Appendix F18

Gardline Marine Services Pty Ltd 2009

Browse LNG Development Environmental Survey June to July 2009 Environmental Baseline Report

BROWSE FLNG DEVELOPMENT
Draft Environmental Impact Statement

EPBC 2013/7079
November 2014

WOODSIDE ENERGY LTD

BROWSE LNG DEVELOPMENT

ENVIRONMENTAL SURVEY

JUNE TO JULY 2009

ENVIRONMENTAL BASELINE REPORT

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EXECUTIVE SUMMARY

Gardline Marine Sciences Pty Ltd was contracted to carry out part of Phase 2 of a survey for Woodside Energy Ltd, in order to gather seabed information with which to establish the baseline physico-chemical characteristics and benthic community at specific points within the survey area. The survey was off the NW coast of Western Australia, extending from the Calliance and Torosa Fields up the continental slope to the proposed Shelf Based Facility (SBF) and onwards to James Price Point, off the Kimberley coast.

Forty-nine stations were selected for environmental sampling and benthic imagery; fourteen along the Export Route, four at the SBF area, three at the Slope corridor, seven at the Calliance Field and eight at the Torosa Field. Sediment and water sampling was cancelled at fifteen stations, due to time restraints and proximity to Scott Reef, and partial sampling was obtained at several other stations. Benthic imagery was obtained at 32 stations, CTD water profiling at 28 stations, sediment samples for physico-chemical analysis at 31 stations and water samples at 29 stations.

Throughout the whole area, depth ranged from 19.8m close to James Price Point to 551m in the vicinity of the Brecknock Field. The geophysical interpretation was predominantly of sand and occasional megarippled sand.

Sediments were highly variable between stations and zones, ranging from silt and clay to coarse sand and gravel. Coarser sediments were recorded along the Export Route, with an increase in fine sediment to the north of the survey area in the Calliance and Torosa Fields, and to the south in the nearshore area near James Price Point. The SBF and Slope zones generally corresponded with the Export Route sediment, with the exception of Slope-24, where the finer sediment can likely be explained by the increase in depth to over 350m.

Sediment TN concentration varied considerably across the survey area, from 40µg g^{-1} at Station Tor-55 to a maximum of 1900µg g^{-1} at Station Cal-29, with a mean of 520µg g^{-1}. Concentrations were generally consistent within zones; with increased TN at stations in deeper waters. There was less variation in TP, though with a comparable mean TP concentration of 584µg g^{-1}. NO_X concentrations were generally consistent across the site, ranging from <0.100µg g^{-1} at Stations Export-56 and Tor-55 to 0.617µg g^{-1} at Station Cal-30, with no obvious correlation with water depth or sediment size. There was some variability of TOC within zones, with less correlation with water depth and sediment type. All TOC levels were ≤0.91% and thus not indicative of nutrient enrichment. Concentrations of TBT were below the levels of detection at all sampling stations, and below the ISQG trigger values and thus could not be compared to background data.

TPH concentrations were all below the limits of detection, and are thus not indicative of any anthropogenic contamination. As, Cd, Cr, Cu, Pb and Zn concentrations were all below their respective ISQG trigger values. Hg and Ni concentrations exceeded their respective trigger values at Station Tor-43, with Ni also recorded marginally above the trigger value at Station Cal-29. There was a slight correlation of metal concentration with water depth and sediment type, which is consistent with the particle size and organic

analyses. The majority of metals; Cu, Co, Hg, Ni, Pb and Zn, increased with increasing depth and finer sediment size, while As concentration correspondingly decreased.

There is a clear pattern in the distribution of ^{228}Ra, with lower concentrations along the Export Route, increased values around the SBF and the highest concentrations in the Calliance Field; corresponding to the deeper waters and decreasing particle size.

An examination of the raw data showed that the separation of Station Tor-43 as statistically distinct was primarily due to the metals Hg, Zn, Cd and Cu. A BEST analysis revealed that three variables (particle size d(0.5), Co and Zn) described 90% of the observed multivariate pattern.

Mean water TN concentrations were 1.0mg L^{-1}, 3.0mg L^{-1} and 1.1mg L^{-1} for the surface, mid-water column and near seabed respectively. Concentrations were generally higher at the Calliance and Torosa Field stations, with the exception of Station Export-36. TP concentrations were largely below the LoR and elevated TP concentrations were generally ≤0.24mg L^{-1}. TN results exceeded the ANZECC trigger value in most samples, and TP in seven samples, suggesting that background levels in the region were higher than expected and that ANZECC data is perhaps unsuitable for comparison. FRP concentrations were largely below the LoR and all results were ≤0.05mg L^{-1}. Concentrations of FRP were generally higher at the Calliance Field stations, and exceeded the ANZECC trigger value in fourteen samples. NH_4 concentrations were largely below the LoR, though this limit was significantly higher than the trigger value upper limit. Concentrations of NH_4 were generally higher at the Export Route and Torosa Field stations and exceeded the ANZECC trigger value in ten samples. Mean NO_X concentrations were 0.03mg L^{-1}, 0.11mg L^{-1} and 0.17mg L^{-1} for the surface, mid-water column and near seabed respectively. NO_X results exceeded the ANZECC trigger value at all stations.

Mean recorded TSS were 29mg L^{-1}, 28mg L^{-1} and 29mg L^{-1} for the surface, mid-water column and near seabed respectively. Results were extremely variable between stations, ranging from as low as 6mg L^{-1} up to a high of 91mg L^{-1}. Concentrations of chlorophyll *a* were below the LoR at all sampling stations. With the exception of arsenic, copper, nickel and zinc, results for water metal concentrations were recorded below the limits of reporting for almost all sampling stations.

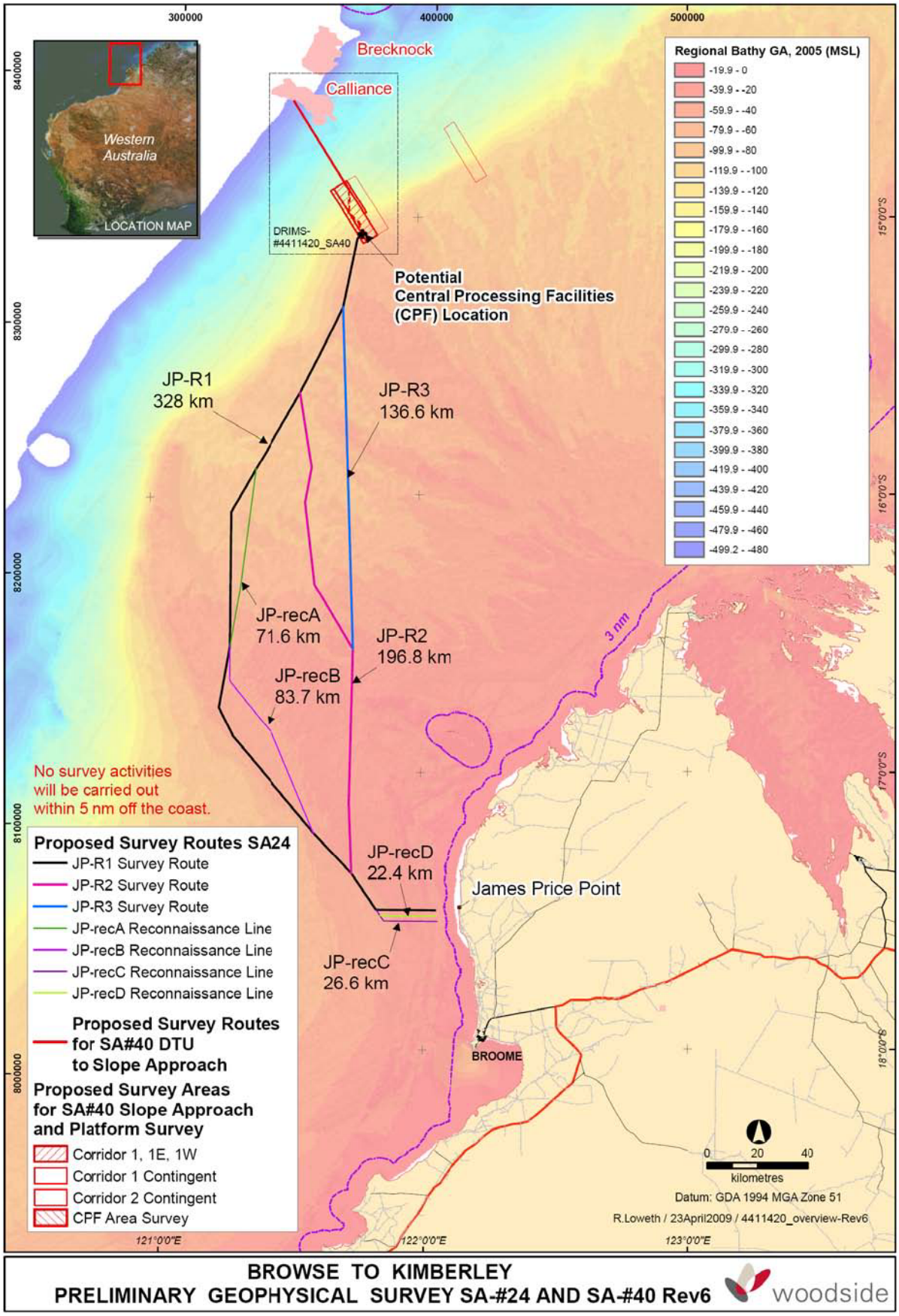
Surface temperatures ranged from 26ºC to 28ºC. There was some variation at the surface, with Export Route stations recording temperatures of between 26ºC and 28ºC and between 27ºC and 28ºC for the Calliance and Torosa Field, SBF and Slope stations. There was an apparent thermocline beginning at approximately 50 metres for the most stations. The coolest temperatures recorded during the survey corresponded with the stations sampled in the deepest waters. Salinity ranged from 34.38PSU to 34.98PSU at the surface, generally with minor fluctuations in the first 30m.

Salinity was generally higher at the surface for the Export Route stations, specifically those in shallower water, Stations Export-36, 52, 56 and 76. A slight halocline was apparent for some of the samples at the Export Route stations in deeper water, the Calliance and Torosa Field stations and the SBF and Slope stations. Due to a problem with the DO

sensor, data could only be analysed for eight of the Export Route stations; surface DO concentrations ranged from 5.16mg L^{-1} to 6.10mg L^{-1}. Surface pH ranged from 6.8 to 8.4, with higher pH generally recorded in the shallower waters of the Export Route and SBF stations. pH for this survey generally appeared a little lower than expected for seawater.

Overall, the data suggests a highly uniform infaunal community that was generally taxonomically poor with low abundances of individuals recorded for most taxa. The physico-chemical attributes appeared to only subtly influence the community. The faunal data showed no pattern in terms of zones, nor was it obviously influenced by sediment type. No conclusions can be drawn about the species present, as most could only be identified at higher taxonomic levels such as Order and Family. Community variation appears to be natural, with no obvious causal factors.

LOCATION MAP



Map taken from Scope of Work (Woodside, 2008)

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GLOSSARY OF TERMS AND ABBREVIATIONS

AET	Apparent Effects Threshold
Alkane	Any of a series of open-chain hydrocarbons C_nH_{2n+2} (as methane and butane)
Anthropogenic	Produced or caused by human activity
ANZECC	Australia & New Zealand Environmental & Conservation Council
Benthic	Relating to the seabed
Biogenic	Produced by living organisms
BSI	British Standards Institute
Clay	Sediment grains <3.9µm in diameter
CPI	Carbon Preference Index
CPT	Cone Penetration Test
DO	Dissolved Oxygen
EBS	Environmental Baseline Survey
ERL	Effects Range Low
ERM	Effects Range Median
Fines	Sediment grains <63µm in diameter (same as Muds)
GEL	Gardline Environmental Limited
Gravel	Sediment grains >2mm in diameter
LAT	Lowest Astronomical Tide
LOR	Limit of Reporting
MDS	Multi Dimensional Scaling
Mud	Sediment grains <63µm (includes silts and clays)
NH_4	Ammonium
NOx	Nitrite and Nitrate
PAH	Polycyclic aromatic hydrocarbons
Petrogenic	Relating to unburned petroleum products
PRIMER	A statistical program - Plymouth Routines in Multivariate Research
PSA	Particle Size Analysis
PSU	Practical Salinity Units
QA	Quality Assurance
QC	Quality Control
Sand	Sediment grains >63µm and <2mm in diameter
Silt	Sediment grains >3.9µm and <63µm in diameter
SoW	Scope of work
TN	Total Nitrogen
TOC	Total Organic Carbon
TOM	Total Organic Matter
TP	Total Phosphorus
TPH	Total Hydrocarbon
Trigger Value	Concentrations of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur, i.e. they should “trigger” the need for investigation/action
TSS	Total Suspended Solids
UCM	Unresolved Complex Mixture
UTM	Universal Transverse Mercator

1 INTRODUCTION

1.1 Survey Summary

Gardline Marine Sciences Pty Ltd was contracted to carry out two geophysical seabed and shallow hazard surveys, two pipeline route surveys, a geotechnical survey and an environmental survey for Woodside Energy Ltd in the Browse Basin on the northwestern continental shelf of Australia. The acquisition programme consisted of two phases; Phase 1: Geophysical data acquisition and Phase 2: Geotechnical and Environmental investigations. The objective was to investigate the proposed Shelf Based Facility (SBF) and determine a suitable sub-sea pipeline route that would extend from the Calliance Field, up the continental slope to the SBF and onwards to James Price Point, off the Kimberley coast of Western Australia.

This report was produced by Gardline Environmental Ltd (GEL) for and on behalf of Gardline Marine Sciences Pty Ltd. The environmental survey was completed in conjunction with a geotechnical survey, utilising 5-metre Cone Penetration Testing (CPT), a 3-metre Piston Corer, deep-water digital stills and video camera, 0.25m^2 box corer, FSI multi-parameter probe (conductivity, temperature, depth sensor; CTD) and 5 litre Niskin bottle. This report details the results of the environmental survey only. The results of the geophysical and geotechnical surveys have been summarised in this report where relevant, but given in more detail in separate reports (Gardline Geosurvey Ltd, 2009a to 2009g).

All environmental fieldwork was conducted between the 05-June and 24-July-2009 onboard the Gardline vessel *MV Ocean Endeavour.* The scope of work (SoW; Woodside, 2008) called for seabed information with which to establish the baseline physico-chemical characteristics and benthic community at specific points within the survey area.

Sampling stations were requested by the onboard client representative, to be placed along the export pipeline route, at the proposed SBF location, at the Calliance and Torosa Fields and along the potential pipeline routes joining these fields to the proposed SBF Location. Sampling at the stations comprised digital video and stills acquisition, with a minimum of three photographs, CTD water profiling, and Niskin water sampling at near-surface, middle of the water column and at the bottom of the water column; these were sub-sampled and then filtered, chilled and frozen as required. In addition two box core samples were obtained. Sub-samples were taken from one box for physico-chemical analysis and one fauna sample; the second box contained the remaining two fauna samples. All fauna samples were screened, on-board, through a 0.5mm sieve and preserved in buffered formalin. Two samples from each station were analysed, where available.

Forty-nine stations were selected for environmental sampling and benthic imagery; fourteen along the Export Route, four at the SBF area, three at the Slope corridor, seven at the Calliance Field and eight at the Torosa Field. Sediment and water sampling was cancelled at fifteen stations, due to time restraints and proximity to Scott Reef, and partial sampling was obtained at several other stations. Benthic imagery was obtained at 32 stations, CTD water profiling at 28 stations, sediment samples for physico-chemical

analysis at 31 stations and water samples at 29 stations. Samples collected from each station are summarised in Table 1.1. Actual sampling locations, which may be slightly offset from the target locations, are presented in Figure 1.1, and in the surveyors' logsheets in Appendix A. Stations assessed with benthic imagery are summarised in Table 1.2 and cancelled environmental stations presented in Table 1.3.

The SoW called for the following sediment and water parameters to be measured:

- Sediment sampling
  - Particle size analysis (PSA)
  - Total petroleum hydrocarbons (TPH)
  - Polycyclic aromatic hydrocarbons (PAH; only where TPH detected)
  - Metals (arsenic, As; cadmium, Cd; copper, Cu; chromium, Cr; cobalt, Co; mercury, Hg; nickel, Ni; lead, Pb; and zinc, Zn)
  - Nutrients (total nitrogen, TN; total phosphorus, TP; and total organic carbon, TOC)
  - Tributyltin (TBT)
  - Radionuclides (radium 226 and 228; and thorium 228)
  - Benthic macrofauna
- Water sampling (within 5m of surface, at mid depth and near seabed)
  - Metals (As, Cd, Cu, Cr, Co, Hg, Ni, Pb and Zn)
  - Total suspended sediments (TSS)
  - Chlorophyll
  - Nutrients (TN; TP; orthophosphate, FRP; ammonia, NH_4; nitrate, NO_2; and nitrite, NO_3).
- Water profiling (from surface to seabed)
  - Temperature
  - Salinity (conductivity)
  - Pressure
  - pH
  - Turbidity
  - Dissolved oxygen (DO)
  - Photosynthetically active radiation (PAR)

It was agreed with Woodside that PAR analysis was not to be conducted as sensors could not be sourced in time for the mobilisation after confirmation of the SoW.

All positional information in this report is referenced to Geodetic Reference System 1980, International Ellipsoid, Universal Transverse Mercator (UTM) Projection, Grid Zone 51S 123º East. Station designations were those agreed upon with Woodside and relate to the name of the area the station is located in and a numerically consecutive value.

Table 1.1 Summary of Environmental Sampling Positions and Samples Acquired

Station	Description of Target or Feature	Water Depth[1] (m Lat)	Easting[2]	Northing[2]	Acceptable Box Core Samples	Samples Acquired									
								Sediment Sub-samples				Water Sub-samples (Top, Mid, Bott)			
								Chemistry							
						Fauna	CTD	HC[3] / Metals / General	TBT[4] / TOC[5]	PSA[6]	Radionuclides	Chlorophyll	Dissolved Metals	NO_2 / NO_3 / FRP[7] / TSS[8]	TN[9] /TP[10]
Export-4	Predetermined Location	101	346270	8291600	2	3	1	1	1	1	1	3	3	3	3
Export-11	Predetermined Location	91	345349	8265610	2	3	1	1	1	1	1	3	3	3	3
Export-16	Predetermined Location	81	346182	8238210	2	3	1	1	1	1	1	3	3	3	3
Export-23	Predetermined Location	80	353564	8213430	2	3	1	1	1	1	1	3	3	3	3
Export-36	Predetermined Location	32	366753	8124649	3	3	1	1	1	1	1	3	3	3	3
Export-39	Predetermined Location	28	367999	8112370	2	3	1	1	1	1	1	0	3	3	3
Export-49	Predetermined Location	32	378996	8073073	2	3	1	1	1	1	1	3	3	3	3
Export-52	Predetermined Location	21	397323	8066518	0	0	1	0	0	0	0	3	3	3	3
Export-53	Possible Biogenic Reef	22	397323	8065519	2	3	0	1	1	1	1	0	0	0	0
Export-56	Predetermined Location	27	389047	8066024	2	3	1	1	1	1	1	3	3	3	3
Export-64	Predetermined Location	97	357502	8313686	2	3	1	1	1	1	1	3	3	3	3
Export-70	Predetermined Location	54	359680	8186160	2	3	1	1	1	1	1	3	3	3	3
Export-76	Predetermined Location	35	366292	8147378	0	0	1	0	0	0	0	3	3	3	3
Cal-28	Predetermined Location	418	356000	8386000	2	3	1	1	1	1	1	3	3	3	3
Cal-29	Predetermined Location	491	349000	8388800	2	3	1	1	1	1	1	3	3	3	3
Cal-30	Predetermined Location	586	343500	8392200	1	1	1	1	1	1	1	3	3	3	3
Cal-31	Predetermined Location	595	353000	8403300	2	3	1	1	1	1	1	3	3	3	3
Cal-33	Predetermined Location	324	362163	8375264	0	0	1	0	0	0	0	3	3	3	3
Cal-38	Predetermined Location	548	353691	8399710	2	3	1	1	1	1	1	3	3	3	3
Cal-41	Predetermined Location	646	355502	8410200	2	3	1	1	1	1	1	3	3	3	3
SBF-41	Predetermined Location	98	369960	8334420	2	3	1	1	1	1	1	3	3	3	3
SBF-42	Predetermined Location	93	368400	8332070	2	3	1	1	1	1	1	3	3	3	3
SBF-43	Predetermined Location	100	370212	8335056	2	3	1	1	1	1	1	3	3	3	3
SBF-44	Predetermined Location	98	370890	8334940	2	3	1	1	1	1	1	3	3	3	3

Table 1.1a Summary of Environmental Sampling Positions and Samples Acquired cont'd

Station	Description of Target or Feature	Water Depth[1] (m Lat)	Easting[2]	Northing[2]	Acceptable Box Core Samples	Samples Acquired									
						Fauna	CTD	Sediment Sub-samples				Water Sub-samples (Top, Mid, Bott)			
								Chemistry		PSA[6]	Radionuclides	Chlorophyll	Dissolved Metals	NO_2 / NO_3 / FRP[7] / TSS[8]	TN[9] / TP[10]
								HC[3] / Metals / General	TBT[4] / TOC[5]						
Slope-16	Predetermined Location	174	365260	8343690	2	3	1	1	1	1	1	3	3	3	3
Slope-22	Predetermined Location	230	365203	8353547	2	3	1	1	1	1	1	3	3	3	3
Slope-24	Predetermined Location	356	352399	8372154	2	3	1	1	1	1	1	3	3	3	3
Tor-43	Predetermined Location	459	388000	8422598	2	3	0	1	1	1	1	0	0	0	0
Tor-44	Predetermined Location	474	398345	8462729	2	3	0	1	1	1	1	3	3	3	3
Tor-45	Predetermined Location	467	392437	8459406	2	3	0	1	1	1	1	0	0	0	0
Tor-53	Predetermined Location	392	388103	8449988	2	3	0	1	1	1	1	0	0	0	0
Tor-54	Predetermined Location	561	370003	8452169	2	3	0	1	1	1	1	0	0	0	0
Tor-55	Predetermined Location	549	369629	8449172	2	3	0	1	1	1	1	0	0	0	0
Tor-57	Predetermined Location	281	372372	8373632	0	0	1	0	0	0	0	3	3	3	3
Tor-58	Predetermined Location	346	380263	8398356	2	3	1	1	1	1	1	3	3	3	3

1 Actual depth at time of sampling, not corrected to LAT
2 Environmental target locations. Actual sampling positions for each individual box core sample are detailed in Appendix A
3 Hydrocarbons
4 Tributyltin
5 Total Organic Carbon
6 Particle Size Analysis
7 Reactive Phosphorous
8 Total Suspended Solids
9 Total Nitrogen
10 Total Phosphorous

Table 1.2 Summary of Seabed Imagery Stations

Station	Description of Target or Feature	Easting[1]	Northing[1]	Number of Photos
Export-4	Predetermined Location	346270	8291600	14
Export-11	Predetermined Location	345349	8265610	12
Export-16	Predetermined Location	346182	8238210	13
Export-23	Predetermined Location	353564	8213430	21
Export-34	Predetermined Location	366387	8163669	13
Export-36	Predetermined Location	366753	8124649	19
Export-39	Predetermined Location	367999	8112370	7
Export-49	Predetermined Location	378996	8073073	9
Export-52	Predetermined Location	397323	8066518	29
Export-53	Possible Biogenic Reef	397323	8065519	16
Export-56	Predetermined Location	389047	8066024	16
Export-64	Predetermined Location	357502	8313686	17
Export-70	Predetermined Location	359680	8186160	17
Export-76	Predetermined Location	366292	8147378	19
Cal-28	Predetermined Location	356000	8386000	20
Cal-29	Predetermined Location	349000	8388800	18
Cal-30	Predetermined Location	343500	8392200	19
Cal-31	Predetermined Location	353000	8403300	7
Cal-33	Predetermined Location	362163	8375264	15
Cal-34	Predetermined Location	342388	8392060	20
Cal-38	Predetermined Location	353691	8399710	11
Cal-40	Predetermined Location	352203	8404393	13
Cal-41	Predetermined Location	355502	8410200	13
SBF-41	Predetermined Location	369960	8334420	4
SBF-42	Predetermined Location	368400	8332070	14
SBF-43	Predetermined Location	370212	8335056	12
SBF-44	Predetermined Location	370890	8334940	13
Slope-16	Predetermined Location	365260	8343690	12
Slope-22	Predetermined Location	365203	8353547	11
Slope-24	Predetermined Location	352399	8372154	13
Tor-57	Predetermined Location	372372	8373632	18
Tor-58	Predetermined Location	380263	8398356	8

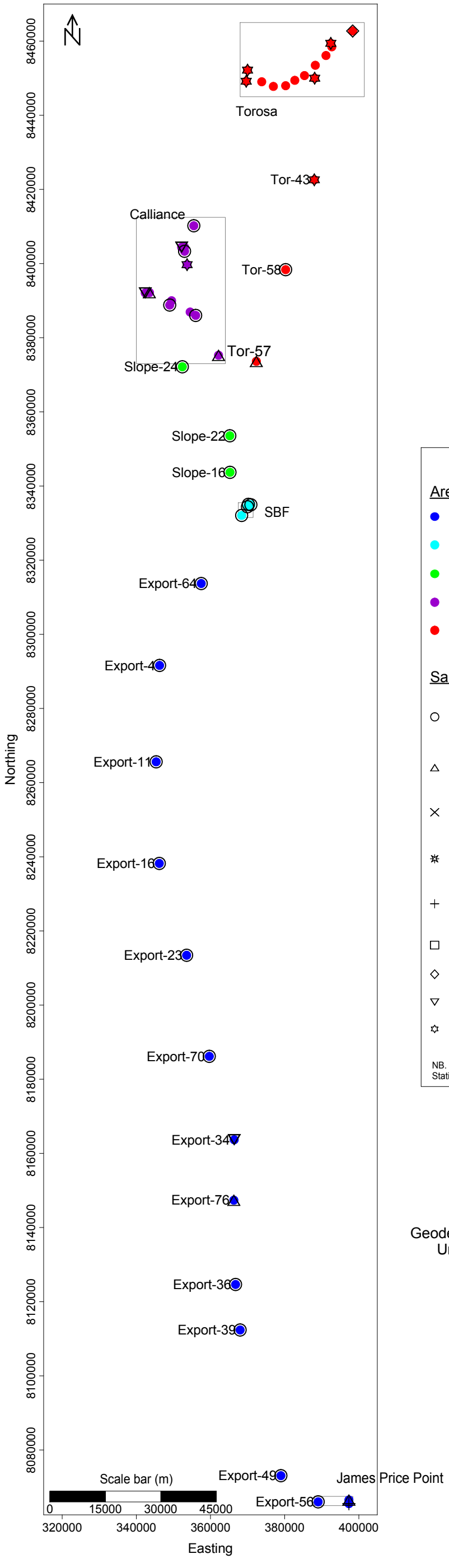
1 Environmental target locations. Actual positions for each photograph are detailed in the surveyors' log in Appendix A

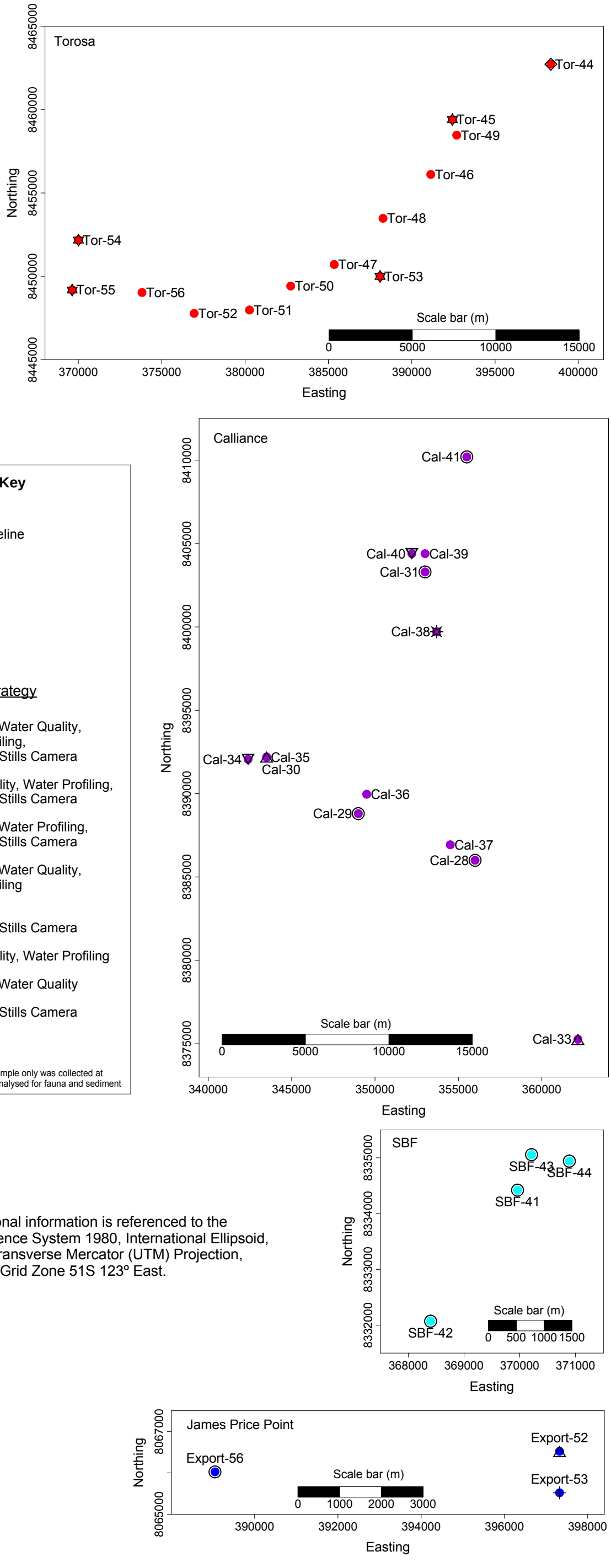
Table 1.3 Summary of Cancelled Environmental Sampling Stations

Station	Description of Target or Feature	Easting[1]	Northing[1]	Reason for Cancellation
Cal-35	Predetermined Location	343500	8392167	Aborted due to time constraints
Cal-36	Predetermined Location	349500	8389961	Aborted due to time constraints
Cal-37	Predetermined Location	354513	8386930	Aborted due to time constraints
Cal-39	Predetermined Location	353000	8404393	Aborted due to time constraints
Tor-46	Predetermined Location	391143	8456110	Cancelled due to close proximity to Scott Reef
Tor-47	Predetermined Location	385349	8450702	Cancelled due to close proximity to Scott Reef
Tor-48	Predetermined Location	388274	8453477	Cancelled due to close proximity to Scott Reef
Tor-49	Predetermined Location	392700	8458465	Cancelled due to close proximity to Scott Reef
Tor-50	Predetermined Location	382739	8449413	Cancelled due to close proximity to Scott Reef
Tor-51	Predetermined Location	380264	8447968	Cancelled due to close proximity to Scott Reef
Tor-52	Predetermined Location	376946	8447768	Cancelled due to close proximity to Scott Reef
Tor-56	Predetermined Location	373816	8449025	Cancelled due to close proximity to Scott Reef

1 Environmental target locations

Figure 1.1 Environmental Imagery and Sampling Locations





Key

Areas

- Export Pipeline
- SBF
- Slope
- Calliance
- Torosa

Sampling Strategy

- ○ Box Core, Water Quality, Water Profiling, Video and Stills Camera
- △ Water Quality, Water Profiling, Video and Stills Camera
- × Box Core, Water Profiling, Video and Stills Camera
- ✳ Box Core, Water Quality, Water Profiling
- \+ Box Core, Video and Stills Camera
- □ Water Quality, Water Profiling
- ◇ Box Core, Water Quality
- ▽ Video and Stills Camera
- ☼ Box Core

NB. One box core sample only was collected at Station Cal-30 and analysed for fauna and sediment

All positional information is referenced to the Geodetic Reference System 1980, International Ellipsoid, Universal Transverse Mercator (UTM) Projection, Grid Zone 51S 123° East.

1.2 Background Information

1.2.1 Sediment Characteristics

In areas that are not disturbed, particle size distributions of sediments are to a large extent determined by hydrodynamic energy at the sediment water interface and the underlying geology found at a site. Strong currents tend to scour the seabed thereby resuspending fine particles and any material associated with them.

The role of sediment in the transport and retention of chemical pollutants is tied to both particle size and to the amount of particulate organic carbon associated with the sediment. The chemically active fraction of sediment is usually cited as that portion which is smaller than 63µm (silt, clay and organic fraction). Many of the persistent, bioaccumulating and toxic contaminants, particularly metals, hydrocarbons and chlorinated compounds are strongly associated with sediment and especially with these organic carbon and finer fractions. This is because metals are highly attracted to, and bind with, ionic exchange sites provided by iron and manganese coatings found on the surface of fine sediment particles. In unpolluted environments the concentrations of many parameters correlate to the proportion of fines found in the sediment as a result of fine particles possessing a relatively large surface area. Fine sediment particles are relatively easily resuspended by waves and currents, and may be transported, along with the materials sorbed to them, over large distances.

Generally speaking, sands and coarser grained materials are often organically deficient. Strong currents have a tendency to resuspend fine materials and their associated organic matter. These may be transported over large distances, finally precipitating in areas of lower hydrodynamic energy. Therefore, in an environment that is not nutrient enriched due to anthropogenic emissions, both total organic matter and total organic carbon will normally be lowest at sites with coarse-grained sediment, where currents are often strongest.

Particle size and organic content of sediments are also critical measurements for the categorisation of habitat type since to large extent they control which organisms are capable of living within sediments. Most benthic organisms exhibit preferences for sediment with particular grain size characteristics. Many organisms live in tubes or burrows that they themselves construct from sediment particles; their ability to do this may be limited by the range of different sized particles available. The distribution and abundance of free-living mobile organisms, i.e. those that do not construct tubes or burrows, are also affected by particle sizes as these influence their ability to move within the sediment. Sand grains of inappropriate sizes may be too big to move or, conversely, too small to be stable.

Feeding guilds are groupings of organisms based upon the feeding strategies they employ (US EPA, 2008) and, as such, sediment particle size and organic content can greatly affect those which can dominate in a particular area. Many deposit-feeding organisms, which process sediment through the alimentary tract to obtain nutrition (Gage and Tyler, 1992), are highly selective of the grain sizes that they will ingest, often preferring finer sediments that possess relatively high organic content. Conversely, resuspension of fine

particulate matter may clog delicate filtering apparatus used by suspension feeders to obtain their suspended food particles from seawater (Gibson *et al.,* 2005), resulting in their exclusion from silt sediments. Additionally, the mixtures of particle sizes determine the ease with which water and oxygen move through the sediment. An abundance of fine particles in a stable environment may lead to the formation of substrates with small interstitial spaces through which limited oxygen diffusion occurs. This may lead to anoxic conditions within the sediment, which further affects the range of species that may inhabit a particular area. Determination of particle sizes and the organic content of the sediments is therefore of critical importance to the interpretation of benthic environmental survey data.

1.2.2 Sediment Hydrocarbons

The principle source of hydrocarbons in the marine environment is anthropogenic (McDougall, 2000); however, contamination of the marine environment with crude oils is not a recent phenomenon, nor solely attributable to anthropogenic activities (Douglas *et al*., 1981). Three general categories of process can add hydrocarbons to marine environments - biosynthetic; geochemical and anthropogenic (McDougall, 2000).

The composition of oil is a complex mixture of compounds, which can be divided into four broad classes – the saturates, the aromatics, the asphaltenses and the resins (Leahy and Colwell, 1990). The hydrocarbons are the principal component, usually contributing >75% of the constituents of the oil (Laflamme and Hites, 1978). These hydrocarbons can subsequently be divided into four main groups (Johnston, 1980): alkanes, isoalkanes, cycloalkanes and aromatics.

Due to the complex and variable composition of oil samples in marine sediments, quantification of total hydrocarbons, groups of hydrocarbons and individual hydrocarbons is required to allow identification of the source of oil within the sediments, be it anthropogenic, biogenic or geochemical.

Total petroleum hydrocarbon concentration (TPH) gives an indication of the total oil in the sediment; it does not give an indication of the source of contamination. The definition of TPH is wholly dependent on the analytical process utilised to quantify it. In this case, the TPH is equivalent to the total n-alkanes (nC_6 to nC_{35}).

1.2.3 Metal Concentrations

Metals are generally persistent and most are toxic to varying degrees. Many essential metals such as copper, zinc and chromium are readily bioaccumulated meaning that they are capable of causing lethal and sub-lethal toxic effects in benthic organisms even when found in apparently low concentrations. Metal concentrations in uncontaminated marine sediments generally exceed those found in overlying seawater by three to five orders of magnitude (Bryan and Langston, 1992) since the buffering effects of saline water cause many metals to be rapidly precipitated. Fresh waters that are metal enriched by terrestrial run off therefore tend to deposit much of their metal load in estuarine or near coastal sediments. Ecological impacts attributable to anthropogenic sources of metal contamination in non-coastal marine environments are often somewhat limited in geographical range close to the point of their origin.

When considering the results of the sediment metal determinations it should be borne in mind that speciation (the particular forms, or species, of any given metal that exist in a sample), sediment granulometry and partitioning of metals between water and sediment phases all affect bioavailability and therefore toxicity. Even if a metal is found in above normal concentrations, it does not necessarily follow that the metal will produce ecologically deleterious effects, particularly if it is present in an insoluble or relatively low toxicity form. Historically, a wide range of different extraction techniques have been employed that were intended to provide an estimate of the concentrations of metals in marine sediments that may be available to the biota. One of the most commonly used methods of modelling metal bioavailability is extraction of oxic (surficial) sediments with weak acids (e.g. 1M nitric acid) since these techniques have been shown to produce results that correlate closely with metal burdens in the tissues of benthic organisms (Luoma and Davis, 1983; Bryan and Langston, 1992). However, the extent to which a particular method of extracting metals from sediments reflects their bioavailability is still not well understood, and the debate regarding which methods may be most appropriate is ongoing.

Total sediment metal concentrations have historically been the preferred measurement for offshore surveys. Whilst these provide little information regarding concentrations of metals that may be bioavailable, they are useful for comparisons between surveys and will give an indication, by comparison to other surveys, if sediments are contaminated. Baseline figures can be compared to trigger value data in order to assess whether sediments in an area may have been anthropogenically contaminated prior to works being carried out, and whether they may exert a toxicological effect on benthic communities. There is a growing body of data that provides water quality trigger values for chemical contaminants that have the potential to exert toxic effects at concentrations that might be encountered in the environment (ANZECC, 2000). Baseline figures may therefore be compared to these data in order to assess whether sediments in an area may have been anthropogenically contaminated prior to any works being carried out. Data for deriving trigger values come from multiple-species toxicity tests. Trigger values for metal concentrations in water, derived using statistical distribution, were calculated at four different protection levels, 99%, 95%, 90% and 80% (ANZECC, 2000). Sediment trigger values were primarily adapted from Long *et al*., 1995. Where elevated concentrations of metals are found, values may be compared to existing sediment metal toxicity data in order to assess whether particular metals may be exerting a toxicological effect on benthic communities (*e.g*. see ANZECC, 2000; Buchman, 2008).

1.2.4 Macrofaunal Analyses

The macrofaunal investigation in this survey is designed to provide a description of the benthic infauna in the survey area. Marine benthic invertebrate communities have been shown to be sensitive to environmental change, particularly environmental degradation as a result of anthropogenic contamination (Davies *et. al.*, 1984; Warwick and Clarke, 1991). Analysis of faunal data sets may therefore provide insight into the deleterious effects of point source pollutants and over what spatial extent they exert an effect.

2 METHODS

2.1 Camera Procedure

Environmental seabed images were taken by means of a high-resolution video camera and a digital stills camera system with a dedicated strobe and video lamps, mounted within a stainless steel frame. A USBL positioning beacon was attached to the internal corner of the camera frame.

Footage was viewed in real time via a sonar cable, assisting in the control of the digital stills camera. This allowed for shot selection, in the event that the system recorded a sediment change or feature at the seafloor.

A minimum of three seabed photographs were taken at each station using a hover and drift technique, separated by a time gap of approximately 5-10 seconds. This technique allowed the frame to move progressively along the seabed as the vessel traversed the work area on its thrusters or drifted. The images were captured remotely using the surface control unit and stored on the camera's internal memory card. Video footage was overlaid with time, position, and depth, and recorded directly onto VHS video and DVD. On completion, photographs were downloaded onto a PC via a USB download cable and copied onto CD-Rom. All CDs, DVDs and videos were labelled with the relevant job details, write protected and stored. The video footage was later edited and burned onto a final DVD. A selection of photographs, taken of the seabed is presented in Appendix B.

Main instrumental and acquisition details are as follows:

Table 2.1 High-resolution camera specifications

Equipment	
Manufacturer	Konsberg/Simrad.
Model	OE14-208
Pixels	5.0 M
Standard Lens	f 7.2 – 28.8 (35mm format equivalent to 38 – 140mm)
Focus Control	Automatic or manual 50mm to infinity
Trigger	Remote from deck
Height Control	USBL Beacon and Video footage
Video Overlay	Oceantools VO4
Field of View	47.8 (deg H) by 36.2 (deg V)
Lighting	1 strobe, 4 video lamp
Scale bar	1cm intervals

2.2 Seabed and Water Sampling

2.2.1 Box Core Procedure

Benthic samples were recovered using a Gardline modified, 0.25m^2 box corer, specifically designed for this type of environmental sampling, and made of steel with a stainless-steel core box.

Box Corer sampling operational procedures were as follows:
The vessel's sampling area was pre-cleaned using a powerful deck fire-hose and seawater. The box corer was thoroughly washed down using Pentane prior to every station to prevent hydrocarbon cross contamination. A 1000m length of 22mm coring wire cable was used to lower the box corer to the seabed.

All containers were thoroughly washed with appropriate solvents and labelled externally prior to use. Biology samples were placed in 1 litre polypropylene screw-top squat jars or 5 litre buckets as sample volume required and provided with an additional internal waterproof label. Hydrocarbon and heavy metals samples were placed in a 250ml glass jar, tributyltins and total organic carbon samples were placed in a 150ml glass jar, particle size distribution samples were placed in a 250g plastic bag, and radionuclide samples were placed in a plastic jar.

For accuracy of sampling in depths greater than 200m the box corer was pre-winched down so that it was approximately 10-15 metres from the seabed. Communication between the deck, bridge crew and the surveyors was conducted by means of VHF radio. When directly over the sampling station the box corer was winched to the seabed and quickly recovered so that the sample could be obtained and the apparatus returned to the pre-deployment position.

Positional fixes were taken for each box core sample immediately following the sampler reaching the sea floor. The precise time that the sampler reached the seabed was determined by observations of the tension on the winch cable. A USBL positioning beacon was attached to the box corer in a special housing at depths of 100m or greater.

On recovery of a sample, the client requested that the overlying water was siphoned off and not retained so that a photograph of the surface features of the sample could be taken prior to sub-sampling. The sample was then divided using pre-cleaned stainless-steel dividers. The exposed sediment surface was examined for acceptability following strict Quality Assurance (QA) criteria. In the following cases, a box core sample would be rejected and the instrument returned to the pre-deployment position;

1. The box doors open on recovery, causing possible surface washout.
2. Half sample obtained where the corer had not struck a flat area of seabed, or not hit true, causing a side, or half core of sediment.
3. Disruption of the sample by obvious shaking or contamination (these can occur when a sample is badly handled or if the box corer strikes the side of the vessel during operations).
4. The sample represents less than 30% of the box corer's total capacity (i.e. less than 15cm penetration).
5. Sample is an unacceptable distance from the desired position (as determined by the on-board surveyors). This depended upon the sample location and the target type.
6. The presence of a "Hag Fish" and/or mucus coagulants.

Box core samples deemed acceptable were photographed and described prior to sub-sampling. Where a sample failed to meet the QA criteria but was acceptable to the client representative the sample was retained and processed.

Brief descriptions of the collected sediments were made at the time of sampling. These are recorded in the environmental scientist's log sheets presented in Appendix A. A selection of photographs, taken of the sediment samples is presented in Appendix C.

Surficial (<2cm depth) sediments were taken directly from the one half of the box core for physico-chemical analysis. Four sediment sub-samples were collected; one for hydrocarbon and heavy metal determination (General (HC/HM)), one for tributyltin and total organic carbon (TBT/TOC), one for particle size analysis (PSA), and the last for Radionuclide analysis. They were collected using a glass scoop into the containers supplied by the laboratory. The HC/HM sample and TBT/TOC sample were stored at less than -18°C prior to analysis. The Radionuclide sample was stored between 1°C and 5°C and the PSA sample was stored at ambient temperature.

Three samples from each station were collected for benthic macrofaunal invertebrate identification. For each 0.1m^2 faunal sample the surface 15cm of sediment was removed from the box corer into a clean plastic tray using a plastic scoop and then transferred to a 0.5mm sieve. Finer sediment fractions were washed from the sample using an auto-sieve, which sprayed a low powered seawater jet onto the underside of the sieve. The residual sieve contents were transferred to uniquely labelled sample jars using a scoop and/or funnel, making sure that none of the sample was lost or trapped in the sieve mesh. Sieved samples were immediately fixed with a known concentration of formaldehyde solution ('formalin', less than 20%). The formalin in the sample pots was subsequently diluted to a concentration of approximately 4%. Two of the faunal samples (normally those identified as A and B) were worked up as a matter of course and a third retained as a spare (normally sample C).

2.2.2 Niskin Bottle Procedure

Water samples were obtained at each station using a 5L Niskin water-sampling bottle attached to a weighted 6mm wire, 1000m in length. Samples were taken at near-surface, mid-depth and near the seabed. A USBL beacon was attached to the deployment cable immediately above the sampler in deep water and the vessel offset of deployment was used to represent the sampler's position in shallow water.

On recovery of a water sample, the Niskin bottle would first be examined for acceptability following strict Quality Assurance (QA) criteria. In the following cases, a water sample would be rejected and the instrument returned to the pre-deployment position:

1. One or both ends have not released and the sampler has failed to trigger.
2. One or both ends have failed to seal the sample and water has leaked out.
3. Disruption of the sample by obvious shaking or contamination.
4. Sample was taken from an unacceptable distance from the desired position or depth (as determined by the on-board surveyors).

The bottle contents were then sub-sampled prior to storage for subsequent analyses. All storage vessels were pre-labelled and pre-cleaned. At each station several sub-samples were collected; one 1000ml plastic bottle was used for Nitrate and Nitrite (NO_X), Reactive Phosphorus (Ortho-Phosphate; FRP) and Total Suspended Solids (TSS), one 60ml plastic bottle for dissolved heavy metals (which was filtered through 0.45µm filter paper), one

125ml plastic bottle for Total Nitrogen (TN) and Total Phosphorus (TP), and one 500ml Amber Glass bottle for Chlorophyll (filtered through 0.45µm GF/C filters and the filters frozen). Air gaps (5cm) were left at the top of each plastic bottle to allow for expansion on freezing. The 60ml and 125ml plastic bottles were chilled, the remainder frozen.

2.2.3 Water Profiling Procedure

A FSI multi-parameter probe was used to measure the characteristics of the seawater column, collecting data on pH, depth, temperature, conductivity, dissolved oxygen, and turbidity in order to produce water profiles of the investigated area.

The probe was deployed using a 1000m length of 6mm dry core galvanised steel cable. The probe was deployed in unattended sampling mode. A USBL beacon was attached to the deployment cable immediately above the probe in deep water and the vessel offset of deployment in shallow water was used to represent the probe's position. The probe was submersed in the surface waters for a minimum of three minutes to allow sensors to stabilise. Positional fixes were taken immediately after deployment, at the end of acclimatisation, at the bottom and at the end of the deployment. Readings were taken at 2Hz. After recovery, recorded data was transferred to a computer hard drive for subsequent analysis.

Main instrumental specifications are detailed in Table 2.2.

Table 2.2 Multi-parameter water quality probe specifications

Equipment	
Manufacturer	FSI NXIC
Sensors fitted	Temperature, Conductivity, Dissolved Oxygen, pH and Depth
Sample Rate	1-15 S/sec
Resolution	20 bits
Baud Rate	1200, 9600, 19200, 38400, 57600, 115200
Data Format	8 data bits, 1 stop bit
Salinity Calculation	PSU-78
Conductivity Range	0-9.0 S/m
Temperature Range	-2 to 32ºC

2.3 Sample Analyses

Sediment, water and faunal samples were analysed by the following laboratories / persons:

- All sediment and water chemistry and particle size analyses were carried out by Australian Laboratory Services Pty Ltd (ALS), Malaga, WA;
- Benthic macrofaunal identification was undertaken by Murdoch Link, Murdoch University, Fremantle, WA;
- CTD water profiling analysis was conducted in-house by Gardline Marine Sciences Pty Ltd.

The laboratories detailed above meet quality control requirements exacted by Gardline's internal procedures (BS/EN/ISO 9001:2000; BSI, 2000). Laboratory sample preparation and analysis methodologies are detailed in Appendix D. Spare samples are retained at

Gardline's Perth office for at least six months after which time the client is contacted to advise on appropriate disposal, continued storage or dispatch to a destination of the client's choice.

2.4 Macrofaunal Analysis

2.4.1 Sorting and Identification

In the laboratory, samples were gently washed across a 0.5mm sieve to remove any sediment fines and preservative. The retained material was sorted by hand to extract all macrofauna. The organisms were identified and counted to produce a species list for each grab sample.

2.4.2 Data Set Rationalisation

The faunal data set was rationalised according to the standard Gardline Environmental procedure (GEL, 2008), which is largely based on British Standard ISO16665:2005 (BSI, 2005) and OSPAR (2004) guidelines. A summary of these methods follows.

Damaged Specimens

Destructive sampling techniques and sieving may damage delicate benthic organisms. It is, therefore, commonplace for fragmented organisms to be found in faunal samples. The following conditions were applied to the recording of damaged specimens and fragments:

- Fragments that constituted a major component of an individual, that unequivocally represented the presence of an entire organism, and that could be identified to species level, were recorded and included with other counts of that species. Examples include: the heads of polychaetes and crustaceans; the complete mouth structure or central disk of brittle stars; the oral area/feeding tentacles of holothurians.
- Fragments that constituted a significant component of an individual, that unequivocally represented the presence of an entire organism, but that could not be identified to species by virtue of their incompleteness, were recorded to the lowest possible taxonomic level.
- Fragments that did not unequivocally represent the presence of an entire organism were ignored, *e.g. Amphiura* arms, *Echinocardium* shell fragments, *etc.*

Recorded fragments, therefore, represent discrete observations of individuals that were alive at the time of sampling and were included in the analysed data set.

Treatment of Specific Groups of Organisms

Gardline Environmental defines macrofauna as organisms that are *normally* larger than the mesh size of the sieve used to separate them from the sediment (GEL, 2008). Meiofaunal organisms, such as the Ostracoda and Copepoda, which would consistently be undersampled, were not recorded. Due to their generally small size (in fully marine environments), species from the Oligochaetea, Tardigradia and Gnathostomulida were only enumerated when a sieve with a mesh size of 0.5mm or less was used to separate organisms from sediments; otherwise, these organisms were noted to be present, but not enumerated.

Planktonic organisms, such as the Chaetognatha and Mysidacea were not recorded. The

presence of nektonic species, such as fish and Cephalopoda, was recorded, but they were not enumerated.

Colonial, stoloniferous and encrusting epibenthic species were identified but not enumerated.

With the exception of discrete sea pen (Pennatulacea) colonies, only solitary tunicates and cnidarians were enumerated and included in statistical analyses. Colonial tunicates and cnidarians were identified but not enumerated.

In accordance with our in-house guidelines the following organisms, where found, were not identified to species, but were enumerated and included in the data set for analyses at a higher taxonomic level:

- Nemertea – identified to phylum,
- Platyhelminthes – identified to phylum,

All analysed samples (2 replicates per station where available) were wet sieved at 0.5mm prior to sorting. Exceptionally large samples, generally greater than 2L, were split (up to 75%) using a Folsom splitter. Samples were stained with rose bengal to aid identification of invertebrate fauna during sorting and all sorting was performed with the aid of a dissecting microscope. All invertebrate fauna were identified according to the Gardline Environmental procedures and were preserved in 70% ethanol.

2.5 Statistical Analyses

The highest taxonomic level possible was used for all faunal statistical analyses.

2.5.2 Univariate Analyses

Univariate diversity indices, as typified by the Shannon-Wiener index, are considered to be a relatively insensitive measure of species diversity. However, benthic ecologists have been able to demonstrate a clear inverse relationship between diversity and total oil concentrations in sediments (e.g. Davies *et al*., 1984). They are therefore of some practical use for making comparisons between stations and sites.

Univariate community analyses were undertaken using the PRIMER (version 6) software package. Univariate indices seek, by means of a single number, to summarise information about some aspect of community structure. The two aspects of community structure contributing to the concept of diversity are species richness (a measure related to the total number of species present) and evenness (a measure relating to the pattern of distribution of individuals among the species present). The following indices were calculated and are presented in the report:

Margalef's Richness Index

Species richness is sometimes given simply as the number of species in a sample but this is of course very dependent upon sample size. Alternatively Margalef's index (d) may be used as this takes account of the number of species present for a given number of individuals. Margalef's Richness index is calculated as follows:

$$d = \frac{(S-1)}{\ln N}$$

where d = Margalef's Richness
S = total number of species
N = total number of individuals

Shannon-Wiener Diversity Index

This is a widely used measure of diversity providing an integrated index of species richness and relative abundance (Clarke and Warwick, 2006). It is basically a measure of the difficulty of predicting the identity of an individual based on overall community composition. The Shannon-Wiener diversity index is expressed as:

$$H' = -\sum_{i=1}^{s} p_i \log_n p_i$$

where H' = Shannon-Wiener Diversity Index
P_i = proportion of the total number of individuals from the i^{th} species
n = log base value (log base 2 is used during this report; Shannon and Weaver, 1949)

H' integrates the number of species and individual abundance to provide a summary value reflecting the diversity of fauna at a station. This index of diversity is influenced by both species richness (i.e. the number of species) and evenness (or equitability) of distribution of individuals between species.

Simpson's Index

Simpson's is a dominance index derived from the probability of picking two individuals from a community at random that are not from the same species. Therefore Simpson's index values will be large when a community is dominated by one or a few species but lower when the community is diverse. Simpson's index was calculated as follows:

$$\lambda = \sum p_i^{\,2}$$

Where: λ = Simpson's Index
P_i = proportion of the total number of individuals from the i^{th} species

Simpson's Index ranges from 0 to 1 with values typically reflecting the abundances of the most common species in the samples.

Evenness

Evenness (or equitability) is a representation of how uniformly individuals are spread between species in a sample. It is a component of, and calculated using, a theoretical diversity measure (in this instance Shannon-Wiener). High values (values range from 0 to

1) indicate low dominance. (NB. the log base that was used to calculate H' must also be used to calculate evenness.)

$$J = \frac{H'}{Log_n S}$$

where J = Pielou's Evenness
H' = Shannon-Wiener Diversity index
S = total number of species in a sample

2.5.3 *Multivariate Analyses*

In addition to univariate analyses, the data were subjected to multivariate analysis using a number of different methods. By considering the full data matrix as a whole and comparing each station with every other, multivariate analyses are able to highlight subtle trends in data sets that are commonly not identified when using univariate techniques. Multivariate techniques are not restricted to use with faunal data sets and if treated appropriately may also be used to compare complex chemical data sets. Multivariate analyses are computed from resemblance or similarity matrices. In the case of faunal abundance data these are constructed using the Bray-Curtis measure of similarity following transformation of the data to downweight the influence of highly abundant or dominant species. For the purposes of this survey, a square-root transformation was utilised. Square root transformation allows the intermediately abundant species to contribute to the similarity, as there was no clear dominance pattern or superabundant species (Clarke and Warwick, 2001). Chemical data resemblance matrices are computed using Euclidean Distance following transformation (where necessary) and normalisation to standardise measurement scales.

