

Appendix C.

Sediment quality and infauna field survey report
(Jacobs 2016b)



Barossa Environmental Studies

ConocoPhillips

Sediment Quality and Infauna Field Survey Report

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Abbreviations

ALS	Australian Laboratory Services Pty Ltd
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agricultural and Resource Management Council of Australia and New Zealand
aRPD	apparent redox potential discontinuity
BEST	Bio-Env and stepwise
BETXN	benzene, toluene, ethylbenzene, xylenes (meta-, para- and ortho-xylene) and naphthalene
BHQ	benthic habitat quality
Bio-Env	biological-environmental
BPPH	benthic primary producer habitat
Bq/g	becquerels per gram
ConocoPhillips	ConocoPhillips Australia Exploration Pty Ltd
DW	dry weight
(g)mS	slightly gravelly muddy sand
(g)S	slightly gravelly sand
gS	gravelly sand
(g)sM	slightly gravelly sandy mud
GPS	global positioning system
ISQG	interim sediment quality guidelines
LOR	limit of reporting
MAFRL	Marine and Freshwater Research Laboratory (Murdoch University)
mg/kg	milligrams per kilogram
MRL	minimum reporting limit
N/A	not applicable
NATA	National Association of Testing Authorities
NAGD	national assessment guidelines for dredging
NEPM	National Environment Protection Measure(s)
n-MDS	non-metric multi-dimensional scaling
NORM	naturally occurring radioactive material
NS	no sample
NT	Northern Territory
PAH	polycyclic aromatic hydrocarbons
PCA	principal components analysis

PRIMER	Plymouth routines in marine environmental research
PSD	particle size distribution
QA/QC	quality assurance/quality control
S	<i>pertaining to Folk classification - sand</i>
S	<i>pertaining to infaunal descriptive statistics - species richness</i>
SIMPROF	similarity profile
sM	sandy mud
SP1	sampling point 1
Sp.	species (singular)
SPI	sediment profile imagery
Spp.	species (plural)
TBT	tributyltin
TKN	total kjeldahl nitrogen
TOC	total organic carbon
TP	total phosphorus
TPH	total petroleum hydrocarbon
TRH	total recoverable hydrocarbon
µg	microgram

Executive Summary

ConocoPhillips Australia Exploration Pty Ltd (ConocoPhillips) are proposing to develop natural gas resources as part of the Barossa area development, located in waters up to 300 m deep in the Bonaparte Basin, in Commonwealth waters offshore of northern Australia. To develop a robust understanding of the existing marine environmental values of the area to inform any future approvals, a targeted baseline marine studies program is being progressed within and surrounding the Barossa field.

A key component of the baseline marine studies program is a sediment quality and infauna survey that was undertaken from 8 to 14 April 2015, during the autumn or tropical transitional season.

Seventeen water quality sampling sites were positioned to provide representative coverage of the permit area and areas of regional interest such as shoals and banks. Sites were located in the permit area (five sites, labelled SP1 to SP5), around Evans Shoal (four sites, SP7 to SP10), around Tassie Shoal (four sites, SP11 to SP14), around Lynedoch Bank (three sites, SP15 to SP17) and between the permit area and Evans Shoal (one site, SP6). Sites surveyed ranged in depth from around 10 m–30 m on top of shoals and banks through to approximately 280 m in the permit area.

Sediment samples were collected from each site for analysis of nutrients, metals/metalloids, hydrocarbons, naturally occurring radioactive materials, particle size distribution and infaunal community composition. Sampling sites ranged in depth from around 70 m at the shoals and banks through to approximately 280 m in the permit area. Shallow sampling sites on the shoals and banks were found to be unsuitable for sediment sampling due to the density of coral/biota cover and lack of consistent sediment patches.

Key conclusions from the sediment quality and infauna survey include:

- Of the metals and metalloids tested, only cobalt and nickel were recorded above the ANZECC & ARMCANZ (2000b) Interim Sediment Quality Guideline (ISQG) - low reliability trigger values. Cobalt was commonly recorded above the ISQG-low reliability trigger value level at all sites except one site at Evans Shoal. Nickel concentrations were recorded at or above the ISQG-low trigger value at two sites within the permit area. Nickel is commonly found in high levels in sediments in Australia (Commonwealth of Australia 2009) and both nickel and cobalt were found at levels greater than the ISQG-low reliability trigger value in deep offshore waters in the Browse Basin (approximately 30 km north-east of Seringapatam Reef) (SKM 2014).
- Tributyltin and hydrocarbons were below the laboratory reporting limits at all sites. Although historic exploration has been undertaken in the permit area, potential impacts from these activities were not detected in the data.
- Radium²²⁶ concentrations were recorded above the minimum reporting limit at two sites (one in the permit area and one to the west of the permit area), but at levels well below the ANZECC & ARMCANZ (2000b) ISQG-low reliability trigger value for radionuclides. Radium²²⁸ and thorium²²⁸ were not detected at any site.
- The highest total nitrogen and total organic carbon concentrations were associated with the permit area sediments, which were the deepest and the finest sediment habitats sampled. Lowest levels were recorded at the shoals. A converse trend was generally observed for sediment total phosphorus concentrations.
- A gradual transition in sediment composition was observed over broad spatial scales (tens of kilometres), particularly between the permit area and the sediments of the shallow shoals. There was a lesser trend of an east-west transition in sediment type in the permit area, with finer sediments (sandy muds) in the east to coarser muddy sands in the west.
- While infaunal communities varied across the survey sites, the sites sampled are considered indicative of the benthic infaunal communities that are likely to occur in the study area. Communities ranged from a relatively depauperate faunal community (only three individuals representing three taxa per 0.1 m²) at a site on Evans Shoal to a diverse and abundant community (63 individuals representing 42 taxa) in the sediments at another site on Evans Shoal.

- The profile images from the Sediment Profile Imagery (SPI) system, deployed at a single site in the permit area, described a consistently fine and unlayered sediment throughout the upper approximately 18 cm of the sediment profile, with slightly coarser material at the surface. Bioturbation was evident in the form of burrows and feeding voids. The particle size analysis of SPI images yielded average particle sizes in the same size class (63–125 μm , or very fine sand) as the median grain size derived from the laboratory analysis of particle size distribution samples.

In summary, the results of the sediment survey contributed to an appropriate baseline characterisation of the sediment quality in the study area, and provided an indication of the composition of infaunal communities that are found in the area.

1. Introduction

1.1 Background

ConocoPhillips Australia Exploration Pty Ltd (ConocoPhillips), as proponent on behalf of the current and future joint ventures, are proposing to develop natural gas resources as part of the Barossa area development, located approximately 300 kilometres (km) north of Darwin, Northern Territory (NT).

To facilitate the environmental approvals process for any future development of the Barossa field and surrounds, a robust understanding of the existing state of the key environmental values and sensitivities will be necessary. This understanding will be gained from a series of studies and surveys to assess and monitor the baseline state of environmental factors such as water quality, sediment quality, noise, metocean conditions and benthic habitats within petroleum retention lease permit NT/RL5 (referred to as the permit area in this report) and across a broader geographical area. The field studies assessing these factors commenced in June 2014.

1.2 Overview of existing regional environment

The Barossa area is located in the North Marine Region (Department of Sustainability, Environment, Water, Population and Communities 2012), which comprises the Commonwealth waters of the Gulf of Carpentaria, Timor Sea and Arafura Sea as far west as the NT and Western Australian border. The North Marine Region contains internationally significant breeding and/or feeding grounds for a number of listed threatened and migratory marine species including nearshore dolphins, turtles, dugongs, seabirds and migratory shorebirds afforded protection under national legislation and international conventions.

The Timor and Arafura Seas support a variety of shark, pelagic finfish and crustacean species of commercial and recreational game-fishing importance, e.g. trawl and various finfish fisheries. The shelf break and slope of the Arafura Shelf is characterised by patch reefs and hard substrate pinnacles that support a diverse array of invertebrate groups, with polychaetes and crustaceans being the most prolific (Heyward et al. 1997, CEE 2002). Surveys indicate that between 50 m and 200 m depth, the benthos consists of predominantly soft, easily resuspended sediments (Heyward et al. 1997, URS 2005, 2007). The diversity and coverage of epibenthos is low and organisms present are predominantly sponges, gorgonians and soft corals (Heyward et al. 1997, URS 2005, 2007).

Numerous shoals (submerged calcareous banks or 'seamounts') exist in the broader region around the permit area; the closest being Evans Shoal, 60 km to the west and Tassie Shoal, 70 km south-west, and Lynedoch Bank, 40 km to the south-east. In addition, the new Oceanic Shoals Commonwealth marine reserve (multiple use zone) lies to the south and south-east of the permit area.

1.3 Objectives

A sediment quality and infauna survey is a key component of the Barossa marine baseline studies program.

Baseline studies were undertaken with reference to the permit area, as shown in **Figure 1-1**. While this represents the area of primary interest as part of ConocoPhillips' staged field development, the broader surrounds were also characterised, including the nearest seabed features of regional interest to the Barossa area (i.e. Evans Shoal, Tassie Shoal and Lynedoch Bank).

The specific objectives of the sediment quality and infauna survey were to:

- determine the sediment quality of the marine benthos within the permit area and in the vicinity of Evans Shoal, Tassie Shoal and Lynedoch Bank
- determine the infaunal community composition throughout the study area.

This report summarises the results of the sediment quality and infauna survey, undertaken in mid-April 2015 during the northern Australian (tropical transitional) autumn.

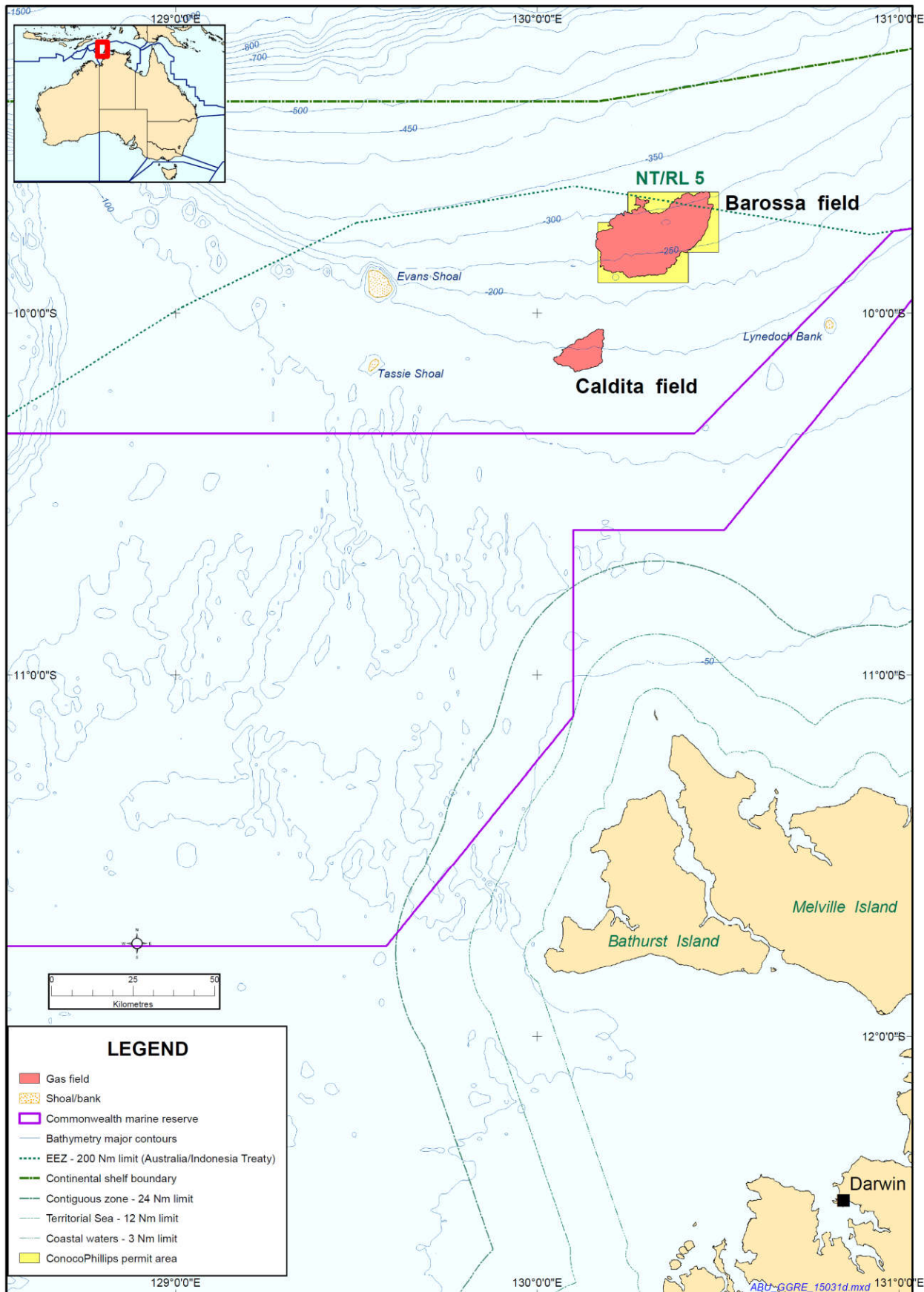


Figure 1-1: Barossa field location

2. Methods

The methods employed during the sediment quality survey follow those detailed in the *Barossa Environmental Studies: Sediment Quality and Infauna Field Sampling Plan Method Statement* (Jacobs 2015a). An overview of the methods is provided in the sections below.

2.1 Sampling sites

Seventeen sampling sites (**Figure 2-2**) were identified to provide coverage of the permit area and of areas of regional interest such as shoals and banks. Sites were located in:

- the permit area (five sites, labelled SP1 to SP5)
- Evans Shoal, approximately 60 km west of the permit area (four sites, SP7 to SP10)
- Tassie Shoal, approximately 70 km south-west of the permit area (four sites, SP11 to SP14)
- Lynedoch Bank, approximately 40 km south-east of the permit area (three sites, SP15 to SP17)
- between the permit area and Evans Shoal, approximately 20 km west of the permit area (one site, SP6).

2.2 Sediment sampling

2.2.1 Sample collection

In water depths less than 100 m, and where remotely operated vehicle imagery had not already been collected as part of the benthic habitat survey (Jacobs 2015b), a GoPro Hero 3+ camera and Mangrove VC-4L6 underwater video light were deployed to obtain imagery of the seabed to assess potential for grab sampling success and potential environmental risk of sampling. Grab samples were not collected at sites lacking large areas of sediment (due to the low chance of success) and/or where coral/benthic primary producer habitat (BPPH) cover was identified to be relatively common and at high risk of damage from grab sampling operations.

Three replicate sediment samples were collected at each site where feasible using a 0.1 m² or 0.2 m² van Veen grab (**Figure 2-1**) deployed from the stern of the survey vessel *Warrego* via the vessel's A-frame. Of the three replicates, two were collected for contaminants, nutrients and particle size distribution (PSD) sampling, and the third grab collected for infaunal sampling. The grab was thoroughly cleaned with Decon 90 prior to deployment at each sampling site.

If no sample was obtained following three replicate deployments, sites were moved at least 500 m and the direction from the original site location noted in the new site label.

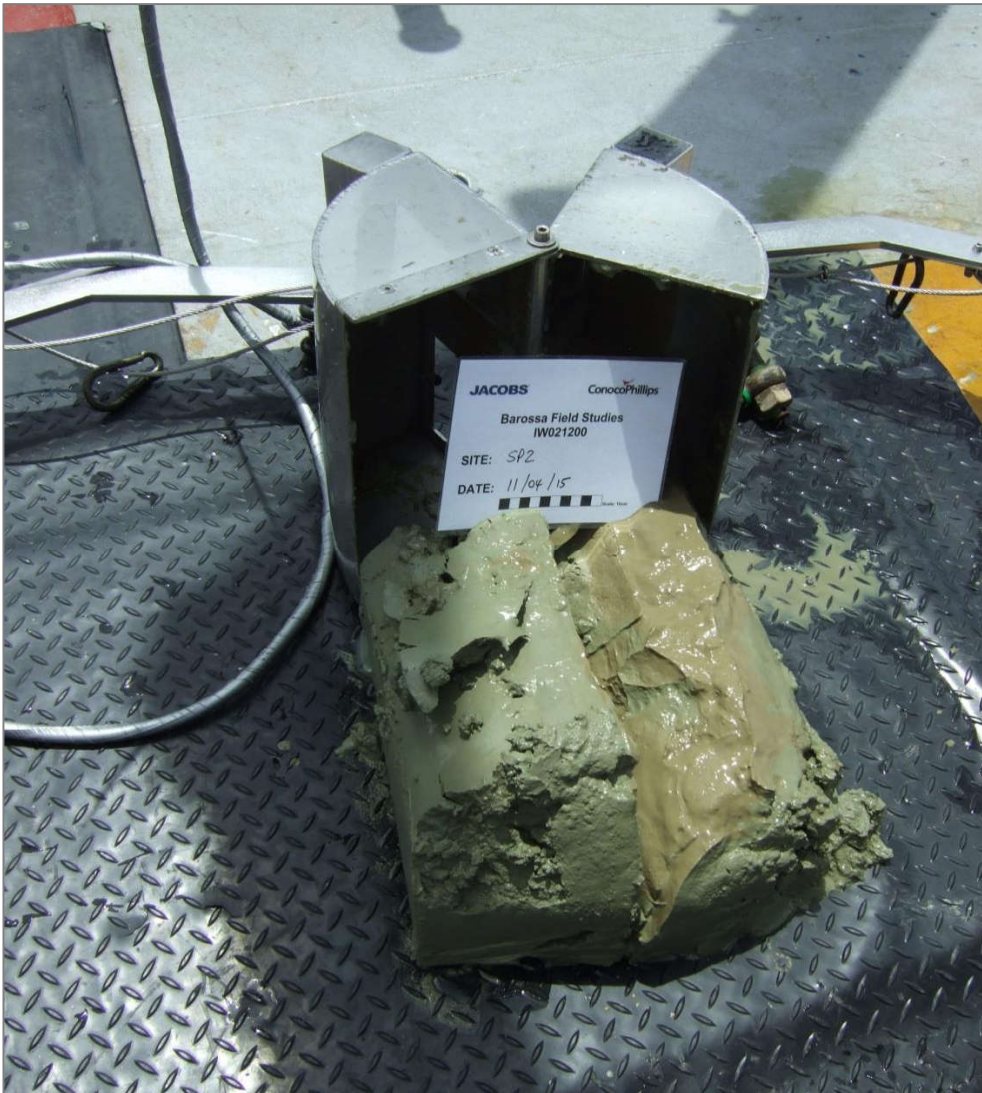


Figure 2-1: van Veen grab with infaunal sediment sample from site SP2

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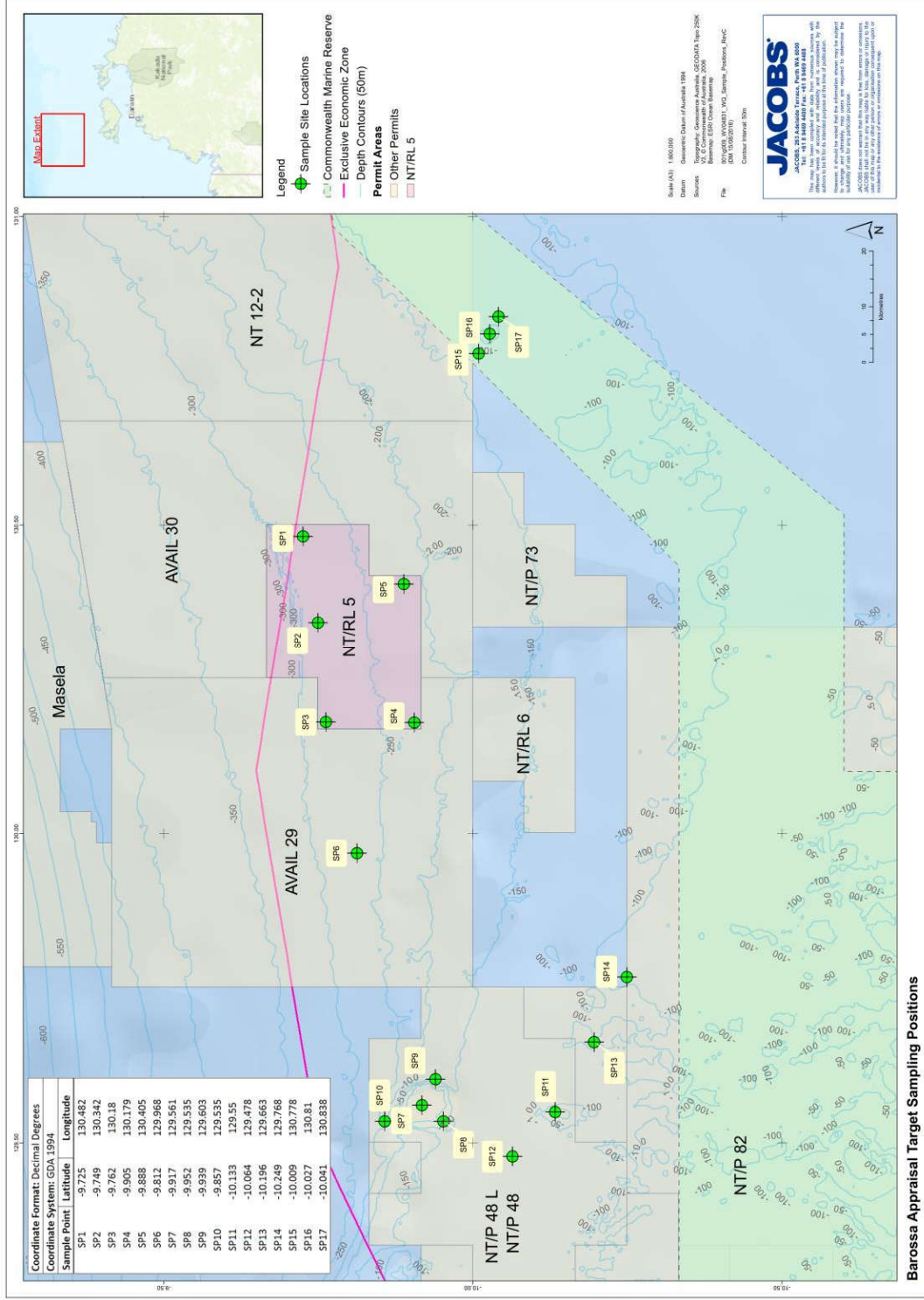


Figure 2-2: Barossa appraisal target sampling positions

2.2.2 Sample processing, preservation and storage

Sampling data were recorded on a field sheet with date, time, position, depth and in situ observations for each grab sampling attempt (see **Appendix A**). Sediment descriptions, descriptions of sediment features (e.g. worm tubes) or biota were also noted, along with type(s) of sample collected for each attempt. Contaminants samples were taken from the surface (upper approximately 5 cm) of sediment from two replicate grab samples per sampling site, where possible. Sediment within the grab was carefully removed and transferred to a glass bowl using plastic sampling utensils that had been pre-cleaned with Decon 90. Sediment within 5 mm of the side of the grab was not sampled to minimise risk of contamination. The sediment was then carefully homogenised in the glass bowl before transfer to appropriate sample jars.

Two replicate grabs samples were collected from which 70 ml of sediment were collected for metals, nutrients and TOC. A 150 ml sample was collected for hydrocarbons and TBT, with 250 ml collected for naturally occurring radioactive materials (NORMs). These samples were processed on board the vessel by filling sample jars to the neck, leaving minimal sufficient air space to allow expansion of the frozen sediment. The contaminants sampling did not require the full sample surface, which allowed collection of a representative PSD sample from one of the same grab samples as the contaminants. A single replicate 300–500 ml sample of sediment was collected for particle size distribution (PSD) analysis, placed in a plastic ziplock bag and frozen.

A third replicate comprising a whole grab sample was collected for infaunal analysis and transferred into a 500 µm box sieve. The sample was then photographed with a slate identifying sample site name and date in view, and then sieved by washing through with seawater from a deck hose. The potential risk of transfer of pelagic biota >500 µm into the sample from the deck hose during processing is mitigated through rationalisation of pelagic biota out of the dataset prior to analysis (**Section 2.2.4**). The remaining material in the sieve was transferred to ziplock bags, into which 80% ethanol was then added. The sample was then gently mixed to make sure that the preservative adequately penetrated the sediment.

Samples were stored in laboratory-supplied jars or ziplock bags, and labelled with the site name, replicate number, the date and time of sampling, and the analysis required. An additional label on waterproof paper was added into the infaunal sample to mitigate for risk of the ethanol degrading the external label during processing. All samples were preserved and handled in accordance with the requirements of the analytical laboratories.

The location of the sampling sites was considered remote and, therefore, the preservation techniques were selected to achieve the maximum holding times for each parameter (**Table 2-1**). For example, the holding time for total recoverable hydrocarbons (TRHs) is 14 days; therefore, these samples were transported to Perth and hand-delivered to the appropriate laboratory in time to meet the holding time requirements.

Samples were then stored appropriately until delivery to the appropriate National Association of Testing Authorities (NATA) accredited laboratory (**Table 2-2**), with supporting chain of custody form requesting the analysis required.

2.2.3 Sample analysis

Analytes and their respective laboratory limits of reporting (LOR), 99% species protection guideline trigger value (ANZECC & ARM CANZ 2000a) and low reliability values for contaminants having insufficient data to derive reliable national guidelines (ANZECC & ARM CANZ 2000b) are presented in **Table 2-1**. All geochemical analyses were undertaken using standard methods at NATA accredited laboratories.

Particle size distribution analysis of sediments was undertaken via laser diffraction and sieving. Full PSD analysis was completed for appropriate differentiation of coarse sediment components, which may be an important factor in an area with such a diverse range of particulate substrate habitats (from shallow offshore shoals to deep offshore sediments). This analysis consisted of:

- i) Laser diffraction of particle sizes ≤500 µm. This characterised the finer sediments and allowed comparison with existing ConocoPhillips data.

- ii) Wet/dry sieving of sediments for the following size classes: <math><500\ \mu\text{m}</math>, 500 μm , 1 mm, 2 mm, 4 mm, 8 mm and >16 mm (i.e. remaining fraction retained on the 16 mm sieve). This appropriately characterised the coarser component of sediments and allowed comparison with existing ConocoPhillips PSD data.

2.2.4 Data analysis

Sediment analyte concentrations were compared to ANZECC & ARMCANZ (2000b) trigger values for Western Australian tropical offshore sediments. All other values were compared to ANZECC & ARMCANZ (2000a) Interim Sediment Quality Guideline (ISQG) low reliability trigger values for marine sediments with a 99% level of species protection where available. Where no ANZECC & ARMCANZ ISQG trigger value is available, comparison was made with other guideline levels, i.e. the National Assessment Guidelines for Dredging (NAGD) where relevant (Commonwealth of Australia 2009).

Multivariate analysis of data was undertaken using the Plymouth Routines In Multivariate Ecological Research (PRIMER) v6 software (Clarke and Gorley 2006). The DIVERSE routine was used to provide the descriptive statistics of infaunal data for each sample collected. After appropriate transformation / normalisation, resemblance matrices were derived using either Bray-Curtis (for infauna) or Euclidean distance (for environmental data). The "Cluster" routine with SIMPROF (similarity profile) permutational tests were used to identify groupings of samples based on survey data. Non-metric Multi-Dimensional Scaling (n-MDS) was used to represent the distribution of samples in 2-dimensional space, and therefore represent the relative similarity (or dissimilarity) of samples to each other. The principal components analysis (PCA) routine was used to further analyse environmental data to determine the effect of input variables (e.g. principal sediment components such as %silt, %sand or %gravel) on the distribution of the sample data in the PCA plot. The Bio-Env option in the Bio-Env and stepwise (BEST) routine was used to determine the environmental variables that had the greatest influence on the distribution of infaunal data. Following this step the Relate routine was used to determine the statistical significance of the combination of variables identified from the BEST analysis.

The physical character of sediments from each sample was then described in terms of the Folk sediment classification, skewness, kurtosis, and sorting. These data facilitate the understanding of the relationship between physical sediment characteristics and other data from the same site (e.g. contaminants, biota).

Infaunal data were rationalised prior to analysis. Taxa were checked for correct nomenclature and full taxonomic classification using the "match taxa" tool provided by the World Register of Marine Species (2015). Following this step, the taxa were then reviewed for the occurrence of pelagic taxa (e.g. Ctenophores, Chaetognatha) that often appear in grab samples but do not represent the benthic ecological community. If pelagic taxa were identified in the infaunal dataset, they were excluded from statistical analysis as "ecological noise". Similarly, all individuals identified as "juveniles" were excluded. Juvenile stages are ephemeral and can exhibit significant post-settlement mortality (OSPAR Commission 2003). Inclusion of juvenile life stages can dominate the analysis due to the impact on abundance of relevant species, and the ephemeral nature of juveniles provides an unrealistic assessment of the benthic infaunal communities at the sample location. This can either generate or mask trends in change in benthic communities over time.

Table 2-1: Analytical LOR, guideline trigger values and sample storage, preservation and holding times

Test parameter	Guideline ¹	LOR	Storage container	Preservation	Holding time
Aluminium (Al) (mg/kg DW)	No value	<20	Glass jar	Freeze	180 days
Arsenic (As) (mg/kg DW)	20	<2	Glass jar	Freeze	180 days
Barium (Ba) (mg/kg DW)	No value	<0.1	Glass jar	Freeze	180 days
Cadmium (Cd) (mg/kg DW)	1.5	<0.1	Glass jar	Freeze	180 days
Chromium (Cr) (mg/kg DW)	80	<0.2	Glass jar	Freeze	180 days
Cobalt (Co) (mg/kg DW)	1.0 ²	<0.2	Glass jar	Freeze	180 days
Copper (Cu) (mg/kg DW)	65	<0.2	Glass jar	Freeze	180 days
Iron (Fe) (mg/kg DW)	No value	<5	Glass jar	Freeze	180 days
Mercury (Hg) (mg/kg DW)	0.15	<0.01	Glass jar	Freeze	28 days
Nickel (Ni) (mg/kg DW)	21 ²	<0.7	Glass jar	Freeze	180 days
Lead (Pb) (mg/kg DW)	50	<1	Glass jar	Freeze	180 days
Zinc (Zn) (mg/kg DW)	200	<0.5	Glass jar	Freeze	180 days
Tributyltin (TBT) (µg Sn/kg DW) ³	9	<0.5	Glass jar	Freeze	56 days
TRH (C ₁₀ -C ₃₆) (mg/kg DW) ³	550 ⁴	<3 - <50	Glass jar	Freeze	14 days
Total PAHs (µg/kg DW) ³	10,000	<3 - <10	Glass jar	Freeze	180 days
BTEXN (µg/g DW) ³	5-500 ²	<0.2 - <1	Glass jar	Freeze	14 days
Radium ²²⁶ (Bq/g DW)		<0.03	Glass jar	Freeze	180 days
Radium ²²⁸ (Bq/g DW)	35 combined	<0.03	Glass jar	Freeze	180 days
Thorium ²²⁸ (Bq/g DW)		<0.03	Glass jar	Freeze	180 days
Total Kjeldahl nitrogen (TKN) (%)	N/A	<0.1	Glass jar	Freeze	14 days
Total phosphorus (TP) (%)	N/A	<0.05	Glass jar	Freeze	14 days
Total organic carbon (TOC) (%)	N/A	<0.2	Glass jar	Freeze	14 days
Moisture content (%)	N/A	N/A	Glass jar	Freeze	N/A
PSD	N/A	N/A	Plastic ziplock bag	Freeze	N/A
Infauna	N/A	N/A	Plastic ziplock bag	80% ethanol	N/A

¹ ANZECC & ARMCANZ (2000a) 99% species protection value unless otherwise specified

² ANZECC & ARMCANZ (2000b) ISQG-low reliability trigger value

³ Normalised to 1% organic carbon

⁴ National Assessment Guidelines for Dredging (NAGD) Guidance Levels (Commonwealth of Australia 2009)^a
mg/kg = milligrams per kilogram, DW = dry weight, Bq/g = Becquerel per gram, µg = microgram, N/A = Not applicable

Table 2-2: Analytes and the corresponding analytical laboratory

Parameter	Laboratory
Metals and metalloids (Al, As, Ba, Cd, Cr, Co, Cu, Fe, Hg, Ni, Pb, Zn)	MAFRL ¹
Nutrients (TKN, TP)	MAFRL
Total organic carbon (TOC)	MAFRL
Particle size distribution (PSD)	MAFRL
Total recoverable hydrocarbons (TRHs)	ALS ²
Benzene, toluene, ethylbenzene, xylenes (meta-, para- and ortho-xylene) and naphthalene (BTEXN)	ALS
Polycyclic aromatic hydrocarbons (PAHs; only where TPHs detected)	ALS
Tributyltin (TBT)	ALS
NORMs (radium ²²⁶ , radium ²²⁸ and thorium ²²⁸)	Radiation Safety Services
Infaunal taxonomy	Dardanus Scientific

¹ MAFRL – Marine and Freshwater Research Laboratory

² ALS – Australian Laboratory Services

2.2.5 Quality control procedures

To test for potential sample contamination during collection, storage or transport, low analyte concentration water samples were provided by the laboratories to be split in two ways:

- transport blank: to estimate any contamination introduced to the sample during the transportation and storage stage, low analyte water was poured directly into the sample containers on site
- field blank: to estimate any contamination introduced to the sample during the collection procedure. This involved following the same sampling procedure using the low analyte water instead of the sample sediment.

Quality control procedures that related to the sediment sampling were:

- sun cream/zinc and any other potential anthropogenic contaminants were avoided by the personnel in contact with the sediment sampling equipment
- smoking was prohibited in the sampling area
- Decon 90-cleaned latex gloves were worn at all times when handling sediment samples. Gloves were cleaned between each replicate.
- sampling utensils (i.e. plastic spoons, glass bowls) were Decon 90-cleaned between replicates just prior to taking samples
- samples were processed on an open area of the deck as far from sources of potential contamination (e.g. the A-frame, vessel exhaust fumes) as possible
- as far as possible, the insides of the sample jar and did not come in contact with any potentially contaminated surfaces or substances (such as hands, workbenches or vessel emissions)
- hands did not come into contact with the insides or lip of the sample jars.

Procedural and record-keeping quality control measures implemented were:

- global positioning system (GPS) waypoints were recorded for all sampling attempts from the vessel when the grab reached the sea bed
- water depths, times, dates, samples collected and in situ observations were also recorded onto field logsheets
- photographs were taken of sediment samples collected
- appropriate chain of custody forms to accompany samples were completed for each laboratory
- any changes to the field procedures were documented.

2.3 Sediment Profile Imagery

2.3.1 Deployment and image capture

Due to incoming poor weather, the Sediment Profile Imagery (SPI) camera system (**Figure 2-3**) was deployed only at site SP3 in the permit area (**Figure 2-2**).



Figure 2-3: SPI system prior to deployment

The SPI system was deployed from the A-frame, and once on the seabed it was left to rest for one minute to allow the profile image to be taken. Time, depth and position were taken each time the SPI was on the seabed. The SPI was then raised approximately 5 m from the seabed and held for one minute to allow the electronics to re-set. The unit was then lowered to the seabed. This was repeated to allow five photograph attempts on the seabed. The unit was then raised to the surface and images checked and downloaded on deck. Three independent images were successfully collected at this site. Deteriorating weather conditions and work priorities did not allow for further deployment at other sites. Once downloaded, images were backed up on an external hard drive for return to Perth.

2.3.2 Image analysis

Images were subject to quality assurance/quality control (QA/QC) procedures, then analysed in the office for the following parameters:

- depth of penetration of the prism
- sediment surface features
- depth of the apparent Redox Potential Discontinuity (aRPD)
- occurrence of methane gas pockets
- bioturbation, including burrows and feeding voids
- Benthic Habitat Quality (BHQ) index
- successional stage (based on BHQ index scores, after Nilsson and Rosenberg (2000))
- average particle size (diameter).

3. Results

3.1 Sediment quality

Sediment survey logs, showing sampling data for all sampling attempts (e.g. date, geographic position, sample descriptions) can be found in **Appendix A**. Photographs of sediment samples can be found in **Appendix B**. A summary of samples collected is presented in **Table 3-1**.

Table 3-1: Number of replicate samples successfully collected at each site

Site	Latitude ²	Longitude ²	Metals	Hydrocarbons	NORMs	PSD	Infauna
SP1	-9.725 °	130.482 °	2	2	2	1	1
SP2	-9.749 °	130.342 °	2	2	2	1	1
SP3	-9.762 °	130.180 °	2	2	2	1	1
SP4 ¹	-9.905 °	130.179 °	1	1	1	1	0
SP5 ¹	-9.888 °	130.405 °	2	2	2	1	1
SP6E	-9.812 °	129.968 °	2	2	2	1	1
SP7	-9.917 °	129.561 °				NS	
SP8	-9.952 °	129.535 °	2	2	2	1	1
SP9	-9.939 °	129.603 °	1	0	0	1	0
SP10N	-9.857 °	129.535 °	2	2	2	1	1
SP11	-10.133 °	129.550 °				NS	
SP12	-10.064 °	129.478 °	2	2	2	1	1
SP13	-10.196 °	129.663 °	2	2	2	1	1
SP14	-10.249 °	129.768 °	2	2	2	1	1
SP15	-10.009 °	130.778 °	2	2	2	1	1
SP16	-10.027 °	130.810 °				NS	
SP17 ¹	-10.041 °	130.838 °	1	1	1	1	0

¹ Samples at SP4, SP5 and SP17 were collected using the 0.2 m² van Veen grab. All other samples were collected using the 0.1 m² van Veen grab.

² GPS co-ordinates presented in decimal degrees. Datum used was WGS84.

NS = No sample

Samples were not collected at sites SP7, SP11 and SP16 due to the occurrence of BPPH. Benthic habitat surveys at SP11 and SP16 had previously collected imagery of benthic habitats, and GoPro imagery was collected at site SP7. Grab sampling at these locations posed a high risk of environmental damage, with low or negligible chance of sampling success (**Figure 3-1**). GoPro imagery was also captured at SP8 as this was less than 100 m water depth, but in this case the substrate was identified as being suitable for sampling (**Figure 3-2**).

Sites SP6 and SP10 were relocated by at least 500 m due to three failed grab sampling attempts at the original locations. These sites were moved to the east and north, and hence renamed SP6E and SP10N, respectively.

