descriptions
Total Organic Carbon	EP003	SOIL	In house C-IR17. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO ₂) is automatically measured by infra-red detector.
Total Carbon	EP003TC	SOIL	In house C-IR07. Dried and pulverised sample is combusted in a LECO furnace in the presence of strong oxidants / catalysts. The evolved Carbon (as CO ₂) is measured by infra-red detector
Total Inorganic Carbon	EP003TIC	SOIL	In house C-CAL15. Determined as the difference between Total Carbon and Organic Carbon.
TPH - Semivolatile Fraction	EP071-SD	SOIL	In house: Referenced to USEPA SW 846 - 8270. Extracts are analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TPH Semivolatile Fraction following Silica Gel Cleanup	EP071-SDSG	SOIL	In house: Referenced to USEPA SW 846 - 8270. Sample extracts are cleaned up using silica gel and are analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX in Sediments	EP080-SD	SOIL	In house: Referenced to USEPA SW 846 - 8260 Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve.
Organotin Analysis	EP090	SOIL	In house: Referenced to USEPA SW 846 - 8270 Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quantified against an established calibration curve.
PAHs in Sediments by GCMS(SIM)	EP132B-SD	SOIL	In house: Referenced to USEPA 8270 GCMS Capillary column, SIM mode using large volume programmed temperature vaporisation injection.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite B	EG020B-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)

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

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<i>Preparation Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids for LVI (Non-concentrating)	ORG17D	SOIL	In house: 10g of sample, Na ₂ SO ₄ and surrogate are extracted with 50mL 1:1 DCM/Acetone by end over end tumbling. An aliquot is concentrated by nitrogen blowdown to a reduced volume for analysis if required.
Organotin Sample Preparation	ORG35	SOIL	In house: 20g sample is spiked with surrogate and leached in a methanol:acetic acid:UHP water mix and vacuum filtered. Reagents and solvents are added to the sample and the mixture tumbled. The butyltin compounds are simultaneously derivatised and extracted. The extract is further extracted with petroleum ether. The resultant extracts are combined and concentrated for analysis.
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM Schedule B(3)
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for sparging.



CHAIN OF CUSTODY

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CLIENT: AECOM Australia Pty Ltd

OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800

PROJECT: 60566025

PURCHASE ORDER NUMBER:

PROJECT MANAGER: Peter Young

SAMPLER: Will Riddell

COC Emailed to ALS? YES

Email Reports to: peter.young@aecom.com

Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com

TURNAROUND REQUIREMENTS: Standard TAT (List due date):
(Standard TAT may be longer for some tests e.g., Ultra Trace Organics)

Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: EP-036-20 V5

COUNTRY OF ORIGIN: AUSTRALIA

CONTACT PH: 0402 225 444

SAMPLER MOBILE: 0427470250

EDD FORMAT (or default):

RELINQUISHED BY: W. Riddell

DATE/TIME: 30/7/20

RECEIVED BY: [Signature]

DATE/TIME: 1:20pm 30/07/20

FOR LABORATORY USE ONLY (Circle):

Custody Seal intact? Yes No

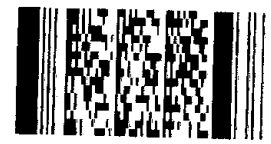
Free ice / frozen ice bricks present upon receipt? Yes No

Random Sample Temperature on Receipt: °C

Other comment: 13.5

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)		CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price)													
	LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE <small>(refer to codes below)</small>	TOTAL BOTTLES	Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (fold filtered bottle required).											
							EG020-SD: Total Metals in sediments by CPMS (MAGD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn	EG005-SD: Total Iron and Aluminium in Sediments by ICPAES (MAGD)	EG035-SD: Mercury in Sediments by FIMS (MDDC-required Level of Reporting)	TPH-SD: Low Level TPH/TEXAN for Sediments	EP132B-SD: Ultra-trace PAHs in Sediments	IN-3S: TOC/TIC/TC (Leuco) Combined Suite	EP090 (solids): Organotins - TBT	EA150H/EA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-11S: Total N + Total P	EA250 Sum: Tot Gross alpha & beta	EA037: ASS Field Screening	EA033-WA: WA - Chromium Suite for Acid Sulphate Soils
	1	SL23_0-0.5-1.0	290720	S	Newcastle	8	/	/	/	/	*	/	/	/	/	/	/	*
	3	SL23A_0-0.5	290720	S	Newcastle	8	/	/	/	/	*	/	/	/	/	/	/	*
	4	SL23_0-0.5	290720	S	Newcastle	8	/	/	/	/	*	/	/	/	/	/	/	*
	5	SL31_0-0.5	290720	S	Newcastle	8	/	/	/	/	*	/	/	/	/	/	/	*
	6	SL31_0-0.5-1.0	290720	S	Newcastle	8	/	/	/	/	*	/	/	/	/	/	/	*
	7	SLRB03	290720	S	Newcastle	1	/	/	/	/	*	/	/	/	/	/	/	*
	7	SLFB03	290720	S	Newcastle	1	/	/	/	/	*	/	/	/	/	/	/	*
	2	SL05C_0-0.5	290720	S	Please forward to	8	/	/	/	/	*	/	/	/	/	/	/	*
	50	SL05B_0-0.5	290720	S	Europias	8	/	/	/	/	*	/	/	/	/	/	/	*
	51	SL22B_0-0.5	290720	S	Europias	8	/	/	/	/	*	/	/	/	/	/	/	*
	52	SL22C_0-0.5	290720	S	triplicate samples	8	/	/	/	/	*	/	/	/	/	/	/	*
	53-65	SLTB01	290720	S		0	0	0	0	0	0	0	0	0	0	0	0	0

Environmental Division
Sydney
Work Order Reference
ES2026249



Telephone: 61-2-8784 8551

*
Analysis for EP132B-SD: Ultra-trace PAHs in Sediments and EA033-WA: WA - Chromium Suite for Acid Sulphate Soils may be undertaken pending initial analytical results. Please retain all samples for instruction on whether to proceed with these analyses.

HOLD

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic

V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Plastic

Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Liqulots Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

LAB OF ORIGIN: DARWIN



CHAIN OF CUSTODY

ALS Laboratory: please tick →

JADELADE 21 Burma Road Ploerske SA 5095
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MELBOURNE 32 Strand Street St Albans VIC 3015
Ph: 07 3243 7722 E: samples.melbourne@alsglobal.com

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NOOWRA 418 Geary Place North Nowra NSW 2541
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WOLLONGONG 89 Kenny Street Wollongong NSW 2520
Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: AECOM Australia Pty Ltd		TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)		<input checked="" type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)		
OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800		ALS QUOTE NO.: EP-036-20 V5		<input type="checkbox"/> Non Standard or urgent TAT (List due date):		Custody Seal Intact? Yes No N/A		
PROJECT: 60566025		COUNTRY OF ORIGIN: AUSTRALIA		COC SEQUENCE NUMBER (Circle)		Free ice / frozen ice bricks present upon receipt? Yes No N/A		
PURCHASE ORDER NUMBER:		CONTACT PH: 0402 225 444		COC: 1 2 3 4 5 6 7		Random Sample Temperature on Receipt: °C		
PROJECT MANAGER: Peter Young		SAMPLER MOBILE: 0427470250		OF: 1 2 3 4 5 6 7		Other comment:		
SAMPLER: Will Riddell		RELINQUISHED BY: W.Riddell		RECEIVED BY:		RECEIVED BY:		
COC Emailed to ALS? YES		EDD FORMAT (or default):		DATE/TIME: 30/7/20		DATE/TIME:		
Email Reports to: peter.young@aecom.com				1315		DATE/TIME:		
Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com						DATE/TIME:		

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Please retain all samples until instructed to dispose

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION	ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).												Additional Information		
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EG020-SD: Total Metals in sediments by ICPMS (NAGD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn	EG005-SD: Total Iron and Aluminium in Sediments by ICPAES (NAGD)	EG035-SD: Mercury in Sediments by FILMS (NOBG-required Level of reporting)	TPH-SD: Low Level TRH/STEN for Sediments	EC132B-SD: Ultra-trace PAHs in Sediments	IN-3S: TOC/TIC/TC (Leco) Combined Suite	EP099 (solids): Organotins - TBT	EA150/HEA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-11S: Total N + Total P	EA250 Sum: Tot Gross alpha & beta	EA037: ASS Field Screening	EA033-WA: WA - Chromium Suite for Acid Sulphate Soils	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.	
8	SL05_0-0.5	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
9	SL05_0.5-1.0	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
10	SL29_0-0.5	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
11	SL29_0.5-1.0	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
12	SL29_1.0-1.5	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
13	SL22_0-0.5	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
14	SL20_0-0.5	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
15	SL20_0.5-1.0	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	SL22_0-0.5	290720	S																
	SL22_0-0.5	290720	S																
16	SL07_0-0.5	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
17	SL02_0-0.5	290720	S		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
TOTAL					0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

Column

2



CHAIN OF CUSTODY

ALS Laboratory: please tick →

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MELBOURNE 2-4 Wattle Road Springvale VIC 3171
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NEWCASTLE 5 Ross Gum Road Warabrook NSW 2304
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WOLLONGONG 99 Kenny Street Wollongong NSW 2500
Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: AECOM Australia Pty Ltd		TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)		<input checked="" type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)	
OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800				<input type="checkbox"/> Non Standard or urgent TAT (List due date):		Custody Seal Intact? Yes No N/A	
PROJECT: 60566025		ALS QUOTE NO.: EP-036-20 V5		COC SEQUENCE NUMBER (Circle)		Free ice / frozen ice bricks present upon receipt? Yes No N/A	
PURCHASE ORDER NUMBER:		COUNTRY OF ORIGIN: AUSTRALIA		COC: 1 2 3 4 5 6 7		Random Sample Temperature on Receipt: °C	
PROJECT MANAGER: Peter Young		CONTACT PH: 0402 225 444		OF: 1 2 3 4 5 6 7		Other comment:	
SAMPLER: Will Riddell		SAMPLER MOBILE: 0427470250		RELINQUISHED BY: W. K. J. J. J.		RECEIVED BY:	
COC Emailed to ALS? YES		EDD FORMAT (or default):		DATE/TIME: 30/7/20		DATE/TIME:	
Email Reports to: peter.young@aecom.com				DATE/TIME: 1315		DATE/TIME:	
Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com						DATE/TIME:	

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Please retain all samples until instructed to dispose

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)		CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).												Additional Information	
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EG020-SD: Total Metals in sediments by (CPMS (NAGD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn)	EG005-SD: Total Iron and Aluminium in Sediments by (CPAES (NAGD))	EG035-SD: Mercury in Sediments by FIMS (NODG-required Level of Reporting)	TPH-SD: Low Level TPH/TEXH for Sediments	EP132B-SD: Ultra-trace PAHs in Sediments	IN-38: TOC/TIC/TC (Laco) Combined Suite	EP090 (solids): Organotin - TBT	EA150/MEA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-11S: Total N + Total P	EA250 Sum: Tot Gross alpha & beta	EA037: ASS Field Screening	EA033-WA: WA - Chromium Suite for Acid Sulphate Soils	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
18	SL26_0-0.5	280720	s		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
19	SL19_0-0.5	280720	s		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
20	SL19_0.5-1.0	280720	s		8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
1	SLRB01	270720	s		1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
22	SLFB01	270720	s		1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
23	SLRB02	280720	s		1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
24	SLFB02	280720	s		1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
25	SLTB01	300720	s		16													<p>Analysis for EP132B-SD: Ultra-trace PAHs in Sediments and EA033-WA: WA - Chromium Suite for Acid Sulphate Soils may be undertaken pending initial analytical results. Please retain all samples for instruction on whether to proceed with these analyses.</p>
			s															
			s															
			s															
TOTAL					0	0	0	0	0	0	0	0	0	0	0	0	0	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.



CHAIN OF CUSTODY

ALS Laboratory: please tick →

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Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: AECOM Australia Pty Ltd		TURNAROUND REQUIREMENTS: <input checked="" type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)			
OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800		(Standard TAT may be longer for some tests e.g., Ultra Trace Organics)		Custody Seal Intact? Yes No N/A			
PROJECT: 60566025		<input type="checkbox"/> Non Standard or urgent TAT (List due date):		Free ice / frozen ice bricks present upon receipt? Yes No N/A			
PURCHASE ORDER NUMBER:		ALS QUOTE NO.: EP-036-20 V5		COC SEQUENCE NUMBER (Circle)			
PROJECT MANAGER: Peter Young		COUNTRY OF ORIGIN: AUSTRALIA		COC: <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7			
SAMPLER: Will Riddell		CONTACT PH: 0402 225 444		OF: <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7			
COC Emailed to ALS? YES		SAMPLER MOBILE: 0427470250		RELINQUISHED BY: W. Riddell		RECEIVED BY:	
Email Reports to: peter.young@aecom.com		EDD FORMAT (or default):		DATE/TIME: 30/7/20		DATE/TIME:	
Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com				DATE/TIME: 1315		DATE/TIME:	

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Please retain all samples until instructed to dispose

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION	ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).											Additional Information		
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EG026-SD: Total Metals in Sediments by ICPMS (NAGD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn	EG005-SD: Total Iron and Aluminium in Sediments by ICPAES (NAGD)	EG035-SD: Mercury in Sediments by FIMS (NODG-required Level of Reporting)	TPH-SD: Low Level TRUBIEN for Sediments	EP132B-SD: Ultra-trace PAHs in Sediments	IN-38: TOC/TC/TC (Leco) Combined Suite	EP090 (solids): Organotins - TBT	EA150H/EA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-11S: Total N + Total P	EA250 Sumr: Tot Gross alpha & Beta	EA037: ASS Field Screening	EA033-WA: WA - Chromium Suite for Acid Sulphate Soils	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
26	SL45_0-0.5	280720	s		8	/	/	/	/	*	/	/	/	/	/	*		
27	SL14_0-0.5	n	s		8	/	/	/	/	*	/	/	/	/	/	*		
28	SL09_0-0.5	n	s		8	/	/	/	/	*	/	/	/	/	/	*		
29	SL08_0-0.5	n	s		8	/	/	/	/	*	/	/	/	/	/	*		
30	SL08_0.5-1.0	n	s		8	/	/	/	/	*	/	/	/	/	/	*		
31	SL03_0-0.5	270720	s		8	/	/	/	/	*	/	/	/	/	/	*		
32	SL21_0-0.5	270720	s		8	/	/	/	/	*	/	/	/	/	/	*		
33	SL21_0.5-1.0	n	s		8	/	/	/	/	*	/	/	/	/	/	*		
34	SL10_0-0.5	n	s		8	/	/	/	/	*	/	/	/	/	/	*		
35	SL27_0-0.5	280720	s		8	/	/	/	/	*	/	/	/	/	/	*		
36	SL27_0.5-1.0	n	s		8	/	/	/	/	*	/	/	/	/	/	*		
37	SL17_0-0.5	n	s		8	/	/	/	/	*	/	/	/	/	/	*		
TOTAL					0	0	0	0	0	0	0	0	0	0	0	0	0	

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.



CHAIN OF CUSTODY

ALS Laboratory: please tick →

LADELAIDE 21 Birnie Road Pokeska SA 5036
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5

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WOLLONGONG 69 Kenny Street Wollongong NSW 2500
Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: AECOM Australia Pty Ltd		TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)		<input checked="" type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)		
OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800				<input type="checkbox"/> Non Standard or urgent TAT (List due date):		Custody Seal intact? Yes No N/A		
PROJECT: 60566025		ALS QUOTE NO.: EP-036-20 V5				Free ice / frozen ice bricks present upon receipt? Yes No N/A		
PURCHASE ORDER NUMBER:		COUNTRY OF ORIGIN: AUSTRALIA				Random Sample Temperature on Receipt: °C		
PROJECT MANAGER: Peter Young		CONTACT PH: 0402 225 444				Other comment:		
SAMPLER: Will Riddell		SAMPLER MOBILE: 0427470250		RELINQUISHED BY: W. Riddell		RECEIVED BY:		
COC Emailed to ALS? YES		EDD FORMAT (or default):		DATE/TIME: 30/7/20 1315		DATE/TIME:		
Email Reports to: peter.young@aecom.com						DATE/TIME:		
Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com						DATE/TIME:		

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Please retain all samples until instructed to dispose

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).													Additional Information
	LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EG020-SD: Total Metals in sediments by ICPMS (NAGD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn	EG005-SD: Total Iron and Aluminium in Sediments by ICPAES (NAGD)	EG035-SD: Mercury in Sediments by FIMS (NODG-required Level of Reporting)	TPH-SD: Low Level TPH/BTEX for Sediments	EP132B-SD: Ultra-trace PAHs in Sediments	IK-3S: TOC/TIC/TC (Leco) Combined Suite	EP090 (solids): Organotins - TBT	EA150/EA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-11S: Total N + Total P	EA250 Sum: Tot Gross alpha & beta	EA037: ASS Field Screening	EA033-WA: WA - Chromium Suite for Acid Sulphate Soils	
38	SL16_1.0-1.5	280720	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
39	SL16_0.5-1.0	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
40	SL16_0-0.5	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
41	SL13_0.5-1.0	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
42	SL13_0-0.5	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
43	SL21_0-0.5	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
44	SL21_0.5-0.8	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
45	SL18_0-0.5	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
46	SL24_0-0.5	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
47	SL06_0-0.5	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
48	SL28_0.5-1.0	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
49	SL23_0-0.5	"	S			8	/	/	/	/	/	/	/	/	/	/	/	/	
TOTAL						0	0	0	0	0	0	0	0	0	0	0	0	0	0

* Analysis for EP132B-SD: Ultra-trace PAHs in Sediments and EA033-WA: WA - Chromium Suite for Acid Sulphate Soils may be undertaken pending initial analytical results. Please retain all samples for instruction on whether to proceed with these analyses.

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles

CERTIFICATE OF ANALYSIS

Work Order : **ES2029399**
Client : **AECOM Australia Pty Ltd**
Contact : PETER YOUNG
Address : GPO BOX 3175
 DARWIN NT, AUSTRALIA 0801
Telephone : 6432 2000
Project : 60566025 Darwin Sediment Sampling
Order number : 60566025
C-O-C number : ----
Sampler : Will Riddell
Site : ----
Quote number : EP/036/20 V4
No. of samples received : 14
No. of samples analysed : 14

Page : 1 of 5
Laboratory : Environmental Division Sydney
Contact : Brenda Hong
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164

Telephone : +61 2 8784 8555
Date Samples Received : 20-Aug-2020 14:10
Date Analysis Commenced : 25-Aug-2020
Issue Date : 26-Aug-2020 13:31



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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	Position	Accreditation Category
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD



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
∅ = 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
- ASS: EA033 (CRS Suite): Laboratory determinations of ANC needs to be corroborated by effectiveness of the measured ANC in relation to incubation ANC. Unless corroborated, the results of ANC testing should be discounted when determining Net Acidity for comparison with action criteria, or for the determination of the acidity hazard and required liming amounts.
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) 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)				Client sample ID	SL01_0.5-1.0	SL08_0-0.5	SL14_0-0.5	SL26_0-0.5	SL19_0-0.5
Client sampling date / time				27-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00
Compound	CAS Number	LOR	Unit	ES2029399-001	ES2029399-002	ES2029399-003	ES2029399-004	ES2029399-005	
				Result	Result	Result	Result	Result	
EA033-A: Actual Acidity									
pH KCl (23A)	----	0.1	pH Unit	9.1	9.2	9.0	9.1	9.1	
Titration Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2	
sulfidic - Titration Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02	
EA033-B: Potential Acidity									
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.175	0.086	0.049	0.066	0.137	
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	109	54	30	42	85	
EA033-C: Acid Neutralising Capacity									
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	38.1	46.9	19.4	40.4	34.3	
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	7610	9380	3870	8070	6860	
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	12.2	15.0	6.20	12.9	11.0	
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	<0.02	<0.02	<0.02	
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10	
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1	
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.18	0.09	0.05	0.07	0.14	
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	109	54	30	42	85	
Liming Rate excluding ANC	----	1	kg CaCO3/t	8	4	2	3	6	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	SL23_0-0.5	SL23_0.5-1.0	SL27_0.5-1.0	SL02_0-0.5	SL10_0-0.5
Client sampling date / time				29-Jul-2020 00:00	29-Jul-2020 00:00	28-Jul-2020 00:00	29-Jul-2020 00:00	27-Jul-2020 00:00	
Compound	CAS Number	LOR	Unit	ES2029399-006	ES2029399-007	ES2029399-008	ES2029399-009	ES2029399-010	
				Result	Result	Result	Result	Result	
EA033-A: Actual Acidity									
pH KCl (23A)	----	0.1	pH Unit	9.2	8.9	8.9	9.2	9.1	
Titration Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2	
sulfidic - Titration Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02	
EA033-B: Potential Acidity									
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.121	0.229	0.084	0.093	0.040	
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	75	143	52	58	25	
EA033-C: Acid Neutralising Capacity									
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	45.6	20.1	4.91	46.8	28.8	
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	9120	4010	982	9360	5750	
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	14.6	6.43	1.57	15.0	9.22	
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	<0.02	<0.02	<0.02	
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10	
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1	
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.12	0.23	0.08	0.09	0.04	
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	75	143	52	58	25	
Liming Rate excluding ANC	----	1	kg CaCO3/t	6	11	4	4	2	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	SL22_0-0.5	SL16_0-0.5	SL16_1.0-1.5	SL24_0-0.5	----
Client sampling date / time			29-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	28-Jul-2020 00:00	----
Compound	CAS Number	LOR	Unit	ES2029399-011	ES2029399-012	ES2029399-013	ES2029399-014	-----
				Result	Result	Result	Result	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	9.3	9.1	9.0	9.4	----
Titration Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	----
sulfidic - Titration Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	0.119	0.072	0.130	0.017	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	74	45	81	11	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	57.6	28.1	26.2	56.8	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	11500	5620	5240	11400	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	18.5	9.00	8.40	18.2	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	1.5	1.5	1.5	1.5	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	----
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.12	0.07	0.13	<0.02	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	74	45	81	11	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	6	3	6	<1	----

QUALITY CONTROL REPORT

Work Order	: ES2029399	Page	: 1 of 4
Client	: AECOM Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: PETER YOUNG	Contact	: Brenda Hong
Address	: GPO BOX 3175 DARWIN NT, AUSTRALIA 0801	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: 6432 2000	Telephone	: +61 2 8784 8555
Project	: 60566025 Darwin Sediment Sampling	Date Samples Received	: 20-Aug-2020
Order number	: 60566025	Date Analysis Commenced	: 25-Aug-2020
C-O-C number	: ----	Issue Date	: 26-Aug-2020
Sampler	: Will Riddell		
Site	: ----		
Quote number	: EP/036/20 V4		
No. of samples received	: 14		
No. of samples analysed	: 14		



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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ben Felgendrejeris	Senior Acid Sulfate Soil 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 (%)
EA033-A: Actual Acidity (QC Lot: 3216567)									
EB2021778-017	Anonymous	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	8.3	8.3	0.00	0% - 20%
EB2021778-027	Anonymous	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	7.3	7.4	1.36	0% - 20%
EA033-A: Actual Acidity (QC Lot: 3216571)									
ES2029399-003	SL14_0-0.5	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	9.0	9.0	0.00	0% - 20%
ES2029399-013	SL16_1.0-1.5	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	9.0	9.0	0.00	0% - 20%
EA033-B: Potential Acidity (QC Lot: 3216567)									
EB2021778-017	Anonymous	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.771	0.771	0.00	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	481	481	0.00	0% - 20%
EB2021778-027	Anonymous	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.129	0.125	3.12	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	80	78	3.12	No Limit
EA033-B: Potential Acidity (QC Lot: 3216571)									
ES2029399-003	SL14_0-0.5	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.049	0.049	0.00	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	30	30	0.00	No Limit



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-B: Potential Acidity (QC Lot: 3216571) - continued									
ES2029399-013	SL16_1.0-1.5	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.130	0.132	1.75	0% - 20%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	81	82	1.75	No Limit
EA033-C: Acid Neutralising Capacity (QC Lot: 3216567)									
EB2021778-017	Anonymous	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	6.13	5.98	2.48	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	1.96	1.92	2.48	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	1220	1200	2.48	0% - 20%
EB2021778-027	Anonymous	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	0.93	0.82	12.5	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	0.30	0.26	12.5	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	185	163	12.5	0% - 50%
EA033-C: Acid Neutralising Capacity (QC Lot: 3216571)									
ES2029399-003	SL14_0-0.5	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	19.4	19.3	0.107	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	6.20	6.19	0.00	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	3870	3860	0.107	0% - 20%
ES2029399-013	SL16_1.0-1.5	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	26.2	26.4	0.909	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	8.40	8.47	0.909	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	5240	5290	0.909	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: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
EA033-A: Actual Acidity (QCLot: 3216567)									
EA033: pH KCl (23A)	----	----	pH Unit	----	4.4 pH Unit	100	91.0	107	
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	15 mole H+ / t	117	70.0	124	
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----	
EA033-A: Actual Acidity (QCLot: 3216571)									
EA033: pH KCl (23A)	----	----	pH Unit	----	4.4 pH Unit	100	91.0	107	
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	15 mole H+ / t	121	70.0	124	
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----	
EA033-B: Potential Acidity (QCLot: 3216567)									
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.198 % S	95.6	77.0	121	
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----	
EA033-B: Potential Acidity (QCLot: 3216571)									
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.198 % S	89.8	77.0	121	
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----	
EA033-C: Acid Neutralising Capacity (QCLot: 3216567)									
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	99.2	91.0	112	
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: 3216571)									
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	96.8	91.0	112	
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	----	----	----	----	

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	: ES2029399	Page	: 1 of 5
Client	: AECOM Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: PETER YOUNG	Telephone	: +61 2 8784 8555
Project	: 60566025 Darwin Sediment Sampling	Date Samples Received	: 20-Aug-2020
Site	: ----	Issue Date	: 26-Aug-2020
Sampler	: Will Riddell	No. of samples received	: 14
Order number	: 60566025	No. of samples analysed	: 14

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
EA033-A: Actual Acidity							
Snap Lock Bag - frozen (EA033) SL01_0.5-1.0, SL10_0-0.5	27-Jul-2020	25-Aug-2020	27-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓
Snap Lock Bag - frozen (EA033) SL08_0-0.5, SL26_0-0.5, SL27_0.5-1.0, SL16_1.0-1.5, SL14_0-0.5, SL19_0-0.5, SL16_0-0.5, SL24_0-0.5	28-Jul-2020	25-Aug-2020	28-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓
Snap Lock Bag - frozen (EA033) SL23_0-0.5, SL02_0-0.5, SL23_0.5-1.0, SL22_0-0.5	29-Jul-2020	25-Aug-2020	29-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓
EA033-B: Potential Acidity							
Snap Lock Bag - frozen (EA033) SL01_0.5-1.0, SL10_0-0.5	27-Jul-2020	25-Aug-2020	27-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓
Snap Lock Bag - frozen (EA033) SL08_0-0.5, SL26_0-0.5, SL27_0.5-1.0, SL16_1.0-1.5, SL14_0-0.5, SL19_0-0.5, SL16_0-0.5, SL24_0-0.5	28-Jul-2020	25-Aug-2020	28-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓
Snap Lock Bag - frozen (EA033) SL23_0-0.5, SL02_0-0.5, SL23_0.5-1.0, SL22_0-0.5	29-Jul-2020	25-Aug-2020	29-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓
EA033-C: Acid Neutralising Capacity							
Snap Lock Bag - frozen (EA033) SL01_0.5-1.0, SL10_0-0.5	27-Jul-2020	25-Aug-2020	27-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓
Snap Lock Bag - frozen (EA033) SL08_0-0.5, SL26_0-0.5, SL27_0.5-1.0, SL16_1.0-1.5, SL14_0-0.5, SL19_0-0.5, SL16_0-0.5, SL24_0-0.5	28-Jul-2020	25-Aug-2020	28-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓
Snap Lock Bag - frozen (EA033) SL23_0-0.5, SL02_0-0.5, SL23_0.5-1.0, SL22_0-0.5	29-Jul-2020	25-Aug-2020	29-Jul-2021	✓	25-Aug-2020	23-Nov-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-D: Retained Acidity								
Snap Lock Bag - frozen (EA033) SL01_0.5-1.0, SL10_0-0.5	27-Jul-2020	25-Aug-2020	27-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓	
Snap Lock Bag - frozen (EA033) SL08_0-0.5, SL26_0-0.5, SL27_0.5-1.0, SL16_1.0-1.5, SL14_0-0.5, SL19_0-0.5, SL16_0-0.5, SL24_0-0.5	28-Jul-2020	25-Aug-2020	28-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓	
Snap Lock Bag - frozen (EA033) SL23_0-0.5, SL02_0-0.5, SL23_0.5-1.0, SL22_0-0.5	29-Jul-2020	25-Aug-2020	29-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓	
EA033-E: Acid Base Accounting								
Snap Lock Bag - frozen (EA033) SL01_0.5-1.0, SL10_0-0.5	27-Jul-2020	25-Aug-2020	27-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓	
Snap Lock Bag - frozen (EA033) SL08_0-0.5, SL26_0-0.5, SL27_0.5-1.0, SL16_1.0-1.5, SL14_0-0.5, SL19_0-0.5, SL16_0-0.5, SL24_0-0.5	28-Jul-2020	25-Aug-2020	28-Jul-2021	✓	25-Aug-2020	23-Nov-2020	✓	
Snap Lock Bag - frozen (EA033) SL23_0-0.5, SL02_0-0.5, SL23_0.5-1.0, SL22_0-0.5	29-Jul-2020	25-Aug-2020	29-Jul-2021	✓	25-Aug-2020	23-Nov-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	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
Analytical Methods							
Laboratory Duplicates (DUP)							
Chromium Suite for Acid Sulphate Soils	EA033	4	32	12.50	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Suite for Acid Sulphate Soils	EA033	2	32	6.25	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	2	32	6.25	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.