Cluster Analysis and SIMPROF

Cluster analysis groups samples according to their similarity *i.e.* samples within a group are more similar to each other than they are to samples in other groups. Clustering was by a hierarchical agglomerative method using group average sorting, and the results are presented as a dendrogram. Using PRIMER v6 it is possible to perform a SIMPROF (similarity profile) test at the same time as the cluster analysis to determine whether groups of samples are statistically indistinguishable or whether they contain identifiable structure. SIMPROF is an *a priori* test designed to identify groups of samples from unstructured data sets. The test employs a permutation-based analysis to determine whether groups of samples below each successive node of a dendrogram possess identifiable internal structure. If the result of a test at a particular node is not significant there is no identifiable structure within the samples below the node and they might therefore be considered to be a uniform group. A significant result indicates that samples within a group (below a particular node in the dendrogram) contain some structure and therefore may not be considered uniform. The analysis therefore identifies groups of samples that are each highly self-similar and also that are distinguishable from each other.

Ordination Analyses using non-Metric Multidimensional Scaling

Ordination methods such as non-metric multidimensional scaling (nMDS or MDS) create a 2- or 3-dimensional 'map' of the samples (or stations) from the similarity matrix. The configuration of the samples on the 'map' is a reflection of their similarity, with distances between samples being representative of their dissimilarly.

It is normal for there to be some distortion (stress) between actual similarity values (in the resemblance matrix) and distance between samples on the ordination plot; perfect solutions are very rarely achieved when dealing with complex data sets. In order to achieve the lowest possible stress PRIMER adopts an iterative approach to ordination, constructing the plot by successively refining the positions of samples until the lowest stress is achieved. In reality the lowest possible stress it not always achieved since data points may become trapped in local minima. It is therefore necessary to re-run the analyses multiple times to ensure that the lowest achievable stress is found. The ordination analysis results reported were the product of a minimum of 25 restarts. In instances where the lowest achieved stress was found for <5 (20%) of the restarts the ordination was repeated with 100 restarts to ensure that a lower stress result could not be found.

The scale and orientation of MDS ordinations are arbitrary so no axes are drawn on the plots. Stress values increase with sample size, and usually also with increasingly severe transformation of the initial data set (due to the increasing influence of rarer species on the outcome of analyses). The stress value may be used as an indication of the usefulness of plots, with a general guide being as follows:

<0.05	Almost perfect representation of rank similarities
0.05 to <0.1	Good representation
0.1 to <0.2	Still useful
0.2 to <0.3	Should be treated with caution
>0.3	Little better than random points

BEST (BIOENV and BVSTEP)

Where differences in macrofaunal community structure are found it is legitimate to attempt to link these to abiotic variations in the environment. This may be achieved using multivariate routines in the PRIMER called BVSTEP and BIOENV. In this instance BVSTEP analysis has been used due to the large size of the data sets.

BVSTEP uses a stepwise procedure to search amongst a specified data matrix (normally the transformed and / or normalised data matrix) to find subsets of variables (or species) that best 'fit' the multivariate pattern of a separately specified resemblance matrix. In other words it identifies a subset (or subsets) of variables within one data set that produces the most similar (highest correlation) pattern to the overall multivariate pattern of another data set. From a random starting point the analysis adds and removes variables from the initial data set and assesses whether these improve or worsen the match to the second data set overall. Once the best match is achieved analysis is terminated. The result depends somewhat upon the starting point of the analysis and the test is therefore always used with multiple restarts in order to ensure that that the best fit is found.

Since BVSTEP may be used to compare any two similarly structured data sets it has a variety of applications. These include Bio-Env tests (where the subset of environmental variables that best fit or 'explain' the biotic data are determined), Env-Bio tests (where the subset of species that best fit the environmental data are determined) and Bio-Bio tests (where a subset or subsets of species that most resemble the overall multivariate biotic pattern are determined). The results of these analyses may provide valuable insight into

the processes affecting species distributions in survey areas.

SIMPER

Where differences between groups of samples are found, SIMPER may be used to interpret which species, or environmental variables, are principally responsible for the differences between the groups and which are most responsible for the similarities within groups. The SIMPER analysis decomposes differences between all pairs of samples, one from each identified group, into their contributions from each species or variable, and ranks them in decreasing order of their contribution to overall dissimilarity.

2.6 Comparison Data

The Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Water Quality Guidelines (ANZECC, 2000) published default trigger values for indicative concentrations or ranges for nutrients and trace metals in offshore marine areas. It is recommended that in the absence of any background reference data for the region, these trigger values be used for comparison. These trigger values are presented in Table 2.3.

Table 2.3 Recommended Water Quality Guidelines

Parameter	Unit	Trigger value[a]
NUTRIENTS		
Chlorophyll *a*	µg L^{-1}	0.5 - 0.9
TP	µg L^{-1}	10
FRP	µg L^{-1}	2 - 5
TN	µg L^{-1}	100
NOX	µg L^{-1}	1 - 4
NH4	µg L^{-1}	1 - 6
DO[b]	% saturation	90
pH		8.2
Turbidity	NTU	1 - 20
METALS		
Arsenic	µg L^{-1}	ID
Cadmium	µg L^{-1}	5.5
Chromium	µg L^{-1}	27.4
Cobalt	µg L^{-1}	1
Copper	µg L^{-1}	1.3
Lead	µg L^{-1}	4.4
Mercury	µg L^{-1}	0.4
Nickel	µg L^{-1}	70
Zinc	µg L^{-1}	15

Table adapted from ANZECC, 2000; Tables 3.3.4 and 3.4.1

a The lower values are typical of clear coral dominated waters (eg. Great Barrier Reef) while higher values typical of turbid macrotidal systems (eg. North-west Shelf of WA).

b Dissolved oxygen values were derived from daytime measurements and may vary diurnally and with depth.

ID Insufficient data

The Water Quality Guidelines also include interim sediment quality guidelines (ISQG; ANZECC, 2000), which are presented in Table 2.4. These low and high values correspond to the effects range-low and –median used by NOAA (Long *et al*., 1995).

It is important to note, however, that the ANZECC guidelines are only "triggered" if over 5% of results exceed the relevant trigger value for that parameter and this only constitutes a potential risk that requires further investigation, rather than a direct need for immediate action.

Table 2.4 Recommended Sediment Quality Guidelines

Contaminant	ISQG-Low (Trigger value)	ISQG-High
METALS (µg g^{-1})		
Arsenic	20	70
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Mercury	0.15	1
Nickel	21	52
Zinc	200	410
ORGANOMETALLICS (µgSn kg^{-1})		
Tributyltin	5	70

Table adapted from ANZECC, 2000; Table 3.
Values primarily adapted from Long *et al*., 1995.

3 RESULTS and DISCUSSION

3.1 Bathymetry and Seabed Features

Gardline Geosurvey conducted two geophysical seabed and shallow hazard surveys and two pipeline route surveys at the Browse LNG Development site, prior to the geotechnical and environmental surveys. The geophysical surveys utilised single- and multi-beam echosounders, sidescan sonar, pinger and sparker equipment.

3.1.1 Bathymetry

Bathymetry is shown in Figure 1.1 with coloured contours at intervals of 1 metre.

The seabed topography across the site was very variable, from areas of flat seabed to areas with large calcarenite ridges and sand waves. Throughout the whole area, depth ranged from 19.8m close to James Price Point to 551m in the vicinity of the Brecknock Field.

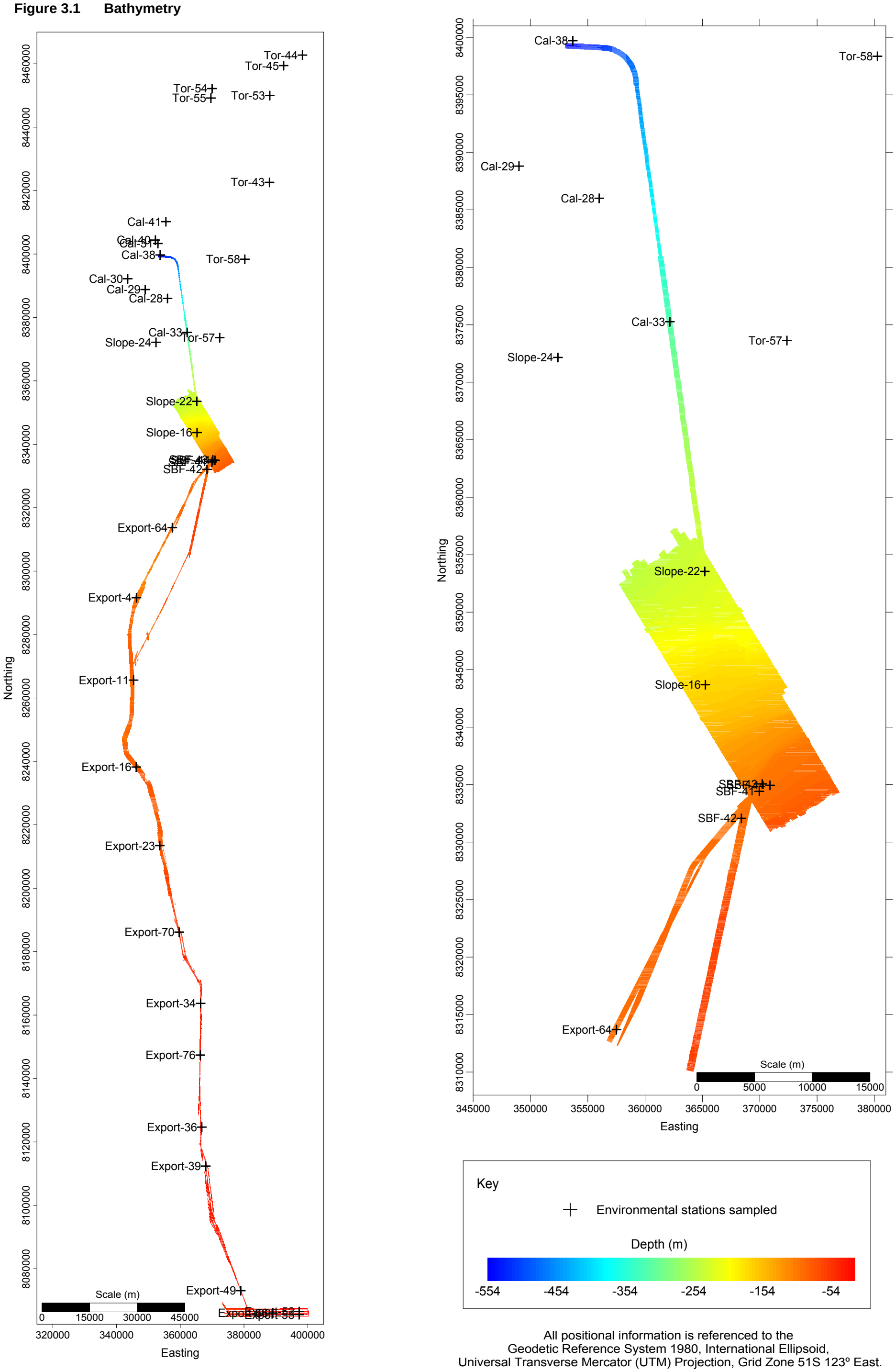
The maximum gradient observed along the JP pipeline route was 11.3º. Gradients of greater than 20º were observed on a number of ridge features located to the north and south of the shelf approach area.

3.1.2 Seabed Features

The geophysical interpretation was predominantly of sand and occasional megarippled sand. Sand wave fields were observed across the site, with heights of up to 9m and gradients of up to 7º. These sand waves were also characterised by megarippled sand superimposed on them, and were thought to be stationary.

Also observed on the sonar and bathymetry data were a series of channels to the north of the SBF, extending from the western edge of the Shelf Approach Survey area (Gardline Geosurvey, 2009b). These channels were between 8m and 20m deep, with a general WSW-ENE orientation and gradients of up to 19º. Much of the site was featureless, with numerous seabed depressions were observed across the site, with a maximum depth of 0.3m.

Figure 3.1 Bathymetry



All positional information is referenced to the
Geodetic Reference System 1980, International Ellipsoid,
Universal Transverse Mercator (UTM) Projection, Grid Zone 51S 123º East.

3.2 Sampling Summary

Seabed imagery was obtained from 32 stations, with a minimum of four photographs at each station. In all, 463 photographs were taken, including five photographs with no position fix and four where there was an error with the beacon.

In total, 31 stations were successfully sampled with the box corer, with two acceptable samples from all stations with the exception of Station Cal-30, where only one box core was collected, and retained for faunal analysis and sediment. Sample retention was excellent, with 62 box core samples retained from 69 attempts. Unsuccessful sampling attempts were generally due to sample washout or box trigger failure; although on two occasions the box core did not reach the seabed. Seabed sampling was abandoned at several stations due to time constraints and the presence of Scott Reef.

The positioning accuracy of all box core samples, with respect to actual proximity to the target location, was good; 61% of all retained samples were obtained within 10m of the target location, and 95% within 20m of their target. Actual sampling positions were a mean distance of 8.5m (± 6.3m SD) from the intended locations, and details of their coordinates are shown in the Surveyor's Log (Appendix A). Photographs of the box core samples are presented in Appendix C.

In total, 29 stations were sampled with the Niskin bottle, with three acceptable samples collected at each station; near the seabed, in the middle of the water column, and near the surface. Positioning accuracy was less important, as samples were being taken from the water column.

Water profiling was conducted at 28 stations. Data was successfully collected for temperature, depth, pressure, salinity, turbidity, and pH. Some inconsistencies were noted with the dissolved oxygen (DO) data, possibly due to a contaminated membrane on the probe. However, due to time constraints, repeat sampling was not possible.

3.3 Habitat Assessment

Seabed photography across the site showed a degree of variability in sediment and fauna.

Sediment along the Export Route was generally fine to coarse sand with shell fragments, with a rockier seabed observed at Station Export-4. There was a visible light rippling to the seabed at Stations Export-49, Export-56 and Export-64. There was no visible fauna at Station Export-11. Visible fauna at other stations included; hard corals, sea fans, sea whips, sea urchins, sponges, feather stars, hydroids, bivalves and gastropods.

At the Calliance Field, sediments generally comprised softer sandy clays and fine silt. Visible fauna included anemone, brittle star, basket star, sea pen, squat lobster and hagfish.

Lightly rippled fine sand with some coarse material and shell fragments was recorded at the SBF stations. There was no visible fauna at Station SBF-41. Visible fauna at the remaining stations included; sea star, anemones, sea pen and bryozoans.

There was a great deal of variation between the Slope stations, in accordance with the change in depth and particle size. Mixed sediment with sand and gravel was recorded at Station Slope-16, while slightly rippled sand with suspended fines was recorded at Slope-22 and very soft silty clay with suspended fines at Slope-24. Visible fauna included; bryozoans, sponges, anemone, sea urchin and possible sea squirt.

Only two stations at the Torosa Field were investigated with the camera and video system; showing slightly rippled silty sand and clay. There was no visible fauna at Station Tor-57, with small anemones recorded at Station Tor-58.

3.4 Sediment Physico-Chemical Characteristics

Initial observations of the sediment at each station were made at the time of sampling, and these were recorded in the environmental scientist's log sheets presented in Appendix A. The sediment was recorded as varying across the site with fine to coarse sand along much of the export route, sand and silty sand at the SBF site, sand and gravelly sand at the slope stations, and fine silty sands or clays at the Calliance and Torosa fields. Photographs of each retained sample while in the box core are presented in Appendix C. Generally sediments appeared to become finer to the north of the survey area and the stations closest to shore in the shallowest part of the survey area, with coarser sediments along the Export Route.

3.4.1 Particle Sizes

Results of the particle size analyses are presented in Table 3.1 and the full results can be found in Appendix F.

The particle size distribution within the sediments was highly variable between stations and zones, ranging from silt and clay to coarse sand and gravel. A higher proportion of percentage fines were found in the deeper water to the north of the survey area, at the Calliance and Torosa Fields, with the highest recorded fines content of 95.73% along the continental shelf slope at Station Slope-24. In contrast, the Export Route had coarser sediments, with all stations except those closest to James Price Point, recording less than 10% fines, with the lowest recorded as 0.58% fines at Station Export-4. Sand content also varied across the site, ranging from 3.97% at Station Slope-24 to 97.82% at Station SBF-44. The stations closest to James Price Point, Export-49, -53 and -56, recorded higher fines contents, 10% to 20%, than the remaining Export Route stations.

Gravels ranged from 0.10% at Stations Cal-30 and Cal-38 to 47.30% at Station Export-36. The proportion of gravels was generally low, and with the exception of Station Slope-22, only stations along the Export Route had gravel contents of >20%. With such a predominance of fines and sandy sediments, it is not surprising that most stations were classified between mud, sandy mud, gravelly mud and gravelly muddy sand under the Modified Folk Classification (as detailed in Folk, 1954). Both Export-70 and Export-36, the

stations with the coarsest sediment were classified as muddy gravel. This distribution of percentage fines and gravels across the survey area are presented in Figure 3.2 along with the different Modified Folk Classifications for each station.

The derived d(0.5) diameter was determined for each sediment sample, indicating the median particle size. This generally corresponded with % fines, sand and gravel content, with the highest median particle size, 900µm at Station Export-36, which also recorded the highest % gravel. The lowest median particle size was observed at two stations, Cal-29 and Cal-38, in the Calliance Field where all samples recorded over 50% fines content.

Table 3.1 Sediment Characteristics

Station Designation	Derived d(0.5) Diameter (µm)	Fines %	Sand %	Gravel %	Modified Folk Classification
Export-4	350	0.58	93.52	5.90	Gravelly muddy SAND
Export-11	390	2.66	80.75	16.60	Gravelly MUD
Export-16	650	0.87	84.43	14.70	Gravelly MUD
Export-23	600	0.62	81.48	17.90	Gravelly muddy SAND
Export-36	900	2.58	50.12	47.30	Muddy GRAVEL
Export-39	650	3.32	69.58	27.10	Gravelly MUD
Export-49	650	11.26	88.14	0.60	MUD
Export-53	250	14.18	83.82	2.00	Slightly gravelly MUD
Export-56	150	10.40	85.20	4.40	Slightly gravelly MUD
Export-64	260	4.82	91.08	4.10	Slightly gravelly sandy MUD
Export-70	750	1.00	61.80	37.20	Muddy GRAVEL
Cal-28	3	78.03	21.67	0.30	MUD
Cal-29	2	93.65	6.15	0.20	MUD
Cal-30	3	90.74	9.16	0.10	MUD
Cal-31	5	87.70	12.10	0.20	MUD
Cal-38	2	93.61	6.29	0.10	MUD
Cal-41	30	64.61	34.59	0.80	MUD
SBF-41	530	1.60	82.50	15.90	Gravelly MUD
SBF-42	255	6.81	78.19	15.00	Gravelly MUD
SBF-43	290	1.66	94.84	3.50	Slightly gravelly sandy MUD
SBF-44	250	1.58	97.82	0.60	Sandy MUD
Slope-16	220	17.60	66.00	16.40	Gravelly MUD
Slope-22	640	4.57	75.23	20.20	Gravelly MUD
Slope-24	5	95.73	3.97	0.30	MUD
Tor-43	4	93.15	6.65	0.20	MUD
Tor-44	7	79.16	20.24	0.60	MUD
Tor-45	30	73.59	25.61	0.80	MUD
Tor-53	360	0.98	96.42	2.60	Slightly gravelly sandy MUD
Tor-54	60	51.59	48.01	0.40	MUD
Tor-55	45	58.81	40.79	0.40	MUD
Tor-58	40	60.40	38.40	1.20	Slightly gravelly MUD
Minimum	**2**	**0.58**	**3.97**	**0.10**	-
Maximum	**900**	**95.73**	**97.82**	**47.30**	
Mean	**270**	**36.84**	**55.13**	**8.03**	
SD	**274**	**38.58**	**33.32**	**12.05**	

Overall, results were consistent, with coarser sediments along the Export Route, and an increase in fine sediment to the north of the survey area in the Calliance and Torosa Fields, and to the south in the nearshore area near James Price Point. The SBF and Slope zones generally corresponded with the Export Route sediment, with the exception of Slope-24, where the finer sediment can likely be explained by the increase in depth to over 350m.

3.4.2 Nutrients

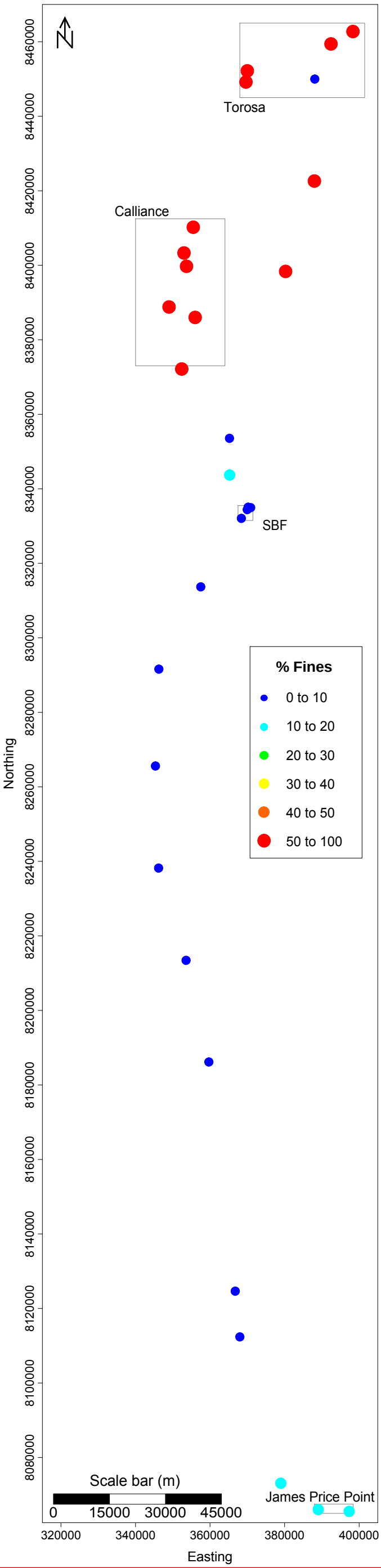
Results of the sediment organic and nutrient measurements are presented in Table 3.3. ISQG trigger values were not available for sediment nutrients and organics, with the exception of tributyltin.

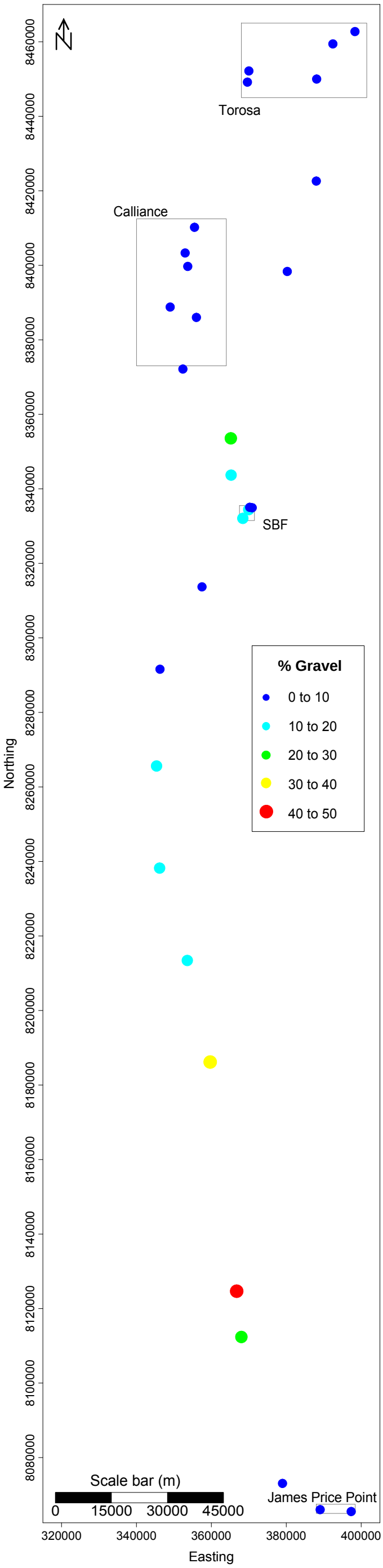
Table 3.3 Sediment Nutrients

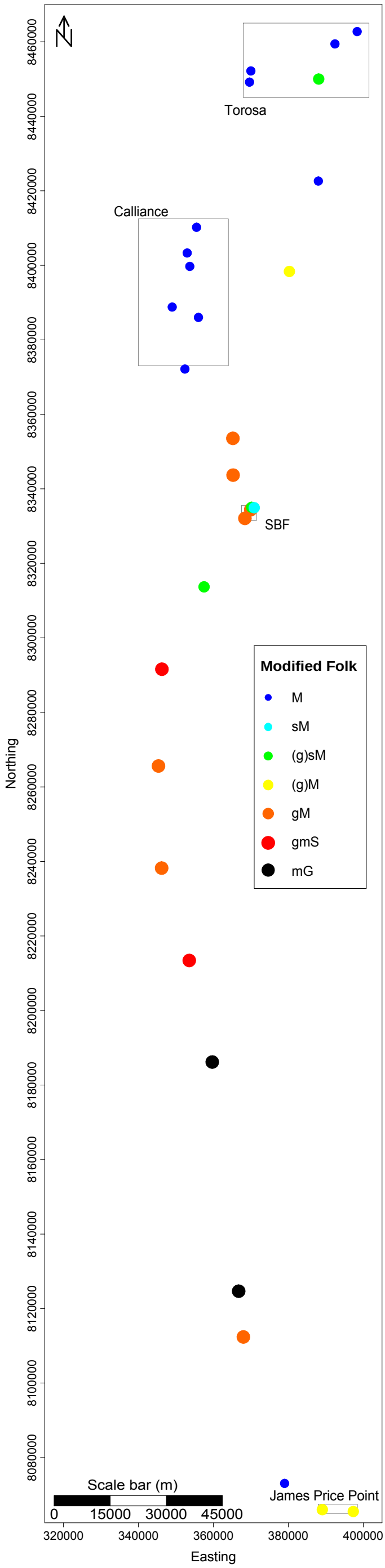
Station Designation	Total Nitrogen (µg g^{-1})	Total Phosphorus (µg g^{-1})	Nitrate / Nitrite (µg g^{-1})	Total Organic Carbon (%)	Tributyltin (µgSn kg^{-1})
Export-4	150	649	0.153	0.10	<0.5
Export-11	240	542	0.282	0.09	<0.5
Export-16	190	535	0.115	0.09	<0.5
Export-23	190	517	0.159	0.08	<0.5
Export-36	170	442	0.257	0.08	<0.5
Export-39	170	526	0.434	0.12	<0.5
Export-49	200	916	0.146	0.20	<0.5
Export-53	340	1390	0.332	0.19	<0.5
Export-56	440	1400	<0.100	0.17	<0.5
Export-64	200	393	0.379	0.13	<0.5
Export-70	260	441	0.357	0.08	<0.5
Cal-28	1170	689	0.159	0.65	<0.5
Cal-29	1900	641	0.254	0.81	<0.5
Cal-30	1500	478	0.617	0.78	<0.5
Cal-31	1190	396	0.374	0.73	<0.5
Cal-38	990	463	0.341	0.90	<0.5
Cal-41	350	322	0.437	0.40	<0.5
SBF-41	230	548	0.138	0.08	<0.5
SBF-42	260	437	0.315	0.13	<0.5
SBF-43	250	515	0.357	0.10	<0.5
SBF-44	210	483	0.151	0.07	<0.5
Slope-16	250	411	0.130	0.16	<0.5
Slope-22	250	1850	0.182	0.09	<0.5
Slope-24	1570	464	0.147	0.80	<0.5
Tor-43	780	480	0.255	0.91	<0.5
Tor-44	640	517	0.523	0.61	<0.5
Tor-45	700	350	0.228	0.41	<0.5
Tor-53	170	337	0.171	0.12	<0.5
Tor-54	280	376	0.223	0.26	<0.5
Tor-55	40	220	<0.100	0.28	<0.5
Tor-58	840	369	0.364	0.41	<0.5
Minimum	**40**	**220**	**<0.100**	**0.07**	**<0.5**
Maximum	**1900**	**1850**	**0.617**	**0.91**	**<0.5**
Mean	**520**	**584**	**0.275**	**0.32**	**<0.5**
SD	**489**	**351**	**0.129**	**0.29**	**NC**

Figure 3.2 Particle Size Analysis

All positional information is referenced to the Geodetic Reference System 1980,
International Ellipsoid, Universal Transverse Mercator (UTM) Projection, Grid Zone 51S 123° East.







Total Nitrogen

Total nitrogen concentrations varied considerably across the survey area, from 40µg g^{-1} at Station Tor-55 to a maximum of 1900µg g^{-1} at Station Cal-29, with a mean of 520µg g^{-1} (± 489µg g^{-1}). Concentrations were generally consistent within zones; with increased TN at stations in the Calliance Field, with the exception of Station Cal-41, appearing to correspond with increasing water depth and decreasing particle size. Stations in shallower water, along the Export Route and in the Slope and SBF zones, recorded lower TN concentrations, with the exception of Slope-24 located in much deeper water.

Total Phosphorus

There was less variation in total phosphorus than in TN, though with a comparable mean TP concentration of 584µg g^{-1} (± 351µg g^{-1}). There were significantly higher TP concentrations of over 1,000µg g^{-1} at three stations; Export-53, Export-56 and Slope-22; the reason is unclear.

Nitrite and Nitrate

Nitrite and nitrate concentrations were generally consistent across the site, ranging from <0.100µg g^{-1} at Stations Export-56 and Tor-55 to 0.617µg g^{-1} at Station Cal-30, with no obvious correlation with water depth or sediment size.

Total Organic Carbon

Mean total organic carbon concentration was 0.32% (± 0.29%), ranging from 0.07% at Station SBF-44 to 0.91% at Station Tor-43. There was some variability of TOC within zones, with less correlation with water depth and sediment type. All TOC levels were ≤0.91% and thus not indicative of nutrient enrichment.

Tributyltin

Concentrations of tributyltin were below the levels of detection at all sampling stations, and below the ISQG trigger values (5µgSn kg^{-1}).

3.4.3 Hydrocarbon Concentrations

Total petroleum hydrocarbon concentrations were all below the limits of detection, and are thus not indicative of any anthropogenic contamination.

3.4.4 Metals

Results of the sediment metal concentrations are presented in Table 3.4.

As, Cd, Cr, Cu, Pb and Zn concentrations were all below their respective ISQG trigger values. Hg and Ni concentrations exceeded their respective trigger values at Station Tor-43, with Ni also recorded marginally above the trigger value at Station Cal-29.

Where available, metal concentrations were also compared to the National Oceanic and Atmospheric Administration's (NOAA) published Apparent Effects Thresholds (AETs) (Buchman, 2008) for the impact of metals on marine fauna. All sediment metal concentrations were below their respective AETs, some substantially so, and thus no impact on marine fauna was to be expected. However, it is important to note that AETs for these elements were based on bioassay to measure the response of particular taxa, in this case either the polychaete worm, Neanthes; a bivalve mollusc; oyster larvae or general

infaunal community impacts; thus levels may not be pertinent to other marine species.

There was a slight correlation of metal concentration with water depth and sediment type, which is consistent with the particle size and organic analyses. The majority of metals; Cu, Co, Hg, Ni, Pb and Zn, increased with increasing depth and finer sediment size, while As concentration correspondingly decreased.

Table 3.4 Sediment Metal Concentrations

Concentrations expressed as µg g^{-1} dry weight sediment									
Station Designation	**Arsenic**	**Cadmium**	**Copper**	**Chromium**	**Cobalt**	**Mercury**	**Nickel**	**Lead**	**Zinc**
Export-4	<1.00	<0.1	<1.0	10.2	0.5	0.01	<1.0	<1.0	2.1
Export-11	2.71	0.2	2.0	15.5	1.4	<0.01	4.6	2.0	8.6
Export-16	9.64	0.2	1.2	14.8	0.9	<0.01	3.5	1.6	3.4
Export-23	5.91	0.2	1.2	13.7	0.8	<0.01	4.0	1.7	3.4
Export-36	6.53	0.1	<1.0	17.6	0.6	<0.01	<1.0	3.4	17.7
Export-39	7.27	0.1	<1.0	24.7	0.7	<0.01	<1.0	1.7	3.4
Export-49	4.54	0.1	<1.0	13.6	0.5	0.01	1.5	<1.0	3.1
Export-53	1.86	<0.1	<1.0	15.2	<0.5	0.01	<1.0	1.1	2.3
Export-56	4.58	0.1	<1.0	16.1	0.6	0.01	1.6	<1.0	3.1
Export-64	2.00	0.2	2.1	13.2	2.2	0.02	3.6	2.1	9.0
Export-70	6.67	0.2	1.1	23.0	0.9	0.01	2.6	2.1	4.4
Cal-28	<1.00	0.2	10.4	15.2	3.6	0.03	11.4	3.1	29.0
Cal-29	1.60	0.3	16.2	19.6	5.6	0.05	22.7	4.1	35.0
Cal-30	1.38	0.3	17.8	21.2	6.3	0.04	24.5	4.5	37.5
Cal-31	<1.00	0.3	14.2	15.8	4.9	0.04	19.8	3.9	30.9
Cal-38	<1.00	0.2	10.3	12.5	4.2	0.03	12.9	2.7	23.3
Cal-41	<1.00	0.3	11.0	11.6	4.0	0.04	16.0	3.3	25.5
SBF-41	2.98	0.2	1.4	15.9	2.5	0.02	2.9	11.3	11.7
SBF-42	1.32	0.1	1.7	11.5	1.9	0.02	2.0	1.5	7.2
SBF-43	2.58	0.2	2.0	16.3	2.6	0.02	2.5	2.6	11.3
SBF-44	2.23	0.1	1.7	15.7	2.5	0.02	2.5	2.4	10.0
Slope-16	2.30	0.1	2.4	10.0	1.6	0.01	2.2	1.6	8.6
Slope-22	1.52	0.2	1.7	8.8	2.3	0.02	2.3	1.9	19.1
Slope-24	<1.00	0.2	11.6	17.2	3.3	0.03	12.3	2.6	30.8
Tor-43	1.98	0.4	20.4	23.5	8.2	0.19	26.2	5.7	52.1
Tor-44	<1.00	0.2	10.7	11.4	4.4	0.03	15.0	3.2	27.2
Tor-45	<1.00	0.2	5.8	6.3	2.3	0.02	5.8	1.8	11.7
Tor-53	<1.00	0.1	<1.0	3.8	0.5	<0.01	<1.0	<1.0	11.5
Tor-54	<1.00	0.2	3.0	3.7	1.4	0.01	3.6	1.3	7.5
Tor-55	<1.00	0.1	2.6	3.6	1.1	0.01	2.9	<1.0	5.0
Tor-58	<1.00	0.2	8.2	12.8	3.1	0.03	12.4	2.4	20.1
Minimum	**<1.00**	**<0.1**	**<1.0**	**3.6**	**<0.5**	**<0.01**	**<1.0**	**<1.0**	**2.1**
Maximum	**9.64**	**0.4**	**20.4**	**24.7**	**8.2**	**0.19**	**26.2**	**11.3**	**52.1**
Mean	**3.66**	**0.2**	**6.7**	**14.0**	**2.5**	**0.03**	**8.5**	**2.9**	**15.3**
±SD	**2.44**	**0.1**	**6.1**	**5.4**	**1.9**	**0.04**	**7.9**	**2.0**	**12.8**
ISQG-trigger value	**20**	**1.5**	**65**	**80**	**NA**	**0.15**	**21**	**50**	**200**

Interim sediment quality guideline low trigger values are highlighted in blue, where available.
Table adapted from ANZECC, 2000; Table 3.5.1.
NA Not Available

3.4.5 Radionuclides

Results of the sediment radionuclide (Ra) concentrations are presented in Table 3.5.

^{226}Ra concentrations varied from 3.3Bq kg^{-1} to 52.0Bq kg^{-1}, with a mean of 16.3Bq kg^{-1} (± 12.2Bq kg^{-1}), while ^{228}Ra varied from 1.3Bq kg^{-1} to 18.0Bq kg^{-1} with a mean of 6.7Bq kg^{-1} (± 4.1Bq kg^{-1}). These concentrations were lower than baseline data recorded in marine sediments off the coast of East Malaysia; mean concentrations of 23 to 30Bq kg^{-1} (± 2Bq kg^{-1}) ^{226}Ra and 35 to 39Bq kg^{-1} (± 4Bq kg^{-1}) ^{228}Ra respectively for coastal Sabah and Sarawak (Yii *et al*., 2008). Mean Thorium concentration was 13.1Bq kg^{-1} (± 5.9Bq kg^{-1}), reaching a maximum of 24.0Bq kg^{-1}.

The distributions of radionuclides across the survey area are presented in Figure 3.3. There is a clear pattern in the distribution of ^{228}Ra, with lower concentrations along the Export Route, increased values around the SBF and the highest concentrations in the Calliance Field; corresponding to the deeper waters and decreasing particle size. The highest levels of all three radionuclides were recorded in the Calliance Field, with the highest concentrations at Station Cal-30. The same pattern is somewhat apparent for ^{226}Ra; however thorium concentration is considerably more variable across the site, though Th values were generally higher at the Calliance Field stations.

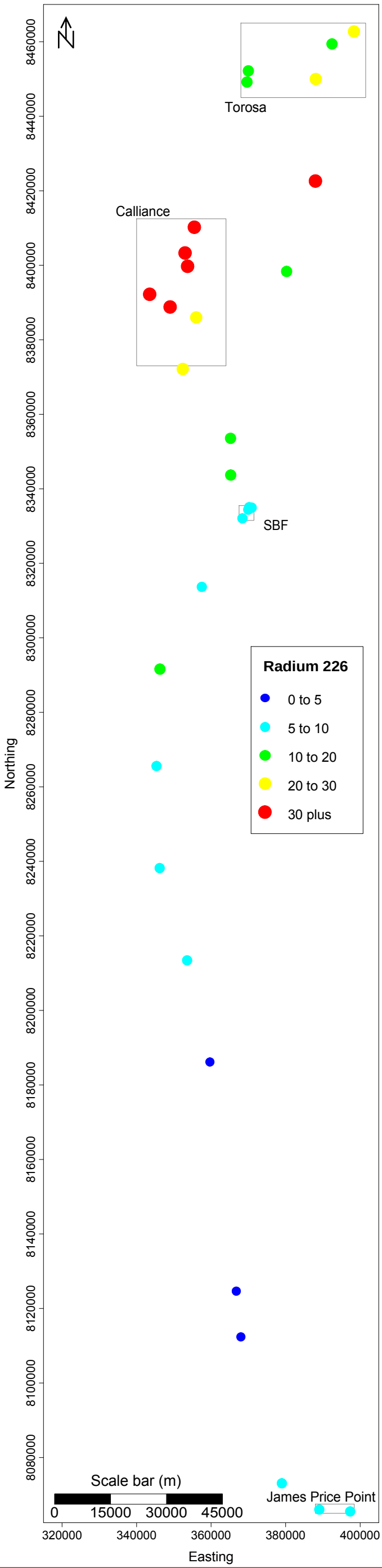
Table 3.5 Radionuclide Concentrations

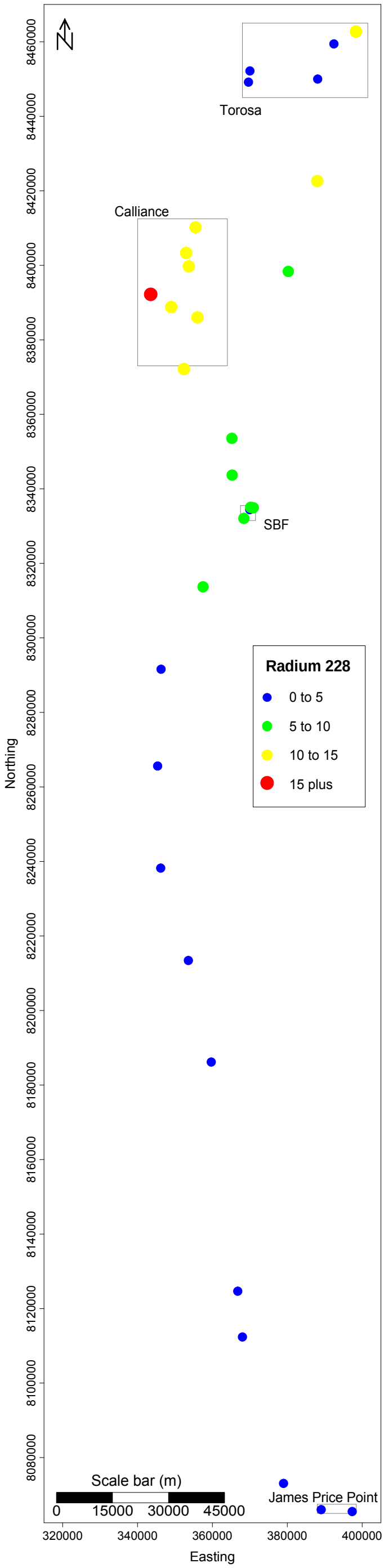
Station Designation	Radium-226 (Bq kg^{-1})	Radium-228 (Bq kg^{-1})	Thorium-228 (Bq kg^{-1})
Export-4	15.0	1.4	NA
Export-11	6.7	4.1	5.8
Export-16	8.0	3.7	NA
Export-23	7.7	3.7	NA
Export-36	4.4	3.2	NA
Export-39	3.9	2.7	NA
Export-49	5.2	4.1	NA
Export-53	6.8	4.2	NA
Export-56	7.1	4.8	NA
Export-64	8.7	9.3	11.7
Export-70	3.3	2.4	NA
Cal-28	25.0	11.0	20.0
Cal-29	31.0	11.0	18.0
Cal-30	52.0	18.0	24.0
Cal-31	38.0	12.0	21.0
Cal-38	37.0	11.0	NA
Cal-41	31.0	10.0	15.0
SBF-41	6.8	4.3	5.9
SBF-42	9.7	8.3	12.5
SBF-43	8.0	5.1	7.9
SBF-44	7.5	6.2	NA
Slope-16	16.0	7.6	10.4
Slope-22	13.0	5.1	9.1
Slope-24	24.0	12.0	17.0
Tor-43	30.0	11.0	20.0
Tor-44	26.0	11.0	17.0
Tor-45	13.0	2.4	4.2
Tor-53	23.0	<1.0	NA
Tor-54	11.0	2.1	8.4
Tor-55	12.0	1.3	7.1
Tor-58	16.0	8.0	14.0
Minimum	**3.3**	**1.3**	**4.2**
Maximum	**52.0**	**18.0**	**24.0**
Mean	**16.3**	**6.7**	**13.1**
SD	**12.2**	**4.1**	**5.9**

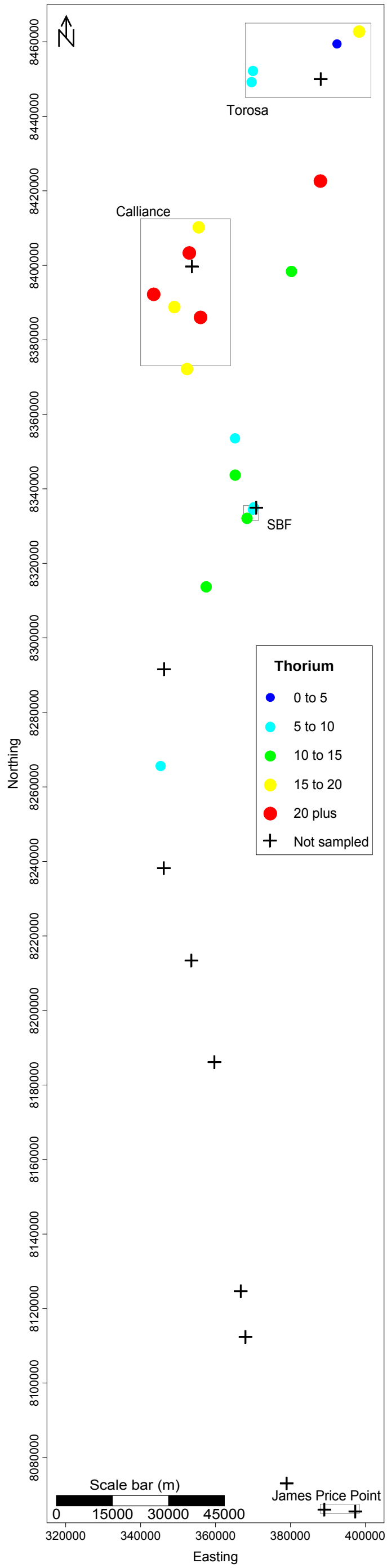
NA Not analysed

Figure 3.3 Radionuclides

All positional information is referenced to the Geodetic Reference System 1980,
International Ellipsoid, Universal Transverse Mercator (UTM) Projection, Grid Zone 51S 123° East.







3.5 Statistical Analyses of Sediment Physico-chemical Results

Multivariate analyses were performed on data from the 31 stations using PRIMER v6 (Plymouth Marine Laboratories). The physico-chemical data were normalised prior to analysis, but transformation to reduce skewness was deemed unnecessary due to the normal distribution of variables. The data were initially subjected to CLUSTER and MDS analyses; the Euclidean distance dendrogram and MDS plots are presented in Figure 3.4a and b.

The hydrocarbon variables and TBT were removed prior to multivariate analysis due to low concentrations below the respective limits of reporting. Most of the remaining sediment physico-chemical variables also recorded concentrations below the LoR for several sampling stations. In order to perform statistical analysis, it was necessary to input whole values for these concentrations; 0.099 instead of <0.100 (NO_X), 0.99 instead of <1.00 (As), 0.9 instead of <1.0 (Cu, Ni, Pb and Radium-228), 0.0 instead of <0.1 (Cd and Co) and 0.00 instead of <0.01 (Hg). Although the amended values were representative rather than precise values, they allowed all concentrations below the LoR to be ranked equally, while still lower than the remaining data. This enabled the data to be analysed by PRIMER.

The CLUSTER analysis (Figure 3.4a) was conducted in conjunction with a SIMPROF routine, which identified five statistically distinct clusters, based on sediment physico-chemistry. Stations that were found to be statistically indistinguishable were plotted on the dendrogram joined with red lines. The MDS ordination, presented in Figure 3.4b, supports the Euclidean distance dendrogram, although not all the distinct clusters were visibly separated. The MDS ordination had a stress value of 0.09 indicating that it is not perfect, but is still a good 2-dimensional representation of the rank similarities.

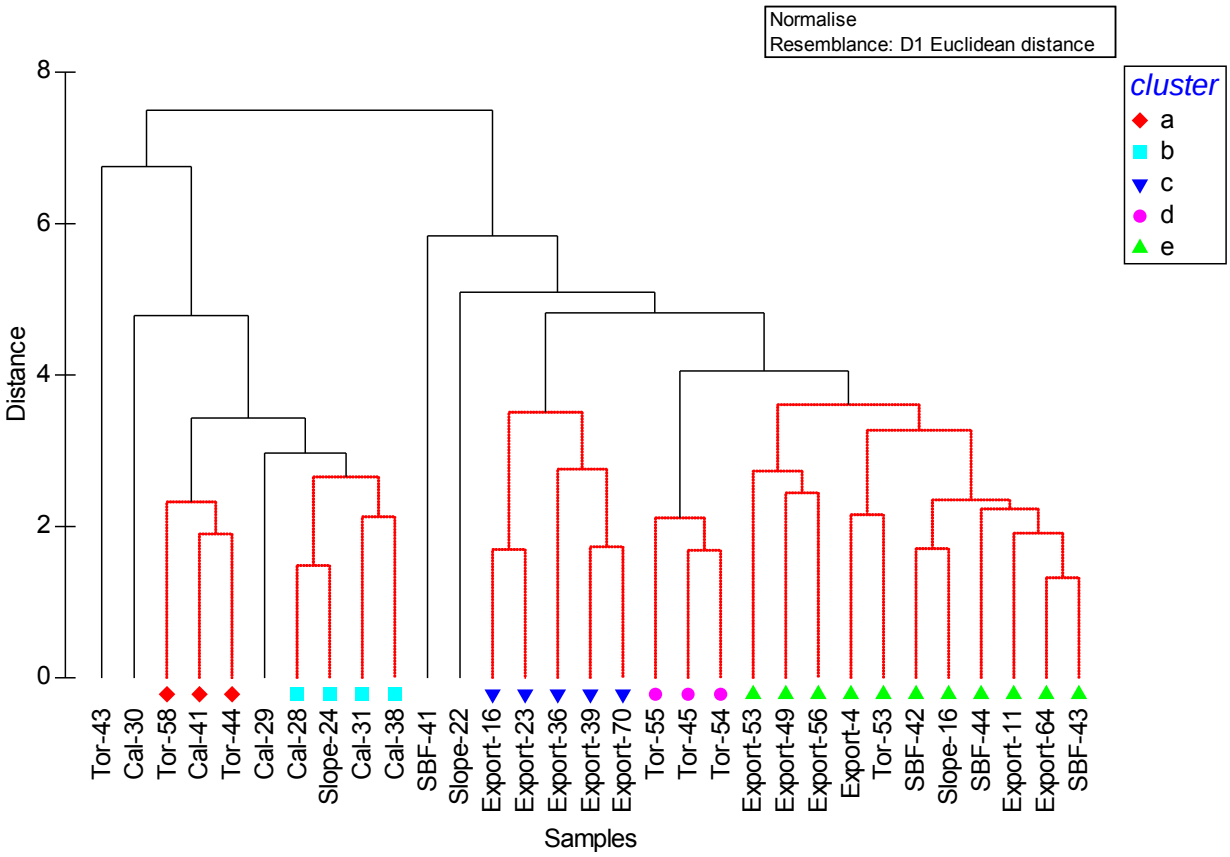
The CLUSTER and SIMPROF tests identified stations as separated at a distance of *c.*7-8, with four stations identified as separate from the clusters; Stations Tor-43, Cal-30, SBF-41 and Slope-22. An examination of the raw data showed that the separation of Station Tor-43 as statistically distinct was primarily due to the metals Hg, Zn, Cd and Cu. The dissimilarity of Station Cal-30 was largely due to Radium-226 and 228, and NO_X, while Pb and TP were primarily responsible for the dissimilarity of Stations SBF-41 and Slope-22 respectively. A BEST analysis was conducted to determine a subset of physico-chemical variables that best explains the observed multivariate pattern. The analysis revealed that three variables (particle size d(0.5), Co and Zn) described 90% of the observed multivariate pattern. Bubble plots of these variables overlying the MDS ordination are presented in Figure 3.4c - e, which clearly show the separation of the two blocks of clusters is due to all three of these variables. A SIMPER test identified particle size variables as the main contributors to the dissimilarities between the two main groups of clusters (a and b, compared to clusters c, d and e). This is apparent in the bubble plots presented in Figure 3.4f - h. Contributions from such a large number of variables to the separation of clusters is not surprising given the low levels of all measured variables.

The clusters can be further described by plotting the results of the SIMPROF routine on their respective target locations (see Figure 3.5). Clusters did not correspond entirely with zones, with the Export Route and Calliance Field stations both divided between two

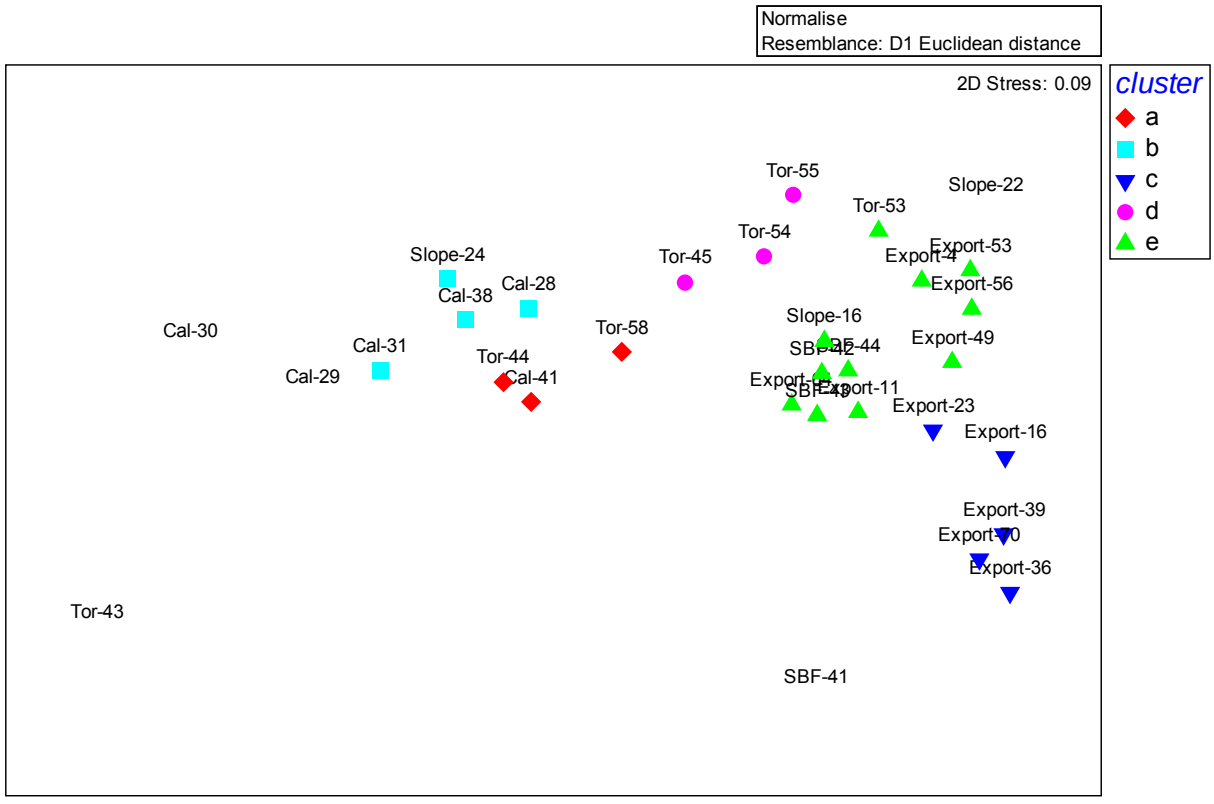
clusters, separated at distances of *c.*5. The separation of Export Route stations was largely due to As and the particle size variables, % gravel and d(0.5) diameter. The Calliance Field stations were separated into two clusters due to several variables, including Radium 226 and 228, NO_X, Ni, TN, TOC, Cd, Cr and Cu. The SBF sampling stations were clustered together, with the exception of Station SBF-41. Slope stations were separated between two clusters and the statistically distinct Station Slope-22, with variation generally due to TN and TP. Tor stations were divided between three clusters and the statistically distinct Station Tor-43. However, larger patterns are apparent, with both the Export Route and Calliance Field stations generally divided between clusters according to depth, and with all nearshore stations in the same cluster.