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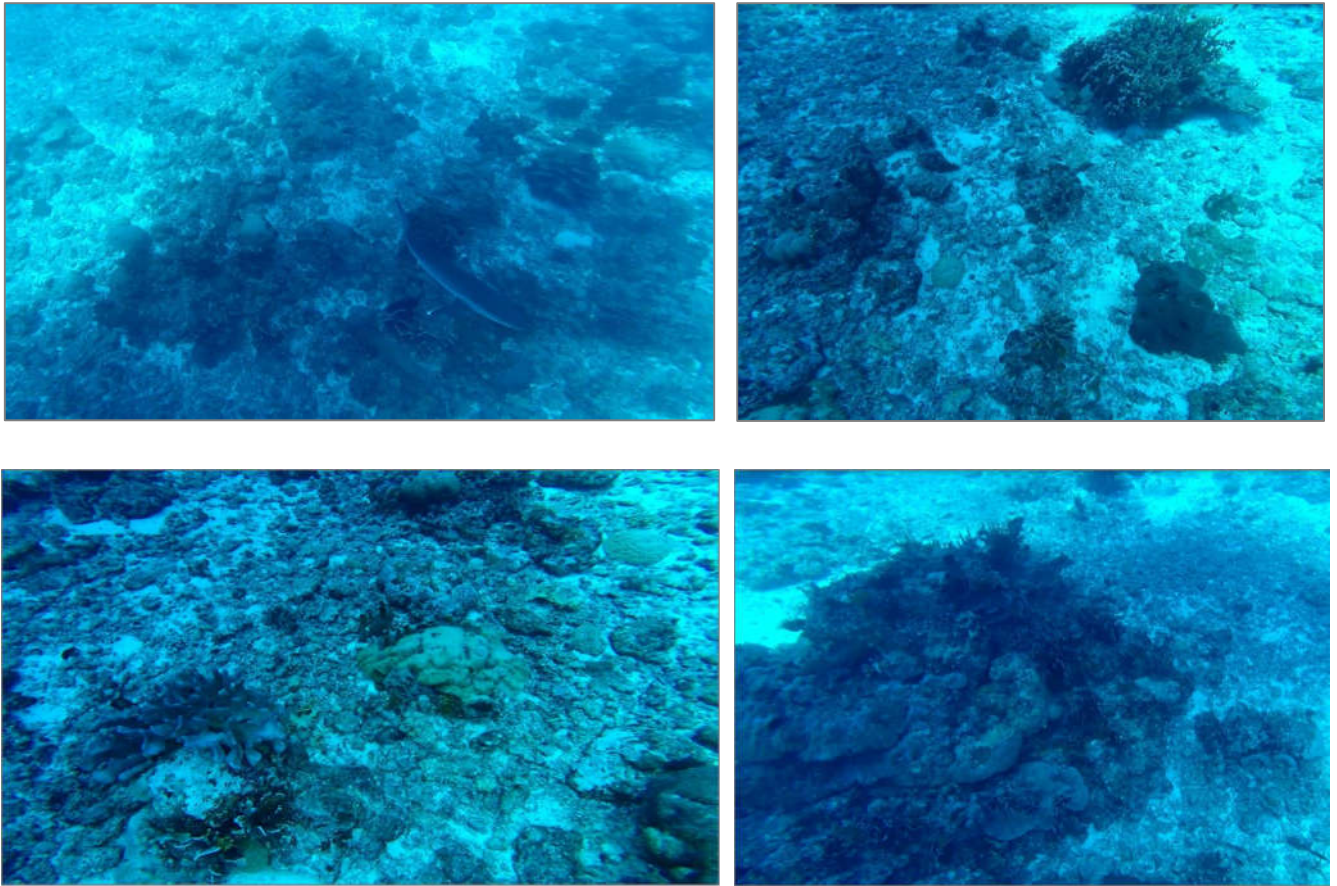


Figure 3-1: Hard substrate coral and sponge habitats at site SP7

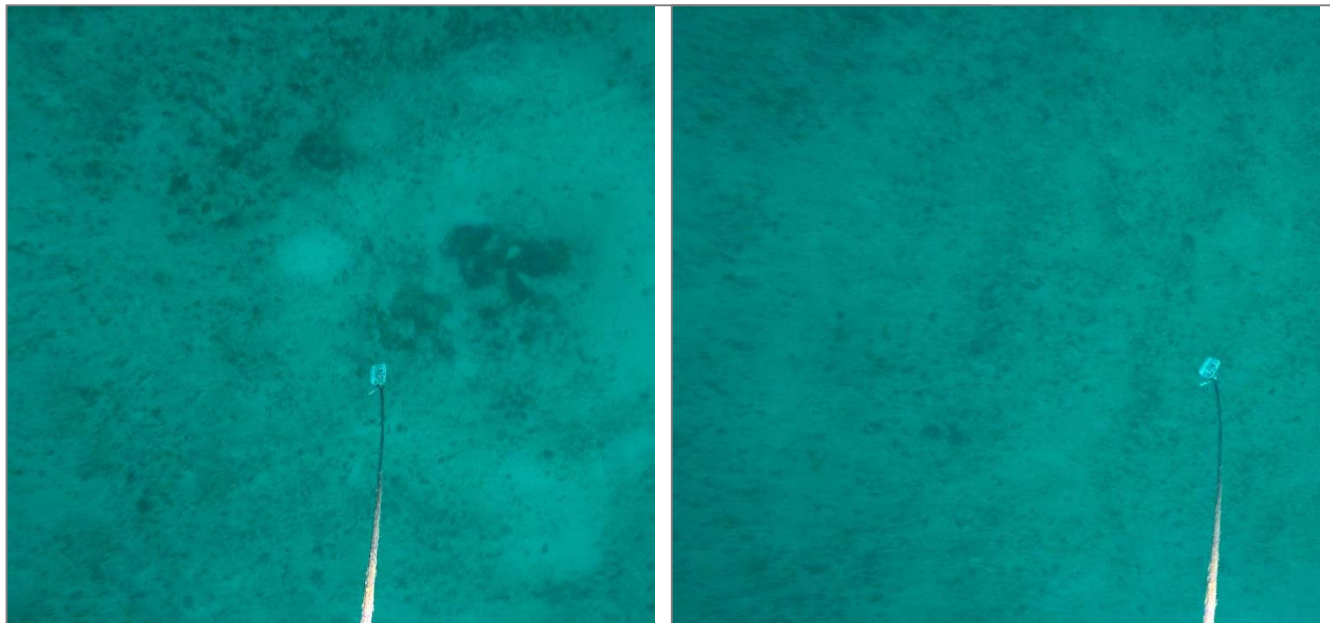


Figure 3-2: Sediment suitable for sampling at site SP8

3.1.1 Metals and metalloids

Of the total metals/metalloids in the sediments sampled from the permit area, Evans Shoal, Tassie Shoal and Lynedoch Bank sites, only cobalt and nickel were recorded were above the ANZECC & ARMCANZ (2000b) ISQG-low reliability trigger value, where trigger values were available (**Table 3-2**). Cobalt was recorded up to seven-fold above the ISQG-low reliability trigger value level of 1.0 mg/kg at all sites except SP8. Nickel concentrations were recorded at or slightly above the ISQG-low trigger value (21 mg/kg DW) at two of the sites (SP1 and SP2). It should be noted that cobalt and nickel (both of which are often strongly associated) tend to complex strongly with organic molecules and are likely to be largely unavailable for biological uptake (Wenziker et al. 2006). None of these levels of cobalt and nickel are indicative of contamination and can be considered to represent the locally specific, naturally occurring background concentrations. High levels of cobalt and nickel are commonly found in sediments in Australia (Commonwealth of Australia 2009).

Concentrations of the metals and metalloids aluminium, barium, chromium, cobalt, copper, iron, mercury, nickel, lead and zinc were generally 2–3 times greater in the deep water permit area than in the shallow water sediments at the shoals.

Total arsenic concentrations were similar at all stations of all the permit area, Evans Shoal, Tassie Shoal and Lynedoch Bank sites and ranged from 3 to 5 mg/kg, well below the ANZECC & ARMCANZ (2000b) ISQG-low reliability trigger value of 20 mg/kg.

Total cadmium concentrations ranged from 0.1 to 0.3 mg/kg at all sites, well below the ANZECC & ARMCANZ (2000b) ISQG-low reliability trigger value of 1.5 mg/kg.

Table 3-2: Total metal and metalloid concentrations

Parameter	Aluminium	Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Iron	Mercury	Nickel	Lead	Zinc
Units	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	<20	<2	<0.1	<0.1	<0.2	<0.2	<0.2	<5	<0.01	<0.7	<1	<0.5
Guideline ¹	No value	20	No value	1.5	80	1.0	65	No value	0.15	21	50	200
Site												
SP1 1 ²	15000	3	21	0.3	28	6.7 ³	13	16000	0.03	21	6	48
SP1 2	16000	3	21	0.2	29	7.2	14	16000	0.03	21	6	47
SP2 1	16000	2	33	0.2	31	7.5	15	16000	0.03	23	7	51
SP2 2	16000	2	29	0.3	31	7.1	14	16000	0.03	23	7	50
SP3 1	14000	2	23	0.3	27	6.5	11	15000	0.03	19	6	46
SP3 2	13000	2	25	0.2	25	6.2	10	15000	0.04	17	5	43
SP4 1	9300	3	9.1	0.2	27	5.6	4.7	17000	0.03	14	5	51
SP5 1	8400	2	11	0.2	20	4.7	5.3	13000	0.02	11	4	38
SP5 2	8200	3	12	0.2	21	4.9	5.5	13000	0.03	12	5	40
SP6E 1	8300	3	14	0.2	20	4.9	5.6	13000	0.03	12	4	36
SP6E 2	9400	3	15	0.1	22	5.2	6.0	13000	0.03	12	4	38
SP8 1	560	2	5.6	0.2	5.0	0.7	0.9	520	<0.01	1.1	<1	2.3
SP8 2	550	3	5.9	0.2	5.2	0.7	1.0	550	<0.01	1.3	1	2.3
SP9 1	2000	5	7.0	0.2	7.4	1.9	1.7	2800	<0.01	4.2	4	6.9
SP10N 1	2900	4	7.8	0.2	7.9	1.8	2.4	3900	0.01	4.6	3	10
SP10N 2	3100	3	7.7	0.3	8.5	1.7	2.5	4300	0.01	4.5	3	11
SP12 1	4200	3	21	0.3	10	2.1	2.6	5300	0.01	5.4	2	11
SP12 2	4400	4	28	0.2	11	2.1	3.0	5800	0.01	5.7	2	12
SP13 1	3300	3	9.8	0.2	8.9	1.8	1.8	4200	<0.01	4.6	2	8.5
SP13 2	2700	3	9.4	0.2	7.7	1.5	1.6	3500	<0.01	3.7	2	7.3
SP14 1	4600	3	8.7	0.2	11	2.3	2.7	5800	0.01	6.1	3	13
SP14 2	4500	3	8.1	0.2	11	2.3	2.7	5800	0.01	5.9	3	12
SP15 1	3400	4	8.8	0.2	7.7	1.9	2.9	5500	<0.01	5.1	3	11
SP15 2	2800	5	8.4	0.2	7.2	1.8	2.6	5000	<0.01	5.0	2	9.8
SP17 1	5500	3	8.0	0.3	11	3.1	3.5	7600	<0.01	7.2	3	18

¹ See Table 2-1 for information on guidelines.² SP1 1 refers to replicate 1 at site SP1³ Values in bold exceed the relevant guideline value

3.1.2 Tributyltin

Tributyltin concentrations at all sites were below the limit of reporting (LOR) (**Table 3-3**) and hence well below the ANZECC & ARMCANZ (2000b) ISQG-low reliability trigger value of 9 µgSn/kg. Monobutyltin and dibutyltin concentrations were also below the LOR. Tripropyltin concentrations ranged from 8.8% at SP3 to 100% at SP6E. There are no guideline values for monobutyltin, dibutyltin or tripropyltin.

Table 3-3: Monobutyltin, dibutyltin, tributyltin and tripropyltin concentrations

Parameter	Monobutyltin	Dibutyltin	Tributyltin	Tripropyltin
Units	µgSn/kg	µgSn/kg	µgSn/kg	%
Limit of reporting	1	1	0.5	0.1
Guideline ¹	N/A	N/A	9	N/A
Site				
SP1 1	<1	<1	<0.5	86.8
SP1 2	<1	<1	<0.5	68.2
SP2 1	<1	<1	<0.5	12.2
SP2 2	<1	<1	<0.5	74.1
SP3 1	<1	<1	<0.5	8.8
SP3 2	<1	<1	<0.5	66.6
SP4 1	<1	<1	<0.5	79.2
SP5 1	<1	<1	<0.5	92.2
SP5 2	<1	<1	<0.5	83.5
SP6E 1	<1	<1	<0.5	89.9
SP6E 2	<1	<1	<0.5	100
SP8 1	<1	<1	<0.5	69.8
SP8 2	<1	<1	<0.5	20.1
SP9 1	NS ²	NS	NS	NS
SP10N 1	1	<1	<0.5	97.2
SP10N 2	<1	<1	<0.5	99.1
SP12 1	<1	<1	<0.5	85.5
SP12 2	<1	<1	<0.5	95.0
SP13 1	<1	<1	<0.5	54.8
SP13 2	<1	<1	<0.5	87.2
SP14 1	<1	<1	<0.5	88.2
SP14 2	<1	<1	<0.5	70.7
SP15 1	<1	<1	<0.5	80.3
SP15 2	<1	<1	<0.5	69.8
SP17 1	<1	<1	<0.5	86.8

¹ ANZECC & ARMCANZ (2000b) ISQG-Low reliability trigger value

² NS = No sample

3.1.3 Hydrocarbons

Historically, total petroleum hydrocarbons (TPHs) were analysed according to carbon chains C₆–C₉, C₁₀–C₁₄, C₁₅–C₂₈ and C₂₉–C₃₆. In an attempt to incorporate health and ecological screening levels for petroleum hydrocarbons, the National Environment Protection Council released draft National Environment Protection Measures (NEPC 2013) that resulted in changes in the carbon chain divisions considered. This was based on analytical factors such as physical and chemical properties and the availability of toxicity data. This new analysis of hydrocarbons is called total recoverable hydrocarbons (TRHs) and includes benzene, toluene, ethylbenzene, meta-, para-, and ortho-xylene and naphthalene (BTEXN).

TPH, TRH and BTEXN concentrations were below the laboratory LOR at all sites and depths in and around the Permit Zone, Evans Shoal, Tassie Shoal and Lynedoch Bank (**Table 3-4**). Consequently, polycyclic aromatic hydrocarbons (PAHs) were not analysed.

Table 3-4: Total petroleum hydrocarbons, total recoverable hydrocarbons and BTEXN (in mg/kg DW) at site SP1

Compound ¹	LOR ²	SP1 1	SP1 2	SP2 1	SP2 2	SP3 1	SP3 2	SP4 1	SP5 1	SP5 2	SP6E 1	SP6E 2	SP8 1	SP8 2	SP9 1	SP10N 1	SP10N 2	SP12 1	SP12 2	SP13 1	SP13 2	SP14 1	SP14 2	SP15 1	SP15 2	SP17 1	SP17 2	
Moisture content (%)	1.0a	62.7	63.3	65.5	63.7	60.4	62.7	45.5	50.1	50.8	52.2	52.9	29.0	28.7	NS ³	33.2	36.3	40.6	41.7	34.0	30.4	40.0	39.7	31.8	29.4	42.7	42.7	
TPH³																												
C ₆ -C ₉	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	NS	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
C ₁₀ -C ₁₄	3	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	NS	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
C ₁₅ -C ₂₈	3	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	NS	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
C ₂₉ -C ₃₆	5	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	NS	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8
C ₁₀ -C ₃₆ (sum)	3	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	NS	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
TRH³																												
C ₆ -C ₁₀	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	NS	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
C ₆ -C ₁₀ minus BTEX	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	NS	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C ₁₀ -C ₁₆	3	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	NS	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
>C ₁₀ -C ₁₆ fraction	50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	NS	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
minus naphthalene	3	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	NS	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
>C ₁₆ -C ₃₄	5	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	NS	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8
>C ₃₄ -C ₄₀	3	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	NS	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
>C ₁₀ -C ₄₀ (sum)	3	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	NS	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
BTEXN																												
Benzene	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NS	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NS	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NS	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-xylene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NS	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ortho-xylene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NS	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total xylenes	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NS	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sum of BTEX	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NS	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Naphthalene	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	NS	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

¹ in mg/kg² Limit of reporting³ NS = No sample

3.1.4 Naturally occurring radioactive materials

Radium²²⁶ was found above the laboratory minimum reporting limit (MRL) in three samples – SP4 1, SP6E 1 and SP6E 2 (**Table 3-5**). Radium²²⁸ and thorium²²⁸ concentrations were all below the MRL at all sites. All of these NORMs were below the ANZECC & ARMCANZ (2000b) ISQG-low reliability trigger value for radionuclides (sum of gross alpha and gross beta) of 35 Bq/g at all sampling sites.

Table 3-5: Naturally occurring radioactive materials

Parameter	Radium ²²⁶	Radium ²²⁸	Thorium ²²⁸
Units	Bq/g	Bq/g	Bq/g
MRL	0.03	0.03	0.03
Site			
SP1 1	<0.03	<0.03	<0.03
SP1 2	<0.03	<0.03	<0.03
SP2 1	<0.03	<0.03	<0.03
SP2 2	<0.03	<0.03	<0.03
SP3 1	<0.03	<0.03	<0.03
SP3 2	<0.03	<0.03	<0.03
SP4 1	0.068	<0.03	<0.03
SP5 1	<0.03	<0.03	<0.03
SP5 2	<0.03	<0.03	<0.03
SP6E 1	0.041	<0.03	<0.03
SP6E 2	0.034	<0.03	<0.03
SP8 1	<0.03	<0.03	<0.03
SP8 2	<0.03	<0.03	<0.03
SP9 1	NS	NS	NS
SP10N 1	<0.03	<0.03	<0.03
SP10N 2	<0.03	<0.03	<0.03
SP12 1	<0.03	<0.03	<0.03
SP12 2	<0.03	<0.03	<0.03
SP13 1	<0.03	<0.03	<0.03
SP13 2	<0.03	<0.03	<0.03
SP14 1	<0.03	<0.03	<0.03
SP14 2	<0.03	<0.03	<0.03
SP15 1	<0.03	<0.03	<0.03
SP15 2	<0.03	<0.03	<0.03
SP17 1	<0.03	<0.03	<0.03

NS = No sample

3.1.5 Nutrients

Total Kjeldahl nitrogen (TKN) concentrations ranged from 0.2 mg N/g at SP8 and SP13, to 2.1 mg N/g at SP2 (**Table 3-6**). TKN concentrations were generally greatest in the northern permit area, 2–3 times lower in the southern permit area, and lowest (4–10 times lower) in the vicinity of the shoals.

Total phosphorus (TP) concentrations ranged from 0.31 mg P/g at SP8 to 2.8 mg P/g at SP4. The spatial pattern in distribution of TP concentrations was less clear than for other nutrients, with greatest concentrations (with the exception of SP4) occurring at sites SP12 to SP17 (at Tassie Shoal and Lynedoch Bank), lower concentrations in the permit area and deeper waters adjacent to the shoals (except SP4) and lowest concentrations at SP8 on Evans Shoal.

Total organic carbon (TOC) concentrations ranged from <0.2% at SP13 (below the laboratory LOR) to 1.5% at SP2. TOC levels were 3–5 times higher in the northern (deeper) permit area.

There are no ANZECC & ARMCANZ (2000a, b) trigger values for nutrients.

Table 3-6: Nutrient concentrations

Parameter	TKN	TP	TOC
Units	mg N/g	mg P/g	% C
LOR	<0.1	<0.05	<0.2
Guideline	N/A	N/A	N/A
Site			
SP1 1	1.9	0.74	1.4
SP1 2	2.0	0.78	1.4
SP2 1	2.1	0.78	1.5
SP2 2	2.1	0.78	1.5
SP3 1	1.6	0.81	1.2
SP3 2	1.5	0.80	1.1
SP4 1	0.5	2.8	0.4
SP5 1	0.6	0.98	0.5
SP5 2	0.7	0.89	0.5
SP6E 1	0.8	1.6	0.6
SP6E 2	0.9	1.6	0.6
SP8 1	0.2	0.31	0.3
SP8 2	0.3	0.31	0.2
SP9 1	0.3	0.79	0.2
SP10N 1	0.3	0.79	0.2
SP10N 2	0.3	0.90	0.3
SP12 1	0.4	1.2	0.3
SP12 2	0.5	1.1	0.4
SP13 1	0.2	1.4	0.2
SP13 2	0.2	1.4	<0.2
SP14 1	0.4	1.9	0.3
SP14 2	0.4	1.9	0.3
SP15 1	0.3	1.8	0.3
SP15 2	0.3	2.0	0.2
SP17 1	0.5	1.3	0.3

3.1.6 Multivariate analysis of sediment quality data

Data for metals/metalloids and nutrients were combined and normalised for multivariate analysis. Data that were consistently or wholly below the laboratory LOR or MRL (i.e. TBT, TPH, TRH, BTEXN and NORMs) were excluded from the analysis. Analysis using PRIMER v6 was based on Euclidean distance resemblance. Cluster analysis with SIMPROF identified five significant groups derived from the sediment quality variables analysed (**Figure 3-3** and **Figure 3-4**):

1. Group A corresponded to the northern (deepest) permit area sites
2. Group B included the southern permit area sites (SP4 and SP5) and SP6E (approximately 20 km west of the permit area)
3. Group C are from Tassie Shoal sites
4. Group D are from SP8 on Evans Shoal
5. Group E comprises samples from Evans Shoal, Tassie Shoal and Lynedoch Bank.

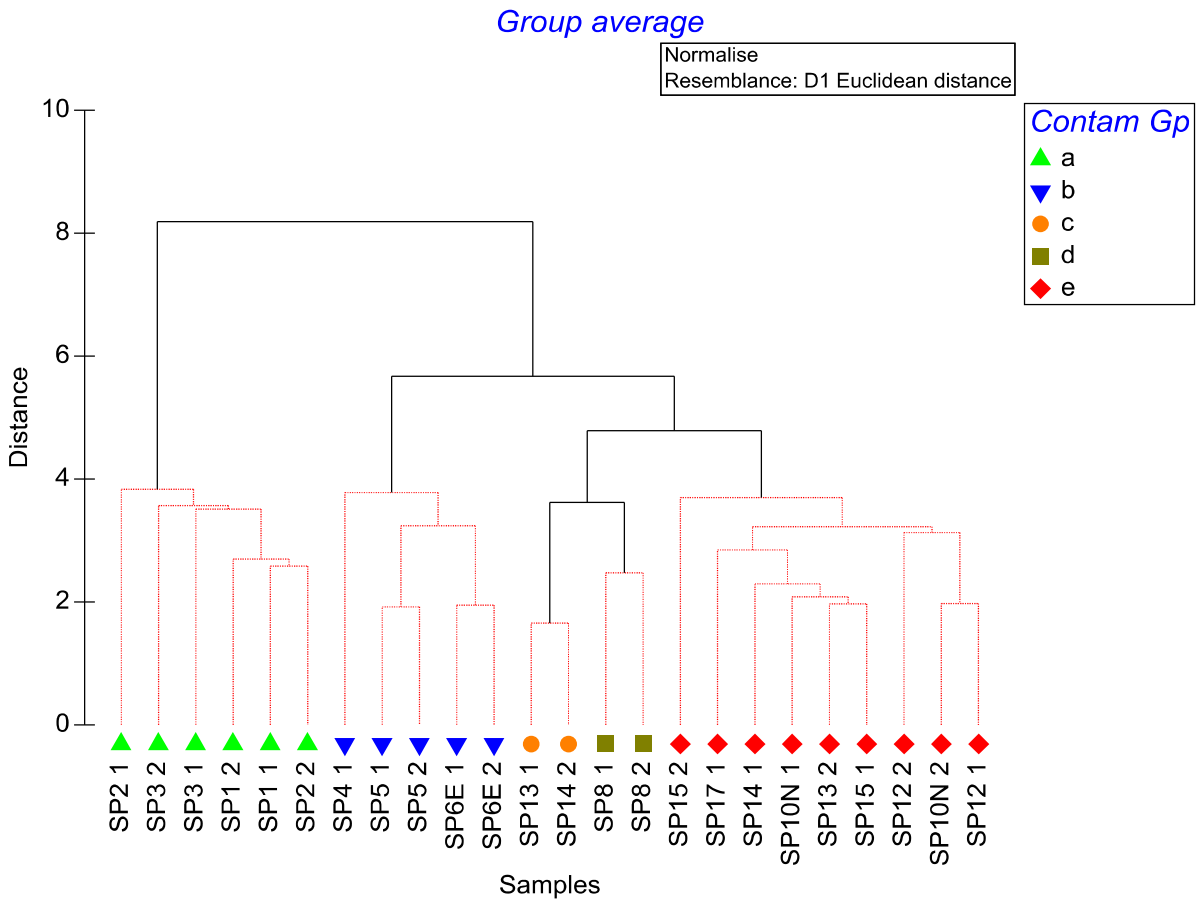


Figure 3-3: Grouping of sites based on similarity in sediment quality

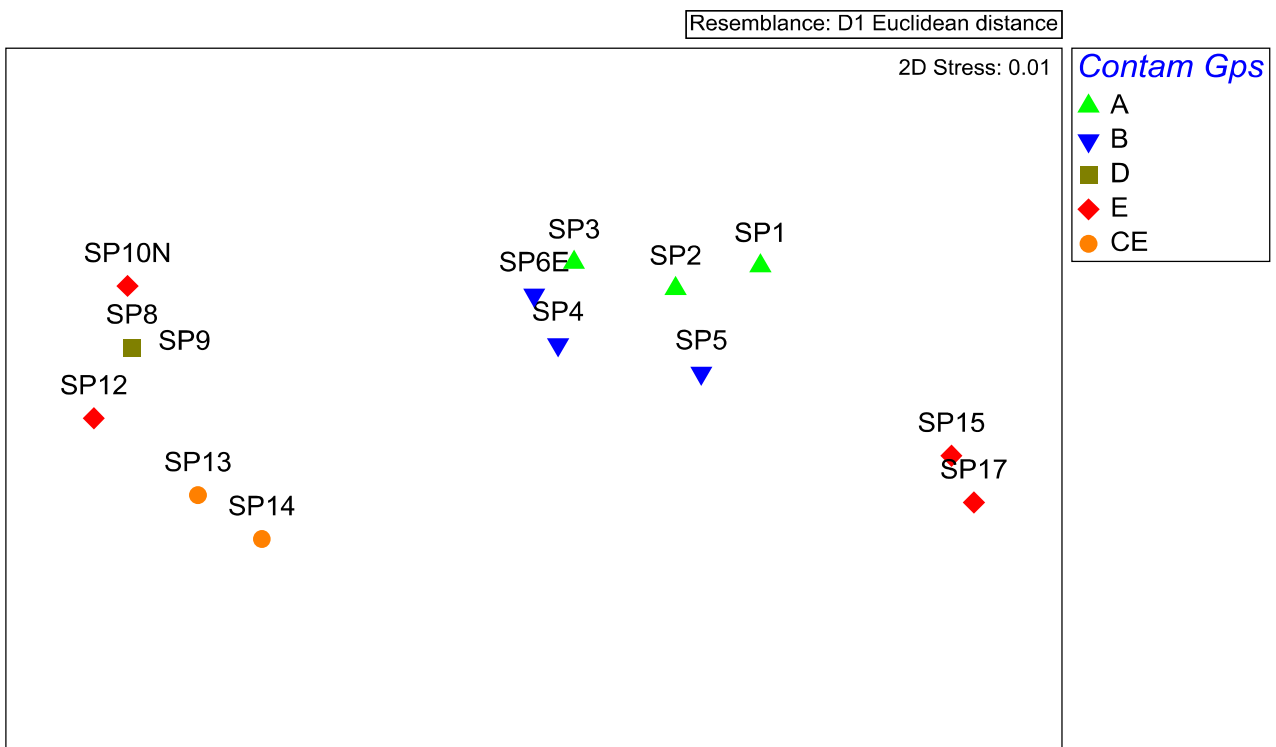


Figure 3-4: Distribution of sediment quality throughout the study area

3.1.7 Particle size distributions

Laboratory PSD results can be found in **Appendix C**. Prior to statistical analysis, data were analysed to characterise sediment samples in terms of Folk sediment classification, sorting, skewness and kurtosis (**Table 3-7**).

Folk sediment classifications provide a high-level description of sediment characteristics. The description is provided in the form of a code, which is made of abbreviations for principal sediment components. The code describes the sediment starting with the least characteristic component and finishing with the most characteristic component (which is capitalised), where:

m/M = muddy / Mud (which is synonymous with silt/clay)

s/S = sandy / Sand

g/G = gravelly or Gravel

() = slightly

For example:

(g)mS = slightly gravelly muddy Sand

smG = sandy muddy Gravel

Folk classifications ranged from sandy mud (sM) at SP2 in the northern (deepest) section of the permit area, to gravelly sand (gS) at SP8 and SP9 (Evans Shoal) (**Figure 3-5**). Folk classifications were also derived from the URS (2005) Caldita-1 pre-drilling environmental survey PSD data to increase the data density in the southern area between the permit area and the shoals. Although the Folk classifications from the Caldita-1 data (approximately 35 km south of the Barossa field) are likely to underestimate the gravel component due to the difference in PSD analysis method used, the data were generally a good fit and provide a useful contribution to the characterisation of the environment (**Figure 3-5**).

Sediments were found to contain a gravel component in the eastern permit area (SP1 and SP5) and became coarser towards the shoals (muddy sands as opposed to sandy muds) (Figure 3-5). Sites in and adjacent to the western permit area were also coarser than SP2, but lacked a gravel component (**Table 3-7**). Sediments were coarser in a southerly direction from the western permit area to Caldita (Caldita-1 is between C5000N to C5000S), transitioning from muddy sands to sands. Sediments at the shoals are generally slightly gravelly sands, with a >10% mud component on the shoal flats. Sites at the shallow shoals were gravelly sands, consisting of <10% mud component and >20% gravel.

Sorting describes the distribution of grain sizes within sediments. Poorly sorted sediments indicate that the sediment is comprised of a wide range of different particle sizes, whereas well sorted sediments are comprised of a small size range of similar particle sizes. This has implications for both the physico-chemical (e.g. pore water flow, oxygenation) and biological characteristics of sediments (based on available ecological niches, available oxygen, energy required to move through sediments, etc.). Sediments in the study area ranged from moderately sorted in the northern (deepest) part of the permit area (SP1 and SP2) to very poorly sorted at the shallow Evans Shoal sites (SP8 and SP9). All other sites were characterised as having poorly sorted sediments (**Table 3-7**).

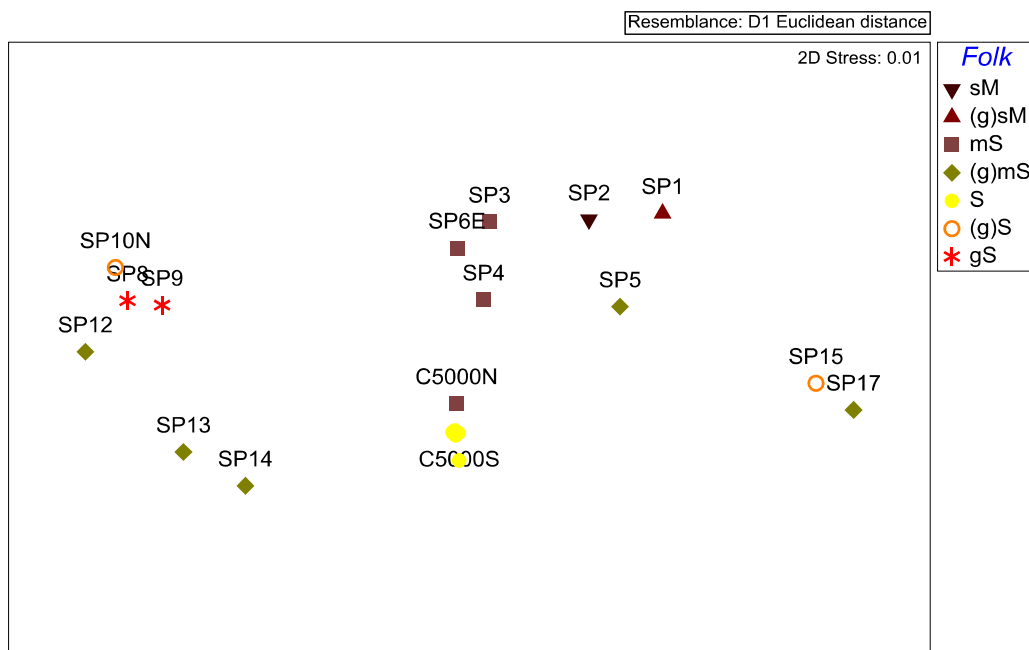
Skewness and kurtosis describe the distribution curve of the sediment particle size distribution, relative to the bell-shaped normal curve. Skewness describes dominance of finer (left or fine skewed) or coarser particle sizes (right or coarse skewed) in the sample, rather than an even distribution. Kurtosis describes the relative dominance of different particle sizes. A leptokurtic ("sharp" or "pointy") curve describes a sediment sample that is highly dominated by a small number of similar size classes. A platykurtic curve describes a sediment sample that has a relatively even representation of particle sizes across the size range. Sediments in the permit area ranged from strongly fine skewed and leptokurtic at SP2 to coarse skewed and mesokurtic at SP4 (**Table 3-7**).

Cluster analysis of Euclidean distance resemblance based on square root transformed PSD data identified four main groups of sediments (**Figure 3-6**). Group A consisted of the northern (deepest) permit area sites (SP1 to SP3). Group B consisted of the shallow Evans Shoal sites (SP9 and SP9) and the seaward shoal slope sites (SP10N and SP15). Group C was comprised of the remaining permit area sites (SP4 and SP5) and SP6E adjacent to the permit area. The final group (Group D) comprised of the shoal flat, Tassie Shoal and shallow Lynedoch Bank sites (SP12, SP13, SP14 and SP17, respectively). The spatial distribution of PSD groups is presented in **Figure 3-7**.

Two-dimensional n-MDS ordination (Figure 3-8) showed an almost linear pattern of distribution of the four groups of sites from the coarsest sediments on the left and the finest sediments on the right.

Table 3-7: Sediment sample particle size characteristics

Site	% Silt/clay (<63 µm)	% Sand (0.063–4 mm)	% Gravel (4–64 mm)	Folk classification	Sorting	Skewness	Kurtosis ¹
SP1	56.99	42.88	0.13	(g)sM	Moderately sorted	Strongly fine skewed	Mesokurtic
SP2	66.35	33.65	0.00	sM	Moderately sorted	Strongly fine skewed	Leptokurtic
SP3	45.16	54.84	0.00	mS	Poorly sorted	Strongly fine skewed	Platykurtic
SP4	16.45	83.55	0.00	mS	Poorly sorted	Coarse skewed	Mesokurtic
SP5	24.65	75.30	0.05	(g)mS	Poorly sorted	Symmetrical	Platykurtic
SP6E	26.21	73.79	0.00	mS	Poorly sorted	Symmetrical	Platykurtic
SP8	4.88	71.48	23.64	gS	Very poorly sorted	Fine skewed	Platykurtic
SP9	5.47	67.37	27.15	gS	Very poorly sorted	Fine skewed	Platykurtic
SP10N	5.93	93.02	1.04	(g)S	Poorly sorted	Symmetrical	Leptokurtic
SP12	15.99	83.59	0.42	(g)mS	Poorly sorted	Fine skewed	Platykurtic
SP13	10.94	87.66	1.39	(g)mS	Poorly sorted	Symmetrical	Platykurtic
SP14	12.36	86.59	1.04	(g)mS	Poorly sorted	Symmetrical	Mesokurtic
SP15	5.93	90.34	3.73	(g)S	Poorly sorted	Fine skewed	Mesokurtic
SP17	13.76	85.94	0.29	(g)mS	Poorly sorted	Fine skewed	Mesokurtic



NB: Includes PSD data from Caldita-1 (C5000N and C5000S) (URS 2005)

Figure 3-5: Distribution of Folk sediment classifications throughout the sampling area

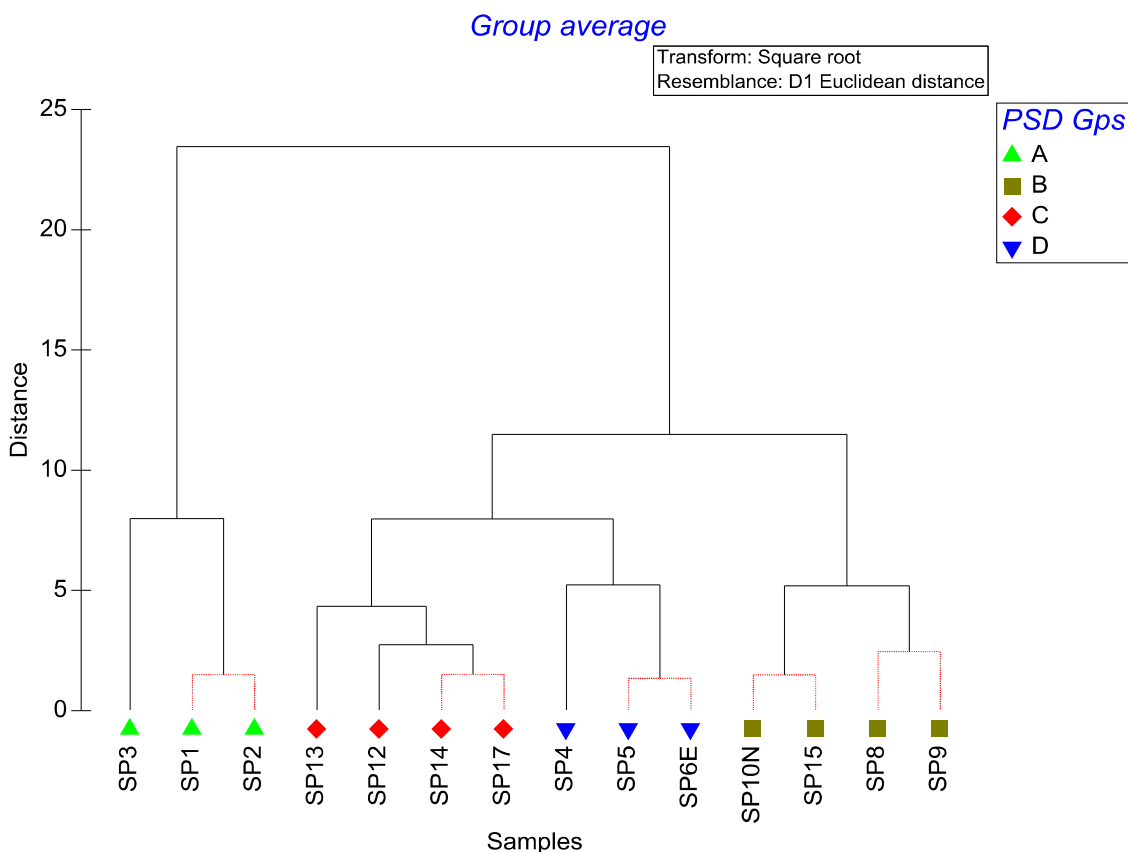


Figure 3-6: Grouping of sites based on sediment particle size characteristics

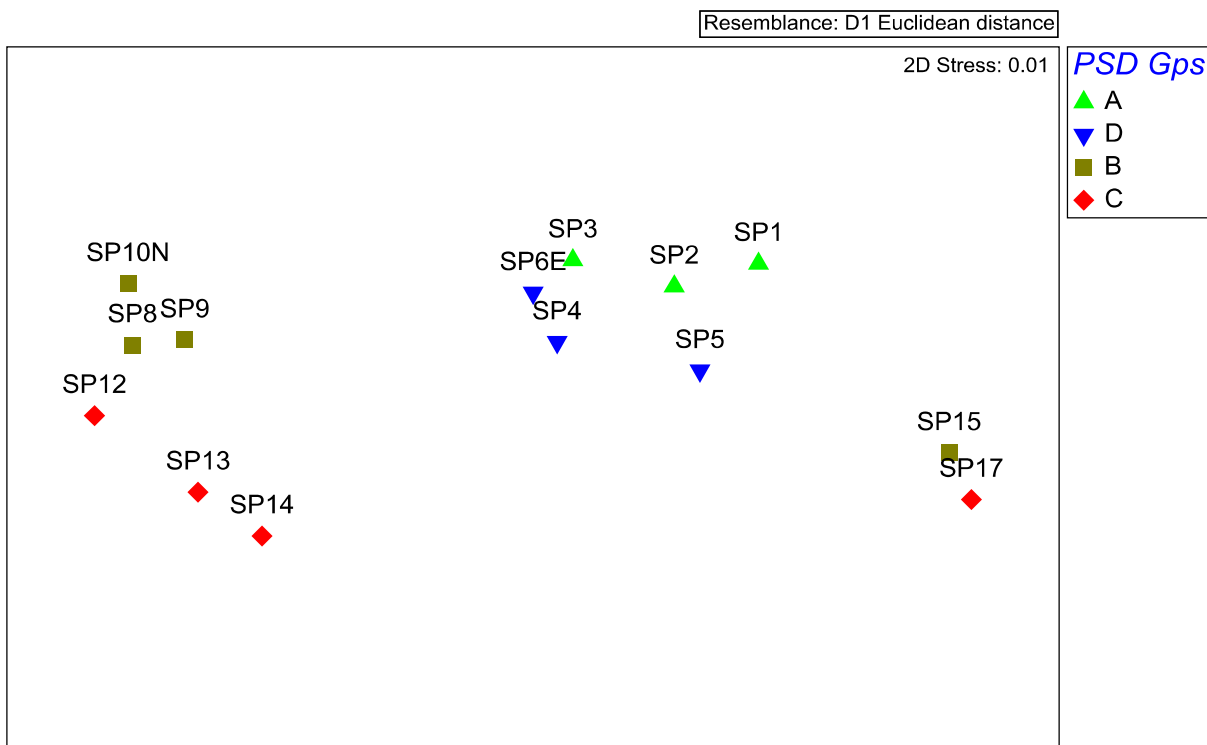


Figure 3-7: Distribution of PSD groups throughout the study area

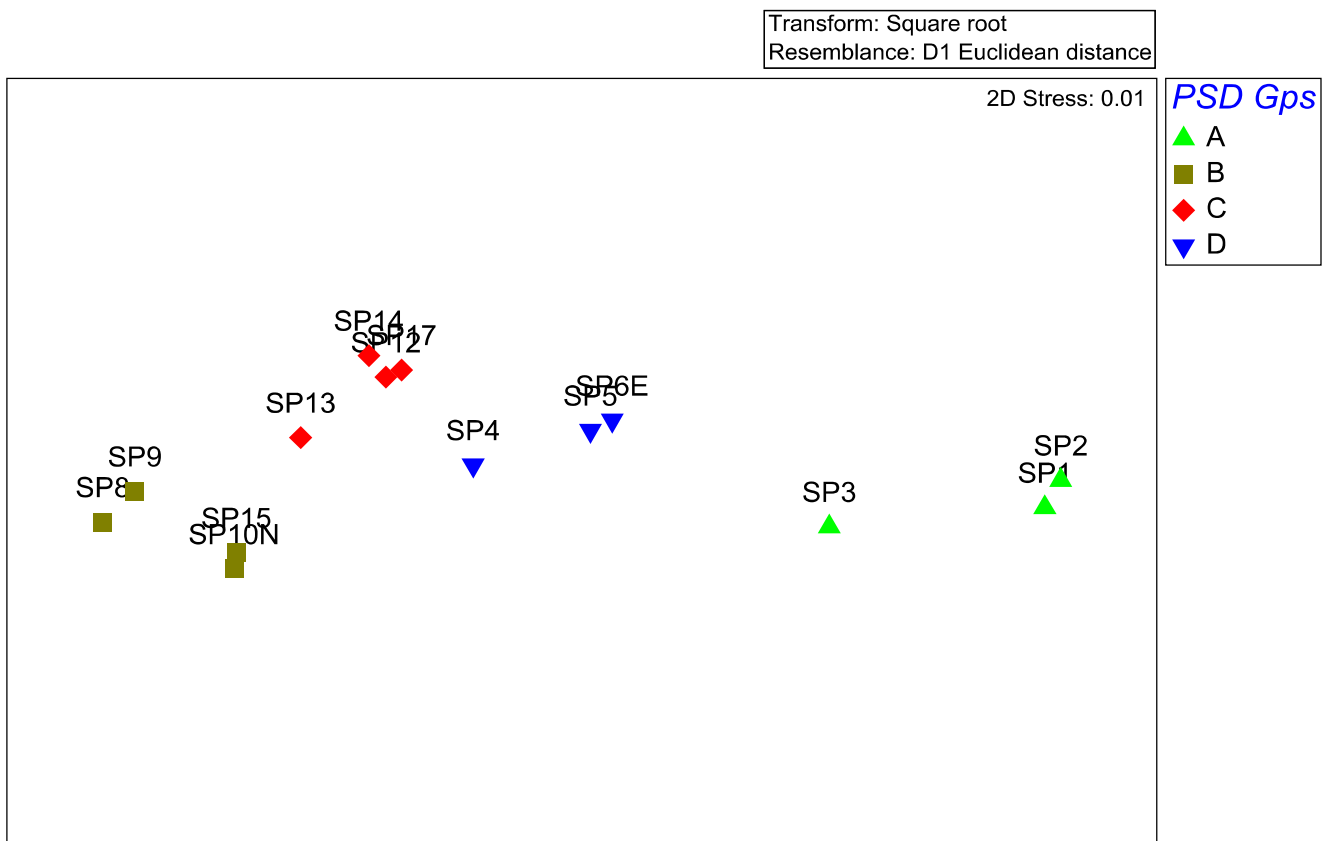


Figure 3-8: Sediment particle size characteristics overlaid with PSD groups

Comparison of PSD groups with the sediment quality groupings identified in Section 3.1.6 indicated similar spatial distributions. To determine if there was a clear relationship between PSD and contaminants, an n-MDS ordination of contaminants data overlaid with contaminant groups (**Figure 3-9**) was compared with the same n-MDS but overlaid with the PSD groupings (**Figure 3-10**). This clearly showed a direct relationship between PSD and contaminants, with contaminant Group A matching PSD Group A, and contaminant Group B matching PSD Group D.