<i>Analytical Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
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.

<i>Preparation Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

#736637

Kim Phan

From: Riddell, William <william.riddell@aecom.com>
Sent: Friday, 31 July 2020 4:46 PM
To: Adrian Degenaar; Helen Simpson
Cc: Uma Nagendiram; Kim Phan
Subject: Re: [EXTERNAL] RE: RE: - Sediment samples sent 30 July, duplicate and triplicate mix up

Hi Helen

Please send both sets for SL23A to Eurofins.

Regarding the trip blanks please analyse all 13. They weren't sampled in the field as we were supposed to but at least they will tell us something about the trip from the dispatch in Darwin to the southern labs.

Thanks

Will

[Get Outlook for Android](#)

Uma Nagendiram
[Signature]
7/31/2020 10:00AM

From: Helen Simpson <helen.simpson@alsglobal.com>
Sent: Friday, July 31, 2020 3:50:50 PM
To: Adrian Degenaar <adrian.degenaar@ALSGlobal.com>; Riddell, William <william.riddell@aecom.com>
Cc: Uma Nagendiram <Uma.Nagendiram@alsglobal.com>; Kim Phan <Kim.Phan@alsglobal.com>
Subject: [EXTERNAL] RE: RE: - Sediment samples sent 30 July, duplicate and triplicate mix up

Hi William,

More queries for you. For sample SL23A, we have 2 sets of samples, 1 set at depth 0-0.5 and the other set as 0.5-1.0. which set needs to be forwarded to Eurofins?

Kind Regards,



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www.alsglobal.com

From: Riddell, William [mailto:william.riddell@aecom.com]

Sent: Friday, 31 July 2020 11:10 AM

To: ALSEnviro Darwin <alsenviro.darwin@alsglobal.com>

Cc: Young, Peter <peter.young@aecom.com>

Subject: [EXTERNAL] - Sediment samples sent 30 July, duplicate and triplicate mix up

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.

Hi Adrian,

As discussed there was a slight mix up with samples on the COC yesterday.

For the record:

- samples marked SL23A and SL22A are duplicates that should be analysed by Eurofins. We have to redirect these.
- Samples marked SL22B, SL22C, SL05b and SL05c have been marked to be sent to Eurofins but need to be redirected to ALS

Hopefully this can be rectified by the labs down south.

Thanks,

Will



CHAIN OF CUSTODY

ALS Laboratory: please tick →

14.8.20
SYDNEY 27-29 Wanders Road, Suite 101
Ph: 02 9794 8556 E: samples.sydney@alsglobal.com

CLIENT: AECOM Australia Pty Ltd	TURNAROUND REQUIREMENTS : <input checked="" type="checkbox"/> Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle) Custody Seal Intact? Yes No <input checked="" type="checkbox"/> N/A Free ice / frozen ice bricks present upon receipt? Yes No <input checked="" type="checkbox"/> N/A Random Sample Temperature on Receipt: °C Other comment: 13.5
OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800	(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) <input type="checkbox"/> Non Standard or urgent TAT (List due date):	
PROJECT: 60566025	ALS QUOTE NO.: EP-036-20 V5	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7 OF: 1 2 3 4 5 6 7
PURCHASE ORDER NUMBER:	COUNTRY OF ORIGIN: AUSTRALIA	
PROJECT MANAGER: Peter Young	CONTACT PH: 0402 225 444	
SAMPLER: Will Riddell	SAMPLER MOBILE: 0427470250	RELINQUISHED BY: W. Riddell
COC Emailed to ALS? YES	EDD FORMAT (or default):	RECEIVED BY: [Signature] 1:20pm
Email Reports to: peter.young@aecom.com		DATE/TIME: 30/7/20
Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com		DATE/TIME: 30/07/20

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Please retain all samples until instructed to dispose

ALS USE ONLY	SAMPLE DETAILS			CONTAINER INFORMATION	ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price)													
	LAB ID	SAMPLE ID	DATE / TIME		MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).										
AS2	1	SL23_0-0.5-1.0	290720	S	Substrate (Perovskite) Analysis: Newcastle	8	EG020-SD: Total Metals in sediments by ICPMS (NAGD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn	EG005-SD: Total Iron and Aluminium in Sediments by ICPAES (NAGD)	EG035-SD: Mercury in Sediments by FIMS (NODS-required Level of Reporting)	TPH-SD: Low Level TRH/BTEX for Sediments	EP132B-SD: Ultra-trace PAHs in Sediments	IN-3S: TOC/TIC/TC (Leco) Combined Suite	EP090 (solids): Organotins - TBT	EA150H/EA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-11S: Total N + Total P	EA250 Sum: Tot Gross alpha & beta	EA037: ASS Field Screening	EA033-WA: WA - Chromium Suite for Acid Sulphate Soils
FW	X	SL23A_0-0.5	290720	S	Substrate (Perovskite) Analysis: Newcastle	8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	3	SL23_0-0.5	290720	S	Substrate (Perovskite) Analysis: Newcastle	8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	4	SL31_0-0.5	290720	S	Substrate (Perovskite) Analysis: Newcastle	8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	5	SL31_0-0.5-1.0	290720	S	Substrate (Perovskite) Analysis: Newcastle	8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	6	SLRB03	290720	S	Substrate (Perovskite) Analysis: Newcastle	1	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	7	SLFB03	290720	S	Substrate (Perovskite) Analysis: Newcastle	1	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	2	SL05C_0-0.5	290720	S	Please forward to Eurojins	8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	50	SL05B_0-0.5	290720	S	Eurojins	8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	51	LS22B_0-0.5	290720	S	- triplicate samples	3	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	52	SL22C_0-0.5	290720	S	- triplicate samples	3	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
	53-65	SLTR01	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	*	
TOTAL						0	0	0	0	0	0	0	0	0	0	0	0	

Environmental Division Sydney
Work Order Reference ES2026249



Telephone: 61-2-8784 8551

* Analysis for EP132B-SD: Ultra-trace PAHs in Sediments and EA033-WA: WA - Chromium Suite for Acid Sulphate Soils may be undertaken pending initial analytical results. Please retain all samples for instruction on whether to proceed with these analyses.

HOLD

LAB OF ORIGIN DARWIN

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Plastic
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lids Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.



CHAIN OF CUSTODY

ALS Laboratory: please tick →

Column

2

CLIENT: AECOM Australia Pty Ltd		TURNAROUND REQUIREMENTS : <input checked="" type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)	
OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800		Standard TAT may be longer for some tests e.g. Ultra Trace Organics		<input type="checkbox"/> Non Standard or urgent TAT (List due date):	
PROJECT: 60566025		ALS QUOTE NO.: EP-036-20 V5		Custody Seal Intact? Yes No N/A	
PURCHASE ORDER NUMBER:		COUNTRY OF ORIGIN: AUSTRALIA		Free ice / frozen ice bricks present upon receipt? Yes No N/A	
PROJECT MANAGER: Peter Young		CONTACT PH: 0402 225 444		Random Sample Temperature on Receipt: °C	
SAMPLER: Will Riddell		SAMPLER MOBILE: 042740250		Other comment:	
COC Emailed to ALS? YES		EDD FORMAT (or default):		RECEIVED BY:	
Email Reports to: peter.young@aecom.com		RELINQUISHED BY: W.Riddell		RECEIVED BY:	
Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com		DATE/TIME: 30/7/20		DATE/TIME:	
		1315		DATE/TIME:	

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Please retain all samples until instructed to dispose

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION	ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).										Additional Information		
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EG020-SD: Total Metals in sediments by ICPMS (NAOD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn	EG005-SD: Total Iron and Aluminium in Sediments by ICPAES (NAOD)	EG035-SD: Mercury in Sediments by FILMS (NODG-required Level of reporting)	TPH-SD: Low Level TRH/BTEX for Sediments	EP132B-SD: Ultra-trace PAHs in Sediments	IN-3S: TOC/TIC/TC (Leco) Combined Suite	EP090 (solids): Organotins - TBT	EA150/HEA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-11S: Total N + Total P	EA250 Sum: Tot Gross alpha & beta	EA037: ASS Field Screening	EA033-WA: WA - Chromium Suite for Acid Sulphate Soils
8	SL05_0-0.5	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
9	SL05_0.5-1.0	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
10	SL29_0-0.5	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
11	SL29_0.5-1.0	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
12	SL29_1.0-1.5	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
13	SL22_0-0.5	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
14	SL20_0-0.5	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
15	SL20_0.5-1.0	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
	SL22_0-0.5	290720	S														
	SL22_0-0.5	290720	S														
16	SL07_0-0.5	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
17	SL02_0-0.5	290720	S		8	✓	✓	✓	✓	*	✓	✓	✓	✓	✓	✓	*
TOTAL					0	0	0	0	0	0	0	0	0	0	0	0	0

* Analysis for EP132B-SD: Ultra-trace PAHs in Sediments and EA033-WA: WA - Chromium Suite for Acid Sulphate Soils may be undertaken pending initial analytical results. Please retain all samples for instruction on whether to proceed with these analyses.

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
 V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
 Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bottle; LI = Lungs Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.



CHAIN OF CUSTODY

ALS Laboratory: please tick →

3

CLIENT: AECOM Australia Pty Ltd		TURNAROUND REQUIREMENTS : <input checked="" type="checkbox"/> Standard TAT (List due date):			FOR LABORATORY USE ONLY (Circle) Custody Seal Intact? Yes No N/A Free ice / frozen ice bricks present upon receipt? Yes No N/A Random Sample Temperature on Receipt: °C Other comment:		
OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800		(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) <input type="checkbox"/> Non Standard or urgent TAT (List due date):					
PROJECT: 60566025		ALS QUOTE NO.: EP-036-20 V5			COC SEQUENCE NUMBER (Circle)		
PURCHASE ORDER NUMBER:		COUNTRY OF ORIGIN: AUSTRALIA			COC: 1 2 3 4 5 6 7		
PROJECT MANAGER: Peter Young		CONTACT PH: 0402 225 444			OF: 1 2 3 4 5 6 7		
SAMPLER: Will Riddell		SAMPLER MOBILE: 0427470250			RECEIVED BY:		
COC Emailed to ALS? YES		EDD FORMAT (or default):			RELINQUISHED BY:		
Email Reports to: peter.young@aecom.com		DATE/TIME: 30/7/20			DATE/TIME:		
Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com		DATE/TIME: 1315			DATE/TIME:		

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Please retain all samples until instructed to dispose

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) <small>Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).</small>										Additional Information		
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE <small>(refer to codes below)</small>	TOTAL BOTTLES	EG020-SD: Total Metals in sediments by ICPMS (NAGD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn	EG005-SD: Total Iron and Aluminium in Sediments by ICPAES (NAGD)	EG035-SD: Mercury in Sediments by FIMS (NODC-required Level of Reporting)	TPH-SD: Low Level TRH/BTEXN for Sediments	EP132B-SD: Ultra-trace PAHs in Sediments	IN-38: TOC/TC/TC (Leco) Combined Suite	EP090 (solids): Organotins - TBT	EA150H/EA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-11S: Total N + Total P	EA250 Summ: Tot Gross alpha & beta	EA037: ASS Field Screening	EA033-WA: WA - Chromium Suite for Acid Sulphate Soils	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
18	SL26_0-0.5	280720	S		8	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✗	
19	SL19_0-0.5	280720	S		8	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✗	
20	SL19_0.5-1.0	280720	S		8	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✗	
21	SLRB01	270720	S		1	✓												
22	SLFB01	270720	S		1	✓												
23	SLRB02	280720	S		1	✓												
24	SLFB02	280720	S		1	✓												
25	SLTB01	300720	S		16													
			S															
			S															
			S															
			S															
TOTAL					0	0	0	0	0	0	0	0	0	0	0	0	0	0

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulfate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bar; LI = Liofols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.



CHAIN OF CUSTODY

ALS Laboratory: please tick →

LEVEL 3, 9 CAVENAGH STREET, DARWIN, NT 0800
PHONE: 08 2243 7222 Fax: 08 2243 7223

4

CLIENT: AECOM Australia Pty Ltd		TURNAROUND REQUIREMENTS : <input checked="" type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)		
OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800		(Standard TAT may be longer for some tests e.g., Ultra Trace Organics)		Custody Seal Intact? Yes No N/A		
PROJECT: 60566025		ALS QUOTE NO.: EP-036-20 V5		Free ice / frozen ice bricks present upon receipt? Yes No N/A		
PURCHASE ORDER NUMBER:		COUNTRY OF ORIGIN: AUSTRALIA		Random Sample Temperature on Receipt: °C		
PROJECT MANAGER: Peter Young		CONTACT PH: 0402 225 444		Other comment:		
SAMPLER: Will Riddell		SAMPLER MOBILE: 0427470250		RECEIVED BY:		
COC Emailed to ALS? YES		EDD FORMAT (or default):		DATE/TIME:		
Email Reports to: peter.young@aecom.com		RELINQUISHED BY: <i>W. Riddell</i>		DATE/TIME: <i>30/7/20</i>		
Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com		DATE/TIME: <i>13/5</i>		DATE/TIME:		

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Please retain all samples until instructed to dispose

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)				CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).											Additional Information	
	LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EG020-SD: Total Metals in sediments by ICP/MS (NA GD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn	EG005-SD: Total Iron and Aluminium in Sediments by ICP/AES (NA GD)	EG035-SD: Mercury in Sediments by FIMS (NODC-required Level of Reporting)	TPH-SD: Low Level TRH/BTEX for Sediments	EP132B-SD: Ultra-trace PAHs in Sediments	IN-3S: TOC/TIC/TC (Leco) Combined Suite	EP090 (solids): Organotin - TBT	EA150H/EA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-11S: Total N + Total P	EA250 Sum: Tot Gross alpha & beta	EA037: ASS Field Screening		EA033-WA: WA - Chromium Suite for Acid Sulphate Soils
26	SL15_0-0.5	230720	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
27	SL14_0-0.5	n	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
28	SL09_0-0.5	n	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
29	SL08_0-0.5	n	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
30	SL08_0.5-1.0	n	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
31	SL03_0-0.5	270720	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
32	SL01_0-0.5	270720	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
33	SL01_0.5-1.0	n	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
34	SL10_0-0.5	n	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
35	SL27_0-0.5	280720	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
36	SL27_0.5-1.0	n	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
37	SL17_0-0.5	n	S			8	/	/	/	/	*	/	/	/	/	/	/	*	
TOTAL						0	0	0	0	0	0	0	0	0	0	0	0	0	0

→ Number

* Analysis for EP132B-SD: Ultra-trace PAHs in Sediments and EA033-WA: WA - Chromium Suite for Acid Sulphate Soils may be undertaken pending initial analytical results. Please retain all samples for instruction on whether to proceed with these analyses.

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl Preserved Plastic; HS = HCl Preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Luvigal Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.



CHAIN OF CUSTODY

ALS Laboratory: please tick →

3

CLIENT: AECOM Australia Pty Ltd		TURNAROUND REQUIREMENTS : <input checked="" type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)		
OFFICE: Level 3, 9 Cavenagh Street, Darwin, NT 0800		(Standard TAT may be longer for some tests e.g. Ultra Trace Organics) <input type="checkbox"/> Non Standard or urgent TAT (List due date):		Custody Seal Intact? Yes No N/A		
PROJECT: 60566025		ALS QUOTE NO.: EP-036-20 V5		Free ice / frozen ice bricks present upon receipt? Yes No N/A		
PURCHASE ORDER NUMBER:		COUNTRY OF ORIGIN: AUSTRALIA		Random Sample Temperature on Receipt: °C		
PROJECT MANAGER: Peter Young		CONTACT PH: 0402 225 444		Other comment:		
SAMPLER: Will Riddell		SAMPLER MOBILE: 0427470250		RECEIVED BY:		RECEIVED BY:
COC Emailed to ALS? YES		EDD FORMAT (or default):		DATE/TIME:		DATE/TIME:
Email Reports to: peter.young@aecom.com		RELINQUISHED BY: W. Riddell		DATE/TIME: 30/7/20		DATE/TIME:
Email Invoice to: AP_CustomerService.ANZ@aecom.com cc: peter.young@aecom.com		DATE/TIME: 1315		DATE/TIME:		DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Please retain all samples until instructed to dispose

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION	ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).													Additional Information	
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EG020-SD: Total Metals in sediments by ICPMS (MAGD) - Sb, As, Cd, Cr, Cu, Pb, Mn, Ni, Ag, Zn	EG005-SD: Total Iron and Aluminium in Sediments by ICPAES (MAGD)	EG035-SD: Mercury in Sediments by FIMS (NODG-required Level of Reporting)	TPH-SD: Low Level TRIBTEXN for Sediments	EP132B-SD: Ultra-trace PAHs in Sediments	IN-38: TOC/TIC/TC (Leco) Combined Suite	EP090 (solitas): Organotins - TBT	EA150H/EA152: Particle Sizing with Hydrometer + Soil Particle Density	NT-119: Total N + Total P	EA250 Sum: Tot Gross alpha & beta	EA037: ASS Field Screening	EA033-WA: WA - Chromium Suite for Acid Sulphate Soils	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.	
38	SL16_1.0-1.5	280720	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
39	SL16_0.5-1.0	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
40	SL16_0-0.5	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
41	SL13_0.5-1.0	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
42	SL13_0-0.5	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
43	SL21_0-0.5	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
44	SL21_0.5-0.8	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
45	SL18_0-0.5	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
46	SL24_0-0.5	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
47	SL06_0-0.5	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
48	SL28_0.5-1.0	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
49	SL28_0-0.5	"	S		8	/	/	/	/	*	/	/	/	/	/	/	*		
TOTAL					0	0	0	0	0	0	0	0	0	0	0	0	0	0	

* Analysis for EP132B-SD: Ultra-trace PAHs in Sediments and EA033-WA: WA - Chromium Suite for Acid Sulphate Soils may be undertaken pending initial analytical results. Please retain all samples for instruction on whether to proceed with these analyses.

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V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bar for Acid Sulphate Soils; B = Unpreserved Bar; LI = Lunois Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.



Australian Government
National Measurement Institute

QUALITY ASSURANCE REPORT

Client: EUROFINS MGT

NMI QA Report No: EURO26/200810

Sample Matrix: Solid

Analyte	Method	LOR	Blank	Sample Duplicates			Recoveries	
				Sample	Duplicate	RPD	LCS	Matrix Spike
		ng/g	ng/g	ng/g	ng/g	%	%	%
Organics Section								
Organotin								
Monobutyltin	NR_35	0.5	<0.5	NA	NA	NA	59	NA
Dibutyltin	NR_35	0.5	<0.5	NA	NA	NA	88	NA
Tributyltin	NR_35	0.5	<0.5	NA	NA	NA	92	NA
Organotin Surrogate								
Tripopyltin (%Rec)	NR_35	-	-	NA	NA	NA	86	NA

Results expressed in percentage (%) or ng/g wherever appropriate.

Acceptable Spike recovery is 30-150% (monobutyltin and Tripopyltin); 40-160% (dibutyltin and tributyltin)

Maximum acceptable RPDs on spikes and duplicates is 60%.

'NA' = Not Applicable.

RPD= Relative Percentage Difference, LCS = Laboratory Control Spike, LOR = Limit of Reporting.

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Signed:

Danny Slee
Organics Manager, NMI-North Ryde
18/08/2020

Date:



REPORT OF ANALYSIS

Page: 1 of 2

Report No. RN1284301

Client : EUROFINS MGT 6 Monterey Road Dandenong South VIC 3175	Job No. : EURO26/200810 Quote No. : QT-02018 Order No. : 20-434-985-736637 Date Received : 10-AUG-2020 Sampled By : CLIENT
Attention : ANDREW BLACK Project Name : Your Client Services Manager : Tim Reddan	Phone : 03 9644 4854

Lab Reg No.	Sample Ref	Sample Description
N20/018461	S20-AU10478	SOIL SL23A_0-0.5 REF: 736637
N20/018462	S20-AU10479	SOIL SL23A_0.5-1.0 REF: 736637
N20/018463	S20-AU10480	SOIL SL22A_0-0.5 REF: 736637

Lab Reg No.		N20/018461	N20/018462	N20/018463		
Date Sampled		29-JUL-2020	29-JUL-2020	29-JUL-2020		
Sample Reference		S20-AU10478	S20-AU10479	S20-AU10480		
	Units					Method
Organotins						
Monobutyltin as Sn	ng/g	<0.5	<0.5	3.3		NR_35
Dibutyltin as Sn	ng/g	<0.5	<0.5	<0.5		NR_35
Tributyltin as Sn	ng/g	<0.5	<0.5	<0.5		NR_35
Surrogate: Tripropyltin	%REC	81	83	80		NR_35
Dates						
Date extracted		13-AUG-2020	13-AUG-2020	13-AUG-2020		
Date analysed		17-AUG-2020	17-AUG-2020	17-AUG-2020		

Luke Baker, Analyst
Organics - NSW
Accreditation No. 198

19-AUG-2020

Lab Reg No.		N20/018461	N20/018462	N20/018463		
Date Sampled		29-JUL-2020	29-JUL-2020	29-JUL-2020		
Sample Reference		S20-AU10478	S20-AU10479	S20-AU10480		
	Units					Method
Trace Elements						
Total Solids	%	68.4	71.8	61.5		NT2_49
Dates						
Date extracted		11-AUG-2020	11-AUG-2020	11-AUG-2020		
Date analysed		12-AUG-2020	12-AUG-2020	12-AUG-2020		


Accredited for compliance with ISO/IEC 17025 - Testing

105 Delhi Road, North Ryde NSW 2113 Tel: +61 2 9449 0111 www.measurement.gov.au

REPORT OF ANALYSIS

Page: 2 of 2
Report No. RN1284301

Lab Reg No.		N20/018461	N20/018462	N20/018463		
Date Sampled		29-JUL-2020	29-JUL-2020	29-JUL-2020		
Sample Reference		S20-AU10478	S20-AU10479	S20-AU10480		
	Units					Method



Pankaj Barai, Analyst
Inorganics - NSW
Accreditation No. 198

19-AUG-2020

All results are expressed on a dry weight basis.



Accredited for compliance with ISO/IEC 17025 - Testing.
This report shall not be reproduced except in full.
Results relate only to the sample(s) as received and tested.

This Report supersedes reports: *RN1284268* *RN1284290*

Measurement Uncertainty is available upon request.

Chemical Accreditation 198: 105 Delhi Road, North Ryde, NSW, 2113

Australia

Melbourne

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Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

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Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

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Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

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Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

Christchurch

43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Sample Receipt Advice

Company name: AECOM Aust Pty Ltd NT
Contact name: Peter Young
Project name: Not provided
Project ID: 60566025
Turnaround time: 1 Day
Date/Time received: Aug 7, 2020 10:00 AM
Eurofins reference: 736637

Sample Information

- ✓ A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- ✓ All samples have been received as described on the above COC.
- ✓ COC has been completed correctly.
- ✗ Attempt to chill was evident.
- ✓ Appropriately preserved sample containers have been used.
- ✓ All samples were received in good condition.
- ✓ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
- ✓ Appropriate sample containers have been used.
- ✓ Sample containers for volatile analysis received with zero headspace.
- ✗ Split sample sent to requested external lab.
- ✓ Some samples have been subcontracted.
- N/A Custody Seals intact (if used).

Notes

Contact

If you have any questions with respect to these samples, please contact your Analytical Sales Manager:

Michael Morrison on Phone : 03 8564 5933 or by email: MichaelMorrison@eurofins.com

Results will be delivered electronically via email to Peter Young - peter.young@aecom.com.