Figure 3.4 Multivariate Analyses of Physico-chemical Data

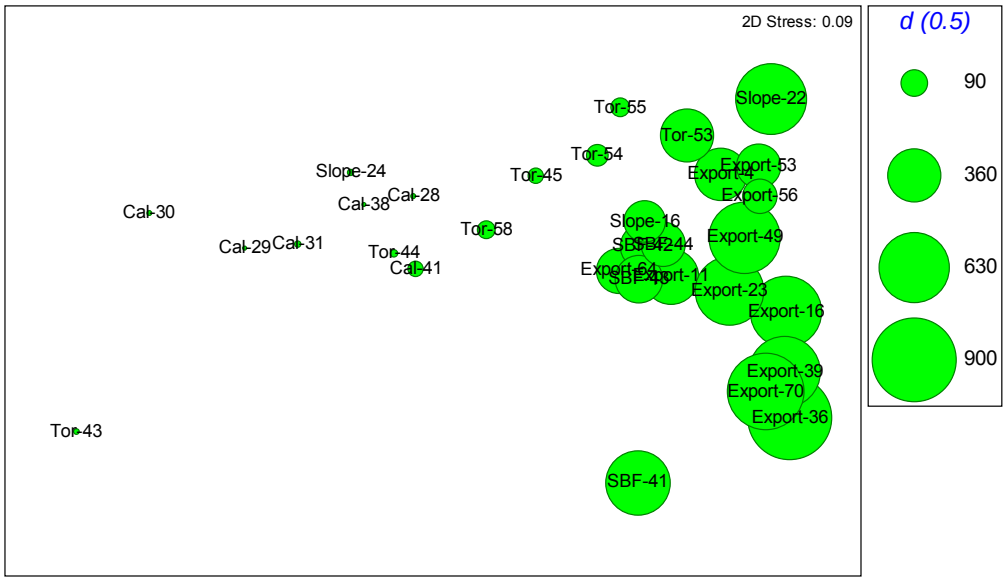
a) Euclidean Distance Dendrogram



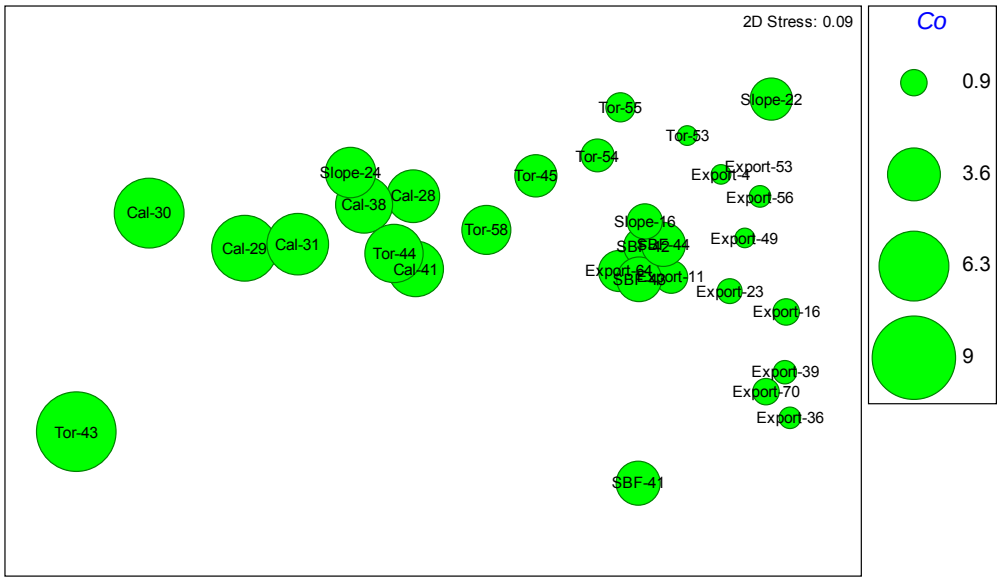
b) MDS Ordination



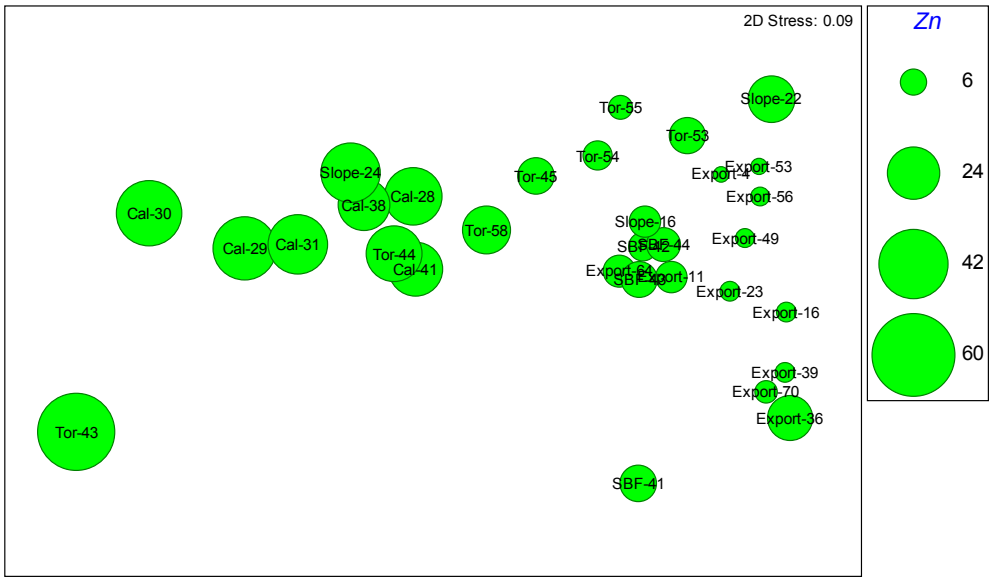
c) MDS ordination overlain with bubble plot of particle size (d(0.5) diameter)



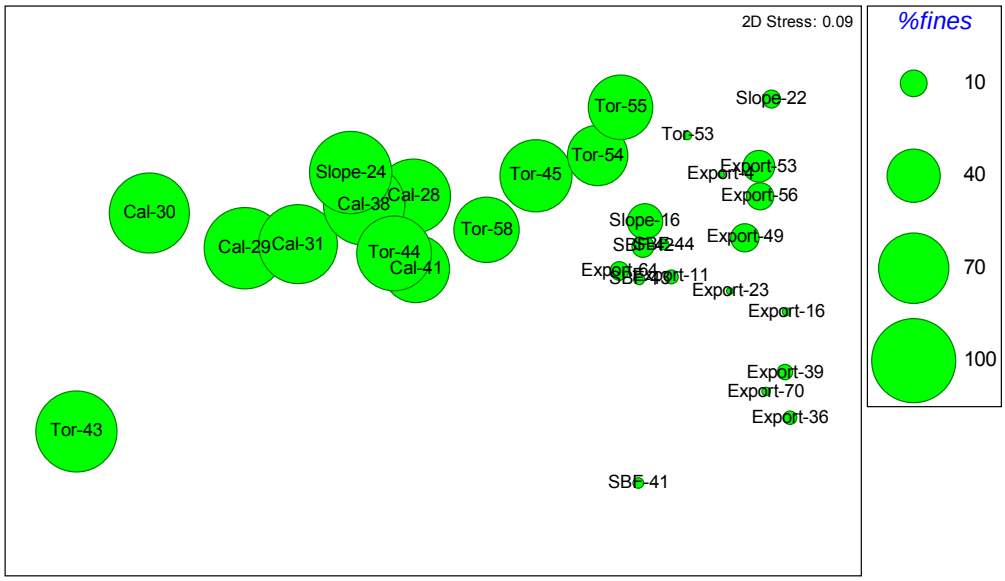
d) MDS ordination overlain with bubble plot of Co (µg g^{-1})



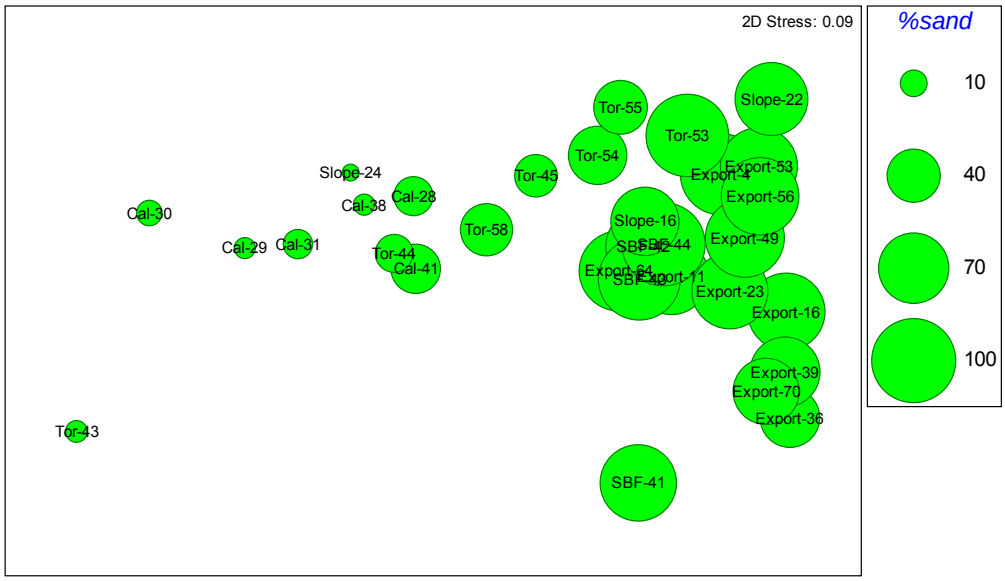
e) MDS ordination overlain with bubble plot of Zn (µg g^{-1})



f) MDS ordination overlain with bubble plot of % fines



g) MDS ordination overlain with bubble plot of % sand



h) MDS ordination overlain with bubble plot of % gravel

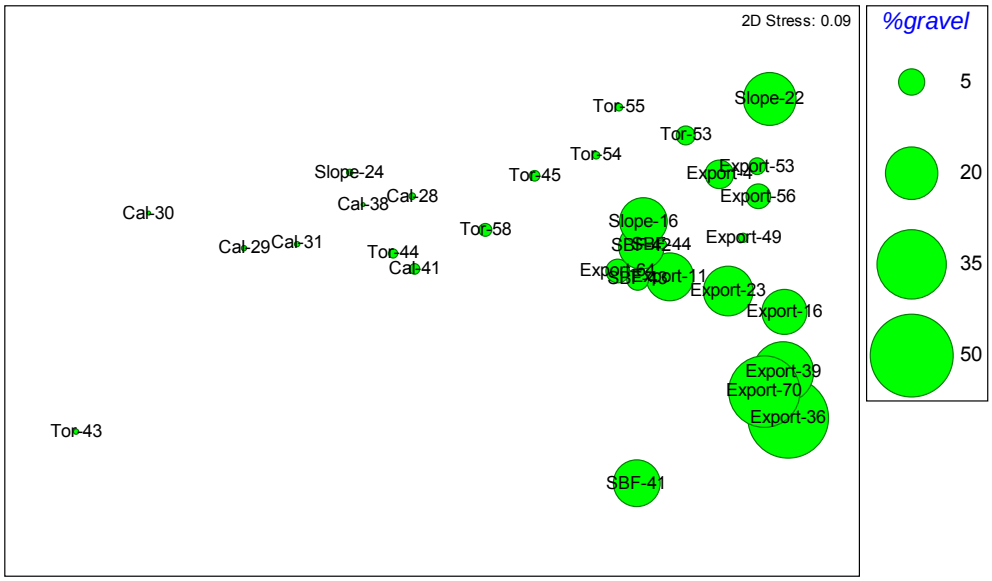
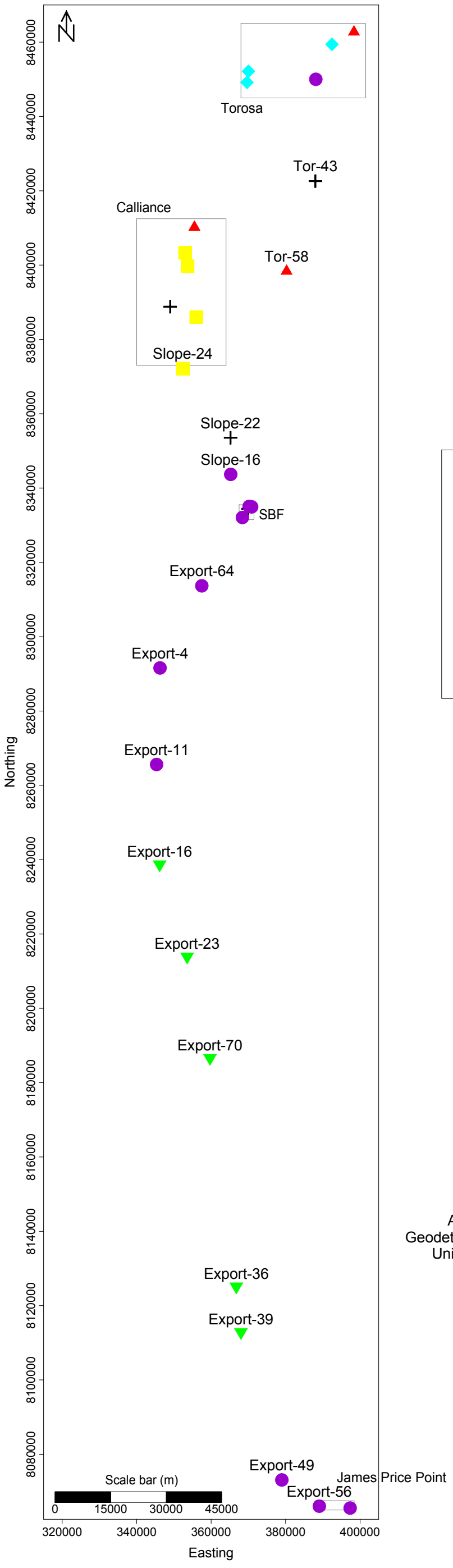
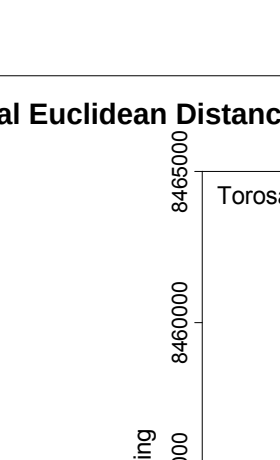
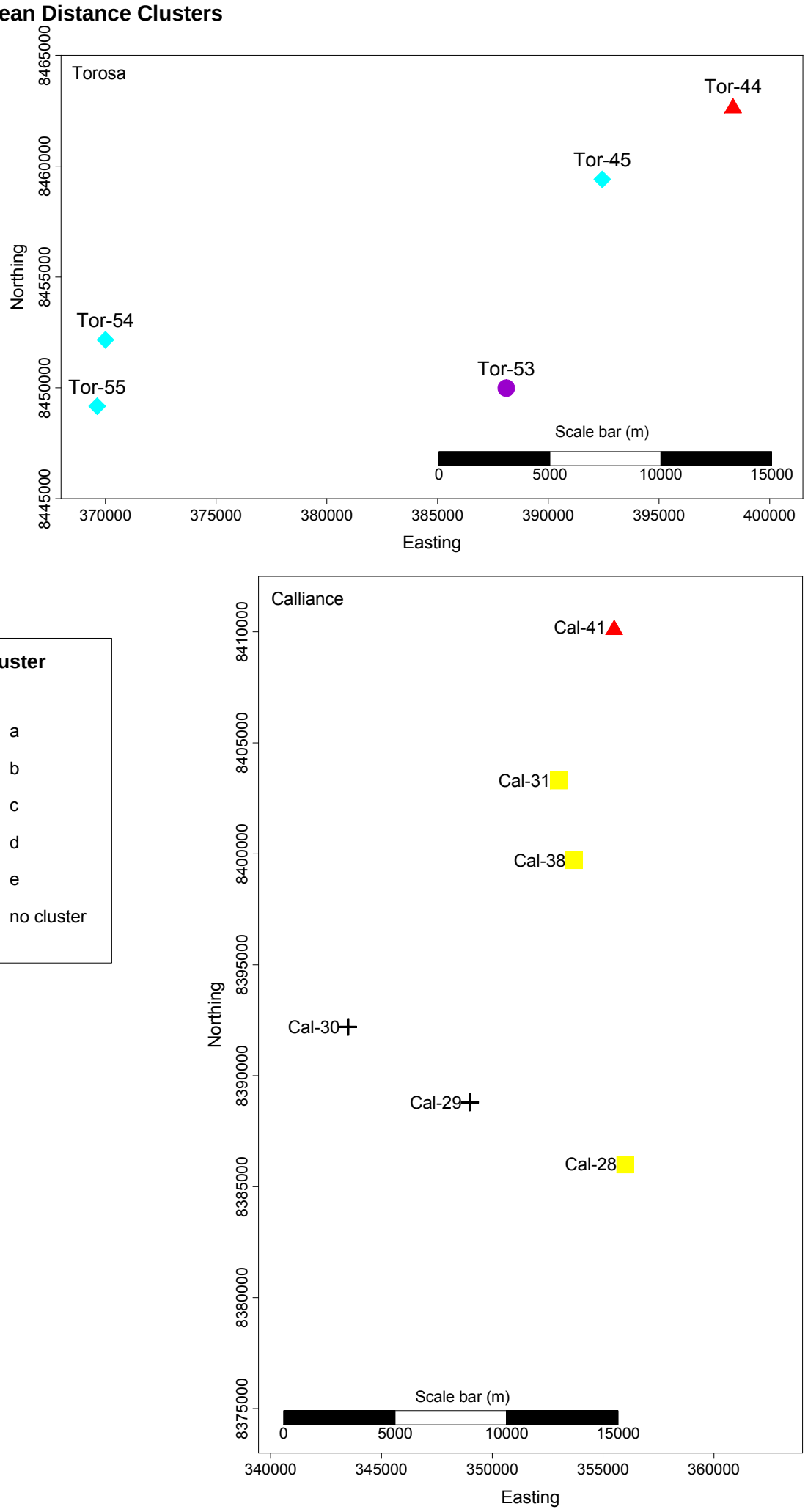


Figure 3.5 Target Locations and Physico-chemical Euclidean Distance Clusters







All positional information is referenced to the Geodetic Reference System 1980, International Ellipsoid, Universal Transverse Mercator (UTM) Projection, Grid Zone 51S 123º East.

3.6 Water Quality Analysis

3.6.1 Nutrients

Data on nutrient concentrations were compared to ANZECC (2000) trigger values for slightly disturbed ecosystems in tropical Australia, as displayed in Table 2.3. Where the limit of reporting (LoR) of a reported result differs from the standard LoR, this was generally assigned by the laboratory to matrix interference (see methods in Appendix D).

Total Nitrogen

TN results are presented in Table 3.6. Mean recorded TN concentrations were 1.0mg L^{-1} (±0.4), 3.0mg L^{-1} (±5.2) and 1.1mg L^{-1} (±0.4) for the surface, mid-water column and near seabed respectively. With the exception of the higher concentrations of 15.2mg $L^{-1}$and 21.3mg L^{-1} recorded in the mid-water column samples at Stations Export-36 and Cal-28, results were generally uniform across the site. Concentrations were marginally higher at the Calliance and Torosa Field stations, with the exception of Station Export-36. TN results exceeded the ANZECC trigger value in most samples, suggesting that background levels in the region were higher than expected and that ANZECC data is perhaps unsuitable for comparison.

Table 3.6 Total Nitrogen Concentrations

Concentrations expressed in mg L^{-1}							
Station Designation	Sample			Station Designation	Sample		
	Top	Middle	Bottom		Top	Middle	Bottom
Export-4	0.8	0.5	<0.5	**SBF-41**	0.6	0.6	0.7
Export-11	1.6	0.6	0.7	**SBF-42**	0.9	0.7	<0.5
Export-16	1.3	0.9	1.1	**SBF-43**	0.9	0.9	1.4
Export-23	0.6	0.6	1.1	**SBF-44**	0.6	<0.5	0.6
Export-36	1.0	15.2	0.6	**Slope-16**	<0.5	<0.5	<0.5
Export-39	0.5	12	<0.5	**Slope-22**	<0.5	<0.5	<0.5
Export-49	<0.5	<0.5	0.6	**Slope-24**	1.3	1.4	1.4
Export-52	<0.5	9.0	0.7	**Tor-44**	0.7	3.1	1.4
Export-56	<0.5	<0.5	<0.5	**Tor-57**	1.6	1.6	1.6
Export-64	<0.5	0.7	0.7	**Tor-58**	1.2	1.7	1.6
Export-70	0.6	0.5	0.7	**Minimum**	**<0.5**	**<0.5**	**<0.5**
Cal-28	0.7	21.3	1.0	**Maximum**	**1.6**	**21.3**	**2.0**
Cal-29	1.4	1.4	1.2	**Mean**	**1.0**	**3.0**	**1.1**
Cal-30	0.6	<0.5	1.2	**SD**	**0.4**	**5.2**	**0.4**
Cal-31	0.6	1.2	1.2	**Trigger value**	**0.1**		
Cal-33	1.4	1.7	1.7				
Cal-38	1.4	1.7	<0.5				
Cal-41	1.5	1.4	2.0				

ANZECC trigger values are highlighted in blue. Table adapted from ANZECC, 2000; Table 3.3.4.

Total Phosphorus

TP results for samples that exceeded the limits of reporting are presented in Table 3.7. TP concentrations were largely below the LoR and elevated TP concentrations were generally ≤0.24mg L^{-1}, with the exception of the surface sample at Station Export-11, which was

recorded as 9.05mg L^{-1}. Such an elevated concentration at the surface, in the absence of any other such concentrations could possibly be attributed to an anomalous result. TP results exceeded the ANZECC trigger value in seven samples (Table 3.7).

Table 3.7 Total Phosphorus Concentrations

Concentrations expressed in mg L^{-1}			
Station Designation	Sample		
	Top	Middle	Bottom
Export-11	9.05	<0.05	<0.05
Export-56	0.24	<0.05	<0.05
Cal-30	<0.05	<0.05	0.08
Cal-38	<0.05	<0.05	0.09
Slope-16	0.11	<0.05	<0.05
Slope-22	0.08	<0.05	<0.05
Tor-58	0.20	<0.05	0.10
Minimum	**<0.05**	**<0.05**	**<0.05**
Maximum	**9.05**	**<0.05**	**0.10**
Mean	**1.94**	**<0.05**	**0.09**
SD	**3.98**	**NC**	**0.01**
Trigger value	**0.01**		
All other results below limit of detection			

ANZECC trigger values are highlighted in blue. Table adapted from ANZECC, 2000; Table 3.3.4.
NC Not calculated

Ortho-phosphate

FRP results for samples that exceeded the limits of reporting are presented in Table 3.8. FRP concentrations were largely below the LoR and all results were ≤0.05mg L^{-1}. There was some variation across the site, with generally higher concentrations of FRP at the Calliance Field stations, and the highest value at Stations Cal-29 and Cal-33. FRP results exceeded the ANZECC trigger value in fourteen samples (Table 3.8), suggesting that background levels in the region were higher than expected and that ANZECC data is perhaps unsuitable for comparison.

Ammonia

NH_4 results for samples that exceeded the limits of reporting are presented in Table 3.9. NH_4 concentrations were largely below the LoR, though this limit was significantly higher than the trigger value upper limit. There was some variation across the site, with generally higher concentrations of NH_4 at the Export Route and Torosa Field stations, and the highest value at Stations Export-11, Export-23 and Tor-57. NH_4 results exceeded the ANZECC trigger value in ten samples (Table 3.9).

Nitrate and Nitrite

NO_X results are presented in Table 3.10. Mean recorded NO_X concentrations were 0.03mg L^{-1} (±0.02), 0.11mg L^{-1} (±0.13) and 0.17mg L^{-1} (±0.17) for the surface, mid-water column and near seabed respectively. There was some variation across the site, particularly in the near seabed samples. Higher concentrations were recorded at the Calliance Field stations, with a maximum of 0.51mg L^{-1} recorded in the near seabed sample at Station

Cal-31. NO_X results exceeded the ANZECC trigger value at all stations, suggesting that background levels in the region were higher than expected and that ANZECC data is perhaps unsuitable for comparison.

Table 3.8 Total Ortho-phosphate Concentrations

Concentrations expressed in mg L^{-1}							
Station Designation	Sample			Station Designation	Sample		
	Top	Middle	Bottom		Top	Middle	Bottom
Export-11	0.02	<0.01	<0.01	**Tor-44**	<0.01	0.02	0.02
Cal-28	<0.01	0.01	0.02	**Tor-57**	<0.01	0.01	0.03
Cal-29	<0.01	0.03	0.05	**Tor-58**	<0.01	<0.01	0.03
Cal-30	<0.01	<0.01	0.02	**Minimum**	<0.01	<0.01	<0.01
Cal-31	<0.01	0.01	0.02	**Maximum**	0.02	0.04	0.05
Cal-33	<0.01	0.01	0.05	**Mean**	0.02	0.02	0.03
Cal-38	<0.01	0.04	0.03	**SD**	NC	0.01	0.01
Cal-41	<0.01	0.03	0.05	**Trigger value**	**0.002 - 0.005**		
Slope-16	<0.01	0.01	0.03	All other results below limit of detection			
Slope-22	<0.01	0.01	0.03				
Slope-24	<0.01	0.03	0.03				

ANZECC trigger values are highlighted in blue; the lower values are typical of clear coral dominated waters (e.g. Great Barrier Reef), while higher values typical for turbid macrotidal systems (eg. North-west Shelf of WA). Table adapted from ANZECC, 2000; Table 3.3.4.

NC Not calculated

Table 3.9 Ammonia Concentrations

Concentrations expressed in mg L^{-1}							
Station Designation	Sample			Station Designation	Sample		
	Top	Middle	Bottom		Top	Middle	Bottom
Export-4	<0.10	0.31	0.16	**Tor-44**	<0.10	<0.10	0.33
Export-11	<0.10	0.42	<0.10	**Tor-57**	<0.10	<0.10	0.49
Export-23	<0.10	0.72	<0.10	**Tor-58**	<0.10	<0.10	0.24
Export-64	<0.10	<0.10	0.33	**Minimum**	<0.10	<0.10	<0.10
Cal-30	0.13	<0.10	<0.10	**Maximum**	0.16	0.72	0.49
Cal-41	0.16	<0.10	<0.10	**Mean**	0.15	0.48	0.29
SBF-43	<0.10	<0.10	0.17	**SD**	0.02	0.21	0.12
				Trigger value	**0.001 – 0.006**		
				All other results below limit of detection			

ANZECC trigger values are highlighted in blue; the lower values are typical of clear coral dominated waters (e.g. Great Barrier Reef), while higher values typical for turbid macrotidal systems (eg. North-west Shelf of WA). Table adapted from ANZECC, 2000; Table 3.3.4.

Table 3.10 Nitrate and Nitrite Concentrations

Concentrations expressed in mg L^{-1}			
Station Designation	Sample		
	Top	Middle	Bottom
Export-4	<0.01	0.02	0.05
Export-11	<0.01	<0.01	0.05
Export-16	<0.01	0.02	0.01
Export-23	<0.01	<0.01	0.01
Export-36	<0.01	<0.01	<0.01
Export-39	0.01	0.01	<0.01
Export-49	<0.01	<0.01	0.02
Export-52	0.01	0.02	0.01
Export-56	0.01	0.01	0.01
Export-64	<0.01	0.01	0.04
Export-70	<0.01	<0.01	<0.01
Cal-28	<0.01	<0.01	0.01
Cal-29	0.02	0.26	0.46
Cal-30	0.09	0.14	0.23
Cal-31	0.02	0.38	0.51
Cal-33	0.02	0.42	0.49
Cal-38	<0.01	0.08	0.34
Cal-41	<0.01	0.26	0.18
SBF-41	<0.01	0.04	0.06
SBF-42	<0.01	0.01	0.05
SBF-43	<0.01	0.04	0.08
SBF-44	0.03	0.01	0.10
Slope-16	<0.01	0.04	0.17
Slope-22	<0.01	0.06	0.20
Slope-24	<0.01	0.15	0.17
Tor-44	0.02	0.37	0.48
Tor-57	0.02	0.07	0.17
Tor-58	<0.01	0.03	0.17
Minimum	**<0.01**	**<0.01**	**<0.01**
Maximum	**0.09**	**0.42**	**0.51**
Mean	**0.03**	**0.11**	**0.17**
SD	**0.02**	**0.13**	**0.17**
Trigger value	**0.001 – 0.004**		

ANZECC trigger values are highlighted in blue; the lower values are typical of clear coral dominated waters (e.g. Great Barrier Reef), while higher values typical for turbid macrotidal systems (eg. North-west Shelf of WA). Table adapted from ANZECC, 2000; Table 3.3.4.

3.6.2 *Total Suspended Sediments*

TSS results are presented in Table 3.11. Mean recorded TSS were 29mg L^{-1}, 28mg L^{-1} and 29mg L^{-1} for the surface, mid-water column and near seabed respectively. Results were extremely variable between stations, ranging from as low as 6mg L^{-1} up to a high of 91mg L^{-1}.

The ANZECC Guidelines do not provide trigger values for TSS, only turbidity, expressed in Nephelometric Turbidity Units (NTU). Turbidity is a measure of cloudiness or haziness of a fluid due to the presence of suspended particulates. ANZECC state that 1-20 NTU is the acceptable range for marine and estuarine waters. However, there is no simple conversion for total suspended solids to NTU as it is dependant on the sampling region.

3.6.3 *Chlorophyll*

Concentrations of chlorophyll *a* were below the LoR at all sampling stations. It is therefore most likely that chlorophyll results were under the trigger value of 0.0009mg L^{-1} for all samples.

3.6.4 *Metals*

With the exception of arsenic, copper, nickel and zinc, results for water metal concentrations were recorded below the limits of reporting for almost all sampling stations. The results are presented in Table 3.12, with values above the LoR highlighted in red. Insufficient data on trigger values are available for As and Hg, thus no comparisons can be

made. Cd, Cr and Ni results were all below their respective trigger values. Cu and Zn concentrations exceeded trigger values at most stations, including all Export Route and SBF stations.

Table 3.11 Total Suspended Sediments

Concentrations expressed in mg L^{-1}								
Station Designation	Sample			Station Designation	Sample		
	Top	Middle	Bottom		Top	Middle	Bottom
Export-4	40	27	41	**SBF-41**	20	20	18
Export-11	32	34	37	**SBF-42**	53	43	44
Export-16	35	56	13	**SBF-43**	18	15	18
Export-23	9	48	51	**SBF-44**	12	28	32
Export-36	32	26	16	**Slope-16**	42	36	51
Export-39	34	38	36	**Slope-22**	26	26	39
Export-49	91	6	34	**Slope-24**	38	26	14
Export-52	14	18	34	**Tor-44**	30	35	28
Export-56	20	30	14	**Tor-57**	25	26	20
Export-64	29	34	23	**Tor-58**	30	12	31
Export-70	17	26	33	**Minimum**	**6**	**6**	**8**
Cal-28	47	33	38	**Maximum**	**91**	**56**	**51**
Cal-29	15	28	19	**Mean**	**29**	**28**	**29**
Cal-30	22	23	32	**SD**	**16**	**11**	**12**
Cal-31	6	14	17				
Cal-33	30	7	32				
Cal-38	30	38	42				
Cal-41	25	34	8				

3.7 Analysis of Water Quality Results

Baseline water quality data collected during this survey often exceeded ANZECC trigger values, suggesting that these data may not be the most appropriate for comparison of background levels. The data show some variation across the site, indicating that a range of background levels would be advisable for comparison.

Further multivariate analysis of water quality data could not be undertaken due to the proportion of results recorded below the respective limits of detection, as PRIMER can not manage samples with missing data points.

Table 3.12 Metal Concentrations

Concentrations expressed in mg L^{-1}										
Station Designation	Sample	Arsenic	Cadmium	Copper	Chromium	Cobalt	Mercury	Nickel	Lead	Zinc
Export-4	Top	0.185	<0.0005	0.013	<0.005	<0.005	<0.0001	0.011	<0.005	0.025
	Middle	0.184	<0.0005	0.013	<0.005	<0.005	<0.0001	0.011	<0.005	0.088
	Bottom	0.183	<0.0005	0.013	<0.005	<0.005	<0.0001	0.011	<0.005	0.056
Export-11	Top	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	<0.005	<0.005	0.054
	Middle	<0.005	<0.0005	0.014	<0.005	<0.005	<0.0001	0.005	<0.005	0.076
	Bottom	<0.005	<0.0005	0.012	<0.005	<0.005	<0.0001	0.005	<0.005	0.074
Export-16	Top	0.186	<0.0005	0.013	<0.005	<0.005	<0.0001	0.010	<0.005	0.034
	Middle	0.187	<0.0005	0.011	<0.005	<0.005	<0.0001	0.010	<0.005	0.061
	Bottom	0.188	<0.0005	0.013	<0.005	<0.005	<0.0001	0.010	<0.005	0.052
Export-23	Top	0.186	<0.0005	0.014	<0.005	<0.005	<0.0001	0.009	<0.005	0.055
	Middle	0.185	<0.0005	0.013	<0.005	<0.005	<0.0001	0.009	<0.005	0.039
	Bottom	0.191	<0.0005	0.013	<0.005	<0.005	<0.0001	0.010	<0.005	0.045
Export-36	Top	<0.005	<0.0005	0.014	<0.005	<0.005	<0.0001	<0.005	<0.005	0.067
	Middle	<0.005	<0.0005	0.015	<0.005	<0.005	<0.0001	<0.005	<0.005	0.067
	Bottom	<0.005	<0.0005	0.014	<0.005	<0.005	<0.0001	<0.005	<0.005	0.063
Export-39	Top	<0.005	<0.0005	0.014	<0.005	<0.005	<0.0001	<0.005	<0.005	0.069
	Middle	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	<0.005	<0.005	0.057
	Bottom	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	<0.005	<0.005	0.089
Export-49	Top	<0.005	<0.0005	0.012	<0.005	<0.005	<0.0001	<0.005	<0.005	0.067
	Middle	<0.005	0.0009	0.016	<0.005	<0.005	<0.0001	0.008	0.007	0.053
	Bottom	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	<0.005	<0.005	0.067
Export-52	Top	<0.005	<0.0005	0.011	<0.005	<0.005	<0.0001	<0.005	<0.005	0.044
	Middle	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	<0.005	<0.005	0.045
	Bottom	<0.005	<0.0005	0.015	<0.005	<0.005	<0.0001	0.006	0.010	0.082
Export-56	Top	<0.005	<0.0005	0.014	<0.005	<0.005	<0.0001	<0.005	<0.005	0.037
	Middle	<0.005	<0.0005	0.014	<0.005	<0.005	<0.0001	<0.005	<0.005	0.063
	Bottom	<0.001	<0.0001	0.004	<0.001	<0.001	<0.0001	<0.001	<0.001	0.007
Export-64	Top	0.182	<0.0005	0.014	<0.005	<0.005	<0.0001	0.011	<0.005	0.041
	Middle	0.178	<0.0005	0.016	<0.005	<0.005	<0.0001	0.011	<0.005	0.087
	Bottom	0.183	<0.0005	0.014	<0.005	<0.005	<0.0001	0.010	<0.005	0.048
Export-70	Top	<0.005	<0.0005	0.014	<0.005	<0.005	<0.0001	0.006	<0.005	0.050
	Middle	<0.005	<0.0005	0.014	<0.005	<0.005	<0.0001	0.006	<0.005	0.054
	Bottom	<0.005	<0.0005	0.088	<0.005	<0.005	<0.0001	0.005	<0.005	0.072
Export-76	Top	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	0.005	<0.005	0.050
	Middle	<0.005	<0.0005	0.012	<0.005	<0.005	<0.0001	0.006	<0.005	0.107
	Bottom	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	<0.005	<0.005	0.050
Cal-28	Top	0.183	<0.0005	0.013	<0.005	<0.005	<0.0001	0.009	0.005	0.036
	Middle	0.186	<0.0005	0.013	<0.005	<0.005	<0.0001	0.009	<0.005	0.032
	Bottom	0.180	0.0005	0.010	<0.005	<0.005	<0.0001	0.010	<0.005	0.121
Cal-29	Top	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	0.057
	Middle	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	0.066
	Bottom	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
Cal-30	Top	0.189	0.0010	0.016	<0.005	<0.005	<0.0001	0.010	0.006	0.108
	Middle	0.189	0.0009	0.015	<0.005	0.005	<0.0001	0.012	0.006	0.031
	Bottom	0.187	<0.0005	0.012	<0.005	<0.005	<0.0001	0.009	<0.005	0.037
Cal-31	Top	0.188	<0.0005	0.013	<0.005	<0.005	<0.0001	0.008	0.005	0.038
	Middle	0.185	<0.0005	0.012	<0.005	<0.005	<0.0001	0.008	<0.005	0.028
	Bottom	0.194	<0.0005	0.012	<0.005	<0.005	<0.0001	0.008	<0.005	0.044

Table 3.12a Metal Concentrations contd

Station Designation	Sample	Arsenic	Cadmium	Copper	Chromium	Cobalt	Mercury	Nickel	Lead	Zinc
Cal-33	Top	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Middle	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Bottom	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
Cal-38	Top	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Middle	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Bottom	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
Cal-41	Top	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Middle	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Bottom	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	0.061
SBF-41	Top	<0.005	<0.0005	0.011	<0.005	<0.005	<0.0001	0.008	<0.005	0.084
	Middle	<0.005	<0.0005	0.012	<0.005	<0.005	<0.0001	0.009	<0.005	0.036
	Bottom	<0.005	<0.0005	0.012	<0.005	<0.005	<0.0001	0.006	<0.005	0.063
SBF-42	Top	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	0.006	<0.005	0.045
	Middle	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	0.006	<0.005	0.106
	Bottom	<0.005	<0.0005	0.013	<0.005	<0.005	<0.0001	0.006	<0.005	0.117
SBF-43	Top	0.170	<0.0005	0.009	<0.005	<0.005	<0.0001	0.012	<0.005	0.104
	Middle	0.177	<0.0005	0.009	<0.005	<0.005	<0.0001	0.011	<0.005	0.029
	Bottom	0.180	0.0008	0.012	<0.005	<0.005	<0.0001	0.015	0.005	<0.025
SBF-44	Top	0.177	<0.0005	0.011	<0.005	<0.005	<0.0001	0.012	<0.005	0.041
	Middle	0.170	<0.0005	0.012	<0.005	<0.005	<0.0001	0.011	<0.005	0.032
	Bottom	0.178	<0.0005	0.013	<0.005	<0.005	<0.0001	0.011	<0.005	0.069
Slope-16	Top	<0.010	<0.0010	0.011	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Middle	<0.010	<0.0010	0.011	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Bottom	<0.010	<0.0010	0.012	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
Slope-22	Top	<0.010	<0.0010	0.011	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Middle	<0.010	<0.0010	0.011	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Bottom	<0.010	<0.0010	0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
Slope-24	Top	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Middle	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Bottom	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	0.072
Tor-44	Top	0.189	<0.0005	0.011	<0.005	<0.005	<0.0001	0.007	<0.005	0.257
	Middle	0.190	<0.0005	0.012	<0.005	<0.005	<0.0001	0.008	<0.005	0.083
	Bottom	0.190	<0.0005	0.012	<0.005	<0.005	<0.0001	0.007	<0.005	0.062
Tor-57	Top	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Middle	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Bottom	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
Tor-58	Top	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Middle	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
	Bottom	<0.010	<0.0010	<0.010	<0.010	<0.010	<0.0001	<0.010	<0.010	<0.050
Minimum		**<0.001**	**<0.0001**	**0.004**	**<0.001**	**<0.001**	**<0.0001**	**<0.001**	**<0.001**	**0.007**
Maximum		**0.194**	**0.0010**	**0.088**	**NC**	**NC**	**NC**	**0.015**	**0.010**	**0.257**
Mean		**0.184**	**0.0008**	**0.014**	**NC**	**NC**	**NC**	**0.009**	**0.006**	**0.063**
±SD		**0.006**	**0.0002**	**0.009**	**NC**	**NC**	**NC**	**0.002**	**0.002**	**0.035**
Trigger values		**ID**	**0.0055**	**0.0013**	**0.0274**	**0.001**	**ID**	**0.07**	**0.0044**	**0.015**

Values above the LoR highlighted in red

ANZECC trigger values are highlighted in blue; these values apply to a 95% species protection level. Table adapted from ANZECC, 2000; Table 3.4.1.

NC Not Calculated

ID Insufficient data

3.8 Water Profiling Characteristics

Temperature, salinity, DO and pH were analysed using the FSI CTD water profiler. Data was checked against ANZECC trigger values for DO and pH, presented in Table 3.13, and Ocean View data.

Table 3.13 ANZECC Default Trigger Values for Physico-chemical parameters in Offshore Marine Areas

Parameter	Trigger Values			
DO (% saturation)[1]	Lower Limit	90	Upper Limit	No data
pH	Lower Limit	8.2	Upper Limit	8.2

Table adapted from ANZECC, 2000, Table 3.3.4.

1 Dissolved oxygen concentrations were derived from daytime measurements, and may vary diurnally and with depth.

3.8.1 Temperature

Surface temperatures ranged from 26ºC to 28ºC. There was some variation at the surface, with Export Route stations recording temperatures of between 26ºC and 28ºC and between 27ºC and 28ºC for the Calliance and Torosa Field, SBF and Slope stations.

There was an apparent thermocline, presented in Figure 3.6, beginning at approximately 50 metres for the deeper Export Route stations, with temperatures dropping at least 1 to 2ºC within 30m. This thermocline is visible in Figure 3.7 between 50 and 80 metres for the Calliance and Torosa Field stations, with temperatures falling to approximately 10ºC at 350m depth, with the Calliance stations in deeper waters falling to approximately 7 to 8ºC at 600m. The same thermocline was responsible for a 1 to 4ºC drop in temperature between 50 and 100m for the SBF and Slope stations, presented in Figure 3.8. Temperatures continued to fall at Stations Slope-16, 22 and 24, situated in areas of deeper water. Slope-24 recorded temperature of approximately 10ºC at a depth of 340m. There was also a minor thermocline evident for Station Export-76, with temperatures falling from 26.5 to 25.8 between 7m and 30m.

Such thermal stratification is to be expected in such deep waters, where there is limited vertical mixing so that temperatures are not distributed evenly. The coolest temperatures recorded during the survey corresponded with the stations sampled in the deepest waters.

3.8.2 Salinity

Salinity ranged from 34.38PSU to 34.98PSU at the surface, generally with minor fluctuations in the first 30m. The salinity of seawater is normally around 35PSU, which correlates well with the data acquired in this survey.

Salinity was generally higher at the surface for the Export Route stations, specifically those in shallower water, Stations Export-36, 52, 56 and 76. A slight halocline was apparent for some of the samples at the Export Route stations in deeper water, but with increases of no more than 0.1PSU; plotted in Figure 3.9. This is to be expected for these stations considering their locations in the shallower waters to the south of the survey area. A halocline is also evident between 50 and 75m depth in the plot of the Calliance and Torosa Field stations (Figure 3.10). Salinity increased by between 0.1 and 0.5PSU for these

stations, until about 200 to 250m where it settled at approximately 34.65PSU. A similar halocline was apparent for the SBF and Slope stations (Figure 3.11), although not until approximately 90m and continuing to 140m, where salinity settled at 34.65 to 34.70PSU.

3.8.3 Dissolved Oxygen

Due to a problem with the DO sensor, data could only be analysed for eight of the Export Route stations; Export-23, 36, 39, 49, 52, 56, 70 and 76, which are plotted in Figure 3.12. Surface DO concentrations ranged from 5.16mg L^{-1} to 6.10mg L^{-1}. There was minor variation in DO for all stations, with the exception of Stations Export-23 and 49, which both showed a slight increase of 0.25 to 0.5mg L-1, before decreasing slightly. The DO for Station Export-23 continued decreasing to 55m depth before settling at 5.21 to 5.27mg L^{-1}.

3.8.4 pH

Anomalous data was recorded for the first 30m for Stations Export-4 and 64, Cal-28, 31 and 33, SBF-42, 43 and 44, Slope-16 and 22, Tor-57 and 58; these data have not been plotted.

Surface pH ranged from 6.8 to 8.4, with higher pH generally recorded in the shallower waters of the Export Route and SBF stations. There was very little variation in pH for the Export Route stations, with a change of no more than 0.2 at any station. Although much of the data for the Calliance and Torosa Field stations suggests a pH at the surface of between 7.2 and 7.8, values for all but two stations appeared to fall under 100m to below pH 7, which is highly unlikely for seawater and suggests anomalous data. Stations Slope-16 and Slope-22 recorded surface pHs of between 7.5 and 8, declining slightly to approximately 7.4. However, Station Slope-24 also appeared to record anomalous data, with a surface pH of 6.6, falling at 100m dow to a low pH of 5.2.

pH for this survey generally appeared a little lower than expected for seawater. Typically surface seawater tends to have a pH in the range of 8.0 to 8.4, and can decrease to 7.5 at depth. The only ANZECC trigger value available was 8.2, suggesting an optimal pH, while pH values between 5.2 and 6.8 suggest acidification and are highly unlikely within this survey area.