To further investigate the drivers for variation in sediment composition in the study area, a Principal Component Analysis (PCA) based on PSD data combined into silt/clay, sand, gravel and cobble size classes was overlaid with PSD groups (**Figure 3-11**). This showed that the main drivers of sediment heterogeneity were the silt/clay and sand fractions. The influence of the gravel fraction was only particular of note at SP8 (and presumably SP9 if a PSD sample had been successfully collected). **Figure 3-12** illustrates the relationship between silt/clay, sand and gravel fractions in the transitional gradient of Folk sediment classifications of sites for the study area.

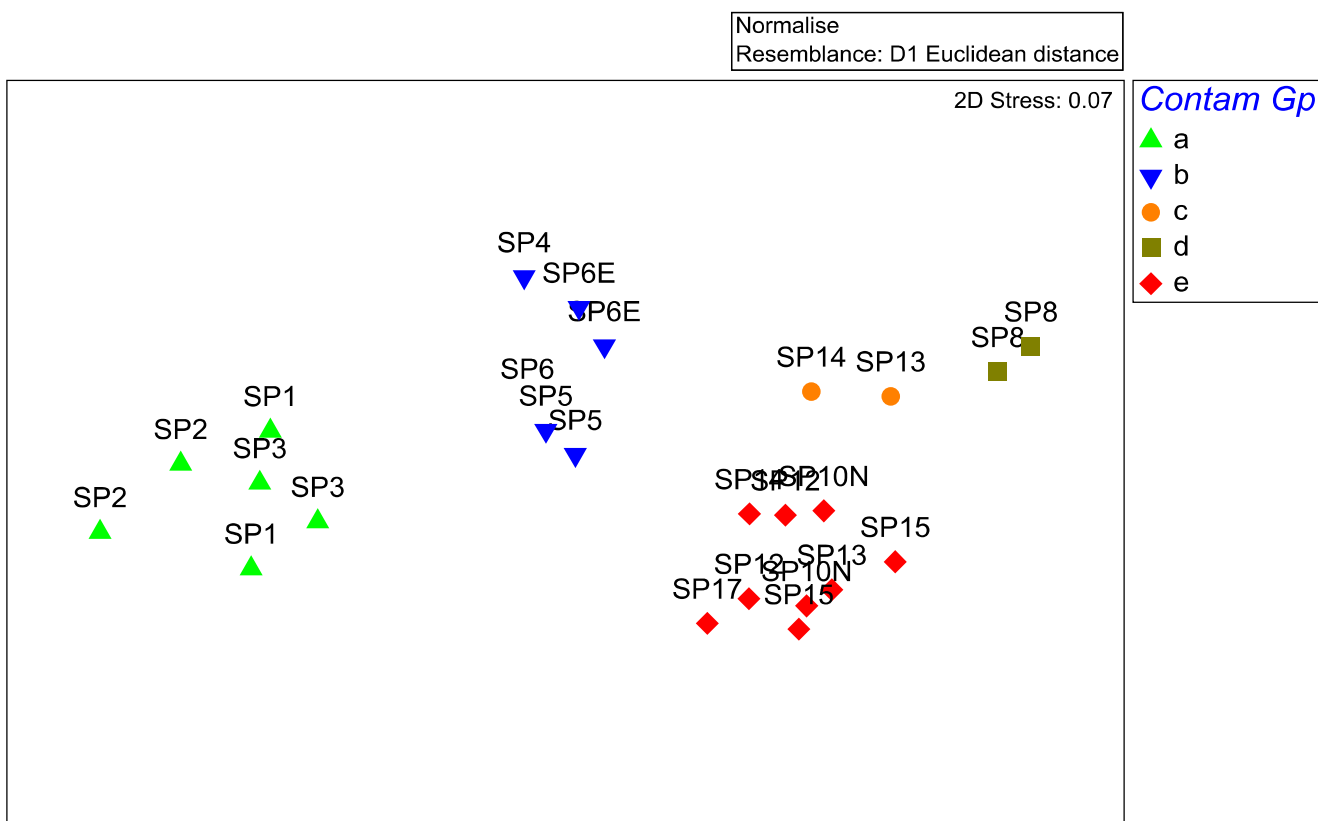


Figure 3-9: Sediment quality characteristics overlaid with contaminant groups

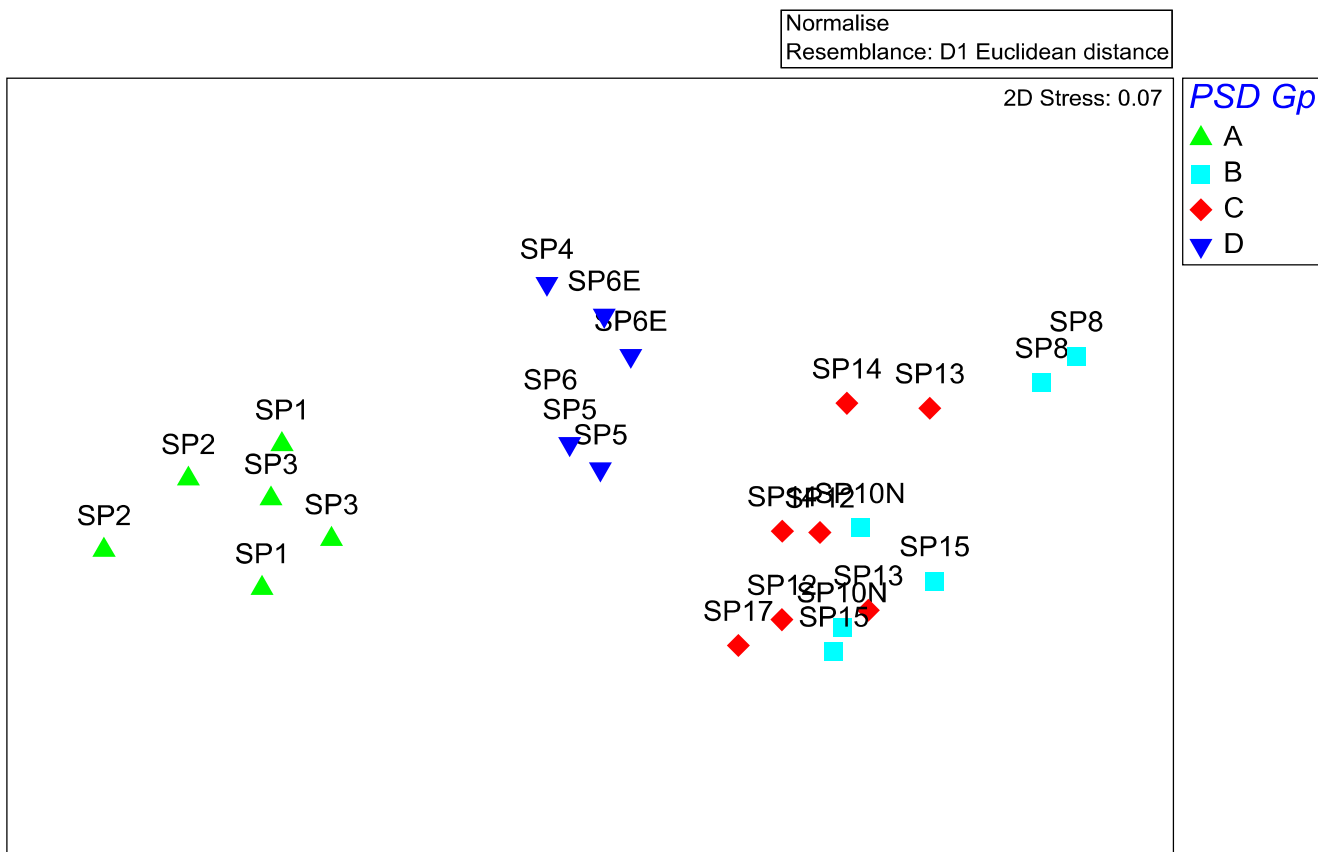


Figure 3-10: Sediment contaminant characteristics overlaid with PSD groups

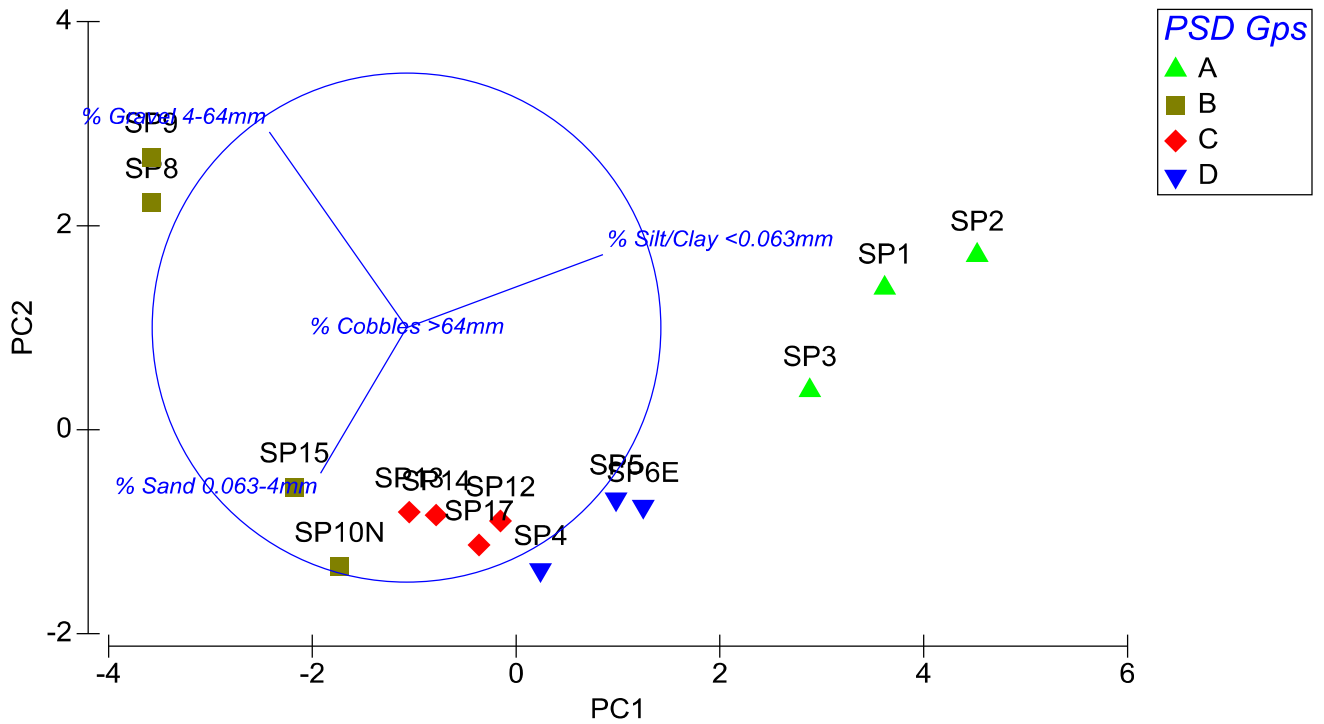


Figure 3-11: Principal components analysis plot of PSD data, overlaid with PSD groups

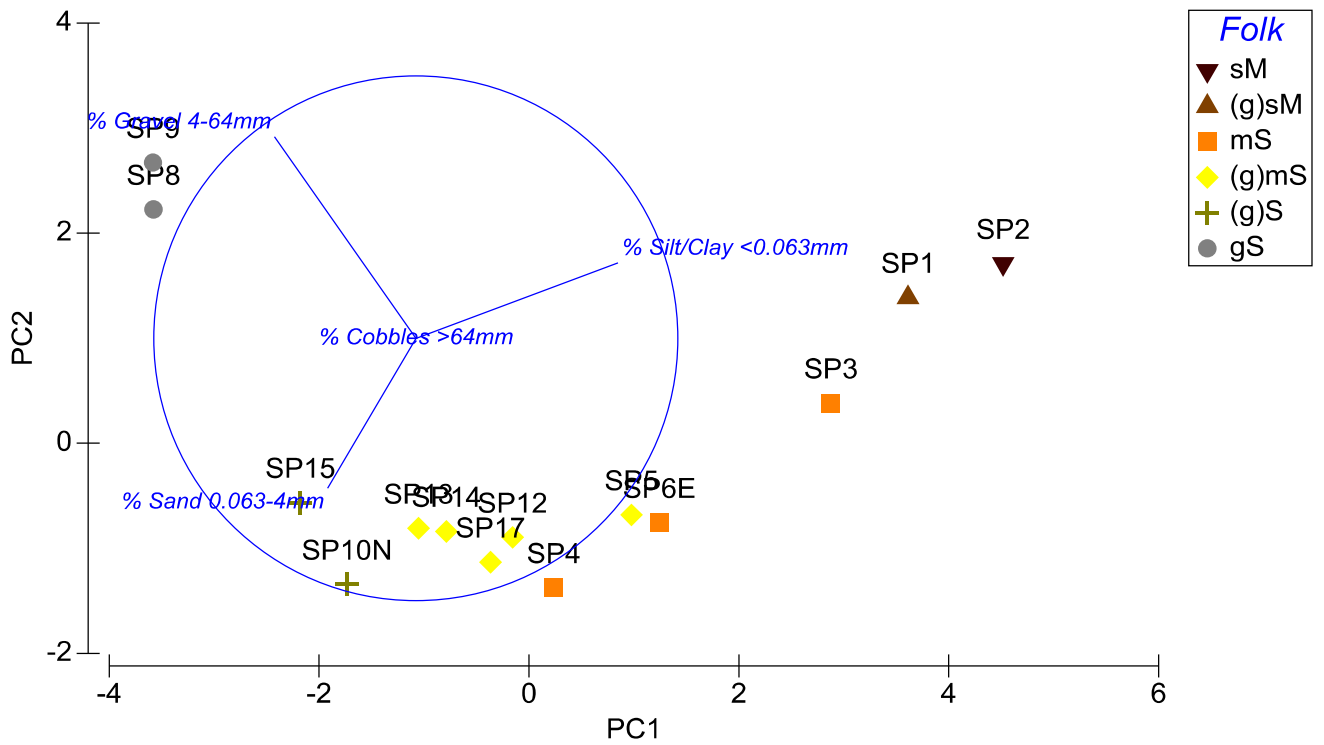


Figure 3-12: Principal components analysis plot of PSD data, overlaid with Folk sediment classifications

The relationship between PSD and contaminants demonstrated in **Section 3.1.6** is demonstrated further by overlaying contaminant groups over the PSD PCA (**Figure 3-13**), with contaminant group A being associated with a high silt/clay and low sand/gravel component. Group D, conversely, was associated with a high gravel and low silt component.

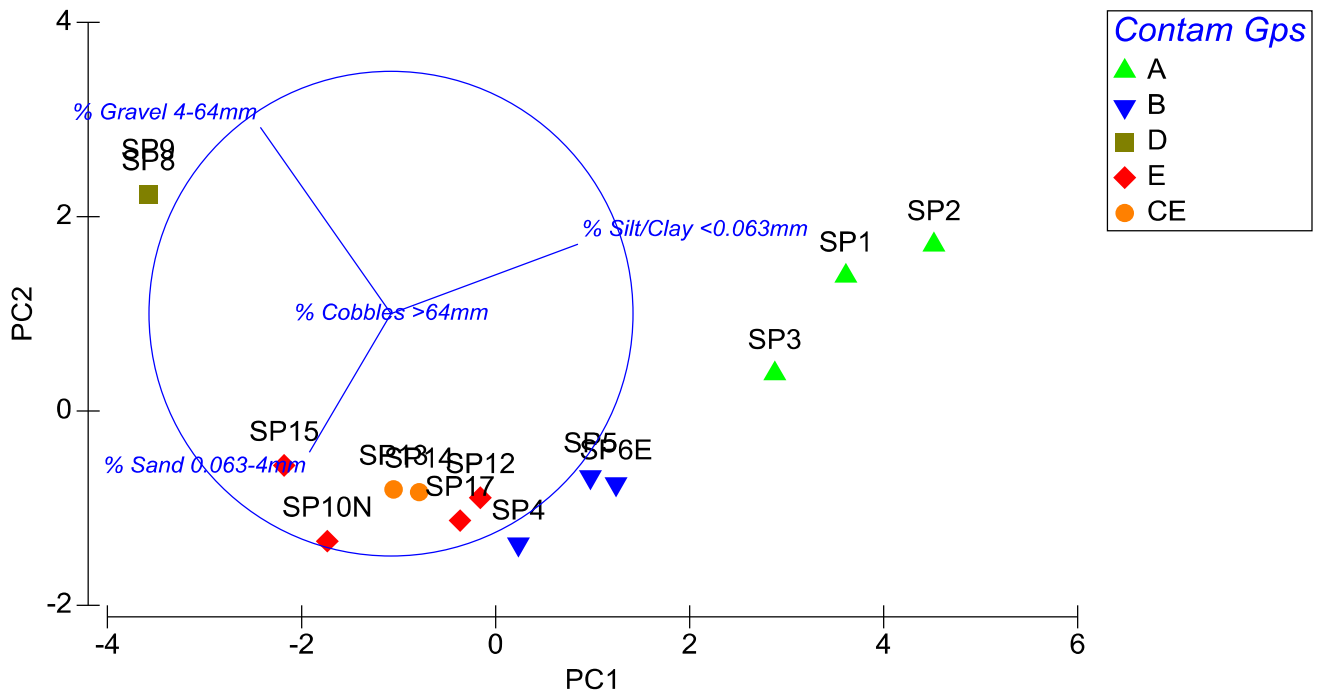


Figure 3-13: Principal components analysis plot of PSD data, overlaid with sediment quality groups

3.2 Infauna

3.2.1 Descriptive statistics

Fourteen infaunal samples were successfully collected. The infaunal data can be found in **Appendix C**. Descriptive statistics of the infaunal community data describing the number of species (S), abundance (N), Margalef's species richness (d), Pielou's evenness (J'), Shannon-Weiner diversity (H') and Simpson's alpha diversity index (1-λ') are presented in **Table 3-8**. The number of species (S) ranged from 3 at SP10N to 42 at SP8. Abundance (N) ranged from three individuals at SP10N to 63 individuals at SP8. Species richness (d) and Shannon-Weiner diversity (H') were consequently lowest at SP10N (1.8 and 1.1, respectively) and highest at SP8 (9.9 and 3.56, respectively). Evenness (J') and alpha diversity (1-λ') were lowest at SP1 and highest at sites where each taxa was represented by a single individual (i.e. SP2, SP10N and SP12).

Table 3-8: Infaunal community descriptive statistics

Site	S ¹	N ¹	d ¹	J' ¹	H'(log _e) ¹	1-λ' ¹
SP1	6	9	2.3	0.88	1.58	0.83
SP2	5	5	2.5	1.00	1.61	1.00
SP3	6	7	2.6	0.98	1.75	0.95
SP5	9	15	3.0	0.92	2.03	0.90
SP6E	8	13	2.7	0.91	1.88	0.88
SP8	42	63	9.9	0.96	3.56	0.98
SP10N	3	3	1.8	1.00	1.10	1.00
SP12	15	19	4.8	0.97	2.63	0.97
SP13	12	12	4.4	1.00	2.48	1.00
SP14	24	33	6.6	0.96	3.06	0.98
SP15	39	56	9.4	0.96	3.52	0.98

¹ S = species richness, N = abundance, d = Margalef's species richness, J' = Pielou's evenness, H' = Shannon-Weiner diversity, 1-λ' = Simpson's index

Sediments at the permit zone were characterised by burrowing taxa and demersal fish, namely foraminifera (an amoeboid protist), nematodes, *Bregmaceros* sp. (codlets), tube-forming Onuphid polychaetes and the superb nut shell *Ennucula superba*. The coarser Tassie Shoal sediments were characterised by syllid polychaetes, tanaid crustaceans, foraminifera, brittlestars and fibularid echinoderms (urchins). Lynedoch Bank (SP15) was characterised by biota that were characteristic of both the permit area and Tassie Shoal, namely nematodes, tanaid crustaceans, and tube-dwelling onuphid polychaetes, but this site was relatively species-rich, and was also characterised by lumbrinerid polychaetes, brittlestars (*Amphioplus* sp.), tube-dwelling chaetopterid polychaetes and mud shrimp (callianassids). This suggested that mixed sediment habitats, comprising coarse and fine sediments, were present at this site. The variability between infaunal communities at Evans Shoal resulted in characteristic taxa being identified at the phylum level, with sediments being dominated by molluscs (e.g. laevidentaliidae), crustaceans (e.g. tanaids, amphipods, isopods, callianassids) and annelid worms (e.g. syllids, *Nematonereis* sp., lumbrinerids).

The infaunal community composition at the phylum level is presented in **Table 3-9**. Note that the infaunal community included foraminifera, which are amoeboid protists. Cluster analysis of infaunal data (**Figure 3-14**) identified that only site SP10N was significantly different to the other sites due to the high degree of variability between remaining sites. Site SP10N had only three individuals from three taxa.

The macrofaunal and infaunal assemblages of the study area were found to be diverse, with 235 individuals representing 124 taxa recorded from 11 grab samples.

3.2.2 Qualitative observations of infauna from grab samples

In situ observations and photographs of conspicuous biota and features were recorded at three sites (SP2, SP8 and SP15) and provide additional qualitative information about the ecology of these three sites.

A photograph of biota in the grab sample (for physico-chemical analysis) from SP8 shows the diversity of this site (**Figure 3-15a**). Biota present were a stomatopod (mantis shrimp), shrimp, several *Lithothamnion thalli* (coralline red algae) and a clump of predominantly biogenic material that included hydroids, bryozoan, ascidians, sponges, red and green algae, and polychaete tubes (**Figure 3-15a**). Also observed in the grab samples from this site were caprellid amphipods (skeleton shrimps), squat lobsters (*Galathea* sp.) and a spider crab (see logsheets in **Appendix B**).

Samples from SP15 were noted to contain large shells (e.g. scallops and other bivalves), gastropod mollusc shells, large pieces of shell hash, and large old calcareous worm tubes (**Figure 3-15b**).

In a grab sample from SP2 in the permit area, a large polychaete (>15 cm long) in a mud tube was collected (**Figure 3-15c**). Polychaetes such as this generally adopt multiple feeding strategies, including carnivory, scavenging, and even filter feeding by producing a mucus plug in their tube. As the tube is irrigated by movement of the worm in the tube, particles are sucked into the mucus and become trapped. The worm then ingests the mucus plug, and digests the trapped organic particles.

Table 3-9: Number of individuals from different phyla at each sampling site

Phylum	SP1	SP2	SP3	SP4	SP5	SP6E	SP8	SP9	SP10N	SP12	SP13	SP14	SP15	SP17
Mollusca	4	1	0	0	2	0	2	0	1	1	2	0	0	0
Cnidaria	0	0	0	0	1	0	12	0	0	0	0	5	0	0
Echinodermata	0	0	1	0	1	0	0	0	0	3	2	3	5	0
Crustacea	1	2	1	0	2	4	26	0	1	6	2	16	16	0
Foraminifera	1	0	0	0	6	1	0	0	0	2	0	2	0	0
Annelida	2	1	5	0	0	3	8	0	1	6	6	5	27	0
Nematoda	0	0	0	0	3	4	0	0	0	0	0	0	5	0
Echiura	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Nemertea	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Arthropoda	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Porifera	0	0	0	0	0	0	13	0	0	0	0	0	2	0
Chordata	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Bryozoa	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sipuncula	0	0	0	0	0	0	1	0	0	0	0	0	0	0

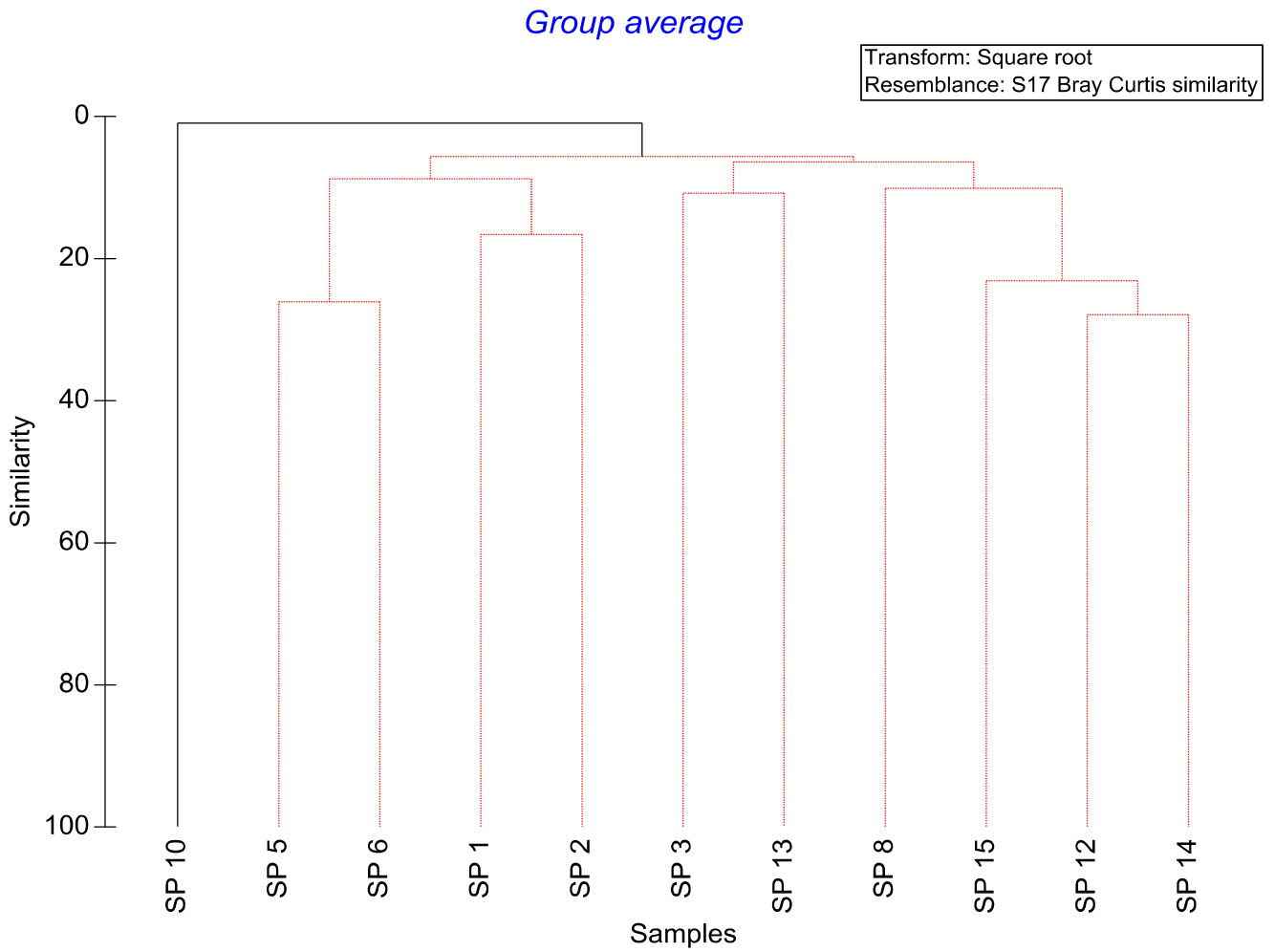


Figure 3-14: Grouping of sites based on similarity of infaunal data

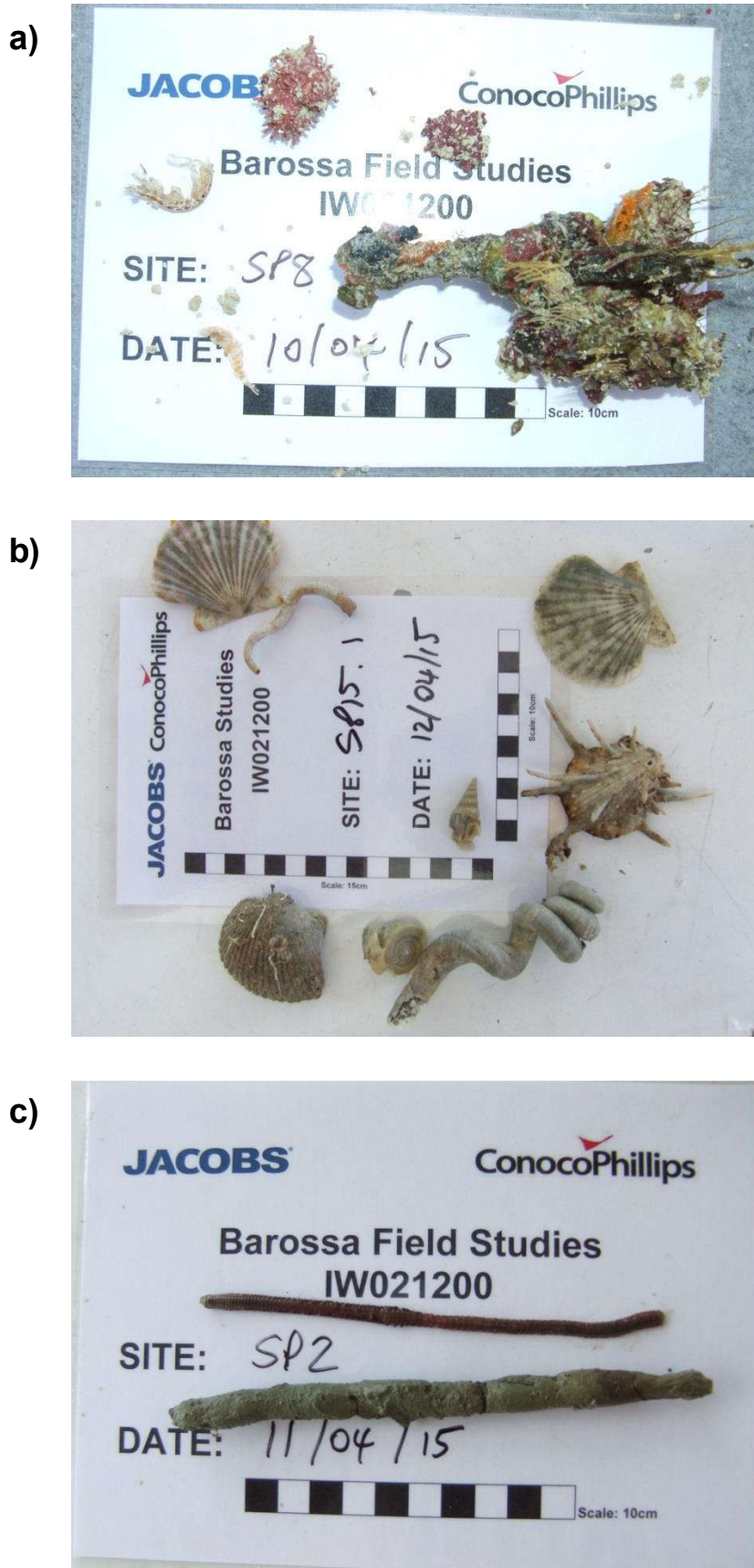


Figure 3-15: Biota collected in a physico-chemical grab sample from SP8 (a), SP15 (b) and SP2 (c)

3.2.3 Multivariate comparison of infaunal data with PSD data

To investigate the relationship between the biological environment and the physical environment, species richness (S), abundance (N) and the abundance of each Phylum was overlaid as a bubble plot over the PSD Principal Components Analysis plot (originally presented in **Figure 3-11**). A general trend of increasing species richness (**Figure 3-16**) and abundance (**Figure 3-17**) with increasing contribution of the coarse sediment component were observed. For many phyla there was also an evident trend of increasing abundance with increasing contribution of the coarse sediment fraction (e.g. annelid worms and crustaceans) (**Figure 3-18** and **Figure 3-19**). However, in some cases this trend was reversed (e.g. Mollusca), where greatest abundances were associated with finer sediments (**Figure 3-20**). Review of relationships between PSD and other phyla indicated that some biota were associated with a more restricted range of sediment types. For example, foraminifera were associated with sediments with a greater fines fraction (**Figure 3-21**), echinoderms were associated with mixed sediments not dominated by a fines or coarse component (**Figure 3-22**), and sessile or encrusting phyla such as cnidarians (anemones, sea pens and corals) and sponges (Porifera) were associated with sediments with a strong coarse component (**Figure 3-23** and **Figure 3-24**).

The PRIMER routine Bio-Env was used to identify the environmental variables that were likely to have had the greatest influence on the distribution of infauna within the study area. Results showed that depth and silt/clay (<63 μm) component had the greatest combined influence on infaunal distribution, although this was not considered significant (Global R = 0.404, significance 6.5%). The RELATE routine was used to compare the distribution of samples based on environmental variables (Latitude, Longitude, depth, %gravel, %sand and %silt) with the distribution based on infaunal community to determine whether there was a relationship between environmental and biological parameters at a broader level. Results indicated that there was a significant relationship between environmental variables and infaunal communities (Rho = 0.3332, significance level of sample statistic = 0.9%), but with low Rho value and Bio-Env Global R values indicating that there was likely to be a lot of overlap between the effects of different environmental variables.

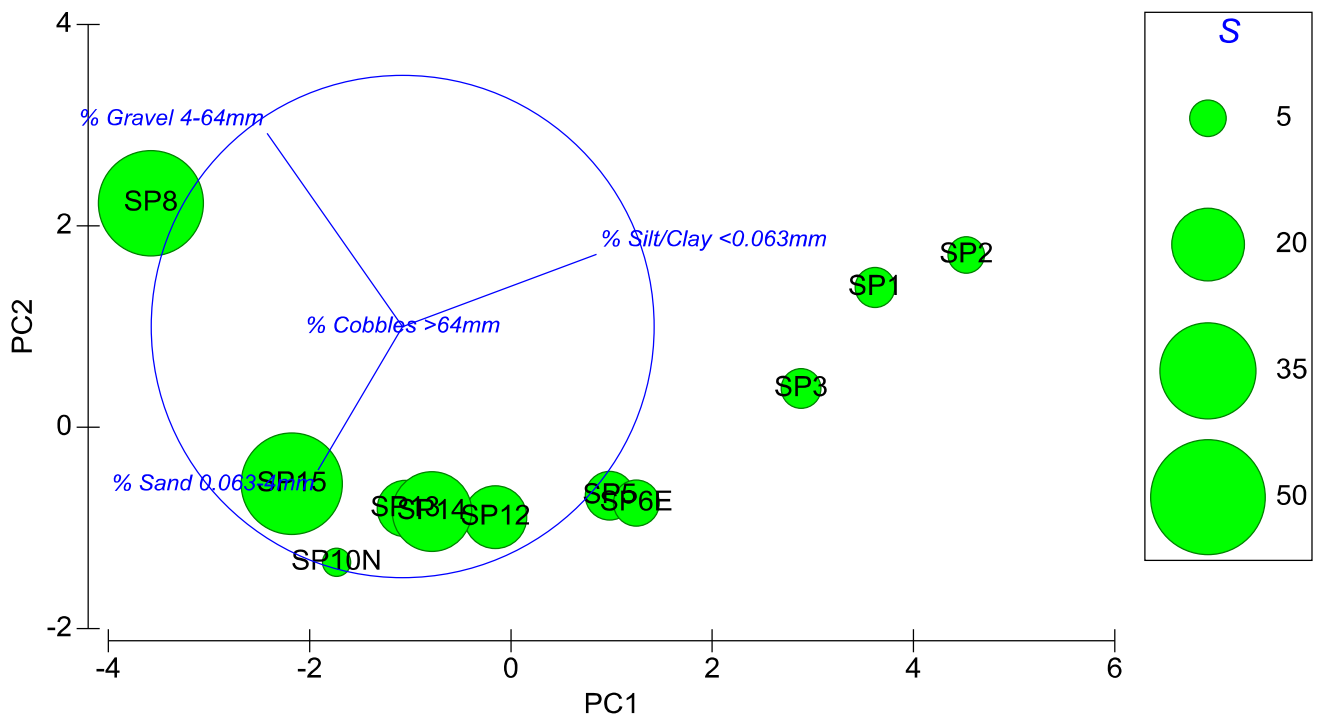


Figure 3-16: Infaunal species richness (S) overlaid over PSD principal components analysis plot

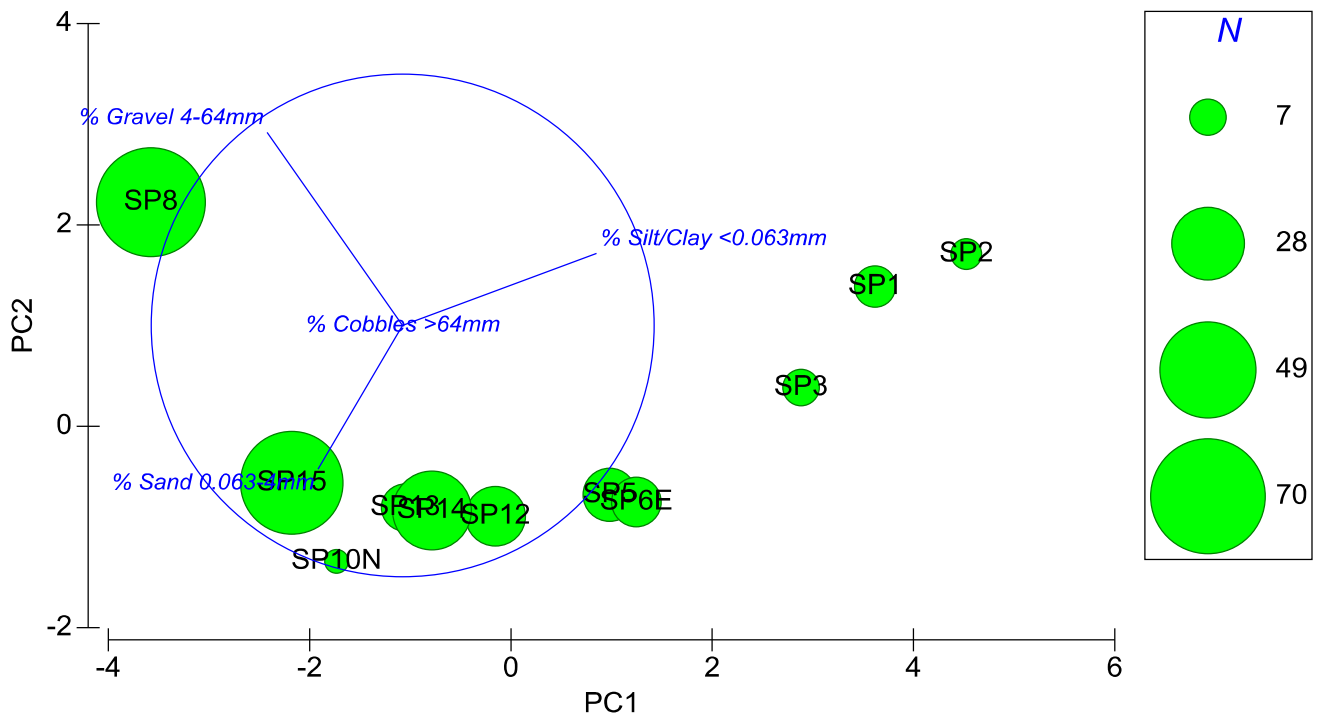


Figure 3-17: Infaunal abundance (N) overlaid over PSD principal components analysis plot