AECOM Aust Pty Ltd NT
Suite 3 17-19 Lindsay St
Darwin
NT 0801

Attention: Peter Young

Report 736637-S

Project name

Project ID 60566025

Received Date Aug 07, 2020

Client Sample ID			SL23A_0-0.5	SL23A_0.5-1.0	SL22A_0-0.5
Sample Matrix			Soil	Soil	Soil
Eurofins Sample No.			S20-Au10478	S20-Au10479	S20-Au10480
Date Sampled			Jul 29, 2020	Jul 29, 2020	Jul 29, 2020
Test/Reference	LOR	Unit			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions					
TRH C6-C9	20	mg/kg	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	< 50	< 50	< 50
BTEX					
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Xylenes - Total*	0.3	mg/kg	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	74	54	53
Total Recoverable Hydrocarbons - 2013 NEPM Fractions					
Naphthalene ^{N02}	0.5	mg/kg	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1) ^{N04}	20	mg/kg	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2) ^{N01}	50	mg/kg	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	< 100	< 100
Polycyclic Aromatic Hydrocarbons (Trace level)					
Acenaphthene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Acenaphthylene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Anthracene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Benz(a)anthracene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Benzo(a)pyrene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Benzo(b&j)fluoranthene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Benzo(g,h,i)perylene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Benzo(k)fluoranthene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Chrysene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Dibenz(a,h)anthracene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Fluoranthene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Fluorene	0.005	mg/kg	< 0.005	< 0.005	< 0.005

Client Sample ID			SL23A_0-0.5	SL23A_0.5-1.0	SL22A_0-0.5
Sample Matrix			Soil	Soil	Soil
Eurofins Sample No.			S20-Au10478	S20-Au10479	S20-Au10480
Date Sampled			Jul 29, 2020	Jul 29, 2020	Jul 29, 2020
Test/Reference	LOR	Unit			
Polycyclic Aromatic Hydrocarbons (Trace level)					
Indeno(1.2.3-cd)pyrene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Naphthalene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Phenanthrene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Pyrene	0.005	mg/kg	< 0.005	< 0.005	< 0.005
Total PAH*	0.005	mg/kg	< 0.005	< 0.005	< 0.005
2-Fluorobiphenyl (surr.)	1	%	114	103	102
p-Terphenyl-d14 (surr.)	1	%	86	86	97
Nitrate & Nitrite (as N)					
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5
Total Carbon	0.1	%	7.3	3.1	7.7
Total Inorganic Carbon	0.1	%	5.8	4.1	5.9
Total Kjeldahl Nitrogen (as N)	10	mg/kg	370	240	390
Total Nitrogen (as N)*	10	mg/kg	370	240	390
Total Organic Carbon	0.1	%	1.6	< 0.1	1.8
Phosphorus	10	mg/kg	690	470	910
Tributyltin (TBT)					
% Moisture	1	%	33	26	33
Density*					
Gross Alpha and Beta (with K-40 correction)					
Particle Size Distribution by Sieve and Hydrometer					
Heavy Metals					
Aluminium	10	mg/kg	7800	12000	9300
Antimony	10	mg/kg	< 10	< 10	< 10
Arsenic	2	mg/kg	55	49	86
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	46	63	61
Copper	5	mg/kg	< 5	9.6	7.5
Iron	20	mg/kg	44000	49000	65000
Lead	5	mg/kg	9.6	15	18
Manganese	5	mg/kg	210	170	260
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	7.2	7.5
Silver	0.2	mg/kg	< 0.2	< 0.2	< 0.2
Zinc	5	mg/kg	9.2	11	15
Acid Sulfate Soils Field pH Test					
pH-F (Field pH test)*	0.1	pH Units	6.7	8.6	8.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	7.0	7.2	7.4
Reaction Ratings* ^{S05}	-	comment	2.0	2.0	2.0
Chromium Suite					
pH-KCL	0.1	pH Units	9.4	9.1	9.4
Acid trail - Titratable Actual Acidity	2	mol H+/t	< 2	< 2	< 2
sulfidic - TAA equiv. S% pyrite	0.003	% pyrite S	< 0.003	< 0.003	< 0.003
Chromium Reducible Sulfur ^{S04}	0.005	% S	0.11	0.40	0.081
Chromium Reducible Sulfur -acidity units	3	mol H+/t	69	250	50
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a
HCl Extractable Sulfur Correction Factor	1	factor	2.0	2.0	2.0
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a

Client Sample ID			SL23A_0-0.5	SL23A_0.5-1.0	SL22A_0-0.5
Sample Matrix			Soil	Soil	Soil
Eurofins Sample No.			S20-Au10478	S20-Au10479	S20-Au10480
Date Sampled			Jul 29, 2020	Jul 29, 2020	Jul 29, 2020
Test/Reference	LOR	Unit			
Chromium Suite					
Net Acid soluble sulfur - equivalent S% pyrite ^{S02}	0.02	% S	n/a	n/a	n/a
Acid Neutralising Capacity (ANCbt)	0.01	% CaCO ₃	36	23	47
Acid Neutralising Capacity - acidity (a-ANCbt)	2	mol H+/t	7300	4600	9400
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt) ^{S03}	0.02	% S	12	7.4	15
ANC Fineness Factor		factor	1.5	1.5	1.5
CRS Suite - Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02
CRS Suite - Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10
CRS Suite - Liming Rate ^{S01}	1	kg CaCO ₃ /t	< 1	< 1	< 1
Extraneous Material					
<2mm Fraction	0.005	g	86	77	76
>2mm Fraction	0.005	g	8.9	1.2	8.7
Analysed Material	0.1	%	91	98	90
Extraneous Material	0.1	%	9.3	1.6	10

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Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported. A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Eurofins Suite B1			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions - Method: LTM-ORG-2010 TRH C6-C40	Sydney	Aug 07, 2020	14 Days
BTEX - Method: LTM-ORG-2010 TRH C6-C40	Sydney	Aug 07, 2020	14 Days
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: LTM-ORG-2010 TRH C6-C40	Sydney	Aug 07, 2020	14 Days
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: LTM-ORG-2010 TRH C6-C40	Sydney	Aug 07, 2020	14 Days
Polycyclic Aromatic Hydrocarbons (Trace level) - Method: LTM-ORG-2130 PAH and Phenols in Soil and Water (trace)	Melbourne	Aug 10, 2020	0 Days
Total Carbon - Method: LTM-INO-4060 Total Organic Carbon in water and soil	Melbourne	Aug 10, 2020	28 Days
Total Inorganic Carbon - Method: LTM-INO-4060 Total Organic Carbon in water and soil	Melbourne	Aug 10, 2020	28 Days
Total Organic Carbon - Method: LTM-INO-4060 Total Organic Carbon in water and soil	Melbourne	Aug 10, 2020	28 Days
Phosphorus - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Sydney	Aug 07, 2020	180 Days
Heavy Metals - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Sydney	Aug 07, 2020	180 Days
Metals M8 - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Sydney	Aug 07, 2020	180 Days
Acid Sulfate Soils Field pH Test - Method: LTM-GEN-7060 Determination of field pH (pHF) and field pH peroxide (pHFOX) tests	Sydney	Aug 10, 2020	7 Days
Total Nitrogen Set (as N)			
Nitrate & Nitrite (as N) - Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA	Melbourne	Aug 10, 2020	28 Days
Total Kjeldahl Nitrogen (as N) - Method: LTM-INO-4310 TKN in Waters & Soils by FIA	Melbourne	Aug 10, 2020	28 Days
% Moisture - Method: LTM-GEN-7080 Moisture	Sydney	Aug 07, 2020	14 Days
Chromium Reducible Sulfur Suite			
Chromium Suite - Method: LTM-GEN-7070 Chromium Reducible Sulfur Suite	Brisbane	Aug 10, 2020	6 Week
Extraneous Material - Method: LTM-GEN-7050/7070	Brisbane	Aug 10, 2020	6 Week

Australia

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6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
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Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

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2/91 Leach Highway
Kewdale WA 6105
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NATA # 1261
Site # 23736

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35 O'Rorke Road
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Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

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Company Name:	AECOM Aust Pty Ltd NT	Order No.:		Received:	Aug 7, 2020 10:00 AM
Address:	Suite 3 17-19 Lindsay St Darwin NT 0801	Report #:	736637	Due:	Aug 10, 2020
Project Name:		Phone:	08 8981 2698	Priority:	1 Day
Project ID:	60566025	Fax:	08 8981 4565	Contact Name:	Peter Young

Eurofins Analytical Services Manager : Michael Morrison

Sample Detail						Aluminium	Antimony	Density*	Gross Alpha and Beta (with K-40 correction)	Iron	Manganese	Particle Size Distribution by Sieve and Hydrometer	Phosphorus	Silver	Tetracycline (TC)	Total Inorganic Carbon	Total Organic Carbon	Tributyltin (TBT)	Acid Sulfate Soils Field pH Test	Metals M8	Total Nitrogen Set (as N)	Chromium Reducible Sulfur Suite	Moisture Set	Eurofins Suite B1	Polycyclic Aromatic Hydrocarbons (Trace level)
Melbourne Laboratory - NATA Site # 1254 & 14271																X	X				X				X
Sydney Laboratory - NATA Site # 18217						X	X			X	X		X	X					X	X	X		X	X	
Brisbane Laboratory - NATA Site # 20794															X							X			
Perth Laboratory - NATA Site # 23736																									
Newcastle Laboratory																									
External Laboratory								X	X			X						X							
No	Sample ID	Sample Date	Sampling Time	Matrix	LAB ID																				
1	SL23A_0-0.5	Jul 29, 2020		Soil	S20-Au10478	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	SL23A_0.5-1.0	Jul 29, 2020		Soil	S20-Au10479	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	SL22A_0-0.5	Jul 29, 2020		Soil	S20-Au10480	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test Counts						3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Internal Quality Control Review and Glossary

General

- Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
- All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
- All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
- Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
- Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
- SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
- Samples were analysed on an 'as received' basis.
- Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
- This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

- Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
- Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
- Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
- Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
- Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
- pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
- Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
- Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
- For Matrix Spikes and LCS results a dash " - " in the report means that the specific analyte was not added to the QC sample.
- Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

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Comments
Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	No
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	Yes

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) 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'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period
S05	Field Screen uses the following fizz rating to classify the rate the samples reacted to the peroxide: 1.0; No reaction to slight. 2.0; Moderate reaction. 3.0; Strong reaction with persistent froth. 4.0; Extreme reaction.

Authorised By

Michael Morrison	Analytical Services Manager
Andrew Sullivan	Senior Analyst-Organic (NSW)
Gabriele Cordero	Senior Analyst-Inorganic (NSW)
Gabriele Cordero	Senior Analyst-Metal (NSW)
Joseph Edouard	Senior Analyst-Organic (VIC)
Myles Clark	Senior Analyst-SPOCAS (QLD)
Scott Beddoes	Senior Analyst-Inorganic (VIC)

**Glenn Jackson
General Manager**

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please [click here](#).

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Appendix D

Field Data Sheets



Level 6, 3 Forrest Place, Perth WA 6000
 T: 61 8 6208 0000; F: 61 8 6208 0999

Field Sediment Sampling Data Sheet

Project Number	60633505	Site Name	Darwin Harbour	Weather Conditions AM:		Time	Height	Time	Height	
Project Name	Darwin Ship Lift	Site Location	East Arm			High Tide	10.36am	6.59m	11.12pm	5.93m
Project Manager	Peter Young	Client Name	NT Government, DTBI	Weather Conditions PM:		Low Tide	4.23am	2.07m	5.16pm	1.93m
Sampled By	Will Riddell, Annabelle Deheny	Sample Method	Vibrocore	Hot, dry, windy		Date:	27/07/2020			

Geo Ref. Sys.				Sample		Sediment		Sediment Description					
Site ID	Time	Latitude	Longitude	Water Depth	Depth (bgl)	Colour	1°	2°	Biota	Shell Presence	Organic Content	Odour	Other Comments (e.g foreign material, veneers, strata, biota)
SL01	15:40	12°29'28.3"	130°53'55.2"	?	1.00	grey			Yes	Yes	Yes	Yes	Gravel + shell abundant. Asorted molluscs. Sandier at depth, sand and shells + corals abundant. Marine mud odour. Nothing unusual.
SL10	16:20	12.49338	130.89828	4.5	0.75	grey			No	No	Yes	No	Very gravelly, no shells. 0.5-0.7m mottled grey and brown. Hit rock at 0.75m. Hard clay at bottom with gravel. Only one horizon sampled, not enough sediment >0.5m.
SL03	16:55	12.29'36.1"	130.53'51.3"	4.0	0.4	brown/grey			Yes	Yes	Yes	No	Rocks very prevelant, shells, not much fine sediment. Hard rock at 0.4m.

Sediment Constituents				
Si = Silt	Cl = Clay	FS = Fine Sand	MS = Medium Sand	CS = Coarse Sand
		Gr = Gravel	Co = Cobbles	

Sediment Colour							
M = Mottled	L = Light	D = Dark	Br = Brown	Bl = Black	Re = Red	Or = Orange	G = Grey

Appendix E

Pro UCL 95% Data
Outputs

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Uncensored Full Data Sets											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.114/10/2020 12:30:53 PM										
5	From File	ASS for ProUCL.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	pH (F)											
12												
13	General Statistics											
14	Total Number of Observations	39			Number of Distinct Observations				7			
15					Number of Missing Observations				0			
16		Minimum			8.3			Mean				8.713
17		Maximum			9.2			Median				8.7
18		SD			0.142			Std. Error of Mean				0.0227
19		Coefficient of Variation			0.0163			Skewness				0.405
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic	0.899			Shapiro Wilk GOF Test							
23	5% Shapiro Wilk Critical Value	0.939			Data Not Normal at 5% Significance Level							
24	Lilliefors Test Statistic	0.208			Lilliefors GOF Test							
25	5% Lilliefors Critical Value	0.14			Data Not Normal at 5% Significance Level							
26	Data Not Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL			95% UCLs (Adjusted for Skewness)								
30	95% Student's-t UCL	8.751			95% Adjusted-CLT UCL (Chen-1995)				8.752			
31					95% Modified-t UCL (Johnson-1978)				8.751			
32												
33	Gamma GOF Test											
34	A-D Test Statistic	1.755			Anderson-Darling Gamma GOF Test							
35	5% A-D Critical Value	0.747			Data Not Gamma Distributed at 5% Significance Level							
36	K-S Test Statistic	0.246			Kolmogorov-Smirnov Gamma GOF Test							
37	5% K-S Critical Value	0.141			Data Not Gamma Distributed at 5% Significance Level							
38	Data Not Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)	3890			k star (bias corrected MLE)				3591			
42	Theta hat (MLE)	0.00224			Theta star (bias corrected MLE)				0.00243			
43	nu hat (MLE)	303456			nu star (bias corrected)				280114			
44	MLE Mean (bias corrected)	8.713			MLE Sd (bias corrected)				0.145			
45					Approximate Chi Square Value (0.05)				278884			
46	Adjusted Level of Significance	0.0437			Adjusted Chi Square Value				278836			
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))	8.751			95% Adjusted Gamma UCL (use when n<50)				8.753			
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic	0.901			Shapiro Wilk Lognormal GOF Test							
53	5% Shapiro Wilk Critical Value	0.939			Data Not Lognormal at 5% Significance Level							
54	Lilliefors Test Statistic	0.211			Lilliefors Lognormal GOF Test							
55	5% Lilliefors Critical Value	0.14			Data Not Lognormal at 5% Significance Level							
56	Data Not Lognormal at 5% Significance Level											
57												
58	Lognormal Statistics											
59	Minimum of Logged Data	2.116			Mean of logged Data				2.165			
60	Maximum of Logged Data	2.219			SD of logged Data				0.0162			
61												
62	Assuming Lognormal Distribution											
63	95% H-UCL	N/A			90% Chebyshev (MVUE) UCL				8.781			
64	95% Chebyshev (MVUE) UCL	8.812			97.5% Chebyshev (MVUE) UCL				8.854			
65	99% Chebyshev (MVUE) UCL	8.938										
66												
67	Nonparametric Distribution Free UCL Statistics											
68	Data do not follow a Discernible Distribution (0.05)											
69												
70	Nonparametric Distribution Free UCLs											
71	95% CLT UCL	8.75			95% Jackknife UCL				8.751			
72	95% Standard Bootstrap UCL	8.75			95% Bootstrap-t UCL				8.752			
73	95% Hall's Bootstrap UCL	8.757			95% Percentile Bootstrap UCL				8.749			
74	95% BCA Bootstrap UCL	8.751										
75	90% Chebyshev(Mean, Sd) UCL	8.781			95% Chebyshev(Mean, Sd) UCL				8.812			
76	97.5% Chebyshev(Mean, Sd) UCL	8.855			99% Chebyshev(Mean, Sd) UCL				8.939			
77												
78	Suggested UCL to Use											
79	95% Student's-t UCL	8.751			or 95% Modified-t UCL				8.751			
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												

	A	B	C	D	E	F	G	H	I	J	K	L	
86													
87	pH (Fox)												
88													
89	General Statistics												
90	Total Number of Observations				39		Number of Distinct Observations				7		
91									Number of Missing Observations				0
92	Minimum				6.2		Mean				6.431		
93	Maximum				6.8		Median				6.4		
94	SD				0.106		Std. Error of Mean				0.0169		
95	Coefficient of Variation				0.0164		Skewness				1.318		
96													
97	Normal GOF Test												
98	Shapiro Wilk Test Statistic				0.816		Shapiro Wilk GOF Test						
99	5% Shapiro Wilk Critical Value				0.939		Data Not Normal at 5% Significance Level						
100	Lilliefors Test Statistic				0.307		Lilliefors GOF Test						
101	5% Lilliefors Critical Value				0.14		Data Not Normal at 5% Significance Level						
102	Data Not Normal at 5% Significance Level												
103													
104	Assuming Normal Distribution												
105	95% Normal UCL								95% UCLs (Adjusted for Skewness)				
106	95% Student's-t UCL				6.459		95% Adjusted-CLT UCL (Chen-1995)				6.462		
107									95% Modified-t UCL (Johnson-1978)				6.46
108													
109	Gamma GOF Test												
110	A-D Test Statistic				3.482		Anderson-Darling Gamma GOF Test						
111	5% A-D Critical Value				0.747		Data Not Gamma Distributed at 5% Significance Level						
112	K-S Test Statistic				0.335		Kolmogorov-Smirnov Gamma GOF Test						
113	5% K-S Critical Value				0.141		Data Not Gamma Distributed at 5% Significance Level						
114	Data Not Gamma Distributed at 5% Significance Level												
115													
116	Gamma Statistics												
117	k hat (MLE)				3862		k star (bias corrected MLE)				3565		
118	Theta hat (MLE)				0.00167		Theta star (bias corrected MLE)				0.0018		
119	nu hat (MLE)				301240		nu star (bias corrected)				278069		
120	MLE Mean (bias corrected)				6.431		MLE Sd (bias corrected)				0.108		
121									Approximate Chi Square Value (0.05)				276843
122	Adjusted Level of Significance				0.0437		Adjusted Chi Square Value				276796		
123													
124	Assuming Gamma Distribution												
125	95% Approximate Gamma UCL (use when n>=50))				6.459		95% Adjusted Gamma UCL (use when n<50)				6.46		
126													
127	Lognormal GOF Test												
128	Shapiro Wilk Test Statistic				0.822		Shapiro Wilk Lognormal GOF Test						
129	5% Shapiro Wilk Critical Value				0.939		Data Not Lognormal at 5% Significance Level						
130	Lilliefors Test Statistic				0.305		Lilliefors Lognormal GOF Test						
131	5% Lilliefors Critical Value				0.14		Data Not Lognormal at 5% Significance Level						
132	Data Not Lognormal at 5% Significance Level												
133													
134	Lognormal Statistics												
135	Minimum of Logged Data				1.825		Mean of logged Data				1.861		
136	Maximum of Logged Data				1.917		SD of logged Data				0.0163		
137													
138	Assuming Lognormal Distribution												
139	95% H-UCL				N/A		90% Chebyshev (MVUE) UCL				6.481		
140	95% Chebyshev (MVUE) UCL				6.504		97.5% Chebyshev (MVUE) UCL				6.535		
141	99% Chebyshev (MVUE) UCL				6.597								
142													
143	Nonparametric Distribution Free UCL Statistics												
144	Data do not follow a Discernible Distribution (0.05)												
145													
146	Nonparametric Distribution Free UCLs												
147	95% CLT UCL				6.459		95% Jackknife UCL				6.459		
148	95% Standard Bootstrap UCL				6.459		95% Bootstrap-t UCL				6.465		
149	95% Hall's Bootstrap UCL				6.47		95% Percentile Bootstrap UCL				6.459		
150	95% BCA Bootstrap UCL				6.459								
151	90% Chebyshev(Mean, Sd) UCL				6.481		95% Chebyshev(Mean, Sd) UCL				6.504		
152	97.5% Chebyshev(Mean, Sd) UCL				6.536		99% Chebyshev(Mean, Sd) UCL				6.599		
153													
154	Suggested UCL to Use												
155	95% Student's-t UCL				6.459		or 95% Modified-t UCL				6.46		
156													
157	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
158	Recommendations are based upon data size, data distribution, and skewness.												
159	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
160	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
161													

	A	B	C	D	E	F	G	H	I	J	K	L	
162													
163	Reaction Rate												
164													
165	General Statistics												
166	Total Number of Observations					39		Number of Distinct Observations					1
167	Number of Missing Observations											0	
168	Minimum					2		Mean					2
169	Maximum					2		Median					2
170													
171	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!												
172	ProUCL (or any other software) should not be used on such a data set!												
173	The data set for variable Reaction Rate was not processed!												
174													
175	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.												
176	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).												
177													
178													

	A	B	C	D	E	F	G	H	I	J	K	L
258	Titrateable Actual Acidity (23F)											
259												
260	General Statistics											
261												
262	Total Number of Observations				11		Number of Distinct Observations				1	
263					Number of Missing Observations				28			
264	Minimum				1		Mean				1	
265	Maximum				1		Median				1	
266												
267	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
268	ProUCL (or any other software) should not be used on such a data set!											
269	The data set for variable Titrateable Actual Acidity (23F) was not processed!											
270												
271	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
272	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
273												
274												
275												
276	sulfidic - Titrateable Actual Acidity (s-23F)											
277												
278	General Statistics											
279	Total Number of Observations				11		Number of Distinct Observations				1	
280					Number of Missing Observations				28			
281	Minimum				0.01		Mean				0.01	
282	Maximum				0.01		Median				0.01	
283												
284	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
285	ProUCL (or any other software) should not be used on such a data set!											
286	The data set for variable sulfidic - Titrateable Actual Acidity (s-23F) was not processed!											
287												
288	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
289	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
290												
291												

	A	B	C	D	E	F	G	H	I	J	K	L		
292	Chromium Reducible Sulfur (22B)													
293														
294														
295	General Statistics													
296	Total Number of Observations				11		Number of Distinct Observations				11			
297					Number of Missing Observations				28					
298	Minimum				0.04		Mean				0.109			
299	Maximum				0.229		Median				0.093			
300	SD				0.056		Std. Error of Mean				0.0169			
301	Coefficient of Variation				0.514		Skewness				0.961			
302														
303	Normal GOF Test													
304	Shapiro Wilk Test Statistic				0.934		Shapiro Wilk GOF Test							
305	5% Shapiro Wilk Critical Value				0.85		Data appear Normal at 5% Significance Level							
306	Lilliefors Test Statistic				0.158		Lilliefors GOF Test							
307	5% Lilliefors Critical Value				0.251		Data appear Normal at 5% Significance Level							
308	Data appear Normal at 5% Significance Level													
309														
310	Assuming Normal Distribution													
311	95% Normal UCL								95% UCLs (Adjusted for Skewness)					
312	95% Student's-t UCL				0.14		95% Adjusted-CLT UCL (Chen-1995)				0.142			
313									95% Modified-t UCL (Johnson-1978)				0.14	
314														
315	Gamma GOF Test													
316	A-D Test Statistic				0.151		Anderson-Darling Gamma GOF Test							
317	5% A-D Critical Value				0.732		Detected data appear Gamma Distributed at 5% Significance Level							
318	K-S Test Statistic				0.108		Kolmogorov-Smirnov Gamma GOF Test							
319	5% K-S Critical Value				0.256		Detected data appear Gamma Distributed at 5% Significance Level							
320	Detected data appear Gamma Distributed at 5% Significance Level													
321														
322	Gamma Statistics													
323	k hat (MLE)				4.316		k star (bias corrected MLE)				3.199			
324	Theta hat (MLE)				0.0253		Theta star (bias corrected MLE)				0.0341			
325	nu hat (MLE)				94.95		nu star (bias corrected)				70.39			
326	MLE Mean (bias corrected)				0.109		MLE Sd (bias corrected)				0.0609			
327									Approximate Chi Square Value (0.05)				52.07	
328	Adjusted Level of Significance				0.0278		Adjusted Chi Square Value				49.51			
329														
330	Assuming Gamma Distribution													
331	95% Approximate Gamma UCL (use when n>=50))				0.147		95% Adjusted Gamma UCL (use when n<50)				0.155			
332														
333	Lognormal GOF Test													
334	Shapiro Wilk Test Statistic				0.983		Shapiro Wilk Lognormal GOF Test							
335	5% Shapiro Wilk Critical Value				0.85		Data appear Lognormal at 5% Significance Level							
336	Lilliefors Test Statistic				0.122		Lilliefors Lognormal GOF Test							
337	5% Lilliefors Critical Value				0.251		Data appear Lognormal at 5% Significance Level							
338	Data appear Lognormal at 5% Significance Level													
339														
340	Lognormal Statistics													
341	Minimum of Logged Data				-3.219		Mean of logged Data				-2.337			
342	Maximum of Logged Data				-1.474		SD of logged Data				0.523			
343														
344	Assuming Lognormal Distribution													
345	95% H-UCL				0.16		90% Chebyshev (MVUE) UCL				0.162			
346	95% Chebyshev (MVUE) UCL				0.186		97.5% Chebyshev (MVUE) UCL				0.219			
347	99% Chebyshev (MVUE) UCL				0.285									
348														
349	Nonparametric Distribution Free UCL Statistics													
350	Data appear to follow a Discernible Distribution at 5% Significance Level													
351														
352	Nonparametric Distribution Free UCLs													
353	95% CLT UCL				0.137		95% Jackknife UCL				0.14			
354	95% Standard Bootstrap UCL				0.135		95% Bootstrap-t UCL				0.148			
355	95% Hall's Bootstrap UCL				0.162		95% Percentile Bootstrap UCL				0.136			
356	95% BCA Bootstrap UCL				0.14									
357	90% Chebyshev(Mean, Sd) UCL				0.16		95% Chebyshev(Mean, Sd) UCL				0.183			
358	97.5% Chebyshev(Mean, Sd) UCL				0.215		99% Chebyshev(Mean, Sd) UCL				0.277			
359														
360	Suggested UCL to Use													
361	95% Student's-t UCL				0.14									
362														
363	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.													
364	Recommendations are based upon data size, data distribution, and skewness.													
365	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).													
366	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.													
367														