Figure 3.6 **Temperature Profile for Export Route Stations**

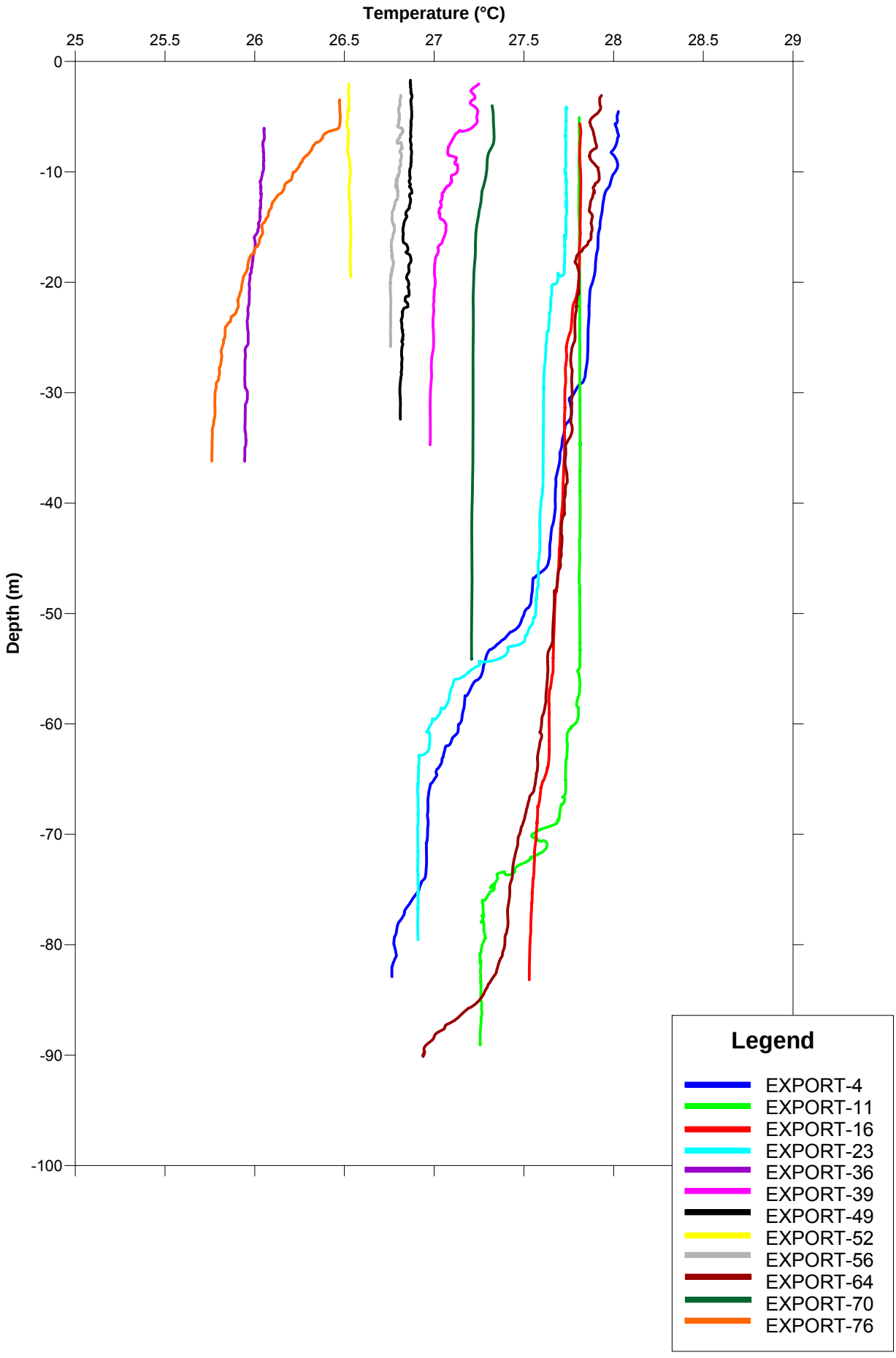


Figure 3.7 **Temperature Profile for Calliance and Torosa Field Stations**

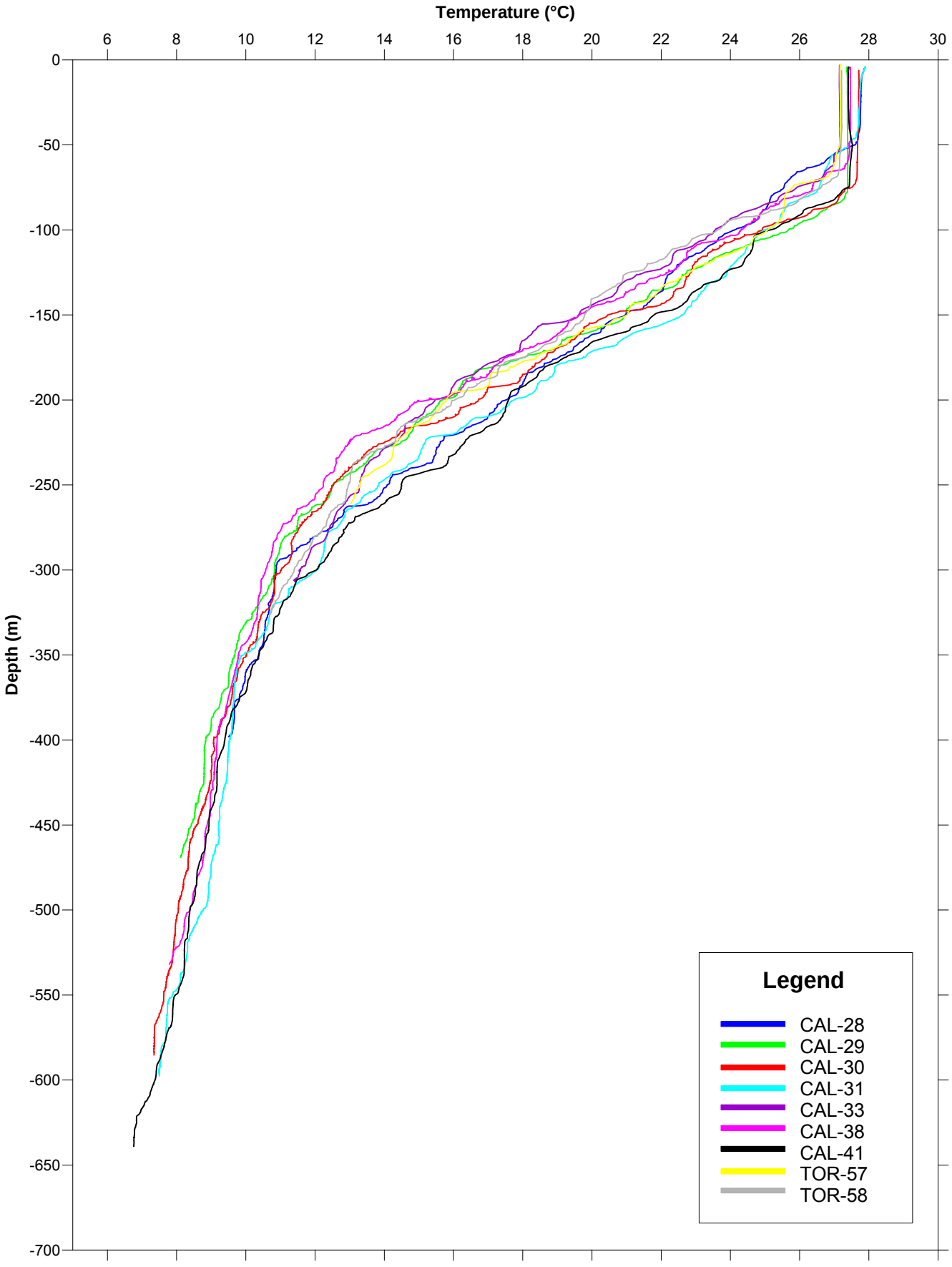


Figure 3.8 Temperature Profile for SBF and Slope Stations

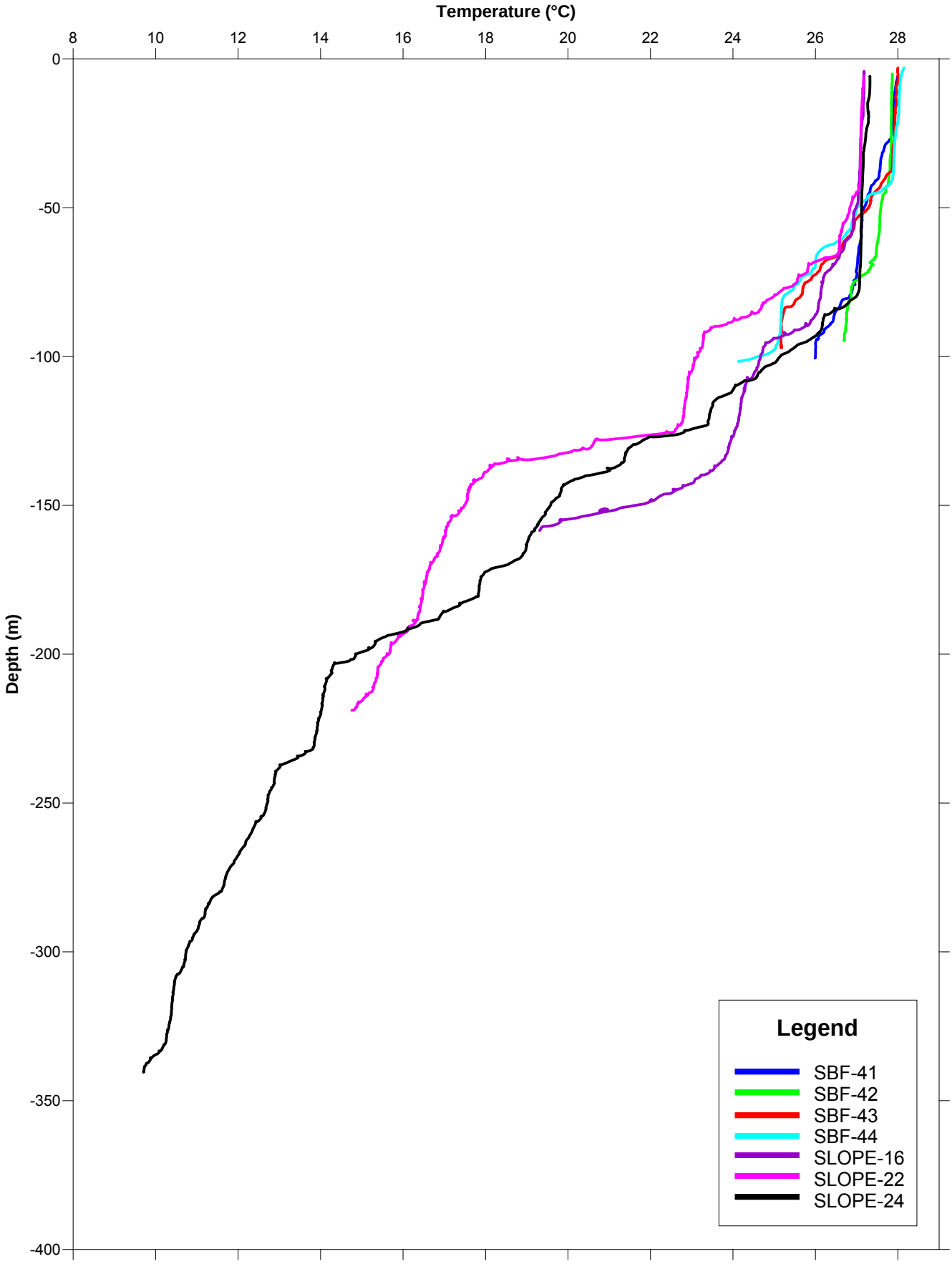


Figure 3.9 **Salinity Profile for Export Route Stations**

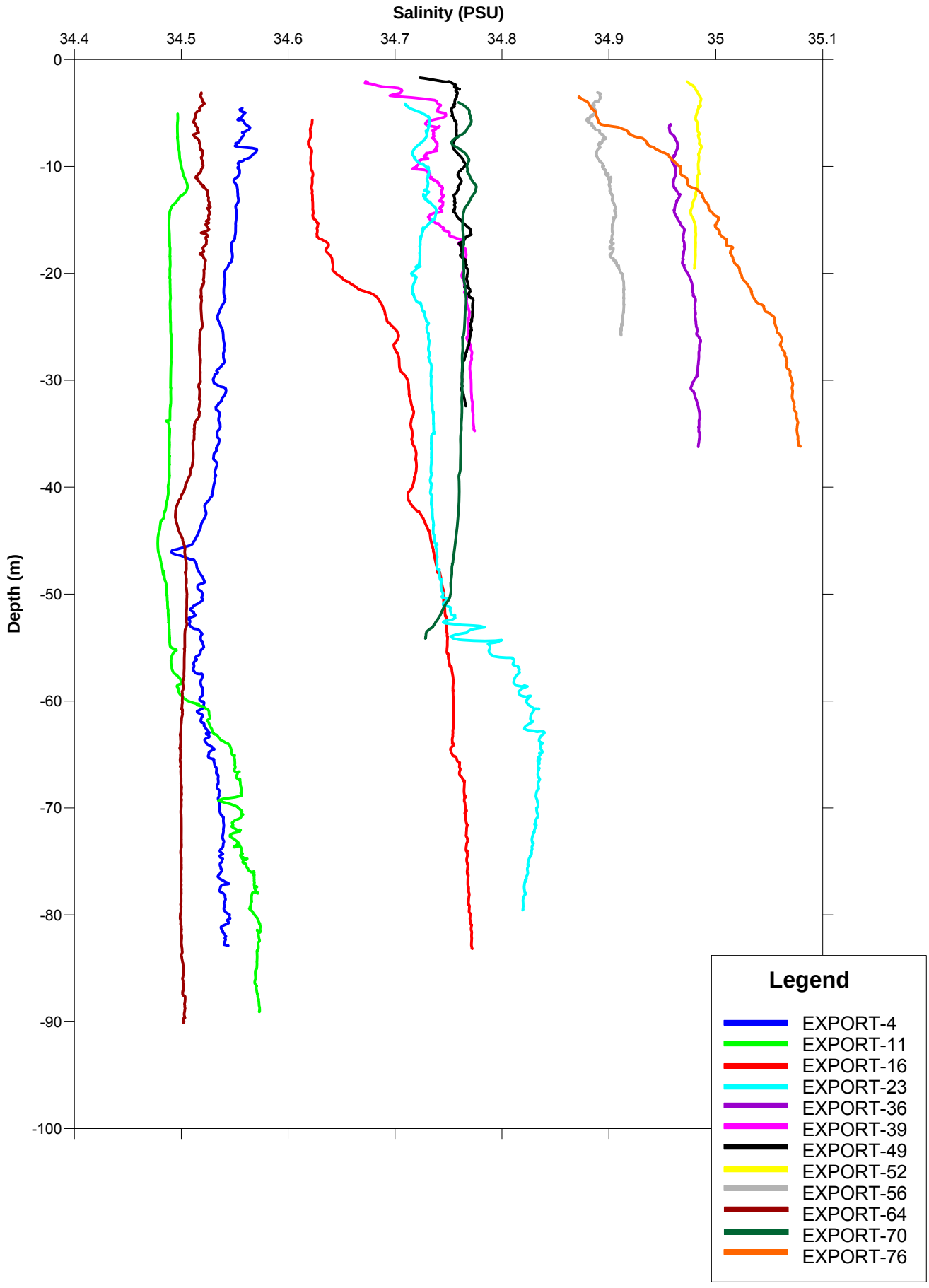


Figure 3.10 **Salinity Profile for Calliance and Torosa Field Stations**

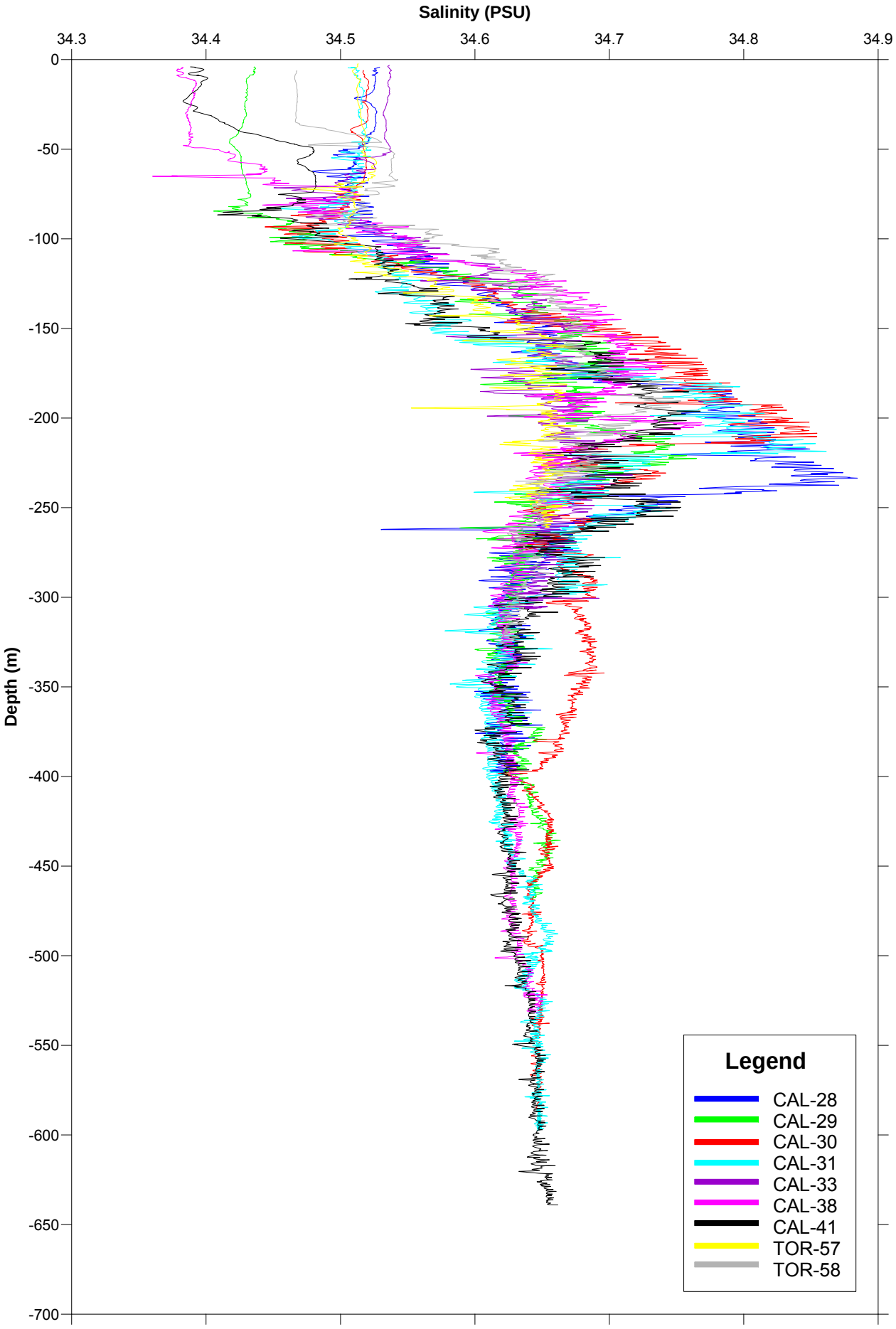


Figure 3.11 **Salinity Profile for SBF and Slope Stations**

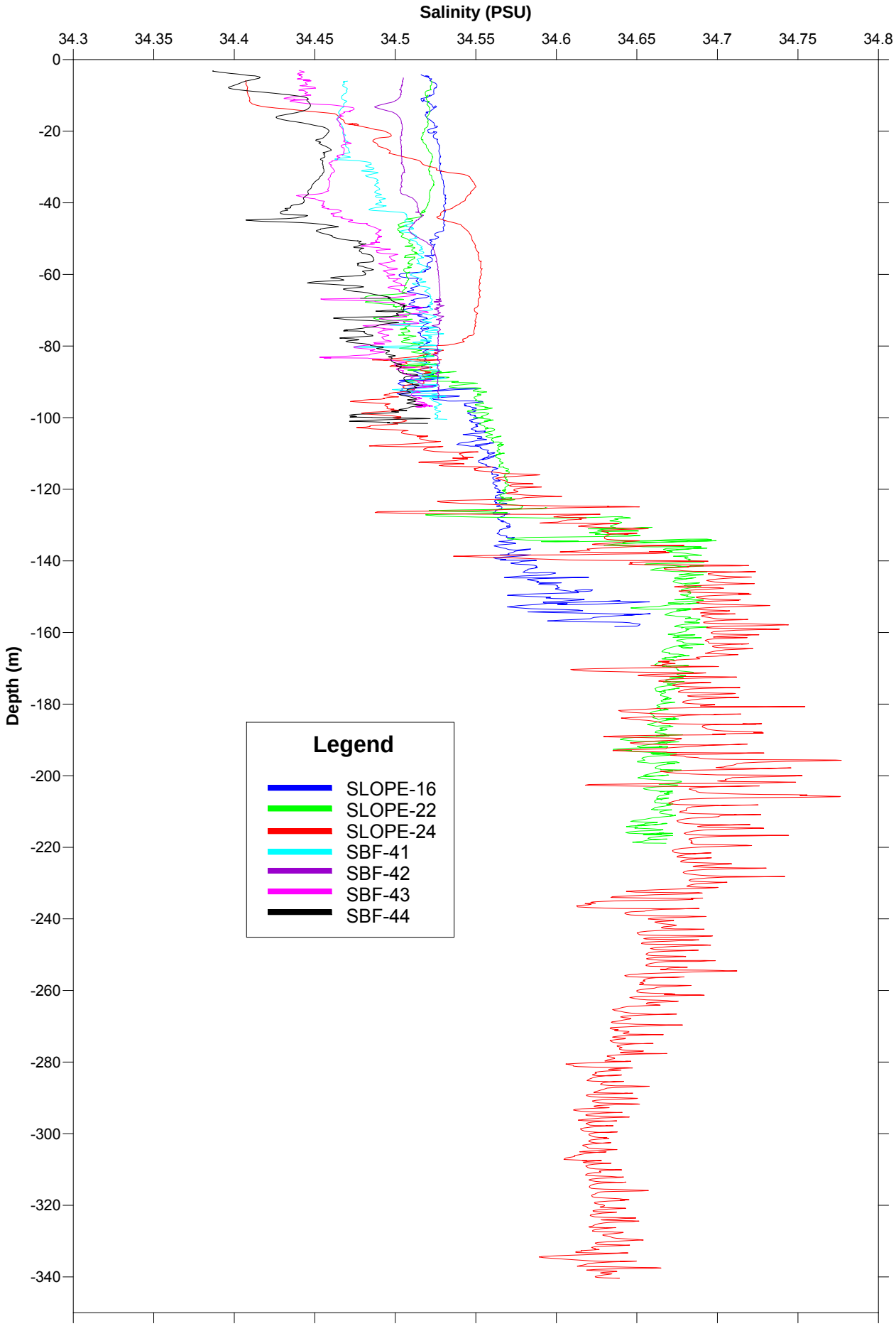


Figure 3.12 **Dissolved Oxygen Profile for Export Route Stations**

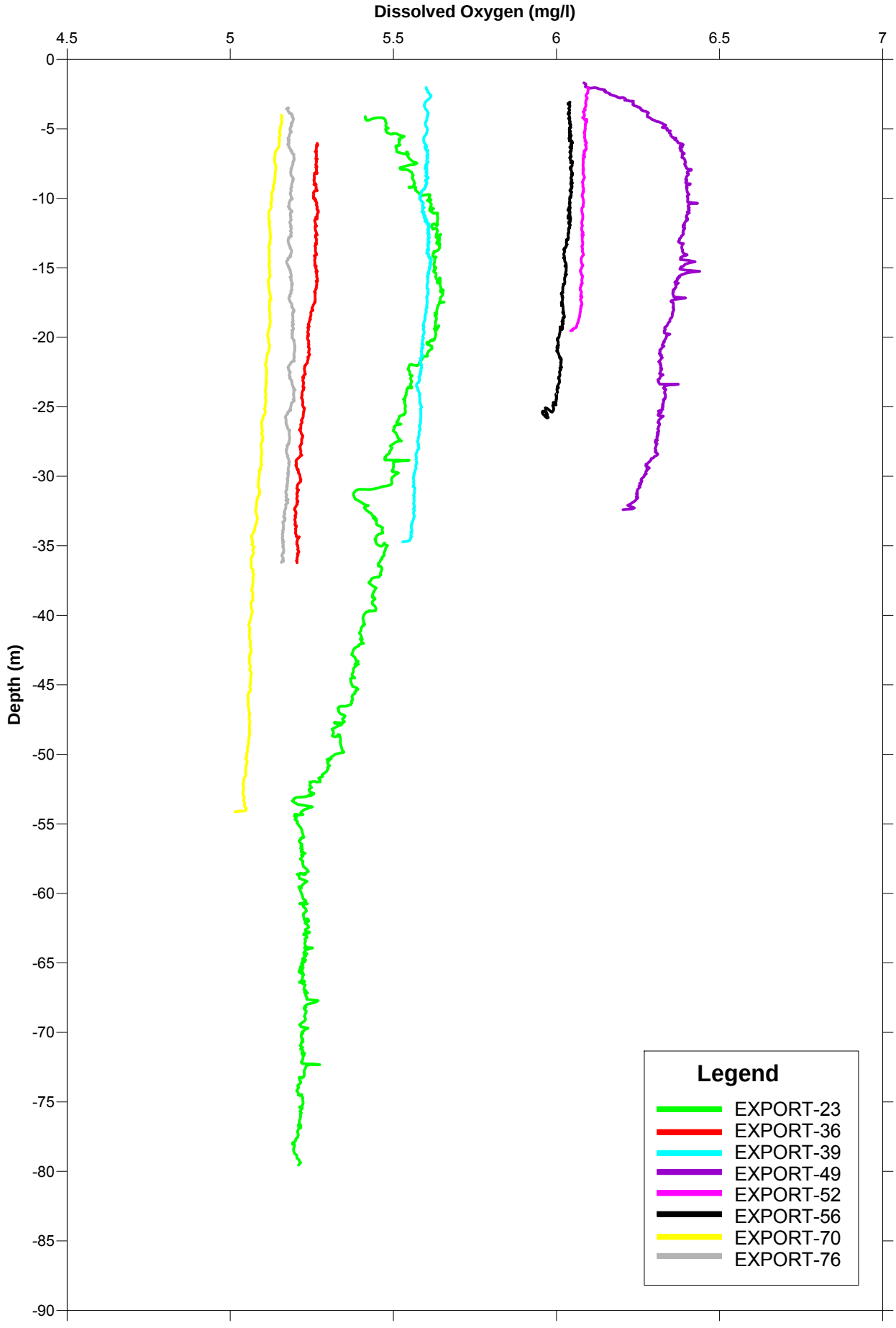


Figure 3.13 pH Profile for Export Route Stations

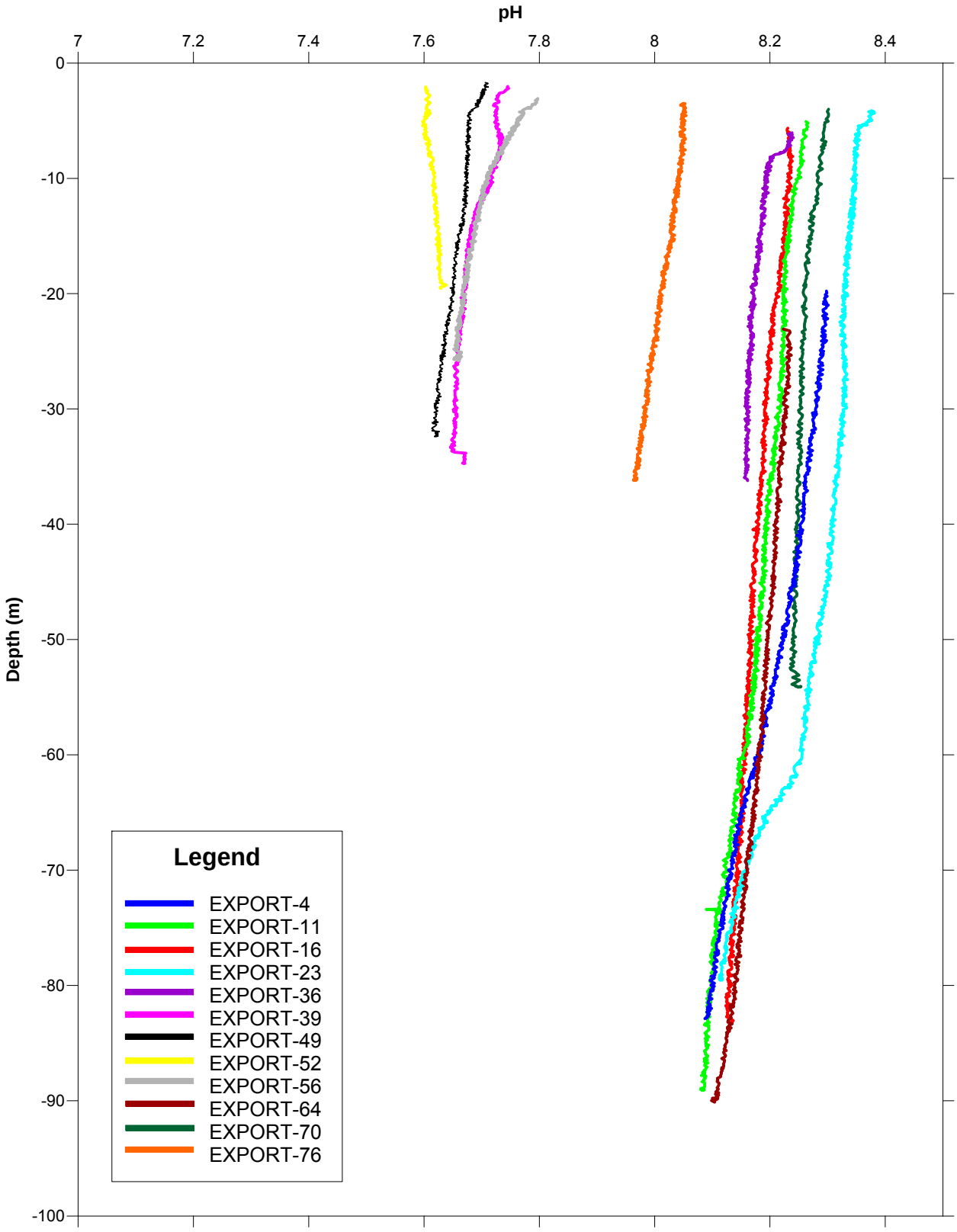


Figure 3.14 pH Profile for Calliance and Torosa Field Stations

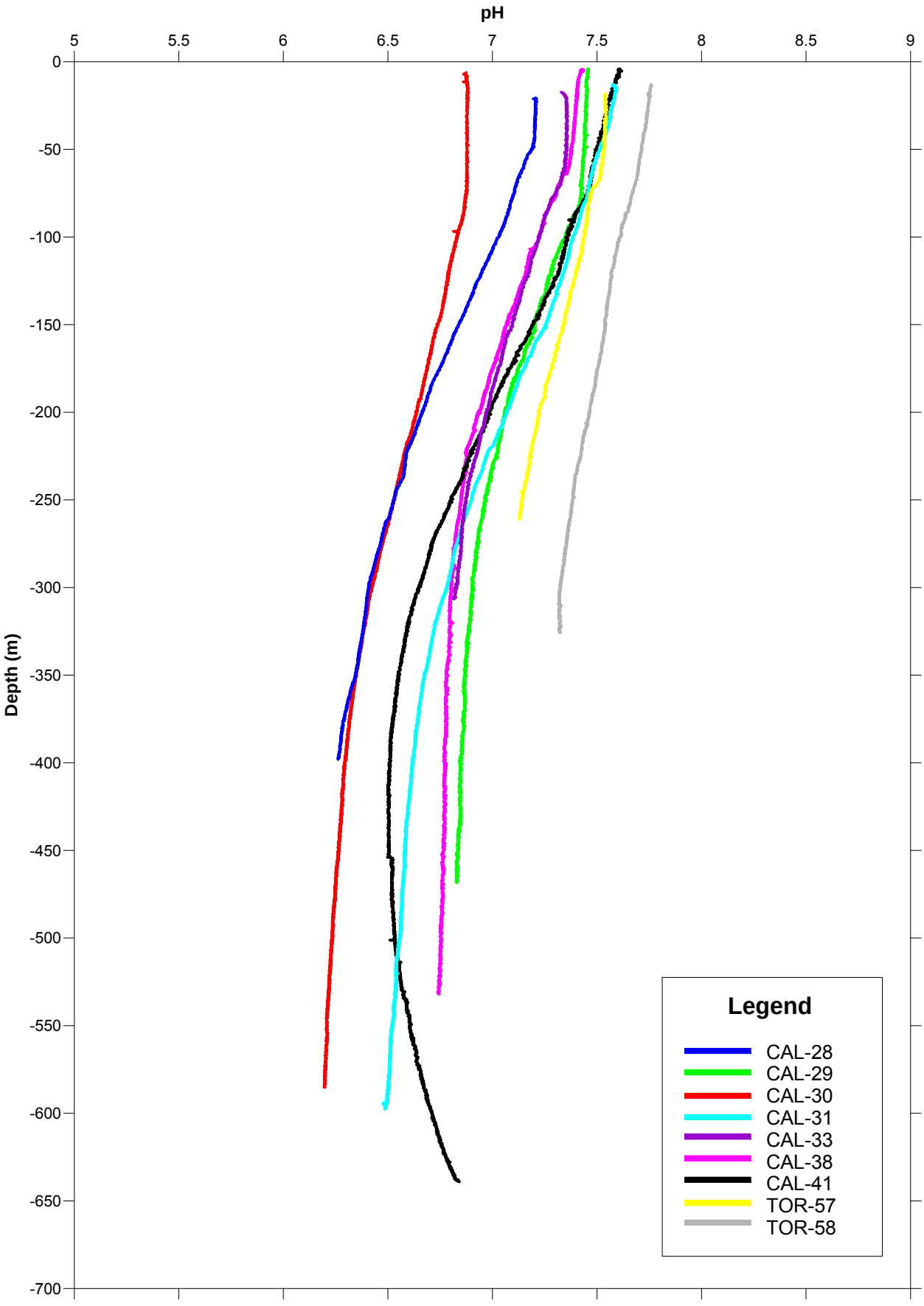
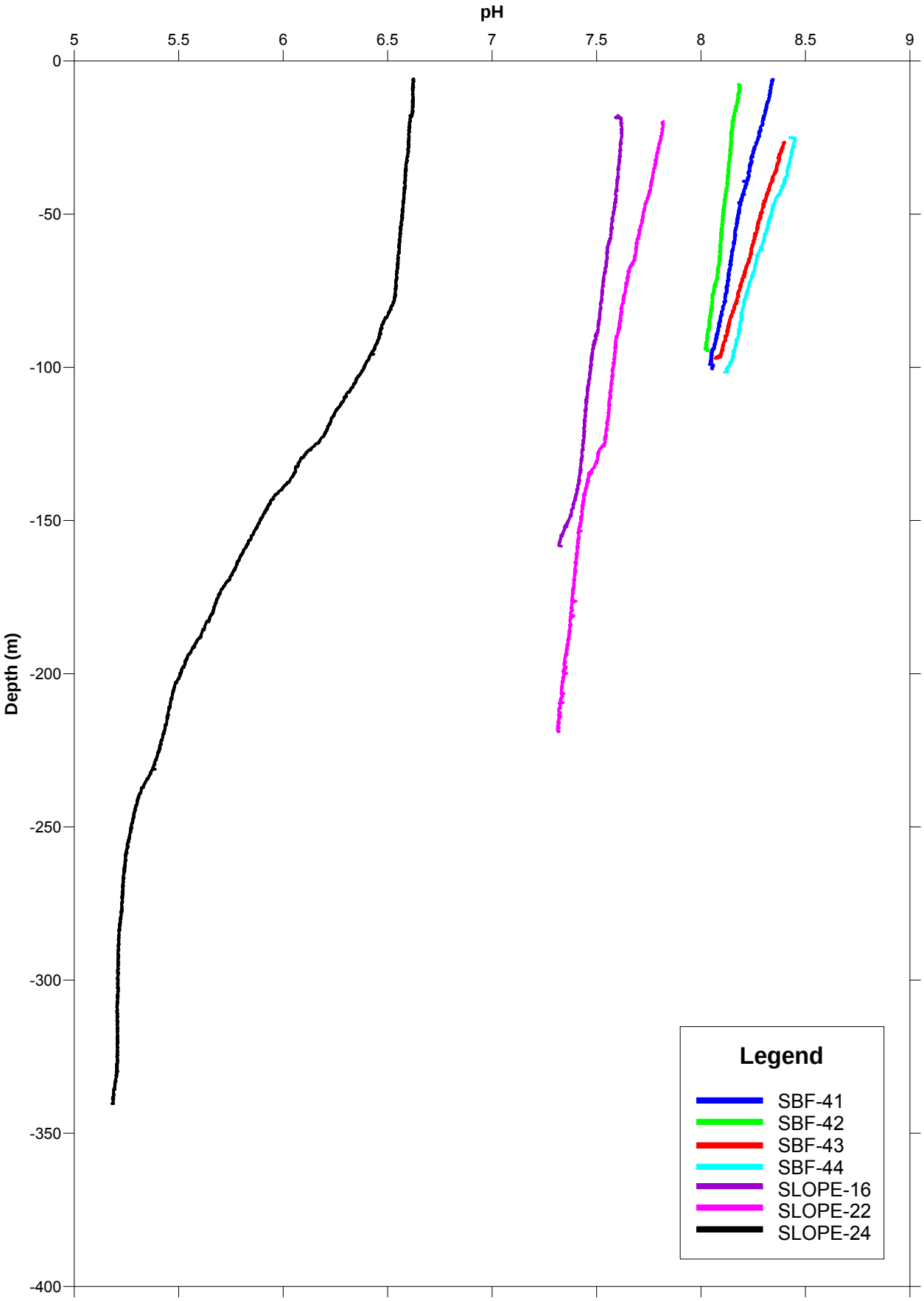


Figure 3.15 pH Profile for SBF and Slope Stations



3.9 Macrofaunal Interpretation

3.9.1 Overview

Three 0.1m^2 faunal samples (A, B and C) were collected from each station, two of which (usually the A and B samples) were worked up and the third retained and appropriately stored as a spare. All faunal samples were screened through a 0.5mm sieve. Before analysing the data set provided by the laboratory, several taxa were removed as per our stated methods; however all records, regardless of whether they were included in statistical analyses, are listed in Appendix G.

3.9.2 Summary and Univariate Statistics

A total of 2258 individuals were recorded from 133 different faunal taxa. There were no juveniles identified in any sample, thus further analyses were conducted on the full rationalised data set. The faunal community appeared sparse with all taxa in low abundance. Only one taxa could be identified to species-level due to the paucity of data on fauna from this region; taxa have been identified to family where possible and assigned unique codes to assist statistical analysis.

The initial stage of analysis was the division of the data set into five gross taxonomic groups; polychaetes, crustaceans, molluscs, echinoderms and other taxa. The proportional contributions of these five taxonomic groups to the abundances of individuals and taxa at each station are displayed in Figure 3.16a and b.

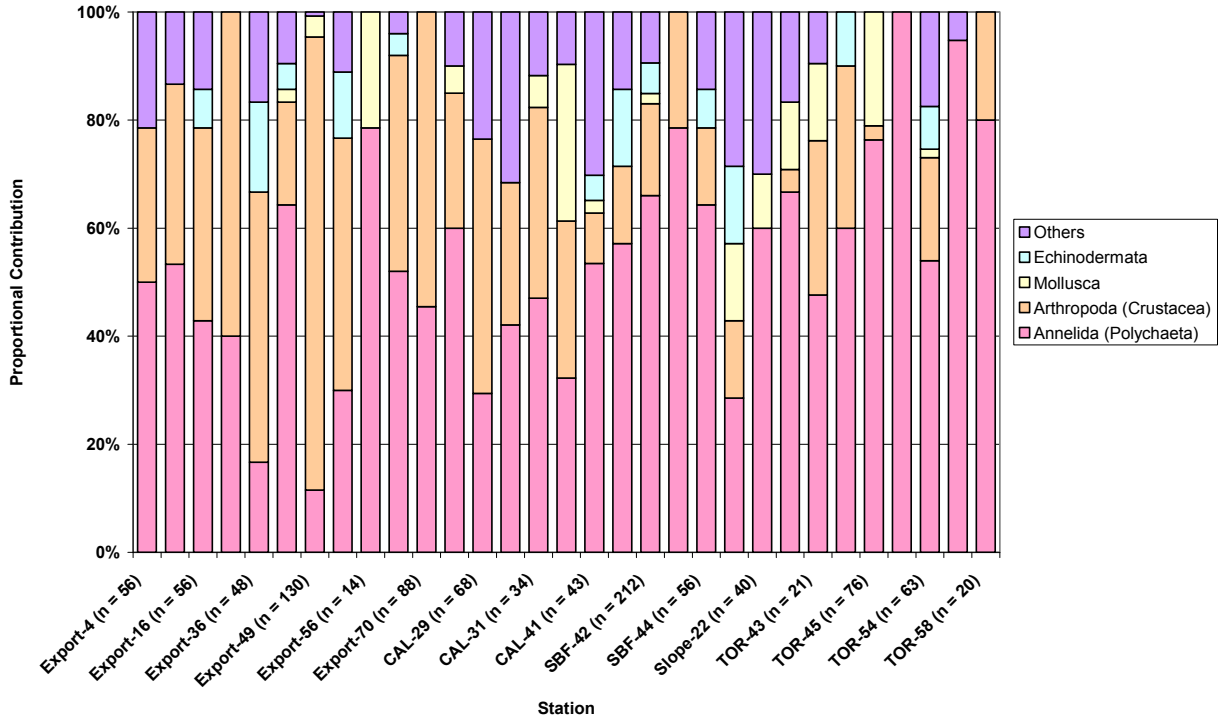
The proportional contributions of each taxonomic group were highly variable between stations, though clearly dominated by polychaete annelids, contributing up to 100% of individuals and taxa recorded at one Station (Tor-53). Arthropods also contributed a great deal, between 0% and 84% of individuals and between 0% and 60% of taxa recorded. There were very few molluscs and echinoderms, contributing respectively 4% and 5% of individuals and 9% and 4% of taxa. Other taxa were also in low abundance, contributing 11% of individuals and 9% of taxa. These other taxa consisted of Nemertea, Platyhelminthes, three Sipuncula taxa, one cnidarian, and one ascidiacean chordate; although five unknown taxa were also recorded and included in this group.

There was a small degree of variability between stations, with Station Tor-53 recording the lowest number of individuals and taxa (n=8 and 2), Station Export-53 recording the highest number of individuals (n=360) and the highest number of taxa at Station Tor-54 (n=30). This suggests a lack of species dominance, further supported by the lack of any particular taxa recorded at every station. In fact, 51 taxa were found at only one station, with 50 recorded in only one sample and 11% of taxa represented by a single individual (n=14). The variation in the number of taxa was minor in comparison to the number of individuals, indicates a degree of uniformity across the survey area.

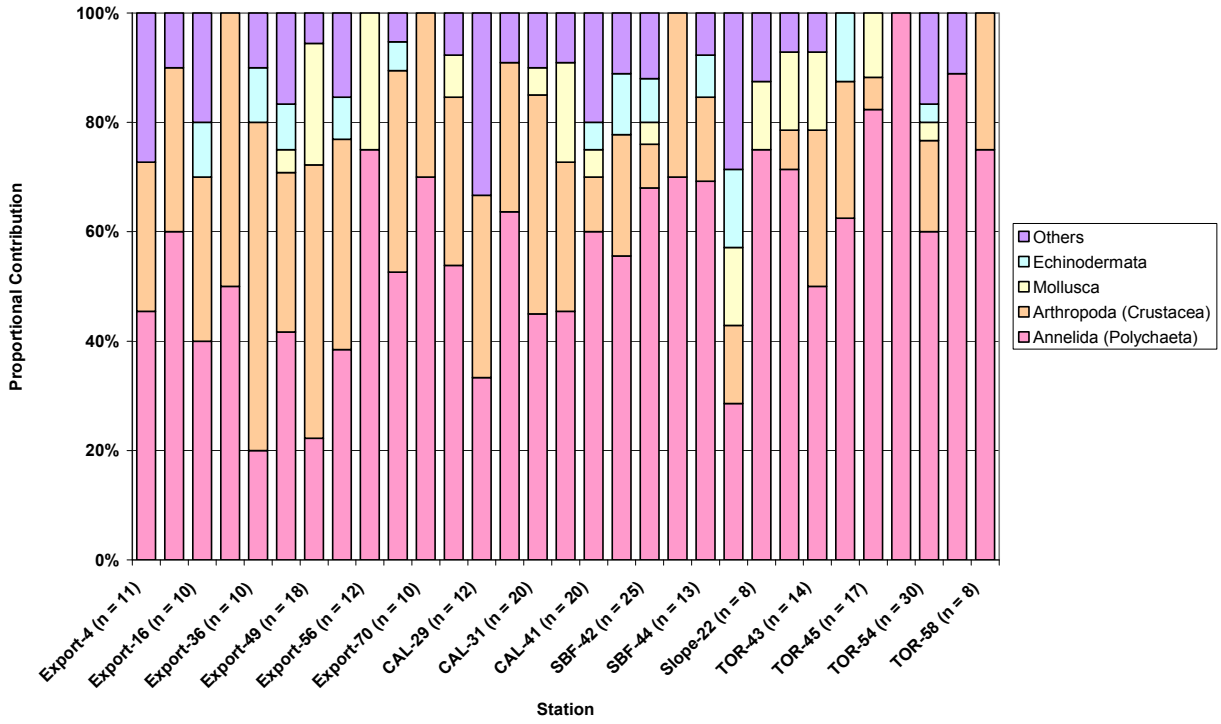
There was minor intra-station variation, with little of significance due to the low overall abundances.

Figure 3.16 Multivariate Analyses of Faunal Sample Data

a) Individuals



b) Taxa



The most abundant taxa overall was a polychaete annelid (n=122), followed by an amphipod (n=120) and isopod arthropod (n=118). The highest number of individuals at one station was of a polychaete annelid (n=64) at Export-39, and the highest number in any one sample was a polychaete annelid in Export-39MFC and an isopod in Export-53MFC (both n=40).

Univariate faunal statistics for the 31 stations are presented in Table 3.14. There was some minor variation in the number of taxa, with Station Tor-54 the most species-rich, and Station Export-23 the most species-poor. However, faunal diversity is on the whole quite species-poor considering the large number of stations, with a mean of only 13 (±5) taxa per station. There was no discernable pattern in the number of taxa, with considerable variability within each zone.

Table 3.14 Faunal Univariate Statistics

Station Designation	N Taxa	n Individuals			Margalef's Richness (*d*)	Simpson's Diversity (λ)	Pielou's Evenness (*J*)	Shannon Wiener Diversity (*H'*)
		A Samples	B Samples	Station				
Export-4	11	20	36	56	2.48	0.10	0.98	3.38
Export-11	10	44	16	60	2.20	0.11	0.98	3.24
Export-16	10	36	20	56	2.24	0.12	0.96	3.18
Export-23	4	4	16	20	1.00	0.28	0.96	1.92
Export-36	10	24	24	48	2.32	0.11	0.98	3.25
Export-39	24	100	68	168	4.49	0.16	0.81	3.73
Export-49	18	63	67	130	3.49	0.32	0.62	2.58
Export-53	26	148	212	360	4.25	0.07	0.90	4.24
Export-56	12	7	7	14	4.17	0.09	0.98	3.52
Export-64	19	56	44	100	3.91	0.07	0.97	4.10
Export-70	10	28	60	88	2.01	0.21	0.83	2.76
Cal-28	13	36	44	80	2.74	0.10	0.96	3.55
Cal-29	12	24	44	68	2.61	0.11	0.94	3.38
Cal-30	11	19	NS	19	3.40	0.16	0.89	3.08
Cal-31	20	18	16	34	5.39	0.07	0.95	4.09
Cal-38	11	40	84	124	2.07	0.17	0.84	2.89
Cal-41	20	26	17	43	5.05	0.07	0.95	4.10
SBF-41	9	24	32	56	1.99	0.15	0.93	2.95
SBF-42	25	100	112	212	4.48	0.07	0.92	4.27
SBF-43	10	36	20	56	2.24	0.14	0.93	3.09
SBF-44	13	40	16	56	2.98	0.08	0.99	3.66
Slope-16	7	4	24	28	1.80	0.14	1.00	2.81
Slope-22	8	24	16	40	1.90	0.16	0.95	2.85
Slope-24	14	28	68	96	2.85	0.10	0.93	3.55
Tor-43	14	8	13	21	4.27	0.08	0.97	3.69
Tor-44	8	6	14	20	2.34	0.14	0.97	2.92
Tor-45	17	12	64	76	3.69	0.08	0.95	3.90
Tor-53	2	4	4	8	0.48	0.50	1.00	1.00
Tor-54	30	41	42	63	7.00	0.05	0.93	4.59
Tor-55	9	18	20	38	2.20	0.14	0.94	2.97
Tor-58	8	14	6	20	2.34	0.16	0.95	2.85
Minimum	**2**	**4**	**4**	**8**	**0.48**	**0.05**	**0.62**	**1.00**
Maximum	**30**	**148**	**212**	**360**	**7.00**	**0.50**	**1.00**	**4.59**
Mean	**13**	**34**	**41**	**73**	**3.04**	**0.14**	**0.93**	**3.29**
SD	**7**	**32**	**42**	**70**	**1.37**	**0.09**	**0.07**	**0.72**

High Pielou's evenness values reveal a highly uniform community, with evenness values of ≥0.81 for every station, with the exception of Export-49 suggesting a slightly more patchy distribution. The Simpson's index values indicate varying diversity in the community across the site, with the most diverse communities with an absence of any strong

dominance structure recorded at Stations Export-53, Export-64, Cal-31, SBF-42 and Tor-54. A notably low diversity was recorded at several stations, including Station Export-23, Export-49 and Tor-53, though this is likely due in part to the exceptionally low abundances of individuals and taxa at many stations. There was some inter-station variability in Shannon-Wiener diversity, from 1.00 to 4.59 reflecting the higher number of taxa in relation to the number of individuals observed at many stations. Highly variable Margalef's Richness values across the site highlight the varying abundances of individuals and taxa, with a mean of 3.04 (±1.37) confirms the interpretation of a moderately species-poor community.

Overall, the univariate statistics suggests a highly uniform community that was generally taxonomically poor with low abundances of individuals recorded for most taxa.

3.9.3 Multivariate analyses

The data were initially subjected to a square root transformation, followed by CLUSTER, SIMPROF and MDS analyses. The Bray-Curtis similarity dendrogram for the station fauna data set is presented in Figure 3.17a, with stations showing a low overall similarity of <10%. Four statistically distinct clusters were identified by SIMPROF, though they did not conform to any pattern regarding zone or sediment type. Those stations that were statistically indistinguishable were joined by red lines. Such low similarity and the presence of several clusters suggest some inconsistency of the taxa at each station; however one cluster includes 20 statistically indistinct stations, indicating a degree of uniformity across the site as a whole.

The MDS ordination in Figure 3.17b has a stress value of 0.22 indicating that it is of some use in interpreting the dis/ similarities across the site. Notably the clusters identified by the SIMPROF routine are not immediately obvious in the MDS ordination, which shows a general cloud pattern, and thus is perhaps not a reasonable representation of the rank similarities. This suggests a level of overall uniformity, with a handful of marginalised stations that possess slightly lower similarity.

The Bray-Curtis dendrogram shows a low overall similarity of <5% between samples. Four main clusters were identified by SIMPROF and analyses indicate that differences between stations are generally consistent between replicate samples, with the exception of Sample Export-23MFA which was considered statistically distinct. This was likely due to the low abundance in that sample, which has thus been excluded from the CLUSTER dendrogram and MDS ordinations presented in Figure 3.18a and b. This highlights the presence of a degree of variation between some stations as identified in Figure 3.17. The stress value of this MDS plot is reasonable at 0.2, indicating a useful representation of the data; however the overlap of clusters in the ordination demonstrates that using a 2-dimensional representation of the rank dissimilarities can sometimes be unreliable.

3.9.4 Comparison of Faunal and Physiochemical Data Sets

Examination of the raw data showed no pattern linking the faunal variation to the environmental variables. A BEST analysis identified three environmental variables as contributing most to the faunal variation; TP, As and d(0.5) particle diameter. However, these variables described <35% of the observed multivariate pattern in the faunal data, thus no conclusions can be drawn between the two datasets. No further attempts were

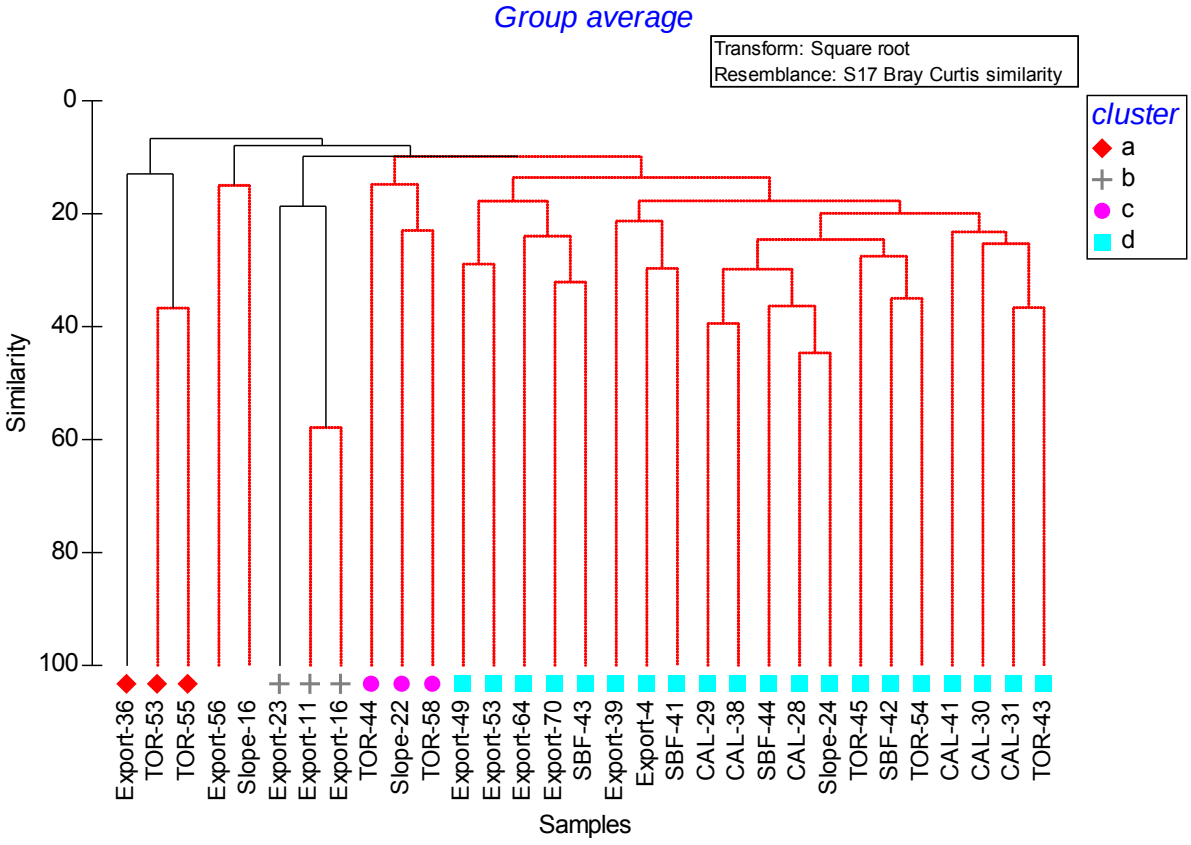
made to statistically relate the environmental data set to the faunal data, because of the relatively high levels of uniformity evident in both.

3.10 Summary of Results

Overall, the data suggests a uniform community that was generally taxonomically poor with low abundances of individuals recorded for most taxa. The physico-chemical attributes appeared to only subtly influence the community. The faunal data showed no pattern in terms of zones, nor was it obviously influenced by sediment type. No conclusions can be drawn about the species present, as most could only be identified at higher taxonomic levels such as Order and Family. Community variation appears to be natural, with no obvious causal factors.

Figure 3.17 Multivariate Analyses of Faunal Station Data

a) Bray-Curtis Similarity Dendrogram



b) MDS Ordination

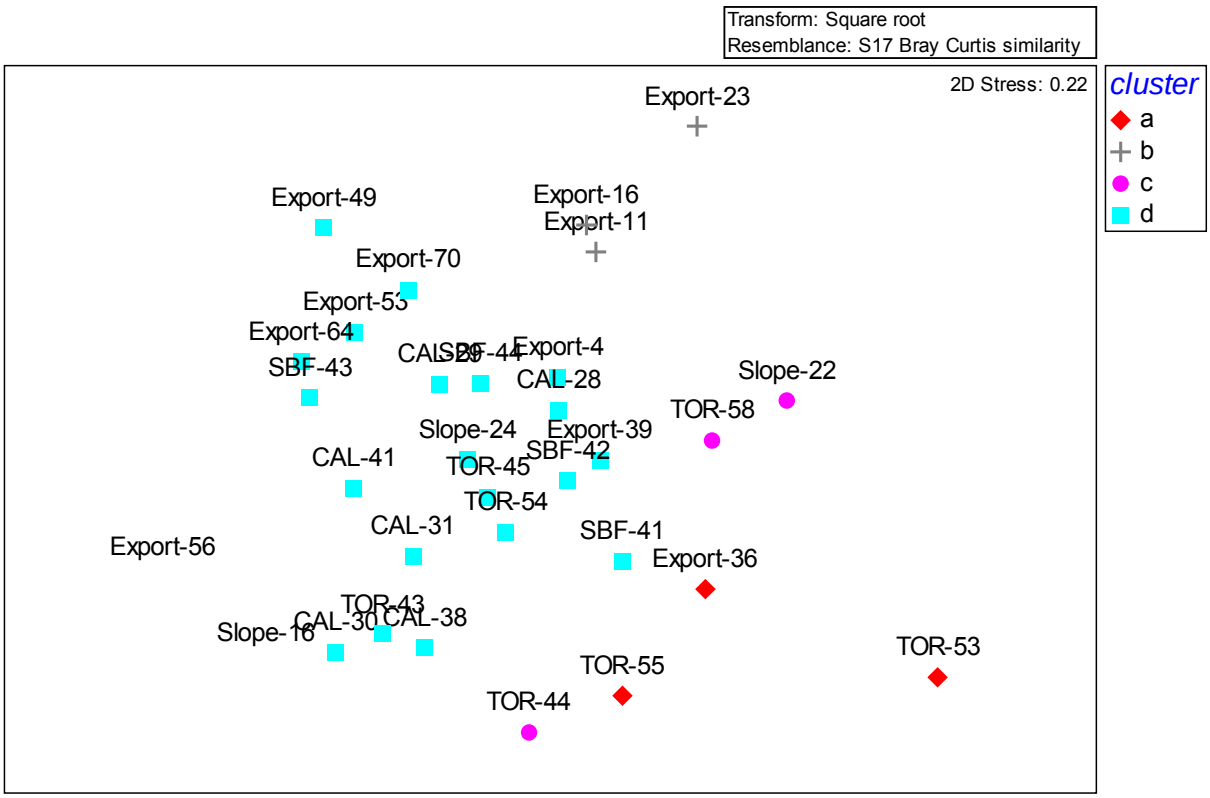
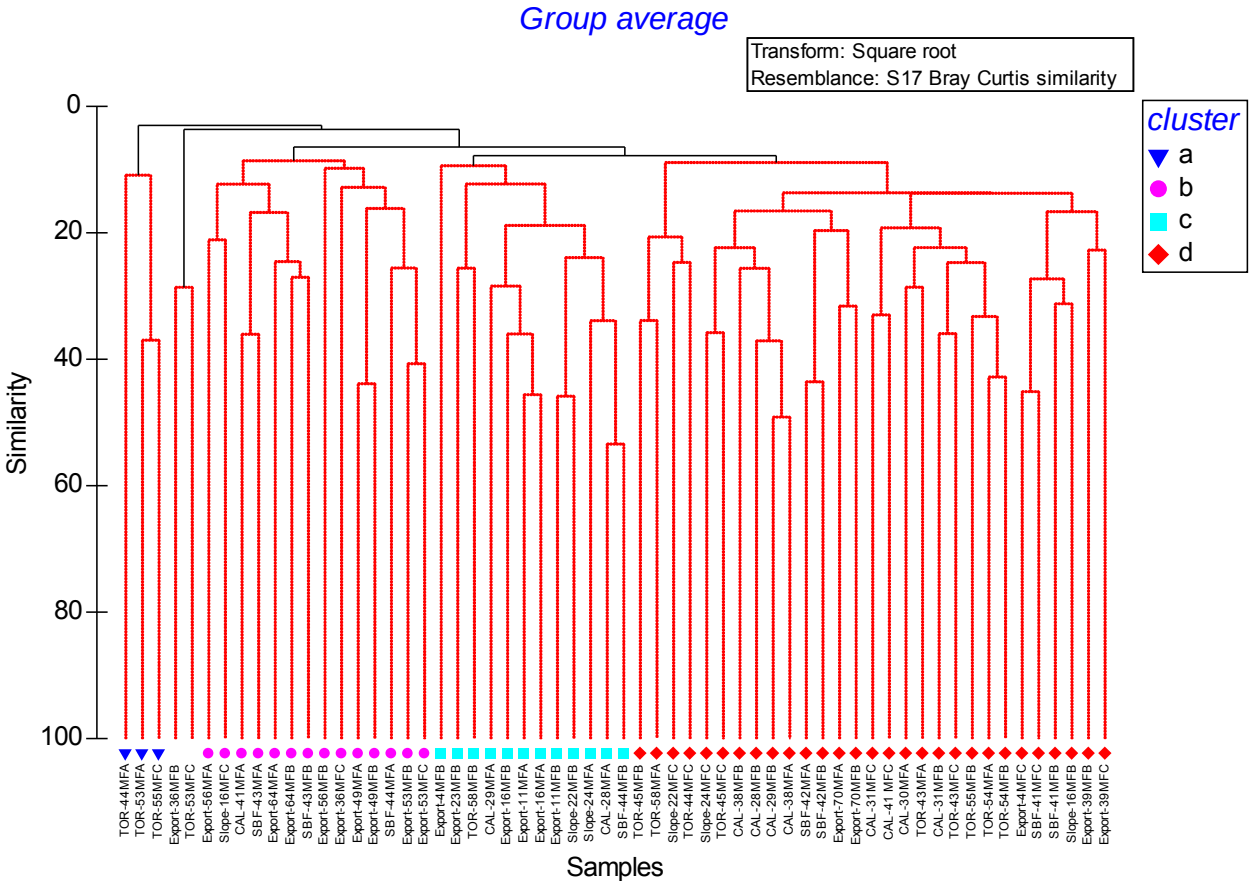
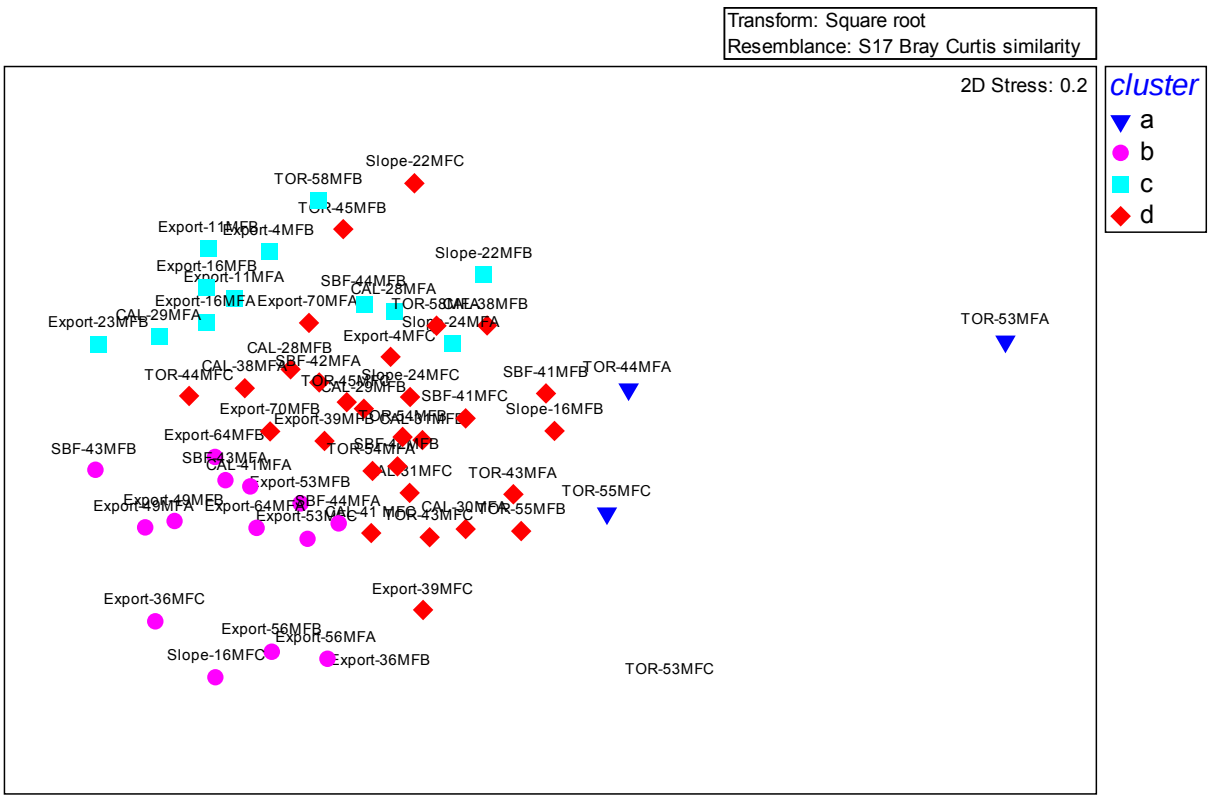


Figure 3.18 Multivariate Analyses of Faunal Sample Data

a) Bray-Curtis Similarity Dendrogram (with Export-23MFA removed)



b) MDS Ordination (with Export-23MFA removed)



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APPENDIX A – FIELD SAMPLING LOG SHEETS

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

Environmentalist's Seabed Imagery Logsheet

SEABED IMAGERY LOG SHEET (Deck)									QPRO-0753
Job No: 7905		**Area:**		**Vessel:** Ocean Endeavour			**Operator:** PN/ CP/ KS/ DC		
Date: from: 05-Jun-09 to: 25-Jul-09		**Page:**		**Client:** Woodside Energy Ltd					
Project: Browse Pipeline Route Environmental Survey									
Sample Number	**Station Number**	**Time on overlay**	**DVD/ Video No**	**DVD Chapter**	**Counter (start & end)**	**Sediment Description**	**Comments**	**TOT FIXES**	**FIXES Nos**
05-Jun-09									
1	Export-53-E-Cam	16:47	1	1	00:00:00	Sandy with shell fragments. Flat, medium sized boulder, bed of stones or possible anemones, suspended fines, lots of fish, starfish, few burrows, areas of bioturbation.	Labelled as Env-45 on overlay	15	3 to 40
		16:55	1		00:12:12				
2	Export-52-E-Cam	17:39	1	2	00:00:00	soft fans, large corals/seafans, sponges, rocky sandy bottom inbetween corals, Red snake/seawhip, Ray, tubes, Lots of fauna, hard ground, some sandy suspension, seaweeds?	Labelled as Env-44 on overlay; lots of fauna	31	52 to 108
		17:56	1		00:19:44				
06-Jun-09									
3	Export-56-E-Cam	08:43	1	3	00:00:00	Sandy seabed with ripples, some bioturbation, some silt, sparse epifauna with the occasional anemone.	Labelled as Env-43 on overlay	31	124 to 142
		09:15	1		00:10:24				
09-Jun-09									
4	Export-49-E-Cam	14:29	2	1	00:00:00	Slightly rippled sandy seabed. Urchin, fish, shrimp, crustacean, burrows, shell fragments in troughs. Very sparse fauna, probably all infaunal.	Labelled as Env-42 on overlay. Very sparse mostly infaunal.	9	152 to 163
		14:37	1		00:08:13				
10-Jun-09									
5	Export-39-E-Cam	03:27	2	2	00:00:00	Coarse to fine shelly sand, little suspended sediment, sparse fauna. Possible seapens, starfish, scorpion fish?	Labelled as Env-41 on overlay. Camera crashed at 03:32, 6 mins of footage	7	189 to 197
		03:38	1		00:06:17				
16-Jun-09									
6	Export-36-E-Cam	05:30	2	3	00:00:00	Coarse sandy seabed with stony outcrops of exposed boulders. Fauna includes sponges, anemones, bryozoans, starfish, and possible hydroids. Pneudibranch also observed.	VCR didn't record	20	207 to 231
			1		00:10:44				
7	Export-76-E-Cam	18:40	2	4	00:00:00	hard sandy bottom with very little suspended sediment, occasional boulders with possible coral attached. Observed fauna includes: starfish, seawhips (red/white), corals, bryozoans, cushion star.	Too many fish to see seabed inititally.	20	253 to 277
		18:55	1		00:14:18				
17-Jun-09									
8	Export-34-E-Cam	02:29	2	5	00:00:00	vary hard compact seabed covered with shell hash and gravels, appears fairly flat and featureless. Occasional starfish, bryozoans and seawhip observed. Coral, bryozoan stalks? Flatfish		13	288 to 306
		02:43	1		00:11:14				
9	Export-70-E-Cam	05:17	3	1	00:00:00	Coarse sand with shell hash, shells, burrows, hydroids, seafan, boulders, possible faunal turf and a starfish.		17	308 to 328
		05:28	1		00:10:09				
20-Jun-09									
10	Export-23-E-Cam	15:26	3	2	00:00:00	Sand, occasional burrows with fish, sponges, small pieces of coral, hydroids and star fish present. Sediment change at fix 389 to sand with lots of shell hash and occasional patches of lightly rippled sand.		20, photo 18 no fix	370 to 393
		15:38	1		00:10:56				
21-Jun-09									
11	Export-16-E-Cam	21:49	3	3	00:00:00	Flat featureless coarse sand with very little suspended sediment. Scattered debris and shell fragments with a few sand ripples, worm casts and burrows. A few fish, coral debris, mollusc, anemone and corals.		13	429 to 446
		22:15	1		00:10:12				
23-Jun-09									
12	Export-11-E-Cam	00:48	3	4	00:00:00	Very coarse gravelly sand with small pebbles, very little suspended sediment present. Fairly flat and featureless with possible worm casts and some shell fragements, occasional sand ripples.		12	465 to 481
		01:00	1		00:10:10				