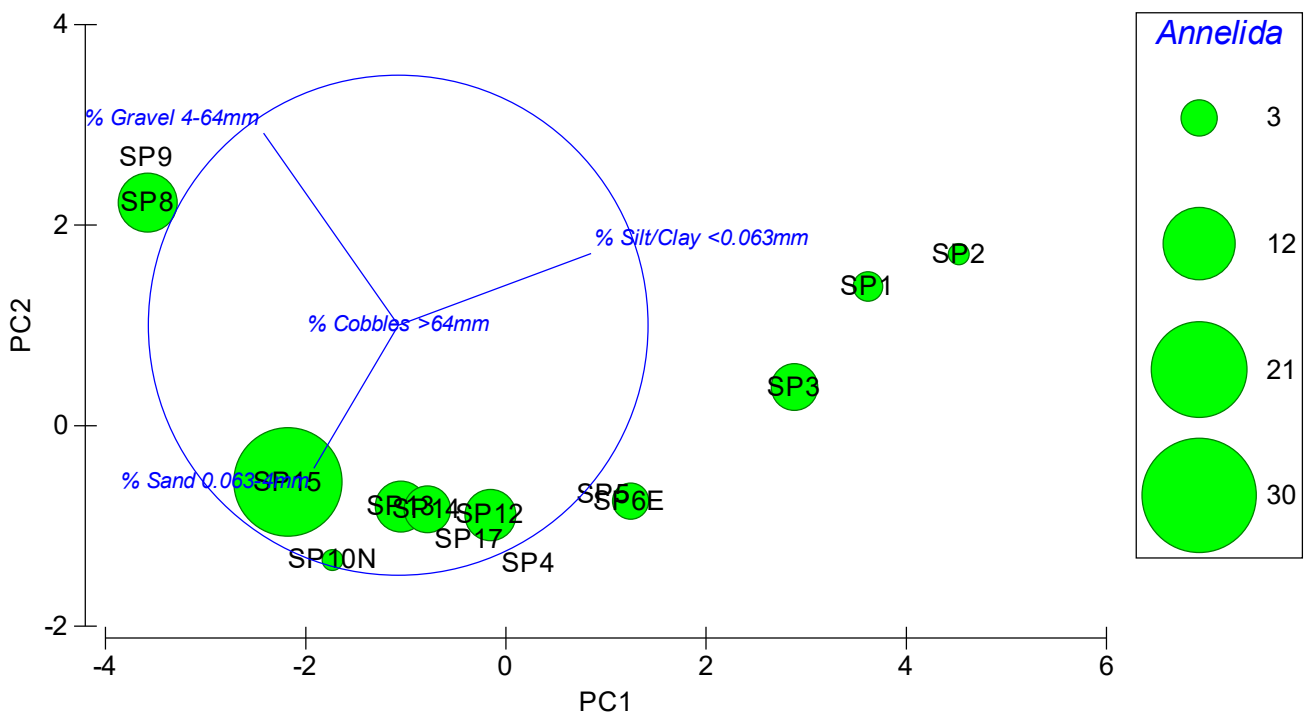


Figure 3-18: Annelid worm abundance overlaid over PSD principal components analysis plot

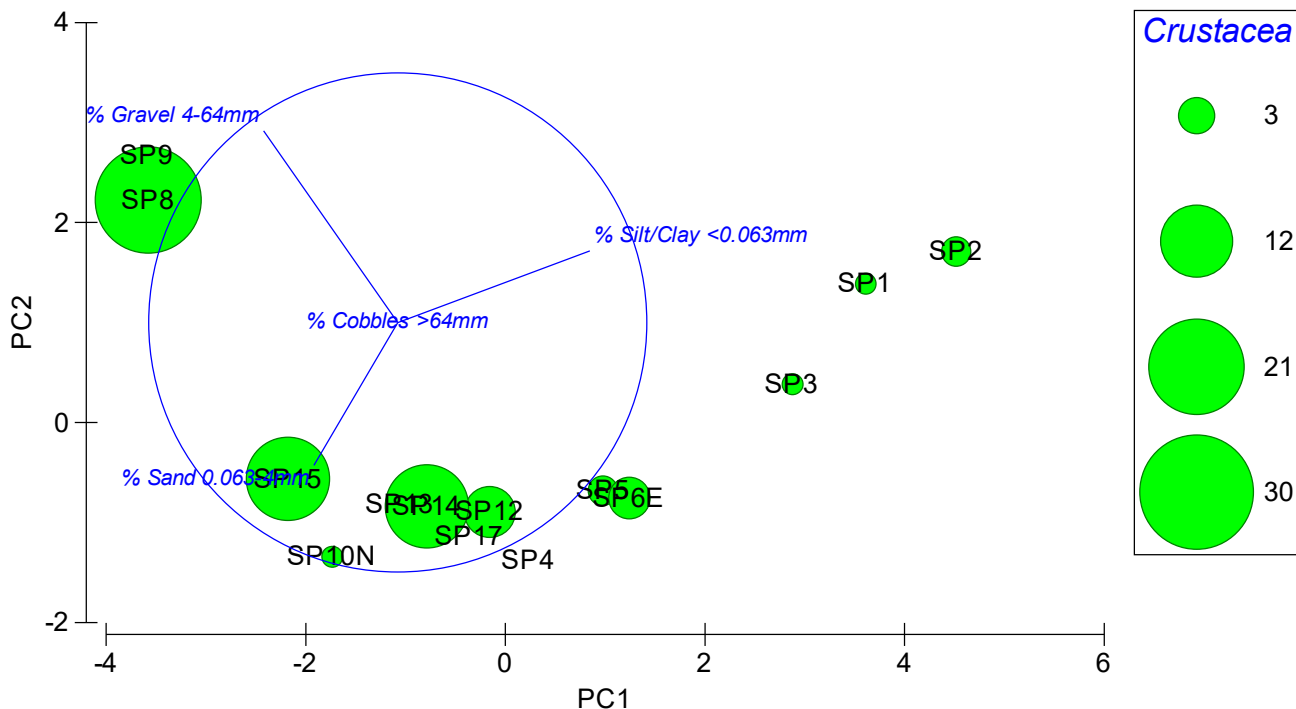


Figure 3-19: Crustacean abundance overlaid over PSD principal components analysis plot

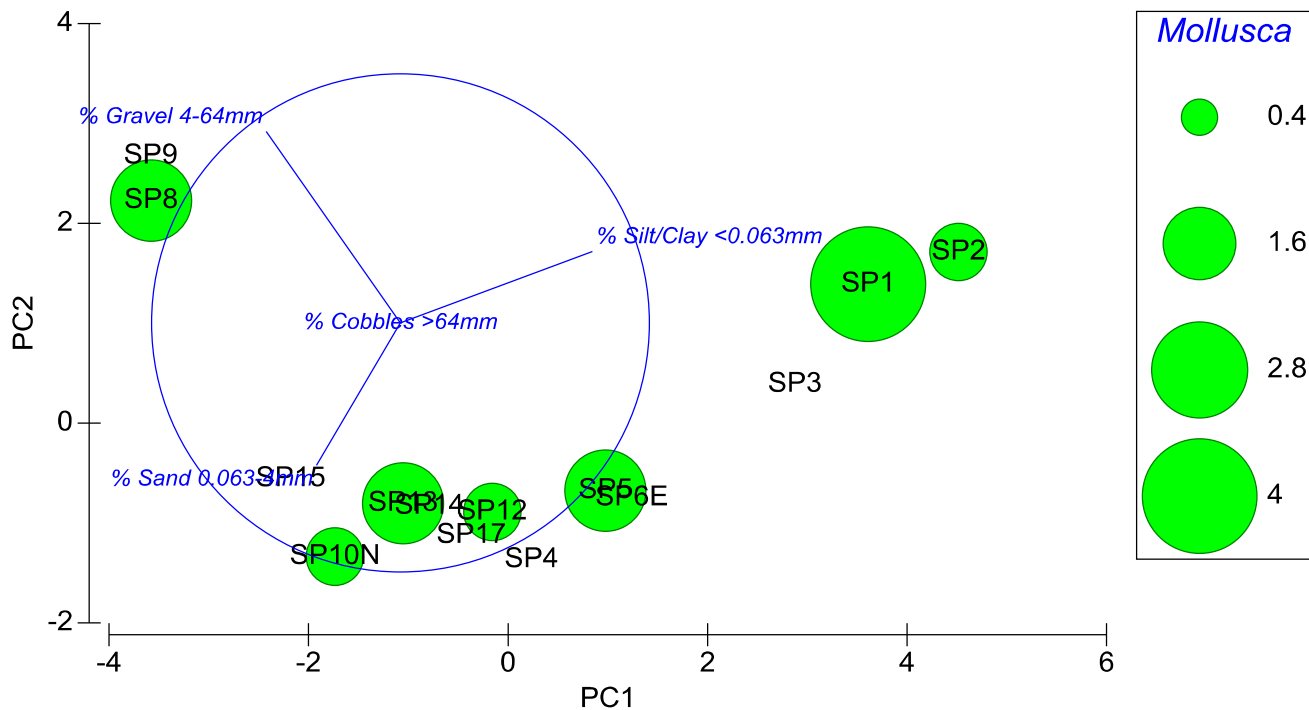


Figure 3-20: Molluscan abundance overlaid over PSD principal components analysis plot

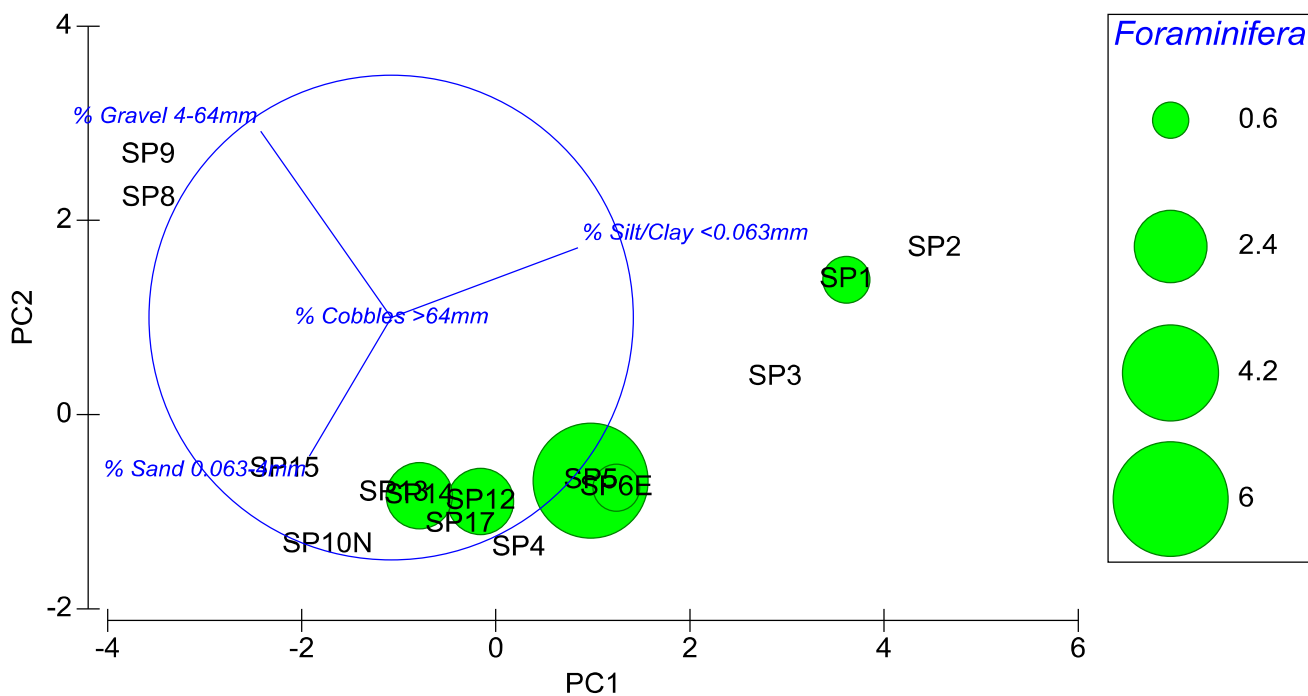


Figure 3-21: Foraminifera abundance overlaid over PSD principal components analysis plot

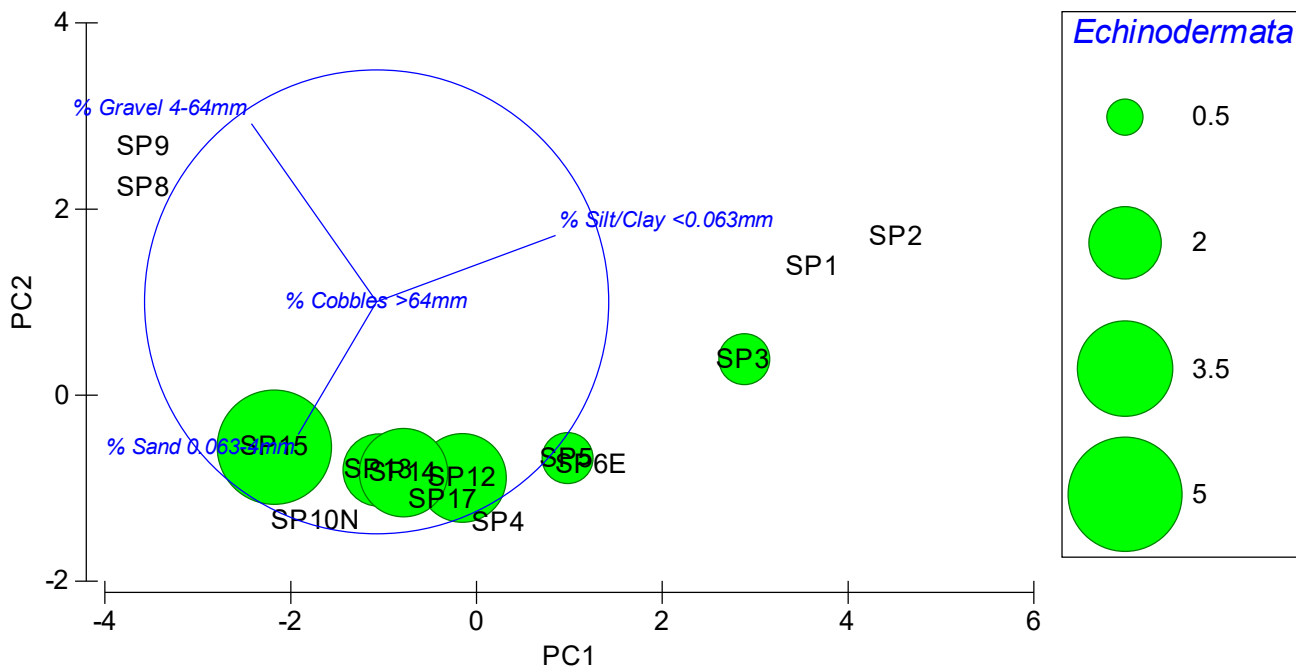


Figure 3-22: Echinoderm abundance overlaid over PSD principal components analysis plot

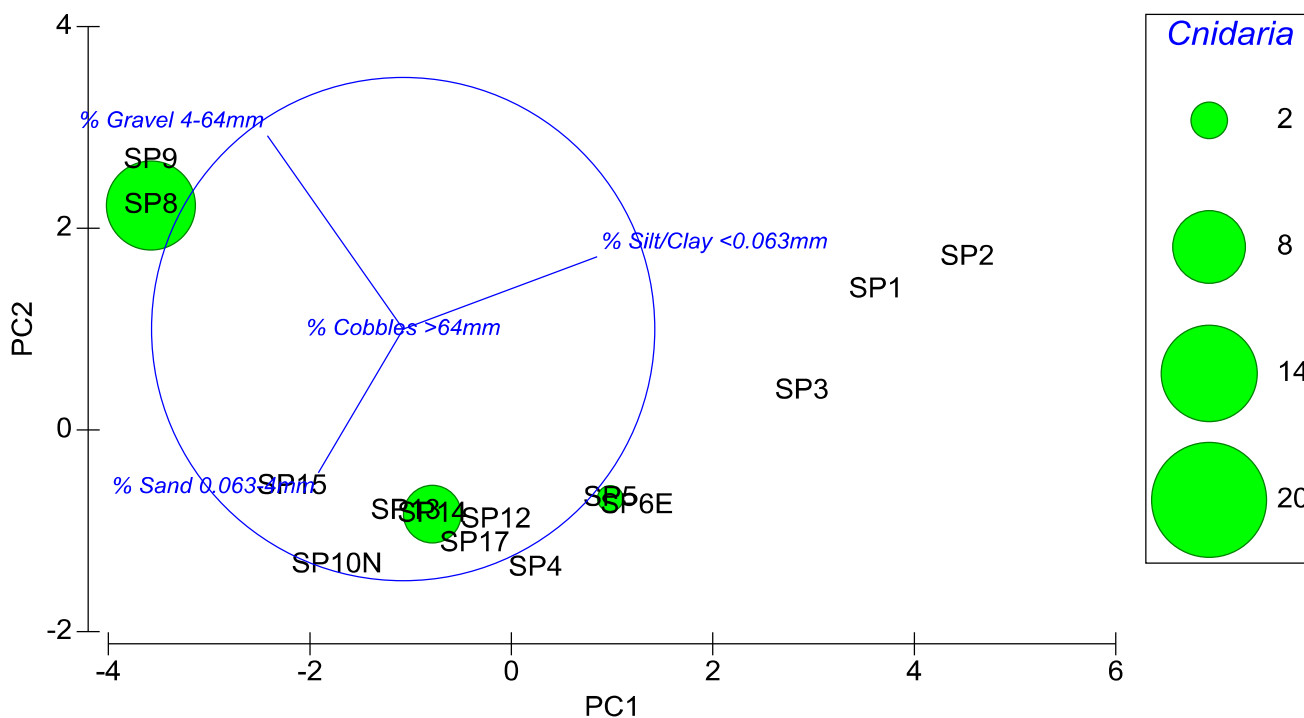


Figure 3-23: Cnidarian abundance overlaid over PSD principal components analysis plot

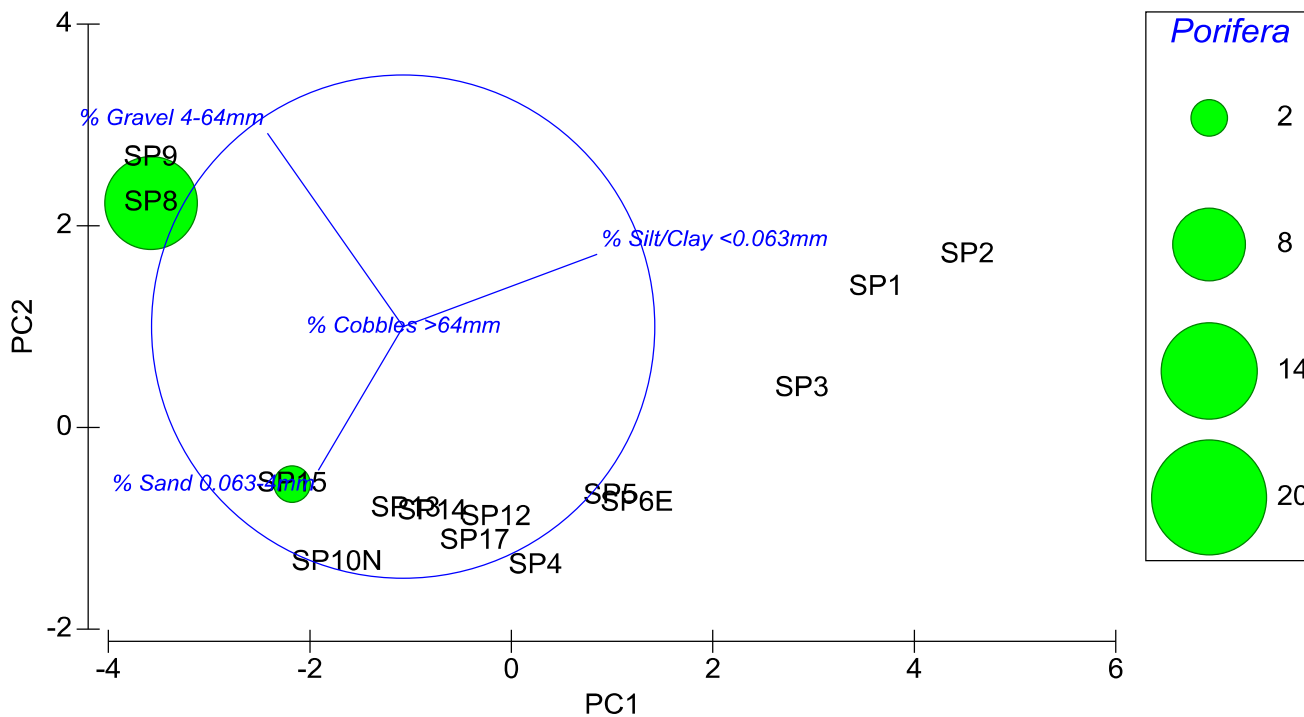


Figure 3-24: Porifera (sponge) occurrence overlaid over PSD principal components analysis plot

3.3 Sediment Profile Imagery

Three images were successfully obtained from the single deployment of the SPI system at SP3 (in the permit area). QA/QC review of the images identified that the sediment surface was not captured in the images due to over-penetration of the prism.

The quality of the images was sufficient for analysis, although depth measurements were recorded as “greater than” (>) as there was no point of reference other than the top of the images. Normally the point of reference used is the sediment surface. The surface of the sediment was not captured due to the soft nature of the sediment. Normally, the first deployment images are reviewed and the maximum penetration depth adjusted on the frame to enable capture of the sediment surface for subsequent deployments. The maximum penetration depth was >17.5 cm (**Table 3-10**), with no evidence of smearing in the images. The apparent Redox Potential Discontinuity (aRPD) layer was not clearly evident, most likely due to the relatively consistent sediment composition throughout the sediment profile in the images. A relatively thin coarser layer was evident in the upper profile, with the majority of the profile consisting of consolidated fine (silt/clay) particles with fine sand and small particles of broken shell. Evidence of bioturbation was recorded in all three images, through the identification of burrows (1) and feeding voids (7) (e.g. **Figure 3-25**). Limited assessment of the Benthic Habitat Quality (BHQ) index (Nilsson and Rosenberg 1997, 2000) could be undertaken, due to the lack of sediment surface in the images. Results were indicative of benthic infaunal successional stage III, which identifies an undisturbed habitat (Pearson and Rosenberg 1978). No evidence of methane gas pockets or hydrocarbons was identified.

The smallest particle size identified from analysis of the images was 55 µm. This defined the lowest limit of resolution of this method.

Table 3-10: Results of analysis of images obtained using the Sediment Profile Imagery system

Parameter	Profile Image 1	Profile Image 2	Profile Image 3
Min. penetration depth (cm)	Not measurable	Not measurable	Not measurable
Max. penetration depth (cm)	>17.6	>17.7	>17.7
Min. aRPD depth (cm)	Not identified	Not identified	Not identified
Max. aRPD depth (cm)	Not identified	Not identified	Not identified
Max. burrow depth (cm)	>4.9	N/A	N/A
Min. feeding void 1 depth (cm)	>12.8	>9.5	>4.2
Max. feeding void 1 depth (cm)	>13.1	>10.1	>4.7
Min. feeding void 2 depth (cm)	N/A	>11.1	>10.3
Max. feeding void 2 depth (cm)	N/A	>11.3	>11.2
Min. feeding void 3 depth (cm)	N/A	>13.4	>10.3
Max. feeding void 3 depth (cm)	N/A	>14.1	>10.7
Successional stage	III	III	III
Benthic Habitat Quality (BHQ) index:			
A =	N/A	N/A	N/A
B =	3	3	3
C =	N/A	N/A	N/A
Average particle size (mm)	0.080	0.087	0.094
Particle count	132443	102386	47805
Total area (%)	2.818	3.283	3.07

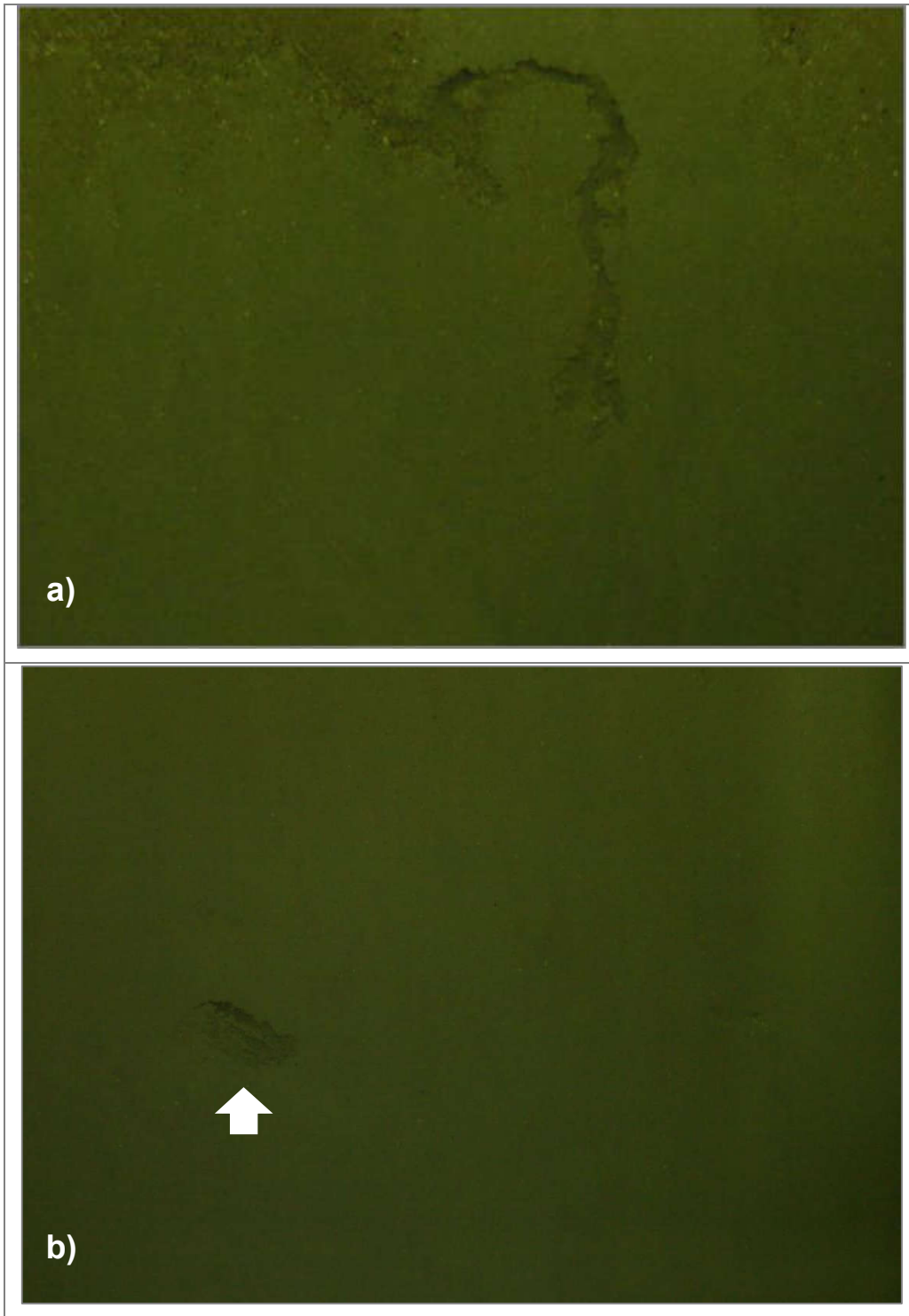


Figure 3-25: Burrow (a) and feeding void (b) in SPI image from site SP3

4. Discussion

This survey provides baseline information on sediment quality and a characterisation of seabed habitats in and around the permit area. In general, the sites surveyed ranged in depth from around 70 m at the shoals and banks to approximately 280 m in the permit area. Shallower sampling sites on the shoals and banks (with minimum depths of <10 m in places) were found to be unsuitable for sediment sampling due to the density of coral/biota cover and lack of consistent sediment patches (following review of remotely operated vehicle or GoPro imagery). Therefore, to mitigate environmental risk, sampling was not undertaken at such sites.

Of the metals and metalloids tested, only cobalt and nickel were recorded above the ANZECC & ARMCANZ (2000b) ISQG-low reliability trigger values. Cobalt was commonly recorded above the ISQG-low reliability trigger value level of 1.0 mg/kg (at all sites except SP8 in the permit area). Nickel concentrations were recorded at or slightly above the ISQG-low trigger value (21 mg/kg DW) at SP1 and SP2 (within the permit area), respectively. Nickel is commonly recorded at high levels in Australian sediments (Commonwealth of Australia 2009).

Tributyltin and hydrocarbons (TPHs, TRHs and BTEXN) were below the laboratory reporting limits at all sites. Although historic exploration has been undertaken in the permit area, potential impacts from these activities were not detected at the sampling locations.

Radium²²⁶ concentrations were recorded above the minimum reporting limit at SP4 (within the permit area) and SP6E (approximately 20 km to the west of the permit area), but at levels well below the ANZECC & ARMCANZ (2000b) ISQG-low reliability trigger value for radionuclides (sum of gross alpha and gross beta) of 35 Bq/g. Radium²²⁸ and thorium²²⁸ were not detected at any site.

Nitrogen, phosphorus and organic carbon are released when organic compounds decay. The highest concentrations of nitrogen and organic carbon were associated with the permit area sediments, which were the deepest and the finest sediment habitats sampled. Deep water sediment habitats are predominantly depositional, as indicated by their relatively high PSD fines component and nutrient content. The benthic biological communities of these habitats are consumers rather than (primary) producers. They utilise the increased nutrient component of sediments through adoption of detritus or deposit feeding strategies, which may be used in combination with other feeding strategies (e.g. carnivory, scavenging or filter feeding).

The sediment type identified during this study were comparable with those found in local and broader regional seabed habitat mapping studies undertaken in the Eastern Joseph Bonaparte Gulf and Timor Sea (URS 2005 and 2008, Fugro 2006a, b, Anderson et al. 2011, Przeslawski et al. 2011). The study area was characterised by a gradual transition in sediment composition over broad spatial scales (tens of kilometres), and in particular between the permit area and the sediments of the shallow shoals. This common trend is often related to depth (and therefore current velocities at the sediment–water interface) and prevailing current or weather direction (e.g. fetch). There was a lesser trend of an east–west transition in sediment type in the permit area, with finer sediments (sandy muds) in the east to coarser muddy sands in the west. This is likely to be related to the prevailing current direction, which flows along a south-eastward to north-westward axis near the seabed (Fugro 2015). The use of Folk sediment classifications was useful in mapping the different sediment types, and clearly illustrated the transition in sediments from finer deep sediments to coarse shallow water sediments.

Infaunal communities were variable throughout the study area and are considered indicative of the benthic infaunal communities that are likely to occur in the study area. Foraminifera (amoeboid protists) were recorded at a number of the permit area sites. These were testate (i.e. have a shell) and were found to be within the macrofaunal size class. These were also found in deep offshore water sediments sampled during a study in the Browse Basin (approximately 30 km north-west of Seringapatam Reef) (SKM 2014). Relatively depauperate faunal communities (only three individuals representing three taxa per 0.1 m²) were found at site SP10N (which consisted of slightly gravelly sand, with approximately 1% gravel) on or adjacent to the steep shoal slope at Evans Shoal. In contrast, the coarser gravelly sand sediments (approximately 24% gravel) at site SP8 in the permit area were found to be diverse (42 taxa), with an abundance of 63 individuals per 0.1 m². The relationship between coarse sediments, high infaunal abundances and species richness has been previously identified in the north-west shelf. Huang et al. (2013) noted that greater species richness and total abundance were associated with coarse-grained, heterogeneous sediments. The infaunal data from this study was found to have a greater number of taxa than recorded from the Browse Basin study (SKM 2014), with a total of 124 taxa from

11 samples in comparison with 67 taxa from 14 samples, respectively. This can be explained by the ratio of samples collected in deep water (12 of 14 samples taken in >400 m in the Browse Basin study area; 5 of 11 samples collected in water depths of >200 m in the current study area). Shallower sites were found to have greater species richness (**Section 3.2.1**). Analysis of PSD from both the current study area and the Browse Basin study showed that the shallower sediments associated with reef, shoals and banks were coarser in nature. Increased light and food availability (due to increased productivity) in the shallow photic zone is also likely to be a contributing factor. The range of infaunal abundances and number of species was greater than that found in the Browse Basin study (from 3 to 63 individuals and 3 to 42 species per 0.1m² compared with 2 to 48 individuals and 2 to 15 species from the Browse Basin). It must be noted, however, that the Browse Basin deep samples were collected using a 0.1 m² box core, and the shallow samples using a 0.025 m² petit ponar grab, so the upper range of infaunal abundance and number of species are likely to be higher for Browse (and potentially more comparable with shallow-water samples collected in the current study). The characteristics of the infaunal community recorded in the study area were comparable with those from other studies in North-West Australia. For example, infaunal data recorded from the Carnarvon Shelf in North-West Australia varied from 4 to 97 individuals per 0.1 m² and from 4 to 48 species per 0.1 m² across the region studied (Przeslawski et al. 2013).

In situ observations and photographs of conspicuous biota collected in grab samples provided important ecological context to the infaunal data (Olenin and Ducrotoy 2006). Aggregations of encrusting and sessile biota (comprising of sponges, ascidians, hydroids, polychaete tubes, red and green algae; for example, as recorded from site SP8 at Evans Shoal) increase the availability of niches for colonisation by a wide range of cryptic biota. Large tube-dwelling infaunal crustacea were also recorded from this site, such as mantis shrimp and shrimp. Large shell hash were recorded at SP15 at Lynedoch Bank, which was found to have the second highest species richness and abundance. Large pieces of shell material and calcareous structures are of ecological importance to particulate sediment biota. They can provide niches for colonisation by encrusting or cryptic biota, such as squat lobsters and other crustaceans, and can also help consolidate sediments. Sediment descriptions and deck sample photographs were considered as part of the interpretation of the PSD and infaunal data, as larger sediment components (e.g. shell hash, cobbles) and biological aggregations are not necessarily incorporated in the PSD and infaunal data. Large particle sizes (large shell hash and cobbles) are often excluded from the sample collected for PSD analysis due to either the low number per surface area sampled or (most commonly) as they take up too large proportion of the sample volume, which would skew the data. Aggregations may be excluded or under-represented by infaunal analysis as colonial organisms may be counted as individuals (under-representing their contribution), or excluded if they do not happen to occur in the sample randomly chosen for infaunal analysis. Therefore, capturing these ecological components through sediment descriptions and deck photos provided additional context in identifying relationships between habitat composition and infaunal diversity and abundance (e.g. at site SP8 in the permit area).

Although only deployed once at one site in the permit area (SP3), the SPI system provided some additional contextual information on undisturbed sediment profiles (e.g. structure) and bioturbation. The images indicated that the site was undisturbed, based on the key features recorded (e.g. burrows, feeding voids and lack of hydrocarbons or methane gas pockets). Particle size analysis from the three SPI images determined that average particle size was 87 µm. The median grain size from PSD analysis on a sediment sample taken in the vicinity was 70 µm. These values are sufficiently similar that they would have been characterised in the same size fraction using the PSD analysis, i.e. very fine sand (63 µm–125 µm).

In summary, the results of the sediment survey contributed to an appropriate baseline characterisation of the sediment quality in the study area, and provided an indication of the composition of infaunal communities that are found in the area.

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Appendix A. Sediment Survey Field Logsheets