	A	B	C	D	E	F	G	H	I	J	K	L
368	acidity - Chromium Reducible Sulfur (a-22B)											
369												
370												
371	General Statistics											
372	Total Number of Observations			11		Number of Distinct Observations			11			
373							Number of Missing Observations			28		
374	Minimum			25		Mean			67.91			
375	Maximum			143		Median			58			
376	SD			34.93		Std. Error of Mean			10.53			
377	Coefficient of Variation			0.514		Skewness			0.975			
378												
379	Normal GOF Test											
380	Shapiro Wilk Test Statistic			0.933		Shapiro Wilk GOF Test						
381	5% Shapiro Wilk Critical Value			0.85		Data appear Normal at 5% Significance Level						
382	Lilliefors Test Statistic			0.157		Lilliefors GOF Test						
383	5% Lilliefors Critical Value			0.251		Data appear Normal at 5% Significance Level						
384	Data appear Normal at 5% Significance Level											
385												
386	Assuming Normal Distribution											
387	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
388	95% Student's-t UCL			87		95% Adjusted-CLT UCL (Chen-1995)			88.54			
389							95% Modified-t UCL (Johnson-1978)			87.51		
390												
391	Gamma GOF Test											
392	A-D Test Statistic			0.153		Anderson-Darling Gamma GOF Test						
393	5% A-D Critical Value			0.732		Detected data appear Gamma Distributed at 5% Significance Level						
394	K-S Test Statistic			0.107		Kolmogorov-Smirnov Gamma GOF Test						
395	5% K-S Critical Value			0.256		Detected data appear Gamma Distributed at 5% Significance Level						
396	Detected data appear Gamma Distributed at 5% Significance Level											
397												
398	Gamma Statistics											
399	k hat (MLE)			4.317		k star (bias corrected MLE)			3.2			
400	Theta hat (MLE)			15.73		Theta star (bias corrected MLE)			21.22			
401	nu hat (MLE)			94.97		nu star (bias corrected)			70.4			
402	MLE Mean (bias corrected)			67.91		MLE Sd (bias corrected)			37.96			
403							Approximate Chi Square Value (0.05)			52.08		
404	Adjusted Level of Significance			0.0278		Adjusted Chi Square Value			49.52			
405												
406	Assuming Gamma Distribution											
407	95% Approximate Gamma UCL (use when n>=50))			91.79		95% Adjusted Gamma UCL (use when n<50)			96.54			
408												
409	Lognormal GOF Test											
410	Shapiro Wilk Test Statistic			0.982		Shapiro Wilk Lognormal GOF Test						
411	5% Shapiro Wilk Critical Value			0.85		Data appear Lognormal at 5% Significance Level						
412	Lilliefors Test Statistic			0.117		Lilliefors Lognormal GOF Test						
413	5% Lilliefors Critical Value			0.251		Data appear Lognormal at 5% Significance Level						
414	Data appear Lognormal at 5% Significance Level											
415												
416	Lognormal Statistics											
417	Minimum of Logged Data			3.219		Mean of logged Data			4.098			
418	Maximum of Logged Data			4.963		SD of logged Data			0.523			
419												
420	Assuming Lognormal Distribution											
421	95% H-UCL			99.4		90% Chebyshev (MVUE) UCL			101			
422	95% Chebyshev (MVUE) UCL			115.9		97.5% Chebyshev (MVUE) UCL			136.6			
423	99% Chebyshev (MVUE) UCL			177.3								
424												
425	Nonparametric Distribution Free UCL Statistics											
426	Data appear to follow a Discernible Distribution at 5% Significance Level											
427												
428	Nonparametric Distribution Free UCLs											
429	95% CLT UCL			85.23		95% Jackknife UCL			87			
430	95% Standard Bootstrap UCL			84.13		95% Bootstrap-t UCL			94.57			
431	95% Hall's Bootstrap UCL			101.2		95% Percentile Bootstrap UCL			84.91			
432	95% BCA Bootstrap UCL			88.64								
433	90% Chebyshev(Mean, Sd) UCL			99.5		95% Chebyshev(Mean, Sd) UCL			113.8			
434	97.5% Chebyshev(Mean, Sd) UCL			133.7		99% Chebyshev(Mean, Sd) UCL			172.7			
435												
436	Suggested UCL to Use											
437	95% Student's-t UCL			87								
438												
439	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
440	Recommendations are based upon data size, data distribution, and skewness.											
441	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
442	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
443												

	A	B	C	D	E	F	G	H	I	J	K	L
444												
445	Acid Neutralising Capacity (19A2)											
446												
447	General Statistics											
448	Total Number of Observations					11	Number of Distinct Observations					11
449							Number of Missing Observations					28
450	Minimum					4.91	Mean					34.81
451	Maximum					57.6	Median					38.1
452	SD					15.34	Std. Error of Mean					4.624
453	Coefficient of Variation					0.441	Skewness					-0.576
454												
455	Normal GOF Test											
456	Shapiro Wilk Test Statistic					0.959	Shapiro Wilk GOF Test					
457	5% Shapiro Wilk Critical Value					0.85	Data appear Normal at 5% Significance Level					
458	Lilliefors Test Statistic					0.13	Lilliefors GOF Test					
459	5% Lilliefors Critical Value					0.251	Data appear Normal at 5% Significance Level					
460	Data appear Normal at 5% Significance Level											
461												
462	Assuming Normal Distribution											
463	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
464	95% Student's-t UCL					43.19	95% Adjusted-CLT UCL (Chen-1995)					41.56
465							95% Modified-t UCL (Johnson-1978)					43.06
466												
467	Gamma GOF Test											
468	A-D Test Statistic					0.631	Anderson-Darling Gamma GOF Test					
469	5% A-D Critical Value					0.733	Detected data appear Gamma Distributed at 5% Significance Level					
470	K-S Test Statistic					0.198	Kolmogorov-Smirnov Gamma GOF Test					
471	5% K-S Critical Value					0.257	Detected data appear Gamma Distributed at 5% Significance Level					
472	Detected data appear Gamma Distributed at 5% Significance Level											
473												
474	Gamma Statistics											
475	k hat (MLE)					3.412	k star (bias corrected MLE)					2.542
476	Theta hat (MLE)					10.2	Theta star (bias corrected MLE)					13.69
477	nu hat (MLE)					75.07	nu star (bias corrected)					55.93
478	MLE Mean (bias corrected)					34.81	MLE Sd (bias corrected)					21.83
479							Approximate Chi Square Value (0.05)					39.75
480	Adjusted Level of Significance					0.0278	Adjusted Chi Square Value					37.53
481												
482	Assuming Gamma Distribution											
483	95% Approximate Gamma UCL (use when n>=50)					48.99	95% Adjusted Gamma UCL (use when n<50)					51.88
484												
485	Lognormal GOF Test											
486	Shapiro Wilk Test Statistic					0.786	Shapiro Wilk Lognormal GOF Test					
487	5% Shapiro Wilk Critical Value					0.85	Data Not Lognormal at 5% Significance Level					
488	Lilliefors Test Statistic					0.216	Lilliefors Lognormal GOF Test					
489	5% Lilliefors Critical Value					0.251	Data appear Lognormal at 5% Significance Level					
490	Data appear Approximate Lognormal at 5% Significance Level											
491												
492	Lognormal Statistics											
493	Minimum of Logged Data					1.591	Mean of logged Data					3.396
494	Maximum of Logged Data					4.054	SD of logged Data					0.692
495												
496	Assuming Lognormal Distribution											
497	95% H-UCL					64.89	90% Chebyshev (MVUE) UCL					60.96
498	95% Chebyshev (MVUE) UCL					71.82	97.5% Chebyshev (MVUE) UCL					86.9
499	99% Chebyshev (MVUE) UCL					116.5						
500												
501	Nonparametric Distribution Free UCL Statistics											
502	Data appear to follow a Discernible Distribution at 5% Significance Level											
503												
504	Nonparametric Distribution Free UCLs											
505	95% CLT UCL					42.42	95% Jackknife UCL					43.19
506	95% Standard Bootstrap UCL					42.13	95% Bootstrap-t UCL					42.26
507	95% Hall's Bootstrap UCL					41.75	95% Percentile Bootstrap UCL					41.5
508	95% BCA Bootstrap UCL					41.56						
509	90% Chebyshev(Mean, Sd) UCL					48.68	95% Chebyshev(Mean, Sd) UCL					54.97
510	97.5% Chebyshev(Mean, Sd) UCL					63.69	99% Chebyshev(Mean, Sd) UCL					80.82
511												
512	Suggested UCL to Use											
513	95% Student's-t UCL					43.19						
514												
515	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
516	Recommendations are based upon data size, data distribution, and skewness.											
517	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
518	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
519												
520	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
521	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
522												

	A	B	C	D	E	F	G	H	I	J	K	L		
523	Acidity - Acid Neutralising Capacity (a-19A2)													
524														
525	General Statistics													
526	Total Number of Observations				11		Number of Distinct Observations				11			
527					Number of Missing Observations				28					
528	Minimum				982		Mean				6956			
529	Maximum				11500		Median				7610			
530	SD				3066		Std. Error of Mean				924.5			
531	Coefficient of Variation				0.441		Skewness				-0.577			
532														
533	Normal GOF Test													
534	Shapiro Wilk Test Statistic				0.958		Shapiro Wilk GOF Test							
535	5% Shapiro Wilk Critical Value				0.85		Data appear Normal at 5% Significance Level							
536	Lilliefors Test Statistic				0.13		Lilliefors GOF Test							
537	5% Lilliefors Critical Value				0.251		Data appear Normal at 5% Significance Level							
538	Data appear Normal at 5% Significance Level													
539														
540	Assuming Normal Distribution													
541	95% Normal UCL				95% UCLs (Adjusted for Skewness)									
542	95% Student's-t UCL				8631		95% Adjusted-CLT UCL (Chen-1995)				8304			
543									95% Modified-t UCL (Johnson-1978)				8604	
544														
545	Gamma GOF Test													
546	A-D Test Statistic				0.63		Anderson-Darling Gamma GOF Test							
547	5% A-D Critical Value				0.733		Detected data appear Gamma Distributed at 5% Significance Level							
548	K-S Test Statistic				0.198		Kolmogorov-Smirnov Gamma GOF Test							
549	5% K-S Critical Value				0.257		Detected data appear Gamma Distributed at 5% Significance Level							
550	Detected data appear Gamma Distributed at 5% Significance Level													
551														
552	Gamma Statistics													
553	k hat (MLE)				3.41		k star (bias corrected MLE)				2.541			
554	Theta hat (MLE)				2039		Theta star (bias corrected MLE)				2737			
555	nu hat (MLE)				75.03		nu star (bias corrected)				55.9			
556	MLE Mean (bias corrected)				6956		MLE Sd (bias corrected)				4364			
557									Approximate Chi Square Value (0.05)				39.72	
558	Adjusted Level of Significance				0.0278		Adjusted Chi Square Value				37.5			
559														
560	Assuming Gamma Distribution													
561	95% Approximate Gamma UCL (use when n>=50)				9790		95% Adjusted Gamma UCL (use when n<50)				10368			
562														
563	Lognormal GOF Test													
564	Shapiro Wilk Test Statistic				0.786		Shapiro Wilk Lognormal GOF Test							
565	5% Shapiro Wilk Critical Value				0.85		Data Not Lognormal at 5% Significance Level							
566	Lilliefors Test Statistic				0.216		Lilliefors Lognormal GOF Test							
567	5% Lilliefors Critical Value				0.251		Data appear Lognormal at 5% Significance Level							
568	Data appear Approximate Lognormal at 5% Significance Level													
569														
570	Lognormal Statistics													
571	Minimum of Logged Data				6.89		Mean of logged Data				8.694			
572	Maximum of Logged Data				9.35		SD of logged Data				0.692			
573														
574	Assuming Lognormal Distribution													
575	95% H-UCL				12966		90% Chebyshev (MVUE) UCL				12180			
576	95% Chebyshev (MVUE) UCL				14350		97.5% Chebyshev (MVUE) UCL				17363			
577	99% Chebyshev (MVUE) UCL				23281									
578														
579	Nonparametric Distribution Free UCL Statistics													
580	Data appear to follow a Discernible Distribution at 5% Significance Level													
581														
582	Nonparametric Distribution Free UCLs													
583	95% CLT UCL				8476		95% Jackknife UCL				8631			
584	95% Standard Bootstrap UCL				8391		95% Bootstrap-t UCL				8442			
585	95% Hall's Bootstrap UCL				8322		95% Percentile Bootstrap UCL				8359			
586	95% BCA Bootstrap UCL				8237									
587	90% Chebyshev (Mean, Sd) UCL				9729		95% Chebyshev (Mean, Sd) UCL				10985			
588	97.5% Chebyshev (Mean, Sd) UCL				12729		99% Chebyshev (Mean, Sd) UCL				16154			
589														
590	Suggested UCL to Use													
591	95% Student's-t UCL				8631									
592														
593	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.													
594	Recommendations are based upon data size, data distribution, and skewness.													
595	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).													
596	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.													
597														
598														
599	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.													
600														
601														

	A	B	C	D	E	F	G	H	I	J	K	L		
602	sulfidic - Acid Neutralising Capacity (s-19A2)													
603														
604	General Statistics													
605	Total Number of Observations				11		Number of Distinct Observations				10			
606									Number of Missing Observations				28	
607					Minimum		1.57						Mean	11.15
608					Maximum		18.5						Median	12.2
609					SD		4.92						Std. Error of Mean	1.483
610					Coefficient of Variation		0.441						Skewness	-0.567
611														
612	Normal GOF Test													
613	Shapiro Wilk Test Statistic				0.959		Shapiro Wilk GOF Test							
614	5% Shapiro Wilk Critical Value				0.85		Data appear Normal at 5% Significance Level							
615	Lilliefors Test Statistic				0.13		Lilliefors GOF Test							
616	5% Lilliefors Critical Value				0.251		Data appear Normal at 5% Significance Level							
617	Data appear Normal at 5% Significance Level													
618														
619	Assuming Normal Distribution													
620	95% Normal UCL				95% UCLs (Adjusted for Skewness)									
621	95% Student's-t UCL				13.84		95% Adjusted-CLT UCL (Chen-1995)				13.32			
622									95% Modified-t UCL (Johnson-1978)				13.79	
623														
624	Gamma GOF Test													
625	A-D Test Statistic				0.629		Anderson-Darling Gamma GOF Test							
626	5% A-D Critical Value				0.733		Detected data appear Gamma Distributed at 5% Significance Level							
627	K-S Test Statistic				0.199		Kolmogorov-Smirnov Gamma GOF Test							
628	5% K-S Critical Value				0.257		Detected data appear Gamma Distributed at 5% Significance Level							
629	Detected data appear Gamma Distributed at 5% Significance Level													
630														
631	Gamma Statistics													
632	k hat (MLE)				3.405		k star (bias corrected MLE)				2.537			
633	Theta hat (MLE)				3.274		Theta star (bias corrected MLE)				4.394			
634	nu hat (MLE)				74.91		nu star (bias corrected)				55.81			
635	MLE Mean (bias corrected)				11.15		MLE Sd (bias corrected)				6.999			
636									Approximate Chi Square Value (0.05)				39.64	
637	Adjusted Level of Significance				0.0278						Adjusted Chi Square Value		37.43	
638														
639	Assuming Gamma Distribution													
640	95% Approximate Gamma UCL (use when n>=50))				15.69		95% Adjusted Gamma UCL (use when n<50)				16.62			
641														
642	Lognormal GOF Test													
643	Shapiro Wilk Test Statistic				0.786		Shapiro Wilk Lognormal GOF Test							
644	5% Shapiro Wilk Critical Value				0.85		Data Not Lognormal at 5% Significance Level							
645	Lilliefors Test Statistic				0.217		Lilliefors Lognormal GOF Test							
646	5% Lilliefors Critical Value				0.251		Data appear Lognormal at 5% Significance Level							
647	Data appear Approximate Lognormal at 5% Significance Level													
648														
649	Lognormal Statistics													
650	Minimum of Logged Data				0.451		Mean of logged Data				2.257			
651	Maximum of Logged Data				2.918		SD of logged Data				0.693			
652														
653	Assuming Lognormal Distribution													
654	95% H-UCL				20.8		90% Chebyshev (MVUE) UCL				19.53			
655	95% Chebyshev (MVUE) UCL				23.01		97.5% Chebyshev (MVUE) UCL				27.85			
656	99% Chebyshev (MVUE) UCL				37.34									
657														
658	Nonparametric Distribution Free UCL Statistics													
659	Data appear to follow a Discernible Distribution at 5% Significance Level													
660														
661	Nonparametric Distribution Free UCLs													
662	95% CLT UCL				13.59		95% Jackknife UCL				13.84			
663	95% Standard Bootstrap UCL				13.41		95% Bootstrap-t UCL				13.61			
664	95% Hall's Bootstrap UCL				13.36		95% Percentile Bootstrap UCL				13.44			
665	95% BCA Bootstrap UCL				13.23									
666	90% Chebyshev (Mean, Sd) UCL				15.6		95% Chebyshev (Mean, Sd) UCL				17.61			
667	97.5% Chebyshev (Mean, Sd) UCL				20.41		99% Chebyshev (Mean, Sd) UCL				25.91			
668														
669	Suggested UCL to Use													
670	95% Student's-t UCL				13.84									
671														
672	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.													
673	Recommendations are based upon data size, data distribution, and skewness.													
674	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).													
675	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.													
676														
677	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.													
678														
679														
680														

	A	B	C	D	E	F	G	H	I	J	K	L
681	ANC % > Sum of existing and potential acidity											
682												
683	General Statistics											
684	Total Number of Observations		11		Number of Distinct Observations		11					
685					Number of Missing Observations		28					
686	Minimum		18.69		Mean		123.7					
687	Maximum		230.5		Median		126.5					
688	SD		68.22		Std. Error of Mean		20.57					
689	Coefficient of Variation		0.551		Skewness		-0.182					
690												
691	Normal GOF Test											
692	Shapiro Wilk Test Statistic		0.964		Shapiro Wilk GOF Test							
693	5% Shapiro Wilk Critical Value		0.85		Data appear Normal at 5% Significance Level							
694	Lilliefors Test Statistic		0.134		Lilliefors GOF Test							
695	5% Lilliefors Critical Value		0.251		Data appear Normal at 5% Significance Level							
696	Data appear Normal at 5% Significance Level											
697												
698	Assuming Normal Distribution											
699	95% Normal UCL				95% UCLs (Adjusted for Skewness)							
700	95% Student's-t UCL		161		95% Adjusted-CLT UCL (Chen-1995)		156.4					
701					95% Modified-t UCL (Johnson-1978)		160.8					
702												
703	Gamma GOF Test											
704	A-D Test Statistic		0.486		Anderson-Darling Gamma GOF Test							
705	5% A-D Critical Value		0.737		Detected data appear Gamma Distributed at 5% Significance Level							
706	K-S Test Statistic		0.208		Kolmogorov-Smirnov Gamma GOF Test							
707	5% K-S Critical Value		0.258		Detected data appear Gamma Distributed at 5% Significance Level							
708	Detected data appear Gamma Distributed at 5% Significance Level											
709												
710	Gamma Statistics											
711	k hat (MLE)		2.383		k star (bias corrected MLE)		1.794					
712	Theta hat (MLE)		51.92		Theta star (bias corrected MLE)		68.97					
713	nu hat (MLE)		52.43		nu star (bias corrected)		39.47					
714	MLE Mean (bias corrected)		123.7		MLE Sd (bias corrected)		92.38					
715					Approximate Chi Square Value (0.05)		26.08					
716	Adjusted Level of Significance		0.0278		Adjusted Chi Square Value		24.31					
717												
718	Assuming Gamma Distribution											
719	95% Approximate Gamma UCL (use when n>=50))		187.3		95% Adjusted Gamma UCL (use when n<50)		200.9					
720												
721	Lognormal GOF Test											
722	Shapiro Wilk Test Statistic		0.858		Shapiro Wilk Lognormal GOF Test							
723	5% Shapiro Wilk Critical Value		0.85		Data appear Lognormal at 5% Significance Level							
724	Lilliefors Test Statistic		0.233		Lilliefors Lognormal GOF Test							
725	5% Lilliefors Critical Value		0.251		Data appear Lognormal at 5% Significance Level							
726	Data appear Lognormal at 5% Significance Level											
727												
728	Lognormal Statistics											
729	Minimum of Logged Data		2.928		Mean of logged Data		4.594					
730	Maximum of Logged Data		5.44		SD of logged Data		0.811					
731												
732	Assuming Lognormal Distribution											
733	95% H-UCL		271		90% Chebyshev (MVUE) UCL		233.9					
734	95% Chebyshev (MVUE) UCL		279.9		97.5% Chebyshev (MVUE) UCL		343.7					
735	99% Chebyshev (MVUE) UCL		469.1									
736												
737	Nonparametric Distribution Free UCL Statistics											
738	Data appear to follow a Discernible Distribution at 5% Significance Level											
739												
740	Nonparametric Distribution Free UCLs											
741	95% CLT UCL		157.6		95% Jackknife UCL		161					
742	95% Standard Bootstrap UCL		155.8		95% Bootstrap-t UCL		160.5					
743	95% Hall's Bootstrap UCL		154.4		95% Percentile Bootstrap UCL		154.4					
744	95% BCA Bootstrap UCL		156.1									
745	90% Chebyshev(Mean, Sd) UCL		185.4		95% Chebyshev(Mean, Sd) UCL		213.4					
746	97.5% Chebyshev(Mean, Sd) UCL		252.2		99% Chebyshev(Mean, Sd) UCL		328.4					
747												
748	Suggested UCL to Use											
749	95% Student's-t UCL		161									
750												
751	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
752	Recommendations are based upon data size, data distribution, and skewness.											
753	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
754	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
755												
756	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
757	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
758												
759												

	A	B	C	D	E	F	G	H	I	J	K	L
828	Net Acidity excluding ANC (sulfur units)											
829												
830	General Statistics											
831												
832	Total Number of Observations			11			Number of Distinct Observations			9		
833							Number of Missing Observations			28		
834	Minimum			0.04			Mean			0.11		
835	Maximum			0.23			Median			0.09		
836	SD			0.0567			Std. Error of Mean			0.0171		
837	Coefficient of Variation			0.516			Skewness			0.959		
838												
839	Normal GOF Test											
840	Shapiro Wilk Test Statistic			0.931			Shapiro Wilk GOF Test					
841	5% Shapiro Wilk Critical Value			0.85			Data appear Normal at 5% Significance Level					
842	Lilliefors Test Statistic			0.183			Lilliefors GOF Test					
843	5% Lilliefors Critical Value			0.251			Data appear Normal at 5% Significance Level					
844	Data appear Normal at 5% Significance Level											
845												
846	Assuming Normal Distribution											
847	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
848	95% Student's-t UCL			0.141			95% Adjusted-CLT UCL (Chen-1995)			0.143		
849							95% Modified-t UCL (Johnson-1978)			0.142		
850												
851	Gamma GOF Test											
852	A-D Test Statistic			0.162			Anderson-Darling Gamma GOF Test					
853	5% A-D Critical Value			0.732			Detected data appear Gamma Distributed at 5% Significance Level					
854	K-S Test Statistic			0.14			Kolmogorov-Smirnov Gamma GOF Test					
855	5% K-S Critical Value			0.256			Detected data appear Gamma Distributed at 5% Significance Level					
856	Detected data appear Gamma Distributed at 5% Significance Level											
857												
858	Gamma Statistics											
859	k hat (MLE)			4.306			k star (bias corrected MLE)			3.192		
860	Theta hat (MLE)			0.0255			Theta star (bias corrected MLE)			0.0345		
861	nu hat (MLE)			94.72			nu star (bias corrected)			70.22		
862	MLE Mean (bias corrected)			0.11			MLE Sd (bias corrected)			0.0616		
863							Approximate Chi Square Value (0.05)			51.93		
864	Adjusted Level of Significance			0.0278			Adjusted Chi Square Value			49.38		
865												
866	Assuming Gamma Distribution											
867	95% Approximate Gamma UCL (use when n>=50))			0.149			95% Adjusted Gamma UCL (use when n<50)			0.156		
868												
869	Lognormal GOF Test											
870	Shapiro Wilk Test Statistic			0.984			Shapiro Wilk Lognormal GOF Test					
871	5% Shapiro Wilk Critical Value			0.85			Data appear Lognormal at 5% Significance Level					
872	Lilliefors Test Statistic			0.109			Lilliefors Lognormal GOF Test					
873	5% Lilliefors Critical Value			0.251			Data appear Lognormal at 5% Significance Level					
874	Data appear Lognormal at 5% Significance Level											
875												
876	Lognormal Statistics											
877	Minimum of Logged Data			-3.219			Mean of logged Data			-2.328		
878	Maximum of Logged Data			-1.47			SD of logged Data			0.523		
879												
880	Assuming Lognormal Distribution											
881	95% H-UCL			0.161			90% Chebyshev (MVUE) UCL			0.164		
882	95% Chebyshev (MVUE) UCL			0.188			97.5% Chebyshev (MVUE) UCL			0.221		
883	99% Chebyshev (MVUE) UCL			0.287								
884												
885	Nonparametric Distribution Free UCL Statistics											
886	Data appear to follow a Discernible Distribution at 5% Significance Level											
887												
888	Nonparametric Distribution Free UCLs											
889	95% CLT UCL			0.138			95% Jackknife UCL			0.141		
890	95% Standard Bootstrap UCL			0.136			95% Bootstrap-t UCL			0.155		
891	95% Hall's Bootstrap UCL			0.163			95% Percentile Bootstrap UCL			0.137		
892	95% BCA Bootstrap UCL			0.14								
893	90% Chebyshev(Mean, Sd) UCL			0.161			95% Chebyshev(Mean, Sd) UCL			0.185		
894	97.5% Chebyshev(Mean, Sd) UCL			0.217			99% Chebyshev(Mean, Sd) UCL			0.28		
895												
896	Suggested UCL to Use											
897	95% Student's-t UCL			0.141								
898												
899	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
900	Recommendations are based upon data size, data distribution, and skewness.											
901	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
902	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
903												