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED IMAGERY LOG SHEET (Deck)									QPRO-0753
Job No: 7905		**Area:**		**Vessel:** Ocean Endeavour			**Operator:** PN/ CP/ KS/ DC		
Date: from: 05-Jun-09 to: 25-Jul-09		**Page:**		**Client:** Woodside Energy Ltd					
Project: Browse Pipeline Route Environmental Survey									
Sample Number	**Station Number**	**Time on overlay**	**DVD/ Video No**	**DVD Chapter**	**Counter (start & end)**	**Sediment Description**	**Comments**	**TOT FIXES**	**FIXES Nos**
24-Jun-09									
13	SBF-42-E-Cam	23:34	3	5	00:00:00	Flat, fine silty sand, some suspended fines present, occasional burrows, urchins, starfish, cushion star, possible anemone, large whip structure, bryozoans.		14	532 to 550
		23:44	1		00:10:12				
25-Jun-09									
14	SBF-41-E-Cam	02:14	4	1	00:00:00	Flat sandy sediment with scattered pebbles and shell fragments, occasional burrows	strong current	12	563 to 580
		02:27	1		00:10:29				
15	SBF-43-E-Cam	02:48	4	2	00:00:00	Flat sandy seabed with some ripples, very few shell/debris, possible seapen and crinoid (starfish?)		12	582 to 598
		03:07	1		00:10:25				
16	SBF-44-E-Cam	04:25	4	3	00:00:00	Sand, lightly rippled, shell fragments and occasional burrow. Very sparse fauna.	2 mins at start with no nav	14	602 to 623
		04:35	1		00:12:11				
17	Export-64-E-Cam	11:58	4	4	00:00:00	Lightly rippled fine sandy seabed, some shell fragments, some bioturbation. Small fish present.	Speed too high for good photos	17	640 to
		12:11	2		00:12:18				
18	Export-4-E-Cam	18:53	4	5	00:00:00	Transect over a seabed rise of 5m. Coarse seabed, patchy slopes with large flat outcrops. Hard corals, seafans, seawhips, starfish, fish. Possible sunken reef.	Speed too high for good photos	15	674 to 697
		19:06	2		00:11:18				
05-Jul-09									
19	Cal-28-E-Cam	08:28	5	1	00:00:00	Sandy clay, with fins sand/silt on the surface. Anemones, stalked sponge, fish, chimera and groupings of burrows present.	Very marginal weather.	24	771 to 803
		08:47	2		00:19:15				
21-Jul-09									
20	Slope-24-E-Cam	16:57	5	2 and 3	00:00 to 05:16	Attempt 1 Stills camera failure. Attempt 2 Very soft silty clay, lots of fines suspended, possible large rock. Sea urchin and sparse fauna.	Marginal weather conditions	12	862 to 878
		17:07	2		00:00 to 10:55				
22-Jul-09									
21	Tor-58-E-Cam	15:57	5	4	00:00:00	Fine sandy silt and clay, some suspended fines, occasional shell fragments, small pebbles and gravel. Small fish, anemones, seapen.		10	939 to 948
		16:09	2		00:11:07				
22	Cal-41-E-Cam	19:21	5	5	00:00:00	Silty clay, lots of suspended fines, bioturbation, anemones, sea stars and possible worm.	long time getting on station	13	950 to 962
		19:35	2		00:12:34				
23	Cal-40-E-Cam	21:17	6	1	00:00:00	Fine sandy silt with lots of suspended fines. Little bit of bioturbation. Sea star, seapen, and possible sea spider.	Camera software keeps freezing	12	964 to 983
		21:32	2		00:14:57				
24	Cal-31-E-Cam	22:33	6	2	00:00:00	Silty clay, lots of suspended fines, shell fragments, some bioturbation. Sea stars and seapen.	Camera software freezing after photo taken. Connections cleaned, DVD	10	985 to 1001
		22:46	2		00:14:15				
25	Cal-38-E-Cam	03:43	7	1	00:00:00	Silty clay with shell fragments and bioturbation. Sea stars present.		11	1008 to 1023
		03:53	3		00:10:36				

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED IMAGERY LOG SHEET (Deck)									QPRO-0753
Job No: 7905		**Area:**		**Vessel:** Ocean Endeavour			**Operator:** PN/ CP/ KS/ DC		
Date: from: 05-Jun-09 to: 25-Jul-09		**Page:**		**Client:** Woodside Energy Ltd					
Project: Browse Pipeline Route Environmental Survey									
Sample Number	**Station Number**	**Time on overlay**	**DVD/ Video No**	**DVD Chapter**	**Counter (start & end)**	**Sediment Description**	**Comments**	**TOT FIXES**	**FIXES Nos**
23-Jul-09									
26	Cal-34-E-Cam	06:14	7	2	00:00:00	Very fine silty surface sediment overlying soft clays, top sediment easily disturbed. Starfish, bryozoans, burrows, urchin.		20	1111 to 1050
		06:28	3		00:14:28				
27	Cal-30-E-Cam	07:22	7	3 / 4	00:00 to 02:25	Fine silt overlying soft clay, urchin, starfish.	Aborted, white images. Crashed 07:25	5 - 2 good	1053 to 1060
		07:28	3		00:00 to 03:27				
24-Jul-09									
28	Cal-30-E-Cam2	08:06	7	5	00:00:00	Fine silt overlying soft clay. Anemone, burrows, occasional shell fragments, starfish, worm tubes and fish present.		18	1065 to 1096
		08:18	3		00:15:20				
29	Cal-29-E-Cam	10:15	8	1	00:00:00	Fine silt overlying soft clay. Anemone, burrows, sea spider, fish, starfish.		17 + 1 no fix	1099 to 1120
		10:28	3		00:13:19				
30	Cal-33-E-Cam	12:43	8	2	00:00:00	Very fine silty surface sediment overlying soft clays, top sediment easily disturbed. Lots of large and small burrows, possibly created by fish or crustaceans, lobster.	Lots of suspended fines creating cloudy appearence	15	1123 to 1141
		12:54	3		00:11:18				
31	Tor-57-E-Cam	14:33	8	3	00:00:00	Slightly rippled sandy silty seabed. Medium to fine sand or very firm clay, silt fraction easily suspended. Sponge, burrows and shell fragments..		18 + 1 no fix	1144 to 1167
		14:48	3		00:13:22				
25-Jul-09									
32	Slope-22-E-Cam	17:10	8	4	00:00:00	Slightly rippled shelly sand, some suspended fines and shell fragments. Urchin and fish present.		11	1170 to 1184
		17:20	3		00:10:17				
33	Slope-16-E-Cam	19:00	8	5	00:00:00	Mixed sediment with sand and gravel. Fish, burrows and anemones also present.	Manual fixes went into line log file so will poss look different in logs.	13	1187 to 1205
		19:14	3		00:11:56				

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

Surveyor's Seabed Imagery Logsheet

SEABED IMAGERY LOG SHEET (Surveyor) QPRO-0754

Job No: 7905	**Area:**	**Vessel:** Ocean	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)
Date: from: 05-Jun-09 to: 25-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)	
Project: Browse Pipeline Route Environmental Survey				

Sample Number	Station Number	Fix Number	Time	Water Depth (m)*	Grid Co-ordinates		Offset from target	
					Easting	Northing	Range (m)	Bearing (°)
05-Jun-09								
1	Export53-CAM-2	11	16:48:03	21.0	397345	8066297	223	354°
2	Export53-CAM-2	14	16:48:55	22.4	397346	8066281	239	355
3	Export53-CAM-2	16	16:49:23	22.4	397345	8066271	249	355
4	Export53-CAM-2	18	16:49:46	22.4	397343	8066263	257	355
5	Export53-CAM-2	19	16:50:07	22.4	397343	8066255	264	356
6	Export53-CAM-2	22	16:50:53	22.4	397348	8066248	273	355
7	Export53-CAM-2	24	16:51:35	22.5	397355	8066247	274	353
8	Export53-CAM-2	26	16:51:52	22.4	397360	8066247	274	352
9	Export53-CAM-2	27	16:52:15	22.4	397366	8066247	275	351
10	Export53-CAM-2	29	16:52:30	22.4	397370	8066249	274	350
11	Export53-CAM-2	32	16:53:17	22.4	397378	8066248	276	348
12	Export53-CAM-2	34	16:53:56	22.4	397386	8066244	282	347
13	Export53-CAM-2	36	16:54:37	22.4	397399	8066246	284	345
14	Export53-CAM-2	38	16:54:53	22.4	397402	8066247	283	344
15	Export53-CAM-2	40	16:55:21	22.5	397409	8066250	283	342
16	Export52-CAM-1	52	17:42:40	20.5	397280	8065491	51	58
17	Export52-CAM-1	53	17:42:54	20.4	397269	8065497	58	68
18	Export52-CAM-1	54	17:43:04	20.5	397274	8065482	61	53
19	Export52-CAM-1	59	17:44:11	20.7	397267	8065455	84	42
20	Export52-CAM-1	60	17:44:23	20.8	397268	8065451	87	39
21	Export52-CAM-1	63	17:45:09	5.6	397285	8065442	85	27
22	Export52-CAM-1	64	17:45:17	20.6	397319	8065443	75	3
23	Export52-CAM-1	66	17:45:57	20.6	397319	8065443	75	3
24	Export52-CAM-1	68	17:46:07	20.5	397301	8065459	62	20
25	Export52-CAM-1	69	17:46:20	20.6	397303	8065464	58	20
26	Export52-CAM-1	70	17:46:31	20.6	397305	8065468	53	19
27	Export52-CAM-1	72	17:46:52	20.7	397307	8065476	45	21
28	Export52-CAM-1	74	17:47:09	20.8	397309	8065485	36	23
29	Export52-CAM-1	75	17:47:18	20.8	397309	8065489	32	26
30	Export52-CAM-1	77	17:47:40	20.8	397311	8065498	23	32
31	Export52-CAM-1	78	17:47:48	20.8	397312	8065500	21	30
32	Export52-CAM-1	79	17:48:00	20.9	397314	8065503	17	32
33	Export52-CAM-1	81	17:48:21	20.9	397316	8065510	11	42
34	Export52-CAM-1	85	17:49:23	20.7	397316	8065532	16	154
35	Export52-CAM-1	87	17:49:41	20.7	397314	8065537	21	155
36	Export52-CAM-1	88	17:49:56	20.4	397312	8065541	26	155
37	Export52-CAM-1	90	17:50:26	20.2	397307	8065550	36	154
38	Export52-CAM-1	92	17:50:59	20.2	397306	8065557	43	157
39	Export52-CAM-1	96	17:52:14	20.2	397315	8065564	46	170
40	Export52-CAM-1	100	17:53:56	20.6	397329	8065545	28	193
41	Export52-CAM-1	103	17:54:42	20.8	397331	8065532	16	210
42	Export52-CAM-1	105	17:55:08	20.6	397333	8065523	11	243
43	Export52-CAM-1	106	17:55:23	20.5	397335	8065518	12	268
44	Export52-CAM-1	108	17:55:57	20.6	397341	8065507	22	302
06-Jun-09								
45†	Export56-CAM-2	124	08:45:53	24.0	388869	8065984	182	77
46†	Export56-CAM-2	125	08:46:40	24.1	388866	8065980	187	76
47	Export56-CAM-2	127	08:47:08	24.0	388862	8065975	192	75
48	Export56-CAM-2	128	08:47:44	24.1	388857	8065970	197	74
49	Export56-CAM-2	129	08:48:13	24.1	388856	8065967	200	73
50	Export56-CAM-2	130	08:48:34	24.0	388856	8065964	200	73
51	Export56-CAM-2	132	08:49:45	24.0	388854	8065953	206	70
52	Export56-CAM-2	133	08:50:16	24.2	388848	8065943	215	68
53	Export56-CAM-2	135	08:51:16	24.1	388842	8065931	225	66
54	Export56-CAM-2	136	08:52:01	24.0	388840	8065923	230	64
55	Export56-CAM-2	137	08:52:30	24.0	388842	8065921	230	63
56	Export56-CAM-2	139	08:52:59	24.0	388840	8065917	233	63
57	Export56-CAM-2	140	08:53:33	24.1	388835	8065910	241	62
58	Export56-CAM-2	141	08:53:52	24.0	388832	8065904	246	61
59	Export56-CAM-2	142	08:54:21	24.0	388830	8065898	251	60

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED IMAGERY LOG SHEET (Surveyor) QPRO-0754

Job No: 7905	**Area:**	**Vessel:** Ocean	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)
Date: from: 05-Jun-09 to: 25-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)	
Project: Browse Pipeline Route Environmental Survey				

Sample Number	Station Number	Fix Number	Time	Water Depth (m)*	Grid Co-ordinates		Offset from target	
					Easting	Northing	Range (m)	Bearing (°)
09-Jun-09								
60†	Export49-CAM-1	152	14:29:28	32.0	378986	8073140	68	172
61	Export49-CAM-1	153	14:30:12	32.0	378995	8073134	61	179
62	Export49-CAM-1	155	14:30:42	31.9	379002	8073129	57	186
63	Export49-CAM-1	156	14:31:27	32.0	379013	8073123	53	199
64	Export49-CAM-1	158	14:32:33	32.0	379015	8073115	46	204
65	Export49-CAM-1	159	14:33:21	32.0	379014	8073109	40	206
66	Export49-CAM-1	160	14:34:24	32.0	379015	8073101	33	215
67	Export49-CAM-1	162	14:35:28	32.0	379017	8073090	27	231
68	Export49-CAM-1	163	14:36:29	32.0	379019	8073080	24	254
10-Jun-09								
69	Export39-CAM-1	189	03:26:36	34.1	368077	8112428	97	233
70	Export39-CAM-1	191	03:27:13	34.0	368070	8112422	88	234
71	Export39-CAM-1	192	03:27:40	34.1	368088	8112440	114	232
72	Export39-CAM-1	193	03:28:29	33.8	368059	8112417	76	232
73	Export39-CAM-1	194	03:28:46	33.8	368059	8112417	76	232
74¥	Export39-CAM-1	196	03:30:02	32.5	369782	8114213	2564	224
75	Export39-CAM-1	197	03:30:59	30.7	368026	8112403	43	220
16-Jun-09								
76	Export36-CAM-1	207	05:30:30	33.4	366812	8124671	63	250
77	Export36-CAM-1	208	05:31:25	33.4	366813	8124668	63	253
78	Export36-CAM-1	210	05:32:03	33.5	366814	8124669	65	252
79	Export36-CAM-1	211	05:32:18	33.5	366816	8124672	68	250
80	Export36-CAM-1	212	05:33:06	33.6	366820	8124666	69	256
81	Export36-CAM-1	214	05:33:46	33.7	366825	8124665	74	258
82	Export36-CAM-1	215	05:34:13	33.8	366830	8124665	79	259
83	Export36-CAM-1	216	05:34:18	33.9	366831	8124665	80	259
84	Export36-CAM-1	217	05:34:47	33.9	366839	8124662	88	262
85	Export36-CAM-1	219	05:35:52	33.9	366849	8124661	97	263
86	Export36-CAM-1	220	05:36:40	33.9	366853	8124652	100	268
87	Export36-CAM-1	221	05:37:02	34.0	366857	8124650	104	270
88	Export36-CAM-1	222	05:37:22	34.0	366860	8124644	108	273
89	Export36-CAM-1	224	05:37:31	34.0	366861	8124644	109	273
90	Export36-CAM-1	225	05:37:46	34.0	366864	8124644	112	273
91	Export36-CAM-1	226	05:38:24	34.0	366870	8124649	117	270
92	Export36-CAM-1	227	05:38:35	34.0	366872	8124649	119	270
93	Export36-CAM-1	228	05:39:03	33.9	366881	8124647	128	271
94	Export36-CAM-1	230	05:39:34	34.0	366890	8124647	137	271
95	Export76-CAM-1	253	18:45:29	36.0	366434	8147442	134	248
96	Export76-CAM-1	255	18:46:03	36.2	366441	8147443	141	249
97	Export76-CAM-1	256	18:46:19	36.0	366444	8147444	144	248
98	Export76-CAM-1	257	18:46:58	35.9	366454	8147448	155	249
99	Export76-CAM-1	258	18:47:21	35.9	366460	8147449	161	249
100	Export76-CAM-1	260	18:47:51	35.9	366467	8147451	168	249
101	Export76-CAM-1	261	18:48:23	36.0	366471	8147449	171	250
102	Export76-CAM-1	262	18:48:57	36.0	366476	8147446	175	252
103	Export76-CAM-1	263	18:49:33	35.9	366483	8147444	181	253
104	Export76-CAM-1	264	18:49:38	35.9	366483	8147443	181	253
105	Export76-CAM-1	266	18:50:20	35.7	366491	8147440	187	255
106	Export76-CAM-1	267	18:50:45	35.7	366497	8147438	193	256
107	Export76-CAM-1	268	18:51:16	35.7	366507	8147435	202	258
108	Export76-CAM-1	269	18:51:40	35.7	366516	8147434	211	258
109	Export76-CAM-1	271	18:52:16	35.6	366534	8147436	228	259
110	Export76-CAM-1	272	18:52:53	35.8	366548	8147438	242	259
111	Export76-CAM-1	273	18:53:19	36.0	366553	8147439	248	259
112	Export76-CAM-1	275	18:54:00	36.1	366559	8147433	252	260
113	Export76-CAM-1	276	18:54:39	36.1	366565	8147427	257	262
17-Jun-09								
114	Export34-CAM-1	288	02:30:17	40.2	366373	8163565	105	7
115	Export34-CAM-1	291	02:34:11	40.0	366449	8163607	87	315
116	Export34-CAM-1	292	02:34:35	39.9	366460	8163607	96	310

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED IMAGERY LOG SHEET (Surveyor) QPRO-0754

Job No: 7905	**Area:**	**Vessel:** Ocean	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)
Date: from: 05-Jun-09 to: 25-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)	
Project: Browse Pipeline Route Environmental Survey				

Sample Number	Station Number	Fix Number	Time	Water Depth (m)*	Grid Co-ordinates		Offset from target	
					Easting	Northing	Range (m)	Bearing (°)
117	Export34-CAM-1	293	02:35:02	39.9	366470	8163614	99	304
118	Export34-CAM-1	294	02:35:35	39.9	366479	8163617	106	299
119	Export34-CAM-1	296	02:36:21	39.8	366486	8163627	108	293
120	Export34-CAM-1	297	02:36:57	39.7	366507	8163629	127	288
121	Export34-CAM-1	299	02:38:11	39.6	366513	8163639	129	283
122	Export34-CAM-1	300	02:38:57	39.5	366518	8163640	134	282
123	Export34-CAM-1	301	02:39:52	39.5	366516	8163650	130	278
124	Export34-CAM-1	303	02:40:46	39.5	366528	8163664	141	272
125	Export34-CAM-1	304	02:41:09	39.5	366534	8163654	148	276
126	Export34-CAM-1	306	02:42:29	39.5	366555	8163653	169	276
127	Export70-CAM-1	308	05:17:57	53.1	359681	8186154	6	352
128	Export70-CAM-1	310	05:18:49	53.2	359678	8186149	11	9
129	Export70-CAM-1	311	05:19:01	53.2	359678	8186147	13	9
130	Export70-CAM-1	312	05:19:30	53.4	359681	8186145	15	356
131	Export70-CAM-1	314	05:20:32	53.7	359687	8186135	26	345
132	Export70-CAM-1	315	05:20:54	53.7	359686	8186130	30	349
133	Export70-CAM-1	316	05:21:32	53.8	359692	8186125	37	341
134	Export70-CAM-1	317	05:21:50	53.9	359695	8186122	41	338
135	Export70-CAM-1	318	05:22:13	53.8	359699	8186116	47	337
136	Export70-CAM-1	320	05:22:54	53.9	359703	8186107	58	336
137	Export70-CAM-1	321	05:23:11	53.8	359706	8186103	62	336
138	Export70-CAM-1	322	05:23:31	53.8	359707	8186098	67	336
139	Export70-CAM-1	323	05:23:50	53.8	359708	8186090	76	338
140	Export70-CAM-1	324	05:24:13	53.8	359711	8186083	83	338
141	Export70-CAM-1	326	05:24:39	53.8	359718	8186077	92	335
142	Export70-CAM-1	327	05:25:11	53.8	359728	8186071	101	332
143	Export70-CAM-1	328	05:25:42	53.8	359734	8186069	106	329
20-Jun-09								
144	Export23-CAM-1	370	15:27:24	81.5	353545	8213579	150	173
145	Export23-CAM-1	371	15:27:36	81.5	353541	8213577	149	171
146	Export23-CAM-1	372	15:28:05	81.3	353534	8213571	143	168
147	Export23-CAM-1	373	15:28:18	81.3	353531	8213568	142	167
148	Export23-CAM-1	374	15:28:35	81.2	353527	8213565	140	165
149	Export23-CAM-1	375	15:28:50	81.2	353525	8213563	138	164
150	Export23-CAM-1	377	15:29:15	81.1	353516	8213556	135	159
151	Export23-CAM-1	378	15:29:55	80.9	353505	8213545	128	153
152	Export23-CAM-1	379	15:30:31	80.9	353498	8213534	123	148
153	Export23-CAM-1	381	15:31:52	80.4	353488	8213507	107	136
154	Export23-CAM-1	382	15:32:18	80.2	353487	8213504	106	134
155	Export23-CAM-1	384	15:33:18	80.3	353479	8213492	104	126
156	Export23-CAM-1	385	15:33:48	80.4	353474	8213485	104	121
157	Export23-CAM-1	386	15:34:40	79.9	353475	8213474	98	116
158	Export23-CAM-1	387	15:35:01	79.7	353474	8213468	97	113
159	Export23-CAM-1	389	15:35:20	79.6	353474	8213465	96	111
160	Export23-CAM-1	390	15:36:01	79.8	353477	8213459	91	108
161	Export23-CAM-1	391	15:36:13	79.9	353479	8213458	89	108
162	Export23-CAM-1	392	15:36:38	79.9	353483	8213456	85	108
163	Export23-CAM-1	393	15:36:50	79.9	353484	8213455	84	107
21-Jun-09								
164	Export16-CAM-1	429	21:51:52	82.1	346227	8238177	56	306
165	Export16-CAM-1	431	21:52:42	82.2	346226	8238177	55	307
166	Export16-CAM-1	432	21:53:37	82.3	346227	8238175	57	308
167	Export16-CAM-1	434	21:54:17	82.6	346228	8238173	59	309
168	Export16-CAM-1	435	21:54:52	82.4	346227	8238175	57	308
169	Export16-CAM-1	436	21:55:14	82.5	346229	8238173	60	308
170	Export16-CAM-1	437	21:55:34	82.5	346230	8238175	59	306
171	Export16-CAM-1	439	21:56:57	82.6	346232	8238179	59	302
172	Export16-CAM-1	440	21:57:11	82.4	346233	8238178	60	302
173	Export16-CAM-1	442	21:58:18	82.4	346232	8238180	59	301
174	Export16-CAM-1	443	21:59:21	82.5	346233	8238179	60	301
175	Export16-CAM-1	445	22:00:18	83.2	346234	8238178	62	302
176	Export16-CAM-1	446	22:01:19	82.4	346234	8238178	61	301

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED IMAGERY LOG SHEET (Surveyor) QPRO-0754

Job No: 7905	**Area:**	**Vessel:** Ocean	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)
Date: from: 05-Jun-09 to: 25-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)	
Project: Browse Pipeline Route Environmental Survey				

Sample Number	Station Number	Fix Number	Time	Water Depth (m)*	Grid Co-ordinates		Offset from target	
					Easting	Northing	Range (m)	Bearing (°)
23-Jun-09								
177	Export11-CAM-1	465	00:49:44	91.0	345382	8265607	33	276
178	Export11-CAM-1	466	00:50:22	91.0	345380	8265609	31	373
179	Export11-CAM-1	468	00:51:29	90.9	345375	8265618	26	254
180	Export11-CAM-1	469	00:51:58	90.9	345372	8265619	25	249
181	Export11-CAM-1	471	00:53:56	90.7	345368	8265638	33	215
182	Export11-CAM-1	472	00:54:32	90.7	345368	8265640	35	212
183	Export11-CAM-1	474	00:55:40	90.5	345362	8265645	37	201
184	Export11-CAM-1	475	00:56:07	90.5	345360	8265648	39	196
185	Export11-CAM-1	476	00:56:58	90.6	345360	8265649	40	195
186	Export11-CAM-1	478	00:57:46	90.2	345360	8265653	44	194
187	Export11-CAM-1	479	00:58:37	90.5	345358	8265655	45	190
188	Export11-CAM-1	481	00:59:38	90.2	345359	8265657	47	192
24-Jun-09								
189	SBF-42-CAM-1	532	23:33:13	94.5	368392	8332041	30	16
190	SBF-42-CAM-1	534	23:34:00	94.5	368394	8332045	26	13
191	SBF-42-CAM-1	535	23:34:47	94.5	368398	8332042	28	4
192	SBF-42-CAM-1	536	23:35:09	94.5	368399	8332038	32	2
193	SBF-42-CAM-1	537	23:35:40	94.6	368400	8332030	40	0
194	SBF-42-CAM-1	539	23:36:34	94.5	368395	8332021	50	6
195	SBF-42-CAM-1	540	23:37:30	94.5	368391	8332024	47	11
196	SBF-42-CAM-1	542	23:38:48	94.5	368396	8332027	44	6
197	SBF-42-CAM-1	543	23:39:10	94.4	368400	8332027	43	0
198	SBF-42-CAM-1	544	23:39:41	94.5	368408	8332027	44	350
199	SBF-42-CAM-1	546	23:40:28	94.6	368418	8332030	44	336
200	SBF-42-CAM-1	547	23:41:42	94.6	368416	8332037	37	334
201	SBF-42-CAM-1	549	23:42:03	94.7	368413	8332036	36	339
202	SBF-42-CAM-1	550	23:42:51	94.6	368410	8332036	35	344
25-Jun-09								
203	SBF-41-CAM-1	566	02:16:55	99.4	370026	8334086	341	349
204	SBF-41-CAM-1	567	02:17:32	99.4	370026	8334083	344	349
205	SBF-41-CAM-1	579	02:25:40	99.8	370066	8334163	278	338
206	SBF-41-CAM-1	580	02:26:11	99.8	370070	8334172	271	336
207	SBF-43-CAM-1	582	02:49:58	102.4	370276	8334951	123	329
208	SBF-43-CAM-1	584	02:50:32	102.4	370271	8334954	118	330
209	SBF-43-CAM-1	585	02:51:40	102.4	370268	8334960	112	330
210	SBF-43-CAM-1	587	02:52:46	102.5	370269	8334971	102	326
211	SBF-43-CAM-1	588	02:53:47	102.7	370271	8334980	96	322
212	SBF-43-CAM-1	590	02:54:42	102.4	370275	8334994	89	315
213	SBF-43-CAM-1	591	02:55:53	102.7	370281	8335014	81	301
214	SBF-43-CAM-1	593	02:57:14	102.7	370296	8335043	85	279
215	SBF-43-CAM-1	594	02:57:50	102.9	370302	8335060	90	268
216	SBF-43-CAM-1	596	02:59:05	102.8	370312	8335088	105	252
217	SBF-43-CAM-1	597	02:59:25	102.9	370314	8335096	110	249
218	SBF-43-CAM-1	598	03:00:03	102.9	370321	8335108	121	244
219	SBF-44-CAM-1	606	04:26:28	101.7	370858	8335201	34	110
220	SBF-44-CAM-1	607	04:26:58	101.8	370859	8335202	33	111
221	SBF-44-CAM-1	608	04:27:35	101.6	370858	8335205	36	115
222	SBF-44-CAM-1	610	04:28:11	101.8	370855	8335209	39	119
223	SBF-44-CAM-1	611	04:28:43	101.7	370853	8335213	43	122
224	SBF-44-CAM-1	612	04:29:49	101.8	370856	8335219	44	131
225	SBF-44-CAM-1	614	04:30:28	101.8	370856	8335223	48	134
226	SBF-44-CAM-1	615	04:31:22	101.8	370855	8335229	52	138
227	SBF-44-CAM-1	617	04:32:04	101.8	370854	8335234	57	141
228	SBF-44-CAM-1	618	04:32:23	101.8	370854	8335237	59	142
229	SBF-44-CAM-1	619	04:32:57	101.8	370854	8335240	62	145
230	SBF-44-CAM-1	620	04:33:41	101.9	370856	8335244	64	148
231	SBF-44-CAM-1	622	04:34:01	101.9	370857	8335248	67	150
232	Export64-CAM-1	641	11:56:32	95.8	356783	8313343	797	65
233	Export64-CAM-1	643	11:57:48	95.9	356772	8313335	810	64
234	Export64-CAM-1	644	11:58:04	95.9	356769	8313333	814	64
235	Export64-CAM-1	645	11:58:33	95.9	356765	8313329	819	64

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED IMAGERY LOG SHEET (Surveyor) QPRO-0754

Job No: 7905	**Area:**	**Vessel:** Ocean	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)
Date: from: 05-Jun-09 to: 25-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)	
Project: Browse Pipeline Route Environmental Survey				

Sample Number	Station Number	Fix Number	Time	Water Depth (m)*	Grid Co-ordinates		Offset from target	
					Easting	Northing	Range (m)	Bearing (°)
236	Export64-CAM-1	646	11:58:53	95.9	356762	8313325	824	64
237	Export64-CAM-1	647	11:59:07	96.0	356760	8313324	825	64
238	Export64-CAM-1	649	11:59:59	96.0	356752	8313315	837	64
239	Export64-CAM-1	650	12:00:54	95.9	356752	8313316	836	64
240	Export64-CAM-1	652	12:01:45	96.1	356752	8313320	835	64
241	Export64-CAM-1	653	12:02:03	96.1	356752	8313320	835	64
242	Export64-CAM-1	654	12:03:19	96.0	356753	8313324	832	64
243	Export64-CAM-1	656	12:03:48	96.1	356755	8313326	829	64
244	Export64-CAM-1	657	12:04:34	96.0	356756	8313327	828	64
245	Export64-CAM-1	658	12:04:56	95.9	356756	8313326	828	64
246	Export64-CAM-1	660	12:06:57	95.8	356772	8313336	809	64
247	Export64-CAM-1	661	12:07:29	95.8	356785	8313343	795	64
248	Export64-CAM-1	663	12:07:54	95.7	356797	8313347	782	64
249	Export4-CAM-1	676	18:55:48	88.6	346245	8291781	182	172
250	Export4-CAM-1	677	18:56:01	88.6	346244	8291784	185	172
251	Export4-CAM-1	678	18:56:16	88.9	346243	8291786	188	172
252	Export4-CAM-1	680	18:56:39	89.3	346239	8291791	194	171
253	Export4-CAM-1	681	18:57:32	89.4	346233	8291798	202	169
254	Export4-CAM-1	682	18:57:57	89.5	346230	8291798	202	169
255	Export4-CAM-1	683	18:58:24	89.6	346226	8291796	201	167
256	Export4-CAM-1	685	18:58:53	90.0	346224	8291796	202	167
257	Export4-CAM-1	686	18:59:08	90.2	346222	8291798	203	166
258	Export4-CAM-1	688	19:00:54	91.8	346217	8291813	219	166
259	Export4-CAM-1	689	19:01:12	92.0	346218	8291813	220	166
260	Export4-CAM-1	690	19:01:31	92.6	346219	8291816	222	167
261	Export4-CAM-1	691	19:02:03	93.1	346222	8291819	224	168
262	Export4-CAM-1	693	19:03:26	94.6	346231	8291833	236	170
05-Jul-09								
263	Cal-28-Cam-1	771	08:29:22	416.3	355954	8386036	48	73
264	Cal-28-Cam-1	773	08:30:01	416.2	355956	8386030	48	66
265	Cal-28-Cam-1	774	08:31:26	416.2	355956	8386031	48	66
266	Cal-28-Cam-1	775	08:31:46	416.3	355956	8386033	47	69
267	Cal-28-Cam-1	778	08:32:32	416.3	355954	8386041	46	79
268	Cal-28-Cam-1	779	08:32:58	416.4	355953	8386048	47	88
269	Cal-28-Cam-1	780	08:33:17	416.2	355953	8386052	47	92
270	Cal-28-Cam-1	781	08:33:37	416.3	355953	8386056	47	97
271	Cal-28-Cam-1	782	08:33:44	416.1	355954	8386057	47	98
272	Cal-28-Cam-1	787	08:37:24	416.2	355960	8386065	42	111
273	Cal-28-Cam-1	788	08:37:52	416.2	355958	8386061	44	104
274	Cal-28-Cam-1	790	08:38:14	416.2	355957	8386055	43	97
275	Cal-28-Cam-1	791	08:39:05	416.1	355957	8386045	44	83
276	Cal-28-Cam-1	793	08:40:40	416.2	355958	8386035	45	70
277	Cal-28-Cam-1	795	08:42:09	416.1	355961	8386034	43	68
278	Cal-28-Cam-1	797	08:43:59	416.0	355960	8386048	40	87
279	Cal-28-Cam-1	798	08:45:18	416.0	355963	8386052	37	94
280	Cal-28-Cam-1	799	08:45:36	416.1	355964	8386055	36	98
281	Cal-28-Cam-1	801	08:46:11	416.2	355968	8386056	33	100
282	Cal-28-Cam-1	802	08:46:44	415.9	355971	8386057	30	104
21-Jul-09								
283	Slope-24-Cam-1	862	16:58:25	354.6	352393	8372200	46	173
284	Slope-24-Cam-1	864	16:59:29	355.4	352393	8372198	44	172
285	Slope-24-Cam-1	865	17:00:22	354.7	352392	8372195	42	170
286	Slope-24-Cam-1	867	17:01:02	354.6	352390	8372193	40	168
287	Slope-24-Cam-1	868	17:01:14	354.9	352390	8372193	40	167
288	Slope-24-Cam-1	870	17:02:46	354.5	352385	8372192	40	160
289	Slope-24-Cam-1	871	17:03:43	354.5	352386	8372190	39	160
290	Slope-24-Cam-1	872	17:04:31	354.5	352386	8372189	37	159
291	Slope-24-Cam-1	874	17:04:57	354.5	352386	8372187	36	158
292	Slope-24-Cam-1	875	17:05:34	354.5	352384	8372185	35	154
293	Slope-24-Cam-1	876	17:05:57	354.4	352384	8372184	34	153
294	Slope-24-Cam-1	877	17:06:22	354.5	352382	8372182	33	150
295	Slope-24-Cam-1	878	17:06:42	354.4	352381	8372181	32	147

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED IMAGERY LOG SHEET (Surveyor) QPRO-0754

Job No: 7905	**Area:**	**Vessel:** Ocean	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)
Date: from: 05-Jun-09 to: 25-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)	
Project: Browse Pipeline Route Environmental Survey				

Sample Number	Station Number	Fix Number	Time	Water Depth (m)*	Grid Co-ordinates		Offset from target	
					Easting	Northing	Range (m)	Bearing (°)
22-Jul-09								
296	Tor-58-Cam-1	941	16:00:17	345.6	380273	8398402	47	193
297	Tor-58-Cam-1	942	16:01:27	345.7	380269	8398397	42	188
298	Tor-58-Cam-1	943	16:03:27	345.6	380264	8398393	37	181
299	Tor-58-Cam-1	944	16:04:04	345.6	380262	8398390	34	178
300	Tor-58-Cam-1	945	16:05:56	345.7	380258	8398381	26	169
301	Tor-58-Cam-1	946	16:06:40	345.7	380256	8398379	24	164
302	Tor-58-Cam-1	947	16:07:15	345.6	380253	8398378	24	157
303	Tor-58-Cam-1	948	16:08:46	345.6	380251	8398374	22	145
304	Cal-41-Cam-1	950	19:22:26	643.0	355542	8410261	73	213
305	Cal-41-Cam-1	951	19:23:30	642.9	355536	8410251	61	214
306	Cal-41-Cam-1	952	19:24:18	642.9	355532	8410244	53	214
307	Cal-41-Cam-1	953	19:24:48	642.9	355528	8410238	46	214
308	Cal-41-Cam-1	954	19:25:52	643.0	355525	8410228	37	220
309	Cal-41-Cam-1	955	19:26:20	643.1	355524	8410225	33	222
310	Cal-41-Cam-1	956	19:26:50	643.2	355523	8410220	29	228
311	Cal-41-Cam-1	957	19:27:39	643.4	355522	8410213	24	237
312	Cal-41-Cam-1	958	19:29:01	643.9	355519	8410202	17	265
313	Cal-41-Cam-1	959	19:30:35	644.6	355513	8410188	16	320
314	Cal-41-Cam-1	960	19:31:49	645.1	355503	8410179	21	356
315	Cal-41-Cam-1	961	19:32:35	645.3	355493	8410175	27	19
316	Cal-41-Cam-1	962	19:34:00	645.7	355474	8410176	37	50
317	Cal-40-Cam-1	964	21:18:51	613.3	352173	8404416	38	127
318	Cal-40-Cam-1	966	21:20:26	612.8	352187	8404401	18	116
319	Cal-40-Cam-1	969	21:24:45	614.7	352201	8404404	12	168
320	Cal-40-Cam-1	971	21:27:16	613.9	352170	8404408	36	115
321	Cal-40-Cam-1	972	21:27:38	615.5	352170	8404409	37	116
322	Cal-40-Cam-1	973	21:27:45	615.3	352169	8404410	37	116
323	Cal-40-Cam-1	975	21:28:34	615.1	352161	8404412	46	114
324	Cal-40-Cam-1	976	21:28:45	615.2	352158	8404412	49	113
325	Cal-40-Cam-1	977	21:30:00	614.8	352139	8404417	68	111
326	Cal-40-Cam-1	979	21:30:51	614.5	352136	8404423	73	114
327	Cal-40-Cam-1	980	21:31:40	614.4	352137	8404430	75	120
328	Cal-40-Cam-1	983	21:32:55	613.8	352151	8404435	67	129
329	Cal-31-Cam-1	985	22:33:20	593.1	353033	8403337	50	222
330	Cal-31-Cam-1	989	22:37:01	592.8	352996	8403314	15	164
331	Cal-31-Cam-1	992	22:39:56	593.1	353000	8403331	31	180
332	Cal-31-Cam-1	994	22:42:17	592.8	353024	8403359	64	202
333	Cal-31-Cam-1	998	22:46:03	592.1	353004	8403334	34	187
334	Cal-31-Cam-1	999	22:46:24	591.7	353004	8403328	29	188
335	Cal-31-Cam-1	1001	22:46:49	591.7	353004	8403322	22	191
336	Cal-38-Cam-1	1008	03:43:41	550.5	353705	8399717	15	243
337	Cal-38-Cam-1	1009	03:44:11	550.4	353695	8399716	8	210
338	Cal-38-Cam-1	1010	03:44:46	550.2	353683	8399717	10	130
339	Cal-38-Cam-1	1011	03:44:58	550.2	353680	8399716	13	118
340	Cal-38-Cam-1	1013	03:45:57	549.9	353662	8399715	29	101
341	Cal-38-Cam-1	1014	03:46:19	549.8	353659	8399714	33	97
342	Cal-38-Cam-1	1016	03:47:53	549.3	353636	8399706	55	85
343	Cal-38-Cam-1	1017	03:49:09	549.2	353622	8399693	71	76
344	Cal-38-Cam-1	1019	03:50:28	549.2	353616	8399679	81	68
345	Cal-38-Cam-1	1021	03:51:37	549.4	353614	8399668	87	62
346	Cal-38-Cam-1	1023	03:53:13	549.6	353616	8399654	93	54
23-Jul-09								
347	Cal-34-Cam-1	1025	06:14:42	600.6	342357	8392163	108	163
348	Cal-34-Cam-1	1027	06:16:33	599.7	342360	8392150	94	163
349	Cal-34-Cam-1	1028	06:16:53	599.6	342360	8392147	91	162
350	Cal-34-Cam-1	1029	06:17:06	599.8	342360	8392145	90	162
351	Cal-34-Cam-1	1030	06:17:09	599.8	342360	8392145	89	162
352	Cal-34-Cam-1	1031	06:17:16	599.7	342361	8392144	89	162
353	Cal-34-Cam-1	1032	06:18:09	599.4	342364	8392133	77	162
354	Cal-34-Cam-1	1033	06:18:42	599.3	342364	8392127	72	160
355	Cal-34-Cam-1	1035	06:19:10	599.6	342366	8392120	64	160
356	Cal-34-Cam-1	1036	06:19:28	598.9	342367	8392117	61	160
357	Cal-34-Cam-1	1037	06:20:12	598.7	342367	8392112	57	159

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED IMAGERY LOG SHEET (Surveyor) QPRO-0754

Job No: 7905	**Area:**	**Vessel:** Ocean	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)
Date: from: 05-Jun-09 to: 25-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)	
Project: Browse Pipeline Route Environmental Survey				

Sample Number	Station Number	Fix Number	Time	Water Depth (m)*	Grid Co-ordinates		Offset from target	
					Easting	Northing	Range (m)	Bearing (°)
358	Cal-34-Cam-1	1040	06:22:16	598.2	342377	8392086	29	157
359	Cal-34-Cam-1	1041	06:22:32	598.1	342377	8392083	26	155
360	Cal-34-Cam-1	1042	06:22:53	598.0	342378	8392079	21	153
361	Cal-34-Cam-1	1044	06:23:14	598.0	342380	8392075	17	152
362	Cal-34-Cam-1	1045	06:24:02	597.9	342382	8392071	12	153
363	Cal-34-Cam-1	1046	06:24:56	597.6	342384	8392066	7	148
364	Cal-34-Cam-1	1048	06:25:40	598.0	342388	8392059	1	22
365	Cal-34-Cam-1	1049	06:26:07	598.0	342391	8392054	6	332
366	Cal-34-Cam-1	1050	06:26:33	597.3	342394	8392047	14	333
24-Jul-09								
367	Cal-30-Cam-1	1053	07:22:49	583.4	343468	8392268	75	155
368	Cal-30-Cam-1	1054	07:23:27	583.2	343471	8392259	66	153
369	Cal-30-Cam-2	1065	08:04:42	586.0	343454	8392252	69	138
370	Cal-30-Cam-2	1067	08:05:13	586.7	343455	8392249	66	138
371	Cal-30-Cam-2	1069	08:06:21	585.8	343457	8392245	62	136
372	Cal-30-Cam-2	1071	08:07:26	585.2	343459	8392240	57	134
373	Cal-30-Cam-2	1073	08:08:12	585.1	343460	8392237	55	133
374	Cal-30-Cam-2	1077	08:10:14	584.4	343471	8392233	44	139
375	Cal-30-Cam-2	1078	08:10:48	584.1	343475	8392233	41	142
376	Cal-30-Cam-2	1080	08:11:43	584.1	343478	8392233	39	146
377	Cal-30-Cam-2	1082	08:12:18	583.7	343482	8392231	36	151
378	Cal-30-Cam-2	1084	08:13:25	583.4	343494	8392228	29	168
379	Cal-30-Cam-2	1086	08:14:17	583.3	343496	8392217	17	167
380	Cal-30-Cam-2	1087	08:14:38	583.0	343497	8392212	12	166
381	Cal-30-Cam-2	1090	08:16:31	583.1	343502	8392206	6	197
382	Cal-30-Cam-2	1092	08:16:53	583.0	343503	8392205	6	212
383	Cal-30-Cam-2	1093	08:17:29	582.8	343505	8392203	6	240
384	Cal-30-Cam-2	1095	08:17:54	582.9	343508	8392199	8	278
385	Cal-30-Cam-2	1096	08:18:41	582.9	343513	8392194	14	293
386	Cal-29-Cam-1	1099	10:16:37	488.8	348966	8388773	41	123
387	Cal-29-Cam-1	1100	10:17:08	488.8	348969	8388775	40	128
388	Cal-29-Cam-1	1101	10:17:27	489.3	348971	8388776	39	132
389	Cal-29-Cam-1	1103	10:18:03	489.2	348973	8388777	38	135
390	Cal-29-Cam-1	1104	10:18:18	488.8	348974	8388778	38	137
391	Cal-29-Cam-1	1105	10:18:32	488.8	348975	8388778	38	138
392	Cal-29-Cam-1	1106	10:19:04	488.4	348978	8388778	36	142
393	Cal-29-Cam-1	1107	10:19:17	488.4	348978	8388778	35	142
394	Cal-29-Cam-1	1109	10:19:55	488.6	348982	8388775	31	144
395	Cal-29-Cam-1	1110	10:20:23	488.5	348984	8388773	28	146
396	Cal-29-Cam-1	1112	10:22:12	488.2	348989	8388764	18	141
397	Cal-29-Cam-1	1113	10:23:39	488.3	348991	8388756	11	124
398	Cal-29-Cam-1	1115	10:24:15	488.2	348992	8388752	9	103
399	Cal-29-Cam-1	1116	10:25:18	488.6	348994	8388748	7	73
400	Cal-29-Cam-1	1118	10:26:25	488.4	348997	8388747	4	41
401	Cal-29-Cam-1	1119	10:27:06	488.5	348996	8388745	6	39
402	Cal-29-Cam-1	1120	10:27:36	488.5	348994	8388743	9	40
403	Cal-33-Cam-1	1123	12:44:03	318.7	362195	8375275	34	252
404	Cal-33-Cam-1	1124	12:45:21	318.7	362192	8375267	29	265
405	Cal-33-Cam-1	1126	12:46:15	318.9	362189	8375262	26	275
406	Cal-33-Cam-1	1127	12:47:04	318.8	362185	8375258	24	286
407	Cal-33-Cam-1	1129	12:47:46	318.9	362182	8375256	22	293
408	Cal-33-Cam-1	1130	12:48:11	318.8	362179	8375254	20	301
409	Cal-33-Cam-1	1131	12:49:02	318.9	362174	8375251	18	319
410	Cal-33-Cam-1	1133	12:49:27	319.1	362171	8375249	17	329
411	Cal-33-Cam-1	1134	12:50:05	319.3	362168	8375247	18	342
412	Cal-33-Cam-1	1135	12:50:57	318.8	362163	8375242	22	0
413	Cal-33-Cam-1	1136	12:51:24	318.9	362160	8375239	25	7
414	Cal-33-Cam-1	1138	12:52:04	319.2	362155	8375234	31	14
415	Cal-33-Cam-1	1139	12:52:29	318.9	362152	8375231	35	18
416	Cal-33-Cam-1	1140	12:53:03	318.8	362148	8375226	41	21
417	Cal-33-Cam-1	1141	12:53:19	318.8	362146	8375224	43	23

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED IMAGERY LOG SHEET (Surveyor) QPRO-0754

Job No: 7905	**Area:**	**Vessel:** Ocean	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)
Date: from: 05-Jun-09 to: 25-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)	
Project: Browse Pipeline Route Environmental Survey				

Sample Number	Station Number	Fix Number	Time	Water Depth (m)*	Grid Co-ordinates		Offset from target	
					Easting	Northing	Range (m)	Bearing (°)
418	Tor-57-Cam-1	1144	14:34:52	279.9	372441	8373634	69	268
419	Tor-57-Cam-1	1146	14:36:24	280.0	372433	8373631	61	271
420	Tor-57-Cam-1	1147	14:36:40	280.3	372432	8373631	60	271
421	Tor-57-Cam-1	1148	14:37:01	280.1	372430	8373630	58	272
422	Tor-57-Cam-1	1149	14:37:41	280.1	372426	8373630	54	272
423	Tor-57-Cam-1	1151	14:38:35	280.1	372422	8373630	50	273
424	Tor-57-Cam-1	1152	14:39:48	280.0	372414	8373630	42	272
425	Tor-57-Cam-1	1154	14:40:24	280.2	372411	8373632	39	271
426	Tor-57-Cam-1	1155	14:41:03	280.2	372405	8373632	33	270
427	Tor-57-Cam-1	1156	14:41:35	281.0	372400	8373633	28	269
428	Tor-57-Cam-1	1157	14:42:08	280.2	372396	8373633	24	267
429	Tor-57-Cam-1	1159	14:42:24	280.3	372395	8373633	23	267
430	Tor-57-Cam-1	1160	14:43:51	280.3	372379	8373638	9	227
431	Tor-57-Cam-1	1161	14:44:06	280.3	372378	8373639	9	221
432	Tor-57-Cam-1	1163	14:44:35	280.3	372374	8373640	8	191
433	Tor-57-Cam-1	1164	14:44:56	280.3	372371	8373641	9	176
434	Tor-57-Cam-1	1166	14:46:40	280.4	372356	8373648	22	134
435	Tor-57-Cam-1	1167	14:47:09	280.3	372353	8373649	26	132
25-Jul-09								
436	Slope-22-Cam-1	1170	17:11:07	230.9	364591	8353628	28	183
437	Slope-22-Cam-1	1171	17:11:48	231.1	364579	8353629	31	159
438	Slope-22-Cam-1	1173	17:13:24	231.3	364556	8353617	38	116
439	Slope-22-Cam-1	1174	17:14:04	231.2	364547	8353611	44	105
440	Slope-22-Cam-1	1175	17:14:29	231.2	364540	8353608	51	99
441	Slope-22-Cam-1	1177	17:14:54	231.0	364534	8353606	56	96
442	Slope-22-Cam-1	1178	17:15:46	231.2	364520	8353602	70	92
443	Slope-22-Cam-1	1179	17:16:22	231.2	364513	8353602	77	92
444	Slope-22-Cam-1	1181	17:16:49	231.5	364506	8353601	84	91
445	Slope-22-Cam-1	1182	17:17:37	231.0	364495	8353600	95	90
446	Slope-22-Cam-1	1184	17:19:24	231.0	364468	8353593	122	87
447	Slope-16-Cam-1	1187	19:00:00	158.8	365199	8343712	64	109
448	Slope-16-Cam-1	1189	19:03:00	158.8	365234	8343686	26	79
449	Slope-16-Cam-1	1190	19:04:00	158.8	365248	8343680	16	47
450	Slope-16-Cam-1	1192	19:05:00	158.8	365266	8343673	19	341
451	Slope-16-Cam-1	1193	19:05:00	158.8	365273	8343670	25	328
452	Slope-16-Cam-1	1195	19:08:00	158.8	365304	8343677	46	287
453	Slope-16-Cam-1	1196	19:09:00	158.8	365308	8343678	50	285
454	Slope-16-Cam-1	1198	19:09:00	158.8	365312	8343679	53	282
455	Slope-16-Cam-1	1199	19:10:00	158.8	365319	8343681	60	279
456	Slope-16-Cam-1	1200	19:10:00	158.8	365323	8343681	64	278
457	Slope-16-Cam-1	1204	19:11:00	158.8	365343	8343662	89	289
458	Slope-16-Cam-1	1205	19:13:00	158.8	365344	8343662	89	290

*Water depth as measured at time of sampling, not corrected to LAT; † Beacon error, fix relates to vessel position; ¥ Fix error, position incorrect.

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

Environmentalist's Sampling Logsheet

SEABED SAMPLING LOG SHEET (Deck)							QPRO-0755
Job No: 7905		**Area:** Browse			**Vessel:** Ocean Endeavour		**Operator:** PN/ CP/ KS/ DC
Date: from: 18-Jun-09 to: 23-Jul-09		**Page:**			**Client:** Woodside Energy Ltd		**Sieve Size:** 0.5mm
Project: Browse Pipeline Route Environmental Survey							**Equipment:** Box Corer
Sample Number	**Station Number**	**Time**	**Load**	**Retention**	**Sieving Comments**	**Sediment Description**	**Comments**
18-Jun-09							
1	Export-36	12:13	Chem only	~13cm to 0cm	NA	Golden sand and shell hash, coarse to fine in texture. Sample slumped on one side, possible seabed relief, possible poor seal on box core.	Not immediately accepted, mitigated, chem sample taken from non slumped area.
2	Export-36	12:58	FB/C	20cm to 0 cm	0.5mm	Golden sand and shell hash, coarse to fine in texture. Sample slumped on one side, possible seabed relief, possible poor seal on box core.	Client accepts as FB and FC. Samples taken across the slump so both samples represent same distribution in box. 2x5l buckets each
3	Export-36	14:00	FA	30cm to 5cm	0.5mm	Golden sand and shell hash, coarse to fine in texture. Sample slumped on one side, possible seabed relief, possible poor seal on box core.	2x5l buckets
4	Export-39	15:35	NS	5cm	NA	Washout at the surface, a stone or carbonat nodule prevented a good seal, sample washed out too much for acceptability.	
5	Export-39	16:14	Chem/FA	16cm to 0cm	0.5mm	Coarse to fine shelly sand, small shrimp in Chem area, worms, gastropods. Slight washout when taking box off corer due to release in downward pressure holding seal. Point of luminescence seen in the FA sample prior to sieving.	Its hard to get a good seal on the corer in this type of sediment. 2x5l buckets
19-Jun-09							
6	Export-39	17:56	FB/C	20 to 10cm	0.5mm	Coarse to fine shelly sand. Slight washout when taking box off corer due to release in downward pressure holding seal.	2x5l buckets each
7	Export-49	21:11	NS	NS	NA	Lost the box, lanyard misplaced on handle of release plate not on box.	
8	Export-49	22:04	NS	NS	NA	Sample washout at surface, a stone or carbonate nodule prevented a good seal.	
9	Export-49	22:37	Chem/FA	20 to 5cm	0.5mm	Fine sand, slight washout at the surface but small compact sands, very few shells present. Fish buried in the sediment (retained) with a worm cast and shell on the surface.	1x1l pots
10	Export-49	23:08	FB/C	20 to 10cm	0.5mm	Fine sand, slight washout at the surface but small compact sands, very few shells present.	1x1l pot each
11	Export-56	00:33	Chem/FA	35 to 10cm	0.5mm	Fine sand with some silt, slight slope to the sediment, good seal on recovery due to the sediment type. Gastropods and worms present.	1x1l pots
12	Export-56	00:54	FB/C	20 to 10cm	0.5mm	Fine sand with some silt, slight slope to the sediment, good seal on recovery due to the sediment type. Gastropods and worms present.	1x1l pots each
13	Export-53	02:00	Chem/FA	20 to 5cm	0.5mm	Sand with lots of shell fragments. Some washout in the corner.	1x5l bucket
14	Export-53	02:22	FB/C	25 to 10cm	0.5mm	Sand with lots of small shell fragments. Urchin present. Slight washout on deck when weight taken off bucket.	2x5l bucket each
26-Jun-09							
15	Export-4	00:17	Chem/FA	30cm	0.5mm	Medium to coarse sand. Some washout at the surface.	2x5l buckets
16	Export-4	00:58	FB/C	30cm	0.5mm	Medium to coarse sand. Large starfish present, in FC	2x5l buckets each
17	Export-64	04:44	Chem/FA	30cm	0.5mm	Fine to medium sand and silt, burrowing anemones present, green in colour, no layers, shell fragments and slight smell of decomposition.	5l bucket
18	Export-64	05:21	FB/C	30cm	0.5mm	Fine to medium sand and silt with a fish and shrimp in FB.	5l bucket each
19	SBF-42	10:07	Chem/FA	30cm to 0cm	0.5mm	Fine to medium silty sand, slight washout at the surface, lots of shell fragments. Burrowing anemone and shrimp in FA.	Very strong currents, 25 degree angle on deployments, 1x5l bucket.
20	SBF-42	10:43	FB/C	30cm to 10cm	0.5mm	Fine to medium silty sand, anemone.	1x5l buckets each.
CHEM = Physico-chemistry sample; MFA, MFB, MFC = Macrofaunal sample; NA = Failed sampling attempt.							