Log sheet No.	Site	Sample	Date	Equipment	Sampler?	Time	Waypoint	S	E	Side depth [E det. depth]	Depth	Proportion of grab	Organics/metals	Hydrocarbons	NO3/NO5	PSD	Infauna	Sediment composition	Sediment features	Conspicuous fauna	Photo?	Comments	
1	SP17	1	8/04/2015	0.2m van Veen	N	17:56	1465	10° 52' 49.30"	10° 02' 37.3333"	130.0380333	115	N/A	N	N	N	N	N	N/A	N/A	N/A	N		
1	SP17	2	8/04/2015	0.2m van Veen	N	17:52	1465	10° 52' 49.30"	10° 02' 37.3333"	130.0380333	115	N/A	N	N	N	N	N	N/A	N/A	N/A	N		
1	SP17	3	8/04/2015	0.2m van Veen	Y	18:07	1465	10° 52' 49.30"	10° 02' 37.3333"	130.0380333	115	1/2	Y	Y	Y	>300	N	Green grey silt/sand with few small shell fragments. Slightly coarser than SP17. Slightly brown coarser layer on surface.	Tubes	Ainfield worm	N		
2	SP5	1	5/04/2015	0.2m van Veen	Y	7:28	1467	09° 54' 29.33"	9.886263333	130.40373	211	> 1/2	Y	Y	Y	>300	N	Green grey silt/sand with few small shell fragments. Slightly coarser than SP17. Slightly orange thin veneer.	None	None	N		
2	SP5	2	5/04/2015	0.2m van Veen	Y	8:11	1468	09° 54' 31.15"	9.886483333	130.40411	211	> 1/2	Y	Y	Y	N	N	As above	None	Polychaete	N		
2	SP5	3	5/04/2015	0.2m van Veen	Y	8:46	1469	09° 54' 32.30"	9.886633333	130.40403	211	N/A	N	N	N	N	N	N/A	N/A	N/A	N		
3	SP4	1	5/04/2015	0.2m van Veen	Y	9:08	1470	09° 54' 32.37"	9.886793333	130.40347	211	> 1/2	N	N	N	N	Y	As previous, shell fragments	Tubes	Pectinaria polychaetes, solitary corals	Y		
3	SP4	2	5/04/2015	0.2m van Veen	Y	11:58	1471	09° 54' 26.26"	9.90236	130.1740767	220	> 1/2	Y	Y	Y	>300	N	Olive coloured silt/sand, some shell fragments	None	None	N		
3	SP4	3	5/04/2015	0.2m van Veen	N (non grab)	12:25	1472	09° 54' 24.24"	9.90242	130.1740667	220	N/A	N	N	N	N	N	N/A	N/A	N/A	N		
4	SP6	1	10/04/2015	0.1m van Veen	N	17:59	1473	09° 48' 37.44"	9.80744	129.9686667	270	Scrapings	N	N	N	N	N	N/A	N/A	N/A	N		
4	SP6	2	10/04/2015	0.1m van Veen	N	18:36	1474	09° 48' 37.36"	9.80736	129.9686667	270	Scrapings	N	N	N	N	N	N/A	N/A	N/A	N		
4	SP6	3	10/04/2015	0.1m van Veen	N	7:34	1475	09° 48' 36.47"	9.80735	129.9686667	161	Scrapings	N	N	N	N	N	N/A	N/A	N/A	N	Moved site to the East	
5	SP9	1	10/04/2015	0.1m van Veen	Y	7:50	1476	09° 46' 49.00"	9.78179	129.938233333	129.60755	~1.5 cm thickness	Y	Y	Y	Y	Y	N	Coral gravel/pebbles	1 dead solitary coral	N		
5	SP9	2	10/04/2015	0.1m van Veen	Y	8:15	1477	09° 46' 48.43"	9.78172	129.937763333	129.60783	169	~1.5 cm thickness	Y	Y	Y	Y	N	Coarse, shelly coral gravel/pebbles with some coarse sand	Tubes, casts	Polychaete tubes	Y	
5	SP9	3	10/04/2015	0.1m van Veen	N	8:55	1478	09° 46' 48.26"	9.78166	129.9345333	200	No sample	N	N	N	N	N	N/A	N/A	N/A	N		
6	SP10	1	10/04/2015	0.1m van Veen	Y	9:38	1479	09° 44' 42.22"	9.85422	129.9249333	242	No sample	N	N	N	N	N	N/A	N/A	N/A	N		
6	SP10	2	10/04/2015	0.1m van Veen	Y	10:45	1480	09° 44' 42.74"	9.85474	129.9262667	242	1/2	Y	Y	Y	>300	N	Sandy with small shell fragments, brownish in colour	None	None	N		
6	SP10	3	10/04/2015	0.1m van Veen	Y	11:25	1481	09° 44' 40.71"	9.85407	129.9337033	242	1/2	Y	Y	Y	Y	N	Sandy with small shell fragments, brownish in colour	None	None	N		
7	SP10	1	10/04/2015	0.1m van Veen	Y	12:05	1482	09° 44' 40.65"	9.85405	129.9258967	242	1/2	Y	Y	Y	Y	N	Sandy with small shell fragments, brownish in colour	Tubes, casts	Pectinaria sp.	Y		
7	SP8	1	10/04/2015	GoPro	N/A	14:02	1483	09° 57' 10.08"	9.95108	129.9344833	69	N/A	N/A	N/A	N/A	N/A	N	N/A	N/A	N/A	N	GoPro video	
7	SP8	2	10/04/2015	0.1m van Veen	Y	14:25	1484	09° 57' 11.12"	9.95112	129.9344833	69	> 1/2	Y	Y	Y	>300	N	Coarse sand, shell (leaves) and coralline algae	None	Caprellid, amphipod, shrimp, red algae, continue algae balls	N/A		
8	SP8	1	10/04/2015	0.1m van Veen	Y	14:45	1485	09° 57' 10.06"	9.95106	129.9344833	69	1/2	Y	Y	Y	Y	N	Coarse sand and shell fragments	Tubes, casts	Mantis shrimp (stomatopod), Galathea sp., sponges, hydroids, ascidian	Y	Labelled photo of bicia, not sediment sample	
8	SP8	2	10/04/2015	0.1m van Veen	Y	15:05	1486	09° 57' 11.35"	9.95135	129.9344833	69	1/2	Y	Y	Y	Y	N	Coarse sand, shell fragments and infaunal tubes	Tubes, casts	Galathea sp., sponges, hydroids, ascidian, polychaete worm tubes	Y		
8	SP12	1	10/04/2015	0.1m van Veen	Y	16:15	1487	10° 03' 38.45"	10.05845	129.9734667	108	> 1/2	Y	Y	Y	>300	N	Silty sand and some shell fragments	Tubes	Polychaete tubes	N		
9	SP12	2	10/04/2015	0.1m van Veen	Y	16:25	1488	10° 03' 38.42"	10.05842	129.9734667	107	2/3	Y	Y	Y	Y	N	Silty sand and some shell fragments	None	None	N		
9	SP12	3	10/04/2015	0.1m van Veen	Y	16:52	1489	10° 03' 38.55"	10.05855	129.9734667	107	2/3	Y	Y	Y	Y	N	Silty sand and some shell fragments	None	None	Y		
9	SP1	1	11/04/2015	0.1m van Veen	Y	7:27	1492	09° 43' 40.24"	9.721266667	130.0758867	276	Full	Y	Y	Y	>300	N	Very slightly sandy silt clay	Tubes, casts	Shrimp, sponge	Y		
10	SP1	2	11/04/2015	0.1m van Veen	Y	8:01	1493	09° 43' 39.99"	9.721266667	130.0758867	277	Full	Y	Y	Y	Y	N	Very slightly sandy silt clay	Tubes, casts	Polychaete	N		
10	SP1	3	11/04/2015	0.1m van Veen	Y	8:32	1496	09° 43' 40.24"	9.721266667	130.0758867	277	Full	Y	Y	Y	Y	N	Very slightly sandy silt clay	Tubes, casts	Polychaetes (including bamboo worms, Pectinaria), fish	Y		
10	SP2	1	11/04/2015	0.1m van Veen	N	11:19	1497	09° 44' 48.85"	9.741818333	130.0390433	277	N/A	N/A	N/A	N/A	N	N	N/A	N/A	N/A	N	Grab failed to close	
11	SP2	2	11/04/2015	0.1m van Veen	Y	11:42	1498	09° 44' 49.29"	9.742823333	130.0386733	277	Full	Y	Y	Y	>300	N	Very slightly sandy silt clay	Burrows, tubes, casts	Polychaetes	Y		
11	SP2	3	11/04/2015	0.1m van Veen	Y	12:15	1499	09° 44' 49.95"	9.742823333	130.0391233	277	Full	Y	Y	Y	Y	N	Very slightly sandy silt clay	Burrows, tubes, casts	Polychaetes	Y		
11	SP2	4	11/04/2015	0.1m van Veen	Y	13:51	1500	09° 44' 50.02"	9.742823333	130.0388133	277	Full	Y	Y	Y	Y	N	Very slightly sandy silt clay	Burrows, tubes, casts	None	N		
12	SP3	1	11/04/2015	0.1m van Veen	Y	14:28	1501	09° 45' 7.02"	9.75702	130.1745767	279	Full	Y	Y	Y	>300	N	Very slightly sandy silt clay - layer with shell at around 10cm depth	Tubes, casts	Polychaetes	N		
12	SP3	2	11/04/2015	0.1m van Veen	Y	14:56	1502	09° 45' 7.33"	9.75733	130.1746767	279	Full	Y	Y	Y	Y	N	Very slightly sandy silt clay - layer with shell at around 10cm depth	Burrows, tubes, casts	Polychaete tubes	Y		
13	SP3	3	11/04/2015	0.1m van Veen	Y	15:23	1503	09° 45' 7.38"	9.75738	130.1746967	279	Full	Y	Y	Y	Y	N	Very slightly sandy silt clay - layer with shell at around 10cm depth	Tubes, casts	None	N		
13	SP4	1	11/04/2015	SPI	N	16:33	1504	09° 45' 6.69"	9.75699	130.1747367	279	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	No image	
13	SP3	2	11/04/2015	SPI	Y	16:35	1505	09° 45' 6.681"	9.75681	130.1747267	279	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	Profile image	
13	SP3	3	11/04/2015	SPI	N	16:39	1506	09° 45' 6.667"	9.75667	130.1746667	279	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	No image	
13	SP3	4	11/04/2015	SPI	Y	16:43	1507	09° 45' 6.556"	9.75656	130.1745867	279	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	Profile image	
13	SP3	5	11/04/2015	SPI	Y	16:46	1508	09° 45' 6.443"	9.75643	130.1745667	279	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	Profile image	
13	SP3	6	11/04/2015	SPI	N	17:06	1509	09° 45' 5.50"	9.75655	130.1745667	279	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	No image	
13	SP4	1	11/04/2015	0.1m van Veen	N	18:07	1510	09° 49' 19.19"	10.07228	9.817856667	130.1386467	260	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	No image	
15	SP4	1	11/04/2015	0.1m van Veen	Y	18:27	1511	09° 49' 0.14"	9.818806667	130.1386467	261	Full	Y	Y	Y	>300	N	Coarser silt/clay	Tubes, casts	Polychaete tubes	Y		
15	SP4	2	11/04/2015	0.1m van Veen	Y	18:53	1512	09° 48' 8.85"	9.80885	130.1387667	261	Full	Y	Y	Y	Y	N	Slightly sandy/shelly silt/clay mud	Tubes, casts	Polychaete tubes	Y		
15	SP4	3	11/04/2015	0.1m van Veen	Y	19:15	1513	09° 48' 8.85"	9.80885	130.1387667	261	Full	Y	Y	Y	Y	N	Slightly sandy/shelly silt/clay mud	Burrows, tubes, casts	Polychaetes	N		
15	SP4	4	11/04/2015	0.1m van Veen	Y	19:25	1514	09° 48' 8.85"	9.80885	130.1387667	261	Full	Y	Y	Y	Y	N	Slightly sandy/shelly silt/clay mud	None	Polychaetes, shell and encrusting tubeworms	N		
15	SP4	5	11/04/2015	0.1m van Veen	Y	19:30	1514	09° 48' 8.85"	9.80885	130.1387667	261	Full	Y	Y	Y	Y	>300	N	Slightly sandy/shelly silt/clay mud	None	Polychaetes	N	
16	SP5	1	12/04/2015	0.1m van Veen	Y	7:41	1515	10° 00' 51.56"	10.00516	130.1736267	123	1/2	Y	Y	Y	Y	N	Shelly silt/clay	Tubes	Brittlestar, polychaetes	N		
16	SP5	2	12/04/2015	0.1m van Veen	Y	7:57	1516	10° 00' 51.56"	10.00516	130.1736267	123	1/3	Y	Y	Y	Y	N	Shelly silt/clay	Tubes	Polychaete tubes	Y		
17	SP4	1	14/04/2015	0.1m van Veen	Y	14:14	1522	10° 44' 8.72"	10.242023333	130.6782667	99	Full	Y	Y	Y	Y	N	Silt/sand	None	None	N	Slightly washed out	
17	SP4	2	14/04/2015	0.1m van Veen	Y	14:23	1523	10° 44' 9.948"	10.242023333	130.6782667	99	1/2	Y	Y	Y	Y	N	Silt/sand	Tubes	Polychaete tubes	Y		
17	SP4	3	14/04/2015	0.1m van Veen	Y	14:43	1524	10° 44' 9.948"	10.242023333	130.6782667	99	1/2	Y										

Appendix B. Photographs of Grab Samples and SPI Profile Images

Sample location	Photograph
SP1	 A photograph of a sediment sample labeled SP1. The sample is a large, irregular mass of light-colored, silty sediment contained within a metal tray. A white label is placed on the right side of the tray, containing the following text: "JACOBS ConocoPhillips Barossa Field Studies IW021200 SITE: SP1 DATE: 11/04/15". A small black and white scale bar is visible at the bottom of the label.
SP2	 A photograph of a sediment sample labeled SP2. The sample is a large, irregular mass of light-colored, silty sediment contained within a metal tray. A white label is placed on the left side of the tray, containing the following text: "JACOBS ConocoPhillips Barossa Field Studies IW021200 SITE: SP2 DATE: 11/04/15". A small black and white scale bar is visible at the bottom of the label.

SP3



SP4

(no image)

SP5



SP6E	
SP7	No sample
SP8	

SP9	
SP10	
SP11	No sample

SP12



SP13



SP14	
SP15	
SP16	No sample

SP17



SP3 SPI
image 1



SP3 SPI
image 2



SP3 SPI
image 3



Appendix C. Analytical Laboratory Reports



Environmental

CERTIFICATE OF ANALYSIS

Work Order : **EP1502881** Page : 1 of 13

Client : **JACOBS GROUP (AUSTRALIA) PTY LTD** Laboratory : Environmental Division Perth

Contact : **MR CHRIS TEASDALE** Contact : **Scott James**

Address : **P O BOX H615** Address : **10 Hod Way Malaga WA Australia 6090**

PERTH WA, AUSTRALIA 6001

E-mail : **cteasdale@globalism.com** E-mail : **perth.enviro.services@alsglobal.com**

Telephone : **+61 08 9469 4400** Telephone : **+61-8-9209 7655**

Facsimile : **+61 08 9469 4488** Facsimile : **+61-8-9209 7600**

Project : **IW021200** QC Level : **NEPM 2013 Schedule B(3) and ALS QCS3 requirement**

Order number : **----** Date Samples Received : **16-APR-2015**

C-O-C number : **----** Issue Date : **06-MAY-2015**

Sampler : **G.H.** No. of samples received : **29**

Site : **----** No. of samples analysed : **25**

Quote number : **ENJ003/14**

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits



**WORLD RECOGNISED
ACCREDITATION**

NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

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

Signatories	Position	Accreditation Category
Matt Frost	Senior Organic Chemist	Brisbane Organics
Rassem Ayoubi	Senior Organic Chemist	Perth Inorganics
Rassem Ayoubi	Senior Organic Chemist	Perth Organics



Page : 2 of 13
Work Order : EP1502881
Client : JACOBS GROUP (AUSTRALIA) PTY LTD
Project : IW021200

General Comments

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

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

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

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

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

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

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

LOR = Limit of reporting

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

● **EP080: Poor matrix spike recoveries due to matrix effects. Confirmed by re-extraction and re-analysis.**

● **EP090: Particular samples shows poor surrogate recovery due to matrix interference. Confirmed by re-extraction and re-analysis.**



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Client sample ID					
			SP1 1	SP1 2	SP2 1	SP2 2	SP3 1	
			Client sampling date / time					
		Unit						
EAO55: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	62.7	63.3	65.5	63.7	60.4
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	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
Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	<1	<1	<1
Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	<1	<1	<1
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	64.2	70.9	66.7	70.6	72.9
Toluene-D8	2037-26-5	0.1	%	68.1	74.1	66.4	72.3	72.6
4-Bromofluorobenzene	460-00-4	0.1	%	69.7	74.4	66.6	74.6	73.4



Page : 4 of 13
Work Order : EP1502881
Client : JACOBS GROUP (AUSTRALIA) PTY LTD
Project : IW021200

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Client sample ID							
			Client sampling date / time	SP1 1	SP1 2	SP2 1	SP2 2	SP3 1		
EP090S: Organotin Surrogate										
Tripopyitin	----	0.1	%	86.8	68.2	12.2	74.1	8.8		



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID							
Compound	CAS Number	LOR	Unit	Client sampling date / time	SP3 2	SP4 1	SP5 1	SP5 2	SP6 1
EAO55: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		62.7	45.5	50.1	50.8	52.7
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	>C10_C16	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	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
Total Xylenes	1330-20-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP090: Organotin Compounds									
Monobutyltin	78763-54-9	1	µgSn/kg		<1	<1	<1	<1	<1
Dibutyltin	1002-53-5	1	µgSn/kg		<1	<1	<1	<1	<1
Tributyltin	56573-85-4	0.5	µgSn/kg		<0.5	<0.5	<0.5	<0.5	<0.5
EP080S: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	0.1	%		73.5	74.0	75.1	74.0	77.1
Toluene-D8	2037-26-5	0.1	%		67.8	74.8	72.6	72.8	72.5
4-Bromofluorobenzene	460-00-4	0.1	%		65.7	75.2	72.0	75.6	73.1



Page : 6 of 13
 Work Order : EP1502881
 Client : JACOBS GROUP (AUSTRALIA) PTY LTD
 Project : IW021200

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Unit	Client sample ID						
				Client sampling date / time	SP3 2	SP4 1	SP5 1	SP5 2	SP6 1	
EP090S: Organotin Surrogate										
Tripopyitin	----	0.1	%		66.6	79.2	92.2	83.5	97.9	
				11-APR-2015 15:23	EP1502881-006	EP1502881-007	EP1502881-008	EP1502881-009	EP1502881-010	
				09-APR-2015 11:58			09-APR-2015 07:28	09-APR-2015 08:11	09-APR-2015 18:27	



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID						
Compound	CAS Number	LOR	Client sampling date / time	SP8 1	SP8 2	SP10N 1	SP10N 2	SP12 1
			Unit	EP1502881-012	EP1502881-013	EP1502881-014	EP1502881-015	EP1502881-016
EAO55: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	29.0	28.7	33.2	36.3	40.6
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	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
Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	1	<1	<1
Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	<1	<1	<1
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	87.4	88.1	76.8	83.6	82.1
Toluene-D8	2037-26-5	0.1	%	80.4	83.1	69.4	74.4	74.4
4-Bromofluorobenzene	460-00-4	0.1	%	78.6	78.5	68.8	71.7	72.0



Page : 8 of 13
 Work Order : EP1502881
 Client : JACOBS GROUP (AUSTRALIA) PTY LTD
 Project : IW021200

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Client sample ID		Client sampling date / time	Unit	%
			SP8 1	SP8 2			
EP090S: Organotin Surrogate			10-APR-2015 14:25	10-APR-2015 14:45	10-APR-2015 10:45	10-APR-2015 11:25	10-APR-2015 16:15
Tripopyitin	----	0.1	EP1502881-012	EP1502881-013	EP1502881-014	EP1502881-015	EP1502881-016
			69.8	20.1	97.2	99.1	85.5



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID						
Compound	CAS Number	LOR	Client sampling date / time	SP12 2	SP15 1	SP15 2	SP17 1	SP14 1
			Unit	EP1502881-017	EP1502881-018	EP1502881-019	EP1502881-020	EP1502881-021
EAO55: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	41.7	31.8	29.4	42.7	40.0
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	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
Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	<1	<1	<1
Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	<1	<1	<1
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	80.4	76.1	83.0	75.9	79.2
Toluene-D8	2037-26-5	0.1	%	73.1	67.0	74.5	67.0	71.5
4-Bromofluorobenzene	460-00-4	0.1	%	68.5	67.4	73.2	66.2	70.9



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Work Order : EP1502881
Client : JACOBS GROUP (AUSTRALIA) PTY LTD
Project : IW021200

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Client sampling date / time		Client sample ID	
			Unit			
EP090S: Organotin Surrogate	-----	0.1	10-APR-2015 16:25	12-APR-2015 07:20	12-APR-2015 07:41	14-APR-2015 14:14
			EP1502881-017	EP1502881-018	EP1502881-019	EP1502881-020
Tripopyitin			95.0	80.3	69.8	86.8

88.2



Analytical Results

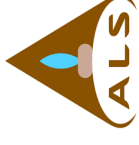
Sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID						
Compound	CAS Number	LOR	Unit	SP14 2	SP13 1	SP13 2	SP6E 1	SP6E 2
Client sampling date / time				14-APR-2015 14:28	14-APR-2015 15:42	14-APR-2015 16:01	11-APR-2015 15:00	11-APR-2015 15:00
CAS Number		Unit		EP1502881-022	EP1502881-023	EP1502881-024	EP1502881-025	EP1502881-030
EAO55: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	39.7	34.0	30.4	52.2	52.9
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
C10 - C36 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	<10	<10	<10
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg	<10	<10	<10	<10	<10
>C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg	<100	<100	<100	<100	<100
>C10 - C40 Fraction (sum)	----	50	mg/kg	<50	<50	<50	<50	<50
>C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg	<50	<50	<50	<50	<50
EP080: BTEXN								
Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	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
Total Xylenes	1330-20-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg	<1	<1	<1	<1	<1
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	<1	<1	<1
Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	<1	<1	<1
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	<0.5	<0.5	<0.5
EP080S: TPH(V)/BTEX Surrogates								
1,2-Dichloroethane-D4	17060-07-0	0.1	%	85.8	89.3	77.4	88.3	86.8
Toluene-D8	2037-26-5	0.1	%	77.2	78.9	66.3	77.5	75.8
4-Bromofluorobenzene	460-00-4	0.1	%	82.2	81.8	70.9	78.9	79.0



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 Work Order : EP1502881
 Client : JACOBS GROUP (AUSTRALIA) PTY LTD
 Project : IW021200

Analytical Results

Compound	CAS Number	LOR	Client sampling date / time		Client sample ID		
			Unit	%	SP13 1	SP13 2	SP6E 1
EP090S: Organotin Surrogate			14-APR-2015 14:28	14-APR-2015 15:42	14-APR-2015 16:01	11-APR-2015 15:00	11-APR-2015 15:00
Tripopyitin	----	0.1	EP1502881-022	EP1502881-023	EP1502881-024	EP1502881-025	EP1502881-030
			70.7	54.8	87.2	89.9	100



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Work Order : EP1502881
Client : JACOBS GROUP (AUSTRALIA) PTY LTD
Project : IW021200

Surrogate Control Limits

Sub-Matrix: SOIL			
Compound	CAS Number	Recovery Limits (%)	
		Low	High
EP080S: TPH(V)/BTX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	63.2	132
Toluene-D8	2037-26-5	66.0	125.4
4-Bromofluorobenzene	460-00-4	60.4	124
EP090S: Organotin Surrogate			
Tripolytin	----	35	130



Environmental

QUALITY CONTROL REPORT

Work Order : EP1502881 Page : 1 of 9
Client : JACOBS GROUP (AUSTRALIA) PTY LTD Laboratory : Environmental Division Perth
Contact : MR CHRIS TEASDALE Contact : Scott James
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Telephone : +61 08 9469 4400 Telephone : +61 -8-9209 7655
Facsimile : +61 08 9469 4488 Facsimile : +61 -8-9209 7600
Project : IW021200 QC Level : NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site : -----
C-O-C number : -----
Sampler : G.H.
Order number : -----
Quote number : EN/003/14

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

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



WORLD RECOGNISED
ACCREDITATION

NATA Accredited
Laboratory 825

Accredited for
compliance with
ISO/IEC 17025.

Signatories

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

Signatories	Position	Accreditation Category
Matt Frost	Senior Organic Chemist	Brisbane Organics
Rassem Ayoubi	Senior Organic Chemist	Perth Inorganics
Rassem Ayoubi	Senior Organic Chemist	Perth Organics



Page : 2 of 9
Work Order : EP1502881
Client : JACOBS GROUP (AUSTRALIA) PTY LTD
Project : IW021200

General Comments

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

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

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

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

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%.

Laboratory Duplicate (DUP) Report									
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA055: Moisture Content (QC Lot: 3907064)									
EP1502881-001	SP1 1	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	62.7	62.8	0.3	0% - 20%
EP1502881-010	SP6 1	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	52.7	52.7	0.0	0% - 20%
EA055: Moisture Content (QC Lot: 3907065)									
EP1502881-022	SP14 2	EA055-103: Moisture Content (dried @ 103°C)	---	1.0	%	39.7	39.7	0.0	0% - 20%
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3904677)									
EP1502881-001	SP1 1	EP071: C15 - C28 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	---	50	mg/kg	<50	<50	0.0	No Limit
EP1502881-012	SP8 1	EP071: C15 - C28 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	---	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3904678)									
EP1502899-001	Anonymous	EP071: C15 - C28 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	---	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3904680)									
EP1502881-001	SP1 1	EP080: C6 - C9 Fraction	---	10	mg/kg	<10	<10	0.0	No Limit
EP1502881-012	SP8 1	EP080: C6 - C9 Fraction	---	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 3904681)									
EP1502899-001	Anonymous	EP080: C6 - C9 Fraction	---	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3904677)									
EP1502881-001	SP1 1	EP071: >C16 - C34 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	<50	0.0	No Limit
EP1502881-012	SP8 1	EP071: >C16 - C34 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3904678)									
EP1502899-001	Anonymous	EP071: >C16 - C34 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	---	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3904680)									
EP1502881-001	SP1 1	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	No Limit
EP1502881-012	SP8 1	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	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 (%)		
EP080: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 3904681)											
EP1502899-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	No Limit		
EP080: BTEXN (QC Lot: 3904680)											
EP1502881-001	SP1 1	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit		
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
		EP080: meta- & para-Xylene	108-38-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
			106-42-3								
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit		
		EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit		
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
		EP080: meta- & para-Xylene	108-38-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
			106-42-3								
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit		
EP080: BTEXN (QC Lot: 3904681)											
EP1502899-001	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit		
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
		EP080: meta- & para-Xylene	108-38-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
			106-42-3								
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit		
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit		
EP090: Organotin Compounds (QC Lot: 3910186)											
EP1502881-007	SP4 1	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	0.0	No Limit		
		EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	0.0	No Limit		
		EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	0.0	No Limit		
EP090: Organotin Compounds (QC Lot: 3910452)											
EP1502881-001	SP1 1	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	0.0	No Limit		
		EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	0.0	No Limit		
		EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	0.0	No Limit		
		EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	0.0	No Limit		
		EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	0.0	No Limit		
		EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	0.0	No Limit		
EP1502881-018	SP15 1	EP090: Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	0.0	No Limit		
		EP090: Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	0.0	No Limit		
		EP090: Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	0.0	No Limit		



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

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

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	
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904677)									
EP071: C10 - C14 Fraction	---	25	mg/kg	<50	1192 mg/kg	87.6	47	135	
EP071: C15 - C28 Fraction	---	50	mg/kg	<100	2699 mg/kg	90.5	63	129	
EP071: C29 - C36 Fraction	---	50	mg/kg	<100	437 mg/kg	75.1	53	135	
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904678)									
EP071: C10 - C14 Fraction	---	25	mg/kg	<50	1192 mg/kg	99.6	47	135	
EP071: C15 - C28 Fraction	---	50	mg/kg	<100	2699 mg/kg	99.6	63	129	
EP071: C29 - C36 Fraction	---	50	mg/kg	<100	437 mg/kg	88.8	53	135	
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904680)									
EP080: C6 - C9 Fraction	---	10	mg/kg	<10	32 mg/kg	103	64	134	
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904681)									
EP080: C6 - C9 Fraction	---	10	mg/kg	<10	32 mg/kg	99.1	64	134	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904677)									
EP071: >C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	1913 mg/kg	89.8	61	133	
EP071: >C16 - C34 Fraction	---	100	mg/kg	<100	2245 mg/kg	90.5	63	135	
EP071: >C34 - C40 Fraction	---	100	mg/kg	<100	151 mg/kg	63.1	50	140	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904678)									
EP071: >C10 - C16 Fraction	>C10_C16	50	mg/kg	<50	1913 mg/kg	99.0	61	133	
EP071: >C16 - C34 Fraction	---	100	mg/kg	<100	2245 mg/kg	101	63	135	
EP071: >C34 - C40 Fraction	---	100	mg/kg	<100	151 mg/kg	93.2	50	140	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904680)									
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	37 mg/kg	102	61	143	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904681)									
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	37 mg/kg	99.2	61	143	
EP080: BTEXN (QCLot: 3904680)									
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	2 mg/kg	98.0	73	127	
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	2 mg/kg	98.8	72	126	
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	2 mg/kg	97.6	73	125	



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 Work Order : EP1502881
 Client : JACOBS GROUP (AUSTRALIA) PTY LTD
 Project : IW021200

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report		
				Spike Concentration	SpikeRecovery(%) MS	Recovery Limits (%) Low High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904678) - continued						
EP1502899-001	Anonymous	EP071: C15 - C28 Fraction	----	2699 mg/kg	92.8	61.7 124
		EP071: C29 - C36 Fraction	----	437 mg/kg	84.2	64.6 131
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904680)						
EP1502881-002	SP1 2	EP080: C6 - C9 Fraction	----	24 mg/kg	# 56.7	69.1 135
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904681)						
EP1502899-001	Anonymous	EP080: C6 - C9 Fraction	----	24 mg/kg	94.6	69.1 135
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904677)						
EP1502881-002	SP1 2	EP071: >C10 - C16 Fraction	>C10_C16	1913 mg/kg	89.1	64.7 126
		EP071: >C16 - C34 Fraction	----	2245 mg/kg	89.2	61.7 124
		EP071: >C34 - C40 Fraction	----	151 mg/kg	66.5	64.6 131
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904678)						
EP1502899-001	Anonymous	EP071: >C10 - C16 Fraction	>C10_C16	1913 mg/kg	93.9	64.7 126
		EP071: >C16 - C34 Fraction	----	2245 mg/kg	94.0	61.7 124
		EP071: >C34 - C40 Fraction	----	151 mg/kg	85.6	64.6 131
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904680)						
EP1502881-002	SP1 2	EP080: C6 - C10 Fraction	C6_C10	29 mg/kg	# 55.4	69.1 135
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904681)						
EP1502899-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	29 mg/kg	91.9	69.1 135
EP080: BTEXN (QCLot: 3904680)						
EP1502881-002	SP1 2	EP080: Benzene	71-43-2	2 mg/kg	# 63.1	76.4 118
		EP080: Toluene	108-88-3	2 mg/kg	# 65.7	67.4 127
EP080: BTEXN (QCLot: 3904681)						
EP1502899-001	Anonymous	EP080: Benzene	71-43-2	2 mg/kg	87.3	76.4 118
		EP080: Toluene	108-88-3	2 mg/kg	90.9	67.4 127
EP090: Organotin Compounds (QCLot: 3910186)						
EP1502881-008	SP5 1	EP090: Monobutyltin	78763-54-9	1.25 µgSn/kg	38.4	35 130
		EP090: Dibutyltin	1002-53-5	1.25 µgSn/kg	80.6	20 130
		EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	80.1	20 130
EP090: Organotin Compounds (QCLot: 3910452)						
EP1502881-002	SP1 2	EP090: Monobutyltin	78763-54-9	1.25 µgSn/kg	# 23.6	35 130
		EP090: Dibutyltin	1002-53-5	1.25 µgSn/kg	67.1	20 130
		EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	77.9	20 130



The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are 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) and Matrix Spike Duplicate (MSD) Report			Recovery Limits (%)			Control Limit
				Spike Concentration	MS	MSD	Low	High	Value	
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904677)										
EP1502881-002	SP1 2	EP071: C10 - C14 Fraction	----	1192 mg/kg	86.4	----	64.7	126	----	----
		EP071: C15 - C28 Fraction	----	2699 mg/kg	89.6	----	61.7	124	----	----
		EP071: C29 - C36 Fraction	----	437 mg/kg	72.9	----	64.6	131	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904677)										
EP1502881-002	SP1 2	EP071: >C10 - C16 Fraction	>C10_C16	1913 mg/kg	89.1	----	64.7	126	----	----
		EP071: >C16 - C34 Fraction	----	2245 mg/kg	89.2	----	61.7	124	----	----
		EP071: >C34 - C40 Fraction	----	151 mg/kg	66.5	----	64.6	131	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904678)										
EP1502899-001	Anonymous	EP071: C10 - C14 Fraction	----	1192 mg/kg	94.4	----	64.7	126	----	----
		EP071: C15 - C28 Fraction	----	2699 mg/kg	92.8	----	61.7	124	----	----
		EP071: C29 - C36 Fraction	----	437 mg/kg	84.2	----	64.6	131	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904678)										
EP1502899-001	Anonymous	EP071: >C10 - C16 Fraction	>C10_C16	1913 mg/kg	93.9	----	64.7	126	----	----
		EP071: >C16 - C34 Fraction	----	2245 mg/kg	94.0	----	61.7	124	----	----
		EP071: >C34 - C40 Fraction	----	151 mg/kg	85.6	----	64.6	131	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904680)										
EP1502881-002	SP1 2	EP080: C6 - C9 Fraction	----	24 mg/kg	# 56.7	----	69.1	135	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904680)										
EP1502881-002	SP1 2	EP080: C6 - C10 Fraction	C6_C10	29 mg/kg	# 55.4	----	69.1	135	----	----
EP080: BTEXN (QCLot: 3904680)										
EP1502881-002	SP1 2	EP080: Benzene	71-43-2	2 mg/kg	# 63.1	----	76.4	118	----	----
		EP080: Toluene	108-88-3	2 mg/kg	# 65.7	----	67.4	127	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 3904681)										
EP1502899-001	Anonymous	EP080: C6 - C9 Fraction	----	24 mg/kg	94.6	----	69.1	135	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 3904681)										
EP1502899-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	29 mg/kg	91.9	----	69.1	135	----	----
EP080: BTEXN (QCLot: 3904681)										
EP1502899-001	Anonymous	EP080: Benzene	71-43-2	2 mg/kg	87.3	----	76.4	118	----	----
		EP080: Toluene	108-88-3	2 mg/kg	90.9	----	67.4	127	----	----
EP090: Organotin Compounds (QCLot: 3910186)										
EP1502881-008	SP5 1	EP090: Monobutyltin	78763-54-9	1.25 µgSh/kg	38.4	----	35	130	----	----



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 Work Order : EP1502881
 Client : JACOBS GROUP (AUSTRALIA) PTY LTD
 Project : IW021200

Sub-Matrix: **SOIL**

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report										
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)		RPDs (%)	
					MS	MSD	Low	High	Value	Control Limit
EP090: Organotin Compounds (QCLot: 3910186) - continued										
EP1502881-008	SP5 1	EP090: Dibutyltin	1002-53-5	1.25 µgSn/kg	80.6	---	20	130	----	----
		EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	80.1	---	20	130	----	----
EP090: Organotin Compounds (QCLot: 3910452)										
EP1502881-002	SP1 2	EP090: Monobutyltin	78763-54-9	1.25 µgSn/kg	# 23.6	---	35	130	----	----
		EP090: Dibutyltin	1002-53-5	1.25 µgSn/kg	67.1	---	20	130	----	----
		EP090: Tributyltin	56573-85-4	1.25 µgSn/kg	77.9	---	20	130	----	----

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EP1502881	Page	: 1 of 8
Client	: JACOBS GROUP (AUSTRALIA) PTY LTD	Laboratory	: Environmental Division Perth
Contact	: MR CHRIS TEASDALE	Contact	: Scott James
Address	: P O BOX H615 PERTH WA, AUSTRALIA 6001	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: cteasdale@globalskm.com	E-mail	: perth.enviro.services@alsglobal.com
Telephone	: +61 08 9469 4400	Telephone	: +61-8-9209 7655
Facsimile	: +61 08 9469 4488	Facsimile	: +61-8-9209 7600
Project	: IW021200	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 16-APR-2015
C-O-C number	: ----	Issue Date	: 06-MAY-2015
Sampler	: G.H.	No. of samples received	: 29
Order number	: ----	No. of samples analysed	: 25
Quote number	: EN/003/14		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers



Page : 2 of 8
 Work Order : EP1502881
 Client : JACOBS GROUP (AUSTRALIA) PTY LTD
 Project : IW021200

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (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	Date analysed	Due for analysis	Evaluation
EA055: Moisture Content							
Soil Glass Jar - Unpreserved (EA055-103)	SP17 1	08-APR-2015	---	----	21-APR-2015	22-APR-2015	✓
Soil Glass Jar - Unpreserved (EA055-103)	SP4 1, SP5 2, SP6 1	09-APR-2015	---	----	21-APR-2015	23-APR-2015	✓
Soil Glass Jar - Unpreserved (EA055-103)	SP8 2, SP10N 1, SP12 1,	10-APR-2015	---	----	21-APR-2015	24-APR-2015	✓
Soil Glass Jar - Unpreserved (EA055-103)	SP1 1, SP2 1, SP3 1, SP6E 1,	11-APR-2015	---	----	21-APR-2015	25-APR-2015	✓
Soil Glass Jar - Unpreserved (EA055-103)	SP15 1,	12-APR-2015	---	----	21-APR-2015	26-APR-2015	✓
Soil Glass Jar - Unpreserved (EA055-103)	SP14 1, SP13 1,	14-APR-2015	---	----	21-APR-2015	28-APR-2015	✓



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	Date analysed	Due for analysis
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions						
Soil Glass Jar - Unpreserved (EP071)						
SP17 1		08-APR-2015	20-APR-2015	22-APR-2015	21-APR-2015	30-MAY-2015
Soil Glass Jar - Unpreserved (EP071)	SP5 1, SP4 1, SP6 2,	09-APR-2015	20-APR-2015	23-APR-2015	21-APR-2015	30-MAY-2015
Soil Glass Jar - Unpreserved (EP071)	SP8 2, SP10N 1, SP12 1,	10-APR-2015	20-APR-2015	24-APR-2015	21-APR-2015	30-MAY-2015
Soil Glass Jar - Unpreserved (EP071)	SP1 2, SP2 2, SP3 2, SP6E 2	11-APR-2015	20-APR-2015	25-APR-2015	21-APR-2015	30-MAY-2015
Soil Glass Jar - Unpreserved (EP071)	SP15 2	12-APR-2015	20-APR-2015	26-APR-2015	21-APR-2015	30-MAY-2015
Soil Glass Jar - Unpreserved (EP071)	SP14 2, SP13 2	14-APR-2015	20-APR-2015	28-APR-2015	21-APR-2015	30-MAY-2015
EP080: BTEXN						
Soil Glass Jar - Unpreserved (EP080)						
SP17 1		08-APR-2015	20-APR-2015	22-APR-2015	21-APR-2015	22-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP5 1, SP4 1, SP6 2,	09-APR-2015	20-APR-2015	23-APR-2015	21-APR-2015	23-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP8 2, SP10N 1, SP12 1,	10-APR-2015	20-APR-2015	24-APR-2015	21-APR-2015	24-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP1 2, SP2 2, SP3 2	11-APR-2015	20-APR-2015	25-APR-2015	21-APR-2015	25-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP6E 2	11-APR-2015	21-APR-2015	25-APR-2015	21-APR-2015	25-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP15 2	12-APR-2015	20-APR-2015	26-APR-2015	21-APR-2015	26-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP14 2, SP13 2	14-APR-2015	20-APR-2015	28-APR-2015	21-APR-2015	28-APR-2015



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	Date analysed	Due for analysis
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions						
Soil Glass Jar - Unpreserved (EP080)	SP17 1	08-APR-2015	20-APR-2015	22-APR-2015	21-APR-2015	22-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP4 1, SP5 1, SP6 1	09-APR-2015	20-APR-2015	23-APR-2015	21-APR-2015	23-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP8 2, SP10N 2, SP12 2	10-APR-2015	20-APR-2015	24-APR-2015	21-APR-2015	24-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP1 2, SP2 2, SP3 2	11-APR-2015	20-APR-2015	25-APR-2015	21-APR-2015	25-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP6E 2	11-APR-2015	21-APR-2015	25-APR-2015	21-APR-2015	25-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP15 2	12-APR-2015	20-APR-2015	26-APR-2015	21-APR-2015	26-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP14 1	14-APR-2015	20-APR-2015	28-APR-2015	21-APR-2015	28-APR-2015
Soil Glass Jar - Unpreserved (EP080)	SP13 1, SP13 2	14-APR-2015	21-APR-2015	28-APR-2015	21-APR-2015	28-APR-2015
EP090: Organotin Compounds						
Soil Glass Jar - Unpreserved (EP090)	SP17 1	08-APR-2015	23-APR-2015	22-APR-2015	04-MAY-2015	02-JUN-2015
Soil Glass Jar - Unpreserved (EP090)	SP4 1, SP5 2, SP6 1	09-APR-2015	23-APR-2015	23-APR-2015	04-MAY-2015	02-JUN-2015
Soil Glass Jar - Unpreserved (EP090)	SP8 2, SP10N 2, SP12 2	10-APR-2015	23-APR-2015	24-APR-2015	04-MAY-2015	02-JUN-2015
Soil Glass Jar - Unpreserved (EP090)	SP1 2, SP2 2, SP3 2, SP6E 2	11-APR-2015	23-APR-2015	25-APR-2015	04-MAY-2015	02-JUN-2015
Soil Glass Jar - Unpreserved (EP090)	SP15 2	12-APR-2015	23-APR-2015	26-APR-2015	04-MAY-2015	02-JUN-2015
Soil Glass Jar - Unpreserved (EP090)	SP14 1, SP13 2	14-APR-2015	23-APR-2015	28-APR-2015	04-MAY-2015	02-JUN-2015



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 (%)		Evaluation
		QC	Regular	Actual	Expected		
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	3	25	12.0	10.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Organotin Analysis	EP090	3	18	16.7	10.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatle Fraction	EP071	3	26	11.5	10.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	3	26	11.5	10.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Organotin Analysis	EP090	2	18	11.1	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatle Fraction	EP071	2	26	7.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	2	26	7.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Organotin Analysis	EP090	2	18	11.1	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatle Fraction	EP071	2	26	7.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	2	26	7.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Organotin Analysis	EP090	2	18	11.1	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatle Fraction	EP071	2	26	7.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	2	26	7.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement



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
Moisture Content	EA055-103	SOIL	In-house. A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
TRH - Semivolatile Fraction	EP071	SOIL	(USEPA SW 846 - 8015A) Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40.
TRH Volatiles/BTEX	EP080	SOIL	(USEPA SW 846 - 8260B) 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	(USEPA SW 846 - 8270D) Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quantified against an established calibration curve.
Preparation Methods	Method	Matrix	Method Descriptions
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	(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	ORG17	SOIL	In-house. Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
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.



Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QW/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EP080/071: Total Petroleum Hydrocarbons	EP1502881-002	SP1 2	C6 - C9 Fraction	----	56.7 %	69.1-135%	Recovery less than lower data quality objective
EP080/071: Total Recoverable Hydrocarbons - NEPM 2015/02881-002	EP1502881-002	SP1 2	C6 - C10 Fraction	C6_C10	55.4 %	69.1-135%	Recovery less than lower data quality objective
EP080: BTEXN	EP1502881-002	SP1 2	Benzene	71-43-2	63.1 %	76.4-118%	Recovery less than lower data quality objective
EP080: BTEXN	EP1502881-002	SP1 2	Toluene	108-88-3	65.7 %	67.4-127%	Recovery less than lower data quality objective
EP090: Organotin Compounds	EP1502881-002	SP1 2	Monobutyltin	78763-54-9	23.6 %	35-130%	Recovery less than lower data quality objective

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.

Regular Sample Surrogates

Sub-Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Samples Submitted							
EP090S: Organotin Surrogate	EP1502881-003	SP2 1	Tripropyltin	----	12.2 %	35-130 %	Recovery less than lower data quality objective
EP090S: Organotin Surrogate	EP1502881-005	SP3 1	Tripropyltin	----	8.8 %	35-130 %	Recovery less than lower data quality objective
EP090S: Organotin Surrogate	EP1502881-013	SP8 2	Tripropyltin	----	20.1 %	35-130 %	Recovery less than lower data quality objective

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **SOIL**

Method Container / Client Sample ID(s)	Extraction / Preparation		Analysis	
	Date extracted	Days over/under	Date analysed	Days over/under
EP090: Organotin Compounds				



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Work Order : EP1502881
Client : JACOBS GROUP (AUSTRALIA) PTY LTD
Project : IW021200

Matrix: **SOIL**

Method	Container / Client Sample ID(s)	Extraction / Preparation			Analysis	
		Date extracted	Due for extraction	Days overdue	Date analysed	Days overdue
EP090: Organotin Compounds - Analysis Holding Time Compliance						
Soil Glass Jar - Unpreserved		23-APR-2015	22-APR-2015	1		
SP17 1						

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

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



ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order : EP1510035 **Page** : 1 of 7
Client : JACOBS GROUP (AUSTRALIA) PTY LTD **Laboratory** : Environmental Division Perth
Contact : MR CHRIS TEASDALE **Contact** : Customer Services EP
Address : P O BOX H615 **Address** : 10 Hod Way Malaga WA, Australia 6090
PERTH WA, AUSTRALIA 6001
E-mail : cteasdale@globaliskm.com **E-mail** : ALSEnviro.Perth@alsglobal.com
Telephone : +61 08 9469 4400 **Telephone** : +61-8-9209 7655
Facsimile : +61 08 9469 4488 **Facsimile** : +61-8-9209 7600
Project : Ex EP1502281 IW021200 **QC Level** : NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number : ---- **Date Samples Received** : 16-Apr-2015 18:00
C-O-C number : ---- **Date Analysis Commenced** : 20-Apr-2015
Sampler : GARNET HOOPER **Issue Date** : 19-May-2015 12:17
Site : ----
Quote number : ---- **No. of samples received** : 25
Site : ---- **No. of samples analysed** : 25

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



WORLD RECOGNISED
ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with
ISO/IEC 17025.

Signatories

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

Signatories	Position	Accreditation Category
Rassem Ayoubi	Senior Organic Chemist	Perth Inorganics
Rassem Ayoubi	Senior Organic Chemist	Perth Organics



Page : 2 of 7
Work Order : EP1510035
Client : JACOBS GROUP (AUSTRALIA) PTY LTD
Project : Ex EP1502281 IW021200

General Comments

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

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

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

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

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

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.

- EP071-SD: LOR raised due to high moisture content.