	A	B	C	D	E	F	G	H	I	J	K	L
904												
905	Net Acidity excluding ANC (acidity units)											
906												
907	General Statistics											
908	Total Number of Observations				11		Number of Distinct Observations				11	
909							Number of Missing Observations				28	
910	Minimum				25		Mean				67.91	
911	Maximum				143		Median				58	
912	SD				34.93		Std. Error of Mean				10.53	
913	Coefficient of Variation				0.514		Skewness				0.975	
914												
915	Normal GOF Test											
916	Shapiro Wilk Test Statistic				0.933		Shapiro Wilk GOF Test					
917	5% Shapiro Wilk Critical Value				0.85		Data appear Normal at 5% Significance Level					
918	Lilliefors Test Statistic				0.157		Lilliefors GOF Test					
919	5% Lilliefors Critical Value				0.251		Data appear Normal at 5% Significance Level					
920	Data appear Normal at 5% Significance Level											
921												
922	Assuming Normal Distribution											
923	95% Normal UCL				95% UCLs (Adjusted for Skewness)							
924	95% Student's-t UCL				87		95% Adjusted-CLT UCL (Chen-1995)				88.54	
925							95% Modified-t UCL (Johnson-1978)				87.51	
926												
927	Gamma GOF Test											
928	A-D Test Statistic				0.153		Anderson-Darling Gamma GOF Test					
929	5% A-D Critical Value				0.732		Detected data appear Gamma Distributed at 5% Significance Level					
930	K-S Test Statistic				0.107		Kolmogorov-Smirnov Gamma GOF Test					
931	5% K-S Critical Value				0.256		Detected data appear Gamma Distributed at 5% Significance Level					
932	Detected data appear Gamma Distributed at 5% Significance Level											
933												
934	Gamma Statistics											
935	k hat (MLE)				4.317		k star (bias corrected MLE)				3.2	
936	Theta hat (MLE)				15.73		Theta star (bias corrected MLE)				21.22	
937	nu hat (MLE)				94.97		nu star (bias corrected)				70.4	
938	MLE Mean (bias corrected)				67.91		MLE Sd (bias corrected)				37.96	
939							Approximate Chi Square Value (0.05)				52.08	
940	Adjusted Level of Significance				0.0278		Adjusted Chi Square Value				49.52	
941												
942	Assuming Gamma Distribution											
943	95% Approximate Gamma UCL (use when n>=50)				91.79		95% Adjusted Gamma UCL (use when n<50)				96.54	
944												
945	Lognormal GOF Test											
946	Shapiro Wilk Test Statistic				0.982		Shapiro Wilk Lognormal GOF Test					
947	5% Shapiro Wilk Critical Value				0.85		Data appear Lognormal at 5% Significance Level					
948	Lilliefors Test Statistic				0.117		Lilliefors Lognormal GOF Test					
949	5% Lilliefors Critical Value				0.251		Data appear Lognormal at 5% Significance Level					
950	Data appear Lognormal at 5% Significance Level											
951												
952	Lognormal Statistics											
953	Minimum of Logged Data				3.219		Mean of logged Data				4.098	
954	Maximum of Logged Data				4.963		SD of logged Data				0.523	
955												
956	Assuming Lognormal Distribution											
957	95% H-UCL				99.4		90% Chebyshev (MVUE) UCL				101	
958	95% Chebyshev (MVUE) UCL				115.9		97.5% Chebyshev (MVUE) UCL				136.6	
959	99% Chebyshev (MVUE) UCL				177.3							
960												
961	Nonparametric Distribution Free UCL Statistics											
962	Data appear to follow a Discernible Distribution at 5% Significance Level											
963												
964	Nonparametric Distribution Free UCLs											
965	95% CLT UCL				85.23		95% Jackknife UCL				87	
966	95% Standard Bootstrap UCL				83.97		95% Bootstrap-t UCL				92.84	
967	95% Hall's Bootstrap UCL				103.1		95% Percentile Bootstrap UCL				84.09	
968	95% BCA Bootstrap UCL				85.82							
969	90% Chebyshev(Mean, Sd) UCL				99.5		95% Chebyshev(Mean, Sd) UCL				113.8	
970	97.5% Chebyshev(Mean, Sd) UCL				133.7		99% Chebyshev(Mean, Sd) UCL				172.7	
971												
972	Suggested UCL to Use											
973	95% Student's-t UCL				87							
974												
975	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
976	Recommendations are based upon data size, data distribution, and skewness.											
977	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
978	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
979												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Uncensored Full Data Sets											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.18/10/2020 10:24:25 PM										
5	From File	Hydrocarbons for ProUCL.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	C15 - C28 Fraction											
12												
13	General Statistics											
14	Total Number of Observations	39					Number of Distinct Observations	35				
15							Number of Missing Observations	0				
16	Minimum	4.688					Mean	24.44				
17	Maximum	52.17					Median	22.73				
18	SD	11.28					Std. Error of Mean	1.807				
19	Coefficient of Variation	0.462					Skewness	0.463				
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic	0.968					Shapiro Wilk GOF Test					
23	5% Shapiro Wilk Critical Value	0.939					Data appear Normal at 5% Significance Level					
24	Lilliefors Test Statistic	0.122					Lilliefors GOF Test					
25	5% Lilliefors Critical Value	0.14					Data appear Normal at 5% Significance Level					
26	Data appear Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
30	95% Student's-t UCL	27.48					95% Adjusted-CLT UCL (Chen-1995)	27.55				
31							95% Modified-t UCL (Johnson-1978)	27.5				
32												
33	Gamma GOF Test											
34	A-D Test Statistic	0.318					Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value	0.752					Detected data appear Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic	0.0789					Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value	0.142					Detected data appear Gamma Distributed at 5% Significance Level					
38	Detected data appear Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)	4.234					k star (bias corrected MLE)	3.926				
42	Theta hat (MLE)	5.771					Theta star (bias corrected MLE)	6.224				
43	nu hat (MLE)	330.3					nu star (bias corrected)	306.2				
44	MLE Mean (bias corrected)	24.44					MLE Sd (bias corrected)	12.33				
45							Approximate Chi Square Value (0.05)	266.7				
46	Adjusted Level of Significance	0.0437					Adjusted Chi Square Value	265.2				
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))	28.06					95% Adjusted Gamma UCL (use when n<50)	28.21				
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic	0.946					Shapiro Wilk Lognormal GOF Test					
53	5% Shapiro Wilk Critical Value	0.939					Data appear Lognormal at 5% Significance Level					
54	Lilliefors Test Statistic	0.114					Lilliefors Lognormal GOF Test					
55	5% Lilliefors Critical Value	0.14					Data appear Lognormal at 5% Significance Level					
56	Data appear Lognormal at 5% Significance Level											
57												
58	Lognormal Statistics											
59	Minimum of Logged Data	1.545					Mean of logged Data	3.073				
60	Maximum of Logged Data	3.955					SD of logged Data	0.538				
61												
62	Assuming Lognormal Distribution											
63	95% H-UCL	29.61					90% Chebyshev (MVUE) UCL	31.66				
64	95% Chebyshev (MVUE) UCL	34.73					97.5% Chebyshev (MVUE) UCL	38.99				
65	99% Chebyshev (MVUE) UCL	47.37										
66												
67	Nonparametric Distribution Free UCL Statistics											
68	Data appear to follow a Discernible Distribution at 5% Significance Level											
69												
70	Nonparametric Distribution Free UCLs											
71	95% CLT UCL	27.41					95% Jackknife UCL	27.48				
72	95% Standard Bootstrap UCL	27.34					95% Bootstrap-t UCL	27.59				
73	95% Hall's Bootstrap UCL	27.67					95% Percentile Bootstrap UCL	27.4				
74	95% BCA Bootstrap UCL	27.68										
75	90% Chebyshev(Mean, Sd) UCL	29.86					95% Chebyshev(Mean, Sd) UCL	32.31				
76	97.5% Chebyshev(Mean, Sd) UCL	35.72					99% Chebyshev(Mean, Sd) UCL	42.41				
77												
78	Suggested UCL to Use											
79	95% Student's-t UCL	27.48										
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												

	A	B	C	D	E	F	G	H	I	J	K	L
162	C10 - C36 Fraction (sum)											
163												
164												
165	General Statistics											
166	Total Number of Observations				39		Number of Distinct Observations				35	
167					Number of Missing Observations				0			
168	Minimum				4.688		Mean				40	
169	Maximum				80		Median				42.31	
170	SD				21.31		Std. Error of Mean				3.412	
171	Coefficient of Variation				0.533		Skewness				0.223	
172												
173	Normal GOF Test											
174	Shapiro Wilk Test Statistic				0.948		Shapiro Wilk GOF Test					
175	5% Shapiro Wilk Critical Value				0.939		Data appear Normal at 5% Significance Level					
176	Lilliefors Test Statistic				0.144		Lilliefors GOF Test					
177	5% Lilliefors Critical Value				0.14		Data Not Normal at 5% Significance Level					
178	Data appear Approximate Normal at 5% Significance Level											
179												
180	Assuming Normal Distribution											
181	95% Normal UCL				95% UCLs (Adjusted for Skewness)							
182	95% Student's-t UCL				45.75		95% Adjusted-CLT UCL (Chen-1995)				45.74	
183					95% Modified-t UCL (Johnson-1978)				45.77			
184												
185	Gamma GOF Test											
186	A-D Test Statistic				0.565		Anderson-Darling Gamma GOF Test					
187	5% A-D Critical Value				0.755		Detected data appear Gamma Distributed at 5% Significance Level					
188	K-S Test Statistic				0.138		Kolmogorov-Smirnov Gamma GOF Test					
189	5% K-S Critical Value				0.142		Detected data appear Gamma Distributed at 5% Significance Level					
190	Detected data appear Gamma Distributed at 5% Significance Level											
191												
192	Gamma Statistics											
193	k hat (MLE)				2.897		k star (bias corrected MLE)				2.691	
194	Theta hat (MLE)				13.81		Theta star (bias corrected MLE)				14.86	
195	nu hat (MLE)				225.9		nu star (bias corrected)				209.9	
196	MLE Mean (bias corrected)				40		MLE Sd (bias corrected)				24.38	
197					Approximate Chi Square Value (0.05)				177.4			
198	Adjusted Level of Significance				0.0437		Adjusted Chi Square Value				176.2	
199												
200	Assuming Gamma Distribution											
201	95% Approximate Gamma UCL (use when n>=50))				47.33		95% Adjusted Gamma UCL (use when n<50)				47.65	
202												
203	Lognormal GOF Test											
204	Shapiro Wilk Test Statistic				0.923		Shapiro Wilk Lognormal GOF Test					
205	5% Shapiro Wilk Critical Value				0.939		Data Not Lognormal at 5% Significance Level					
206	Lilliefors Test Statistic				0.163		Lilliefors Lognormal GOF Test					
207	5% Lilliefors Critical Value				0.14		Data Not Lognormal at 5% Significance Level					
208	Data Not Lognormal at 5% Significance Level											
209												
210	Lognormal Statistics											
211	Minimum of Logged Data				1.545		Mean of logged Data				3.506	
212	Maximum of Logged Data				4.382		SD of logged Data				0.675	
213												
214	Assuming Lognormal Distribution											
215	95% H-UCL				52.45		90% Chebyshev (MVUE) UCL				56.14	
216	95% Chebyshev (MVUE) UCL				62.74		97.5% Chebyshev (MVUE) UCL				71.91	
217	99% Chebyshev (MVUE) UCL				89.93							
218												
219	Nonparametric Distribution Free UCL Statistics											
220	Data appear to follow a Discernible Distribution at 5% Significance Level											
221												
222	Nonparametric Distribution Free UCLs											
223	95% CLT UCL				45.61		95% Jackknife UCL				45.75	
224	95% Standard Bootstrap UCL				45.56		95% Bootstrap-t UCL				45.84	
225	95% Hall's Bootstrap UCL				45.8		95% Percentile Bootstrap UCL				45.62	
226	95% BCA Bootstrap UCL				45.61							
227	90% Chebyshev(Mean, Sd) UCL				50.23		95% Chebyshev(Mean, Sd) UCL				54.87	
228	97.5% Chebyshev(Mean, Sd) UCL				61.3		99% Chebyshev(Mean, Sd) UCL				73.94	
229												
230	Suggested UCL to Use											
231	95% Student's-t UCL				45.75							
232												
233	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
234	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
235												
236	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
237	Recommendations are based upon data size, data distribution, and skewness.											
238	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
239	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
240												

	A	B	C	D	E	F	G	H	I	J	K	L
241												
242	>C16 - C34 Fraction											
243												
244	General Statistics											
245	Total Number of Observations			39			Number of Distinct Observations			35		
246							Number of Missing Observations			0		
247	Minimum			4.688			Mean			37.95		
248	Maximum			69.57			Median			36.36		
249	SD			14.69			Std. Error of Mean			2.353		
250	Coefficient of Variation			0.387			Skewness			0.25		
251												
252	Normal GOF Test											
253	Shapiro Wilk Test Statistic			0.973			Shapiro Wilk GOF Test					
254	5% Shapiro Wilk Critical Value			0.939			Data appear Normal at 5% Significance Level					
255	Lilliefors Test Statistic			0.12			Lilliefors GOF Test					
256	5% Lilliefors Critical Value			0.14			Data appear Normal at 5% Significance Level					
257	Data appear Normal at 5% Significance Level											
258												
259	Assuming Normal Distribution											
260	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
261	95% Student's-t UCL			41.92			95% Adjusted-CLT UCL (Chen-1995)			41.92		
262							95% Modified-t UCL (Johnson-1978)			41.93		
263												
264	Gamma GOF Test											
265	A-D Test Statistic			0.532			Anderson-Darling Gamma GOF Test					
266	5% A-D Critical Value			0.751			Detected data appear Gamma Distributed at 5% Significance Level					
267	K-S Test Statistic			0.124			Kolmogorov-Smirnov Gamma GOF Test					
268	5% K-S Critical Value			0.142			Detected data appear Gamma Distributed at 5% Significance Level					
269	Detected data appear Gamma Distributed at 5% Significance Level											
270												
271	Gamma Statistics											
272	k hat (MLE)			5.459			k star (bias corrected MLE)			5.056		
273	Theta hat (MLE)			6.952			Theta star (bias corrected MLE)			7.506		
274	nu hat (MLE)			425.8			nu star (bias corrected)			394.4		
275	MLE Mean (bias corrected)			37.95			MLE Sd (bias corrected)			16.88		
276							Approximate Chi Square Value (0.05)			349.4		
277	Adjusted Level of Significance			0.0437			Adjusted Chi Square Value			347.7		
278												
279	Assuming Gamma Distribution											
280	95% Approximate Gamma UCL (use when n>=50))			42.84			95% Adjusted Gamma UCL (use when n<50)			43.05		
281												
282	Lognormal GOF Test											
283	Shapiro Wilk Test Statistic			0.872			Shapiro Wilk Lognormal GOF Test					
284	5% Shapiro Wilk Critical Value			0.939			Data Not Lognormal at 5% Significance Level					
285	Lilliefors Test Statistic			0.152			Lilliefors Lognormal GOF Test					
286	5% Lilliefors Critical Value			0.14			Data Not Lognormal at 5% Significance Level					
287	Data Not Lognormal at 5% Significance Level											
288												
289	Lognormal Statistics											
290	Minimum of Logged Data			1.545			Mean of logged Data			3.542		
291	Maximum of Logged Data			4.242			SD of logged Data			0.493		
292												
293	Assuming Lognormal Distribution											
294	95% H-UCL			45.46			90% Chebyshev (MVUE) UCL			48.51		
295	95% Chebyshev (MVUE) UCL			52.88			97.5% Chebyshev (MVUE) UCL			58.94		
296	99% Chebyshev (MVUE) UCL			70.84								
297												
298	Nonparametric Distribution Free UCL Statistics											
299	Data appear to follow a Discernible Distribution at 5% Significance Level											
300												
301	Nonparametric Distribution Free UCLs											
302	95% CLT UCL			41.82			95% Jackknife UCL			41.92		
303	95% Standard Bootstrap UCL			41.84			95% Bootstrap-t UCL			41.9		
304	95% Hall's Bootstrap UCL			42.23			95% Percentile Bootstrap UCL			41.75		
305	95% BCA Bootstrap UCL			41.86								
306	90% Chebyshev(Mean, Sd) UCL			45.01			95% Chebyshev(Mean, Sd) UCL			48.21		
307	97.5% Chebyshev(Mean, Sd) UCL			52.64			99% Chebyshev(Mean, Sd) UCL			61.36		
308												
309	Suggested UCL to Use											
310	95% Student's-t UCL			41.92								
311												
312	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
313	Recommendations are based upon data size, data distribution, and skewness.											
314	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
315	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
316												

	A	B	C	D	E	F	G	H	I	J	K	L						
317																		
318	>C34 - C40 Fraction																	
319																		
320	General Statistics																	
321	Total Number of Observations				39				Number of Distinct Observations				30					
322									Number of Missing Observations				0					
323	Minimum				4.464				Mean				12.9					
324	Maximum				50				Median				10.87					
325	SD				8.091				Std. Error of Mean				1.296					
326	Coefficient of Variation				0.627				Skewness				2.73					
327																		
328	Normal GOF Test																	
329	Shapiro Wilk Test Statistic				0.765				Shapiro Wilk GOF Test									
330	5% Shapiro Wilk Critical Value				0.939				Data Not Normal at 5% Significance Level									
331	Lilliefors Test Statistic				0.149				Lilliefors GOF Test									
332	5% Lilliefors Critical Value				0.14				Data Not Normal at 5% Significance Level									
333	Data Not Normal at 5% Significance Level																	
334																		
335	Assuming Normal Distribution																	
336	95% Normal UCL						95% UCLs (Adjusted for Skewness)											
337	95% Student's-t UCL				15.08				95% Adjusted-CLT UCL (Chen-1995)				15.64					
338									95% Modified-t UCL (Johnson-1978)				15.18					
339																		
340	Gamma GOF Test																	
341	A-D Test Statistic				0.584				Anderson-Darling Gamma GOF Test									
342	5% A-D Critical Value				0.753				Detected data appear Gamma Distributed at 5% Significance Level									
343	K-S Test Statistic				0.132				Kolmogorov-Smirnov Gamma GOF Test									
344	5% K-S Critical Value				0.142				Detected data appear Gamma Distributed at 5% Significance Level									
345	Detected data appear Gamma Distributed at 5% Significance Level																	
346																		
347	Gamma Statistics																	
348	k hat (MLE)				3.802				k star (bias corrected MLE)				3.526					
349	Theta hat (MLE)				3.393				Theta star (bias corrected MLE)				3.658					
350	nu hat (MLE)				296.5				nu star (bias corrected)				275					
351	MLE Mean (bias corrected)				12.9				MLE Sd (bias corrected)				6.87					
352									Approximate Chi Square Value (0.05)				237.6					
353	Adjusted Level of Significance				0.0437				Adjusted Chi Square Value				236.3					
354																		
355	Assuming Gamma Distribution																	
356	95% Approximate Gamma UCL (use when n>=50)				14.93				95% Adjusted Gamma UCL (use when n<50)				15.02					
357																		
358	Lognormal GOF Test																	
359	Shapiro Wilk Test Statistic				0.974				Shapiro Wilk Lognormal GOF Test									
360	5% Shapiro Wilk Critical Value				0.939				Data appear Lognormal at 5% Significance Level									
361	Lilliefors Test Statistic				0.108				Lilliefors Lognormal GOF Test									
362	5% Lilliefors Critical Value				0.14				Data appear Lognormal at 5% Significance Level									
363	Data appear Lognormal at 5% Significance Level																	
364																		
365	Lognormal Statistics																	
366	Minimum of Logged Data				1.496				Mean of logged Data				2.42					
367	Maximum of Logged Data				3.912				SD of logged Data				0.508					
368																		
369	Assuming Lognormal Distribution																	
370	95% H-UCL				14.99				90% Chebyshev (MVUE) UCL				16.01					
371	95% Chebyshev (MVUE) UCL				17.48				97.5% Chebyshev (MVUE) UCL				19.53					
372	99% Chebyshev (MVUE) UCL				23.56													
373																		
374	Nonparametric Distribution Free UCL Statistics																	
375	Data appear to follow a Discernible Distribution at 5% Significance Level																	
376																		
377	Nonparametric Distribution Free UCLs																	
378	95% CLT UCL				15.03				95% Jackknife UCL				15.08					
379	95% Standard Bootstrap UCL				15.04				95% Bootstrap-t UCL				16.22					
380	95% Hall's Bootstrap UCL				18.7				95% Percentile Bootstrap UCL				15.22					
381	95% BCA Bootstrap UCL				15.66													
382	90% Chebyshev(Mean, Sd) UCL				16.79				95% Chebyshev(Mean, Sd) UCL				18.55					
383	97.5% Chebyshev(Mean, Sd) UCL				20.99				99% Chebyshev(Mean, Sd) UCL				25.79					
384																		
385	Suggested UCL to Use																	
386	95% Adjusted Gamma UCL				15.02													
387																		
388	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.																	
389	Recommendations are based upon data size, data distribution, and skewness.																	
390	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).																	
391	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.																	
392																		

	A	B	C	D	E	F	G	H	I	J	K	L	
393													
394	>C10 - C40 Fraction (sum)												
395													
396	General Statistics												
397	Total Number of Observations				39		Number of Distinct Observations				34		
398									Number of Missing Observations				0
399	Minimum				4.688		Mean				42.04		
400	Maximum				86.96		Median				38.46		
401	SD				18.76		Std. Error of Mean				3.005		
402	Coefficient of Variation				0.446		Skewness				0.447		
403													
404	Normal GOF Test												
405	Shapiro Wilk Test Statistic				0.972		Shapiro Wilk GOF Test						
406	5% Shapiro Wilk Critical Value				0.939		Data appear Normal at 5% Significance Level						
407	Lilliefors Test Statistic				0.114		Lilliefors GOF Test						
408	5% Lilliefors Critical Value				0.14		Data appear Normal at 5% Significance Level						
409	Data appear Normal at 5% Significance Level												
410													
411	Assuming Normal Distribution												
412	95% Normal UCL				95% UCLs (Adjusted for Skewness)								
413	95% Student's-t UCL				47.11		95% Adjusted-CLT UCL (Chen-1995)				47.22		
414									95% Modified-t UCL (Johnson-1978)				47.14
415													
416	Gamma GOF Test												
417	A-D Test Statistic				0.304		Anderson-Darling Gamma GOF Test						
418	5% A-D Critical Value				0.752		Detected data appear Gamma Distributed at 5% Significance Level						
419	K-S Test Statistic				0.0865		Kolmogorov-Smirnov Gamma GOF Test						
420	5% K-S Critical Value				0.142		Detected data appear Gamma Distributed at 5% Significance Level						
421	Detected data appear Gamma Distributed at 5% Significance Level												
422													
423	Gamma Statistics												
424	k hat (MLE)				4.326		k star (bias corrected MLE)				4.011		
425	Theta hat (MLE)				9.718		Theta star (bias corrected MLE)				10.48		
426	nu hat (MLE)				337.5		nu star (bias corrected)				312.8		
427	MLE Mean (bias corrected)				42.04		MLE Sd (bias corrected)				20.99		
428									Approximate Chi Square Value (0.05)				272.9
429	Adjusted Level of Significance				0.0437		Adjusted Chi Square Value				271.4		
430													
431	Assuming Gamma Distribution												
432	95% Approximate Gamma UCL (use when n>=50))				48.2		95% Adjusted Gamma UCL (use when n<50)				48.46		
433													
434	Lognormal GOF Test												
435	Shapiro Wilk Test Statistic				0.912		Shapiro Wilk Lognormal GOF Test						
436	5% Shapiro Wilk Critical Value				0.939		Data Not Lognormal at 5% Significance Level						
437	Lilliefors Test Statistic				0.113		Lilliefors Lognormal GOF Test						
438	5% Lilliefors Critical Value				0.14		Data appear Lognormal at 5% Significance Level						
439	Data appear Approximate Lognormal at 5% Significance Level												
440													
441	Lognormal Statistics												
442	Minimum of Logged Data				1.545		Mean of logged Data				3.619		
443	Maximum of Logged Data				4.465		SD of logged Data				0.549		
444													
445	Assuming Lognormal Distribution												
446	95% H-UCL				51.63		90% Chebyshev (MVUE) UCL				55.22		
447	95% Chebyshev (MVUE) UCL				60.67		97.5% Chebyshev (MVUE) UCL				68.24		
448	99% Chebyshev (MVUE) UCL				83.11								
449													
450	Nonparametric Distribution Free UCL Statistics												
451	Data appear to follow a Discernible Distribution at 5% Significance Level												
452													
453	Nonparametric Distribution Free UCLs												
454	95% CLT UCL				46.99		95% Jackknife UCL				47.11		
455	95% Standard Bootstrap UCL				47.03		95% Bootstrap-t UCL				47.38		
456	95% Hall's Bootstrap UCL				47.38		95% Percentile Bootstrap UCL				47.05		
457	95% BCA Bootstrap UCL				47.23								
458	90% Chebyshev(Mean, Sd) UCL				51.06		95% Chebyshev(Mean, Sd) UCL				55.14		
459	97.5% Chebyshev(Mean, Sd) UCL				60.81		99% Chebyshev(Mean, Sd) UCL				71.94		
460													
461	Suggested UCL to Use												
462	95% Student's-t UCL				47.11								
463													
464	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
465	Recommendations are based upon data size, data distribution, and skewness.												
466	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
467	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
468													