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

Environmentalist's Sampling Logsheet

SEABED SAMPLING LOG SHEET (Deck)							QPRO-0755
Job No: 7905		**Area:** Browse			**Vessel:** Ocean Endeavour		**Operator:** PN/ CP/ KS/ DC
Date: from: 18-Jun-09 to: 23-Jul-09		**Page:**			**Client:** Woodside Energy Ltd		**Sieve Size:** 0.5mm
Project: Browse Pipeline Route Environmental Survey							**Equipment:** Box Corer
Sample Number	**Station Number**	**Time**	**Load**	**Retention**	**Sieving Comments**	**Sediment Description**	**Comments**
21	SBF-41	11:37	Chem/FA	30cm	0.5mm	Slight washout in the corner. Medium to coarse sand, some small shell fragments.	3x5l buckets
22	SBF-41	12:14	FB/C	30cm	0.5mm	Slight washout in the corner. Medium to coarse sand, some small shell fragments.	2x5l buckets each
23	SBF-43	12:54	Chem/FA	30cm	0.5mm	Fine to medium sand, probable collapsed burrow, some shell fragments, slightly olive in colour, no odour.	1x5l bucket
24	SBF-43	13:28	FB/C	20cm	0.5mm	Top water retained in FB sample, fine sand, some shell fragments, no odour, olive in colour.	1x5l bucket each.
25	SBF-44	14:07	Chem/FA	20cm	0.5mm	Fine to medium sand with shell fragments, burrow collapsed, slight washout at surface, olive in colour, no odour.	1x1l pot
26	SBF-44	14:41	FB/C	20cm	0.5mm	Seal broken on the surface, leaked mostly into the sieve and therefore FB sample, Fine to medium sand with shell fragments.	1x1l pot each
27-Jun-09							
27	Export-11	07:16	Chem/FA	20cm	0.5mm	Sand with lots of shell fragments, no obvious fauna.	Hermit crab. 2x5l buckets
28	Export-11	07:57	FB/C	20cm	0.5mm	Sand with lots of shell fragments, no obvious fauna.	Brittlestar and fish in FB. 2x5l buckets each.
28-Jun-09							
29	Export-16	00:33	Chem/FA	35 to 10cm	0.5mm	Coarse shelly sand with some washout in the corner on recovery.	Small crab. 2x5l bucket
30	Export-16	01:09	FB/C	40 to 30cm	0.5mm	Coarse shelly sand with some washout in the corner on recovery.	2x5l bucket each
31	Export-23	03:56	Chem/FA	30cm	0.5mm	Medium to coarse golden sand with lots of shell fragments, no obvious fauna.	Juvenile sea snake. 3x5l buckets
32	Export-23	04:39	FB/C	30cm	0.5mm	Medium to coarse golden sand with lots of shell fragments, no obvious fauna.	FB 3x5l bucket, FC 2x5l bucket
02-Jul-09							
33	Slope-16	19:03	NS	15 to 0 cm	NA	Sample rejected due to washout and poor recovery	
34	Slope-16	19:51	Chem/FA	15 to 5cm	0.5mm	Yellowish brown gravelly sand with shell fragments and some coral. Lots of washout.	Very difficult to sample 1x5l bucket
35	Slope-16	20:33	FB/C	10 to 0 cm	0.5mm	Yellowish brown gravelly sand with shell fragments and some coral. Lots of washout.	Very difficult to sample 1x5l bucket each
36	Slope-22	04:00	Chem/FA	30 to 0 cm	0.5mm	Sand, some urchin spines, lots of shell fragments, washout present. Some clay at the bottom of the sample.	Difficult to sieve. 3x5l buckets
37	Slope-22	05:10	FB/C	30cm	0.5mm	Sand for the top 8cm becoming silty sand with some clay.	Difficult to sieve. 2x5l buckets each
03-Jul-09							
38	Cal-38	23:07	Chem/FA	30 to 40cm	0.5mm	Silty clay, yellow brown in colour, occasional shell fragments on the surface, becoming firmer grey silty clay below 10cm.	1x1ltr pot
39	Cal-38	00:44	NA	NS	NA	Did not reach seabed.	Did not trigger.
40	Cal-38	01:24	FB/C	40cm	0.5mm	Silty clay, yellow brown in colour, occasional shell fragments on the surface, becoming firmer grey silty clay below 10cm.	1x1ltr pot each
04-Jul-09							
41	Tor-54	00:38	Chem/FA	20cm	0.5mm	Yellow brown silty sand, some shell fragments, sea star and some coral.	Surface washout, client accepted, plastic cable present in sample, poss fishing line/net. 1x5ltr bucket
42	Tor-54	01:45	FB/C	20cm	0.5mm	Yellow brown silty sand, some shell fragments.	Surface washout. 1x5l bucket each
43	Tor-55	03:12	Chem/FA	20 to 25 cm	0.5mm	Yellow brown silty sand, some shell fragments, lots of opaque urchin spines present.	1x1l pot
44	Tor-55	05:39	NA	NS	NA	Did not reach seabed.	
CHEM = Physico-chemistry sample; MFA, MFB, MFC = Macrofaunal sample; NA = Failed sampling attempt.							

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED SAMPLING LOG SHEET (Deck)							QPRO-0755
Job No: 7905		**Area:** Browse			**Vessel:** Ocean Endeavour		**Operator:** PN/ CP/ KS/ DC
Date: from: 18-Jun-09 to: 23-Jul-09		**Page:**			**Client:** Woodside Energy Ltd		**Sieve Size:** 0.5mm
Project: Browse Pipeline Route Environmental Survey							**Equipment:** Box Corer
Sample Number	**Station Number**	**Time**	**Load**	**Retention**	**Sieving Comments**	**Sediment Description**	**Comments**
45	Tor-55	06:17	FB/C	15 to 0 cm	0.5mm	Fine silty sand with urchin spines, yellow brown in colour, no odour.	Washed out, client accepted. FB 1x1l pot FC 2x1ltr pot
46	Tor-53	08:44	Chem/FA	15 to 0 cm	0.5mm	Large washout at the surface. Golden sand with high percentange of shell frags.	Client accepted 1x5ltr bucket
47	Tor-53	09:35	FB/C	10 to 0 cm	0.5mm	Large washout at the surface. Golden sand with high percentange of shell frags.	Client accepted 1x5ltr bucket each
48	Tor-45	11:32	Chem/FA	15 to 0 cm	0.5mm	Yellow brown fine silty sand, lots of shed urchin spines.	Half sample washed out, client accepted, 1x5ltr bucket
49	Tor-45	12:31	FB/C	20 to 0 cm	0.5mm	Yellow brown fine silty sand, lots of shed urchin spines.	1x1ltr pot each.
50	Tor-43	17:09	Chem/FA	45cm	0.5mm	Yellow brown silty clay, becoming firmer grey clay from about 10cm depth.	1x1ltr pot
51	Tor-43	17:57	FB/C	40cm	0.5mm	Yellow brown silty clay, becoming firmer grey clay from about 10cm depth.	1x1ltr pots each
52	Tor-44	22:45	Chem/FA	45cm	0.5mm	Yellow brown silty clay with some sand, becoming firm grey clay from 10cm depth.	1x1ltr pot, lots of urchin spines.
53	Tor-44	23:39	FB/C	30cm	0.5mm	Yellow brown silty clay with some sand, becoming firm grey clay from 10cm depth.	1x1ltr pots each, worms and brittlestar in FB
54	Cal-28	11:47	Chem/FA	40cm	0.5mm	Thick brown/grey clay, with some sand, very cohesive and sticky. 2cm of loose silt on top.	Marginal weather 1x1ltr pot
55	Cal-28	13:15	FB/C	40cm	0.5mm	Thick brown/grey clay, with some sand, very cohesive and sticky. 2cm of loose silt on top.	1x5ltr bucket each.
18-Jul-09							
56	Export-76	18:03	NA	6cm	NA	Very poor recovery, CPT recording 6-10cm so client didn't want a second attempt.	Station abandoned.
57	Export-70	21:12	Chem/FA	20cm	0.5mm	Surface washout. Coarse yellow sand with lots of shell fragments.	Sea spider present 2x5ltr buckets
58	Export-70	21:39	FB/C	20cm	0.5mm	Surface washout. Coarse yellow sand with lots of shell fragments.	2x5ltr buckets each
20-Jul-09							
59	Cal-29	03:56	Chem/FA	50cm	0.5mm	Thick grey clay, 2cm of fine brown silt on the surface. Some sand present.	Fix from steered node, 1x1ltr pot
60	Cal-29	05:04	FB/C	50cm	0.5mm	Thick grey clay, 2cm of fine brown silt on the surface. Some sand present.	1x1ltr each
61	Slope-24	12:33	Chem/FA	50cm	0.5mm	Thick clay, grey in colour, 2cm of brown silt on top.	1x1ltr
62	Slope-24	13:17	FB/C	50cm	0.5mm	Thick clay, grey in colour, 2cm of brown silt on top.	1x1ltr each
21-Jul-09							
63	Cal-41	03:42	Chem/FA	35cm	0.5mm	Fine sandy silt, starfish imprint on the surface. Sediment brown to gray in colour - brown to 2cm depth, grey below.	1x5ltr bucket
64	Cal-41	04:59	FB/C	40cm	0.5mm	Fine sandy silt, starfish imprint on the surface. Sediment brown to gray in colour - brown to 2cm depth, grey below.	1x1ltr pot each
22-Jul-09							
65	Tor-58	14:07	Chem/FA	35cm	0.5mm	Fine sandy silt. Some patches of grey clay with 2cm of brown silt on the surface. Lots of shell fragments.	2x1ltr pots
66	Tor-58	14:57	FB/C	35cm	0.5mm	Fine sandy silt. Some patches of grey clay with 2cm of brown silt on the surface. Lots of shell fragments.	2x1ltr pots each
23-Jul-09							
67	Cal-31	00:55	Chem/FA	40cm	0.5mm	Grey silty clay, brown on the surface. Some shell fragments.	1x1ltr pot
68	Cal-31	01:56	FB/C	45cm	0.5mm	Grey silty clay, brown on the surface. Some shell fragments.	1x1ltr pot each
69	Cal-30	08:30	Chem/FA	35cm	0.5mm	Fine silt overlying grey clay.	1x1ltr pot
CHEM = Physico-chemistry sample; MFA, MFB, MFC = Macrofaunal sample; NA = Failed sampling attempt.							

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

Surveyor's Sampling Logsheet

SEABED SAMPLING LOG SHEET (Surveyor) QPRO-0756

Job No: 7905	**Area:** Browse	**Vessel:** Ocean Endeavour	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)	
Date: from: 18-Jun-09 to: 23-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)		
Project: Browse Pipeline Route Environmental Survey					

Sample Number	Station Number	Fix No.	Time	Retention	Water Depth (m)	Grid Co-ordinates		Offset from target	
						Easting	Northing	Range (m)	Bearing (°)
18-Jun-09									
1	Export36-B-1	336	12:13:11	CHEM	33	366753	8124641	8	357
2	Export36-EB-1	337	12:58:30	FB/FC	32	366753	8124651	2	191
3	Export36-EB-2	338	14:01:31	FA	32	366753	8124646	3	352
4	Export39-No Sample	339	15:35:50	NS	27	367998	8112369	1	042
5	Export39-EB-1	340	16:14:14	CHEM/FA	28	368003	8112370	4	267
19-Jun-09									
6	Export39-EB-2/B-2	341	17:56:01	FB/FC	30	368008	8112373	10	254
7	Export49- No Sample	342	21:11:14	NS	31	378997	8073080	7	188
8	Export49- No Sample	343	22:04:56	NS	32	378998	8073080	7	191
9	Export49-EB-1	344	22:37:42	CHEM/FA	32	379000	8073086	13	198
10	Export49-EB/B-1	345	23:08:48	FB/FC	32	378991	8073077	7	124
11	Export56-EB/B-1	346	00:33:22	CHEM/FA	27	389029	8066023	19	085
12	Export56-EB-1	347	00:54:44	FB/FC	27	389044	8066024	3	084
13	Export53-EB-1	348	02:01:19	CHEM/FA	22	397320	8066519	3	083
14	Export53-EB/B-1	349	02:22:42	FB/FC	22	397323	8066519	0	102
26-Jun-09									
15	Export3-EB-/B-1	707	00:17:05	CHEM/FA	101	346534	8292333	1	290
16	Export3-EB-1	708	00:58:20	FB/FC	102	346534	8292333	1	311
17	Export64-EB/B-1	710	04:44:31	CHEM/FA	97	357514	8313678	14	303
18	Export64-EB-1	711	05:21:28	FB/FC	97	357502	8313687	1	170
19	SBF-42-EB/B-1	713	10:07:42	CHEM/FA	93	368390	8332059	15	041
20	SBF-42-EB-1	714	10:43:32	FB/FC	93	368393	8332059	13	033
21	SBF-41-EB/B-1	715	11:37:12	CHEM/FA	98	369956	8334406	15	015
22	SBF-41-EB-1	716	12:14:46	FB/FC	98	369953	8334411	11	037
23	SBF-43-EB-1	717	12:54:00	CHEM/FA	100	370207	8335046	11	029
24	SBF-43-EB-2	718	13:28:32	FB/FC	100	370212	8335045	11	001
25	SBF-44-EB-1	719	14:07:26	CHEM/FA	98	370890	8334933	7	001
26	SBF-44-EB-2	720	14:41:53	FB/FC	98	370899	8334933	12	307
27-Jun-09									
27	Export11-EB/B-1	722	07:16:48	CHEM/FA	91	345341	8265615	9	121
28	Export11-EB-1	723	07:57:23	FB/FC	90	345338	8265617	13	120
28-Jun-09									
29	Export16-EB-1	725	00:33:48	CHEM/FA	81	346181	8238211	2	135
30	Export16-EB/B-1	726	01:09:52	FB/FC	82	346184	8238212	3	234
31	Export23-EB/B-1	728	03:56:35	CHEM/FA	80	353579	8213432	15	262
32	Export23-EB-1	729	04:39:56	FB/FC	81	353576	8213423	14	299
02-Jul-09									
33	Slope-16-EB/B-1	739	19:03:00	NS	174	365262	8343698	9	205
34	Slope-16-EB-1/B-2	740	19:51:02	CHEM/FA	174	365262	8343694	5	205
35	Slope-16-EB-2	741	20:33:19	FB/FC	174	365260	8343697	7	178
36	Slope-22-EB-1	747	04:00:46	CHEM/FA	230	364592	8353597	4	323
37	Slope-22-EB-2	748	05:10:36	FB/FC	230	364590	8353598	2	354
03-Jul-09									
38	Cal-38-EB-1	749	23:07:31	CHEM/FA	548	353687	8399709	4	083
39	Cal-38-EB-2	750	00:44:09	NS	550	353689	8399711	2	124
40	Cal-38-EB-3	751	01:24:01	FB/FC	545	353687	8399715	6	140
04-Jul-09									
41	Tor-54-EB-1	752	00:38:42	CHEM/FA	561	370004	8452170	1	204
42	Tor-54-EB-2	753	01:45:53	FB/FC	561	370000	8452166	4	049
43	Tor-55-EB-1	754	03:12:01	CHEM/FA	559	369626	8449172	3	096
44	Tor-55-EB-2	755	05:39:32	NS	549	369626	8449170	4	050
45	Tor-55-EB-3	756	06:17:16	FB/FC	556	369623	8449172	6	091
46	Tor-53-EB-1	757	08:44:06	CHEM/FA	392	388103	8449985	3	355
47	Tor-53-EB-2	758	09:35:47	FB/FC	393	388103	8449983	5	357
48	Tor-45-EB-1	759	11:32:44	CHEM/FA	467	392444	8459402	9	299
49	Tor-45-EB-2	760	12:31:04	FB/FC	468	392438	8459400	6	349
50	Tor-43-EB-1	761	17:09:14	CHEM/FA	459	387994	8422592	9	046
51	Tor-43-EB-2	762	17:57:33	FB/FC	459	387989	8422597	12	083
52	Tor-44-EB-1	763	22:45:19	CHEM/FA	474	398354	8462720	13	314
53	Tor-44-EB-2	764	23:39:22	FB/FC	474	398351	8462724	8	309
54	Cal-28-EB-1	810	11:47:55	CHEM/FA	418	356007	8386045	8	306
55	Cal-28-EB-2	811	13:15:05	FB/FC	418	356001	8386047	4	338
18-Jul-09									
56	Export76-EB-1	825	18:03:47	NS	35	366292	8147379	1	157
57	Export70-EB-1/B-1	826	21:12:48	CHEM/FA	54	359689	8186156	10	296
58	Export70-EB-2	827	21:39:37	FB/FC	54	359690	8186153	12	304

CHEM = Physico-chemistry sample; MFA, MFB, MFC = Macrofaunal sample; NS = Failed sampling attempt.
*** Water depth as measured at time of sampling, not corrected to LAT**

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

SEABED SAMPLING LOG SHEET (Surveyor) QPRO-0756

Job No: 7905	**Area:** Browse	**Vessel:** Ocean Endeavour	**Ellipsoid:** GRS 80	**Projection:** UTM Zone 51 S (123°E)	
Date: from: 18-Jun-09 to: 23-Jul-09	**Page:**	**Client:** Woodside Energy Ltd	**Datum:** GDA 94 (2009)		
Project: Browse Pipeline Route Environmental Survey					

Sample Number	Station Number	Fix No.	Time	Retention	Water Depth (m)	Grid Co-ordinates		Offset from target	
						Easting	Northing	Range (m)	Bearing (°)
20-Jul-09									
59	Cal-29-EB-1	841	03:56:32	CHEM/FA	491	349002	8388751	2	254
60	Cal-29-EB-2	842	05:04:11	FB/FC	491	348994	8388752	6	111
61	Slope-24-ENV-EB-1	845	12:33:21	CHEM/FA	355	352409	8372157	11	256
62	Slope-24-ENV-EB-2	846	13:17:43	FB/FC	356	352407	8372154	8	273
21-Jul-09									
63	Cal-41-EB-1	885	03:42:19	CHEM/FA	647	355494	8410208	11	135
64	Cal-41-EB-2	886	04:59:27	FB/FC	646	355481	8410210	23	116
22-Jul-09									
65	Tor-58-EB-1	937	14:07:17	CHEM/FA	345	380266	8398356	3	270
66	Tor-58-EB-2	938	14:57:47	FB/FC	346	380280	8398353	18	280
23-Jul-09									
67	Cal-31-EB-1	1003	00:55:28	CHEM/FA	595	353030	8403293	31	283
68	Cal-31-EB-2	1004	01:56:42	FB/FC	595	353025	8403295	26	280
69	Cal-30-EB-1	1062	08:30:45	CHEM/FA	586	343502	8392206	6	199

CHEM = Physico-chemistry sample; MFA, MFB, MFC = Macrofaunal sample; NS = Failed sampling attempt.
*** Water depth as measured at time of sampling, not corrected to LAT**

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

Environmentalist's Water Profiling Logsheet

WATER PROFILING LOG SHEET (Deck)					
Job No:	7905	**Area:**		**Vessel:** Ocean Endeavour	**Operator:** PN/ CP/ KS/ DC
Date:	from: 05-Jun-09 to: 22-Jul-09	**Page:**		**Client:** Woodside Energy Ltd	**Equipment:** FSI CTD
Project: Browse Pipeline Route Environmental Survey					
Calibration Procedure		Temperature (Celsius)	25	pH (Buffers)	4, 7, 10
Time	15:10	Salinity / Conductivity	NA	Dissolved Oxygen	YES
Date	6/2/2009	Depth (level)	NA	Turbidity	NA
File Number	**File Name**	**Start**	**Stop**	**Interval**	**Date**
		HH:MM	HH:MM	HH:MM	DD/MM/YYYY
Export-52-E-CTD	Env-44	18:52	18:59	0:07	6/5/2009
Export-56-E-CTD	Env-43	5:00	5:23	0:23	6/6/2009
Export-49-E-CTD	Env-42	14:50	15:16	0:26	6/9/2009
Export-39-E-CTD	Env-41	3:58	4:19	0:21	6/10/2009
Export-36-E-CTD	Export-36-CTD	5:49	6:09	0:20	6/16/2009
Export-76-E-CTD	Export-76-CTD	19:19	19:53	0:34	6/16/2009
Export-70-E-CTD	Export-70-CTD	5:37	5:55	0:18	6/17/2009
Export-23-E-CTD	Export-23-CTD	15:45	16:23	0:38	6/20/2009
Export-16-E-CTD	Export-16-CTD	20:48	21:20	0:38	6/22/2009
Export-11-E-CTD	Export-11-CTD	23:46	0:30	0:44	6/23/2009
SBF-42-E-CTD	SBF-42-CTD	23:52	0:38	0:46	6/25/2009
SBF-41-E-CTD	SBF-41-CTD	1:28	1:55	0:27	6/25/2009
SBF-43-E-CTD	SBF-43-CTD	3:10	3:40	0:30	6/25/2009
SBF-44-E-CTD	SBF-44-CTD	4:46	5:08	0:22	6/25/2009
Export-64-E-CTD	Export-64-CTD	11:04	11:30	0:26	6/25/2009
Export-4-E-CTD	Export-4-CTD	19:20	19:49	0:29	6/26/2009
Cal-28-E-CTD	Cal-28-CTD	9:15	10:35	1:20	7/6/2009
Cal-30-E-CTD	Cal-30-CTD	1:56	3:15	1:19	7/6/2009
Cal-31-E-CTD	Cal-31-CTD	5:46	7:27	1:31	7/6/2009
Slope-24-E-CTD	Slope-24-CTD	14:21	15:24	1:03	7/20/2009
Cal-41-E-CTD	Cal-41-CTD	6:14	7:45	1:30	7/21/2009
Cal-38-E-CTD	Cal-38-CTD	11:07	12:28	1:20	7/21/2009
Cal-29-E-CTD	Cal-29-CTD	14:52	16:14	1:20	7/21/2009
Cal-33-E-CTD	Cal-33-CTD	18:55	19:34	0:40	7/21/2009
Tor-57-E-CTD	Tor-57-CTD	21:17	21:51	0:30	7/21/2009
Tor-58-E-CTD	Tor-58-CTD	0:16	0:41	0:25	7/22/2009
Slope-22-E-CTD	Slope-22-CTD	5:18	6:06	0:50	7/22/2009
Slope-16-E-CTD	Slope-16-CTD	8:00	8:52	0:52	7/22/2009

APPENDIX A – FIELD SAMPLING AND IMAGERY LOG SHEETS

Surveyor's Water Profiling Logsheet

WATER PROFILING LOG SHEET (Surveyor)

Job No: 7905	**Area:**	**Vessel:** Ocean Endeavour	**Operator:** PN/ CP/ KS/ DC	**Equipment:** FSI CTD
Date: from: 05-Jun-09 to: 22-Jul-09	**Page:**	**Client:** Woodside Energy Ltd		

Project: Browse Pipeline Route Environmental Survey

File Name	Start Time	End Time	Fix	Surface		Deployment		Seabed		Recovery		
				Easting	Northing	Easting	Northing	Easting	Northing	Easting	Northing	Water Depth (m)
5-Jun-09												
Export52-CTD-1	18:52	18:59	110-113	396831	8066077			396743	8066119	396672	8066150	19
6-Jun-09												
Export56-CTD-1	5:00	5:23	116-119	389189	8066047	389242	8065890	389281	8065776	389318	8065675	26
9-Jun-09												
Export49-CTD-1	14:50	15:16	165-168	379014	8073169	379066	8073099	379086	8073084	379166	8073011	32
10-Jun-09												
Export39-CTD-1	3:58	4:19	200-203	368065	8112507	368157	8112515	368187	8112527	368202	8112563	34
16-Jun-09												
Export 36-CTD-1	5:49	6:09	232-235	366919	8124632	366942	8124631	366957	8124624	366971	8124633	34
Export76-CTD-1	19:19	19:53	278-283	366849	8147522	366940	8147556	366993	8147539	367093	8147629	36
17-Jun-09												
Export70-CTD-1	5:37	5:55	330-333	359715	8186056	359810	8186004	359818	8186008	359812	8186019	54
20-Jun-09												
Export23-CTD-1	15:45	16:23	394-397	353522	8213414	353351	8213398	353266	8213541	353065	8213599	81
22-Jun-09												
Export16-CTD-1	20:48	21:20	421-424	346218	8238188	346215	8238186	346221	8238186	346222	8238186	82
23-Jun-09												
Export11-CTD-1	23:46	0:30	457-461	345396	8265575	345398	8265586	345401	8265583	345341	8265567	90
25-Jun-09												
SBF-42-CTD-1	23:52	0:38	551-555	368424	8332072	368290	8331939	368314	331981	368233	8331975	96
SBF-41-CTD-1	1:28	1:55	557-561	369944	8334325	369985	8334360	370130	8334438	370197	8334500	101
SBF-4-CTD-1	3:10	3:40	599-603	370325	8335212	370235	8335047	370239	8335063	370221	8335081	103
SBF-5-CTD-1	4:46	5:08	624-627	370898	8335374	370949	8335506	371007	8335554	371043	8335587	102
Export64-CTD-1	11:04	11:30	634-637	357543	8313696	357557	8313711	357435	8313712	357297	8313692	93
26-Jun-09												
Export4-CTD-1	19:20	19:49	698-702	346118	8291866	346105	8291809	346092	8291777	346091	8291716	85
6-Jul-09												
Cal-28-CTD-1	9:15	10:35	804, 805,807,808	355944	8386142	355808	8386137	355968	8386064	356006	8386108	418
Cal-30-CTD-1	1:56	3:15	813,814,816,817	342907	8392043	342953	8391466	342462	8392641	343500	8392250	615
Cal-31-CTD-1	5:46	7:27	819,821,822,823	353330	8402855	353005	8403117	351642	8403919	350418	8404576	643
20-Jul-09												
Slope-24-CTD-1	14:21	15:24	847-850	352431	8372210	352402	8372182	352408	8372193	352394	8372179	355
21-Jul-09												
Cal-41-CTD-1	6:14	7:45	887-891	355470	8410238	355495	8410227	355456	8410225	355378	8410206	644
Cal-38-CTD-1	11:07	12:28	894-897	353582	8400071	353688	8400343	354443	8401076	354782	8401832	553
Cal-29-CTD-1	14:52	16:14	900-903	348854	8388180	348934	8388487	348873	8389296	348900	8388800	508
Cal-33-CTD-1	18:55	19:34	906,907,909,910	361744	8374707	361662	8374908	361544	8375191	361512	8375491	320
Tor-57-CTD-1	21:17	21:51	912,913,914,915	372499	8373152	372372	8373632	372465	8373717	372465	8374110	277
22-Jul-09												
Tor-58-CTD-1	0:16	0:41	918,919,921,922	380903	8398429	381147	8398791	381473	8399195	381803	8399974	344
Slope-22-CTD-1	5:18	6:06	924-927	364377	8353615	364169	8354025	363746	8354697	363395	8355403	233
Slope-16-CTC-1	8:00	8:52	930-934	365528	8343192	365062	8343726	364745	8344024	364389	8344409	171

APPENDIX B – SEABED IMAGERY PHOTOGRAPHS

APPENDIX B –SEABED PHOTOGRAPHS

Station Export-4-E-Cam

Fix No: 676
Location: 346245E, 8291781N
Depth: 89m

Sediment Description
Rocky seabed with coarse sand and shell hash. Patchy slopes with large flat outcrops. Possible sunken reef.

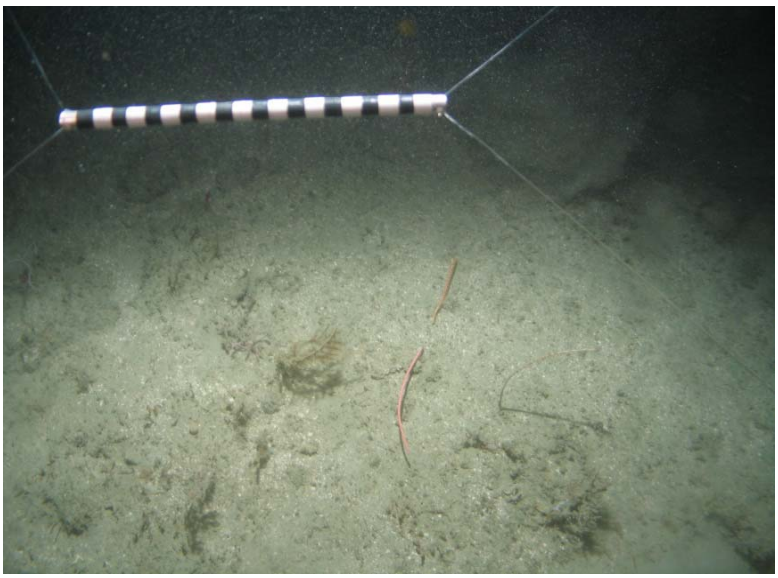
Flora and Fauna
Hard corals, sponges, sea whips.

Station Export-4-E-Cam

Fix No: 681
Location: 346233E, 8291798N
Depth: 89m

Sediment Description
Rocky seabed with coarse sand and shell hash. Patchy slopes with large flat outcrops. Possible sunken reef.

Flora and Fauna
Hard corals, seawhips and a sea pens (Pennatulidae).



Station Export-4-E-Cam

Fix No: 693
Location: 346231E, 8291833N
Depth: 95m

Sediment Description
Coarse sand with high density of shell hash. Large rocky outcrop visible.

Flora and Fauna
Hard corals, seafans, seawhips and hydroid. Loose sediment obstructing thorough identification.

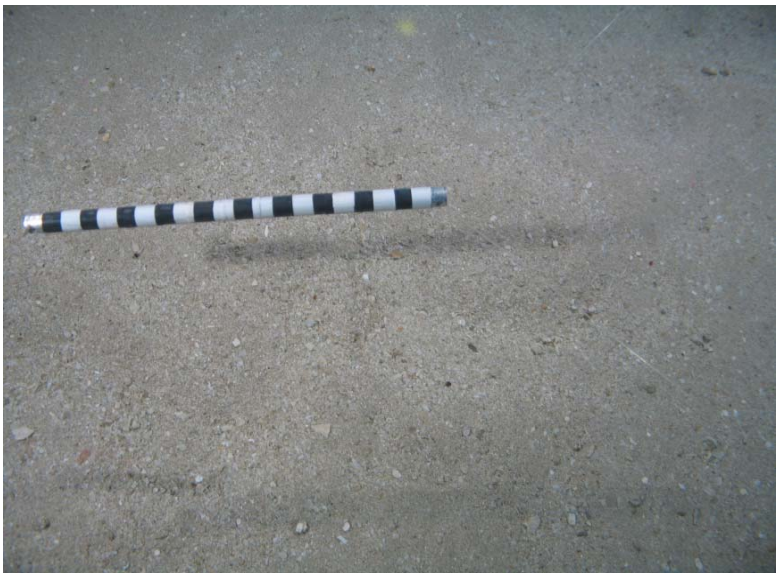
APPENDIX B –SEABED PHOTOGRAPHS

Station Export-11-E-Cam

Fix No: 466
Location: 345380E, 8265609N
Depth: 91m

Sediment Description
Fine to medium sand with shell fragments.

Flora and Fauna
No visible fauna.



Station Export-11-E-Cam

Fix No: 476
Location: 345360E, 8265649N
Depth: 91m

Sediment Description
Fine to medium sand with shell fragments.

Flora and Fauna
No visible fauna.

Station Export-11-E-Cam

Fix No: 481
Location: 345359E, 8265657N
Depth: 90m

Sediment Description
Fine to medium sand with shell fragments

Flora and Fauna
No visible fauna.

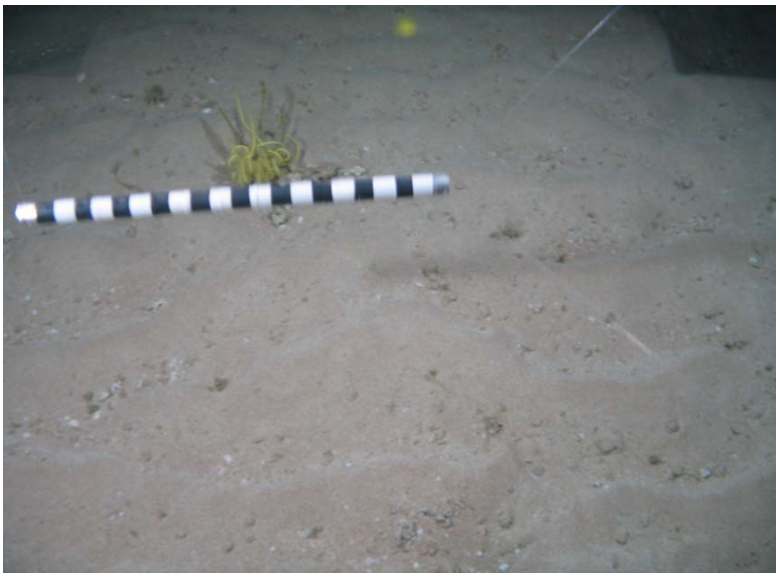
APPENDIX B –SEABED PHOTOGRAPHS

Station Export-16-E-Cam

Fix No: 435
Location: 346227E, 8238175N
Depth: 82m

Sediment Description
Coarse sand with gravel and shell fragments.

Flora and Fauna
Evidence of bivalves and gastropods from shell fragments.

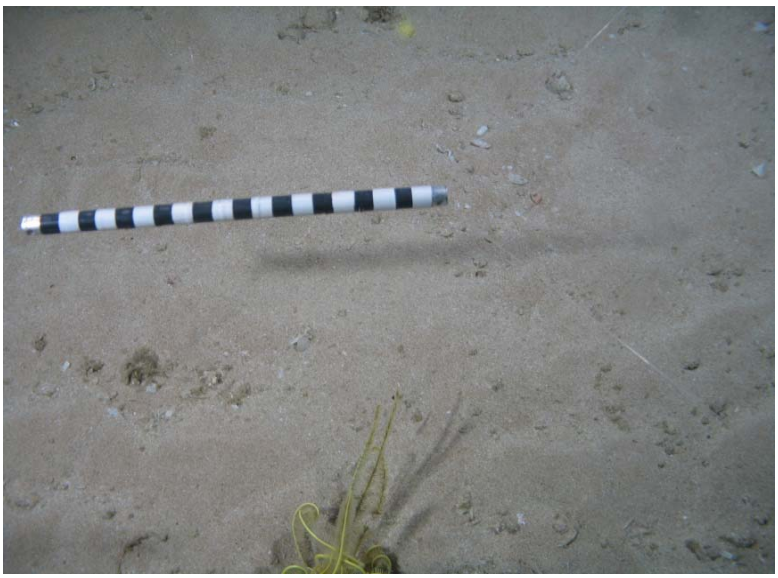


Station Export-16-E-Cam

Fix No: 440
Location: 346233E, 8238178N
Depth: 82m

Sediment Description
Lightly rippled medium to coarse sand with gravel and shell fragments.

Flora and Fauna
Feather star (Comasteridae; possibly *Oxycomanthus bennetti)* and faunal burrows.



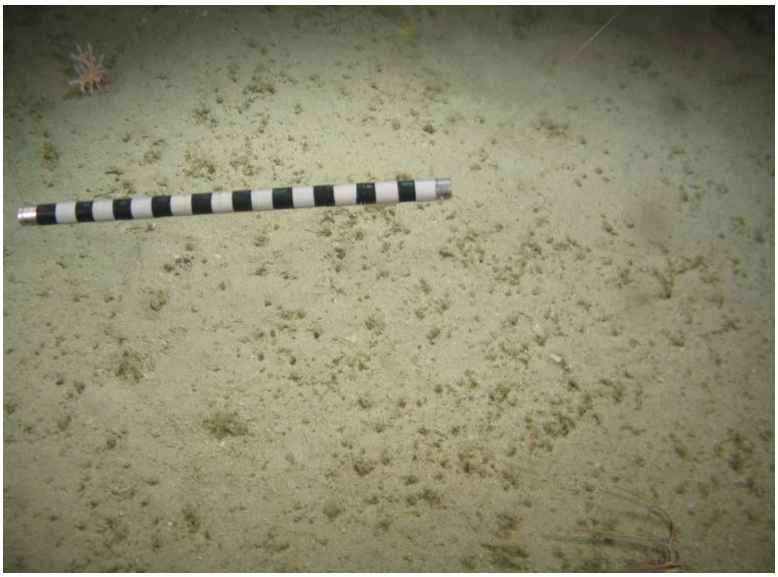
Station Export-16-E-Cam

Fix No: 443
Location: 346233E, 8238179N
Depth: 83m

Sediment Description
Fine sand with shell fragments. Lightly rippled.

Flora and Fauna
Feather star (Comasteridae; possibly *Oxycomanthus bennetti).*

APPENDIX B –SEABED PHOTOGRAPHS



Station Export-23-E-Cam

Fix No: 372
Location: 353534E, 8213571N
Depth: 81m

Sediment Description
Fine to coarse sand with shell fragments and some bioturbation.

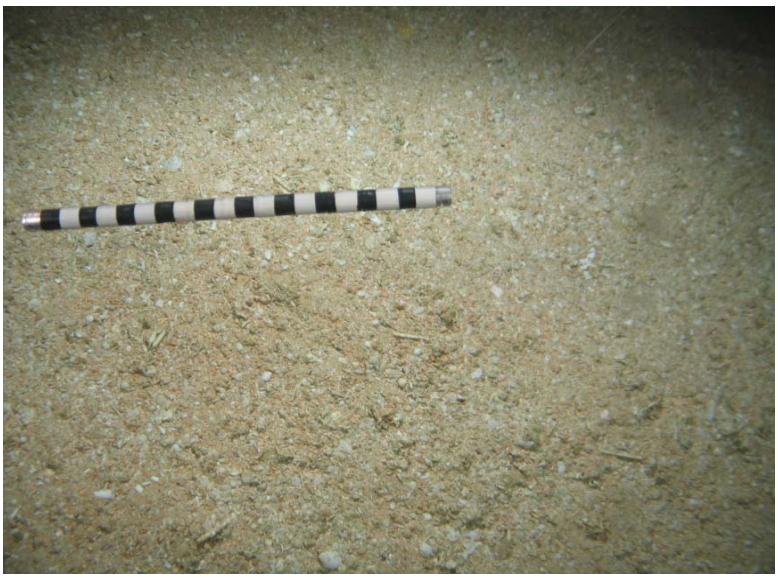
Flora and Fauna
Coral debris and faunal burrows, a possible whip coral (Gorgonacea).

Station Export-23-E-Cam

Fix No: 375
Location: 353525E, 8213563N
Depth: 81m

Sediment Description
Fine sand with some gravel, or coral debris, and shell hash.

Flora and Fauna
Sponges, feather stars (crinoids), hydroids, bryozoans, sea pen (Pennatulidae) and fan corals (Gorgonacea).



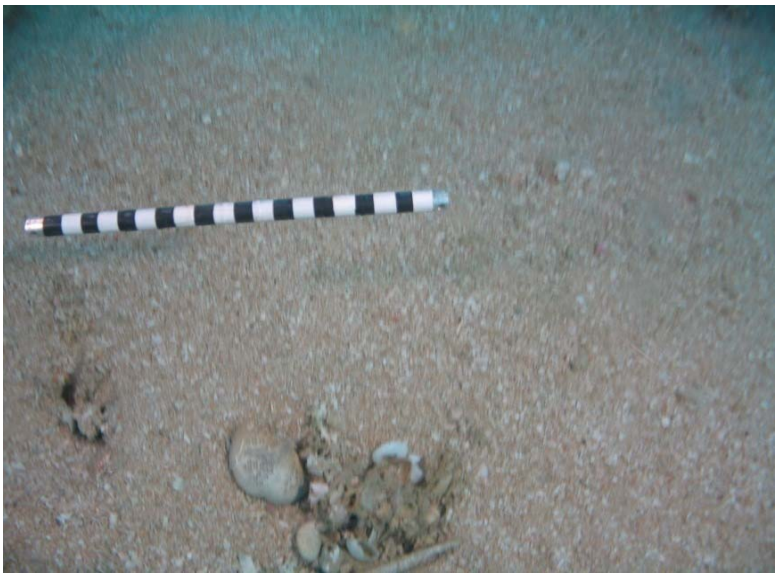
Station Export-23-E-Cam

Fix No: 389
Location: 353474E, 8213465N
Depth: 80m

Sediment Description
Fine to coarse sand with lots of shell hash and occasional coral debris.

Flora and Fauna
Bivalves and gastropods present, unclear whether living. Large amount of shell hash.

APPENDIX B –SEABED PHOTOGRAPHS



Station Export-34-E-Cam

Fix No: 293
Location: 366470E, 8163614N
Depth: 40m

Sediment Description
Coarse sand with shell fragments.

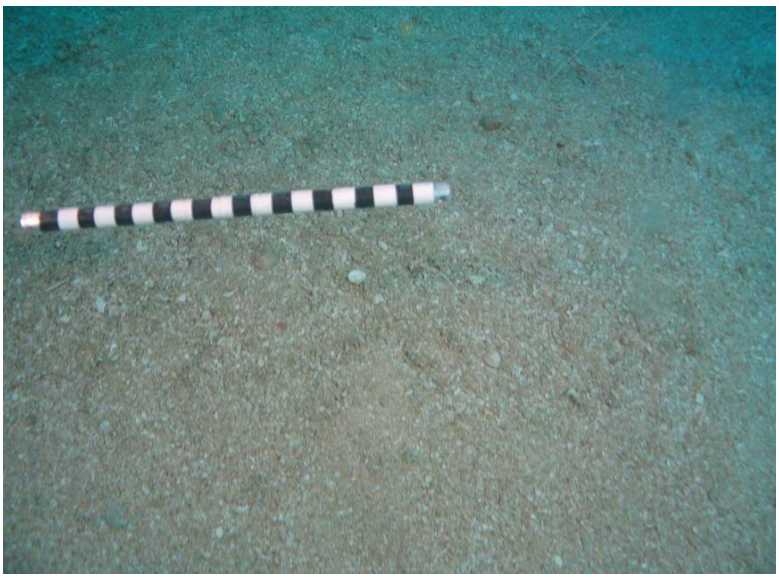
Flora and Fauna
Coral debris. Large amount of shell hash.

Station Export-34-E-Cam

Fix No: 297
Location: 366507E, 8163629N
Depth: 40m

Sediment Description
Coarse sand with shell fragments.

Flora and Fauna
Large amount of shell hash with occasional faunal tubes. Some evidence of porifera.



Station Export-34-E-Cam

Fix No: 301
Location: 366516E, 8163650N
Depth: 40m

Sediment Description
Coarse sand with shell fragments.

Flora and Fauna
Large amounts of shell hash, with occasional faunal burrows.

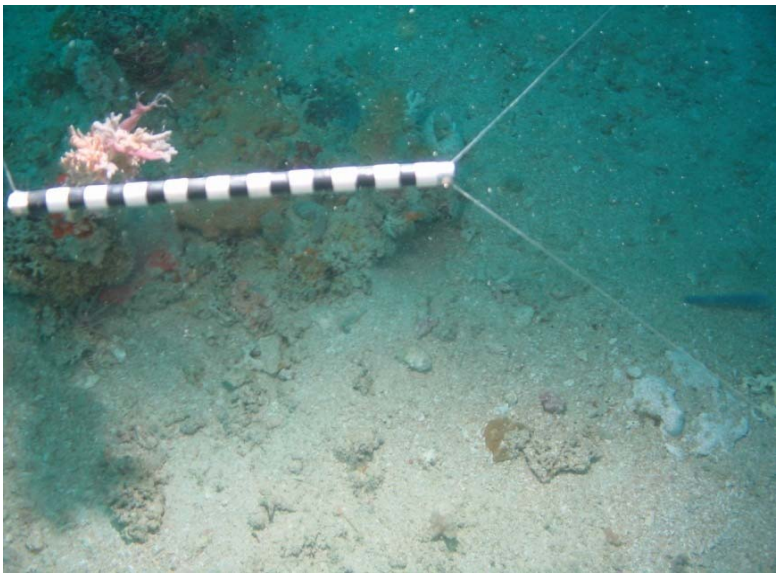
APPENDIX B –SEABED PHOTOGRAPHS

Station Export-36-E-Cam

Fix No: 222
Location: 366860E, 8124644N
Depth: 34m

Sediment Description
Fine to coarse sand with shell fragments and some bioturbation.

Flora and Fauna
Faunal burrows visible with a possible soft coral.

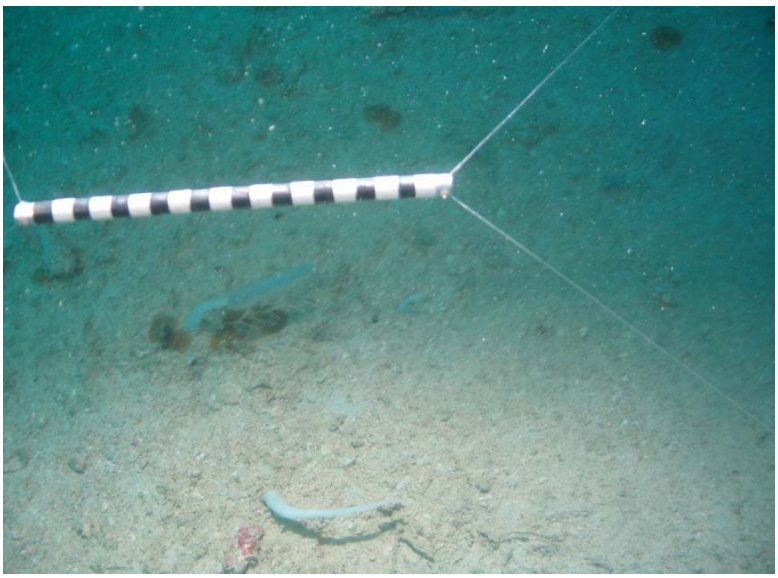


Station Export-36-E-Cam

Fix No: 225
Location: 366864E, 8124644N
Depth: 34m

Sediment Description
Fine to coarse sand with shell fragments and some bioturbation. Outcrops of hard substrata.

Flora and Fauna
Corals (Possible *Acropora* sp.), hydroids and a small unidentified fish.



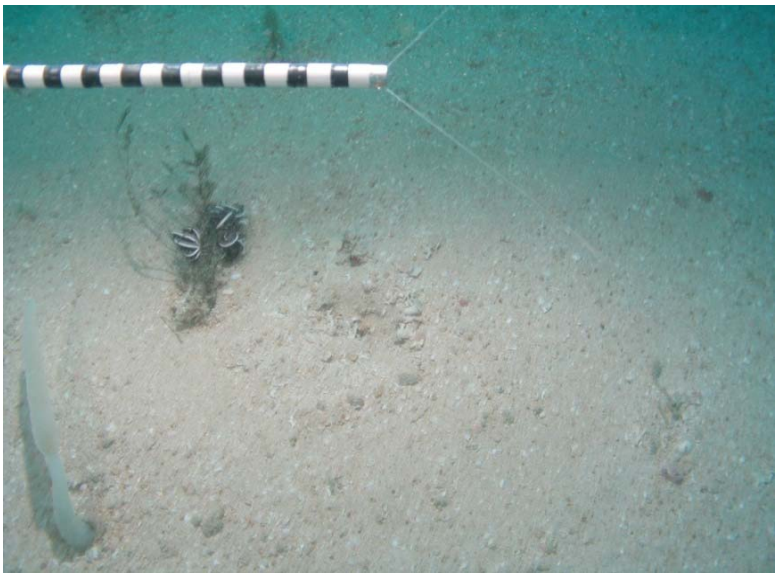
Station Export-36-E-Cam

Fix No: 228
Location: 366881E, 8124647N
Depth: 34m

Sediment Description
Fine to coarse sand with shell fragments and some bioturbation.

Flora and Fauna
Faunal burrows visible. Unidentified organisms.

APPENDIX B –SEABED PHOTOGRAPHS

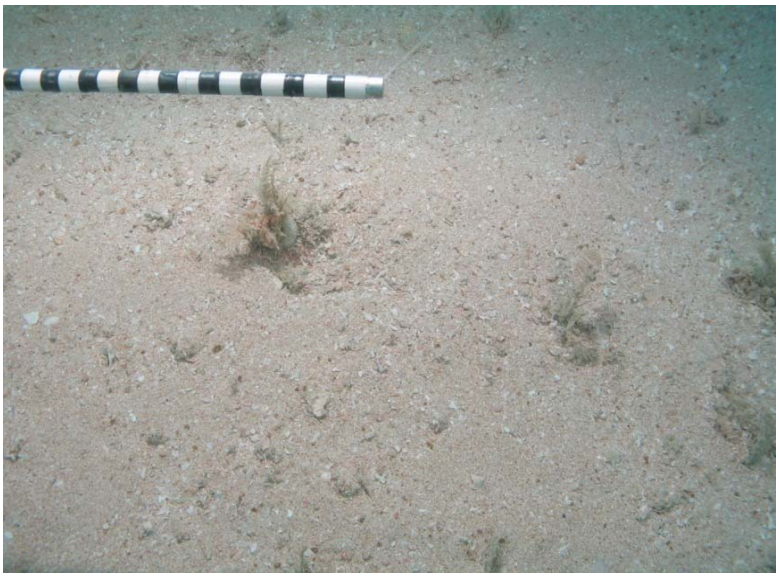


Station Export-39-E-Cam

Fix No: 192
Location: 368088E, 8112440N
Depth: 34m

Sediment Description
Coarse to fine sand with shell fragments and some bioturbation.

Flora and Fauna
Hydroids, feather stars (crinoids) and a possible unidentified soft coral.

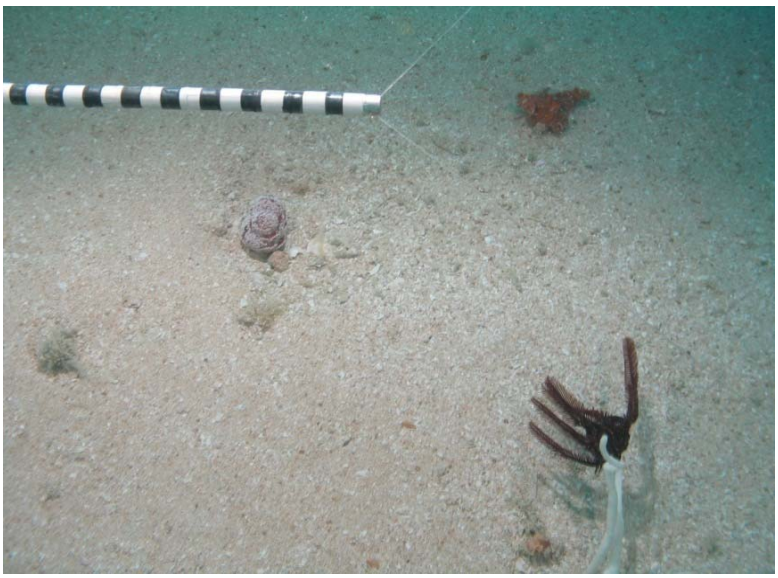


Station Export-39-E-Cam

Fix No: 194
Location: 368059E, 8114217N
Depth: 34m

Sediment Description
Coarse to fine sand with shell fragments and some bioturbation.

Flora and Fauna
Hydroid, possible octocoral and a coral. Possible Pennatulidae.



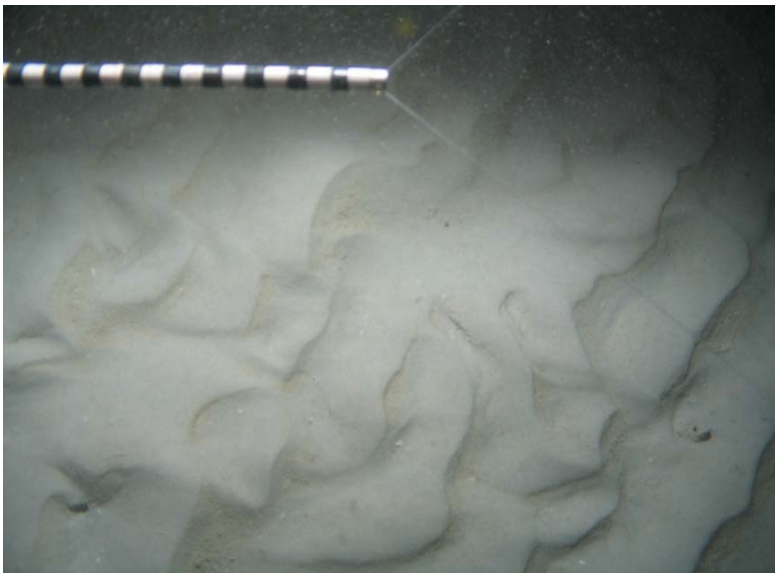
Station Export-39-E-Cam

Fix No: 197
Location: 368026E, 8112403N
Depth: 31m

Sediment Description
Coarse to fine sand with shell fragments and some bioturbation.

Flora and Fauna
Corals, sponge with feather star (Crinoid) on top and hydroids.

APPENDIX B –SEABED PHOTOGRAPHS



Station Export-49-E-Cam

Fix No: 153
Location: 378995E, 8073134N
Depth: 32m

Sediment Description
Fine sand with some silt and shell fragments, lightly rippled with some bioturbation. Some suspended sediment.

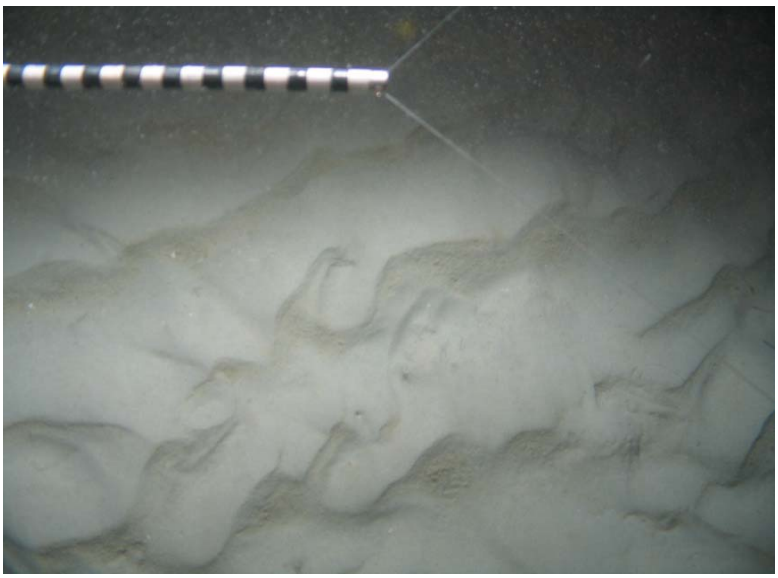
Flora and Fauna
Faunal burrows.

Station Export-49-E-Cam

Fix No: 158
Location: 379015E, 8073115N
Depth: 32m

Sediment Description
Lightly rippled fine, silty, sand with some shell fragments and bioturbation. Some suspended sediment.

Flora and Fauna
Faunal burrows.



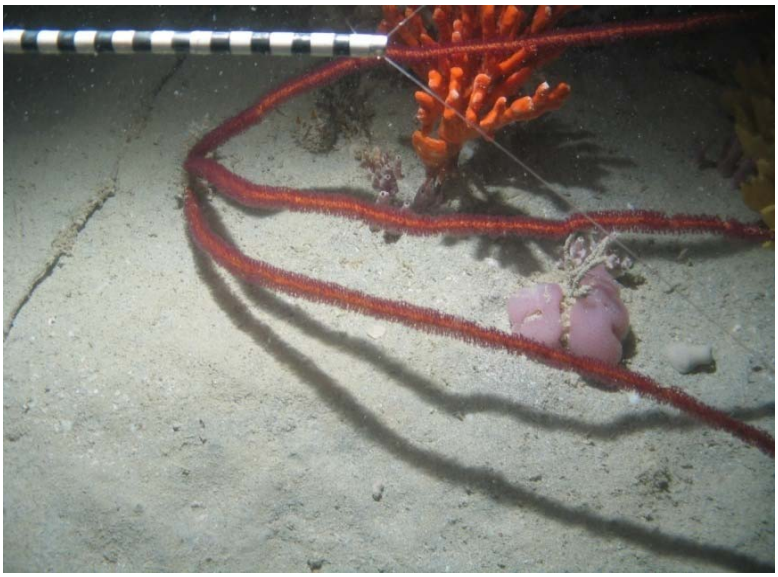
Station Export-49-E-Cam

Fix No: 162
Location: 379017E, 8073090N
Depth: 32m

Sediment Description
Fine sand with some silt and shell fragments, lightly rippled with some bioturbation. Some suspended sediment.