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)	Client sample ID	Client sampling date / time		SP1 1-1	SP1 2-1	SP2 1-1	SP2 2-1	SP3 1-1
		CAS Number	LOR					
EAO55: Moisture Content								
^ Moisture Content (dried @ 103°C)	1		%	62.7	63.3	65.5	63.7	60.4
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	3		mg/kg	<4	<4	<4	<4	<4
>C16 - C34 Fraction	3		mg/kg	<4	<4	<4	<4	<4
>C34 - C40 Fraction	5		mg/kg	<8	<8	<8	<8	<8
^ >C10 - C40 Fraction (sum)	3		mg/kg	<4	<4	<4	<4	<4
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C10 - C14 Fraction	3		mg/kg	<4	<4	<4	<4	<4
C15 - C28 Fraction	3		mg/kg	<4	<4	<4	<4	<4
C29 - C36 Fraction	5		mg/kg	<8	<8	<8	<8	<8
^ C10 - C36 Fraction (sum)	3		mg/kg	<4	<4	<4	<4	<4



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)	Client sample ID		Client sampling date / time	Unit	LOR	CAS Number	SP3 2-1	SP4 1-1	SP5 1-1	SP5 2-1	SP6 1-1
	Result	Result					Result	Result	Result	Result	
EAO55: Moisture Content											
^ Moisture Content (dried @ 103°C)	1	%	09-Apr-2015 15:23				62.7	45.5	50.1	50.8	52.7
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions											
>C10 - C16 Fraction	3	mg/kg					<4	<4	<4	<4	<4
>C16 - C34 Fraction	3	mg/kg					<4	<4	<4	<4	<4
>C34 - C40 Fraction	5	mg/kg					<8	<8	<8	<8	<8
^ >C10 - C40 Fraction (sum)	3	mg/kg					<4	<4	<4	<4	<4
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons											
C10 - C14 Fraction	3	mg/kg					<4	<4	<4	<4	<4
C15 - C28 Fraction	3	mg/kg					<4	<4	<4	<4	<4
C29 - C36 Fraction	5	mg/kg					<8	<8	<8	<8	<8
^ C10 - C36 Fraction (sum)	3	mg/kg					<4	<4	<4	<4	<4



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)	Client sample ID		Client sampling date / time	Unit	LOR	CAS Number	SP12 2-1	SP15 1-1	SP15 2-1	SP17 1-1	SP14 1-1
	Result	Result					Result	Result	Result		
EAO55: Moisture Content											
^ Moisture Content (dried @ 103°C)	1	%	10-Apr-2015 16:25				41.7	31.8	29.4	42.7	40.0
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions											
>C10 - C16 Fraction	3	mg/kg	12-Apr-2015 07:20				<4	<4	<4	<4	<4
>C16 - C34 Fraction	3	mg/kg	12-Apr-2015 07:41				<4	<4	<4	<4	<4
>C34 - C40 Fraction	5	mg/kg	12-Apr-2015 07:20				<8	<8	<8	<8	<8
^ >C10 - C40 Fraction (sum)	3	mg/kg	10-Apr-2015 16:25				<4	<4	<4	<4	<4
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons											
C10 - C14 Fraction	3	mg/kg	10-Apr-2015 16:25				<4	<4	<4	<4	<4
C15 - C28 Fraction	3	mg/kg	10-Apr-2015 16:25				<4	<4	<4	<4	<4
C29 - C36 Fraction	5	mg/kg	10-Apr-2015 16:25				<8	<8	<8	<8	<8
^ C10 - C36 Fraction (sum)	3	mg/kg	10-Apr-2015 16:25				<4	<4	<4	<4	<4



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)	Client sample ID	Client sampling date / time		SP14 2-1	SP13 1-1	SP13 2-1	SP6E 1-1	SPGE 2-1
		CAS Number	LOR					
EAO55: Moisture Content								
^ Moisture Content (dried @ 103°C)	1			39.7	34.0	30.4	52.2	52.9
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
>C10 - C16 Fraction	3			<4	<4	<4	<4	<4
>C16 - C34 Fraction	3			<4	<4	<4	<4	<4
>C34 - C40 Fraction	5			<8	<8	<8	<8	<8
^ >C10 - C40 Fraction (sum)	3			<4	<4	<4	<4	<4
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
C10 - C14 Fraction	3			<4	<4	<4	<4	<4
C15 - C28 Fraction	3			<4	<4	<4	<4	<4
C29 - C36 Fraction	5			<8	<8	<8	<8	<8
^ C10 - C36 Fraction (sum)	3			<4	<4	<4	<4	<4

QUALITY CONTROL REPORT

Work Order	: EP1510035	Page	: 1 of 4
Client	: JACOBS GROUP (AUSTRALIA) PTY LTD	Laboratory	: Environmental Division Perth
Contact	: MR CHRIS TEASDALE	Contact	: Customer Services EP
Address	: P O BOX H615	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: PERTH WA, AUSTRALIA 6001	E-mail	: ALSEnviro.Perth@alsglobal.com
Telephone	: cteasdale@globalaskm.com	Telephone	: +61-8-9209 7655
Facsimile	: +61 08 9469 4400	Facsimile	: +61-8-9209 7600
Project	: Ex EP1502281 IW021200	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 16-Apr-2015
C-O-C number	: ----	Date Analysis Commenced	: 20-Apr-2015
Sampler	: GARNET HOOPER	Issue Date	: 19-May-2015
Site	: ----	No. of samples received	: 25
Quote number	: ----	No. of samples analysed	: 25

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

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



NATA Accredited
Laboratory 825

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

Accredited for
compliance with
ISO/IEC 17025.

Signatories

Signatories
Rassem Ayoubi
Rassem Ayoubi

Position
Senior Organic Chemist
Senior Organic Chemist

Accreditation Category

Perth Inorganics
Perth Organics



Page : 2 of 4
Work Order : EP1510035
Client : JACOBS GROUP (AUSTRALIA) PTY LTD
Project : Ex EP1502281 IW021200

General Comments

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

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

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

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%.

Laboratory sample ID		Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA055: Moisture Content (QC Lot: 98331)										
EP1510035-001	SP1 1-1		EA055-103: Moisture Content (dried @ 103°C)	---	1	%	62.7	62.7	0.00	0% - 20%
EP1510035-010	SP6 1-1		EA055-103: Moisture Content (dried @ 103°C)	---	1	%	52.7	52.7	0.00	0% - 20%
EA055: Moisture Content (QC Lot: 98332)										
EP1510035-021	SP14 2-1		EA055-103: Moisture Content (dried @ 103°C)	---	1	%	39.7	39.7	0.00	0% - 20%
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 97566)										
EP1510035-001	SP1 1-1		EP071-SD: >C10 - C16 Fraction	>C10_C16	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: >C10 - C40 Fraction (sum)	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: >C16 - C34 Fraction	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: >C34 - C40 Fraction	---	5	mg/kg	<8	<8	0.00	No Limit
EP1510035-011	SP8 1-1		EP071-SD: >C10 - C16 Fraction	>C10_C16	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: >C10 - C40 Fraction (sum)	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: >C16 - C34 Fraction	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: >C34 - C40 Fraction	---	5	mg/kg	<8	<8	0.00	No Limit
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QC Lot: 97566)										
EP1510035-001	SP1 1-1		EP071-SD: C10 - C14 Fraction	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: C10 - C36 Fraction (sum)	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: C15 - C28 Fraction	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: C29 - C36 Fraction	---	5	mg/kg	<8	<8	0.00	No Limit
EP1510035-011	SP8 1-1		EP071-SD: C10 - C14 Fraction	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: C10 - C36 Fraction (sum)	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: C15 - C28 Fraction	---	3	mg/kg	<4	<4	0.00	No Limit
			EP071-SD: C29 - C36 Fraction	---	5	mg/kg	<8	<8	0.00	No Limit

Sub-Matrix: SOIL



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 Sample (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.

Method / Compound	CAS Number	LOR	Unit	Method Blank (MB) Report		Laboratory Control Spike (LCS) Report			
				Result	Concentration	Spike Recovery (%)	LCS	Low	High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 97566)									
EP071-SD: >C10 - C16 Fraction	>C10_C16	3	mg/kg	<4	202 mg/kg	83.3	70	130	
EP071-SD: >C10 - C40 Fraction (sum)	---	3	mg/kg	<4	---	---	---	---	
EP071-SD: >C16 - C34 Fraction	---	3	mg/kg	<4	258 mg/kg	88.4	70	130	
EP071-SD: >C34 - C40 Fraction	---	5	mg/kg	<8	18 mg/kg	96.2	70	130	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 97567)									
EP071-SD: >C10 - C16 Fraction	>C10_C16	3	mg/kg	<4	202 mg/kg	83.8	70	130	
EP071-SD: >C10 - C40 Fraction (sum)	---	3	mg/kg	<4	---	---	---	---	
EP071-SD: >C16 - C34 Fraction	---	3	mg/kg	<4	258 mg/kg	89.4	70	130	
EP071-SD: >C34 - C40 Fraction	---	5	mg/kg	<8	18 mg/kg	100	70	130	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 97566)									
EP071-SD: C10 - C14 Fraction	---	3	mg/kg	<4	138 mg/kg	82.9	70	130	
EP071-SD: C10 - C36 Fraction (sum)	---	3	mg/kg	<4	---	---	---	---	
EP071-SD: C15 - C28 Fraction	---	3	mg/kg	<4	290 mg/kg	94.6	70	130	
EP071-SD: C29 - C36 Fraction	---	5	mg/kg	<8	51 mg/kg	104	70	130	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons (QCLot: 97567)									
EP071-SD: C10 - C14 Fraction	---	3	mg/kg	<4	138 mg/kg	83.5	70	130	
EP071-SD: C10 - C36 Fraction (sum)	---	3	mg/kg	<4	---	---	---	---	
EP071-SD: C15 - C28 Fraction	---	3	mg/kg	<4	290 mg/kg	96.1	70	130	
EP071-SD: C29 - C36 Fraction	---	5	mg/kg	<8	51 mg/kg	120	70	130	

Matrix Spike (MS) Report

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

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

QA/QC Compliance Assessment for DQO Reporting

Work Order	: EP1510035	Page	: 1 of 5
Client	: JACOBS GROUP (AUSTRALIA) PTY LTD	Laboratory	: Environmental Division Perth
Contact	: MR CHRIS TEASDALE	Telephone	: +61-8-9209 7655
Project	: Ex EP1502281 IW021200	Date Samples Received	: 16-Apr-2015
Site	: ----	Issue Date	: 19-May-2015
Sampler	: GARNET HOOPER	No. of samples received	: 25
Order number	: ----	No. of samples analysed	: 25

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

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



Outliers : Frequency of Quality Control Samples

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
TPH - Semivolatile Fraction	0	5	0.00	10.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)					
TPH - Semivolatile Fraction	0	20	0.00	5.00	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Analysis Holding Time Compliance

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	Date analysed	Due for analysis	
EA055: Moisture Content							
Soil Glass Jar - Unpreserved (EA055-103)							
SP17 1-1		08-Apr-2015	---	---	21-Apr-2015	22-Apr-2015	✔
Soil Glass Jar - Unpreserved (EA055-103)							
SP3 2-1, SP5 1-1, SP6 1-1	SP4 1-1, SP5 2-1,	09-Apr-2015	---	---	21-Apr-2015	23-Apr-2015	✔
Soil Glass Jar - Unpreserved (EA055-103)							
SP8 1-1, SPION 2-1, SP12 2-1	SPION 1-1, SP12 1-1,	10-Apr-2015	---	---	21-Apr-2015	24-Apr-2015	✔
Soil Glass Jar - Unpreserved (EA055-103)							
SP1 1-1, SP2 1-1, SP3 1-1, SP6E 1-1,	SP1 2-1, SP2 2-1, SP8 2-1, SP6E 2-1	11-Apr-2015	---	---	21-Apr-2015	25-Apr-2015	✔
Soil Glass Jar - Unpreserved (EA055-103)							
SP15 1-1,	SP15 2-1	12-Apr-2015	---	---	21-Apr-2015	26-Apr-2015	✔
Soil Glass Jar - Unpreserved (EA055-103)							
SP14 1-1, SP13 1-1,	SP14 2-1, SP13 2-1	14-Apr-2015	---	---	21-Apr-2015	28-Apr-2015	✔



Page : 3 of 5
 Work Order : EP1510035
 Client : JACOBS GROUP (AUSTRALIA) PTY LTD
 Project : Ex EP1502281 IW021200

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	Due for analysis	Evaluation	Evaluation	
EP080-SD / EP071-SD: Total Petroleum Hydrocarbons								
Soil Glass Jar - Unpreserved (EP071-SD)								
SP17 1-1		08-Apr-2015	20-Apr-2015	22-Apr-2015	✓	14-May-2015	30-May-2015	✓
Soil Glass Jar - Unpreserved (EP071-SD)								
SP3 2-1, SP5 1-1, SP6 1-1	SP4 1-1, SP5 2-1,	09-Apr-2015	20-Apr-2015	23-Apr-2015	✓	14-May-2015	30-May-2015	✓
Soil Glass Jar - Unpreserved (EP071-SD)								
SP8 1-1, SPION 2-1, SP12 2-1	SPION 1-1, SP12 1-1,	10-Apr-2015	20-Apr-2015	24-Apr-2015	✓	14-May-2015	30-May-2015	✓
Soil Glass Jar - Unpreserved (EP071-SD)								
SP1 1-1, SP2 1-1, SP3 1-1, SP6E 1-1,	SP1 2-1, SP2 2-1, SP8 2-1, SPGE 2-1	11-Apr-2015	20-Apr-2015	25-Apr-2015	✓	14-May-2015	30-May-2015	✓
Soil Glass Jar - Unpreserved (EP071-SD)								
SP15 1-1,	SP15 2-1	12-Apr-2015	20-Apr-2015	26-Apr-2015	✓	14-May-2015	30-May-2015	✓
Soil Glass Jar - Unpreserved (EP071-SD)								
SP14 1-1, SP13 1-1,	SP14 2-1, SP13 2-1	14-Apr-2015	20-Apr-2015	28-Apr-2015	✓	14-May-2015	30-May-2015	✓



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 Analytical Methods	Method	Count		Rate (%)		Evaluation	Quality Control Specification
		QC	Regular	Actual	Expected		
Laboratory Duplicates (DUP)							
Moisture Content	EA055-103	2	20	10.00	10.00	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071-SD	2	20	10.00	10.00	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
TPH - Semivolatile Fraction	EP071-SD	1	20	5.00	5.00	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
TPH - Semivolatile Fraction	EP071-SD	1	20	5.00	5.00	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
TPH - Semivolatile Fraction	EP071-SD	0	20	0.00	5.00	✗	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

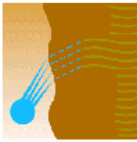


Page : 5 of 5
Work Order : EP1510035
Client : JACOBS GROUP (AUSTRALIA) PTY LTD
Project : Ex EP1502281 IW021200

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
Moisture Content	EA055-103	SOIL	In-house. A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
TPH - Semivolatle Fraction	EP071-SD	SOIL	(USEPA SW 846 - 8270B) 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 (2013) Schedule B(3) (Method 504)



**Marine and Freshwater
Research Laboratory
Environmental Science**

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Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or
measurements included in this document are
traceable to Australian/national standards.



Contact: Garnet Hooper
Customer: Jacobs

Address: Level 11, Durack Centre, 263 Adelaide Terrace, Perth WA 6001

Date of Issue: 13/05/2015
Date Received: 16/04/2015
Our Reference: JAC15-8
Your Reference: IW021200

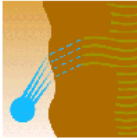
SEDIMENT DATA

METHOD SAMPLE CODE	Sampling Date	2600 TKN mg.N/g <0.1	4500 TOTAL P mg.P/g <0.05	6200 TOC %C <0.2	ICP002 Total Ext Al mg/kg <20	ICP002 Total Ext As mg/kg <2	ICP002 Total Ext Ba mg/kg <0.1	ICP002 Total Ext Cd mg/kg <0.1	ICP002 Total Ext Co mg/kg <0.2
Reporting Limit									
File		15042901	15042901	15050101-1101	15050101	15050101	15050101	15050101	15050101
SP1 1-1	11/04/2015	1.9	0.74	1.4	15000	3	21	0.3	6.7
SP1 2-1	11/04/2015	2.0	0.78	1.4	16000	3	21	0.2	7.2
SP2 1-1	11/04/2015	2.1	0.78	1.5	16000	2	33	0.2	7.5
SP2 2-1	11/04/2015	2.1	0.78	1.5	16000	2	29	0.3	7.1
SP3 1-1	11/04/2015	1.6	0.81	1.2	14000	2	23	0.3	6.5
SP3 2-1	11/04/2015	1.5	0.80	1.1	13000	2	25	0.2	6.2
SP4 1-1	09/04/2015	0.5	2.8	0.4	9300	3	9.1	0.2	5.6
SP5 1-1	09/04/2015	0.6	0.98	0.5	8400	2	11	0.2	4.7
SP5 2-1	09/04/2015	0.7	0.89	0.5	8200	3	12	0.2	4.9
SP6E 1-1	09/04/2015	0.8	1.6	0.6	8300	3	14	0.2	4.9
SP6E 2-1	09/04/2015	0.9	1.6	0.6	9400	3	15	0.1	5.2
SP8 1-1	10/04/2015	0.2	0.31	0.3	560	2	5.6	0.2	0.7
SP8 2-1	10/04/2015	0.3	0.31	0.2	550	3	5.9	0.2	0.7
SP9 1-1	10/04/2015	0.3	0.79	0.2	2000	5	7.0	0.2	1.9
SP10N 1-1	10/04/2015	0.3	0.79	0.2	2900	4	7.8	0.2	1.8
SP10N 2-1	10/04/2015	0.3	0.90	0.3	3100	3	7.7	0.3	1.7
SP12 1-1	10/04/2015	0.4	1.2	0.3	4200	3	21	0.3	2.1
SP12 2-1	10/04/2015	0.5	1.1	0.4	4400	4	28	0.2	2.1
SP13 1-1	14/04/2015	0.2	1.4	0.2	3300	3	9.8	0.2	1.8
SP13 2-1	14/04/2015	0.2	1.4	<0.2	2700	3	9.4	0.2	1.5
SP14 1-1	14/04/2015	0.4	1.9	0.3	4600	3	8.7	0.2	2.3

Signatory: Jamie Woodward
Date: 13/05/2015

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

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**Marine and Freshwater
Research Laboratory
Environmental Science**

Tel: +61 8 93602907 Address: 90 South St, Murdoch, WA, 6150



Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or
measurements included in this document are
traceable to Australian/national standards.



Contact: Garnet Hooper
Customer: Jacobs
Address: Level 11, Durack Centre, 263 Adelaide Terrace, Perth WA 6001

Date of Issue: 13/05/2015
Date Received: 16/04/2015
Our Reference: JAC15-8
Your Reference: IW021200

SEDIMENT DATA

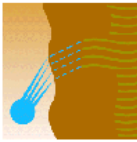
METHOD SAMPLE CODE	Sampling Date	2600 TKN mg.N/g	4500 TOTAL P mg.P/g	6200 TOC %C	ICP002 Total Ext Al mg/kg	ICP002 Total Ext As mg/kg	ICP002 Total Ext Ba mg/kg	ICP002 Total Ext Cd mg/kg	ICP002 Total Ext Co mg/kg	Reporting Limit
		15042901	15042901	15050101-1101	15050101	15050101	15050101	15050101	15050101	
SP14 2-1	14/04/2015	0.4	1.9	0.3	4500	3	8.1	0.2	2.3	
SP15 1-1	12/04/2015	0.3	1.8	0.3	3400	4	8.8	0.2	1.9	
SP15 2-1	12/04/2015	0.3	2.0	0.2	2800	5	8.4	0.2	1.8	
SP17 1-1	08/04/2015	0.5	1.3	0.3	5500	3	8.0	0.3	3.1	
SP6 1-1	09/04/2015	0.9	1.7	0.6	9600	3	15	0.1	4.8	
TB1	12/04/2015	<0.1	<0.05	<0.2	<20	<2	<0.1	<0.1	<0.2	
MB1	12/04/2015	<0.1	<0.05	<0.2	<20	<2	<0.1	<0.1	<0.2	

Note: Ba by ICP002 is outside the scope of accreditation. Results expressed on a dry weight basis

Signatory: Jamie Woodward
Date: 13/05/2015

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Date Received: 16/04/2015
Our Reference: JAC15-8
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SEDIMENT DATA

METHOD SAMPLE CODE	ICP002 Total Ext Cr mg/kg	ICP002 Total Ext Cu mg/kg	ICP002 Total Ext Fe mg/kg	ICP002 Total Ext Ni mg/kg	ICP002 Total Ext Pb mg/kg	ICP002 Total Ext Zn mg/kg	ICP007 Total Ext Hg mg/kg
Reporting Limit	<0.2	<0.2	<5	<0.7	<1	<0.5	<0.01
File	15050101	15050101	15050101	15050101	15050101	15050101	15050602-0701
SP1 1-1	28	13	16000	21	6	48	0.03
SP1 2-1	29	14	16000	21	6	47	0.03
SP2 1-1	31	15	16000	23	7	51	0.03
SP2 2-1	31	14	16000	23	7	50	0.03
SP3 1-1	27	11	15000	19	6	46	0.03
SP3 2-1	25	10	15000	17	5	43	0.04
SP4 1-1	27	4.7	17000	14	5	51	0.03
SP5 1-1	20	5.3	13000	11	4	38	0.02
SP5 2-1	21	5.5	13000	12	5	40	0.03
SP6E 1-1	20	5.6	13000	12	4	36	0.03
SP6E 2-1	22	6.0	13000	12	4	38	0.03
SP8 1-1	5.0	0.9	520	1.1	<1	2.3	<0.01
SP8 2-1	5.2	1.0	550	1.3	1	2.3	<0.01
SP9 1-1	7.4	1.7	2800	4.2	4	6.9	<0.01
SP10N 1-1	7.9	2.4	3900	4.6	3	10	0.01
SP10N 2-1	8.5	2.5	4300	4.5	3	11	0.01
SP12 1-1	10	2.6	5300	5.4	2	11	0.01
SP12 2-1	11	3.0	5800	5.7	2	12	0.01
SP13 1-1	8.9	1.8	4200	4.6	2	8.5	<0.01
SP13 2-1	7.7	1.6	3500	3.7	2	7.3	<0.01
SP14 1-1	11	2.7	5800	6.1	3	13	0.01

G. Woodward

Signatory: Jamie Woodward
Date: 13/05/2015

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Date of Issue: 13/05/2015
Date Received: 16/04/2015
Our Reference: JAC15-8
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SEDIMENT DATA

METHOD SAMPLE CODE	ICP002 Total Ext Cr mg/kg	ICP002 Total Ext Cu mg/kg	ICP002 Total Ext Fe mg/kg	ICP002 Total Ext Ni mg/kg	ICP002 Total Ext Pb mg/kg	ICP002 Total Ext Zn mg/kg	ICP007 Total Ext Hg mg/kg
Reporting Limit	<0.2	<0.2	<5	<0.7	<1	<0.5	<0.01
File	15050101	15050101	15050101	15050101	15050101	15050101	15050602-0701
SP14 2-1	11	2.7	5800	5.9	3	12	0.01
SP15 1-1	7.7	2.9	5500	5.1	3	11	<0.01
SP15 2-1	7.2	2.6	5000	5.0	2	9.8	<0.01
SP17 1-1	11	3.5	7600	7.2	3	18	<0.01
SP6 1-1	22	6.2	14000	13	5	40	0.03
TB1	<0.2	<0.2	<5	<0.7	<1	<0.5	<0.01
MB1	<0.2	<0.2	<5	<0.7	<1	<0.5	<0.01

Signatory: Jamie Woodward
Date: 13/05/2015

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

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PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP1
Sampling Date:	11/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	17-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	17.79
Fine Silt % (4-16µm)	19.32
Medium Silt % (16-31µm)	10.16
Course Silt % (31-62µm)	19.54
Fine sand % (62-250µm)	28.36
Medium sand % (250-500µm)	3.57
Coarse sand % (500-2000µm)	1.26
Pebbles/Cobbles/Boulders (>2000µm)	0.00
SOP Name	SOP-LV-3REPS-ikm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
500	1.21
1000	0.06
2000	0.00
4000	0.00
8000	0.00
16000	0.00

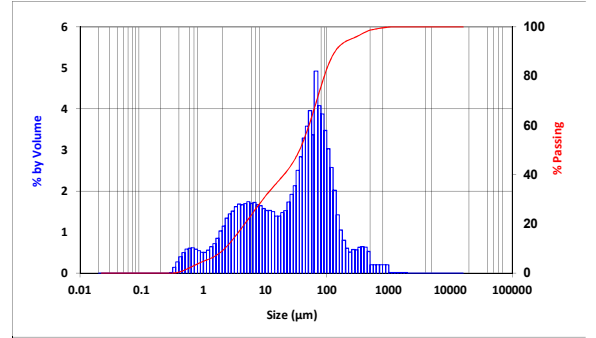
Sample visual assessment
 Mud with a small amount of sand present

Size Fractions Table

Differential Data			Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.01	0.01	0.317	0.01
0.317	0.356	0.14	0.14	0.356	0.15
0.356	0.399	0.27	0.27	0.399	0.43
0.399	0.448	0.40	0.40	0.448	0.83
0.448	0.502	0.50	0.50	0.502	1.33
0.502	0.564	0.59	0.59	0.564	1.91
0.564	0.632	0.61	0.61	0.632	2.52
0.632	0.710	0.62	0.62	0.710	3.14
0.710	0.796	0.58	0.58	0.796	3.72
0.796	0.893	0.55	0.55	0.893	4.26
0.893	1.000	0.51	0.51	1.000	4.77
1.000	1.120	0.50	0.50	1.120	5.28
1.120	1.260	0.56	0.56	1.260	5.84
1.260	1.420	0.64	0.64	1.420	6.48
1.420	1.590	0.72	0.72	1.590	7.20
1.590	1.780	0.85	0.85	1.780	8.04
1.780	2.000	1.02	1.02	2.000	9.06
2.000	2.240	1.15	1.14	2.240	10.21
2.240	2.520	1.34	1.34	2.520	11.54
2.520	2.830	1.45	1.44	2.830	12.99
2.830	3.170	1.51	1.51	3.170	14.50
3.170	3.560	1.62	1.62	3.560	16.11
3.560	4.000	1.68	1.68	4.000	17.79
4.000	4.480	1.67	1.67	4.480	19.46
4.480	5.020	1.69	1.69	5.020	21.15
5.020	5.640	1.74	1.74	5.640	22.88
5.640	6.320	1.70	1.70	6.320	24.58
6.320	7.100	1.72	1.72	7.100	26.30
7.100	7.960	1.67	1.67	7.960	27.96
7.960	8.930	1.64	1.64	8.930	29.60
8.930	10.000	1.57	1.57	10.000	31.17
10.000	11.200	1.53	1.52	11.200	32.70
11.200	12.600	1.53	1.52	12.600	34.22
12.600	14.200	1.50	1.50	14.200	35.72
14.200	15.900	1.39	1.39	15.900	37.11
15.900	17.800	1.39	1.39	17.800	38.50
17.800	20.000	1.48	1.47	20.000	39.97
20.000	22.400	1.52	1.52	22.400	41.49
22.400	25.200	1.73	1.73	25.200	43.22
25.200	28.300	1.92	1.92	28.300	45.14
28.300	31.700	2.14	2.13	31.700	47.27
31.700	35.600	2.51	2.50	35.600	49.78
35.600	39.900	2.84	2.84	39.900	52.61
39.900	44.800	3.29	3.29	44.800	55.90
44.800	50.200	3.59	3.58	50.200	59.48
50.200	56.400	3.96	3.96	56.400	63.44
56.400	62.000	3.37	3.37	62.000	66.81
62.000	71.000	4.93	4.92	71.000	71.73
71.000	79.600	4.08	4.08	79.600	75.81
79.600	89.300	3.88	3.88	89.300	79.69
89.300	100.000	3.48	3.47	100.000	83.16
100.000	112.000	3.04	3.03	112.000	86.19
112.000	126.000	2.58	2.57	126.000	88.76
126.000	142.000	2.02	2.02	142.000	90.78
142.000	159.000	1.42	1.42	159.000	92.20
159.000	178.000	1.05	1.05	178.000	93.25
178.000	200.000	0.80	0.80	200.000	94.05
200.000	224.000	0.61	0.60	224.000	94.65
224.000	250.000	0.51	0.51	250.000	95.17
250.000	283.000	0.58	0.57	283.000	95.74
283.000	317.000	0.57	0.57	317.000	96.31
317.000	356.000	0.63	0.63	356.000	96.93
356.000	399.000	0.64	0.64	399.000	97.58
399.000	448.000	0.63	0.63	448.000	98.21
448.000	500.000	0.53	0.53	500.000	98.74
500.00	1000.00	1.21	1.21	1000.00	99.94
1000.00	2000.00	0.06	0.06	2000.00	100.00
2000.00	4000.00	0.00	0.00	4000.00	100.00
4000.00	8000.00	0.00	0.00	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00

1.26 98.74
 98.88 100.00

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

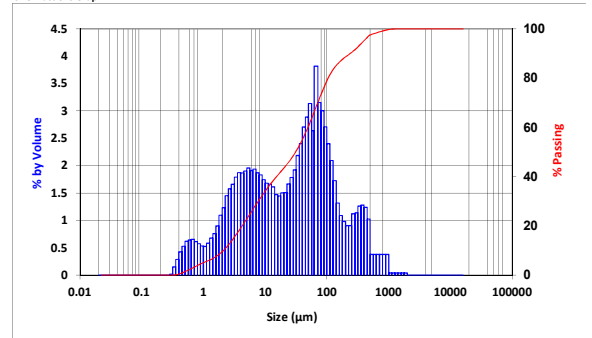
Sample Name:	SP2
Sampling Date:	11/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	17-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	19.13
Fine Silt % (4-16µm)	21.44
Medium Silt % (16-31µm)	9.83
Course Silt % (31-62µm)	15.96
Fine sand % (62-250µm)	24.10
Medium sand % (250-500µm)	7.06
Coarse sand % (500-2000µm)	2.49
Pebbles/Cobbles/Boulders (>2000µm)	0.00
SOP Name	SOP-LV-3REPS-ikm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 2.27
	1000 0.22
	2000 0.00
	4000 0.00
	8000 0.00
	16000 0.00

Sample visual assessment
 Mud with a small amount of sand present

Size Fractions Table

Differential Data		Cumulative Data			
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.01	0.01	0.317	0.01
0.317	0.356	0.15	0.15	0.356	0.16
0.356	0.399	0.29	0.29	0.399	0.45
0.399	0.448	0.43	0.42	0.448	0.87
0.448	0.502	0.53	0.53	0.502	1.40
0.502	0.564	0.62	0.62	0.564	2.02
0.564	0.632	0.64	0.64	0.632	2.66
0.632	0.710	0.65	0.65	0.710	3.31
0.710	0.796	0.61	0.61	0.796	3.92
0.796	0.893	0.58	0.57	0.893	4.49
0.893	1.000	0.53	0.53	1.000	5.02
1.000	1.120	0.53	0.52	1.120	5.55
1.120	1.260	0.58	0.58	1.260	6.13
1.260	1.420	0.68	0.67	1.420	6.80
1.420	1.590	0.76	0.76	1.590	7.56
1.590	1.780	0.90	0.90	1.780	8.46
1.780	2.000	1.10	1.09	2.000	9.55
2.000	2.240	1.24	1.23	2.240	10.78
2.240	2.520	1.46	1.45	2.520	12.23
2.520	2.830	1.58	1.58	2.830	13.81
2.830	3.170	1.67	1.66	3.170	15.47
3.170	3.560	1.80	1.79	3.560	17.26
3.560	4.000	1.88	1.87	4.000	19.13
4.000	4.480	1.87	1.86	4.480	20.99
4.480	5.020	1.91	1.90	5.020	22.89
5.020	5.640	1.97	1.96	5.640	24.85
5.640	6.320	1.92	1.91	6.320	26.76
6.320	7.100	1.94	1.93	7.100	28.69
7.100	7.960	1.88	1.87	7.960	30.56
7.960	8.930	1.84	1.83	8.930	32.39
8.930	10.000	1.75	1.74	10.000	34.14
10.000	11.200	1.69	1.68	11.200	35.81
11.200	12.600	1.67	1.66	12.600	37.48
12.600	14.200	1.62	1.61	14.200	39.09
14.200	15.900	1.48	1.47	15.900	40.56
15.900	17.800	1.45	1.45	17.800	42.01
17.800	20.000	1.51	1.50	20.000	43.51
20.000	22.400	1.52	1.51	22.400	45.02
22.400	25.200	1.67	1.67	25.200	46.69
25.200	28.300	1.79	1.78	28.300	48.47
28.300	31.700	1.93	1.92	31.700	50.39
31.700	35.600	2.20	2.19	35.600	52.58
35.600	39.900	2.41	2.40	39.900	54.98
39.900	44.800	2.72	2.71	44.800	57.69
44.800	50.200	2.90	2.89	50.200	60.58
50.200	56.400	3.15	3.14	56.400	63.71
56.400	62.000	2.65	2.64	62.000	66.35
62.000	71.000	3.84	3.82	71.000	70.17
71.000	79.600	3.17	3.15	79.600	73.32
79.600	89.300	3.02	3.00	89.300	76.32
89.300	100.000	2.72	2.71	100.000	79.03
100.000	112.000	2.41	2.40	112.000	81.43
112.000	126.000	2.10	2.09	126.000	83.53
126.000	142.000	1.73	1.73	142.000	85.25
142.000	159.000	1.32	1.32	159.000	86.57
159.000	178.000	1.09	1.09	178.000	87.66
178.000	200.000	0.98	0.98	200.000	88.64
200.000	224.000	0.91	0.90	224.000	89.54
224.000	250.000	0.91	0.90	250.000	90.45
250.000	283.000	1.13	1.12	283.000	91.57
283.000	317.000	1.14	1.14	317.000	92.71
317.000	356.000	1.27	1.26	356.000	93.97
356.000	399.000	1.28	1.28	399.000	95.24
399.000	448.000	1.24	1.24	448.000	96.48
448.000	500.000	1.03	1.02	500.000	97.51
500.00	1000.00	2.27	2.27	1000.00	99.78
1000.00	2000.00	0.22	0.22	2000.00	100.00
2000.00	4000.00	0.00	0.00	4000.00	100.00
4000.00	8000.00	0.00	0.00	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00
		2.49	97.51		
		97.95			

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP3
Sampling Date:	11/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	17-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	11.79
Fine Silt % (4-16µm)	13.00
Medium Silt % (16-31µm)	6.74
Course Silt % (31-62µm)	13.64
Fine sand % (62-250µm)	31.63
Medium sand % (250-500µm)	16.54
Coarse sand % (500-2000µm)	6.18
Pebbles/Cobbles/Boulders (>2000µm)	0.48
SOP Name	SOP-LV-3REPS-ikm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 5.49
	1000 0.69
	2000 0.48
	4000 0.00
	8000 0.00
	16000 0.00

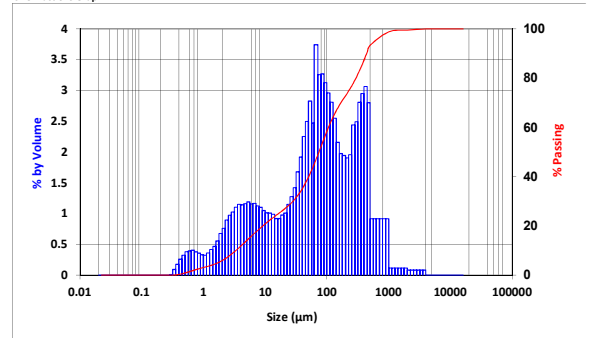
Sample visual assessment
 Mud with a small amount of sand present

Size Fractions Table

		Differential Data			Cumulative Data	
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing	
0.020	0.022	0.00	0.00	0.022	0.00	
0.022	0.025	0.00	0.00	0.025	0.00	
0.025	0.028	0.00	0.00	0.028	0.00	
0.028	0.032	0.00	0.00	0.032	0.00	
0.032	0.036	0.00	0.00	0.036	0.00	
0.036	0.040	0.00	0.00	0.040	0.00	
0.040	0.045	0.00	0.00	0.045	0.00	
0.045	0.050	0.00	0.00	0.050	0.00	
0.050	0.056	0.00	0.00	0.056	0.00	
0.056	0.063	0.00	0.00	0.063	0.00	
0.063	0.071	0.00	0.00	0.071	0.00	
0.071	0.080	0.00	0.00	0.080	0.00	
0.080	0.089	0.00	0.00	0.089	0.00	
0.089	0.100	0.00	0.00	0.100	0.00	
0.100	0.112	0.00	0.00	0.112	0.00	
0.112	0.126	0.00	0.00	0.126	0.00	
0.126	0.142	0.00	0.00	0.142	0.00	
0.142	0.159	0.00	0.00	0.159	0.00	
0.159	0.178	0.00	0.00	0.178	0.00	
0.178	0.200	0.00	0.00	0.200	0.00	
0.200	0.224	0.00	0.00	0.224	0.00	
0.224	0.252	0.00	0.00	0.252	0.00	
0.252	0.283	0.00	0.00	0.283	0.00	
0.283	0.317	0.01	0.01	0.317	0.01	
0.317	0.356	0.09	0.09	0.356	0.10	
0.356	0.399	0.17	0.17	0.399	0.27	
0.399	0.448	0.25	0.26	0.448	0.53	
0.448	0.502	0.32	0.32	0.502	0.85	
0.502	0.564	0.37	0.38	0.564	1.23	
0.564	0.632	0.39	0.39	0.632	1.63	
0.632	0.710	0.39	0.40	0.710	2.03	
0.710	0.796	0.37	0.38	0.796	2.41	
0.796	0.893	0.35	0.36	0.893	2.76	
0.893	1.000	0.32	0.33	1.000	3.09	
1.000	1.120	0.32	0.32	1.120	3.42	
1.120	1.260	0.35	0.36	1.260	3.78	
1.260	1.420	0.41	0.42	1.420	4.19	
1.420	1.590	0.46	0.47	1.590	4.66	
1.590	1.780	0.54	0.55	1.780	5.21	
1.780	2.000	0.66	0.67	2.000	5.89	
2.000	2.240	0.74	0.76	2.240	6.65	
2.240	2.520	0.88	0.90	2.520	7.54	
2.520	2.830	0.95	0.97	2.830	8.51	
2.830	3.170	1.00	1.02	3.170	9.54	
3.170	3.560	1.08	1.10	3.560	10.64	
3.560	4.000	1.12	1.15	4.000	11.79	
4.000	4.480	1.12	1.14	4.480	12.93	
4.480	5.020	1.13	1.16	5.020	14.09	
5.020	5.640	1.16	1.19	5.640	15.28	
5.640	6.320	1.13	1.15	6.320	16.43	
6.320	7.100	1.14	1.16	7.100	17.60	
7.100	7.960	1.10	1.12	7.960	18.72	
7.960	8.930	1.07	1.10	8.930	19.81	
8.930	10.000	1.02	1.05	10.000	20.86	
10.000	11.200	0.99	1.01	11.200	21.87	
11.200	12.600	0.99	1.01	12.600	22.88	
12.600	14.200	0.97	0.99	14.200	23.87	
14.200	15.900	0.90	0.92	15.900	24.79	
15.900	17.800	0.90	0.92	17.800	25.70	
17.800	20.000	0.95	0.98	20.000	26.68	
20.000	22.400	0.99	1.01	22.400	27.69	
22.400	25.200	1.12	1.15	25.200	28.83	
25.200	28.300	1.24	1.27	28.300	30.11	
28.300	31.700	1.39	1.42	31.700	31.53	
31.700	35.600	1.64	1.68	35.600	33.20	
35.600	39.900	1.87	1.92	39.900	35.12	
39.900	44.800	2.20	2.25	44.800	37.37	
44.800	50.200	2.44	2.50	50.200	39.87	
50.200	56.400	2.76	2.83	56.400	42.69	
56.400	62.000	2.42	2.47	62.000	45.16	
62.000	71.000	3.66	3.74	71.000	48.90	
71.000	79.600	3.18	3.25	79.600	52.16	
79.600	89.300	3.20	3.27	89.300	55.43	
89.300	100.000	3.06	3.13	100.000	58.55	
100.000	112.000	2.89	2.96	112.000	61.51	
112.000	126.000	2.75	2.81	126.000	64.32	
126.000	142.000	2.49	2.55	142.000	66.87	
142.000	159.000	2.11	2.15	159.000	69.02	
159.000	178.000	1.93	1.97	178.000	70.99	
178.000	200.000	1.90	1.94	200.000	72.94	
200.000	224.000	1.86	1.90	224.000	74.84	
224.000	250.000	1.91	1.96	250.000	76.80	
250.000	283.000	2.39	2.44	283.000	79.24	
283.000	317.000	2.44	2.49	317.000	81.73	
317.000	356.000	2.74	2.80	356.000	84.53	
356.000	399.000	2.88	2.95	399.000	87.48	
399.000	448.000	3.00	3.06	448.000	90.54	
448.000	500.000	2.74	2.80	500.000	93.34	
500.00	1000.00	5.49	5.49	1000.00	98.83	
1000.00	2000.00	0.69	0.69	2000.00	99.52	
2000.00	4000.00	0.48	0.48	4000.00	100.00	
4000.00	8000.00	0.00	0.00	8000.00	100.00	
8000.00	16000.00	0.00	0.00	16000.00	100.00	
>16000		0.00	0.00		100.00	

6.66 93.34
 91.29 100.00

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP4
Sampling Date:	9/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	20-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	4.57
Fine Silt % (4-16µm)	5.06
Medium Silt % (16-31µm)	2.78
Course Silt % (31-62µm)	4.04
Fine sand % (62-250µm)	36.27
Medium sand % (250-500µm)	30.67
Coarse sand % (500-2000µm)	14.56
Pebbles/Cobbles/Boulders (>2000µm)	2.04
SOP Name	SOP-3REPS-skm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 10.92
	1000 3.65
	2000 2.04
	4000 0.00
	8000 0.00
	16000 0.00

Sample visual assessment

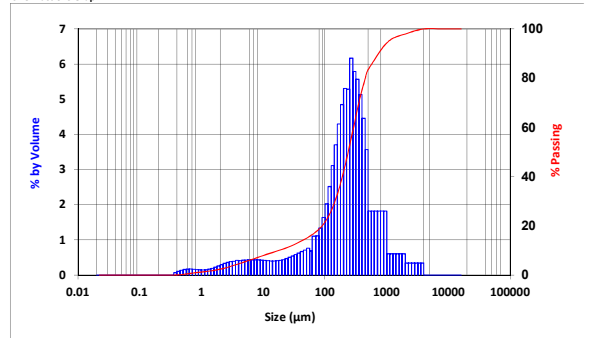
Sandy mud with some coral and shell present. A large bit of shell was removed from the sample prior to homogenisation as it was not representative of the sample.