UCL Statistics for Uncensored Full Data Sets				
1				
2				
3	User Selected Options			
4	Date/Time of Computation	ProUCL 5.18/10/2020 10:44:05 PM		
5	From File	Metals for ProUCL1.xls		
6	Full Precision	OFF		
7	Confidence Coefficient	95%		
8	Number of Bootstrap Operations	2000		
9				
10				
11	Aluminium			
12				
13	General Statistics			
14	Total Number of Observations	39	Number of Distinct Observations	37
15			Number of Missing Observations	0
16	Minimum	1850	Mean	7525
17	Maximum	11500	Median	7720
18	SD	1660	Std. Error of Mean	265.9
19	Coefficient of Variation	0.221	Skewness	-0.949
20				
21	Normal GOF Test			
22	Shapiro Wilk Test Statistic	0.936	Shapiro Wilk GOF Test	
23	5% Shapiro Wilk Critical Value	0.939	Data Not Normal at 5% Significance Level	
24	Lilliefors Test Statistic	0.148	Lilliefors GOF Test	
25	5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level	
26	Data Not Normal at 5% Significance Level			
27				
28	Assuming Normal Distribution			
29	95% Normal UCL		95% UCLs (Adjusted for Skewness)	
30	95% Student's-t UCL	7973	95% Adjusted-CLT UCL (Chen-1995)	7919
31			95% Modified-t UCL (Johnson-1978)	7966
32				
33	Gamma GOF Test			
34	A-D Test Statistic	1.925	Anderson-Darling Gamma GOF Test	
35	5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level	
36	K-S Test Statistic	0.198	Kolmogorov-Smirnov Gamma GOF Test	
37	5% K-S Critical Value	0.141	Data Not Gamma Distributed at 5% Significance Level	
38	Data Not Gamma Distributed at 5% Significance Level			
39				
40	Gamma Statistics			
41	k hat (MLE)	15.01	k star (bias corrected MLE)	13.87
42	Theta hat (MLE)	501.4	Theta star (bias corrected MLE)	542.5
43	nu hat (MLE)	1171	nu star (bias corrected)	1082
44	MLE Mean (bias corrected)	7525	MLE Sd (bias corrected)	2020
45			Approximate Chi Square Value (0.05)	1007
46	Adjusted Level of Significance	0.0437	Adjusted Chi Square Value	1004
47				
48	Assuming Gamma Distribution			
49	95% Approximate Gamma UCL (use when n>=50)	8088	95% Adjusted Gamma UCL (use when n<50)	8111
50				
51	Lognormal GOF Test			
52	Shapiro Wilk Test Statistic	0.755	Shapiro Wilk Lognormal GOF Test	
53	5% Shapiro Wilk Critical Value	0.939	Data Not Lognormal at 5% Significance Level	
54	Lilliefors Test Statistic	0.224	Lilliefors Lognormal GOF Test	
55	5% Lilliefors Critical Value	0.14	Data Not Lognormal at 5% Significance Level	
56	Data Not Lognormal at 5% Significance Level			
57				
58	Lognormal Statistics			
59	Minimum of Logged Data	7.523	Mean of logged Data	8.892
60	Maximum of Logged Data	9.35	SD of logged Data	0.295
61				
62	Assuming Lognormal Distribution			
63	95% H-UCL	8278	90% Chebyshev (MVUE) UCL	8686
64	95% Chebyshev (MVUE) UCL	9182	97.5% Chebyshev (MVUE) UCL	9870
65	99% Chebyshev (MVUE) UCL	11222		
66				
67	Nonparametric Distribution Free UCL Statistics			
68	Data do not follow a Discernible Distribution (0.05)			
69				
70	Nonparametric Distribution Free UCLs			
71	95% CLT UCL	7962	95% Jackknife UCL	7973
72	95% Standard Bootstrap UCL	7957	95% Bootstrap-t UCL	7931
73	95% Hall's Bootstrap UCL	7944	95% Percentile Bootstrap UCL	7958
74	95% BCA Bootstrap UCL	7898		
75	90% Chebyshev (Mean, Sd) UCL	8322	95% Chebyshev (Mean, Sd) UCL	8684
76	97.5% Chebyshev (Mean, Sd) UCL	9185	99% Chebyshev (Mean, Sd) UCL	10170
77				
78	Suggested UCL to Use			
79	95% Student's-t UCL	7973	or 95% Modified-t UCL	7966
80				
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
82	Recommendations are based upon data size, data distribution, and skewness.			
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
85				
86	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be			
87	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.			
88				

	A	B	C	D	E	F	G	H	I	J	K	L
168	Antimony											
169												
170	General Statistics											
171	Total Number of Observations		39		Number of Distinct Observations		2					
172					Number of Missing Observations		0					
173												
174	Minimum		0.25		Mean		0.257					
175	Maximum		0.52		Median		0.25					
176	SD		0.0432		Std. Error of Mean		0.00692					
177	Coefficient of Variation		0.168		Skewness		6.245					
178												
179	Normal GOF Test											
180	Shapiro Wilk Test Statistic		0.163		Shapiro Wilk GOF Test							
181	5% Shapiro Wilk Critical Value		0.939		Data Not Normal at 5% Significance Level							
182	Lilliefors Test Statistic		0.538		Lilliefors GOF Test							
183	5% Lilliefors Critical Value		0.14		Data Not Normal at 5% Significance Level							
184	Data Not Normal at 5% Significance Level											
185												
186	Assuming Normal Distribution											
187	95% Normal UCL				95% UCLs (Adjusted for Skewness)							
188	95% Student's-t UCL		0.269		95% Adjusted-CLT UCL (Chen-1995)		0.276					
189					95% Modified-t UCL (Johnson-1978)		0.27					
190												
191	Gamma GOF Test											
192	A-D Test Statistic		14.64		Anderson-Darling Gamma GOF Test							
193	5% A-D Critical Value		0.746		Data Not Gamma Distributed at 5% Significance Level							
194	K-S Test Statistic		0.54		Kolmogorov-Smirnov Gamma GOF Test							
195	5% K-S Critical Value		0.141		Data Not Gamma Distributed at 5% Significance Level							
196	Data Not Gamma Distributed at 5% Significance Level											
197												
198	Gamma Statistics											
199	k hat (MLE)		58.73		k star (bias corrected MLE)		54.23					
200	Theta hat (MLE)		0.00437		Theta star (bias corrected MLE)		0.00474					
201	nu hat (MLE)		4581		nu star (bias corrected)		4230					
202	MLE Mean (bias corrected)		0.257		MLE Sd (bias corrected)		0.0349					
203					Approximate Chi Square Value (0.05)		4080					
204	Adjusted Level of Significance		0.0437		Adjusted Chi Square Value		4074					
205												
206	Assuming Gamma Distribution											
207	95% Approximate Gamma UCL (use when n>=50))		0.266		95% Adjusted Gamma UCL (use when n<50)		0.267					
208												
209	Lognormal GOF Test											
210	Shapiro Wilk Test Statistic		0.163		Shapiro Wilk Lognormal GOF Test							
211	5% Shapiro Wilk Critical Value		0.939		Data Not Lognormal at 5% Significance Level							
212	Lilliefors Test Statistic		0.538		Lilliefors Lognormal GOF Test							
213	5% Lilliefors Critical Value		0.14		Data Not Lognormal at 5% Significance Level							
214	Data Not Lognormal at 5% Significance Level											
215												
216	Lognormal Statistics											
217	Minimum of Logged Data		-1.386		Mean of logged Data		-1.368					
218	Maximum of Logged Data		-0.654		SD of logged Data		0.117					
219												
220	Assuming Lognormal Distribution											
221	95% H-UCL		0.265		90% Chebyshev (MVUE) UCL		0.271					
222	95% Chebyshev (MVUE) UCL		0.278		97.5% Chebyshev (MVUE) UCL		0.287					
223	99% Chebyshev (MVUE) UCL		0.305									
224												
225	Nonparametric Distribution Free UCL Statistics											
226	Data do not follow a Discernible Distribution (0.05)											
227												
228	Nonparametric Distribution Free UCLs											
229	95% CLT UCL		0.268		95% Jackknife UCL		N/A					
230	95% Standard Bootstrap UCL		N/A		95% Bootstrap-t UCL		N/A					
231	95% Hall's Bootstrap UCL		N/A		95% Percentile Bootstrap UCL		N/A					
232	95% BCA Bootstrap UCL		N/A									
233	90% Chebyshev (Mean, Sd) UCL		0.278		95% Chebyshev (Mean, Sd) UCL		0.287					
234	97.5% Chebyshev (Mean, Sd) UCL		0.3		99% Chebyshev (Mean, Sd) UCL		0.326					
235												
236	Suggested UCL to Use											
237	95% Student's-t UCL		0.269		or 95% Modified-t UCL		0.27					
238												
239	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
240	Recommendations are based upon data size, data distribution, and skewness.											
241	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
242	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
243												

	A	B	C	D	E	F	G	H	I	J	K	L
244												
245	Arsenic											
246												
247	General Statistics											
248	Total Number of Observations			39			Number of Distinct Observations			37		
249							Number of Missing Observations			0		
250	Minimum			3.1			Mean			50.14		
251	Maximum			83.5			Median			49.4		
252	SD			18.91			Std. Error of Mean			3.027		
253	Coefficient of Variation			0.377			Skewness			-0.402		
254												
255	Normal GOF Test											
256	Shapiro Wilk Test Statistic			0.976			Shapiro Wilk GOF Test					
257	5% Shapiro Wilk Critical Value			0.939			Data appear Normal at 5% Significance Level					
258	Lilliefors Test Statistic			0.0671			Lilliefors GOF Test					
259	5% Lilliefors Critical Value			0.14			Data appear Normal at 5% Significance Level					
260	Data appear Normal at 5% Significance Level											
261												
262	Assuming Normal Distribution											
263	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
264	95% Student's-t UCL			55.24			95% Adjusted-CLT UCL (Chen-1995)			54.91		
265							95% Modified-t UCL (Johnson-1978)			55.21		
266												
267	Gamma GOF Test											
268	A-D Test Statistic			1.225			Anderson-Darling Gamma GOF Test					
269	5% A-D Critical Value			0.752			Data Not Gamma Distributed at 5% Significance Level					
270	K-S Test Statistic			0.14			Kolmogorov-Smirnov Gamma GOF Test					
271	5% K-S Critical Value			0.142			Detected data appear Gamma Distributed at 5% Significance Level					
272	Detected data follow Appr. Gamma Distribution at 5% Significance Level											
273												
274	Gamma Statistics											
275	k hat (MLE)			4.422			k star (bias corrected MLE)			4.099		
276	Theta hat (MLE)			11.34			Theta star (bias corrected MLE)			12.23		
277	nu hat (MLE)			344.9			nu star (bias corrected)			319.7		
278	MLE Mean (bias corrected)			50.14			MLE Sd (bias corrected)			24.77		
279							Approximate Chi Square Value (0.05)			279.3		
280	Adjusted Level of Significance			0.0437			Adjusted Chi Square Value			277.8		
281												
282	Assuming Gamma Distribution											
283	95% Approximate Gamma UCL (use when n>=50))			57.4			95% Adjusted Gamma UCL (use when n<50)			57.71		
284												
285	Lognormal GOF Test											
286	Shapiro Wilk Test Statistic			0.76			Shapiro Wilk Lognormal GOF Test					
287	5% Shapiro Wilk Critical Value			0.939			Data Not Lognormal at 5% Significance Level					
288	Lilliefors Test Statistic			0.183			Lilliefors Lognormal GOF Test					
289	5% Lilliefors Critical Value			0.14			Data Not Lognormal at 5% Significance Level					
290	Data Not Lognormal at 5% Significance Level											
291												
292	Lognormal Statistics											
293	Minimum of Logged Data			1.131			Mean of logged Data			3.798		
294	Maximum of Logged Data			4.425			SD of logged Data			0.6		
295												
296	Assuming Lognormal Distribution											
297	95% H-UCL			64.84			90% Chebyshev (MVUE) UCL			69.42		
298	95% Chebyshev (MVUE) UCL			76.82			97.5% Chebyshev (MVUE) UCL			87.08		
299	99% Chebyshev (MVUE) UCL			107.2								
300												
301	Nonparametric Distribution Free UCL Statistics											
302	Data appear to follow a Discernible Distribution at 5% Significance Level											
303												
304	Nonparametric Distribution Free UCLs											
305	95% CLT UCL			55.12			95% Jackknife UCL			55.24		
306	95% Standard Bootstrap UCL			55.09			95% Bootstrap-t UCL			55.28		
307	95% Hall's Bootstrap UCL			54.93			95% Percentile Bootstrap UCL			54.93		
308	95% BCA Bootstrap UCL			54.95								
309	90% Chebyshev(Mean, Sd) UCL			59.22			95% Chebyshev(Mean, Sd) UCL			63.34		
310	97.5% Chebyshev(Mean, Sd) UCL			69.05			99% Chebyshev(Mean, Sd) UCL			80.26		
311												
312	Suggested UCL to Use											
313	95% Student's-t UCL			55.24								
314												
315	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
316	Recommendations are based upon data size, data distribution, and skewness.											
317	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
318	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
319												
320	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
321	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
322												

	A	B	C	D	E	F	G	H	I	J	K	L
323												
324	Cadmium											
325	General Statistics											
326	Total Number of Observations		39		Number of Distinct Observations		3					
327					Number of Missing Observations		0					
328	Minimum		0.05		Mean		0.0603					
329	Maximum		0.3		Median		0.05					
330	SD		0.0461		Std. Error of Mean		0.00739					
331	Coefficient of Variation		0.766		Skewness		4.651					
332												
333	Normal GOF Test											
334	Shapiro Wilk Test Statistic		0.246		Shapiro Wilk GOF Test							
335	5% Shapiro Wilk Critical Value		0.939		Data Not Normal at 5% Significance Level							
336	Lilliefors Test Statistic		0.537		Lilliefors GOF Test							
337	5% Lilliefors Critical Value		0.14		Data Not Normal at 5% Significance Level							
338	Data Not Normal at 5% Significance Level											
339												
340	Assuming Normal Distribution											
341	95% Normal UCL											
342	95% Student's-t UCL		0.0727		95% UCLs (Adjusted for Skewness)							
343					95% Adjusted-CLT UCL (Chen-1995)		0.0783					
344					95% Modified-t UCL (Johnson-1978)		0.0736					
345												
346	Gamma GOF Test											
347	A-D Test Statistic		14		Anderson-Darling Gamma GOF Test							
348	5% A-D Critical Value		0.751		Data Not Gamma Distributed at 5% Significance Level							
349	K-S Test Statistic		0.547		Kolmogorov-Smirnov Gamma GOF Test							
350	5% K-S Critical Value		0.142		Data Not Gamma Distributed at 5% Significance Level							
351	Data Not Gamma Distributed at 5% Significance Level											
352												
353	Gamma Statistics											
354	k hat (MLE)		4.918		k star (bias corrected MLE)		4.557					
355	Theta hat (MLE)		0.0123		Theta star (bias corrected MLE)		0.0132					
356	nu hat (MLE)		383.6		nu star (bias corrected)		355.4					
357	MLE Mean (bias corrected)		0.0603		MLE Sd (bias corrected)		0.0282					
358					Approximate Chi Square Value (0.05)		312.7					
359	Adjusted Level of Significance		0.0437		Adjusted Chi Square Value		311.2					
360												
361	Assuming Gamma Distribution											
362	95% Approximate Gamma UCL (use when n>=50))		0.0685		95% Adjusted Gamma UCL (use when n<50)		0.0688					
363												
364	Lognormal GOF Test											
365	Shapiro Wilk Test Statistic		0.247		Shapiro Wilk Lognormal GOF Test							
366	5% Shapiro Wilk Critical Value		0.939		Data Not Lognormal at 5% Significance Level							
367	Lilliefors Test Statistic		0.539		Lilliefors Lognormal GOF Test							
368	5% Lilliefors Critical Value		0.14		Data Not Lognormal at 5% Significance Level							
369	Data Not Lognormal at 5% Significance Level											
370												
371	Lognormal Statistics											
372	Minimum of Logged Data		-2.996		Mean of logged Data		-2.914					
373	Maximum of Logged Data		-1.204		SD of logged Data		0.358					
374												
375	Assuming Lognormal Distribution											
376	95% H-UCL		0.0643		90% Chebyshev (MVUE) UCL		0.0679					
377	95% Chebyshev (MVUE) UCL		0.0725		97.5% Chebyshev (MVUE) UCL		0.0789					
378	99% Chebyshev (MVUE) UCL		0.0915									
379												
380	Nonparametric Distribution Free UCL Statistics											
381	Data do not follow a Discernible Distribution (0.05)											
382												
383	Nonparametric Distribution Free UCLs											
384	95% CLT UCL		0.0724		95% Jackknife UCL		0.0727					
385	95% Standard Bootstrap UCL		N/A		95% Bootstrap-t UCL		N/A					
386	95% Hall's Bootstrap UCL		N/A		95% Percentile Bootstrap UCL		N/A					
387	95% BCA Bootstrap UCL		N/A									
388	90% Chebyshev(Mean, Sd) UCL		0.0824		95% Chebyshev(Mean, Sd) UCL		0.0925					
389	97.5% Chebyshev(Mean, Sd) UCL		0.106		99% Chebyshev(Mean, Sd) UCL		0.134					
390												
391	Suggested UCL to Use											
392	95% Student's-t UCL		0.0727		or 95% Modified-t UCL		0.0736					
393												
394	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
395	Recommendations are based upon data size, data distribution, and skewness.											
396	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
397	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
398												

	A	B	C	D	E	F	G	H	I	J	K	L
399												
400	Chromium											
401												
402	General Statistics											
403	Total Number of Observations			39			Number of Distinct Observations			35		
404							Number of Missing Observations			0		
405	Minimum			3.6			Mean			36.21		
406	Maximum			89.2			Median			33		
407	SD			15.91			Std. Error of Mean			2.548		
408	Coefficient of Variation			0.439			Skewness			1.22		
409												
410	Normal GOF Test											
411	Shapiro Wilk Test Statistic			0.918			Shapiro Wilk GOF Test					
412	5% Shapiro Wilk Critical Value			0.939			Data Not Normal at 5% Significance Level					
413	Lilliefors Test Statistic			0.139			Lilliefors GOF Test					
414	5% Lilliefors Critical Value			0.14			Data appear Normal at 5% Significance Level					
415	Data appear Approximate Normal at 5% Significance Level											
416												
417	Assuming Normal Distribution											
418	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
419	95% Student's-t UCL			40.51			95% Adjusted-CLT UCL (Chen-1995)			40.93		
420							95% Modified-t UCL (Johnson-1978)			40.59		
421												
422	Gamma GOF Test											
423	A-D Test Statistic			0.643			Anderson-Darling Gamma GOF Test					
424	5% A-D Critical Value			0.751			Detected data appear Gamma Distributed at 5% Significance Level					
425	K-S Test Statistic			0.117			Kolmogorov-Smirnov Gamma GOF Test					
426	5% K-S Critical Value			0.142			Detected data appear Gamma Distributed at 5% Significance Level					
427	Detected data appear Gamma Distributed at 5% Significance Level											
428												
429	Gamma Statistics											
430	k hat (MLE)			4.979			k star (bias corrected MLE)			4.613		
431	Theta hat (MLE)			7.273			Theta star (bias corrected MLE)			7.85		
432	nu hat (MLE)			388.3			nu star (bias corrected)			359.8		
433	MLE Mean (bias corrected)			36.21			MLE Sd (bias corrected)			16.86		
434							Approximate Chi Square Value (0.05)			316.8		
435	Adjusted Level of Significance			0.0437			Adjusted Chi Square Value			315.3		
436												
437	Assuming Gamma Distribution											
438	95% Approximate Gamma UCL (use when n>=50))			41.12			95% Adjusted Gamma UCL (use when n<50)			41.33		
439												
440	Lognormal GOF Test											
441	Shapiro Wilk Test Statistic			0.861			Shapiro Wilk Lognormal GOF Test					
442	5% Shapiro Wilk Critical Value			0.939			Data Not Lognormal at 5% Significance Level					
443	Lilliefors Test Statistic			0.146			Lilliefors Lognormal GOF Test					
444	5% Lilliefors Critical Value			0.14			Data Not Lognormal at 5% Significance Level					
445	Data Not Lognormal at 5% Significance Level											
446												
447	Lognormal Statistics											
448	Minimum of Logged Data			1.281			Mean of logged Data			3.486		
449	Maximum of Logged Data			4.491			SD of logged Data			0.512		
450												
451	Assuming Lognormal Distribution											
452	95% H-UCL			43.66			90% Chebyshev (MVUE) UCL			46.63		
453	95% Chebyshev (MVUE) UCL			50.96			97.5% Chebyshev (MVUE) UCL			56.98		
454	99% Chebyshev (MVUE) UCL			68.79								
455												
456	Nonparametric Distribution Free UCL Statistics											
457	Data appear to follow a Discernible Distribution at 5% Significance Level											
458												
459	Nonparametric Distribution Free UCLs											
460	95% CLT UCL			40.4			95% Jackknife UCL			40.51		
461	95% Standard Bootstrap UCL			40.35			95% Bootstrap-t UCL			41.41		
462	95% Hall's Bootstrap UCL			41.58			95% Percentile Bootstrap UCL			40.38		
463	95% BCA Bootstrap UCL			41.09								
464	90% Chebyshev(Mean, Sd) UCL			43.85			95% Chebyshev(Mean, Sd) UCL			47.32		
465	97.5% Chebyshev(Mean, Sd) UCL			52.12			99% Chebyshev(Mean, Sd) UCL			61.56		
466												
467	Suggested UCL to Use											
468	95% Student's-t UCL			40.51								
469												
470	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
471	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
472												
473	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
474	Recommendations are based upon data size, data distribution, and skewness.											
475	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
476	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
477												

	A	B	C	D	E	F	G	H	I	J	K	L
630												
631	Manganese											
632	General Statistics											
633												
634	Total Number of Observations			39			Number of Distinct Observations			37		
635							Number of Missing Observations			0		
636	Minimum			16			Mean			226.2		
637	Maximum			700			Median			221		
638	SD			119.9			Std. Error of Mean			19.21		
639	Coefficient of Variation			0.53			Skewness			1.796		
640	Normal GOF Test											
641												
642	Shapiro Wilk Test Statistic			0.864			Shapiro Wilk GOF Test					
643	5% Shapiro Wilk Critical Value			0.939			Data Not Normal at 5% Significance Level					
644	Lilliefors Test Statistic			0.203			Lilliefors GOF Test					
645	5% Lilliefors Critical Value			0.14			Data Not Normal at 5% Significance Level					
646	Data Not Normal at 5% Significance Level											
647												
648	Assuming Normal Distribution											
649	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
650	95% Student's-t UCL			258.5			95% Adjusted-CLT UCL (Chen-1995)			263.6		
651							95% Modified-t UCL (Johnson-1978)			259.5		
652	Gamma GOF Test											
653												
654	A-D Test Statistic			1.137			Anderson-Darling Gamma GOF Test					
655	5% A-D Critical Value			0.754			Data Not Gamma Distributed at 5% Significance Level					
656	K-S Test Statistic			0.142			Kolmogorov-Smirnov Gamma GOF Test					
657	5% K-S Critical Value			0.142			Detected data appear Gamma Distributed at 5% Significance Level					
658	Detected data follow Appr. Gamma Distribution at 5% Significance Level											
659												
660	Gamma Statistics											
661	k hat (MLE)			3.506			k star (bias corrected MLE)			3.253		
662	Theta hat (MLE)			64.51			Theta star (bias corrected MLE)			69.52		
663	nu hat (MLE)			273.4			nu star (bias corrected)			253.7		
664	MLE Mean (bias corrected)			226.2			MLE Sd (bias corrected)			125.4		
665							Approximate Chi Square Value (0.05)			217.8		
666	Adjusted Level of Significance			0.0437			Adjusted Chi Square Value			216.5		
667	Assuming Gamma Distribution											
668												
669	95% Approximate Gamma UCL (use when n>=50)			263.4			95% Adjusted Gamma UCL (use when n<50)			265		
670	Lognormal GOF Test											
671												
672	Shapiro Wilk Test Statistic			0.859			Shapiro Wilk Lognormal GOF Test					
673	5% Shapiro Wilk Critical Value			0.939			Data Not Lognormal at 5% Significance Level					
674	Lilliefors Test Statistic			0.181			Lilliefors Lognormal GOF Test					
675	5% Lilliefors Critical Value			0.14			Data Not Lognormal at 5% Significance Level					
676	Data Not Lognormal at 5% Significance Level											
677												
678	Lognormal Statistics											
679	Minimum of Logged Data			2.773			Mean of logged Data			5.272		
680	Maximum of Logged Data			6.551			SD of logged Data			0.626		
681	Assuming Lognormal Distribution											
682												
683	95% H-UCL			291			90% Chebyshev (MVUE) UCL			311.6		
684	95% Chebyshev (MVUE) UCL			346.1			97.5% Chebyshev (MVUE) UCL			393.9		
685	99% Chebyshev (MVUE) UCL			487.7								
686	Nonparametric Distribution Free UCL Statistics											
687	Data appear to follow a Discernible Distribution at 5% Significance Level											
688												
689	Nonparametric Distribution Free UCLs											
690												
691	95% CLT UCL			257.7			95% Jackknife UCL			258.5		
692	95% Standard Bootstrap UCL			257.9			95% Bootstrap-t UCL			269.2		
693	95% Hall's Bootstrap UCL			283.3			95% Percentile Bootstrap UCL			258.9		
694	95% BCA Bootstrap UCL			265.3								
695	90% Chebyshev(Mean, Sd) UCL			283.8			95% Chebyshev(Mean, Sd) UCL			309.9		
696	97.5% Chebyshev(Mean, Sd) UCL			346.1			99% Chebyshev(Mean, Sd) UCL			417.2		
697	Suggested UCL to Use											
698												
699	95% Adjusted Gamma UCL			265								
700												
701	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
702	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
703												
704	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
705	Recommendations are based upon data size, data distribution, and skewness.											
706	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
707	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
708												

	A	B	C	D	E	F	G	H	I	J	K	L
709												
710	Nickel											
711												
712	General Statistics											
713	Total Number of Observations				39		Number of Distinct Observations				27	
714					Number of Missing Observations				0			
715	Minimum				1.3		Mean				7.762	
716	Maximum				58.4		Median				5.8	
717	SD				8.954		Std. Error of Mean				1.434	
718	Coefficient of Variation				1.154		Skewness				5.106	
719												
720	Normal GOF Test											
721	Shapiro Wilk Test Statistic				0.39		Shapiro Wilk GOF Test					
722	5% Shapiro Wilk Critical Value				0.939		Data Not Normal at 5% Significance Level					
723	Lilliefors Test Statistic				0.387		Lilliefors GOF Test					
724	5% Lilliefors Critical Value				0.14		Data Not Normal at 5% Significance Level					
725	Data Not Normal at 5% Significance Level											
726												
727	Assuming Normal Distribution											
728	95% Normal UCL				95% UCLs (Adjusted for Skewness)							
729	95% Student's-t UCL				10.18		95% Adjusted-CLT UCL (Chen-1995)				11.37	
730					95% Modified-t UCL (Johnson-1978)				10.37			
731												
732	Gamma GOF Test											
733	A-D Test Statistic				5.452		Anderson-Darling Gamma GOF Test					
734	5% A-D Critical Value				0.757		Data Not Gamma Distributed at 5% Significance Level					
735	K-S Test Statistic				0.298		Kolmogorov-Smirnov Gamma GOF Test					
736	5% K-S Critical Value				0.143		Data Not Gamma Distributed at 5% Significance Level					
737	Data Not Gamma Distributed at 5% Significance Level											
738												
739	Gamma Statistics											
740	k hat (MLE)				2.434		k star (bias corrected MLE)				2.264	
741	Theta hat (MLE)				3.189		Theta star (bias corrected MLE)				3.428	
742	nu hat (MLE)				189.8		nu star (bias corrected)				176.6	
743	MLE Mean (bias corrected)				7.762		MLE Sd (bias corrected)				5.159	
744					Approximate Chi Square Value (0.05)				146.8			
745	Adjusted Level of Significance				0.0437		Adjusted Chi Square Value				145.8	
746												
747	Assuming Gamma Distribution											
748	95% Approximate Gamma UCL (use when n>=50))				9.333		95% Adjusted Gamma UCL (use when n<50)				9.401	
749												
750	Lognormal GOF Test											
751	Shapiro Wilk Test Statistic				0.753		Shapiro Wilk Lognormal GOF Test					
752	5% Shapiro Wilk Critical Value				0.939		Data Not Lognormal at 5% Significance Level					
753	Lilliefors Test Statistic				0.237		Lilliefors Lognormal GOF Test					
754	5% Lilliefors Critical Value				0.14		Data Not Lognormal at 5% Significance Level					
755	Data Not Lognormal at 5% Significance Level											
756												
757	Lognormal Statistics											
758	Minimum of Logged Data				0.262		Mean of logged Data				1.83	
759	Maximum of Logged Data				4.067		SD of logged Data				0.551	
760												
761	Assuming Lognormal Distribution											
762	95% H-UCL				8.644		90% Chebyshev (MVUE) UCL				9.246	
763	95% Chebyshev (MVUE) UCL				10.16		97.5% Chebyshev (MVUE) UCL				11.43	
764	99% Chebyshev (MVUE) UCL				13.93							
765												
766	Nonparametric Distribution Free UCL Statistics											
767	Data do not follow a Discernible Distribution (0.05)											
768												
769	Nonparametric Distribution Free UCLs											
770	95% CLT UCL				10.12		95% Jackknife UCL				10.18	
771	95% Standard Bootstrap UCL				10.02		95% Bootstrap-t UCL				15.51	
772	95% Hall's Bootstrap UCL				17.93		95% Percentile Bootstrap UCL				10.57	
773	95% BCA Bootstrap UCL				11.96							
774	90% Chebyshev(Mean, Sd) UCL				12.06		95% Chebyshev(Mean, Sd) UCL				14.01	
775	97.5% Chebyshev(Mean, Sd) UCL				16.72		99% Chebyshev(Mean, Sd) UCL				22.03	
776												
777	Suggested UCL to Use											
778	95% Chebyshev (Mean, Sd) UCL				14.01							
779												
780	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
781	Recommendations are based upon data size, data distribution, and skewness.											
782	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
783	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
784												