Flora and Fauna
Faunal burrows.

APPENDIX B –SEABED PHOTOGRAPHS

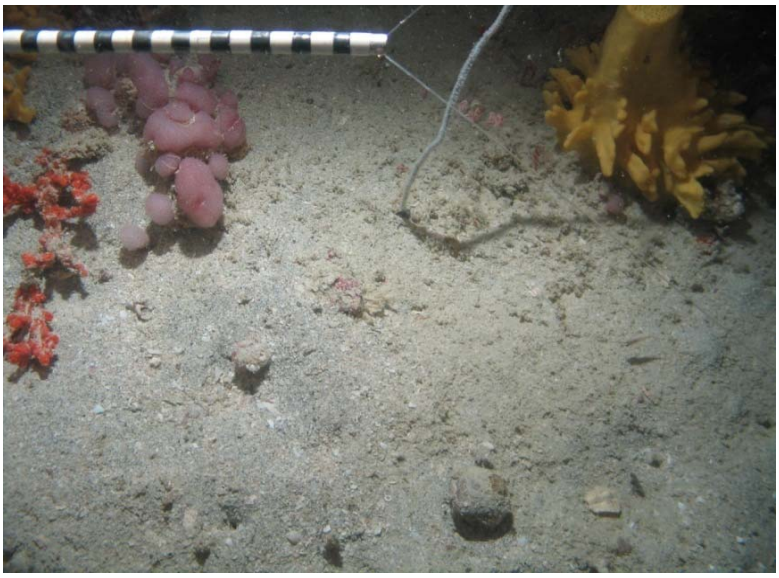


Station Export-52-E-Cam

Fix No: 72
Location: 397307E, 8065476N
Depth: 21m

Sediment Description
Fine sand with shell fragments, lightly rippled with some bioturbation.

Flora and Fauna
Corals (Gorgonacea and Acroporidae), including sea whips possibly *Ellisella* sp. and encrusting coral possibly *Montipora* sp. Unidentified porifera.

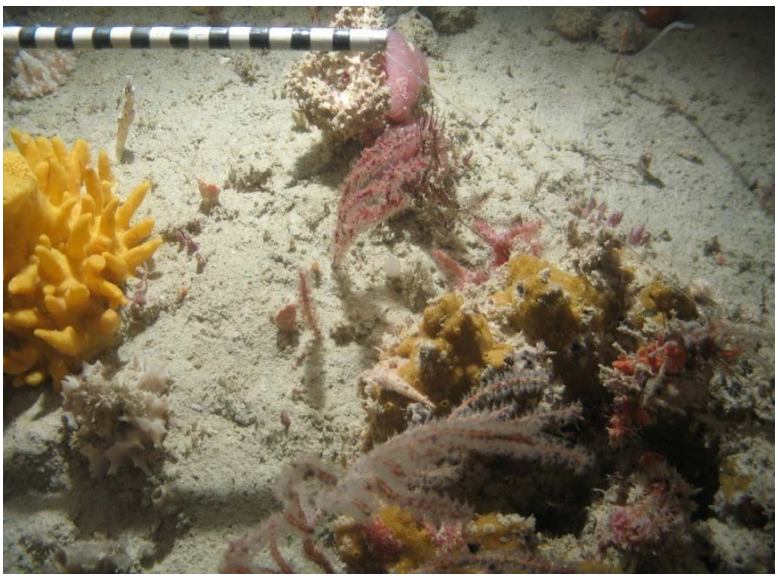


Station Export-52-E-Cam

Fix No: 79
Location: 397314E, 8065503N
Depth: 21m

Sediment Description
Lightly rippled fine sand with some shell fragments and bioturbation.

Flora and Fauna
Corals (Gorgonacea and Acroporidae), including sea whips (possibly *Junceella* spp.) Brittle star (Ophuiroidea), indeterminate poriferan. Unidentified fish. Faunal burrows.



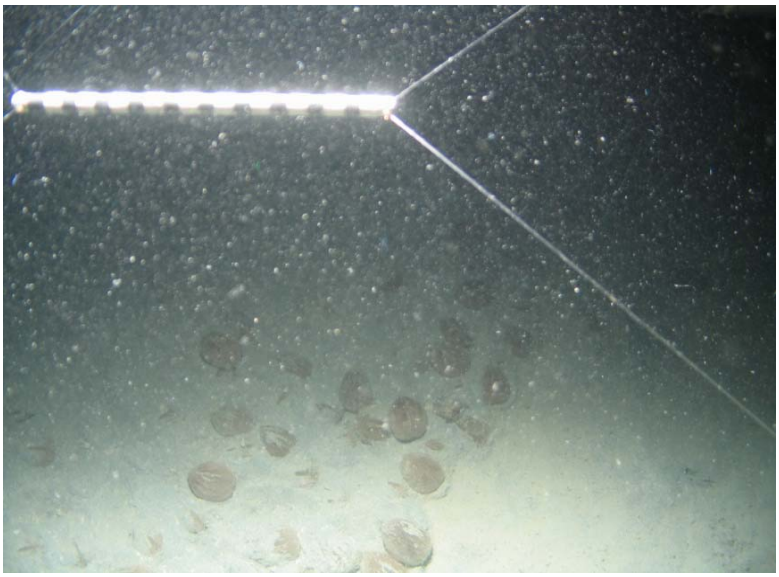
Station Export-52-E-Cam

Fix No: 90
Location: 397307E, 8065550N
Depth: 20m

Sediment Description
Fine sand with shell fragments snd some bioturbation.

Flora and Fauna
Corals (Gorgonacea and Acroporidae), feather star (Crinoidea), sea whip (possibly *Junceella* Spp.) brittle star (Ophiuroidea), sea fans (possibly *Plexauridae* sp.) and gastropod (possibly *Terebra sp*.). Unidentified porifera.

APPENDIX B –SEABED PHOTOGRAPHS

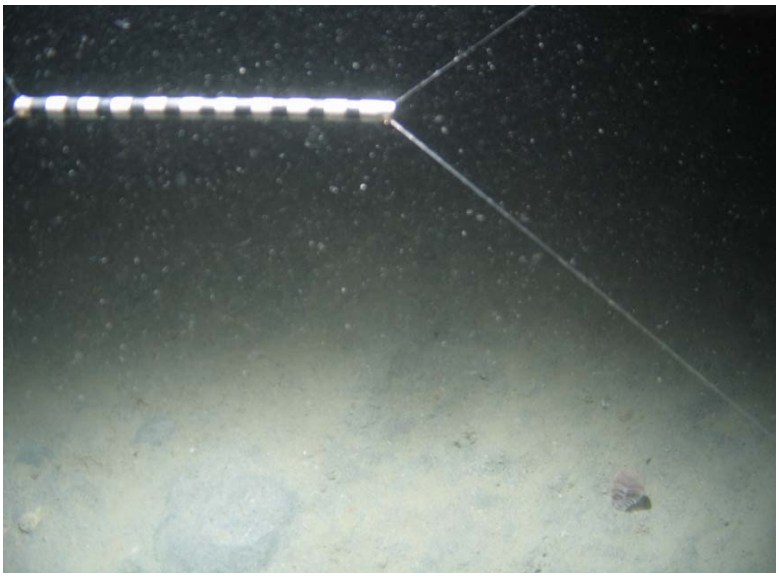


Station Export-53-E-Cam

Fix No: 18
Location: 397343E, 8066263N
Depth: 22m

Sediment Description
Sandy with shell fragments.

Flora and Fauna
Echinoderms (Heart urchin, possibly *Breynia sp.*), occasional burrows with lots of fish present.

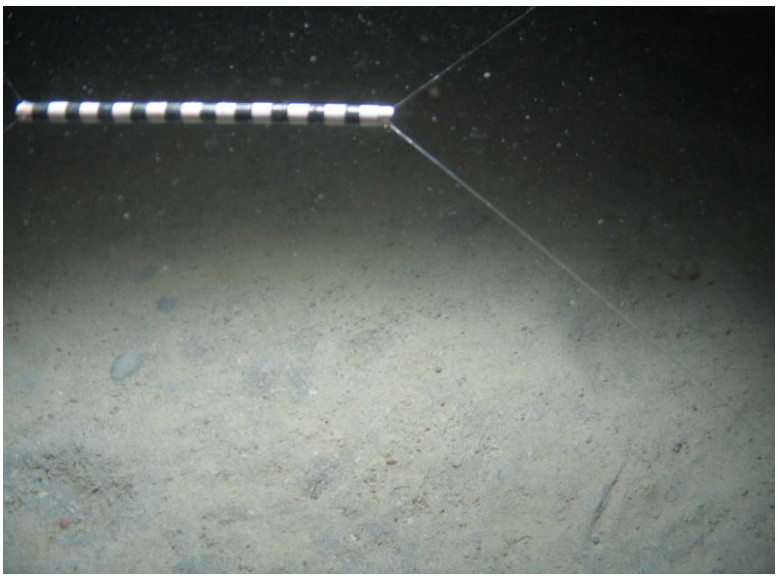


Station Export-53-E-Cam

Fix No: 27
Location: 397366E, 8066247N
Depth: 22m

Sediment Description
Fine sand with some shell fragments and bioturbation. Some suspended sediment in water column.

Flora and Fauna
Cnidarian (Sea pen, Pennatulidae). Lebensspuren in the form of burrows and faunal tracks.



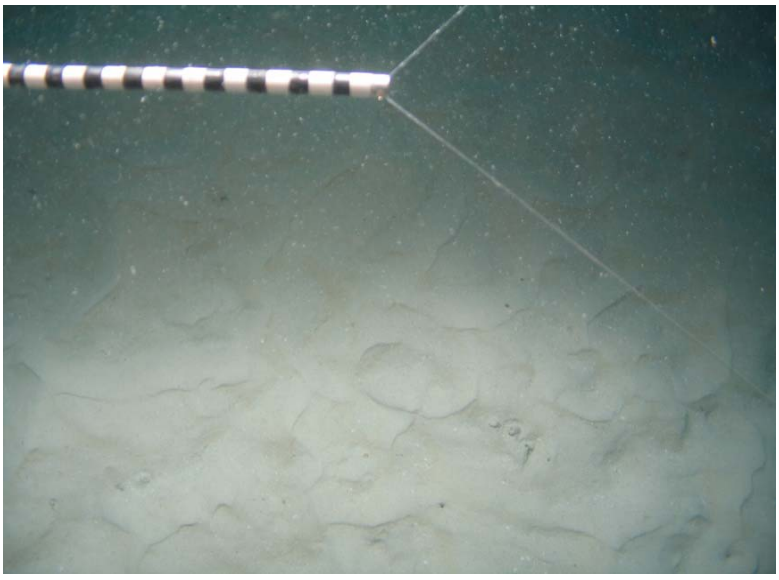
Station Export-53-E-Cam

Fix No: 38
Location: 397402E, 8066247N
Depth: 22m

Sediment Description
Fine sand with shell fragments, lightly rippled with some bioturbation. Some suspended sediment in the water column.

Flora and Fauna
No visible fauna. Some faunal tracks and bioturbation. Faunal tubes and casts visible on seabed.

APPENDIX B –SEABED PHOTOGRAPHS



Station Export-56-E-Cam

Fix No: 129
Location: 388856E, 8065967N
Depth: 24m

Sediment Description
Fine sand with some silt and shell fragments, lightly rippled with some bioturbation.

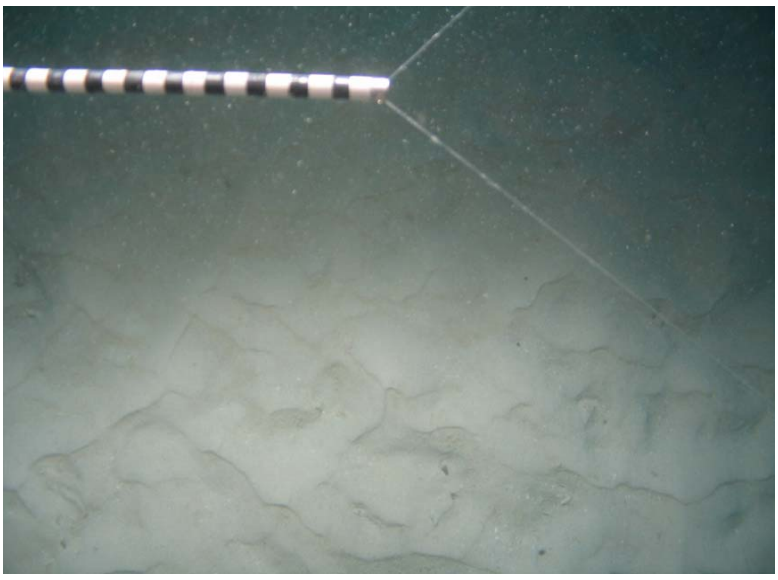
Flora and Fauna
Faunal burrows.

Station Export-56-E-Cam

Fix No: 135
Location: 388842E, 8065931N
Depth: 24m

Sediment Description
Lightly rippled fine sand with some shell fragments, silt and bioturbation.

Flora and Fauna
Faunal burrows.



Station Export-56-E-Cam

Fix No: 141
Location: 388832E, 8065904N
Depth: 24m

Sediment Description
Fine sand with some silt and shell fragments, lightly rippled with some bioturbation.

Flora and Fauna
Faunal burrows.

APPENDIX B –SEABED PHOTOGRAPHS

Station Export-64-E-Cam

Fix No: 645
Location: 356765E, 8313329N
Depth: 96m

Sediment Description
Lightly rippled fine sandy seabed, some shell fragments, some bioturbation.

Flora and Fauna
No visible fauna.

Station Export-64-E-Cam

Fix No: 656
Location: 356755E, 8313326N
Depth: 96m

Sediment Description
Lightly rippled fine sandy seabed, some shell fragments, some bioturbation.

Flora and Fauna
Anemone (Actiniaria) and unidentified fish.

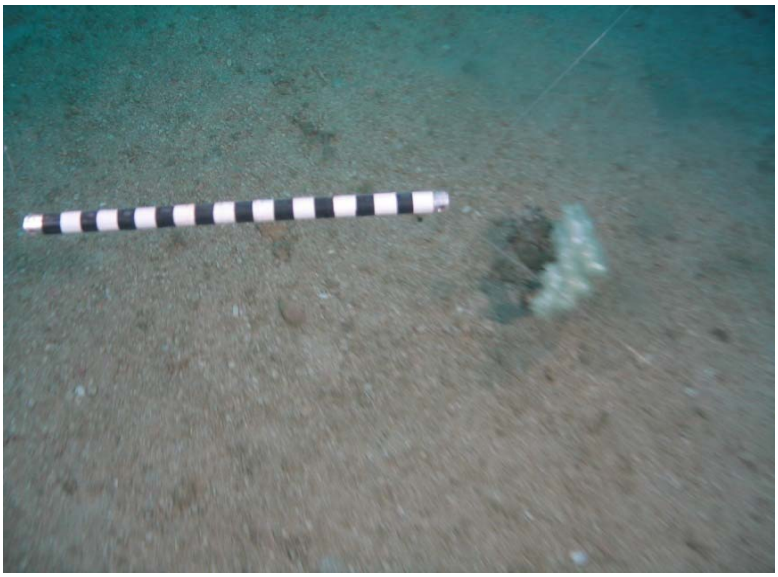
Station Export-64-E-Cam

Fix No: 661
Location: 356785E, 8313343N
Depth: 96m

Sediment Description
Lightly rippled fine sandy seabed, some shell fragments, some bioturbation.

Flora and Fauna
Unidentified polyps.

APPENDIX B –SEABED PHOTOGRAPHS

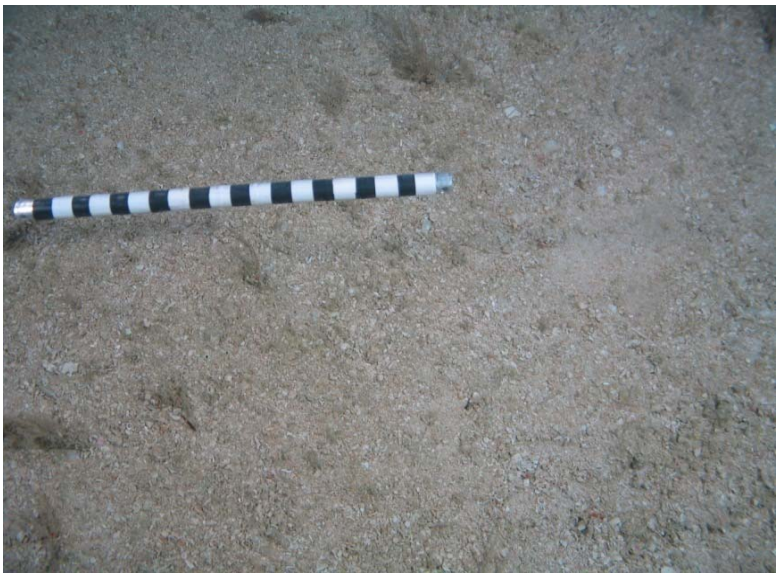


Station Export-70-E-Cam

Fix No: 321
Location: 359706E, 8186103N
Depth: 54m

Sediment Description
Coarse sand with shell fragments.

Flora and Fauna
Coral debris and shell hash.

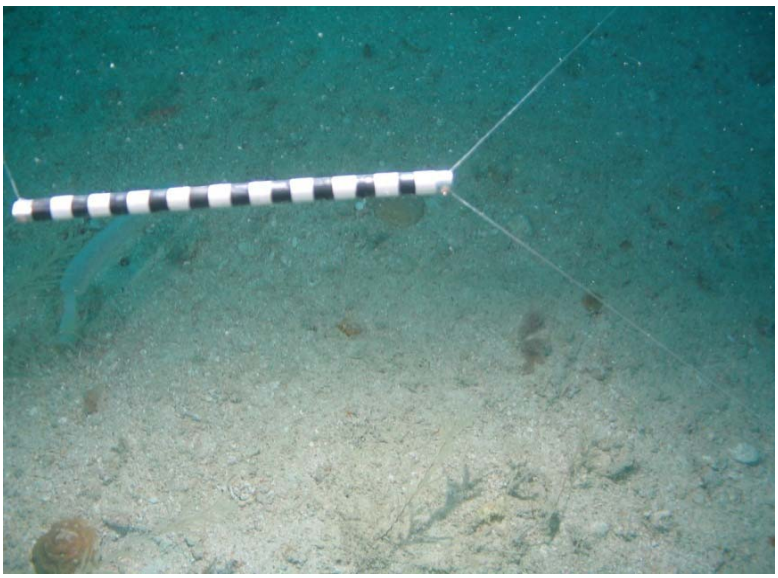


Station Export-70-E-Cam

Fix No: 327
Location: 359728E, 8186071N
Depth: 54m

Sediment Description
Coarse sand with shell fragments.

Flora and Fauna
Hydroids. Large amounts of shell fragments and shell hash.



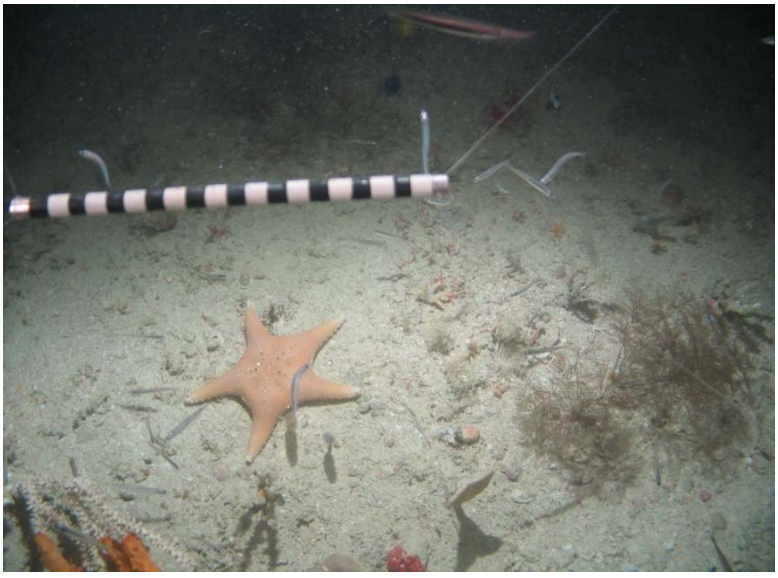
Station Export-70-E-Cam

Fix No: 328
Location: 359734E, 8186069N
Depth: 54m

Sediment Description
Fine to coarse sand with shell fragments.

Flora and Fauna
Porifera, hydroids and soft corals. Large amounts of shell hash

APPENDIX B –SEABED PHOTOGRAPHS

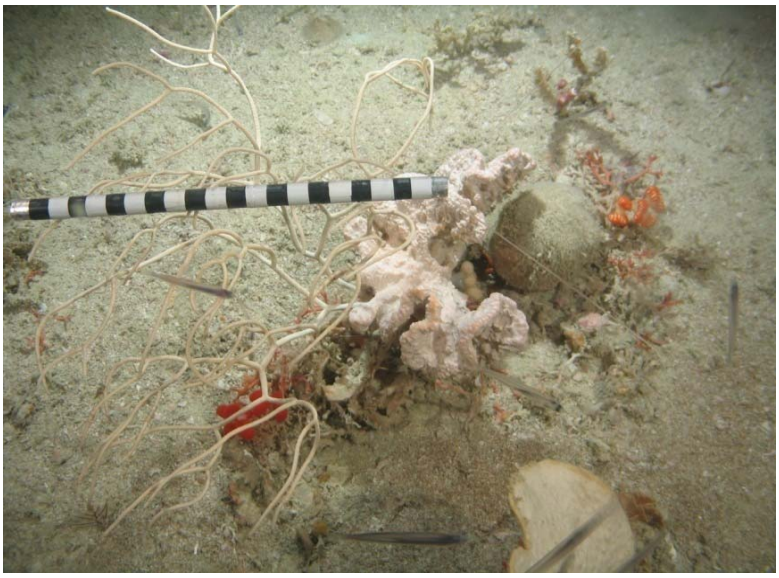


Station Export-76-E-Cam

Fix No: 258
Location: 366460E, 8147449N
Depth: 36m

Sediment Description
Fine to coarse sand with shell fragments.

Flora and Fauna
Cushion star (Oreasteridae), sea urchin (indeterminate) octocorals, unidentified fish, possible Pennatulidae, unknown Gorgonian (possible whip coral) and hydroids.



Station Export-76-E-Cam

Fix No: 264
Location: 366483E, 8147443N
Depth: 36m

Sediment Description
Fine to coarse sand with shell fragments. Outcrops of hard substrata.

Flora and Fauna
Gorgonian (Possible sea whip and whip coral), porifera, unidentified corals and unknown fish.

Station Export-76-E-Cam

Fix No: 272
Location: 366548E, 8147438N
Depth: 36m

Sediment Description
Fine to coarse sand with shell fragments.

Flora and Fauna
Sea urchin, Sea fans (Gorgonacea), Sea whips, unidentified blue coral, soft corals, pennatulid and porifera.

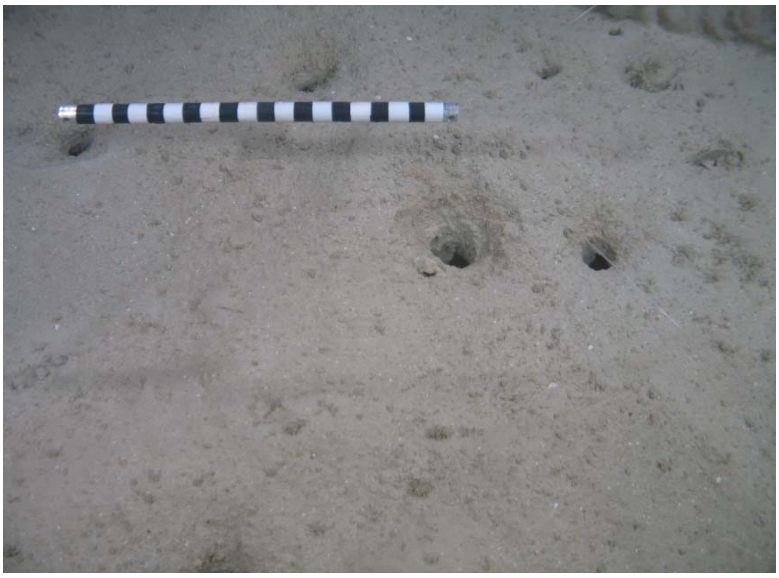
APPENDIX B –SEABED PHOTOGRAPHS

Station Cal-28-E-Cam

Fix No: 780
Location: 355953E, 8386052N
Depth: 416m

Sediment Description
Soft sandy clay with surface silt.

Flora and Fauna
Flattened seapen (Pennatulidae) and a squat lobster (Galatheidae) .

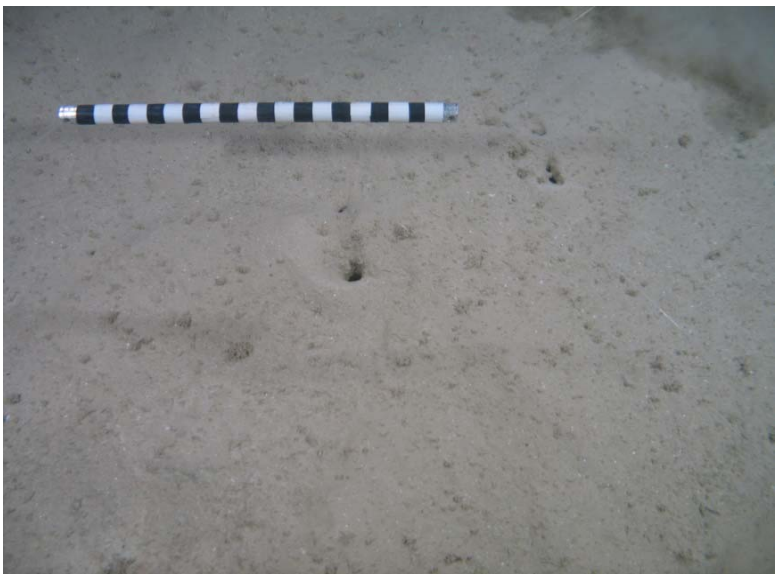


Station Cal-28-E-Cam

Fix No: 782
Location: 355954E, 8386057N
Depth: 416m

Sediment Description
Soft sandy clay with surface silt.

Flora and Fauna
Large faunal burrows (Possibly Nephrops) and a small bryozoan.



Station Cal-28-E-Cam

Fix No: 795
Location: 355961E, 8386034N
Depth: 416m

Sediment Description
Soft sandy clay with surface silt.

Flora and Fauna
Faunal burrows.

APPENDIX B –SEABED PHOTOGRAPHS

Station Cal-29-E-Cam

Fix No: 1105
Location: 348975E, 8388778N
Depth: 489m

Sediment Description
Fine silt overlying soft clay.

Flora and Fauna
Possible bryozoans.

Station Cal-29-E-Cam

Fix No: 1112
Location: 348989E, 8388764N
Depth: 488m

Sediment Description
Fine silt overlying soft clay.

Flora and Fauna
No visible fauna. Evidence of bioturbation and faunal burrows.

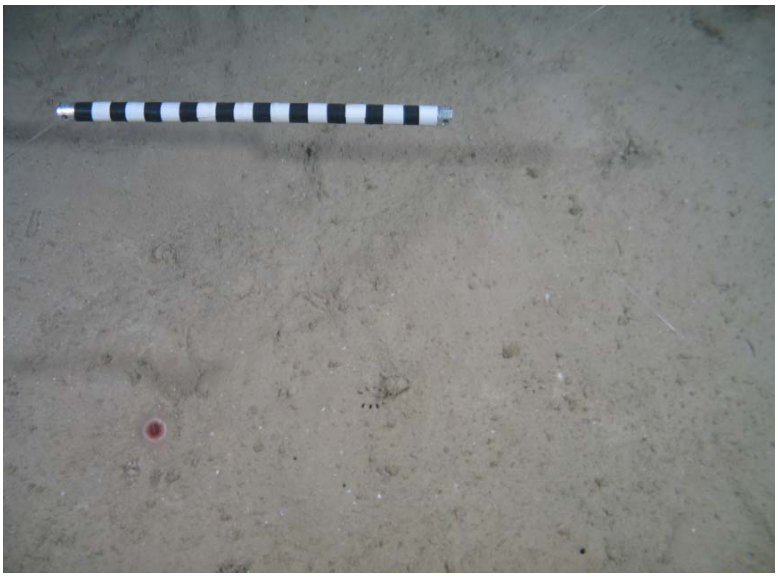
Station Cal-29-E-Cam

Fix No: 1115
Location: 348992E, 8388752N
Depth: 488m

Sediment Description
Fine silt overlying soft clay.

Flora and Fauna
Unidentified organism protruding from seabed. Faunal burrows.

APPENDIX B –SEABED PHOTOGRAPHS

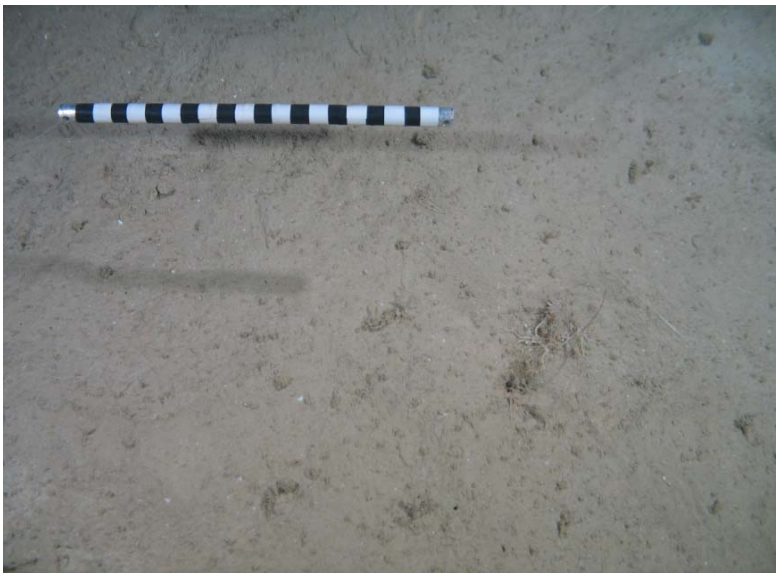


Station Cal-30-E-Cam

Fix No: 1065
Location: 343454E, 8392252N
Depth: 586m

Sediment Description
Fine silt overlying soft clay with occasional shell fragments.

Flora and Fauna
Anemone (Actiniaria) and faunal burrows.

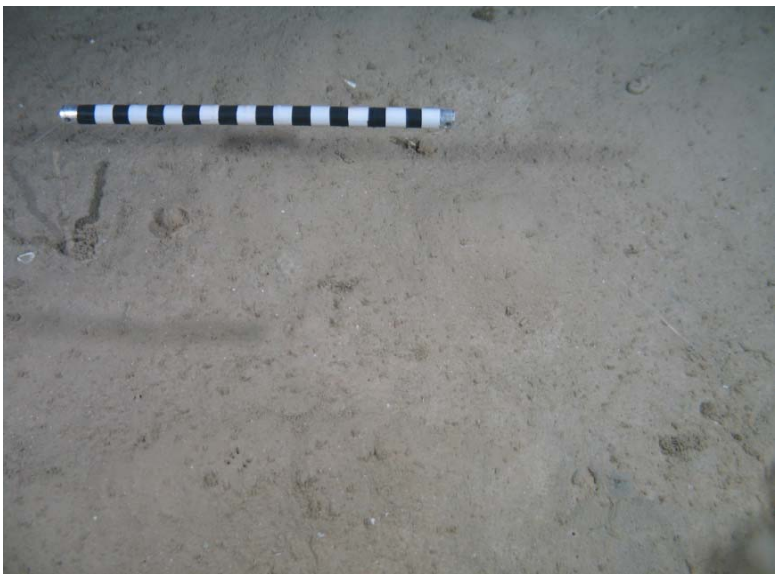


Station Cal-30-E-Cam

Fix No: 1078
Location: 343475E, 8392233N
Depth: 584m

Sediment Description
Fine silt overlying soft clay with occasional shell fragments.

Flora and Fauna
Brittlestar and basket star (Ophiuroidea), faunal burrows and polychaete tubes.



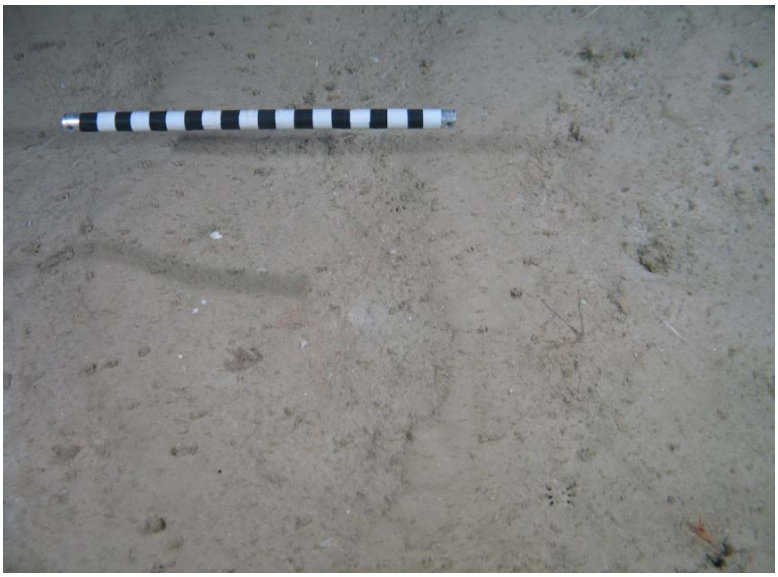
Station Cal-30-E-Cam

Fix No: 1096
Location: 343513E, 8392194N
Depth: 583m

Sediment Description
Fine silt overlying soft clay with occasional shell fragments.

Flora and Fauna
Possible unidentified porifera and faunal burrows.

APPENDIX B –SEABED PHOTOGRAPHS

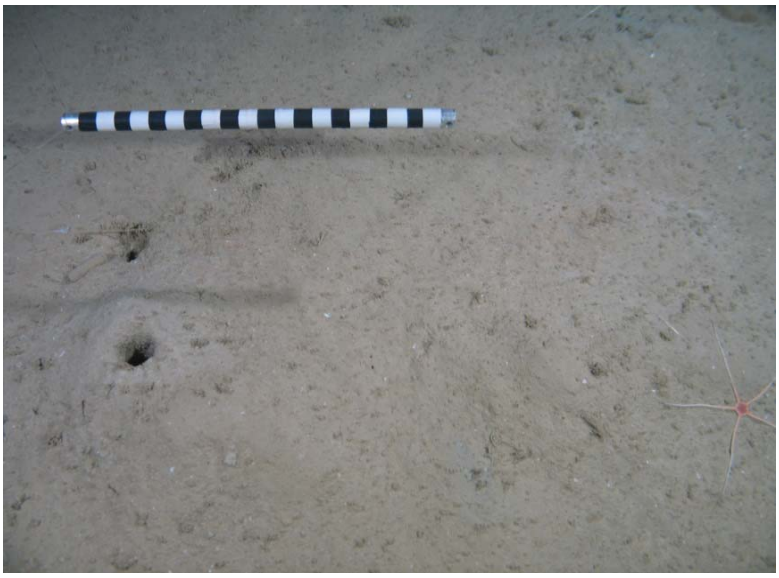


Station Cal-31-E-Cam

Fix No: 992
Location: 353000E, 8403331N
Depth: 593m

Sediment Description
Silty clay, lots of suspended fines, shell fragments and some bioturbation.

Flora and Fauna
Small shrimp (Possibly Solenoceridae), occasional polychaete tubes, small burrows and faunal imprints.



Station Cal-31-E-Cam

Fix No: 994
Location: 353024E, 8403359N
Depth: 593m

Sediment Description
Silty clay, lots of suspended fines, shell fragments and some bioturbation.

Flora and Fauna
Brittlestar (Ophiuroidea) , possible sea cucumber (Holothuroidea), polychaete tubes and faunal burrows (Possibly Nephrops).

Station Cal-31-E-Cam

Fix No: 1001
Location: 353004E, 8403322N
Depth: 592m

Sediment Description
Silty clay, lots of suspended fines, shell fragments and some bioturbation.

Flora and Fauna
Sea cucumber (Holothuroidea), possible bryozoan and faunal burrows.

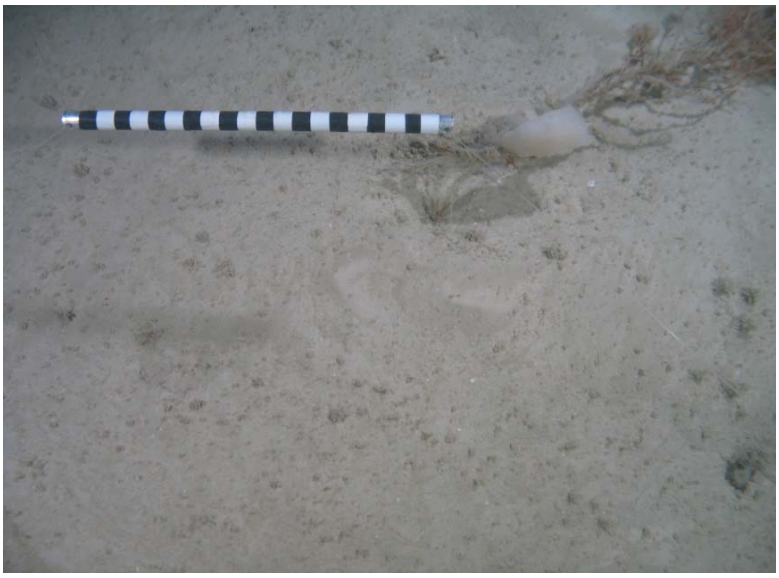
APPENDIX B –SEABED PHOTOGRAPHS

Station Cal-33-E-Cam

Fix No: 1124
Location: 362192E, 8375267N
Depth: 319m

Sediment Description
Very fine silty surface sediment overlying soft clays, surficial sediment easily disturbed.

Flora and Fauna
Possible bryozoans with large mega-faunal burrows.



Station Cal-33-E-Cam

Fix No: 1133
Location: 362171E, 8375249N
Depth: 319m

Sediment Description
Very fine silty surface sediment overlying soft clays, top sediment easily disturbed.

Flora and Fauna
Unidentified coral with possible white porifers attached, and brittlestar.

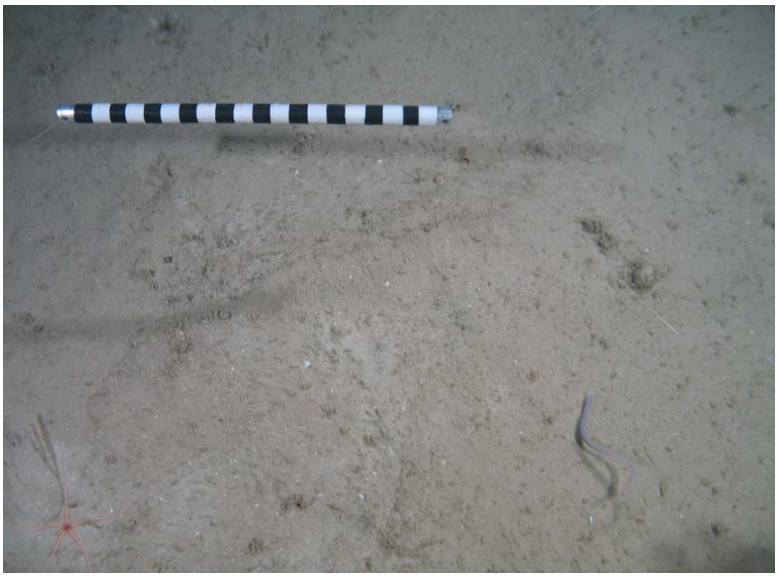
Station Cal-33-E-Cam

Fix No: 1135
Location: 362163E, 8375242N
Depth: 319m

Sediment Description
Very fine silty surface sediment overlying soft clays, top sediment easily disturbed.

Flora and Fauna
No visible fauna with large mega-faunal burrows (Possibly Nephrops).

APPENDIX B –SEABED PHOTOGRAPHS

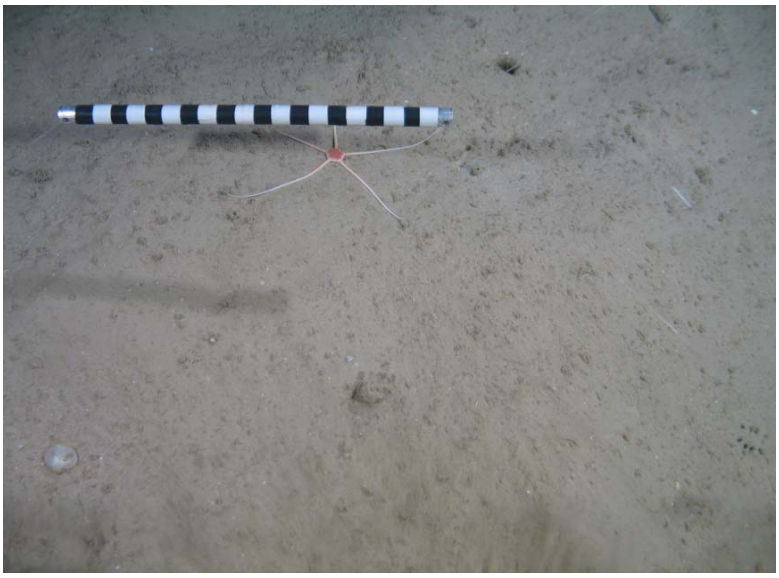


Station Cal-34-E-Cam

Fix No: 1033
Location: 342364E, 8392127N
Depth: 599m

Sediment Description
Very fine silty surface sediment overlying soft clays, top sediment easily disturbed.

Flora and Fauna
Brittlestar (Ophiuroidea), Hagfish (Myxinidae), unidentified hydroids and faunal burrows.



Station Cal-34-E-Cam

Fix No: 1036
Location: 342367E, 8392117N
Depth: 599m

Sediment Description
Very fine silty surface sediment overlying soft clays, top sediment easily disturbed.

Flora and Fauna
Brittlestar (Ophiuroidea), small bivalve, polychaete tubes and faunal burrows.

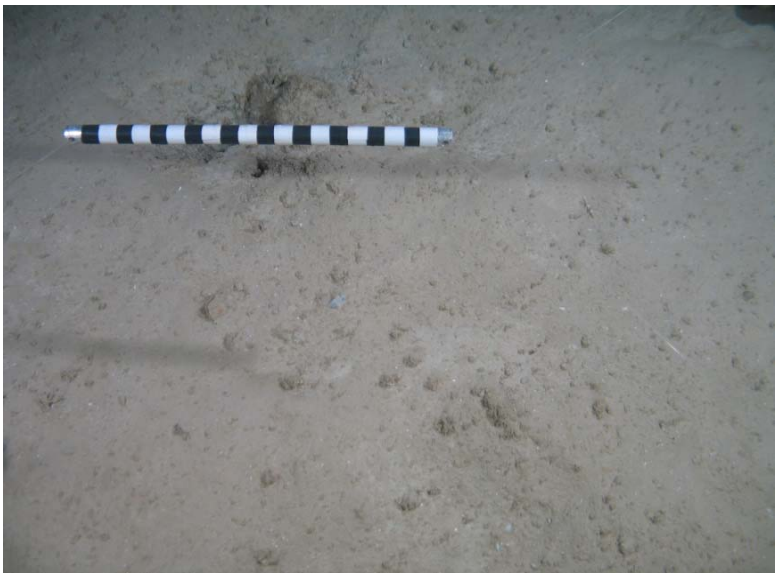
Station Cal-34-E-Cam

Fix No: 1045
Location: 342382E, 8392071N
Depth: 598m

Sediment Description
Very fine silty surface sediment overlying soft clays, top sediment easily disturbed.

Flora and Fauna
No visible fauna. Polychaete tubes and faunal burrows.

APPENDIX B –SEABED PHOTOGRAPHS

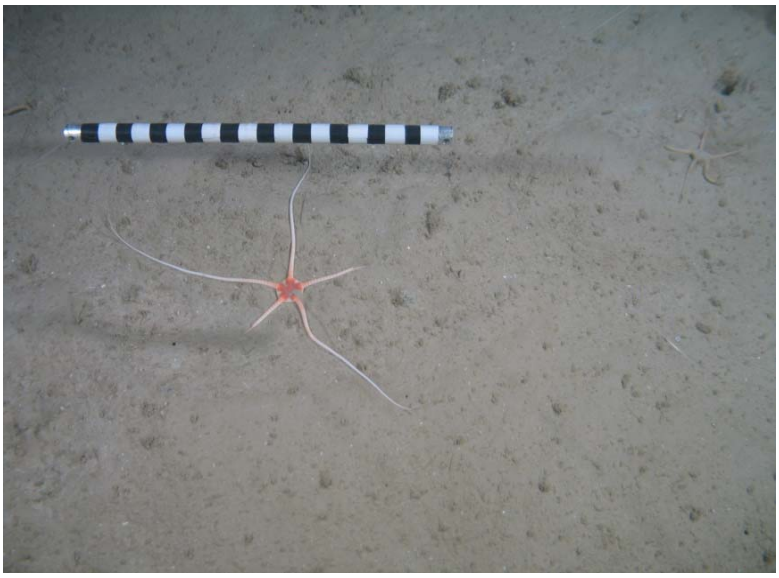


Station Cal-38-E-Cam

Fix No: 1009
Location: 353695E, 8399716N
Depth: 550m

Sediment Description
Silty clay with shell fragments and bioturbation.

Flora and Fauna
Bryozoan. Large amount of bioturbation with faunal burrows and polychaete tubes.

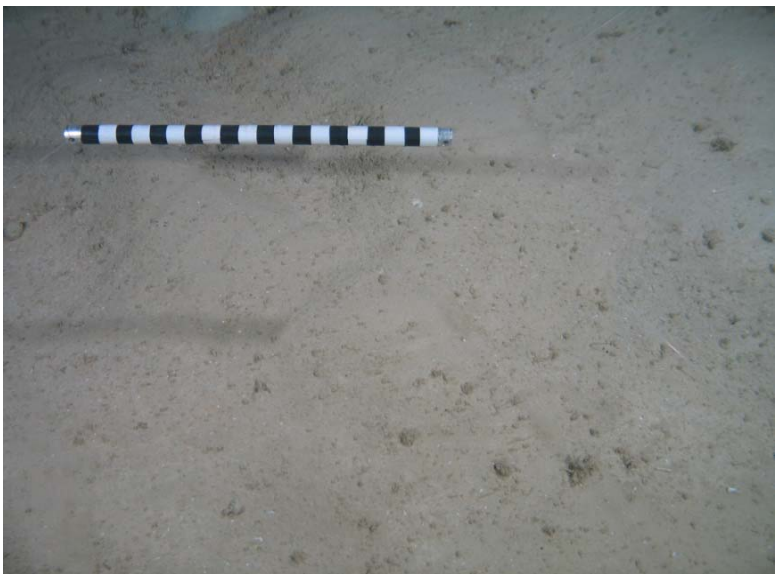


Station Cal-38-E-Cam

Fix No: 1011
Location: 353680E, 8399716N
Depth: 550m

Sediment Description
Silty clay with shell fragments and bioturbation.

Flora and Fauna
Brittlestars (Ophiuroidea), polychaete tubes and some small burrows.



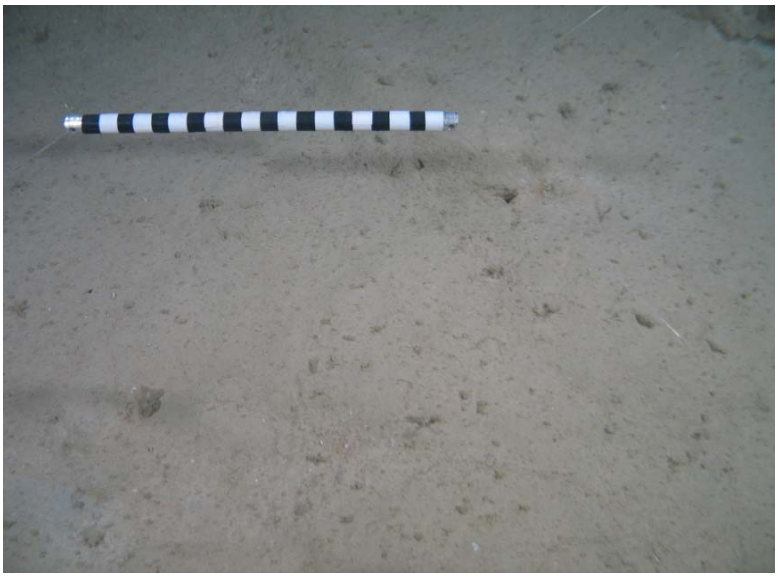
Station Cal-38-E-Cam

Fix No: 1019
Location: 353616E, 8399679N
Depth: 549m

Sediment Description
Silty clay with shell fragments and bioturbation.

Flora and Fauna
No visible epifauna. Bioturbation in the form of faunal burrows and polychaete tubes.

APPENDIX B –SEABED PHOTOGRAPHS

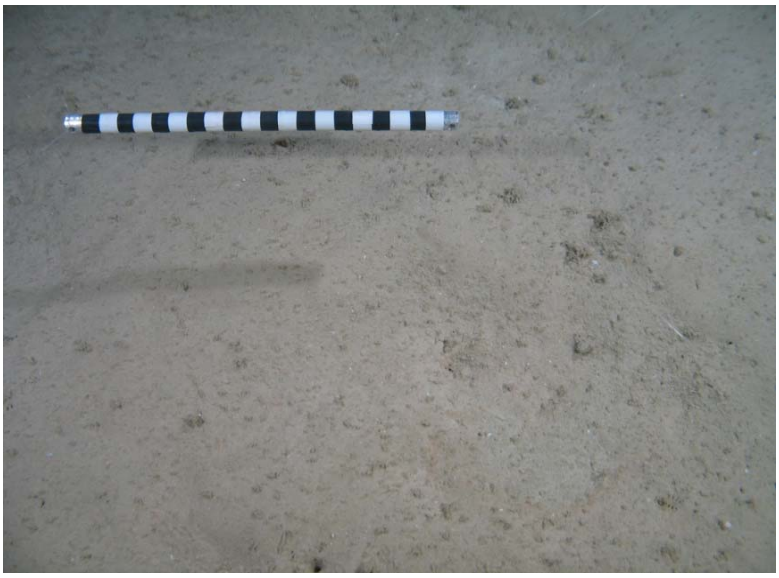


Station Cal-40-E-Cam

Fix No: 972
Location: 352170E, 8404409N
Depth: 616m

Sediment Description
Fine silty sand with lots of suspended fines. Some bioturbation.

Flora and Fauna
Unidentified polyp. Faunal burrows and shell debris.

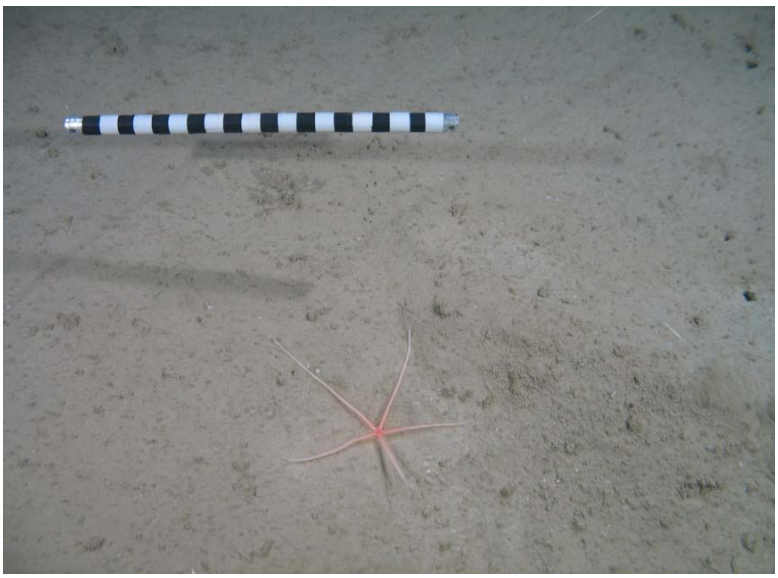


Station Cal-40-E-Cam

Fix No: 973
Location: 352169E, 8404410N
Depth: 615m

Sediment Description
Fine silty sand with lots of suspended fines. Some bioturbation.

Flora and Fauna
Polychaete tubes and faunal burrows..



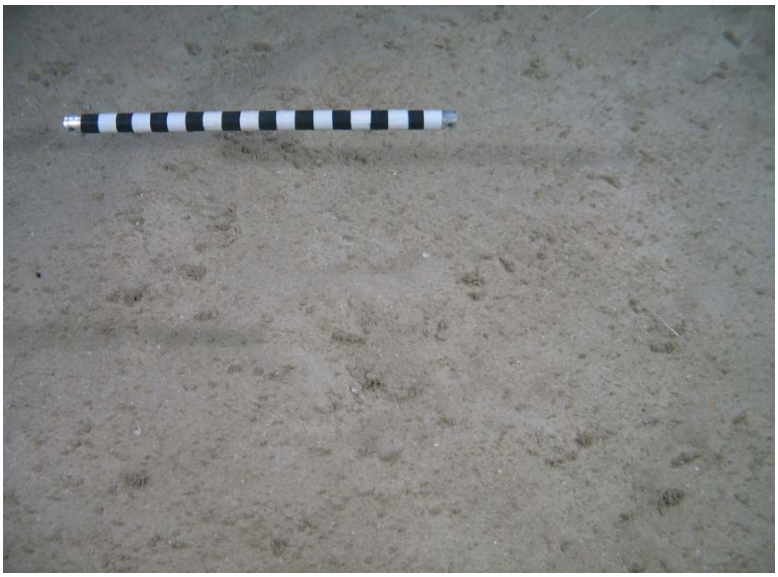
Station Cal-40-E-Cam

Fix No: 976
Location: 352158E, 8404412N
Depth: 615m

Sediment Description
Fine silty sand with lots of suspended fines. Some bioturbation.

Flora and Fauna
Brittlestar (Ophiuroidea) with faunal burrows and bioturbation.

APPENDIX B –SEABED PHOTOGRAPHS

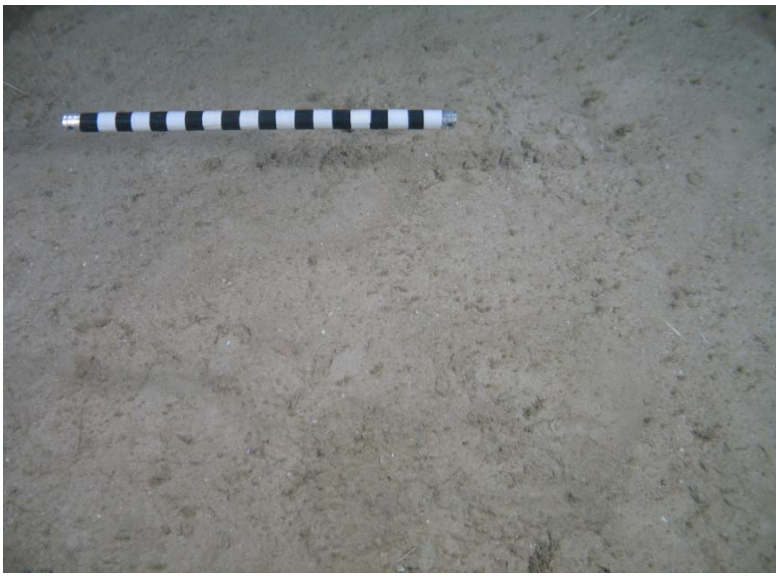


Station Cal-41-E-Cam

Fix No: 950
Location: 355542E, 8410261N
Depth: 643m

Sediment Description
Silty clay with lots of suspended fines.

Flora and Fauna
No visible fauna. Bioturbation in the form of burrows.



Station Cal-41-E-Cam

Fix No: 959
Location: 355513E, 8410188N
Depth: 645m

Sediment Description
Silty clay with lots of suspended fines.

Flora and Fauna
Bioturbation in the form of polychaete tubes and burrows.