Size Fractions Table

Differential Data			Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.00	0.00	0.317	0.00
0.317	0.356	0.00	0.00	0.356	0.00
0.356	0.399	0.07	0.07	0.399	0.07
0.399	0.448	0.11	0.10	0.448	0.17
0.448	0.502	0.15	0.13	0.502	0.31
0.502	0.564	0.17	0.16	0.564	0.46
0.564	0.632	0.18	0.17	0.632	0.63
0.632	0.710	0.19	0.17	0.710	0.80
0.710	0.796	0.18	0.16	0.796	0.96
0.796	0.893	0.17	0.16	0.893	1.12
0.893	1.002	0.16	0.15	1.002	1.27
1.002	1.125	0.16	0.14	1.125	1.41
1.125	1.262	0.16	0.15	1.262	1.56
1.262	1.416	0.18	0.17	1.416	1.73
1.416	1.589	0.21	0.19	1.589	1.92
1.589	1.783	0.24	0.22	1.783	2.14
1.783	2.000	0.28	0.26	2.000	2.40
2.000	2.244	0.32	0.29	2.244	2.69
2.244	2.518	0.36	0.33	2.518	3.02
2.518	2.825	0.39	0.36	2.825	3.38
2.825	3.170	0.42	0.38	3.170	3.76
3.170	3.557	0.43	0.40	3.557	4.15
3.557	4.000	0.46	0.42	4.000	4.57
4.000	4.477	0.45	0.41	4.477	4.98
4.477	5.024	0.46	0.42	5.024	5.40
5.024	5.637	0.47	0.43	5.637	5.83
5.637	6.325	0.47	0.43	6.325	6.26
6.325	7.096	0.48	0.44	7.096	6.70
7.096	7.962	0.48	0.44	7.962	7.14
7.962	8.934	0.47	0.43	8.934	7.57
8.934	10.024	0.47	0.43	10.024	8.00
10.024	11.247	0.46	0.42	11.247	8.42
11.247	12.619	0.45	0.41	12.619	8.83
12.619	14.159	0.44	0.40	14.159	9.23
14.159	15.887	0.44	0.40	15.887	9.63
15.887	17.825	0.44	0.41	17.825	10.03
17.825	20.000	0.46	0.42	20.000	10.45
20.000	22.440	0.48	0.44	22.440	10.89
22.440	25.179	0.51	0.47	25.179	11.36
25.179	28.251	0.55	0.50	28.251	11.87
28.251	31.698	0.59	0.54	31.698	12.41
31.698	35.566	0.64	0.58	35.566	12.99
35.566	39.905	0.68	0.63	39.905	13.62
39.905	44.774	0.73	0.67	44.774	14.29
44.774	50.238	0.78	0.71	50.238	15.00
50.238	56.368	0.84	0.76	56.368	15.76
56.368	62.000	0.75	0.69	62.000	16.45
62.000	70.963	1.21	1.10	70.963	17.55
70.963	79.621	1.22	1.11	79.621	18.67
79.621	89.337	1.46	1.34	89.337	20.00
89.337	100.237	1.79	1.64	100.237	21.64
100.237	112.468	2.22	2.03	112.468	23.67
112.468	126.191	2.75	2.51	126.191	26.18
126.191	141.589	3.41	3.11	141.589	29.29
141.589	158.866	4.05	3.70	158.866	33.00
158.866	178.250	4.70	4.29	178.250	37.29
178.250	200.000	5.30	4.84	200.000	42.14
200.000	224.404	5.81	5.31	224.404	47.44
224.404	250.000	5.78	5.28	250.000	52.72
250.000	282.508	6.75	6.17	282.508	58.89
282.508	316.979	6.33	5.79	316.979	64.68
316.979	355.656	6.09	5.56	355.656	70.24
355.656	399.052	5.62	5.13	399.052	75.37
399.052	447.744	4.88	4.46	447.744	79.83
447.744	500.000	3.90	3.57	500.000	83.40
500.00	1000.00	10.92	10.92	1000.00	94.31
1000.00	2000.00	3.65	3.65	2000.00	97.96
2000.00	4000.00	2.04	2.04	4000.00	100.00
4000.00	8000.00	0.00	0.00	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00

16.60 83.40
 91.29 100.00

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP5
Sampling Date:	9/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	20-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	6.02
Fine Silt % (4-16µm)	6.99
Medium Silt % (16-31µm)	4.13
Course Silt % (31-62µm)	7.52
Fine sand % (62-250µm)	37.60
Medium sand % (250-500µm)	24.07
Coarse sand % (500-2000µm)	12.68
Pebbles/Cobbles/Boulders (>2000µm)	1.00
SOP Name	SOP-3REPS-skm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 0.72
	1000 2.96
	2000 0.95
	4000 0.05
	8000 0.00
	16000 0.00

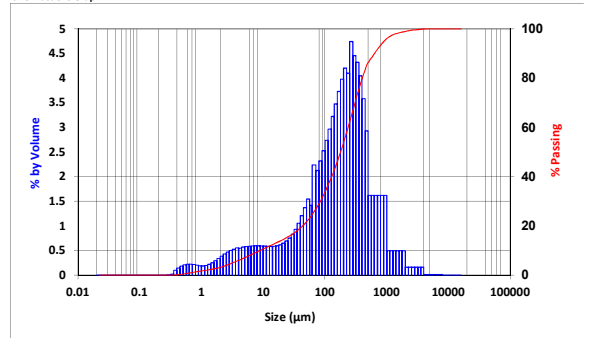
Sample visual assessment
 Muddy sand with some shell present.

Size Fractions Table

Differential Data			Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.00	0.00	0.317	0.00
0.317	0.356	0.02	0.02	0.356	0.02
0.356	0.399	0.10	0.10	0.399	0.11
0.399	0.448	0.15	0.14	0.448	0.26
0.448	0.502	0.19	0.18	0.502	0.44
0.502	0.564	0.22	0.21	0.564	0.64
0.564	0.632	0.24	0.22	0.632	0.86
0.632	0.710	0.24	0.22	0.710	1.08
0.710	0.796	0.23	0.21	0.796	1.30
0.796	0.893	0.21	0.20	0.893	1.50
0.893	1.002	0.20	0.19	1.002	1.68
1.002	1.125	0.20	0.18	1.125	1.87
1.125	1.262	0.21	0.19	1.262	2.06
1.262	1.416	0.23	0.22	1.416	2.28
1.416	1.589	0.27	0.25	1.589	2.53
1.589	1.783	0.31	0.29	1.783	2.82
1.783	2.000	0.36	0.34	2.000	3.16
2.000	2.244	0.41	0.39	2.244	3.54
2.244	2.518	0.46	0.43	2.518	3.97
2.518	2.825	0.50	0.47	2.825	4.44
2.825	3.170	0.54	0.50	3.170	4.94
3.170	3.557	0.56	0.52	3.557	5.47
3.557	4.000	0.59	0.55	4.000	6.02
4.000	4.477	0.59	0.55	4.477	6.56
4.477	5.024	0.61	0.57	5.024	7.13
5.024	5.637	0.62	0.58	5.637	7.71
5.637	6.325	0.63	0.58	6.325	8.29
6.325	7.096	0.63	0.59	7.096	8.88
7.096	7.962	0.64	0.59	7.962	9.48
7.962	8.934	0.64	0.59	8.934	10.07
8.934	10.024	0.64	0.59	10.024	10.67
10.024	11.247	0.63	0.59	11.247	11.25
11.247	12.619	0.63	0.58	12.619	11.84
12.619	14.159	0.63	0.58	14.159	12.42
14.159	15.887	0.63	0.59	15.887	13.01
15.887	17.825	0.64	0.60	17.825	13.60
17.825	20.000	0.66	0.61	20.000	14.22
20.000	22.440	0.69	0.65	22.440	14.86
22.440	25.179	0.74	0.69	25.179	15.56
25.179	28.251	0.81	0.75	28.251	16.31
28.251	31.698	0.89	0.83	31.698	17.14
31.698	35.566	1.00	0.93	35.566	18.06
35.566	39.905	1.13	1.05	39.905	19.12
39.905	44.774	1.29	1.21	44.774	20.32
44.774	50.238	1.47	1.37	50.238	21.69
50.238	56.368	1.66	1.54	56.368	23.23
56.368	62.000	1.52	1.42	62.000	24.65
62.000	70.963	2.40	2.24	70.963	26.89
70.963	79.621	2.27	2.12	79.621	29.01
79.621	89.337	2.49	2.32	89.337	31.33
89.337	100.237	2.71	2.52	100.237	33.85
100.237	112.468	2.93	2.73	112.468	36.58
112.468	126.191	3.18	2.96	126.191	39.55
126.191	141.589	3.46	3.22	141.589	42.77
141.589	158.866	3.73	3.47	158.866	46.24
158.866	178.250	4.00	3.73	178.250	49.97
178.250	200.000	4.27	3.98	200.000	53.95
200.000	224.404	4.51	4.20	224.404	58.15
224.404	250.000	4.40	4.10	250.000	62.25
250.000	282.508	5.09	4.74	282.508	66.99
282.508	316.979	4.78	4.45	316.979	71.44
316.979	355.656	4.64	4.32	355.656	75.76
355.656	399.052	4.34	4.05	399.052	79.81
399.052	447.744	3.85	3.58	447.744	83.39
447.744	500.000	3.14	2.93	500.000	86.32
500.00	1000.00	9.72	9.72	1000.00	96.04
1000.00	2000.00	2.96	2.96	2000.00	99.00
2000.00	4000.00	0.95	0.95	4000.00	99.95
4000.00	8000.00	0.05	0.05	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00

13.68 86.32
 92.63 100.00

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP6E
Sampling Date:	9/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	22-Apr-15
Instrument	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant	Water
Additives	10mL Sodium Hexametaphosphate
Sonication (s)	300
Wentworth Aggregate Classification	
Clay % (<4µm)	6.44
Fine Silt % (4-16µm)	6.45
Medium Silt % (16-31µm)	3.73
Course Silt % (31-62µm)	9.59
Fine sand % (62-250µm)	38.38
Medium sand % (250-500µm)	21.53
Coarse sand % (500-2000µm)	12.56
Pebbles/Cobbles/Boulders (>2000µm)	1.32
SOP Name	SOP-LV-3REPS-ikm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 10.32
	1000 2.24
	2000 1.32
	4000 0.00
	8000 0.00
	16000 0.00

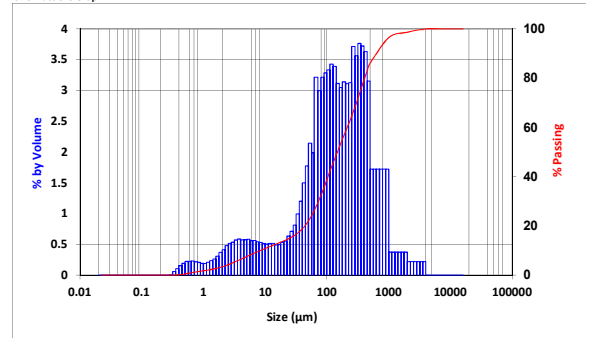
Sample visual assessment
 Sand with shell and mud present.

Size Fractions Table

Differential Data			Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.01	0.00	0.317	0.01
0.317	0.356	0.06	0.06	0.356	0.06
0.356	0.399	0.11	0.10	0.399	0.16
0.399	0.448	0.16	0.15	0.448	0.32
0.448	0.502	0.20	0.19	0.502	0.50
0.502	0.564	0.23	0.22	0.564	0.72
0.564	0.632	0.24	0.23	0.632	0.95
0.632	0.710	0.24	0.23	0.710	1.18
0.710	0.796	0.23	0.22	0.796	1.39
0.796	0.893	0.21	0.20	0.893	1.60
0.893	1.000	0.20	0.19	1.000	1.79
1.000	1.120	0.20	0.19	1.120	1.97
1.120	1.260	0.22	0.21	1.260	2.18
1.260	1.420	0.25	0.24	1.420	2.41
1.420	1.590	0.28	0.26	1.590	2.68
1.590	1.780	0.32	0.31	1.780	2.98
1.780	2.000	0.39	0.37	2.000	3.35
2.000	2.240	0.43	0.41	2.240	3.76
2.240	2.520	0.50	0.48	2.520	4.24
2.520	2.830	0.54	0.51	2.830	4.76
2.830	3.170	0.56	0.53	3.170	5.29
3.170	3.560	0.60	0.57	3.560	5.86
3.560	4.000	0.61	0.58	4.000	6.44
4.000	4.480	0.60	0.57	4.480	7.01
4.480	5.020	0.60	0.57	5.020	7.59
5.020	5.640	0.61	0.58	5.640	8.17
5.640	6.320	0.59	0.56	6.320	8.73
6.320	7.100	0.59	0.56	7.100	9.29
7.100	7.960	0.57	0.54	7.960	9.83
7.960	8.930	0.56	0.53	8.930	10.36
8.930	10.000	0.54	0.51	10.000	10.87
10.000	11.200	0.53	0.50	11.200	11.37
11.200	12.600	0.54	0.51	12.600	11.88
12.600	14.200	0.54	0.52	14.200	12.40
14.200	15.900	0.51	0.49	15.900	12.89
15.900	17.800	0.52	0.50	17.800	13.38
17.800	20.000	0.56	0.53	20.000	13.92
20.000	22.400	0.58	0.55	22.400	14.47
22.400	25.200	0.66	0.63	25.200	15.10
25.200	28.300	0.75	0.71	28.300	15.81
28.300	31.700	0.85	0.81	31.700	16.62
31.700	35.600	1.05	0.99	35.600	17.61
35.600	39.900	1.26	1.20	39.900	18.81
39.900	44.800	1.57	1.50	44.800	20.31
44.800	50.200	1.86	1.77	50.200	22.08
50.200	56.400	2.25	2.14	56.400	24.22
56.400	62.000	2.09	1.99	62.000	26.21
62.000	71.000	3.38	3.21	71.000	29.42
71.000	79.600	3.15	3.00	79.600	32.42
79.600	89.300	3.38	3.21	89.300	35.63
89.300	100.000	3.45	3.28	100.000	38.91
100.000	112.000	3.50	3.33	112.000	42.24
112.000	126.000	3.61	3.43	126.000	45.67
126.000	142.000	3.56	3.39	142.000	49.06
142.000	159.000	3.27	3.11	159.000	52.17
159.000	178.000	3.21	3.05	178.000	55.22
178.000	200.000	3.30	3.14	200.000	58.36
200.000	224.000	3.27	3.11	224.000	61.46
224.000	250.000	3.29	3.12	250.000	64.59
250.000	283.000	3.90	3.71	283.000	68.30
283.000	317.000	3.75	3.56	317.000	71.86
317.000	356.000	3.96	3.76	356.000	75.62
356.000	399.000	3.91	3.72	399.000	79.34
399.000	448.000	3.82	3.63	448.000	82.97
448.000	500.000	3.31	3.15	500.000	86.12
500.00	1000.00	10.32	10.32	1000.00	96.44
1000.00	2000.00	2.24	2.24	2000.00	98.68
2000.00	4000.00	1.32	1.32	4000.00	100.00
4000.00	8000.00	0.00	0.00	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00

13.88 86.12
 90.61 100.00

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

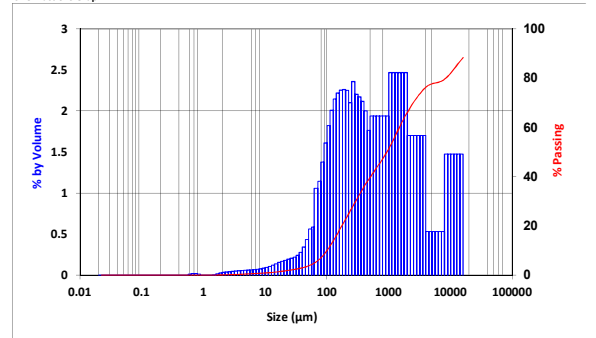
Sample Name:	SP8
Sampling Date:	10/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	20-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	0.35
Fine Silt % (4-16µm)	0.98
Medium Silt % (16-31µm)	1.12
Course Silt % (31-62µm)	2.44
Fine sand % (62-250µm)	22.24
Medium sand % (250-500µm)	12.61
Coarse sand % (500-2000µm)	26.43
Pebbles/Cobbles/Boulders (>2000µm)	33.84
SOP Name:	SOP-3REPS-skm.msop
Analysis Model:	General Purpose
Result Units:	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 11.63
	1000 14.80
	2000 10.20
	4000 3.18
	8000 8.84
	16000 11.62

Sample visual assessment
 Shelly sand with mud and rock present.

Size Fractions Table

Differential Data			Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.00	0.00	0.317	0.00
0.317	0.356	0.00	0.00	0.356	0.00
0.356	0.399	0.00	0.00	0.399	0.00
0.399	0.448	0.00	0.00	0.448	0.00
0.448	0.502	0.00	0.00	0.502	0.00
0.502	0.564	0.00	0.00	0.564	0.00
0.564	0.632	0.02	0.01	0.632	0.01
0.632	0.710	0.04	0.02	0.710	0.03
0.710	0.796	0.04	0.02	0.796	0.04
0.796	0.893	0.02	0.01	0.893	0.06
0.893	1.002	0.00	0.00	1.002	0.06
1.002	1.125	0.00	0.00	1.125	0.06
1.125	1.262	0.00	0.00	1.262	0.06
1.262	1.416	0.00	0.00	1.416	0.06
1.416	1.589	0.00	0.00	1.589	0.06
1.589	1.783	0.03	0.01	1.783	0.07
1.783	2.000	0.05	0.02	2.000	0.10
2.000	2.244	0.07	0.03	2.244	0.13
2.244	2.518	0.08	0.04	2.518	0.16
2.518	2.825	0.09	0.04	2.825	0.20
2.825	3.170	0.10	0.04	3.170	0.25
3.170	3.557	0.11	0.05	3.557	0.30
3.557	4.000	0.12	0.05	4.000	0.35
4.000	4.477	0.12	0.05	4.477	0.40
4.477	5.024	0.13	0.06	5.024	0.46
5.024	5.637	0.13	0.06	5.637	0.52
5.637	6.325	0.14	0.06	6.325	0.58
6.325	7.096	0.14	0.07	7.096	0.65
7.096	7.962	0.15	0.07	7.962	0.72
7.962	8.934	0.17	0.08	8.934	0.79
8.934	10.024	0.18	0.08	10.024	0.88
10.024	11.247	0.20	0.09	11.247	0.97
11.247	12.619	0.23	0.11	12.619	1.07
12.619	14.159	0.27	0.12	14.159	1.19
14.159	15.887	0.30	0.14	15.887	1.33
15.887	17.825	0.34	0.15	17.825	1.48
17.825	20.000	0.37	0.17	20.000	1.65
20.000	22.440	0.40	0.18	22.440	1.83
22.440	25.179	0.43	0.19	25.179	2.02
25.179	28.251	0.45	0.20	28.251	2.23
28.251	31.698	0.48	0.22	31.698	2.45
31.698	35.566	0.53	0.24	35.566	2.69
35.566	39.905	0.61	0.28	39.905	2.96
39.905	44.774	0.75	0.34	44.774	3.31
44.774	50.238	0.95	0.43	50.238	3.74
50.238	56.368	1.23	0.56	56.368	4.30
56.368	62.000	1.29	0.59	62.000	4.88
62.000	70.963	2.33	1.06	70.963	5.94
70.963	79.621	2.52	1.14	79.621	7.08
79.621	89.337	3.03	1.38	89.337	8.46
89.337	100.237	3.54	1.61	100.237	10.07
100.237	112.468	4.02	1.82	112.468	11.89
112.468	126.191	4.42	2.01	126.191	13.90
126.191	141.589	4.72	2.14	141.589	16.04
141.589	158.866	4.89	2.22	158.866	18.26
158.866	178.250	4.96	2.25	178.250	20.51
178.250	200.000	4.98	2.26	200.000	22.77
200.000	224.404	4.96	2.25	224.404	25.02
224.404	250.000	4.62	2.10	250.000	27.12
250.000	282.508	5.20	2.36	282.508	29.48
282.508	316.979	4.85	2.20	316.979	31.68
316.979	355.656	4.78	2.17	355.656	33.85
355.656	399.052	4.66	2.11	399.052	35.97
399.052	447.744	4.41	2.00	447.744	37.97
447.744	500.000	3.89	1.76	500.000	39.73
500.00	1000.00	11.63	11.63	1000.00	51.36
1000.00	2000.00	14.80	14.80	2000.00	66.16
2000.00	4000.00	10.20	10.20	4000.00	76.36
4000.00	8000.00	3.18	3.18	8000.00	79.54
8000.00	16000.00	8.84	8.84	16000.00	88.38
>16000		11.62	11.62		100.00
		60.27	39.73		
		87.53			
		100.00			

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP9
Sampling Date:	10/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	20-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	0.95
Fine Silt % (4-16µm)	1.36
Medium Silt % (16-31µm)	1.17
Course Silt % (31-62µm)	2.00
Fine sand % (62-250µm)	23.44
Medium sand % (250-500µm)	16.38
Coarse sand % (500-2000µm)	18.71
Pebbles/Cobbles/Boulders (>2000µm)	35.99
SOP Name	SOP-3REPS-skm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 8.66
	1000 10.05
	2000 8.84
	4000 4.51
	8000 8.71
	16000 13.94

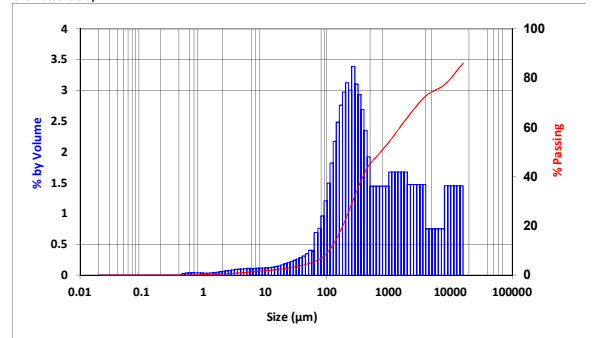
Sample visual assessment
 Sand with rock, coral, shell and mud present.

Size Fractions Table

Differential Data		Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	Size (µm)	% Passing
0.020	0.022	0.00	0.022	0.00
0.022	0.025	0.00	0.025	0.00
0.025	0.028	0.00	0.028	0.00
0.028	0.032	0.00	0.032	0.00
0.032	0.036	0.00	0.036	0.00
0.036	0.040	0.00	0.040	0.00
0.040	0.045	0.00	0.045	0.00
0.045	0.050	0.00	0.050	0.00
0.050	0.056	0.00	0.056	0.00
0.056	0.063	0.00	0.063	0.00
0.063	0.071	0.00	0.071	0.00
0.071	0.080	0.00	0.080	0.00
0.080	0.089	0.00	0.089	0.00
0.089	0.100	0.00	0.100	0.00
0.100	0.112	0.00	0.112	0.00
0.112	0.126	0.00	0.126	0.00
0.126	0.142	0.00	0.142	0.00
0.142	0.159	0.00	0.159	0.00
0.159	0.178	0.00	0.178	0.00
0.178	0.200	0.00	0.200	0.00
0.200	0.224	0.00	0.224	0.00
0.224	0.252	0.00	0.252	0.00
0.252	0.283	0.00	0.283	0.00
0.283	0.317	0.00	0.317	0.00
0.317	0.356	0.00	0.356	0.00
0.356	0.399	0.00	0.399	0.00
0.399	0.448	0.00	0.448	0.00
0.448	0.502	0.00	0.502	0.02
0.502	0.564	0.07	0.564	0.06
0.564	0.632	0.07	0.632	0.09
0.632	0.710	0.08	0.710	0.13
0.710	0.796	0.07	0.796	0.17
0.796	0.893	0.07	0.893	0.20
0.893	1.002	0.07	1.002	0.24
1.002	1.125	0.06	1.125	0.27
1.125	1.262	0.06	1.262	0.30
1.262	1.416	0.07	1.416	0.33
1.416	1.589	0.08	1.589	0.37
1.589	1.783	0.09	1.783	0.42
1.783	2.000	0.11	2.000	0.47
2.000	2.244	0.12	2.244	0.54
2.244	2.518	0.14	2.518	0.60
2.518	2.825	0.15	2.825	0.68
2.825	3.170	0.17	3.170	0.76
3.170	3.557	0.18	3.557	0.85
3.557	4.000	0.19	4.000	0.95
4.000	4.477	0.19	4.477	1.05
4.477	5.024	0.20	5.024	1.15
5.024	5.637	0.21	5.637	1.26
5.637	6.325	0.21	6.325	1.36
6.325	7.096	0.22	7.096	1.47
7.096	7.962	0.22	7.962	1.58
7.962	8.934	0.22	8.934	1.70
8.934	10.024	0.23	10.024	1.81
10.024	11.247	0.23	11.247	1.92
11.247	12.619	0.24	12.619	2.04
12.619	14.159	0.25	14.159	2.17
14.159	15.887	0.27	15.887	2.31
15.887	17.825	0.30	17.825	2.46
17.825	20.000	0.33	20.000	2.62
20.000	22.440	0.36	22.440	2.81
22.440	25.179	0.40	25.179	3.01
25.179	28.251	0.44	28.251	3.23
28.251	31.698	0.48	31.698	3.47
31.698	35.566	0.52	35.566	3.74
35.566	39.905	0.57	39.905	4.02
39.905	44.774	0.62	44.774	4.33
44.774	50.238	0.69	50.238	4.68
50.238	56.368	0.80	56.368	5.08
56.368	62.000	0.78	62.000	5.47
62.000	70.963	1.37	70.963	6.16
70.963	79.621	1.51	79.621	6.92
79.621	89.337	1.91	89.337	7.88
89.337	100.237	2.40	100.237	9.09
100.237	112.468	2.97	112.468	10.58
112.468	126.191	3.63	126.191	12.40
126.191	141.589	4.33	141.589	14.57
141.589	158.866	4.95	158.866	17.06
158.866	178.250	5.49	178.250	19.82
178.250	200.000	5.92	200.000	22.79
200.000	224.404	6.23	224.404	25.92
224.404	250.000	5.98	250.000	28.92
250.000	282.508	6.75	282.508	32.31
282.508	316.979	6.18	316.979	35.41
316.979	355.656	5.84	355.656	38.34
355.656	399.052	5.35	399.052	41.03
399.052	447.744	4.68	447.744	43.38
447.744	500.000	3.82	500.000	45.30
500.00	1000.00	8.66	1000.00	53.96
1000.00	2000.00	10.05	2000.00	64.01
2000.00	4000.00	8.84	4000.00	72.85
4000.00	8000.00	4.51	8000.00	77.35
8000.00	16000.00	8.71	16000.00	86.06
>16000		13.94		100.00

54.70 45.30
 90.21 100.00

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

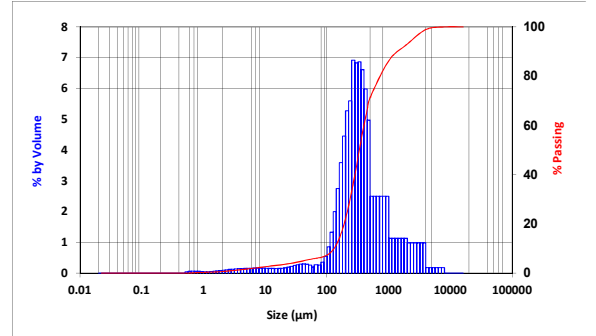
Sample Name:	SP10N
Sampling Date:	10/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	20-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	1.37
Fine Silt % (4-16µm)	1.84
Medium Silt % (16-31µm)	1.13
Course Silt % (31-62µm)	1.59
Fine sand % (62-250µm)	27.24
Medium sand % (250-500µm)	38.17
Coarse sand % (500-2000µm)	21.71
Pebbles/Cobbles/Boulders (>2000µm)	6.95
SOP Name	SOP-3REPS-skm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 14.95
	1000 6.75
	2000 5.90
	4000 1.04
	8000 0.00
	16000 0.00

Sample visual assessment
 Sand with rock, coral, shell and mud present.

Size Fractions Table

Differential Data			Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.00	0.00	0.317	0.00
0.317	0.356	0.00	0.00	0.356	0.00
0.356	0.399	0.00	0.00	0.399	0.00
0.399	0.448	0.00	0.00	0.448	0.00
0.448	0.502	0.00	0.00	0.502	0.00
0.502	0.564	0.04	0.03	0.564	0.03
0.564	0.632	0.07	0.06	0.632	0.09
0.632	0.710	0.07	0.06	0.710	0.15
0.710	0.796	0.07	0.06	0.796	0.21
0.796	0.893	0.07	0.06	0.893	0.27
0.893	1.002	0.06	0.05	1.002	0.32
1.002	1.125	0.05	0.04	1.125	0.35
1.125	1.262	0.05	0.04	1.262	0.39
1.262	1.416	0.06	0.05	1.416	0.44
1.416	1.589	0.07	0.06	1.589	0.50
1.589	1.783	0.08	0.07	1.783	0.57
1.783	2.000	0.10	0.08	2.000	0.65
2.000	2.244	0.11	0.09	2.244	0.75
2.244	2.518	0.13	0.11	2.518	0.85
2.518	2.825	0.14	0.12	2.825	0.97
2.825	3.170	0.15	0.13	3.170	1.09
3.170	3.557	0.16	0.13	3.557	1.22
3.557	4.000	0.17	0.14	4.000	1.37
4.000	4.477	0.17	0.14	4.477	1.51
4.477	5.024	0.18	0.15	5.024	1.66
5.024	5.637	0.18	0.15	5.637	1.81
5.637	6.325	0.19	0.16	6.325	1.97
6.325	7.096	0.19	0.16	7.096	2.13
7.096	7.962	0.19	0.16	7.962	2.29
7.962	8.934	0.19	0.16	8.934	2.45
8.934	10.024	0.19	0.16	10.024	2.61
10.024	11.247	0.19	0.16	11.247	2.76
11.247	12.619	0.18	0.15	12.619	2.91
12.619	14.159	0.18	0.15	14.159	3.06
14.159	15.887	0.18	0.15	15.887	3.21
15.887	17.825	0.18	0.15	17.825	3.36
17.825	20.000	0.19	0.16	20.000	3.51
20.000	22.440	0.21	0.17	22.440	3.68
22.440	25.179	0.23	0.19	25.179	3.88
25.179	28.251	0.26	0.22	28.251	4.10
28.251	31.698	0.30	0.25	31.698	4.34
31.698	35.566	0.33	0.27	35.566	4.61
35.566	39.905	0.35	0.29	39.905	4.90
39.905	44.774	0.35	0.29	44.774	5.20
44.774	50.238	0.34	0.28	50.238	5.48
50.238	56.368	0.31	0.26	56.368	5.74
56.368	62.000	0.24	0.20	62.000	5.93
62.000	70.963	0.32	0.27	70.963	6.20
70.963	79.621	0.31	0.26	79.621	6.46
79.621	89.337	0.42	0.35	89.337	6.81
89.337	100.237	0.65	0.54	100.237	7.36
100.237	112.468	1.02	0.85	112.468	8.21
112.468	126.191	1.59	1.32	126.191	9.53
126.191	141.589	2.40	1.99	141.589	11.52
141.589	158.866	3.30	2.75	158.866	14.27
158.866	178.250	4.31	3.59	178.250	17.86
178.250	200.000	5.35	4.45	200.000	22.31
200.000	224.404	6.34	5.27	224.404	27.58
224.404	250.000	6.72	5.59	250.000	33.18
250.000	282.508	8.32	6.92	282.508	40.10
282.508	316.979	8.21	6.83	316.979	46.93
316.979	355.656	8.25	6.86	355.656	53.79
355.656	399.052	7.94	6.61	399.052	60.40
399.052	447.744	7.19	5.98	447.744	66.38
447.744	500.000	5.97	4.97	500.000	71.35
500.00	1000.00	14.95	14.95	1000.00	86.30
1000.00	2000.00	6.75	6.75	2000.00	93.05
2000.00	4000.00	5.90	5.90	4000.00	98.96
4000.00	8000.00	1.04	1.04	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00
		28.65	71.35		
		85.74	100.00		

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP12
Sampling Date:	10/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	20-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	2.04
Fine Silt % (4-16µm)	2.76
Medium Silt % (16-31µm)	2.88
Course Silt % (31-62µm)	8.32
Fine sand % (62-250µm)	37.83
Medium sand % (250-500µm)	11.17
Coarse sand % (500-2000µm)	29.75
Pebbles/Cobbles/Boulders (>2000µm)	5.26
SOP Name	SOP-3REPS-skm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 16.60
	1000 13.16
	2000 4.85
	4000 0.42
	8000 0.00
	16000 0.00

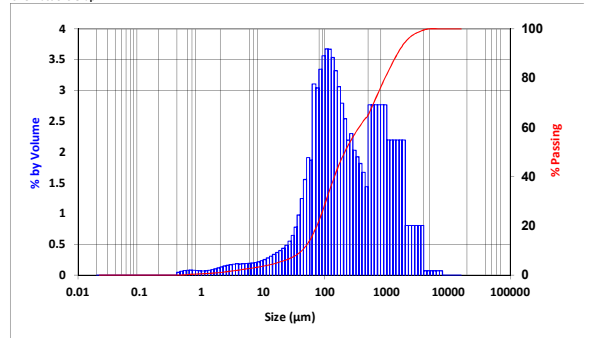
Sample visual assessment
 Sand with shell and mud present.

Size Fractions Table

Lower Size (µm)	Differential Data			Cumulative Data	
	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.00	0.00	0.317	0.00
0.317	0.356	0.00	0.00	0.356	0.00
0.356	0.399	0.00	0.00	0.399	0.00
0.399	0.448	0.06	0.04	0.448	0.04
0.448	0.502	0.09	0.06	0.502	0.11
0.502	0.564	0.11	0.07	0.564	0.18
0.564	0.632	0.11	0.08	0.632	0.26
0.632	0.710	0.11	0.08	0.710	0.34
0.710	0.796	0.11	0.08	0.796	0.41
0.796	0.893	0.10	0.07	0.893	0.49
0.893	1.002	0.10	0.07	1.002	0.55
1.002	1.125	0.10	0.07	1.125	0.62
1.125	1.262	0.10	0.07	1.262	0.69
1.262	1.416	0.11	0.08	1.416	0.77
1.416	1.589	0.13	0.09	1.589	0.86
1.589	1.783	0.15	0.10	1.783	0.96
1.783	2.000	0.17	0.12	2.000	1.08
2.000	2.244	0.19	0.13	2.244	1.21
2.244	2.518	0.21	0.15	2.518	1.35
2.518	2.825	0.23	0.16	2.825	1.51
2.825	3.170	0.24	0.17	3.170	1.68
3.170	3.557	0.25	0.18	3.557	1.86
3.557	4.000	0.27	0.18	4.000	2.04
4.000	4.477	0.26	0.18	4.477	2.22
4.477	5.024	0.27	0.18	5.024	2.40
5.024	5.637	0.27	0.19	5.637	2.59
5.637	6.325	0.27	0.19	6.325	2.78
6.325	7.096	0.28	0.19	7.096	2.97
7.096	7.962	0.29	0.20	7.962	3.17
7.962	8.934	0.31	0.22	8.934	3.39
8.934	10.024	0.34	0.23	10.024	3.62
10.024	11.247	0.37	0.25	11.247	3.87
11.247	12.619	0.41	0.28	12.619	4.15
12.619	14.159	0.45	0.31	14.159	4.46
14.159	15.887	0.49	0.34	15.887	4.80
15.887	17.825	0.53	0.37	17.825	5.16
17.825	20.000	0.58	0.40	20.000	5.56
20.000	22.440	0.63	0.44	22.440	6.00
22.440	25.179	0.70	0.48	25.179	6.48
25.179	28.251	0.80	0.55	28.251	7.03
28.251	31.698	0.93	0.64	31.698	7.67
31.698	35.566	1.13	0.78	35.566	8.45
35.566	39.905	1.41	0.97	39.905	9.42
39.905	44.774	1.80	1.24	44.774	10.66
44.774	50.238	2.25	1.55	50.238	12.22
50.238	56.368	2.76	1.91	56.368	14.12
56.368	62.000	2.71	1.87	62.000	15.99
62.000	70.963	4.50	3.10	70.963	19.10
70.963	79.621	4.41	3.04	79.621	22.14
79.621	89.337	4.84	3.34	89.337	25.48
89.337	100.237	5.16	3.56	100.237	29.04
100.237	112.468	5.32	3.67	112.468	32.72
112.468	126.191	5.32	3.67	126.191	36.38
126.191	141.589	5.12	3.53	141.589	39.92
141.589	158.866	4.81	3.32	158.866	43.24
158.866	178.250	4.43	3.06	178.250	46.30
178.250	200.000	4.04	2.79	200.000	49.09
200.000	224.404	3.68	2.54	224.404	51.63
224.404	250.000	3.18	2.19	250.000	53.82
250.000	282.508	3.33	2.30	282.508	56.12
282.508	316.979	2.94	2.03	316.979	58.14
316.979	355.656	2.78	1.92	355.656	60.07
355.656	399.052	2.63	1.81	399.052	61.88
399.052	447.744	2.42	1.67	447.744	63.55
447.744	500.000	2.08	1.44	500.000	64.99
500.00	1000.00	16.60	16.60	1000.00	81.58
1000.00	2000.00	13.16	13.16	2000.00	94.74
2000.00	4000.00	4.85	4.85	4000.00	99.58
4000.00	8000.00	0.42	0.42	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00

35.01 64.99
 94.17 100.00

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

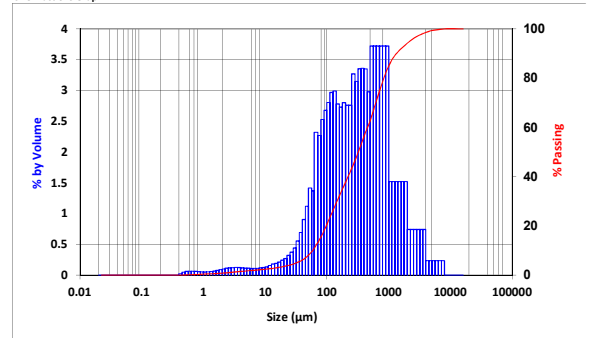
Sample Name:	SP13
Sampling Date:	14/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	22-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	1.48
Fine Silt % (4-16µm)	1.56
Medium Silt % (16-31µm)	1.86
Course Silt % (31-62µm)	6.05
Fine sand % (62-250µm)	32.36
Medium sand % (250-500µm)	19.45
Coarse sand % (500-2000µm)	31.42
Pebbles/Cobbles/Boulders (>2000µm)	5.82
SOP Name	SOP-LV-3REPS-ikm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 22.32
	1000 9.10
	2000 4.43
	4000 1.39
	8000 0.00
	16000 0.00

Sample visual assessment
 Sand with coral, shell and mud present.