	A	B	C	D	E	F	G	H	I	J	K	L
937												
938	Mercury											
939												
940	General Statistics											
941	Total Number of Observations			39			Number of Distinct Observations			3		
942							Number of Missing Observations			0		
943	Minimum			0.005			Mean			0.00641		
944	Maximum			0.05			Median			0.005		
945	SD			0.00725			Std. Error of Mean			0.00116		
946	Coefficient of Variation			1.131			Skewness			6.028		
947												
948	Normal GOF Test											
949	Shapiro Wilk Test Statistic			0.211			Shapiro Wilk GOF Test					
950	5% Shapiro Wilk Critical Value			0.939			Data Not Normal at 5% Significance Level					
951	Lilliefors Test Statistic			0.5			Lilliefors GOF Test					
952	5% Lilliefors Critical Value			0.14			Data Not Normal at 5% Significance Level					
953	Data Not Normal at 5% Significance Level											
954												
955	Assuming Normal Distribution											
956	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
957	95% Student's-t UCL			0.00837			95% Adjusted-CLT UCL (Chen-1995)			0.00952		
958							95% Modified-t UCL (Johnson-1978)			0.00855		
959												
960	Gamma GOF Test											
961	A-D Test Statistic			12.76			Anderson-Darling Gamma GOF Test					
962	5% A-D Critical Value			0.754			Data Not Gamma Distributed at 5% Significance Level					
963	K-S Test Statistic			0.524			Kolmogorov-Smirnov Gamma GOF Test					
964	5% K-S Critical Value			0.142			Data Not Gamma Distributed at 5% Significance Level					
965	Data Not Gamma Distributed at 5% Significance Level											
966												
967	Gamma Statistics											
968	k hat (MLE)			3.407			k star (bias corrected MLE)			3.162		
969	Theta hat (MLE)			0.00188			Theta star (bias corrected MLE)			0.00203		
970	nu hat (MLE)			265.7			nu star (bias corrected)			246.6		
971	MLE Mean (bias corrected)			0.00641			MLE Sd (bias corrected)			0.0036		
972							Approximate Chi Square Value (0.05)			211.3		
973	Adjusted Level of Significance			0.0437			Adjusted Chi Square Value			210		
974												
975	Assuming Gamma Distribution											
976	95% Approximate Gamma UCL (use when n>=50))			0.00748			95% Adjusted Gamma UCL (use when n<50)			0.00753		
977												
978	Lognormal GOF Test											
979	Shapiro Wilk Test Statistic			0.275			Shapiro Wilk Lognormal GOF Test					
980	5% Shapiro Wilk Critical Value			0.939			Data Not Lognormal at 5% Significance Level					
981	Lilliefors Test Statistic			0.518			Lilliefors Lognormal GOF Test					
982	5% Lilliefors Critical Value			0.14			Data Not Lognormal at 5% Significance Level					
983	Data Not Lognormal at 5% Significance Level											
984												
985	Lognormal Statistics											
986	Minimum of Logged Data			-5.298			Mean of logged Data			-5.204		
987	Maximum of Logged Data			-2.996			SD of logged Data			0.394		
988												
989	Assuming Lognormal Distribution											
990	95% H-UCL			0.00668			90% Chebyshev (MVUE) UCL			0.00709		
991	95% Chebyshev (MVUE) UCL			0.00761			97.5% Chebyshev (MVUE) UCL			0.00834		
992	99% Chebyshev (MVUE) UCL			0.00977								
993												
994	Nonparametric Distribution Free UCL Statistics											
995	Data do not follow a Discernible Distribution (0.05)											
996												
997	Nonparametric Distribution Free UCLs											
998	95% CLT UCL			0.00832			95% Jackknife UCL			0.00837		
999	95% Standard Bootstrap UCL			N/A			95% Bootstrap-t UCL			N/A		
1000	95% Hall's Bootstrap UCL			N/A			95% Percentile Bootstrap UCL			N/A		
1001	95% BCA Bootstrap UCL			N/A								
1002	90% Chebyshev(Mean, Sd) UCL			0.00989			95% Chebyshev(Mean, Sd) UCL			0.0115		
1003	97.5% Chebyshev(Mean, Sd) UCL			0.0137			99% Chebyshev(Mean, Sd) UCL			0.018		
1004												
1005	Suggested UCL to Use											
1006	95% Student's-t UCL			0.00837			or 95% Modified-t UCL			0.00855		
1007												
1008	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1009	Recommendations are based upon data size, data distribution, and skewness.											
1010	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1011	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1012												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Uncensored Full Data Sets											
2												
3	User Selected Options											
4	Date/Time of Computation	ProUCL 5.18/10/2020 10:45:10 PM										
5	From File	Organics data for ProUCL.xls										
6	Full Precision	OFF										
7	Confidence Coefficient	95%										
8	Number of Bootstrap Operations	2000										
9												
10												
11	Nitrite + Nitrate as N (Sol.)											
12												
13	General Statistics											
14	Total Number of Observations	39			Number of Distinct Observations	4						
15					Number of Missing Observations	0						
16	Minimum	0.05			Mean	0.0949						
17	Maximum	0.3			Median	0.05						
18	SD	0.0626			Std. Error of Mean	0.01						
19	Coefficient of Variation	0.66			Skewness	1.559						
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic	0.716			Shapiro Wilk GOF Test							
23	5% Shapiro Wilk Critical Value	0.939			Data Not Normal at 5% Significance Level							
24	Lilliefors Test Statistic	0.288			Lilliefors GOF Test							
25	5% Lilliefors Critical Value	0.14			Data Not Normal at 5% Significance Level							
26	Data Not Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL				95% UCLs (Adjusted for Skewness)							
30	95% Student's-t UCL	0.112			95% Adjusted-CLT UCL (Chen-1995)	0.114						
31					95% Modified-t UCL (Johnson-1978)	0.112						
32												
33	Gamma GOF Test											
34	A-D Test Statistic	3.967			Anderson-Darling Gamma GOF Test							
35	5% A-D Critical Value	0.754			Data Not Gamma Distributed at 5% Significance Level							
36	K-S Test Statistic	0.309			Kolmogorov-Smirnov Gamma GOF Test							
37	5% K-S Critical Value	0.142			Data Not Gamma Distributed at 5% Significance Level							
38	Data Not Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)	3.133			k star (bias corrected MLE)	2.909						
42	Theta hat (MLE)	0.0303			Theta star (bias corrected MLE)	0.0326						
43	nu hat (MLE)	244.4			nu star (bias corrected)	226.9						
44	MLE Mean (bias corrected)	0.0949			MLE Sd (bias corrected)	0.0556						
45					Approximate Chi Square Value (0.05)	193						
46	Adjusted Level of Significance	0.0437			Adjusted Chi Square Value	191.8						
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50)	0.112			95% Adjusted Gamma UCL (use when n<50)	0.112						
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic	0.765			Shapiro Wilk Lognormal GOF Test							
53	5% Shapiro Wilk Critical Value	0.939			Data Not Lognormal at 5% Significance Level							
54	Lilliefors Test Statistic	0.315			Lilliefors Lognormal GOF Test							
55	5% Lilliefors Critical Value	0.14			Data Not Lognormal at 5% Significance Level							
56	Data Not Lognormal at 5% Significance Level											
57												
58	Lognormal Statistics											
59	Minimum of Logged Data	-2.996			Mean of logged Data	-2.523						
60	Maximum of Logged Data	-1.204			SD of logged Data	0.557						
61												
62	Assuming Lognormal Distribution											
63	95% H-UCL	0.112			90% Chebyshev (MVUE) UCL	0.12						
64	95% Chebyshev (MVUE) UCL	0.132			97.5% Chebyshev (MVUE) UCL	0.148						
65	99% Chebyshev (MVUE) UCL	0.181										
66												
67	Nonparametric Distribution Free UCL Statistics											
68	Data do not follow a Discernible Distribution (0.05)											
69												
70	Nonparametric Distribution Free UCLs											
71	95% CLT UCL	0.111			95% Jackknife UCL	0.112						
72	95% Standard Bootstrap UCL	N/A			95% Bootstrap-t UCL	N/A						
73	95% Hall's Bootstrap UCL	N/A			95% Percentile Bootstrap UCL	N/A						
74	95% BCA Bootstrap UCL	N/A										
75	90% Chebyshev(Mean, Sd) UCL	0.125			95% Chebyshev(Mean, Sd) UCL	0.139						
76	97.5% Chebyshev(Mean, Sd) UCL	0.157			99% Chebyshev(Mean, Sd) UCL	0.195						
77												
78	Suggested UCL to Use											
79	95% Chebyshev (Mean, Sd) UCL	0.139										
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												

	A	B	C	D	E	F	G	H	I	J	K	L
86												
87	Total Kjeldahl Nitrogen as N											
88												
89	General Statistics											
90	Total Number of Observations				39		Number of Distinct Observations				23	
91							Number of Missing Observations				0	
92	Minimum				90		Mean				288.2	
93	Maximum				560		Median				270	
94	SD				85.13		Std. Error of Mean				13.63	
95	Coefficient of Variation				0.295		Skewness				0.658	
96												
97	Normal GOF Test											
98	Shapiro Wilk Test Statistic				0.962		Shapiro Wilk GOF Test					
99	5% Shapiro Wilk Critical Value				0.939		Data appear Normal at 5% Significance Level					
100	Lilliefors Test Statistic				0.112		Lilliefors GOF Test					
101	5% Lilliefors Critical Value				0.14		Data appear Normal at 5% Significance Level					
102	Data appear Normal at 5% Significance Level											
103												
104	Assuming Normal Distribution											
105	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
106	95% Student's-t UCL				311.2		95% Adjusted-CLT UCL (Chen-1995)				312.2	
107							95% Modified-t UCL (Johnson-1978)				311.4	
108												
109	Gamma GOF Test											
110	A-D Test Statistic				0.565		Anderson-Darling Gamma GOF Test					
111	5% A-D Critical Value				0.748		Detected data appear Gamma Distributed at 5% Significance Level					
112	K-S Test Statistic				0.132		Kolmogorov-Smirnov Gamma GOF Test					
113	5% K-S Critical Value				0.141		Detected data appear Gamma Distributed at 5% Significance Level					
114	Detected data appear Gamma Distributed at 5% Significance Level											
115												
116	Gamma Statistics											
117	k hat (MLE)				11.15		k star (bias corrected MLE)				10.31	
118	Theta hat (MLE)				25.86		Theta star (bias corrected MLE)				27.97	
119	nu hat (MLE)				869.4		nu star (bias corrected)				803.9	
120	MLE Mean (bias corrected)				288.2		MLE Sd (bias corrected)				89.78	
121							Approximate Chi Square Value (0.05)				739.1	
122	Adjusted Level of Significance				0.0437		Adjusted Chi Square Value				736.6	
123												
124	Assuming Gamma Distribution											
125	95% Approximate Gamma UCL (use when n>=50))				313.5		95% Adjusted Gamma UCL (use when n<50)				314.5	
126												
127	Lognormal GOF Test											
128	Shapiro Wilk Test Statistic				0.94		Shapiro Wilk Lognormal GOF Test					
129	5% Shapiro Wilk Critical Value				0.939		Data appear Lognormal at 5% Significance Level					
130	Lilliefors Test Statistic				0.154		Lilliefors Lognormal GOF Test					
131	5% Lilliefors Critical Value				0.14		Data Not Lognormal at 5% Significance Level					
132	Data appear Approximate Lognormal at 5% Significance Level											
133												
134	Lognormal Statistics											
135	Minimum of Logged Data				4.5		Mean of logged Data				5.618	
136	Maximum of Logged Data				6.328		SD of logged Data				0.319	
137												
138	Assuming Lognormal Distribution											
139	95% H-UCL				317.9		90% Chebyshev (MVUE) UCL				334.5	
140	95% Chebyshev (MVUE) UCL				354.9		97.5% Chebyshev (MVUE) UCL				383.3	
141	99% Chebyshev (MVUE) UCL				439.1							
142												
143	Nonparametric Distribution Free UCL Statistics											
144	Data appear to follow a Discernible Distribution at 5% Significance Level											
145												
146	Nonparametric Distribution Free UCLs											
147	95% CLT UCL				310.6		95% Jackknife UCL				311.2	
148	95% Standard Bootstrap UCL				311		95% Bootstrap-t UCL				313.8	
149	95% Hall's Bootstrap UCL				314.9		95% Percentile Bootstrap UCL				311.3	
150	95% BCA Bootstrap UCL				310.5							
151	90% Chebyshev (Mean, Sd) UCL				329.1		95% Chebyshev (Mean, Sd) UCL				347.6	
152	97.5% Chebyshev (Mean, Sd) UCL				373.3		99% Chebyshev (Mean, Sd) UCL				423.8	
153												
154	Suggested UCL to Use											
155	95% Student's-t UCL				311.2							
156												
157	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
158	Recommendations are based upon data size, data distribution, and skewness.											
159	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
160	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
161												

	A	B	C	D	E	F	G	H	I	J	K	L
162	Total Nitrogen as N											
163												
164												
165	General Statistics											
166	Total Number of Observations	39						Number of Distinct Observations	23			
167								Number of Missing Observations	0			
168	Minimum	90						Mean	288.2			
169	Maximum	560						Median	270			
170	SD	85.13						Std. Error of Mean	13.63			
171	Coefficient of Variation	0.295						Skewness	0.658			
172												
173	Normal GOF Test											
174	Shapiro Wilk Test Statistic	0.962						Shapiro Wilk GOF Test				
175	5% Shapiro Wilk Critical Value	0.939						Data appear Normal at 5% Significance Level				
176	Lilliefors Test Statistic	0.112						Lilliefors GOF Test				
177	5% Lilliefors Critical Value	0.14						Data appear Normal at 5% Significance Level				
178	Data appear Normal at 5% Significance Level											
179												
180	Assuming Normal Distribution											
181	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
182	95% Student's-t UCL	311.2					95% Adjusted-CLT UCL (Chen-1995)	312.2				
183							95% Modified-t UCL (Johnson-1978)	311.4				
184												
185	Gamma GOF Test											
186	A-D Test Statistic	0.565						Anderson-Darling Gamma GOF Test				
187	5% A-D Critical Value	0.748						Detected data appear Gamma Distributed at 5% Significance Level				
188	K-S Test Statistic	0.132						Kolmogorov-Smirnov Gamma GOF Test				
189	5% K-S Critical Value	0.141						Detected data appear Gamma Distributed at 5% Significance Level				
190	Detected data appear Gamma Distributed at 5% Significance Level											
191												
192	Gamma Statistics											
193	k hat (MLE)	11.15					k star (bias corrected MLE)	10.31				
194	Theta hat (MLE)	25.86					Theta star (bias corrected MLE)	27.97				
195	nu hat (MLE)	869.4					nu star (bias corrected)	803.9				
196	MLE Mean (bias corrected)	288.2					MLE Sd (bias corrected)	89.78				
197							Approximate Chi Square Value (0.05)	739.1				
198	Adjusted Level of Significance	0.0437					Adjusted Chi Square Value	736.6				
199												
200	Assuming Gamma Distribution											
201	95% Approximate Gamma UCL (use when n>=50))	313.5					95% Adjusted Gamma UCL (use when n<50)	314.5				
202												
203	Lognormal GOF Test											
204	Shapiro Wilk Test Statistic	0.94						Shapiro Wilk Lognormal GOF Test				
205	5% Shapiro Wilk Critical Value	0.939						Data appear Lognormal at 5% Significance Level				
206	Lilliefors Test Statistic	0.154						Lilliefors Lognormal GOF Test				
207	5% Lilliefors Critical Value	0.14						Data Not Lognormal at 5% Significance Level				
208	Data appear Approximate Lognormal at 5% Significance Level											
209												
210	Lognormal Statistics											
211	Minimum of Logged Data	4.5					Mean of logged Data	5.618				
212	Maximum of Logged Data	6.328					SD of logged Data	0.319				
213												
214	Assuming Lognormal Distribution											
215	95% H-UCL	317.9					90% Chebyshev (MVUE) UCL	334.5				
216	95% Chebyshev (MVUE) UCL	354.9					97.5% Chebyshev (MVUE) UCL	383.3				
217	99% Chebyshev (MVUE) UCL	439.1										
218												
219	Nonparametric Distribution Free UCL Statistics											
220	Data appear to follow a Discernible Distribution at 5% Significance Level											
221												
222	Nonparametric Distribution Free UCLs											
223	95% CLT UCL	310.6					95% Jackknife UCL	311.2				
224	95% Standard Bootstrap UCL	310.3					95% Bootstrap-t UCL	312.5				
225	95% Hall's Bootstrap UCL	313.5					95% Percentile Bootstrap UCL	310.5				
226	95% BCA Bootstrap UCL	312.1										
227	90% Chebyshev(Mean, Sd) UCL	329.1					95% Chebyshev(Mean, Sd) UCL	347.6				
228	97.5% Chebyshev(Mean, Sd) UCL	373.3					99% Chebyshev(Mean, Sd) UCL	423.8				
229												
230	Suggested UCL to Use											
231	95% Student's-t UCL	311.2										
232												
233	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
234	Recommendations are based upon data size, data distribution, and skewness.											
235	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
236	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
237												

	A	B	C	D	E	F	G	H	I	J	K	L						
238	Total Phosphorus as P																	
239																		
240																		
241	General Statistics																	
242	Total Number of Observations				39				Number of Distinct Observations				36					
243									Number of Missing Observations				0					
244					Minimum				134				Mean		689.2			
245					Maximum				1290				Median				668	
246					SD				235.5				Std. Error of Mean				37.72	
247					Coefficient of Variation				0.342				Skewness				0.14	
248																		
249	Normal GOF Test																	
250	Shapiro Wilk Test Statistic				0.979				Shapiro Wilk GOF Test									
251	5% Shapiro Wilk Critical Value				0.939				Data appear Normal at 5% Significance Level									
252	Lilliefors Test Statistic				0.101				Lilliefors GOF Test									
253	5% Lilliefors Critical Value				0.14				Data appear Normal at 5% Significance Level									
254	Data appear Normal at 5% Significance Level																	
255																		
256	Assuming Normal Distribution																	
257	95% Normal UCL								95% UCLs (Adjusted for Skewness)									
258	95% Student's-t UCL				752.8				95% Adjusted-CLT UCL (Chen-1995)				752.1					
259									95% Modified-t UCL (Johnson-1978)				752.9					
260																		
261	Gamma GOF Test																	
262	A-D Test Statistic				0.712				Anderson-Darling Gamma GOF Test									
263	5% A-D Critical Value				0.75				Detected data appear Gamma Distributed at 5% Significance Level									
264	K-S Test Statistic				0.147				Kolmogorov-Smirnov Gamma GOF Test									
265	5% K-S Critical Value				0.142				Data Not Gamma Distributed at 5% Significance Level									
266	Detected data follow Appr. Gamma Distribution at 5% Significance Level																	
267																		
268	Gamma Statistics																	
269	k hat (MLE)				7.047				k star (bias corrected MLE)				6.522					
270	Theta hat (MLE)				97.8				Theta star (bias corrected MLE)				105.7					
271	nu hat (MLE)				549.7				nu star (bias corrected)				508.7					
272	MLE Mean (bias corrected)				689.2				MLE Sd (bias corrected)				269.9					
273									Approximate Chi Square Value (0.05)				457.4					
274	Adjusted Level of Significance				0.0437				Adjusted Chi Square Value				455.5					
275																		
276	Assuming Gamma Distribution																	
277	95% Approximate Gamma UCL (use when n>=50)				766.5				95% Adjusted Gamma UCL (use when n<50)				769.7					
278																		
279	Lognormal GOF Test																	
280	Shapiro Wilk Test Statistic				0.867				Shapiro Wilk Lognormal GOF Test									
281	5% Shapiro Wilk Critical Value				0.939				Data Not Lognormal at 5% Significance Level									
282	Lilliefors Test Statistic				0.18				Lilliefors Lognormal GOF Test									
283	5% Lilliefors Critical Value				0.14				Data Not Lognormal at 5% Significance Level									
284	Data Not Lognormal at 5% Significance Level																	
285																		
286	Lognormal Statistics																	
287	Minimum of Logged Data				4.898				Mean of logged Data				6.463					
288	Maximum of Logged Data				7.162				SD of logged Data				0.426					
289																		
290	Assuming Lognormal Distribution																	
291	95% H-UCL				798.4				90% Chebyshev (MVUE) UCL				848.4					
292	95% Chebyshev (MVUE) UCL				915.6				97.5% Chebyshev (MVUE) UCL				1009					
293	99% Chebyshev (MVUE) UCL				1192													
294																		
295	Nonparametric Distribution Free UCL Statistics																	
296	Data appear to follow a Discernible Distribution at 5% Significance Level																	
297																		
298	Nonparametric Distribution Free UCLs																	
299	95% CLT UCL				751.2				95% Jackknife UCL				752.8					
300	95% Standard Bootstrap UCL				750.6				95% Bootstrap-t UCL				753.4					
301	95% Hall's Bootstrap UCL				752.7				95% Percentile Bootstrap UCL				747.8					
302	95% BCA Bootstrap UCL				746													
303	90% Chebyshev (Mean, Sd) UCL				802.4				95% Chebyshev (Mean, Sd) UCL				853.6					
304	97.5% Chebyshev (Mean, Sd) UCL				924.7				99% Chebyshev (Mean, Sd) UCL				1064					
305																		
306	Suggested UCL to Use																	
307	95% Student's-t UCL				752.8													
308																		
309	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.																	
310	Recommendations are based upon data size, data distribution, and skewness.																	
311	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).																	
312	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.																	
313																		

	A	B	C	D	E	F	G	H	I	J	K	L												
314	Total Organic Carbon																							
315																								
316	General Statistics																							
317																								
318	Total Number of Observations				39				Number of Distinct Observations				24											
319									Number of Missing Observations				0											
320	Minimum				0.05				Mean				0.292											
321	Maximum				0.56				Median				0.29											
322	SD				0.109				Std. Error of Mean				0.0175											
323	Coefficient of Variation				0.373				Skewness				0.178											
324																								
325	Normal GOF Test																							
326	Shapiro Wilk Test Statistic				0.988				Shapiro Wilk GOF Test															
327	5% Shapiro Wilk Critical Value				0.939				Data appear Normal at 5% Significance Level															
328	Lilliefors Test Statistic				0.0878				Lilliefors GOF Test															
329	5% Lilliefors Critical Value				0.14				Data appear Normal at 5% Significance Level															
330	Data appear Normal at 5% Significance Level																							
331																								
332	Assuming Normal Distribution																							
333	95% Normal UCL						95% UCLs (Adjusted for Skewness)																	
334	95% Student's-t UCL				0.322				95% Adjusted-CLT UCL (Chen-1995)				0.322											
335									95% Modified-t UCL (Johnson-1978)				0.322											
336																								
337	Gamma GOF Test																							
338	A-D Test Statistic				0.525				Anderson-Darling Gamma GOF Test															
339	5% A-D Critical Value				0.751				Detected data appear Gamma Distributed at 5% Significance Level															
340	K-S Test Statistic				0.135				Kolmogorov-Smirnov Gamma GOF Test															
341	5% K-S Critical Value				0.142				Detected data appear Gamma Distributed at 5% Significance Level															
342	Detected data appear Gamma Distributed at 5% Significance Level																							
343																								
344	Gamma Statistics																							
345	k hat (MLE)				5.992				k star (bias corrected MLE)				5.548											
346	Theta hat (MLE)				0.0488				Theta star (bias corrected MLE)				0.0527											
347	nu hat (MLE)				467.4				nu star (bias corrected)				432.7											
348	MLE Mean (bias corrected)				0.292				MLE Sd (bias corrected)				0.124											
349									Approximate Chi Square Value (0.05)				385.5											
350	Adjusted Level of Significance				0.0437				Adjusted Chi Square Value				383.8											
351																								
352	Assuming Gamma Distribution																							
353	95% Approximate Gamma UCL (use when n>=50))						0.328						95% Adjusted Gamma UCL (use when n<50)						0.33					
354																								
355	Lognormal GOF Test																							
356	Shapiro Wilk Test Statistic				0.904				Shapiro Wilk Lognormal GOF Test															
357	5% Shapiro Wilk Critical Value				0.939				Data Not Lognormal at 5% Significance Level															
358	Lilliefors Test Statistic				0.165				Lilliefors Lognormal GOF Test															
359	5% Lilliefors Critical Value				0.14				Data Not Lognormal at 5% Significance Level															
360	Data Not Lognormal at 5% Significance Level																							
361																								
362	Lognormal Statistics																							
363	Minimum of Logged Data				-2.996				Mean of logged Data				-1.316											
364	Maximum of Logged Data				-0.58				SD of logged Data				0.461											
365																								
366	Assuming Lognormal Distribution																							
367	95% H-UCL				0.344				90% Chebyshev (MVUE) UCL				0.366											
368	95% Chebyshev (MVUE) UCL				0.397				97.5% Chebyshev (MVUE) UCL				0.44											
369	99% Chebyshev (MVUE) UCL				0.525																			
370																								
371	Nonparametric Distribution Free UCL Statistics																							
372	Data appear to follow a Discernible Distribution at 5% Significance Level																							
373																								
374	Nonparametric Distribution Free UCLs																							
375	95% CLT UCL				0.321				95% Jackknife UCL				0.322											
376	95% Standard Bootstrap UCL				0.32				95% Bootstrap-t UCL				0.323											
377	95% Hall's Bootstrap UCL				0.322				95% Percentile Bootstrap UCL				0.322											
378	95% BCA Bootstrap UCL				0.322																			
379	90% Chebyshev (Mean, Sd) UCL				0.345				95% Chebyshev (Mean, Sd) UCL				0.368											
380	97.5% Chebyshev (Mean, Sd) UCL				0.401				99% Chebyshev (Mean, Sd) UCL				0.466											
381																								
382	Suggested UCL to Use																							
383	95% Student's-t UCL				0.322																			
384																								
385	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL																							
386	Recommendations are based upon data size, data distribution, and skewness.																							
387	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006)																							
388	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.																							
389																								