Size Fractions Table

Differential Data			Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.00	0.00	0.317	0.00
0.317	0.356	0.00	0.00	0.356	0.00
0.356	0.399	0.00	0.00	0.399	0.00
0.399	0.448	0.03	0.02	0.448	0.02
0.448	0.502	0.06	0.05	0.502	0.07
0.502	0.564	0.08	0.06	0.564	0.12
0.564	0.632	0.08	0.06	0.632	0.19
0.632	0.710	0.09	0.06	0.710	0.25
0.710	0.796	0.08	0.06	0.796	0.31
0.796	0.893	0.08	0.06	0.893	0.36
0.893	1.000	0.07	0.05	1.000	0.41
1.000	1.120	0.07	0.05	1.120	0.46
1.120	1.260	0.07	0.05	1.260	0.51
1.260	1.420	0.08	0.06	1.420	0.57
1.420	1.590	0.09	0.06	1.590	0.63
1.590	1.780	0.10	0.07	1.780	0.71
1.780	2.000	0.12	0.09	2.000	0.80
2.000	2.240	0.13	0.10	2.240	0.89
2.240	2.520	0.15	0.11	2.520	1.00
2.520	2.830	0.16	0.12	2.830	1.12
2.830	3.170	0.16	0.12	3.170	1.24
3.170	3.560	0.17	0.12	3.560	1.36
3.560	4.000	0.17	0.12	4.000	1.48
4.000	4.480	0.16	0.12	4.480	1.60
4.480	5.020	0.15	0.11	5.020	1.71
5.020	5.640	0.15	0.11	5.640	1.82
5.640	6.320	0.15	0.11	6.320	1.93
6.320	7.100	0.15	0.11	7.100	2.04
7.100	7.960	0.15	0.11	7.960	2.15
7.960	8.930	0.16	0.12	8.930	2.26
8.930	10.000	0.17	0.12	10.000	2.39
10.000	11.200	0.18	0.13	11.200	2.52
11.200	12.600	0.21	0.16	12.600	2.67
12.600	14.200	0.24	0.18	14.200	2.85
14.200	15.900	0.26	0.19	15.900	3.04
15.900	17.800	0.29	0.21	17.800	3.25
17.800	20.000	0.34	0.24	20.000	3.49
20.000	22.400	0.37	0.27	22.400	3.76
22.400	25.200	0.44	0.32	25.200	4.09
25.200	28.300	0.51	0.37	28.300	4.46
28.300	31.700	0.60	0.44	31.700	4.90
31.700	35.600	0.76	0.55	35.600	5.45
35.600	39.900	0.95	0.69	39.900	6.14
39.900	44.800	1.24	0.90	44.800	7.04
44.800	50.200	1.54	1.12	50.200	8.16
50.200	56.400	1.95	1.41	56.400	9.57
56.400	62.000	1.89	1.37	62.000	10.94
62.000	71.000	3.19	2.32	71.000	13.26
71.000	79.600	3.12	2.26	79.600	15.53
79.600	89.300	3.48	2.53	89.300	18.05
89.300	100.000	3.68	2.67	100.000	20.73
100.000	112.000	3.86	2.80	112.000	23.53
112.000	126.000	4.09	2.97	126.000	26.50
126.000	142.000	4.12	2.99	142.000	29.49
142.000	159.000	3.83	2.78	159.000	32.27
159.000	178.000	3.76	2.73	178.000	34.99
178.000	200.000	3.86	2.80	200.000	37.79
200.000	224.000	3.80	2.76	224.000	40.55
224.000	250.000	3.80	2.76	250.000	43.31
250.000	283.000	4.50	3.27	283.000	46.58
283.000	317.000	4.33	3.15	317.000	49.72
317.000	356.000	4.62	3.35	356.000	53.07
356.000	399.000	4.63	3.36	399.000	56.43
399.000	448.000	4.61	3.35	448.000	59.78
448.000	500.000	4.10	2.98	500.000	62.76
500.00	1000.00	22.32	22.32	1000.00	85.07
1000.00	2000.00	9.10	9.10	2000.00	94.18
2000.00	4000.00	4.43	4.43	4000.00	98.61
4000.00	8000.00	1.39	1.39	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00
		37.24	62.76		
		86.44			
			100.00		

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP14
Sampling Date:	14/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	22-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	1.73
Fine Silt % (4-16µm)	1.83
Medium Silt % (16-31µm)	2.30
Course Silt % (31-62µm)	6.51
Fine sand % (62-250µm)	49.64
Medium sand % (250-500µm)	21.32
Coarse sand % (500-2000µm)	14.26
Pebbles/Cobbles/Boulders (>2000µm)	2.41
SOP Name	SOP-LV-3REPS-ikm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 9.63
	1000 4.63
	2000 1.37
	4000 1.04
	8000 1.00
	16000 1.00

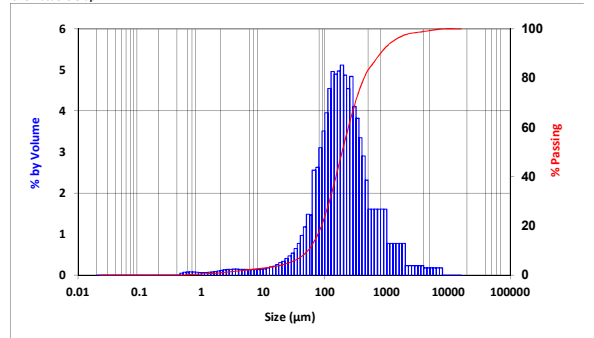
Sample visual assessment
 Sand with shell and mud present.

Size Fractions Table

Differential Data			Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.00	0.00	0.317	0.00
0.317	0.356	0.00	0.00	0.356	0.00
0.356	0.399	0.00	0.00	0.399	0.00
0.399	0.448	0.00	0.00	0.448	0.00
0.448	0.502	0.05	0.05	0.502	0.05
0.502	0.564	0.08	0.07	0.564	0.12
0.564	0.632	0.08	0.07	0.632	0.19
0.632	0.710	0.09	0.08	0.710	0.27
0.710	0.796	0.08	0.07	0.796	0.34
0.796	0.893	0.08	0.07	0.893	0.41
0.893	1.000	0.07	0.06	1.000	0.47
1.000	1.120	0.07	0.06	1.120	0.53
1.120	1.260	0.07	0.06	1.260	0.59
1.260	1.420	0.08	0.07	1.420	0.66
1.420	1.590	0.08	0.07	1.590	0.74
1.590	1.780	0.10	0.09	1.780	0.82
1.780	2.000	0.11	0.10	2.000	0.92
2.000	2.240	0.13	0.11	2.240	1.03
2.240	2.520	0.14	0.13	2.520	1.16
2.520	2.830	0.15	0.14	2.830	1.30
2.830	3.170	0.16	0.14	3.170	1.44
3.170	3.560	0.16	0.14	3.560	1.58
3.560	4.000	0.16	0.14	4.000	1.73
4.000	4.480	0.16	0.14	4.480	1.86
4.480	5.020	0.15	0.14	5.020	2.00
5.020	5.640	0.15	0.14	5.640	2.14
5.640	6.320	0.15	0.13	6.320	2.27
6.320	7.100	0.15	0.13	7.100	2.40
7.100	7.960	0.15	0.13	7.960	2.53
7.960	8.930	0.15	0.14	8.930	2.67
8.930	10.000	0.16	0.14	10.000	2.81
10.000	11.200	0.17	0.15	11.200	2.96
11.200	12.600	0.20	0.17	12.600	3.13
12.600	14.200	0.23	0.20	14.200	3.33
14.200	15.900	0.25	0.22	15.900	3.55
15.900	17.800	0.28	0.25	17.800	3.80
17.800	20.000	0.34	0.30	20.000	4.10
20.000	22.400	0.38	0.34	22.400	4.44
22.400	25.200	0.46	0.41	25.200	4.85
25.200	28.300	0.53	0.47	28.300	5.32
28.300	31.700	0.60	0.54	31.700	5.86
31.700	35.600	0.73	0.65	35.600	6.50
35.600	39.900	0.86	0.77	39.900	7.27
39.900	44.800	1.09	0.97	44.800	8.24
44.800	50.200	1.32	1.17	50.200	9.42
50.200	56.400	1.66	1.48	56.400	10.90
56.400	62.000	1.64	1.46	62.000	12.36
62.000	71.000	2.86	2.55	71.000	14.91
71.000	79.600	2.94	2.62	79.600	17.54
79.600	89.300	3.48	3.10	89.300	20.64
89.300	100.000	3.94	3.51	100.000	24.15
100.000	112.000	4.44	3.95	112.000	28.10
112.000	126.000	5.10	4.55	126.000	32.65
126.000	142.000	5.56	4.96	142.000	37.61
142.000	159.000	5.49	4.89	159.000	42.50
159.000	178.000	5.57	4.97	178.000	47.47
178.000	200.000	5.74	5.12	200.000	52.59
200.000	224.000	5.46	4.87	224.000	57.46
224.000	250.000	5.10	4.55	250.000	62.01
250.000	283.000	5.43	4.84	283.000	66.84
283.000	317.000	4.60	4.10	317.000	70.95
317.000	356.000	4.28	3.82	356.000	74.77
356.000	399.000	3.75	3.34	399.000	78.11
399.000	448.000	3.26	2.90	448.000	81.01
448.000	500.000	2.59	2.31	500.000	83.33
500.00	1000.00	9.63	9.63	1000.00	92.96
1000.00	2000.00	4.63	4.63	2000.00	97.59
2000.00	4000.00	1.37	1.37	4000.00	98.96
4000.00	8000.00	1.04	1.04	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00

16.67 83.33
 93.48 100.00

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP15
Sampling Date:	12/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	22-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	1.59
Fine Silt % (4-16µm)	1.63
Medium Silt % (16-31µm)	0.97
Course Silt % (31-62µm)	1.74
Fine sand % (62-250µm)	28.95
Medium sand % (250-500µm)	29.18
Coarse sand % (500-2000µm)	21.25
Pebbles/Cobbles/Boulders (>2000µm)	14.69
SOP Name	SOP-LV-3REPS-ikm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 9.34
	1000 11.91
	2000 10.96
	4000 2.29
	8000 1.44
	16000 0.00

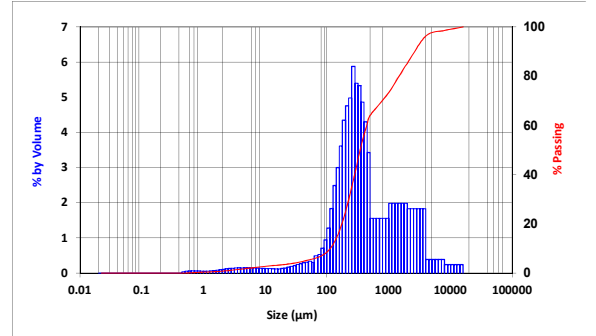
Sample visual assessment
 Sand with coral, shell and mud present.

Size Fractions Table

Differential Data		Cumulative Data			
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.00	0.00	0.317	0.00
0.317	0.356	0.00	0.00	0.356	0.00
0.356	0.399	0.00	0.00	0.399	0.00
0.399	0.448	0.00	0.00	0.448	0.00
0.448	0.502	0.05	0.04	0.502	0.04
0.502	0.564	0.08	0.06	0.564	0.09
0.564	0.632	0.08	0.06	0.632	0.15
0.632	0.710	0.09	0.06	0.710	0.22
0.710	0.796	0.08	0.06	0.796	0.28
0.796	0.893	0.08	0.06	0.893	0.34
0.893	1.000	0.07	0.05	1.000	0.39
1.000	1.120	0.07	0.05	1.120	0.44
1.120	1.260	0.08	0.05	1.260	0.49
1.260	1.420	0.09	0.06	1.420	0.56
1.420	1.590	0.09	0.07	1.590	0.62
1.590	1.780	0.11	0.08	1.780	0.70
1.780	2.000	0.13	0.10	2.000	0.80
2.000	2.240	0.15	0.11	2.240	0.90
2.240	2.520	0.17	0.12	2.520	1.03
2.520	2.830	0.18	0.13	2.830	1.16
2.830	3.170	0.19	0.14	3.170	1.30
3.170	3.560	0.20	0.15	3.560	1.44
3.560	4.000	0.21	0.15	4.000	1.59
4.000	4.480	0.20	0.15	4.480	1.74
4.480	5.020	0.20	0.15	5.020	1.88
5.020	5.640	0.21	0.15	5.640	2.03
5.640	6.320	0.20	0.14	6.320	2.18
6.320	7.100	0.20	0.15	7.100	2.32
7.100	7.960	0.19	0.14	7.960	2.46
7.960	8.930	0.19	0.14	8.930	2.60
8.930	10.000	0.18	0.13	10.000	2.73
10.000	11.200	0.17	0.13	11.200	2.86
11.200	12.600	0.17	0.12	12.600	2.98
12.600	14.200	0.17	0.12	14.200	3.10
14.200	15.900	0.16	0.12	15.900	3.22
15.900	17.800	0.16	0.12	17.800	3.34
17.800	20.000	0.18	0.13	20.000	3.47
20.000	22.400	0.20	0.14	22.400	3.61
22.400	25.200	0.23	0.17	25.200	3.78
25.200	28.300	0.26	0.19	28.300	3.97
28.300	31.700	0.30	0.21	31.700	4.18
31.700	35.600	0.34	0.25	35.600	4.43
35.600	39.900	0.37	0.27	39.900	4.70
39.900	44.800	0.41	0.29	44.800	4.99
44.800	50.200	0.42	0.31	50.200	5.30
50.200	56.400	0.46	0.33	56.400	5.63
56.400	62.000	0.41	0.30	62.000	5.93
62.000	71.000	0.68	0.49	71.000	6.42
71.000	79.600	0.73	0.53	79.600	6.95
79.600	89.300	0.98	0.71	89.300	7.66
89.300	100.000	1.30	0.94	100.000	8.60
100.000	112.000	1.77	1.28	112.000	9.88
112.000	126.000	2.54	1.83	126.000	11.71
126.000	142.000	3.45	2.49	142.000	14.20
142.000	159.000	4.15	3.00	159.000	17.19
159.000	178.000	5.00	3.61	178.000	20.81
178.000	200.000	6.02	4.35	200.000	25.16
200.000	224.000	6.58	4.75	224.000	29.91
224.000	250.000	6.89	4.97	250.000	34.88
250.000	283.000	8.13	5.87	283.000	40.75
283.000	317.000	7.47	5.40	317.000	46.15
317.000	356.000	7.38	5.33	356.000	51.48
356.000	399.000	6.72	4.86	399.000	56.33
399.000	448.000	5.96	4.30	448.000	60.63
448.000	500.000	4.75	3.43	500.000	64.06
500.00	1000.00	9.34	9.34	1000.00	73.40
1000.00	2000.00	11.91	11.91	2000.00	85.31
2000.00	4000.00	10.96	10.96	4000.00	96.27
4000.00	8000.00	2.29	2.29	8000.00	98.56
8000.00	16000.00	1.44	1.44	16000.00	100.00
>16000		0.00	0.00		100.00

35.94
 88.72
 100.00

Size Fractions Graph



PARTICLE SIZE ANALYSIS REPORT

Size distribution analysis by laser diffraction (<500µm) and wet sieving (500-16000µm)

Customer: Jacobs
 Contact: Garnett Hooper
 Address: Level 11, 263 Adelaide Tce, Perth WA 6001
 Date Received: 16/04/2015
 Date of Issue: 29/04/2015



Summary Report

Sample Name:	SP17
Sampling Date:	8/04/2015
Sample Type:	Sediment
MAFRL Job Code:	JAC15-7
Client Reference:	W021200
Analysis Date:	22-Apr-15
Instrument:	Mastersizer3000
RI/ABS:	2.74 / 1
Dispersant:	Water
Additives:	10mL Sodium Hexametaphosphate
Sonication (s):	300
Wentworth Aggregate Classification	
Clay % (<4µm)	2.25
Fine Silt % (4-16µm)	2.41
Medium Silt % (16-31µm)	2.22
Course Silt % (31-62µm)	6.88
Fine sand % (62-250µm)	47.33
Medium sand % (250-500µm)	20.26
Coarse sand % (500-2000µm)	16.07
Pebbles/Cobbles/Boulders (>2000µm)	2.58
SOP Name	SOP-LV-3REPS-ikm.msop
Analysis Model	General Purpose
Result Units	Volume
Extended range by sieving	
Extended size, µm	Extended percent retained at size
	500 0.79
	1000 6.28
	2000 2.29
	4000 0.29
	8000 0.00
	16000 0.00

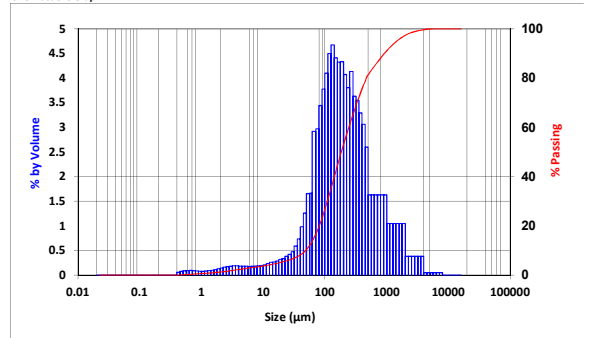
Sample visual assessment
 Sand with shell and mud present.

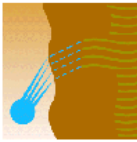
Size Fractions Table

Differential Data			Cumulative Data		
Lower Size (µm)	Upper Size (µm)	% in Interval	% in Interval after scaling	Size (µm)	% Passing
0.020	0.022	0.00	0.00	0.022	0.00
0.022	0.025	0.00	0.00	0.025	0.00
0.025	0.028	0.00	0.00	0.028	0.00
0.028	0.032	0.00	0.00	0.032	0.00
0.032	0.036	0.00	0.00	0.036	0.00
0.036	0.040	0.00	0.00	0.040	0.00
0.040	0.045	0.00	0.00	0.045	0.00
0.045	0.050	0.00	0.00	0.050	0.00
0.050	0.056	0.00	0.00	0.056	0.00
0.056	0.063	0.00	0.00	0.063	0.00
0.063	0.071	0.00	0.00	0.071	0.00
0.071	0.080	0.00	0.00	0.080	0.00
0.080	0.089	0.00	0.00	0.089	0.00
0.089	0.100	0.00	0.00	0.100	0.00
0.100	0.112	0.00	0.00	0.112	0.00
0.112	0.126	0.00	0.00	0.126	0.00
0.126	0.142	0.00	0.00	0.142	0.00
0.142	0.159	0.00	0.00	0.159	0.00
0.159	0.178	0.00	0.00	0.178	0.00
0.178	0.200	0.00	0.00	0.200	0.00
0.200	0.224	0.00	0.00	0.224	0.00
0.224	0.252	0.00	0.00	0.252	0.00
0.252	0.283	0.00	0.00	0.283	0.00
0.283	0.317	0.00	0.00	0.317	0.00
0.317	0.356	0.00	0.00	0.356	0.00
0.356	0.399	0.00	0.00	0.399	0.00
0.399	0.448	0.06	0.05	0.448	0.05
0.448	0.502	0.08	0.07	0.502	0.13
0.502	0.564	0.10	0.09	0.564	0.22
0.564	0.632	0.10	0.09	0.632	0.31
0.632	0.710	0.10	0.09	0.710	0.40
0.710	0.796	0.10	0.09	0.796	0.49
0.796	0.893	0.09	0.08	0.893	0.57
0.893	1.000	0.09	0.08	1.000	0.65
1.000	1.120	0.08	0.07	1.120	0.72
1.120	1.260	0.09	0.08	1.260	0.80
1.260	1.420	0.10	0.09	1.420	0.89
1.420	1.590	0.11	0.10	1.590	0.99
1.590	1.780	0.12	0.11	1.780	1.10
1.780	2.000	0.15	0.13	2.000	1.23
2.000	2.240	0.16	0.14	2.240	1.37
2.240	2.520	0.18	0.16	2.520	1.53
2.520	2.830	0.19	0.17	2.830	1.70
2.830	3.170	0.20	0.18	3.170	1.88
3.170	3.560	0.21	0.19	3.560	2.07
3.560	4.000	0.21	0.19	4.000	2.25
4.000	4.480	0.20	0.18	4.480	2.44
4.480	5.020	0.20	0.18	5.020	2.62
5.020	5.640	0.20	0.18	5.640	2.80
5.640	6.320	0.20	0.18	6.320	2.98
6.320	7.100	0.20	0.18	7.100	3.15
7.100	7.960	0.20	0.18	7.960	3.33
7.960	8.930	0.21	0.18	8.930	3.52
8.930	10.000	0.21	0.19	10.000	3.71
10.000	11.200	0.23	0.20	11.200	3.91
11.200	12.600	0.26	0.23	12.600	4.14
12.600	14.200	0.29	0.26	14.200	4.40
14.200	15.900	0.30	0.27	15.900	4.66
15.900	17.800	0.32	0.29	17.800	4.95
17.800	20.000	0.36	0.32	20.000	5.27
20.000	22.400	0.38	0.34	22.400	5.61
22.400	25.200	0.43	0.38	25.200	5.99
25.200	28.300	0.47	0.42	28.300	6.41
28.300	31.700	0.53	0.48	31.700	6.88
31.700	35.600	0.66	0.59	35.600	7.47
35.600	39.900	0.82	0.73	39.900	8.21
39.900	44.800	1.10	0.98	44.800	9.19
44.800	50.200	1.41	1.26	50.200	10.45
50.200	56.400	1.86	1.65	56.400	12.10
56.400	62.000	1.87	1.66	62.000	13.76
62.000	71.000	3.28	2.92	71.000	16.69
71.000	79.600	3.34	2.97	79.600	19.66
79.600	89.300	3.86	3.44	89.300	23.10
89.300	100.000	4.24	3.78	100.000	26.88
100.000	112.000	4.60	4.10	112.000	30.97
112.000	126.000	5.05	4.50	126.000	35.47
126.000	142.000	5.24	4.67	142.000	40.15
142.000	159.000	4.95	4.41	159.000	44.56
159.000	178.000	4.85	4.32	178.000	48.88
178.000	200.000	4.86	4.33	200.000	53.21
200.000	224.000	4.57	4.07	224.000	57.28
224.000	250.000	4.27	3.81	250.000	61.09
250.000	283.000	4.64	4.13	283.000	65.22
283.000	317.000	4.07	3.63	317.000	68.85
317.000	356.000	3.98	3.55	356.000	72.40
356.000	399.000	3.69	3.29	399.000	75.69
399.000	448.000	3.44	3.06	448.000	78.76
448.000	500.000	2.91	2.60	500.000	81.35
500.00	1000.00	9.79	9.79	1000.00	91.14
1000.00	2000.00	6.28	6.28	2000.00	97.42
2000.00	4000.00	2.29	2.29	4000.00	99.71
4000.00	8000.00	0.29	0.29	8000.00	100.00
8000.00	16000.00	0.00	0.00	16000.00	100.00
>16000		0.00	0.00		100.00

18.65 81.35
 91.29 100.00

Size Fractions Graph





**Marine and Freshwater
Research Laboratory
Environmental Science**

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Contact: Garnet Hooper
Customer: Jacobs

Address: Level 11, Durack Centre, 263 Adelaide Terrace, Perth WA 6001

Date of Issue: 13/05/2015
Date Received: 16/04/2015
Our Reference: JAC15-8
Your Reference: IW021200

SEDIMENT DATA

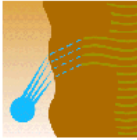
METHOD SAMPLE CODE	Sampling Date	2600 TKN mg.N/g <0.1	4500 TOTAL P mg.P/g <0.05	6200 TOC %C <0.2	ICP002 Total Ext Al mg/kg <20	ICP002 Total Ext As mg/kg <2	ICP002 Total Ext Ba mg/kg <0.1	ICP002 Total Ext Cd mg/kg <0.1	ICP002 Total Ext Co mg/kg <0.2
Reporting Limit									
File		15042901	15042901	15050101-1101	15050101	15050101	15050101	15050101	15050101
SP1 1-1	11/04/2015	1.9	0.74	1.4	15000	3	21	0.3	6.7
SP1 2-1	11/04/2015	2.0	0.78	1.4	16000	3	21	0.2	7.2
SP2 1-1	11/04/2015	2.1	0.78	1.5	16000	2	33	0.2	7.5
SP2 2-1	11/04/2015	2.1	0.78	1.5	16000	2	29	0.3	7.1
SP3 1-1	11/04/2015	1.6	0.81	1.2	14000	2	23	0.3	6.5
SP3 2-1	11/04/2015	1.5	0.80	1.1	13000	2	25	0.2	6.2
SP4 1-1	09/04/2015	0.5	2.8	0.4	9300	3	9.1	0.2	5.6
SP5 1-1	09/04/2015	0.6	0.98	0.5	8400	2	11	0.2	4.7
SP5 2-1	09/04/2015	0.7	0.89	0.5	8200	3	12	0.2	4.9
SP6E 1-1	09/04/2015	0.8	1.6	0.6	8300	3	14	0.2	4.9
SP6E 2-1	09/04/2015	0.9	1.6	0.6	9400	3	15	0.1	5.2
SP8 1-1	10/04/2015	0.2	0.31	0.3	560	2	5.6	0.2	0.7
SP8 2-1	10/04/2015	0.3	0.31	0.2	550	3	5.9	0.2	0.7
SP9 1-1	10/04/2015	0.3	0.79	0.2	2000	5	7.0	0.2	1.9
SP10N 1-1	10/04/2015	0.3	0.79	0.2	2900	4	7.8	0.2	1.8
SP10N 2-1	10/04/2015	0.3	0.90	0.3	3100	3	7.7	0.3	1.7
SP12 1-1	10/04/2015	0.4	1.2	0.3	4200	3	21	0.3	2.1
SP12 2-1	10/04/2015	0.5	1.1	0.4	4400	4	28	0.2	2.1
SP13 1-1	14/04/2015	0.2	1.4	0.2	3300	3	9.8	0.2	1.8
SP13 2-1	14/04/2015	0.2	1.4	<0.2	2700	3	9.4	0.2	1.5
SP14 1-1	14/04/2015	0.4	1.9	0.3	4600	3	8.7	0.2	2.3

G. Woodward

Signatory: Jamie Woodward
Date: 13/05/2015

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

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**Marine and Freshwater
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Environmental Science**

Tel: +61 8 93602907 Address: 90 South St, Murdoch, WA, 6150



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Contact: Garnet Hooper
Customer: Jacobs
Address: Level 11, Durack Centre, 263 Adelaide Terrace, Perth WA 6001

Date of Issue: 13/05/2015
Date Received: 16/04/2015
Our Reference: JAC15-8
Your Reference: IW021200

SEDIMENT DATA

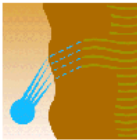
METHOD SAMPLE CODE	Sampling Date	2600 TKN mg.N/g	4500 TOTAL P mg.P/g	6200 TOC %C	ICP002 Total Ext Al mg/kg	ICP002 Total Ext As mg/kg	ICP002 Total Ext Ba mg/kg	ICP002 Total Ext Cd mg/kg	ICP002 Total Ext Co mg/kg	Reporting Limit
		15042901	15042901	15050101-1101	15050101	15050101	15050101	15050101	15050101	
SP14 2-1	14/04/2015	0.4	1.9	0.3	4500	3	8.1	0.2	2.3	
SP15 1-1	12/04/2015	0.3	1.8	0.3	3400	4	8.8	0.2	1.9	
SP15 2-1	12/04/2015	0.3	2.0	0.2	2800	5	8.4	0.2	1.8	
SP17 1-1	08/04/2015	0.5	1.3	0.3	5500	3	8.0	0.3	3.1	
SP6 1-1	09/04/2015	0.9	1.7	0.6	9600	3	15	0.1	4.8	
TB1	12/04/2015	<0.1	<0.05	<0.2	<20	<2	<0.1	<0.1	<0.2	
MB1	12/04/2015	<0.1	<0.05	<0.2	<20	<2	<0.1	<0.1	<0.2	

Note: Ba by ICP002 is outside the scope of accreditation. Results expressed on a dry weight basis

Signatory: Jamie Woodward
Date: 13/05/2015

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Address: Level 11, Durack Centre, 263 Adelaide Terrace, Perth WA 6001

Date of Issue: 13/05/2015
Date Received: 16/04/2015
Our Reference: JAC15-8
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SEDIMENT DATA

METHOD SAMPLE CODE	ICP002 Total Ext Cr mg/kg <0.2	ICP002 Total Ext Cu mg/kg <0.2	ICP002 Total Ext Fe mg/kg <5	ICP002 Total Ext Ni mg/kg <0.7	ICP002 Total Ext Pb mg/kg <1	ICP002 Total Ext Zn mg/kg <0.5	ICP007 Total Ext Hg mg/kg <0.01
Reporting Limit	15050101	15050101	15050101	15050101	15050101	15050101	15050602-0701
File	15050101	15050101	15050101	15050101	15050101	15050101	15050602-0701
SP1 1-1	28	13	16000	21	6	48	0.03
SP1 2-1	29	14	16000	21	6	47	0.03
SP2 1-1	31	15	16000	23	7	51	0.03
SP2 2-1	31	14	16000	23	7	50	0.03
SP3 1-1	27	11	15000	19	6	46	0.03
SP3 2-1	25	10	15000	17	5	43	0.04
SP4 1-1	27	4.7	17000	14	5	51	0.03
SP5 1-1	20	5.3	13000	11	4	38	0.02
SP5 2-1	21	5.5	13000	12	5	40	0.03
SP6E 1-1	20	5.6	13000	12	4	36	0.03
SP6E 2-1	22	6.0	13000	12	4	38	0.03
SP8 1-1	5.0	0.9	520	1.1	<1	2.3	<0.01
SP8 2-1	5.2	1.0	550	1.3	1	2.3	<0.01
SP9 1-1	7.4	1.7	2800	4.2	4	6.9	<0.01
SP10N 1-1	7.9	2.4	3900	4.6	3	10	0.01
SP10N 2-1	8.5	2.5	4300	4.5	3	11	0.01
SP12 1-1	10	2.6	5300	5.4	2	11	0.01
SP12 2-1	11	3.0	5800	5.7	2	12	0.01
SP13 1-1	8.9	1.8	4200	4.6	2	8.5	<0.01
SP13 2-1	7.7	1.6	3500	3.7	2	7.3	<0.01
SP14 1-1	11	2.7	5800	6.1	3	13	0.01

G. Woodward

Signatory: Jamie Woodward
Date: 13/05/2015

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Contact: Garnet Hooper
Customer: Jacobs
Address: Level 11, Durack Centre, 263 Adelaide Terrace, Perth WA 6001

Date of Issue: 13/05/2015
Date Received: 16/04/2015
Our Reference: JAC15-8
Your Reference: IW021200

SEDIMENT DATA

METHOD SAMPLE CODE	ICP002 Total Ext Cr mg/kg	ICP002 Total Ext Cu mg/kg	ICP002 Total Ext Fe mg/kg	ICP002 Total Ext Ni mg/kg	ICP002 Total Ext Pb mg/kg	ICP002 Total Ext Zn mg/kg	ICP007 Total Ext Hg mg/kg
Reporting Limit	<0.2	<0.2	<5	<0.7	<1	<0.5	<0.01
File	15050101	15050101	15050101	15050101	15050101	15050101	15050602-0701
SP14 2-1	11	2.7	5800	5.9	3	12	0.01
SP15 1-1	7.7	2.9	5500	5.1	3	11	<0.01
SP15 2-1	7.2	2.6	5000	5.0	2	9.8	<0.01
SP17 1-1	11	3.5	7600	7.2	3	18	<0.01
SP6 1-1	22	6.2	14000	13	5	40	0.03
TB1	<0.2	<0.2	<5	<0.7	<1	<0.5	<0.01
MB1	<0.2	<0.2	<5	<0.7	<1	<0.5	<0.01

Signatory: Jamie Woodward
Date: 13/05/2015

All test items tested as received. Spare test items will be held for two months unless otherwise requested.

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Genus species	Family	Order	Class	Phylum	SP 1	SP 2	SP 3	SP 5	SP 6	SP 8	SP 10	SP 12	SP 13	SP 14	SP 15
1 Einnucula superba (Hedley:1902)	Nuculidae	Nuculoidea	Bivalvia	Mollusca			1		1					1	
2 anemone	anemone family 1	Actinaria	Anthozoa	Cnidaria					1						
3 Amphipolus sp	Amphiporidae	Ophiurida	Ophiuroidea	Echinodermata					1						2
4 ostracod 1	ostracod family 1			Crustacea					2						
5 foram 1				Foraminifera					1						
6 Nuculana watsoni (Smith:1885)	Nuculidae	Nuculoidea	Bivalvia	Mollusca					1						
7 foram 2				Foraminifera		1			4	1		2		2	
8 copepod			Copepoda	Crustacea					3						
9 Paralacydonia paradoxa Fauvel:1913	Lacydoniidae	Phylodocida		Annelida					1					1	
10 nemalode				Nematoda					3	4					5
11 lumbrinerid 1	Lumbrineridae	Eunicida	Polychaeta	Annelida					1						
12 Blank															
13 foram 3				Foraminifera					1						
14 spionid 1	Spionidae	Spionida	Polychaeta	Annelida					1						
15 Blank															
16 amphipod 1	amphipod family 1	Amphipoda	Malacostraca	Crustacea					1						
17 echurian				Echiura					1						
18 Blank															
19 Fibularid	Fibularidae	Clypeasteroidea	Echinoidea	Echinodermata									1	1	
20 arcturid	Arcturidae	Isopoda	Malacostraca	Crustacea									1	1	
21 lanaid	lanaid family 1	Tanaidacea	Malacostraca	Crustacea						3		3	3	4	
22 Cuspidaria sp	Cuspidariidae	Pholadomyoidea	Gastropoda	Mollusca									1		
23 Poecilochaetus sp	Poecilochaetidae	Spionida	Polychaeta	Annelida					1						
24 nereid	Nereididae	Phylodocida	Polychaeta	Annelida								2			
25 sylvid 1	Syllidae	Phylodocida	Polychaeta	Annelida						1			1	1	1
26 ostracod 2	ostracod family 2		Ostracoda	Crustacea							1	1			
27 Arabella sp	Oenoneidae	Eunicida	Polychaeta	Annelida											
28 nemertean	nemertean family 1			Nemertea											1
29 Terebellides sp	Trichobranchiidae	Terebellida	Polychaeta	Annelida									1	2	
30 hermit crab	Diogenidae	Decapoda	Malacostraca	Crustacea							1		1	1	
31 holothurian 1	holothurian family 1		Holothuroidea	Echinodermata									1		
32 Dorvilleidae	Dorvilleidae	Eunicida		Annelida								1			
33 laevidentalidae	Laevidentalidae	Dentalida	Scaphopoda	Mollusca								1			
34 Glycera sp	Glyceridae	Phylodocida	Polychaeta	Annelida										1	1
35 Magelona sp	Magelonidae	Spionida	Polychaeta	Annelida				2						1	
36 sphaeromatid	Sphaeromatidae	Isopoda	Malacostraca	Crustacea									1	1	
37 Pyramidella sp	Pyramidellidae	Heterogastropoda	Gastropoda	Mollusca									1		
38 lumbrinerid 2	Lumbrineridae	Eunicida	Polychaeta	Annelida							1				
39 brittlestar 2	brittlestar family 1		Ophiuroidea	Echinodermata									1	1	
40 brittlestar 3	brittlestar family 1		Ophiuroidea	Echinodermata									1		
41 spionid 2	Spionidae	Spionida	Polychaeta	Annelida											
42 Blank															
43 gnathid	Gnathidae	Isopoda	Malacostraca	Crustacea									1		
44 Marphysa sp	Eunicidae	Eunicida	Polychaeta	Annelida										1	
45 Platyschnopus sp	Platyschnopidae	Amphipoda	Malacostraca	Crustacea										1	
46 brittlestar 4	brittlestar family 1		Ophiuroidea	Echinodermata										1	
47 pycnogonid		Pantapodia	Pycnogonida	Arthropoda										2	
48 cumacean 1	cumacean family 1	Cumacea	Malacostraca	Crustacea										1	
49 sea pen	sea pen family 1	Pennatulacea	Anthozoa	Cnidaria										1	
50 ostracod 3	ostracod family 3			Ostracoda							1				
51 soft coral 1		Alcyonacea	Anthozoa	Cnidaria										4	
52 polychaete ? family 1			Polychaeta	Annelida										1	1
53 shrimp 1	shrimp family 1	Decapoda	Malacostraca	Crustacea										1	
54 amphipod 2	amphipod family 2	Amphipoda	Malacostraca	Crustacea										1	
55 anthurid 1	Anthuridae	Isopoda	Malacostraca	Crustacea											1
56 amphipod 3	amphipod family 3	Amphipoda	Malacostraca	Crustacea										1	
57 amphipod 4	amphipod family 4	Amphipoda	Malacostraca	Crustacea				1						2	
58 amphipod 5	amphipod family 5	Amphipoda	Malacostraca	Crustacea								3		1	
59 anthurid 2	Anthuridae	Isopoda	Malacostraca	Crustacea										1	
60 pararonid	Pararonidae	Scolecida	Polychaeta	Annelida										1	1
61 onuphid	Onuphidae	Eunicida	Polychaeta	Annelida										1	3
62 alpheid 1	Alpheidae	Decapoda	Malacostraca	Crustacea				1							
63 brittlestar 5	brittlestar family 2		Ophiuroidea	Echinodermata										1	
64 lumbrinerid 3	Lumbrineridae	Eunicida	Polychaeta	Annelida										1	3
65 capitellid 1	Capitellidae	Scolecida	Polychaeta	Annelida										1	
66 Owenia fusiformis Dele Chiaje:1844	Oweniidae	Cansipalpata	Polychaeta	Annelida											1
67 sabelid	Sabelidae	Sabelida	Polychaeta	Annelida											1
68 Spiophanes sp	Spionidae	Spionida	Polychaeta	Annelida											1
69 amphipod 6	amphipod family 6	Amphipoda	Malacostraca	Crustacea										1	
70 cirratulid	Cirratulidae	Terebellida	Polychaeta	Annelida											1
71 maldanid	Maldanidae	Scolecida	Polychaeta	Annelida											1
72 aphroditid	Aphroditidae	Phylodocida	Polychaeta	Annelida											1
73 cumacean 2	cumacean family 2	Cumacea	Malacostraca	Crustacea											2
74 sylvid 2	Syllidae	Phylodocida	Polychaeta	Annelida											1
75 janiridae	Janiridae	Isopoda	Malacostraca	Crustacea							3				
76 chaetopterid	Chaetopteridae	Spionida	Polychaeta	Annelida											2
77 holothurian 2	holothurian family 1		Holothuroidea	Echinodermata											1
78 brittlestar 6	brittlestar family 1		Ophiuroidea	Echinodermata											1
79 sponge 1	sponge family 1		Demospongiae	Porifera											2
80 capitellid 2	Capitellidae	Scolecida	Polychaeta	Annelida											2
81 ampharetid	Ampharetidae	Terebellida	Polychaeta	Annelida											1
82 spionid 3	Spionidae	Spionida	Polychaeta	Annelida						1					1
83 polychaete ? family 2			Polychaeta	Annelida											1
84 callianassid	Callianassidae	Decapoda	Malacostraca	Crustacea											2
85 Axius sp	Axiidae	Decapoda	Malacostraca	Crustacea											1
86 cumacean 3	cumacean family 3	Cumacea	Malacostraca	Crustacea											1
87 amphipod 7	amphipod family 7	Amphipoda	Malacostraca	Crustacea											1
88 amphipod 8	amphipod family 8	Amphipoda	Malacostraca	Crustacea											1
89 cumacean 4	cumacean family 4	Cumacea	Malacostraca	Crustacea											1
90 Bregmaceros sp	Bregmacerotidae	Gastropoda	Actinopterygii	Chordata											1
91 Sigalioidae	Sigalioidae	Phylodocida	Polychaeta	Annelida											1
92 fasciolarid 1	Fasciolaridae	Caenogastropoda	Gastropoda	Mollusca											4
93 cirolanid	Cirolanidae	Isopoda	Malacostraca	Crustacea											1
94 amphipod 9	amphipod family 9	Amphipoda	Malacostraca	Crustacea											2
95 Eubranchia sp	Phoxocephalidae	Amphipoda	Malacostraca	Crustacea											2
96 sponge 2	sponge family 2		Calcarea	Porifera											1
97 Dendrophyllum sp & commensal sipunculd	Dendrophyllidae	Scleractinia	Anthozoa	Cnidaria											1
98 Flabellum sp	Flabellidae	Scleractinia	Anthozoa	Cnidaria											1
99 sponge 3	sponge family 3		Demospongiae	Porifera											1
100 sponge 4	sponge family 4		Calcarea	Porifera											1
101 leucosid	Leucosidae	Decapoda	Malacostraca	Crustacea											1
102 bryozoa	bryozoa family 1			Bryozoa											1
103 hydroid 1	hydroid family 1	Hydroida	Hydrozoa	Cnidaria											4
104 hydroid 2	hydroid family 2	Hydroida	Hydrozoa	Cnidaria											1
105 sponge 5	sponge family 5		Calcarea	Porifera											3
106 Aspidosiphon sp	Aspidosiphonidae	Aspidosiphonida	Phascolosomatidea	Sipuncula											1
107 xanthid	Xanthidae	Decapoda	Malacostraca	Crustacea											1
108 amphipod 10	amphipod family 10	Amphipoda	Malacostraca	Crustacea											1
109 fasciolarid 2	Fasciolaridae	Caenogastropoda	Gastropoda	Mollusca											1
110 sponge 6			Demospongiae	Porifera											1
111 sponge 7			Demospongiae	Porifera											1
112 sponge 8			Demospongiae	Porifera											1
113 sponge 9			Demospongiae	Porifera											1
114 sponge 10			Demospongiae	Porifera											1
115 sponge 11			Demospongiae	Porifera											1
116 sponge 12			Demospongiae	Porifera											1
117 Blank			Demospongiae	Porifera											
118 hydroid 3	hydroid family 3	Hydroida	Hydrozoa	Cnidaria											3
119 hard coral		Hexacorallia		Cnidaria											1
120 soft coral 2		Alcyonacea	Anthozoa	Cnidaria											1
121 alpheid 2	Alpheidae	Decapoda	Malacostraca	Crustacea											1
122 trochid	Trochidae	Archaeogastropoda	Gastropoda	Mollusca											1
123 anthurid 3	Anthuridae	Isopoda	Malacostraca	Crustacea											1
124 anthurid 4	Anthuridae	Isopoda	Malacostraca	Crustacea											2
125 Nematoneis sp	Eunicidae	Eunicida	Polychaeta	Annelida											5
126 Ophelina sp	Ophelidae	Scolecida	Polychaeta	Annelida											1
127 ostracod 4	ostracod family 4		Ostracoda	Crustacea											2
128 ostracod 5	ostracod family 5		Ostracoda	Crustacea											1
129 shrimp 2	shrimp family 1	Decapoda	Malacostraca	Crustacea											