	A	B	C	D	E	F	G	H	I	J	K	L
390												
391	Total Carbon											
392	General Statistics											
393												
394	Total Number of Observations			39			Number of Distinct Observations			39		
395							Number of Missing Observations			0		
396	Minimum			0.21			Mean			4.358		
397	Maximum			7.16			Median			4.65		
398	SD			1.95			Std. Error of Mean			0.312		
399	Coefficient of Variation			0.448			Skewness			-0.455		
400												
401	Normal GOF Test											
402	Shapiro Wilk Test Statistic			0.937			Shapiro Wilk GOF Test					
403	5% Shapiro Wilk Critical Value			0.939			Data Not Normal at 5% Significance Level					
404	Lilliefors Test Statistic			0.129			Lilliefors GOF Test					
405	5% Lilliefors Critical Value			0.14			Data appear Normal at 5% Significance Level					
406	Data appear Approximate Normal at 5% Significance Level											
407												
408	Assuming Normal Distribution											
409	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
410	95% Student's-t UCL			4.885			95% Adjusted-CLT UCL (Chen-1995)			4.848		
411							95% Modified-t UCL (Johnson-1978)			4.881		
412												
413	Gamma GOF Test											
414	A-D Test Statistic			1.681			Anderson-Darling Gamma GOF Test					
415	5% A-D Critical Value			0.754			Data Not Gamma Distributed at 5% Significance Level					
416	K-S Test Statistic			0.208			Kolmogorov-Smirnov Gamma GOF Test					
417	5% K-S Critical Value			0.142			Data Not Gamma Distributed at 5% Significance Level					
418	Data Not Gamma Distributed at 5% Significance Level											
419												
420	Gamma Statistics											
421	k hat (MLE)			3.035			k star (bias corrected MLE)			2.819		
422	Theta hat (MLE)			1.436			Theta star (bias corrected MLE)			1.546		
423	nu hat (MLE)			236.7			nu star (bias corrected)			219.9		
424	MLE Mean (bias corrected)			4.358			MLE Sd (bias corrected)			2.596		
425							Approximate Chi Square Value (0.05)			186.5		
426	Adjusted Level of Significance			0.0437			Adjusted Chi Square Value			185.3		
427												
428	Assuming Gamma Distribution											
429	95% Approximate Gamma UCL (use when n>=50)			5.137			95% Adjusted Gamma UCL (use when n<50)			5.17		
430												
431	Lognormal GOF Test											
432	Shapiro Wilk Test Statistic			0.788			Shapiro Wilk Lognormal GOF Test					
433	5% Shapiro Wilk Critical Value			0.939			Data Not Lognormal at 5% Significance Level					
434	Lilliefors Test Statistic			0.228			Lilliefors Lognormal GOF Test					
435	5% Lilliefors Critical Value			0.14			Data Not Lognormal at 5% Significance Level					
436	Data Not Lognormal at 5% Significance Level											
437												
438	Lognormal Statistics											
439	Minimum of Logged Data			-1.561			Mean of logged Data			1.298		
440	Maximum of Logged Data			1.969			SD of logged Data			0.729		
441												
442	Assuming Lognormal Distribution											
443	95% H-UCL			6.134			90% Chebyshev (MVUE) UCL			6.554		
444	95% Chebyshev (MVUE) UCL			7.377			97.5% Chebyshev (MVUE) UCL			8.519		
445	99% Chebyshev (MVUE) UCL			10.76								
446												
447	Nonparametric Distribution Free UCL Statistics											
448	Data appear to follow a Discernible Distribution at 5% Significance Level											
449												
450	Nonparametric Distribution Free UCLs											
451	95% CLT UCL			4.872			95% Jackknife UCL			4.885		
452	95% Standard Bootstrap UCL			4.856			95% Bootstrap-t UCL			4.868		
453	95% Hall's Bootstrap UCL			4.834			95% Percentile Bootstrap UCL			4.848		
454	95% BCA Bootstrap UCL			4.872								
455	90% Chebyshev(Mean, Sd) UCL			5.295			95% Chebyshev(Mean, Sd) UCL			5.72		
456	97.5% Chebyshev(Mean, Sd) UCL			6.309			99% Chebyshev(Mean, Sd) UCL			7.466		
457												
458	Suggested UCL to Use											
459	95% Student's-t UCL			4.885								
460												
461	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
462	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
463												
464	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
465	Recommendations are based upon data size, data distribution, and skewness.											
466	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
467	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
468												
469	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
470	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
471												

	A	B	C	D	E	F	G	H	I	J	K	L
472												
473	Total Inorganic Carbon											
474												
475	General Statistics											
476	Total Number of Observations			39			Number of Distinct Observations			38		
477							Number of Missing Observations			0		
478	Minimum			0.16			Mean			4.066		
479	Maximum			6.86			Median			4.31		
480	SD			1.892			Std. Error of Mean			0.303		
481	Coefficient of Variation			0.465			Skewness			-0.377		
482												
483	Normal GOF Test											
484	Shapiro Wilk Test Statistic			0.943			Shapiro Wilk GOF Test					
485	5% Shapiro Wilk Critical Value			0.939			Data appear Normal at 5% Significance Level					
486	Lilliefors Test Statistic			0.0994			Lilliefors GOF Test					
487	5% Lilliefors Critical Value			0.14			Data appear Normal at 5% Significance Level					
488	Data appear Normal at 5% Significance Level											
489												
490	Assuming Normal Distribution											
491	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
492	95% Student's-t UCL			4.577			95% Adjusted-CLT UCL (Chen-1995)			4.545		
493							95% Modified-t UCL (Johnson-1978)			4.574		
494												
495	Gamma GOF Test											
496	A-D Test Statistic			1.584			Anderson-Darling Gamma GOF Test					
497	5% A-D Critical Value			0.756			Data Not Gamma Distributed at 5% Significance Level					
498	K-S Test Statistic			0.184			Kolmogorov-Smirnov Gamma GOF Test					
499	5% K-S Critical Value			0.142			Data Not Gamma Distributed at 5% Significance Level					
500	Data Not Gamma Distributed at 5% Significance Level											
501												
502	Gamma Statistics											
503	k hat (MLE)			2.762			k star (bias corrected MLE)			2.567		
504	Theta hat (MLE)			1.472			Theta star (bias corrected MLE)			1.584		
505	nu hat (MLE)			215.4			nu star (bias corrected)			200.2		
506	MLE Mean (bias corrected)			4.066			MLE Sd (bias corrected)			2.538		
507							Approximate Chi Square Value (0.05)			168.5		
508	Adjusted Level of Significance			0.0437			Adjusted Chi Square Value			167.3		
509												
510	Assuming Gamma Distribution											
511	95% Approximate Gamma UCL (use when n>=50)			4.832			95% Adjusted Gamma UCL (use when n<50)			4.865		
512												
513	Lognormal GOF Test											
514	Shapiro Wilk Test Statistic			0.787			Shapiro Wilk Lognormal GOF Test					
515	5% Shapiro Wilk Critical Value			0.939			Data Not Lognormal at 5% Significance Level					
516	Lilliefors Test Statistic			0.223			Lilliefors Lognormal GOF Test					
517	5% Lilliefors Critical Value			0.14			Data Not Lognormal at 5% Significance Level					
518	Data Not Lognormal at 5% Significance Level											
519												
520	Lognormal Statistics											
521	Minimum of Logged Data			-1.833			Mean of logged Data			1.211		
522	Maximum of Logged Data			1.926			SD of logged Data			0.776		
523												
524	Assuming Lognormal Distribution											
525	95% H-UCL			5.95			90% Chebyshev (MVUE) UCL			6.341		
526	95% Chebyshev (MVUE) UCL			7.179			97.5% Chebyshev (MVUE) UCL			8.343		
527	99% Chebyshev (MVUE) UCL			10.63								
528												
529	Nonparametric Distribution Free UCL Statistics											
530	Data appear to follow a Discernible Distribution at 5% Significance Level											
531												
532	Nonparametric Distribution Free UCLs											
533	95% CLT UCL			4.564			95% Jackknife UCL			4.577		
534	95% Standard Bootstrap UCL			4.544			95% Bootstrap-t UCL			4.551		
535	95% Hall's Bootstrap UCL			4.551			95% Percentile Bootstrap UCL			4.543		
536	95% BCA Bootstrap UCL			4.534								
537	90% Chebyshev (Mean, Sd) UCL			4.975			95% Chebyshev (Mean, Sd) UCL			5.387		
538	97.5% Chebyshev (Mean, Sd) UCL			5.958			99% Chebyshev (Mean, Sd) UCL			7.08		
539												
540	Suggested UCL to Use											
541	95% Student's-t UCL			4.577								
542												
543	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
544	Recommendations are based upon data size, data distribution, and skewness.											
545	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
546	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
547												
548	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be											
549	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.											
550												

	A	B	C	D	E	F	G	H	I	J	K	L
551												
552	Tributylin											
553												
554	General Statistics											
555	Total Number of Observations				39		Number of Distinct Observations				1	
556					Number of Missing Observations				0			
557	Minimum				0.25		Mean				0.25	
558	Maximum				0.25		Median				0.25	
559												
560	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
561	ProUCL (or any other software) should not be used on such a data set!											
562	The data set for variable Tributylin was not processed!											
563												
564	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
565	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
566												
567												

	A	B	C	D	E	F	G	H	I	J	K	L		
1	UCL Statistics for Uncensored Full Data Sets													
2														
3	User Selected Options													
4	Date/Time of Computation		ProUCL 5.18/10/2020 10:46:41 PM											
5	From File		PAH for ProUCL.xls											
6	Full Precision		OFF											
7	Confidence Coefficient		95%											
8	Number of Bootstrap Operations		2000											
9														
10														
11	2-Methylnaphthalene													
12														
13	General Statistics													
14	Total Number of Observations				39		Number of Distinct Observations				1			
15							Number of Missing Observations				0			
16	Minimum				2.5		Mean				2.5			
17	Maximum				2.5		Median				2.5			
18														
19	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!													
20	ProUCL (or any other software) should not be used on such a data set!													
21	The data set for variable 2-Methylnaphthalene was not processed!													
22														
23	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.													
24	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).													
25														
26														
27														
28	Phenanthrene													
29														
30	General Statistics													
31	Total Number of Observations				39		Number of Distinct Observations				1			
32							Number of Missing Observations				0			
33	Minimum				2		Mean				2			
34	Maximum				2		Median				2			
35														
36	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!													
37	ProUCL (or any other software) should not be used on such a data set!													
38	The data set for variable Phenanthrene was not processed!													
39														
40	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.													
41	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).													
42														
43														
44														
45	Fluoranthene													
46														
47	General Statistics													
48	Total Number of Observations				39		Number of Distinct Observations				1			
49							Number of Missing Observations				0			
50	Minimum				2		Mean				2			
51	Maximum				2		Median				2			
52														
53	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!													
54	ProUCL (or any other software) should not be used on such a data set!													
55	The data set for variable Fluoranthene was not processed!													
56														
57	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.													
58	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).													
59														
60														

	A	B	C	D	E	F	G	H	I	J	K	L
129												
130	Benzo(a)pyrene											
131												
132	General Statistics											
133	Total Number of Observations				39		Number of Distinct Observations				1	
134					Number of Missing Observations				0			
135	Minimum				2		Mean				2	
136	Maximum				2		Median				2	
137												
138	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
139	ProUCL (or any other software) should not be used on such a data set!											
140	The data set for variable Benzo(a)pyrene was not processed!											
141												
142	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
143	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
144												
145												
146												
147	Benzo(g,h,i)perylene											
148												
149	General Statistics											
150	Total Number of Observations				39		Number of Distinct Observations				1	
151					Number of Missing Observations				0			
152	Minimum				2		Mean				2	
153	Maximum				2		Median				2	
154												
155	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
156	ProUCL (or any other software) should not be used on such a data set!											
157	The data set for variable Benzo(g,h,i)perylene was not processed!											
158												
159	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
160	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
161												
162												
163												
164	Sum of PAHs											
165												
166	General Statistics											
167	Total Number of Observations				39		Number of Distinct Observations				1	
168					Number of Missing Observations				0			
169	Minimum				2		Mean				2	
170	Maximum				2		Median				2	
171												
172	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
173	ProUCL (or any other software) should not be used on such a data set!											
174	The data set for variable Sum of PAHs was not processed!											
175												
176	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
177	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
178												
179												

	A	B	C	D	E	F	G	H	I	J	K	L	
1	UCL Statistics for Uncensored Full Data Sets												
2													
3	User Selected Options												
4	Date/Time of Computation	ProUCL 5.18/10/2020 10:47:45 PM											
5	From File	Radionuclides for ProUCL.xls											
6	Full Precision	OFF											
7	Confidence Coefficient	95%											
8	Number of Bootstrap Operations	2000											
9													
10													
11	Gross alpha												
12													
13	General Statistics												
14	Total Number of Observations	39							Number of Distinct Observations	31			
15									Number of Missing Observations	0			
16	Minimum	250							Mean	830			
17	Maximum	1420							Median	800			
18	SD	306							Std. Error of Mean	49			
19	Coefficient of Variation	0.369							Skewness	0.0142			
20													
21	Normal GOF Test												
22	Shapiro Wilk Test Statistic	0.964							Shapiro Wilk GOF Test				
23	5% Shapiro Wilk Critical Value	0.939							Data appear Normal at 5% Significance Level				
24	Lilliefors Test Statistic	0.0913							Lilliefors GOF Test				
25	5% Lilliefors Critical Value	0.14							Data appear Normal at 5% Significance Level				
26	Data appear Normal at 5% Significance Level												
27													
28	Assuming Normal Distribution												
29	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
30	95% Student's-t UCL	912.6							95% Adjusted-CLT UCL (Chen-1995)	910.7			
31									95% Modified-t UCL (Johnson-1978)	912.6			
32													
33	Gamma GOF Test												
34	A-D Test Statistic	0.603							Anderson-Darling Gamma GOF Test				
35	5% A-D Critical Value	0.75							Detected data appear Gamma Distributed at 5% Significance Level				
36	K-S Test Statistic	0.101							Kolmogorov-Smirnov Gamma GOF Test				
37	5% K-S Critical Value	0.142							Detected data appear Gamma Distributed at 5% Significance Level				
38	Detected data appear Gamma Distributed at 5% Significance Level												
39													
40	Gamma Statistics												
41	k hat (MLE)	6.301							k star (bias corrected MLE)	5.833			
42	Theta hat (MLE)	131.7							Theta star (bias corrected MLE)	142.3			
43	nu hat (MLE)	491.5							nu star (bias corrected)	455			
44	MLE Mean (bias corrected)	830							MLE Sd (bias corrected)	343.7			
45									Approximate Chi Square Value (0.05)	406.5			
46	Adjusted Level of Significance	0.0437							Adjusted Chi Square Value	404.7			
47													
48	Assuming Gamma Distribution												
49	95% Approximate Gamma UCL (use when n>=50)	928.9							95% Adjusted Gamma UCL (use when n<50)	933.1			
50													
51	Lognormal GOF Test												
52	Shapiro Wilk Test Statistic	0.895							Shapiro Wilk Lognormal GOF Test				
53	5% Shapiro Wilk Critical Value	0.939							Data Not Lognormal at 5% Significance Level				
54	Lilliefors Test Statistic	0.124							Lilliefors Lognormal GOF Test				
55	5% Lilliefors Critical Value	0.14							Data appear Lognormal at 5% Significance Level				
56	Data appear Approximate Lognormal at 5% Significance Level												
57													
58	Lognormal Statistics												
59	Minimum of Logged Data	5.521							Mean of logged Data	6.64			
60	Maximum of Logged Data	7.258							SD of logged Data	0.439			
61													
62	Assuming Lognormal Distribution												
63	95% H-UCL	962.8							90% Chebyshev (MVUE) UCL	1024			
64	95% Chebyshev (MVUE) UCL	1107							97.5% Chebyshev (MVUE) UCL	1223			
65	99% Chebyshev (MVUE) UCL	1450											
66													
67	Nonparametric Distribution Free UCL Statistics												
68	Data appear to follow a Discernible Distribution at 5% Significance Level												
69													
70	Nonparametric Distribution Free UCLs												
71	95% CLT UCL	910.6							95% Jackknife UCL	912.6			
72	95% Standard Bootstrap UCL	911.5							95% Bootstrap-t UCL	914.3			
73	95% Hall's Bootstrap UCL	912.4							95% Percentile Bootstrap UCL	912.8			
74	95% BCA Bootstrap UCL	903.6											
75	90% Chebyshev(Mean, Sd) UCL	977							95% Chebyshev(Mean, Sd) UCL	1044			
76	97.5% Chebyshev(Mean, Sd) UCL	1136							99% Chebyshev(Mean, Sd) UCL	1318			
77													
78	Suggested UCL to Use												
79	95% Student's-t UCL	912.6											
80													
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
82	Recommendations are based upon data size, data distribution, and skewness.												
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
85													

	A	B	C	D	E	F	G	H	I	J	K	L
86												
87	Gross beta											
88												
89	General Statistics											
90	Total Number of Observations			39			Number of Distinct Observations			17		
91							Number of Missing Observations			0		
92	Minimum			250			Mean			430.3		
93	Maximum			910			Median			250		
94	SD			238.2			Std. Error of Mean			38.14		
95	Coefficient of Variation			0.554			Skewness			0.863		
96												
97	Normal GOF Test											
98	Shapiro Wilk Test Statistic			0.729			Shapiro Wilk GOF Test					
99	5% Shapiro Wilk Critical Value			0.939			Data Not Normal at 5% Significance Level					
100	Lilliefors Test Statistic			0.365			Lilliefors GOF Test					
101	5% Lilliefors Critical Value			0.14			Data Not Normal at 5% Significance Level					
102	Data Not Normal at 5% Significance Level											
103												
104	Assuming Normal Distribution											
105	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
106	95% Student's-t UCL			494.6			95% Adjusted-CLT UCL (Chen-1995)			498.6		
107							95% Modified-t UCL (Johnson-1978)			495.4		
108												
109	Gamma GOF Test											
110	A-D Test Statistic			4.893			Anderson-Darling Gamma GOF Test					
111	5% A-D Critical Value			0.753			Data Not Gamma Distributed at 5% Significance Level					
112	K-S Test Statistic			0.378			Kolmogorov-Smirnov Gamma GOF Test					
113	5% K-S Critical Value			0.142			Data Not Gamma Distributed at 5% Significance Level					
114	Data Not Gamma Distributed at 5% Significance Level											
115												
116	Gamma Statistics											
117	k hat (MLE)			3.845			k star (bias corrected MLE)			3.566		
118	Theta hat (MLE)			111.9			Theta star (bias corrected MLE)			120.6		
119	nu hat (MLE)			299.9			nu star (bias corrected)			278.2		
120	MLE Mean (bias corrected)			430.3			MLE Sd (bias corrected)			227.8		
121							Approximate Chi Square Value (0.05)			240.5		
122	Adjusted Level of Significance			0.0437			Adjusted Chi Square Value			239.2		
123												
124	Assuming Gamma Distribution											
125	95% Approximate Gamma UCL (use when n>=50)			497.6			95% Adjusted Gamma UCL (use when n<50)			500.4		
126												
127	Lognormal GOF Test											
128	Shapiro Wilk Test Statistic			0.714			Shapiro Wilk Lognormal GOF Test					
129	5% Shapiro Wilk Critical Value			0.939			Data Not Lognormal at 5% Significance Level					
130	Lilliefors Test Statistic			0.376			Lilliefors Lognormal GOF Test					
131	5% Lilliefors Critical Value			0.14			Data Not Lognormal at 5% Significance Level					
132	Data Not Lognormal at 5% Significance Level											
133												
134	Lognormal Statistics											
135	Minimum of Logged Data			5.521			Mean of logged Data			5.929		
136	Maximum of Logged Data			6.813			SD of logged Data			0.513		
137												
138	Assuming Lognormal Distribution											
139	95% H-UCL			502.9			90% Chebyshev (MVUE) UCL			537.1		
140	95% Chebyshev (MVUE) UCL			587.1			97.5% Chebyshev (MVUE) UCL			656.5		
141	99% Chebyshev (MVUE) UCL			792.7								
142												
143	Nonparametric Distribution Free UCL Statistics											
144	Data do not follow a Discernible Distribution (0.05)											
145												
146	Nonparametric Distribution Free UCLs											
147	95% CLT UCL			493			95% Jackknife UCL			494.6		
148	95% Standard Bootstrap UCL			494.6			95% Bootstrap-t UCL			499.1		
149	95% Hall's Bootstrap UCL			493.4			95% Percentile Bootstrap UCL			492.1		
150	95% BCA Bootstrap UCL			496.7								
151	90% Chebyshev(Mean, Sd) UCL			544.7			95% Chebyshev(Mean, Sd) UCL			596.5		
152	97.5% Chebyshev(Mean, Sd) UCL			668.4			99% Chebyshev(Mean, Sd) UCL			809.8		
153												
154	Suggested UCL to Use											
155	95% Chebyshev (Mean, Sd) UCL			596.5								
156												
157	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
158	Recommendations are based upon data size, data distribution, and skewness.											
159	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
160	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
161												

	A	B	C	D	E	F	G	H	I	J	K	L				
162	Total Gross Alpha & Beta															
163																
164																
165	General Statistics															
166	Total Number of Observations				39				Number of Distinct Observations				30			
167									Number of Missing Observations				0			
168	Minimum				250				Mean				1113			
169	Maximum				2290				Median				980			
170	SD				598.8				Std. Error of Mean				95.88			
171	Coefficient of Variation				0.538				Skewness				0.41			
172																
173	Normal GOF Test															
174	Shapiro Wilk Test Statistic				0.921				Shapiro Wilk GOF Test							
175	5% Shapiro Wilk Critical Value				0.939				Data Not Normal at 5% Significance Level							
176	Lilliefors Test Statistic				0.147				Lilliefors GOF Test							
177	5% Lilliefors Critical Value				0.14				Data Not Normal at 5% Significance Level							
178	Data Not Normal at 5% Significance Level															
179																
180	Assuming Normal Distribution															
181	95% Normal UCL						95% UCLs (Adjusted for Skewness)									
182	95% Student's-t UCL				1274				95% Adjusted-CLT UCL (Chen-1995)				1277			
183									95% Modified-t UCL (Johnson-1978)				1276			
184																
185	Gamma GOF Test															
186	A-D Test Statistic				0.664				Anderson-Darling Gamma GOF Test							
187	5% A-D Critical Value				0.754				Detected data appear Gamma Distributed at 5% Significance Level							
188	K-S Test Statistic				0.117				Kolmogorov-Smirnov Gamma GOF Test							
189	5% K-S Critical Value				0.142				Detected data appear Gamma Distributed at 5% Significance Level							
190	Detected data appear Gamma Distributed at 5% Significance Level															
191																
192	Gamma Statistics															
193	k hat (MLE)				3.199				k star (bias corrected MLE)				2.97			
194	Theta hat (MLE)				347.9				Theta star (bias corrected MLE)				374.7			
195	nu hat (MLE)				249.5				nu star (bias corrected)				231.6			
196	MLE Mean (bias corrected)				1113				MLE Sd (bias corrected)				645.8			
197									Approximate Chi Square Value (0.05)				197.4			
198	Adjusted Level of Significance				0.0437				Adjusted Chi Square Value				196.2			
199																
200	Assuming Gamma Distribution															
201	95% Approximate Gamma UCL (use when n>=50)				1306				95% Adjusted Gamma UCL (use when n<50)				1314			
202																
203	Lognormal GOF Test															
204	Shapiro Wilk Test Statistic				0.926				Shapiro Wilk Lognormal GOF Test							
205	5% Shapiro Wilk Critical Value				0.939				Data Not Lognormal at 5% Significance Level							
206	Lilliefors Test Statistic				0.117				Lilliefors Lognormal GOF Test							
207	5% Lilliefors Critical Value				0.14				Data appear Lognormal at 5% Significance Level							
208	Data appear Approximate Lognormal at 5% Significance Level															
209																
210	Lognormal Statistics															
211	Minimum of Logged Data				5.521				Mean of logged Data				6.85			
212	Maximum of Logged Data				7.736				SD of logged Data				0.614			
213																
214	Assuming Lognormal Distribution															
215	95% H-UCL				1393				90% Chebyshev (MVUE) UCL				1492			
216	95% Chebyshev (MVUE) UCL				1654				97.5% Chebyshev (MVUE) UCL				1879			
217	99% Chebyshev (MVUE) UCL				2321											
218																
219	Nonparametric Distribution Free UCL Statistics															
220	Data appear to follow a Discernible Distribution at 5% Significance Level															
221																
222	Nonparametric Distribution Free UCLs															
223	95% CLT UCL				1271				95% Jackknife UCL				1274			
224	95% Standard Bootstrap UCL				1267				95% Bootstrap-t UCL				1267			
225	95% Hall's Bootstrap UCL				1271				95% Percentile Bootstrap UCL				1276			
226	95% BCA Bootstrap UCL				1289											
227	90% Chebyshev (Mean, Sd) UCL				1400				95% Chebyshev (Mean, Sd) UCL				1531			
228	97.5% Chebyshev (Mean, Sd) UCL				1712				99% Chebyshev (Mean, Sd) UCL				2067			
229																
230	Suggested UCL to Use															
231	95% Adjusted Gamma UCL				1314											
232																
233	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.															
234	Recommendations are based upon data size, data distribution, and skewness.															
235	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).															
236	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.															
237																

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