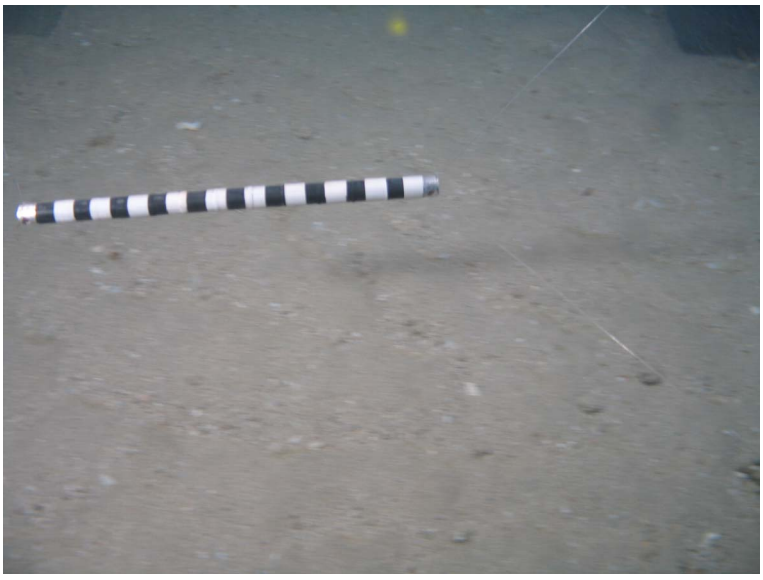
Station Cal-41-E-Cam

Fix No: 961
Location: 355493E, 8410175N
Depth: 645m

Sediment Description
Silty clay with lots of suspended fines.

Flora and Fauna
Bryozoan with faunal tracks and burrows. Some shell hash visible.

APPENDIX B –SEABED PHOTOGRAPHS

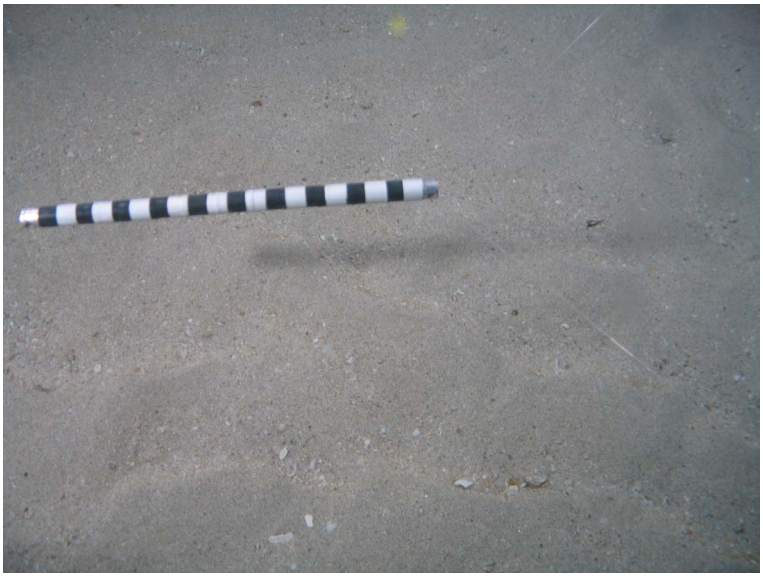


Station SBF-41-E-Cam

Fix No: 566
Location: 370026 E 8334086
Depth: 99m

Sediment Description
Lightly rippled fine sand with some coarse material and shell hash.

Flora and Fauna
No visible fauna



Station SBF-41-E-Cam

Fix No: 567
Location: 370026E, 8334083N
Depth: 99m

Sediment Description
Lightly rippled fine sand with some coarse material and shell hash.

Flora and Fauna
No visible fauna.

NB Seabed not visible in other seabed photographs due to the strong current at this station

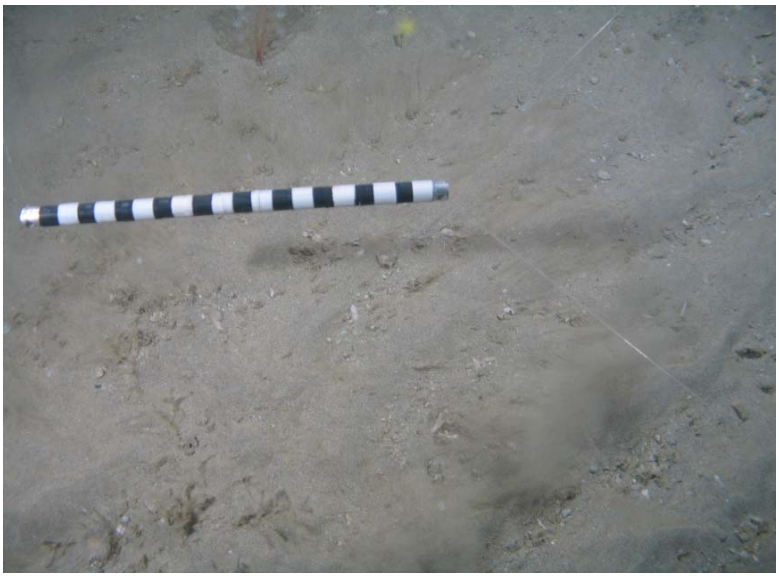
APPENDIX B –SEABED PHOTOGRAPHS

Station SBF-42-E-Cam

Fix No: 535
Location: 368398E, 8332042N
Depth: 95m

Sediment Description
Lightly rippled fine sand with some coarse material in troughs of waves.

Flora and Fauna
Small white anemones and bryozoan.



Station SBF-42-E-Cam

Fix No: 540
Location: 368391E, 8332024N
Depth: 95m

Sediment Description
Lightly rippled fine sand with some coarse material in troughs of waves.

Flora and Fauna
Seapen (Pennatulidae), small white anemones and possible bryozoans.

Station SBF-42-E-Cam

Fix No: 547
Location: 368416E, 8332037N
Depth: 95m

Sediment Description
Lightly rippled fine sand with some coarse material in troughs of waves.

Flora and Fauna
Sea star (Asteroidea) and small white anemones.

APPENDIX B –SEABED PHOTOGRAPHS

Station SBF-43-E-Cam

Fix No: 584
Location: 370271 E, 8334954 N
Depth: 102m

Sediment Description
Lightly rippled fine sand with shell fragments.

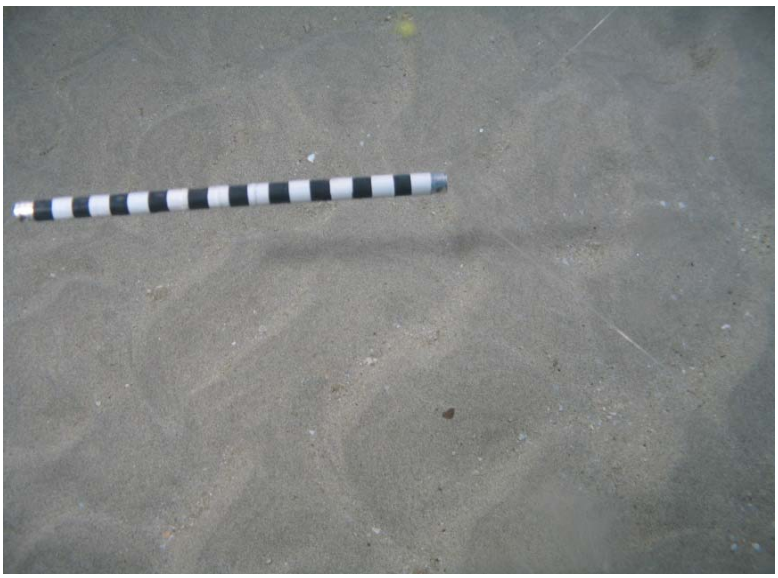
Flora and Fauna
No visible fauna.

Station SBF-43-E-Cam

Fix No: 587
Location: 370269 E, 8334971 N
Depth: 103m

Sediment Description
Lightly rippled fine sand with shell fragments.

Flora and Fauna
Anemone (Actiniaria).



Station SBF-43-E-Cam

Fix No: 597
Location: 370314 E, 8335096 N
Depth: 103m

Sediment Description
Lightly rippled fine sand with shell fragments.

Flora and Fauna
No visible fauna.

APPENDIX B –SEABED PHOTOGRAPHS

Station SBF-44-E-Cam

Fix No: 607
Location: 370859E, 8335202N
Depth: 102m

Sediment Description
Lightly rippled sand with some coarse material and shell fragments.

Flora and Fauna
Anemone (Actiniaria) and polychaete tubes.

Station SBF-44-E-Cam

Fix No: 615
Location: 370855E, 8335229N
Depth: 102m

Sediment Description
Lightly rippled sand with some coarse material and shell fragments.

Flora and Fauna
Anemones (Actiniaria) and faunal burrow.

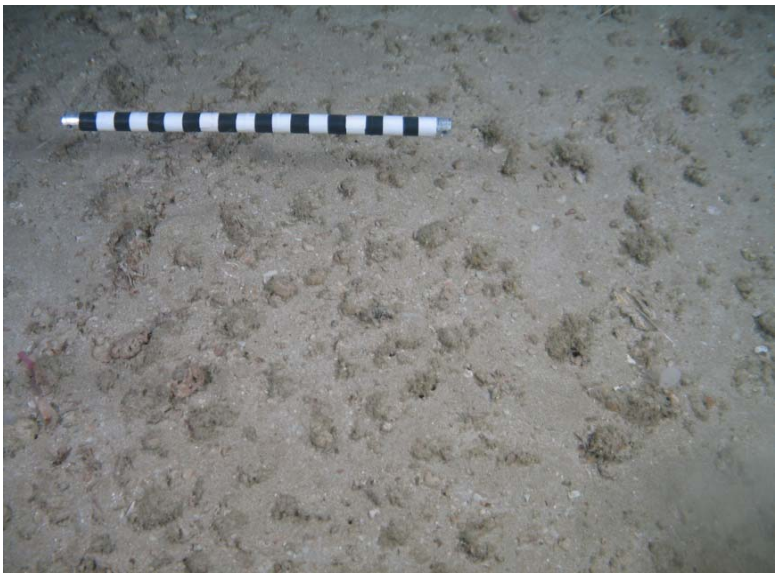
Station SBF-44-E-Cam

Fix No: 618
Location: 370854E, 8335237N
Depth: 102m

Sediment Description
Lightly rippled sand with some coarse material and shell fragments.

Flora and Fauna
No visible fauna.

APPENDIX B –SEABED PHOTOGRAPHS

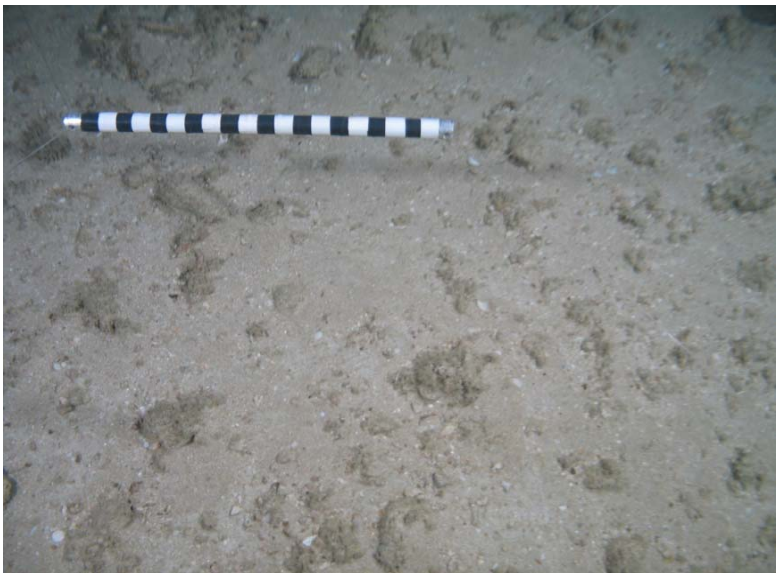


Station Slope-16-E-Cam

Fix No: 1193
Location: 365273E, 8343670N
Depth: 259m

Sediment Description
Mixed sediment with sand and gravel. Some pebbles visible.

Flora and Fauna
Unidentified porifera, bryozoans and possible sea squirt.

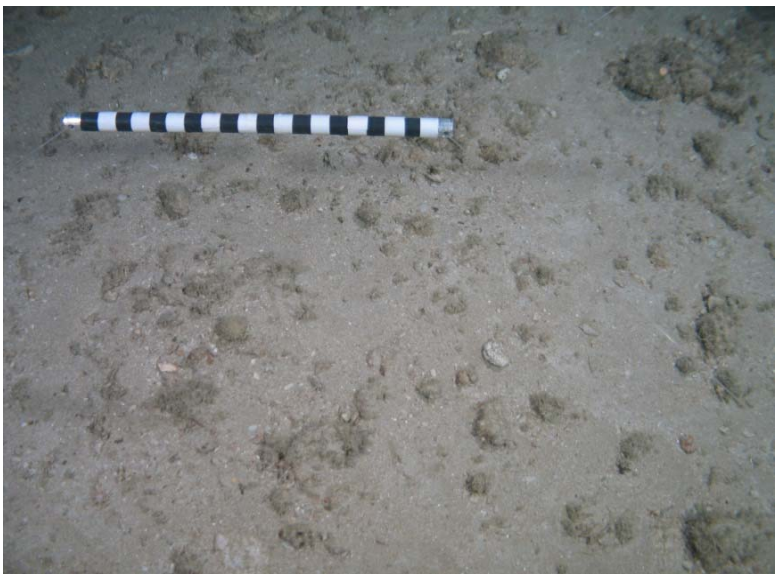


Station Slope-16-E-Cam

Fix No: 1198
Location: 365312E, 8343679N
Depth: 159m

Sediment Description
Mixed sediment with sand and gravel. Some pebbles visible.

Flora and Fauna
Bryozoans.



Station Slope-16-E-Cam

Fix No: 1205
Location: 365344E, 8343662N
Depth: 159m

Sediment Description
Mixed sediment with sand and gravel. Some pebbles visible.

Flora and Fauna
Bryozoans.

APPENDIX B –SEABED PHOTOGRAPHS

Station Slope-22-E-Cam

Fix No: 1171
Location: 364579E, 8353629N
Depth: 231m

Sediment Description
Slightly rippled sand, some suspended fines and shell fragments.

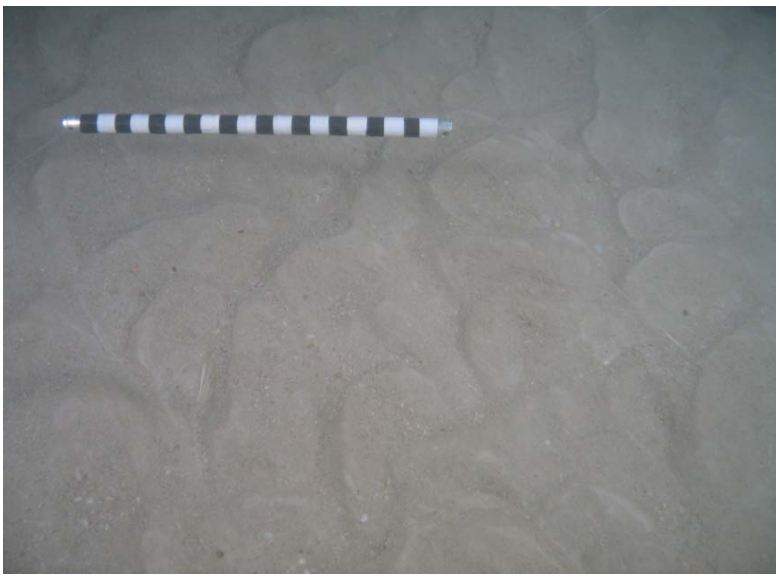
Flora and Fauna
No visible fauna.

Station Slope-22-E-Cam

Fix No: 1178
Location: 364520E, 8353602N
Depth: 231m

Sediment Description
Slightly rippled sand, some suspended fines and shell fragments.

Flora and Fauna
Sea urchin.



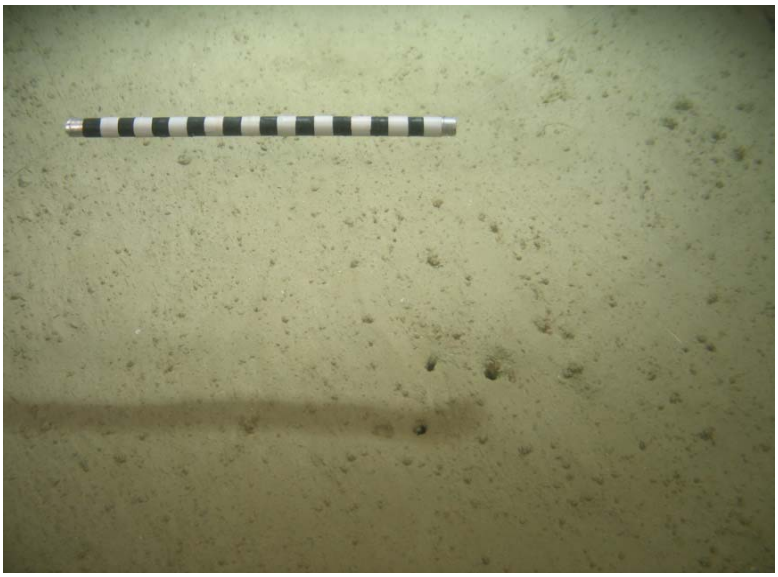
Station Slope-22-E-Cam

Fix No: 1182
Location: 364495E, 8353600N
Depth: 231m

Sediment Description
Slightly rippled sand, some suspended fines and shell fragments.

Flora and Fauna
No visible fauna.

APPENDIX B –SEABED PHOTOGRAPHS

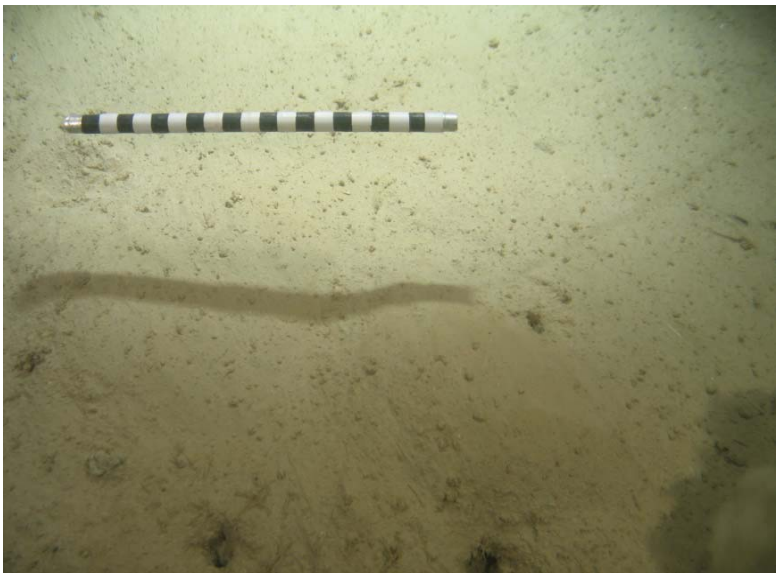


Station Slope-24-E-Cam

Fix No: 862
Location: 352393E, 8372200N
Depth: 355m

Sediment Description
Very soft silty clay, lots of fines suspended.

Flora and Fauna
Faunal burrows.

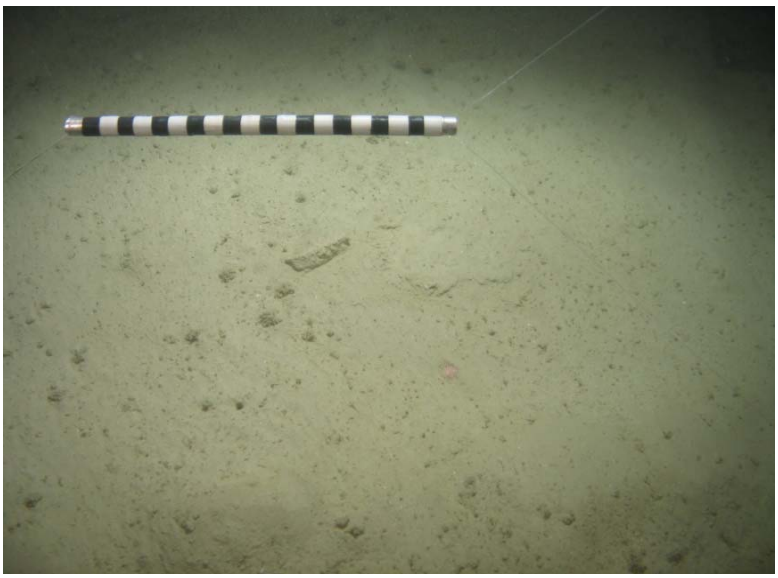


Station Slope-24-E-Cam

Fix No: 875
Location: 352384E, 8372185N
Depth: 355m

Sediment Description
Very soft silty clay, lots of fines suspended.

Flora and Fauna
Lebensspuren in the form of faunal burrows and possible polychaete tests.



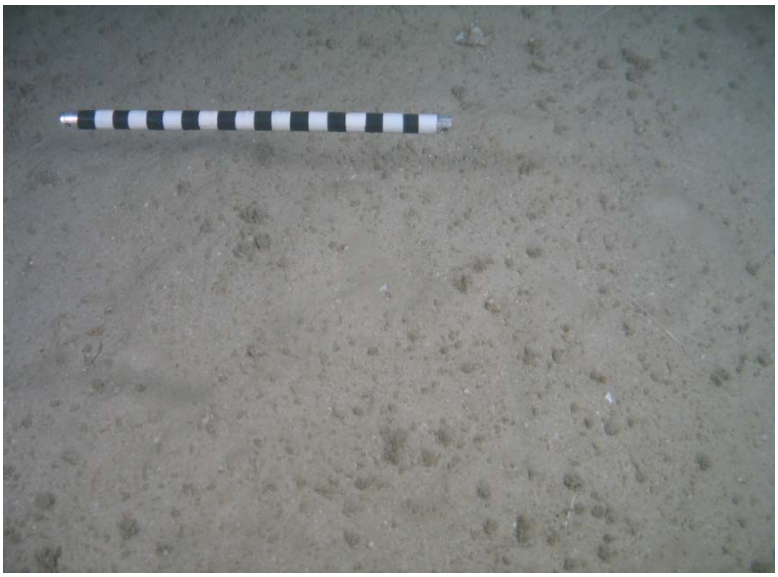
Station Slope-24-E-Cam

Fix No: 878
Location: 352381E, 8372181N
Depth: 354m

Sediment Description
Very soft silty clay, lots of fines suspended.

Flora and Fauna
Small anemone and bioturbation.

APPENDIX B –SEABED PHOTOGRAPHS



Station Tor-57-E-Cam

Fix No: 1149
Location: 372426E, 8373630N
Depth: 280m

Sediment Description
Slightly rippled silty sand. Medium to fine sand, silt fraction easily suspended.

Flora and Fauna
No visible fauna.

Station Tor-57-E-Cam

Fix No: 1155
Location: 372405E, 8373632N
Depth: 280m

Sediment Description
Slightly rippled silty sand. Medium to fine sand, silt fraction easily suspended.

Flora and Fauna
No visible fauna.

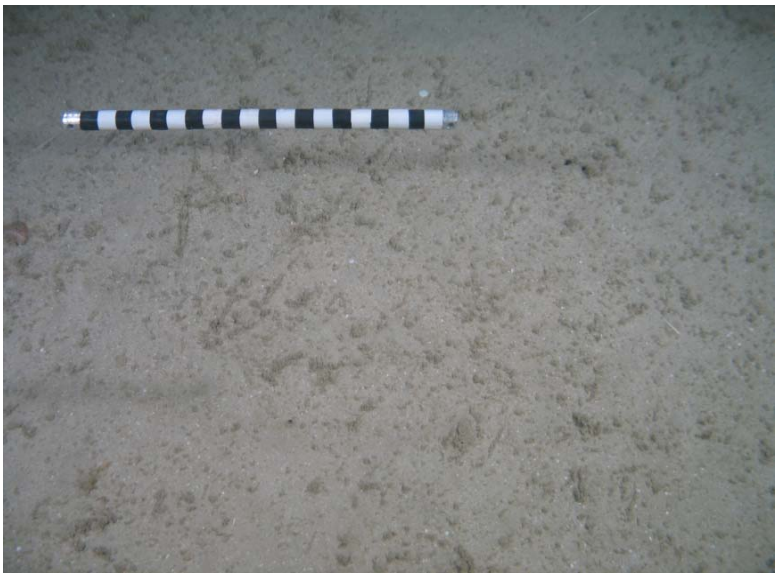
Station Tor-57-E-Cam

Fix No: 1161
Location: 372378E, 8373639N
Depth: 280m

Sediment Description
Slightly rippled silty sand. Medium to fine sand, silt fraction easily suspended.

Flora and Fauna
No visible fauna.

APPENDIX B –SEABED PHOTOGRAPHS

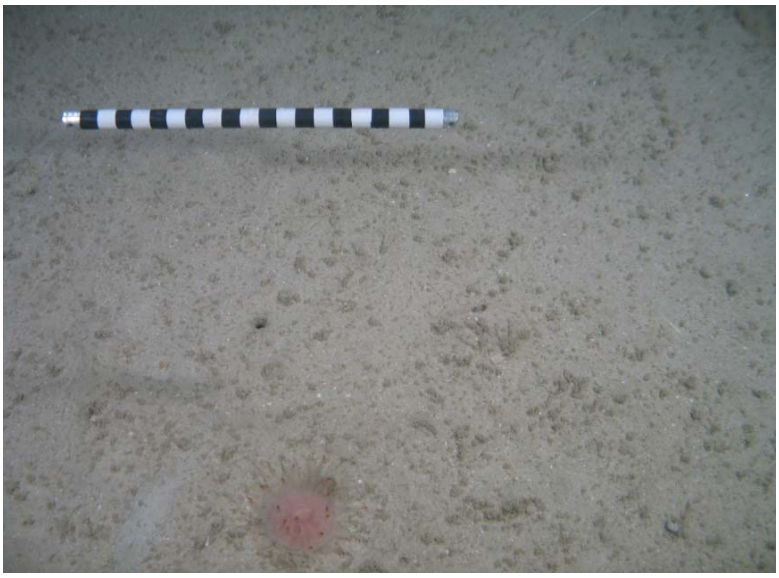


Station Tor-58-E-Cam

Fix No: 942
Location: 380269E, 8398397N
Depth: 346m

Sediment Description
Silty clay, some suspended fines, shell fragments and small pebbles.

Flora and Fauna
Small anemones and faunal burrows.

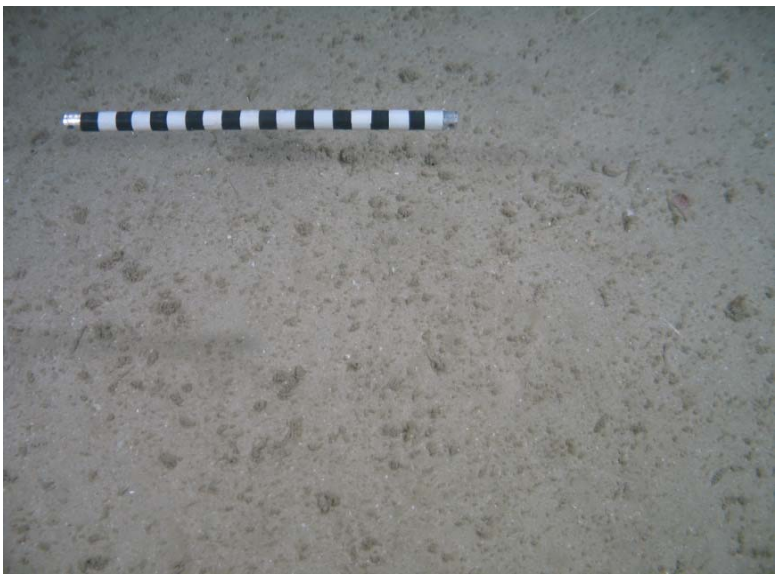


Station Tor-58-E-Cam

Fix No: 945
Location: 380258E, 8398381N
Depth: 346m

Sediment Description
Silty clay, some suspended fines, shell fragments and small pebbles.

Flora and Fauna
Anemone (Actiniaria) and faunal burrows.



Station Tor-58-E-Cam

Fix No: 947
Location: 380253E, 8398378N
Depth: 346m

Sediment Description
Silty clay, some suspended fines, shell fragments and small pebbles.

Flora and Fauna
No visible fauna.

APPENDIX C – SEDIMENT SAMPLE PHOTOGRAPHS

APPENDIX C – SAMPLE PHOTOGRAPHS

Station Export-4-EB-1

Fix No: 707
Location: 346534E, 8292333N
Range: 1m
Bearing: 290°
Depth: 101m

Sediment Description
Coarse sand with pockets of soft sandy clay. Some washout at the surface.

Flora and Fauna
No obvious fauna.

Station Export-11-EB-1

Fix No: 722
Location: 345341E, 8265615N
Range: 9m
Bearing: 121°
Depth: 91m

Sediment Description
Medium to coarse golden sand with lots of shell fragments.

Flora and Fauna
Small hermit crab.

Station Export-16-EB-2

Fix No: 717
Location: 370207E, 8335046N
Range: 11m
Bearing: 29°
Depth: 100m

Sediment Description
Coarse shelly sand with some washout in the corner on recovery.

Flora and Fauna
No obvious fauna.

APPENDIX C – SAMPLE PHOTOGRAPHS

Station Export-23-EB-2

Fix No: 729
Location: 353576E, 8213423N
Range: 14m
Bearing: 299°
Depth: 81m

Sediment Description
Medium to coarse golden sand with lots of shell fragments.

Flora and Fauna
No obvious fauna.

Station Export-36-EB-1

Fix No: 337
Location: 366753E, 8124651N
Range: 2m
Bearing: 191°
Depth: 32m

Sediment Description
Golden sand and shell hash, coarse to fine in texture with carbonate nodules. Sample slumped on one side, possible seabed relief.

Flora and Fauna
Some faunal casts.

Station Export-39-EB-1

Fix No: 340
Location: 368003E, 8112370N
Range: 4m
Bearing: 267°
Depth: 28m

Sediment Description
Coarse to fine shelly sand, occasional carbonate nodules.

Flora and Fauna
Small shrimp in Chem area, worms, gastropods. Point of luminescence seen in the FA sample prior to sieving.

APPENDIX C – SAMPLE PHOTOGRAPHS

Station Export-49-EB- 1

Fix No: 344
Location: 379000E, 8073086N
Range: 13m
Bearing: 198°
Depth: 32m

Sediment Description
Fine sand, slight washout at the surface but small compact sands, very few shells present.

Flora and Fauna
Fish buried in the sediment (retained) with a worm cast and shell on the surface.

Station Export-53-EB-2

Fix No: 349
Location: 397323E, 8066519N
Range: 0m
Bearing: 102°
Depth: 22m

Sediment Description
Fine sand with lots of small shell fragments. Small washout on deck when weight taken off bucket.

Flora and Fauna
Urchin present.

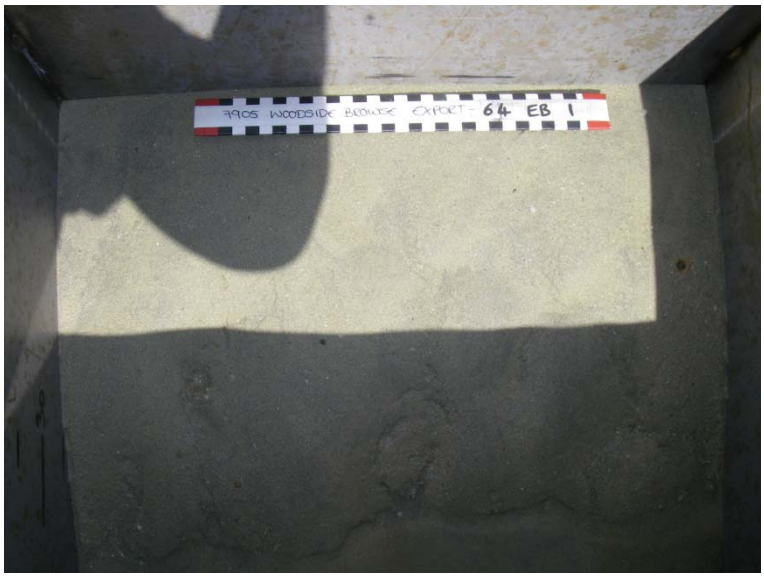
Station Export-56-EB-2

Fix No: 347
Location: 389044E, 8066024N
Range: 3m
Bearing: 84°
Depth: 27m

Sediment Description
Fine silty sand, slight slope to the sediment, good seal on recovery due to the sediment type.

Flora and Fauna
Gastropods and worms present.

APPENDIX C – SAMPLE PHOTOGRAPHS



Station Export-64-EB-1

Fix No: 710
Location: 357514E, 8313678N
Range: 14m
Bearing: 303°
Depth: 97m

Sediment Description
Fine sand and silt, green in colour, no layers, shell fragments and slight smell of decomposition.

Flora and Fauna
Burrowing anemones present.

Station Export-70-EB-2

Fix No: 827
Location: 359690E, 8186153N
Range: 12m
Bearing: 304°
Depth: 54m

Sediment Description
Surface washout. Coarse yellow sand with lots of shell fragments.

Flora and Fauna
No obvious fauna.

Station Cal-28-EB-1

Fix No: 810
Location: 356007E, 8386045N
Range: 8m
Bearing: 306°
Depth: 418m

Sediment Description
Thick brown/grey clay, slight sand content, very cohesive and sticky. 2cm of loose silt on top.

Flora and Fauna
No obvious fauna.

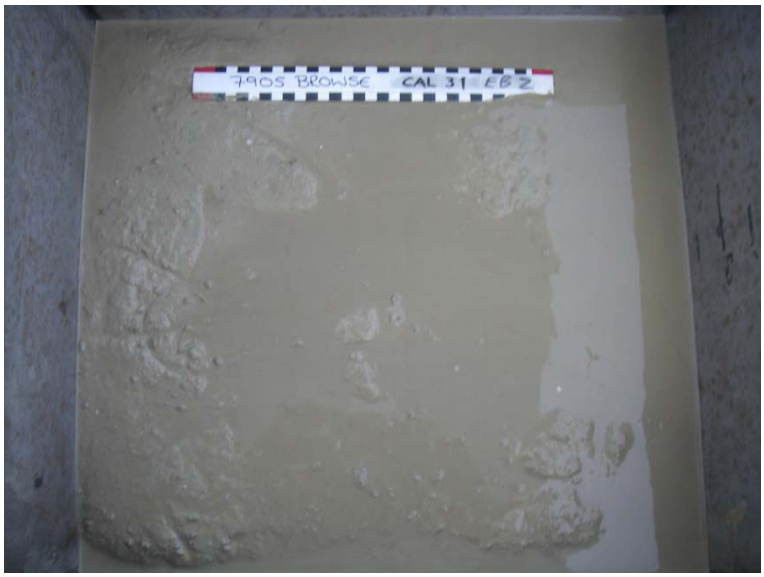
APPENDIX C – SAMPLE PHOTOGRAPHS

Station Cal-29-EB-1

Fix No: 841
Location: 349002E, 8388751N
Range: 2m
Bearing: 254°
Depth: 491m

Sediment Description
Thick grey clay, slippery but fractures easily, 2cm of fine brown silt on the surface. Some sand present.

Flora and Fauna
No obvious fauna.

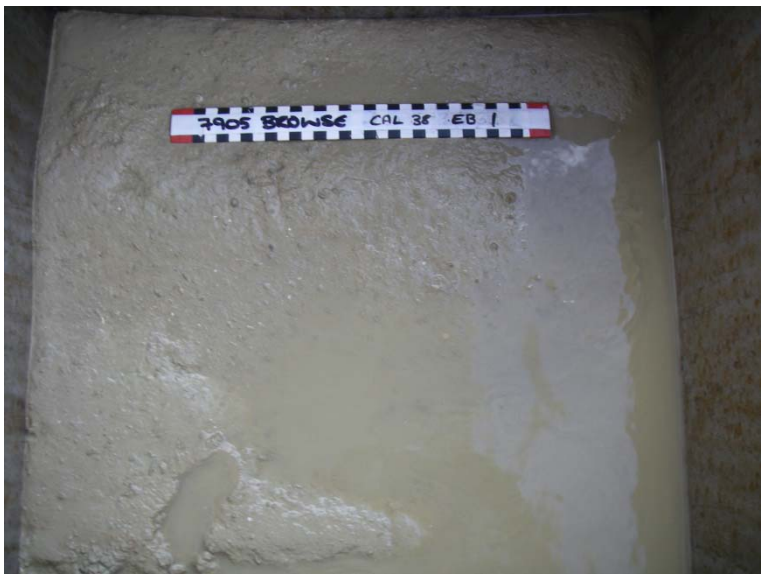


Station Cal-31-EB-2

Fix No:1004
Location: 353025E, 8403295N
Range: 26m
Bearing: 280°
Depth: 595m

Sediment Description
Thick clay, grey in colour, 2cm of brown silt on top. Clay slippery in some areas and dry in others.

Flora and Fauna
No obvious fauna.



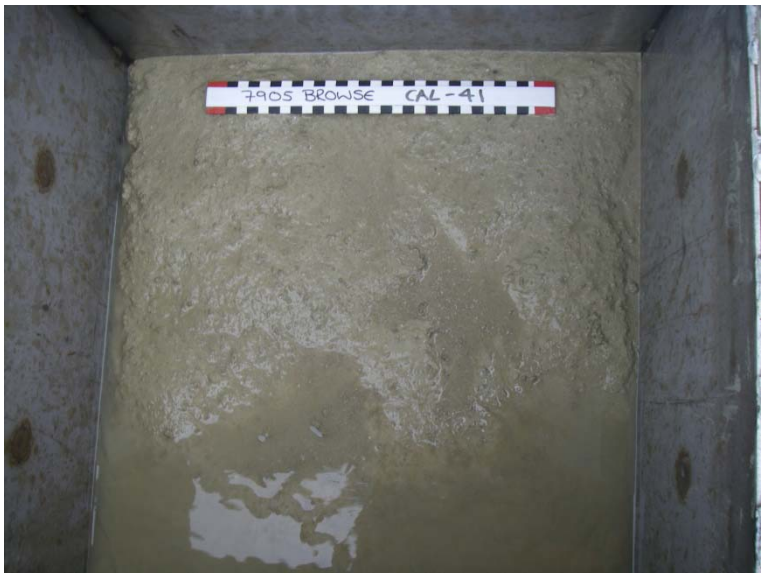
Station Cal-38-EB-1

Fix No: 749
Location: 353687E, 8399709N
Range: 4m
Bearing: 83°
Depth: 548m

Sediment Description
Silty clay, yellow brown in colour, occasional shell fragments on the surface, becoming firmer grey silty clay below 10cm.

Flora and Fauna
No obvious fauna.

APPENDIX C – SAMPLE PHOTOGRAPHS



Station Cal-41-EB-2

Fix No: 886
Location: 355481E, 8410210N
Range: 23m
Bearing: 116°
Depth: 646m

Sediment Description
Fine sandy silt, starfish imprint on the surface. Sediment brown to gray in colour - brown to 2cm depth, grey below.

Flora and Fauna
No obvious fauna.

Station SBF-41-EB-1

Fix No: 715
Location: 369956E, 8334406N
Range: 15m
Bearing: 15°
Depth: 98m

Sediment Description
Slight washout in the corner. Medium to coarse sand, some small shell fragments, very loose.

Flora and Fauna
No obvious fauna.

Station SBF-42-EB-1

Fix No: 713
Location: 368390E, 8332059N
Range: 15m
Bearing: 41°
Depth: 93m

Sediment Description
Fine sand with some silt, slight washout at the surface, lots of shell fragments.

Flora and Fauna
Burrowing anemone and shrimp in FA.

APPENDIX C – SAMPLE PHOTOGRAPHS

Station SBF-43-EB-1

Fix No: 717
Location: 370207E, 8335046N
Range: 11m
Bearing: 29°
Depth: 100m

Sediment Description
Fine to medium sand, probable collapsed burrow, some shell fragments, slightly olive in colour, no odour.

Flora and Fauna
No obvious fauna.

Station SBF-44-EB-1

Fix No: 719
Location: 370890E, 8334933N
Range: 7m
Bearing: 001°
Depth: 98m

Sediment Description
Fine sand with shell fragments, burrow collapsed, slight washout at surface, olive in colour, no odour.

Flora and Fauna
No obvious fauna.

Station Slope 16-EB-1

Fix No: 740
Location: 365262E, 8343694N
Range: 5m
Bearing: 205°
Depth: 174m

Sediment Description
Yellowish Brown gravelly sand with shell fragments and some coral.

Flora and Fauna
No obvious fauna.

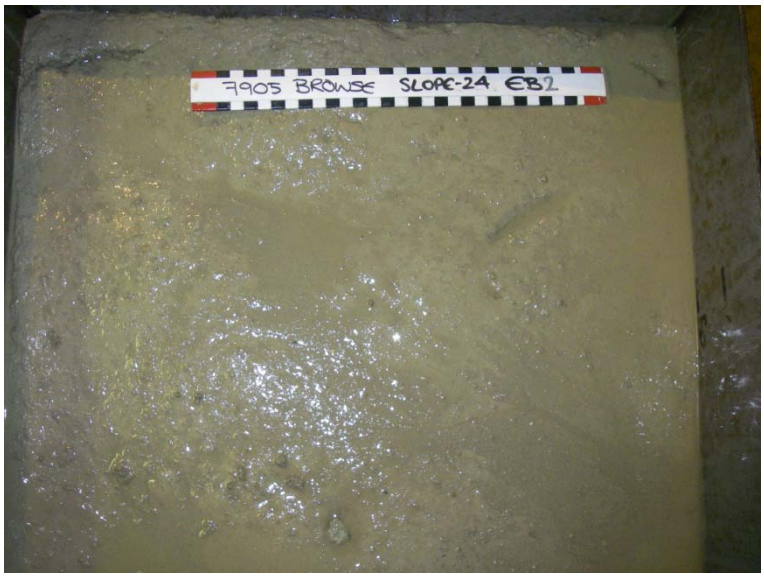
APPENDIX C – SAMPLE PHOTOGRAPHS

Station Slope-22-EB-1

Fix No: 747
Location: 364592E, 8353597N
Range: 4m
Bearing: 323°
Depth: 230m

Sediment Description
Fine sand, some urchin spines, lots of shell fragments, Washout present. Slightly clayey at the bottom of the sample.

Flora and Fauna
No obvious fauna.

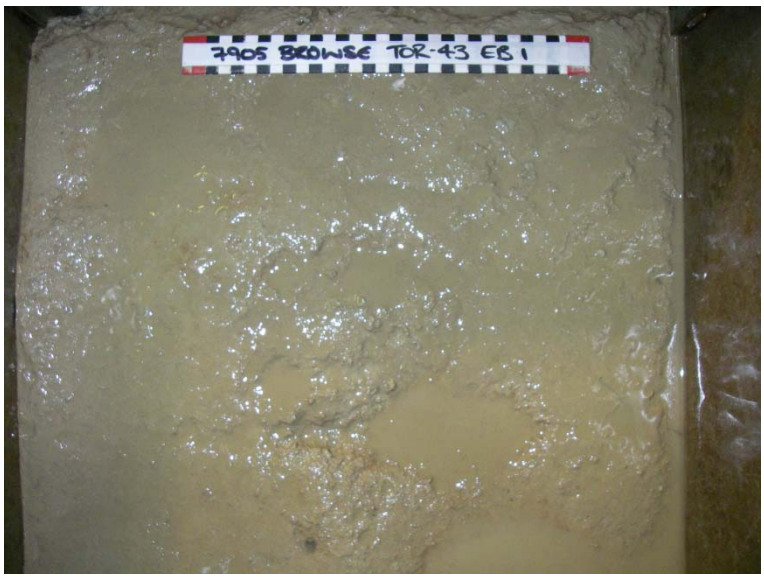


Station Slope-24-EB-2

Fix No: 846
Location: 352407E, 8372154N
Range: 8m
Bearing: 273°
Depth: 418m

Sediment Description
Thick clay, grey in colour, 2cm of brown silt on top. Clay slippery in some areas and dry in others.

Flora and Fauna
No obvious fauna.



Station Tor-43-EB-1

Fix No: 761
Location: 387994E, 8422592N
Range: 9m
Bearing: 46°
Depth: 459m

Sediment Description
Yellow-brown silty clay, becoming firmer grey clay from about 10cm depth.

Flora and Fauna
No obvious fauna.

APPENDIX C – SAMPLE PHOTOGRAPHS

Station Tor-44-EB-1

Fix No: 763
Location: 398354E, 8462720N
Range: 13m
Bearing: 314°
Depth: 474m

Sediment Description
Yellow-brown silty clay with some sand, becoming firm grey clay from 10cm depth.

Flora and Fauna
Annelids and a brittlestar.

Station Tor-45-EB-1

Fix No: 759
Location: 392444E, 8459402N
Range: 9m
Bearing: 299°
Depth: 467m

Sediment Description
Yellow brown fine silty sand, lots of shed urchin spines.

Flora and Fauna
No obvious fauna.

Station Tor-53-EB-1

Fix No: 757
Location: 388103E, 8449985N
Range: 3m
Bearing: 355°
Depth: 392m

Sediment Description
Fine golden sand with high percentage of shell fragments.

Flora and Fauna
No obvious fauna.

APPENDIX C – SAMPLE PHOTOGRAPHS

Station Tor-54-EB-1

Fix No: 752
Location: 370004E, 8452170N
Range: 1m
Bearing: 204°
Depth: 561m

Sediment Description
Yellow brown silty sand with some shell fragments.

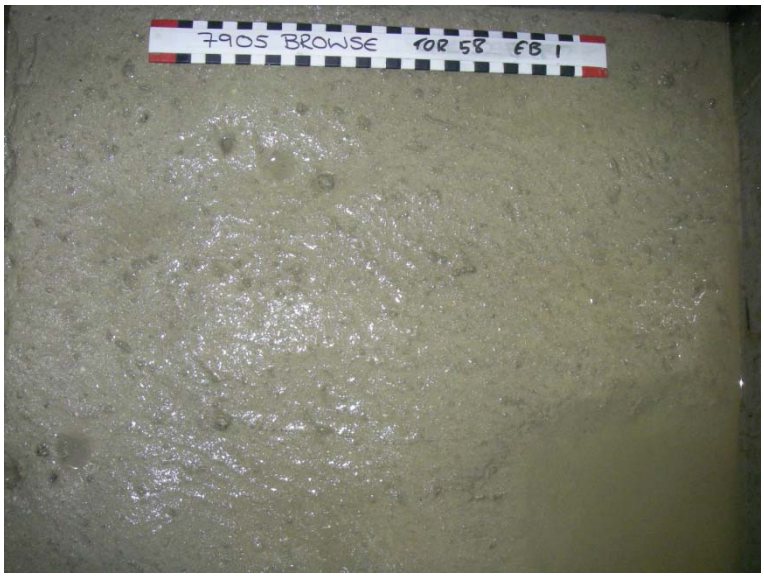
Flora and Fauna
Sea star and some coral.

Station Tor-55-EB-1

Fix No: 754
Location: 369626E, 8449172N
Range: 3m
Bearing: 96°
Depth: 559m

Sediment Description
Yellow brown silty sand, some shell fragments, lots of opaque urchin spines present.

Flora and Fauna
No obvious fauna.



Station Tor-58-EB-1

Fix No: 937
Location: 380266E, 8398356N
Range: 3m
Bearing: 270°
Depth: 345m

Sediment Description
Fine sandy silt. Some patches of grey clay with 2cm of brown silt on the surface. Lots of shell fragments.

Flora and Fauna
No obvious fauna.

APPENDIX D – LABORATORY METHODOLOGIES

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	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (1999) Schedule B(3) (Method 102)
Total Metals in Sediments by ICPMS	EG020-SD	SOIL	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector. Analyte list and LORs per NODG.
Total Mercury by FIMS (Low Level)	EG035T-LL	SOIL	AS 3550, APHA 21st ed., 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3)
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	SOIL	APHA 21st ed., 4500 NO3- F. Combined oxidised Nitrogen (NO2+NO3) in a water extract is determined by Cadmium Reduction, and direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	APHA 21st ed., 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NOx) By Discrete Analyser	EK062G	SOIL	APHA 21st ed., 4500 Norg/NO3- Total Nitrogen is determined as the sum of TKN and Oxidised Nitrrogen, each determined seperately as N.
Total Phosporus By Discrete Analyser	EK067G	SOIL	APHA 21st ed., 4500 P-B&F This procedure involves sulfuric acid digestion and quantification using Discrete Analyser.
Total Organic Carbon	EP005	SOIL	In-house. Dried and pulverised sample is reacted with acid to remove inorganic Carbonates, then combusted in a LECO furnace in the presence of strong oxidants / catalysts. The evolved (Organic) Carbon (as CO2) is automaticaly measured by infra-red detector.
TPH - 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 - C36. This method is compliant with NEPM (1999) Schedule B(3) (Method 506.1)
PAH/Phenols (SIM)	EP075(SIM)	SOIL	(USEPA SW 846 - 8270B) Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Method 502 and 507)
TPH 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. This method is compliant with NEPM (1999) Schedule B(3) (Method 501)
Organotin Analysis	EP090	SOIL	(USEPA SW 846 - 8270D) Prepared sample extracts are analysed by GC/MS coupled with high volume injection, and quanitified against an established calibration curve.
Miscellaneous Subcontracted Analysis	MIS-SOL	SOIL	Miscellaneous Subcontracted Analysis conducted by Subcontracting Laboratory

Analytical Methods	Method	Matrix	Method Descriptions
Suspended Solids	EA025	WATER	APHA 21st ed., 2540D A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite as N by Discrete Analyser	EK057G	WATER	APHA 21st ed., 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrate as N by Discrete Analyser	EK058G	WATER	APHA 21st ed., 4500-NO3- F. Nitrate is reduced to nitrite by way of a cadmium reduction column followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Cadmium Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D. 25mL water samples are digested using a traditional Kjeldahl digestion followed by determination by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO3-. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	APHA 21st ed., 4500-P B&F This procedure involves sulphuric acid digestion of a 100mL sample to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	APHA 21st ed., 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	SOIL	APHA 21st ed., 4500 Norg- D; APHA 21st ed., 4500 P - H. Macro Kjeldahl digestion.
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

Preparation Methods	Method	Matrix	Method Descriptions
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	USEPA 200.2 Mod. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (1999) Schedule B(3) (Method 202)
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 (Option B - Non-concentrating)	ORG17B	SOIL	In-house, Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 20mL 1:1 DCM/Acetone by end over end tumble. The solvent is transferred directly to a GC vial 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.
TKN/TP Digestion	EK061/EK067	WATER	APHA 21st ed., 4500 Norg - D; APHA 21st ed., 4500 P - H. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

APPENDIX E – RAW SEDIMENT AND WATER QUALITY DATA

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EP0903809**	Page	: 1 of 26
Client	: **GARDLINE ENVIRONMENTAL**	Laboratory	: Environmental Division Perth
Contact	: ANDREW CAMPBELL	Contact	: Michael Sharp
Address	: Unit 2/22 Blackly Row Cockburn Central 6164	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: andrew.campbell@gardline.co.uk	E-mail	: michael.sharp@alsenviro.com
Telephone	: 08 9499 6850	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: 7905	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 1897		
C-O-C number	: ----	Date Samples Received	: 13-JUL-2009
Sampler	: ----	Issue Date	: 30-JUL-2009
Site	: Browse Pipeline Route		
		No. of samples received	: 84
Quote number	: EP-005-09 V3	No. of samples analysed	: 84

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

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

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*
Ankit Joshi	Inorganic Chemist	Perth Inorganics
Kim McCabe	Senior Inorganic Chemist	Inorganics
Kim McCabe	Senior Inorganic Chemist	Stafford Minerals - AY
Matthew Goodwin	Senior Organic Chemist	Organics
Rassem Ayoubi	Organic Chemist	Perth Inorganics
Rassem Ayoubi	Organic Chemist	Perth Organics
Scott James	Assistant Laboratory Manager	Perth Inorganics

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 insuffient 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 date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

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

- **EK061G, EK067G: LOR for Total Kjeldahl Nitrogen, Total Phosphorus was raised due to matrix effects.**
- **EK067G: Poor matrix spike recoveries due to matrix effects. Confirmed by reanalysis**
- **LOR raised for Ammonia due to matrix interferences.**
- **Metals LOR's for raised due to high TDS content.**
- **Organotins: High failing MBT in LCS deemed acceptable as all associated analyte results are less than LOR.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SBF-43	SBF-44	SBF-16	SBF-22	SBF-41
				Client sampling date / time: 26-JUN-2009 15:00	26-JUN-2009 15:00	02-JUL-2009 15:00	02-JUL-2009 15:00	26-JUN-2009 15:00
				EP0903809-001	EP0903809-002	EP0903809-003	EP0903809-004	EP0903809-005
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	39.8	33.7	31.0	20.3	23.8
EG020-SD: Total Metals in Sediments by ICPMS								
Arsenic	7440-38-2	1.00	mg/kg	2.58	2.23	2.30	1.52	2.98
Cadmium	7440-43-9	0.1	mg/kg	0.2	0.1	0.1	0.2	0.2
Chromium	7440-47-3	1.0	mg/kg	16.3	15.7	10.0	8.8	15.9
Copper	7440-50-8	1.0	mg/kg	2.0	1.7	2.4	1.7	1.4
Cobalt	7440-48-4	0.5	mg/kg	2.6	2.5	1.6	2.3	2.5
Lead	7439-92-1	1.0	mg/kg	2.6	2.4	1.6	1.9	11.3
Nickel	7440-02-0	1.0	mg/kg	2.5	2.5	2.2	2.3	2.9
Zinc	7440-66-6	1.0	mg/kg	11.3	10.0	8.6	19.1	11.7
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	0.02	0.02	0.01	0.02	0.02
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.100	mg/kg	0.357	0.151	0.130	0.182	0.138
EK061G: Total Kjeldahl Nitrogen as N								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	250	210	250	250	230
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	20	mg/kg	250	210	250	250	230
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	515	483	411	1850	548
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.10	0.07	0.16	0.09	0.08
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)fluoranthene	205-99-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SBF-43	SBF-44	SBF-16	SBF-22	SBF-41
				Client sampling date / time: 26-JUN-2009 15:00	26-JUN-2009 15:00	02-JUL-2009 15:00	02-JUL-2009 15:00	26-JUN-2009 15:00
				EP0903809-001	EP0903809-002	EP0903809-003	EP0903809-004	EP0903809-005
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
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
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
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**99.1**	**91.0**	**85.2**	**83.2**	**87.1**
2-Chlorophenol-D4	93951-73-6	0.1	%	**91.6**	**89.6**	**85.7**	**83.9**	**87.6**
2.4.6-Tribromophenol	118-79-6	0.1	%	**81.2**	**93.2**	**89.2**	**86.9**	**89.5**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**80.0**	**84.7**	**82.0**	**80.6**	**84.6**
Anthracene-d10	1719-06-8	0.1	%	**94.1**	**91.5**	**92.9**	**92.5**	**91.4**
4-Terphenyl-d14	1718-51-0	0.1	%	**92.7**	**99.3**	**102**	**96.2**	**108**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**101**	**103**	**95.8**	**115**	**111**
Toluene-D8	2037-26-5	0.1	%	**86.2**	**84.2**	**82.0**	**89.2**	**89.9**
4-Bromofluorobenzene	460-00-4	0.1	%	**89.3**	**81.1**	**83.9**	**95.1**	**95.6**
EP090S: Organotin Surrogate								
Tripropyltin	----	0.1	%	**104**	**95.8**	**104**	**94.4**	**113**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SBF-42	Export 3	Export-64	Export-11	Export-16
				Client sampling date / time: 26-JUN-2009 15:00	26-JUN-2009 15:00	26-JUN-2009 15:00	27-JUN-2009 15:00	27-JUN-2009 15:00
				EP0903809-006	EP0903809-007	EP0903809-008	EP0903809-009	EP0903809-010
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	28.6	18.1	40.7	41.5	12.8
EG020-SD: Total Metals in Sediments by ICPMS								
Arsenic	7440-38-2	1.00	mg/kg	1.32	<1.00	2.00	2.71	9.64
Cadmium	7440-43-9	0.1	mg/kg	0.1	<0.1	0.2	0.2	0.2
Chromium	7440-47-3	1.0	mg/kg	11.5	10.2	13.2	15.5	14.8
Copper	7440-50-8	1.0	mg/kg	1.7	<1.0	2.1	2.0	1.2
Cobalt	7440-48-4	0.5	mg/kg	1.9	0.5	2.2	1.4	0.9
Lead	7439-92-1	1.0	mg/kg	1.5	<1.0	2.1	2.0	1.6
Nickel	7440-02-0	1.0	mg/kg	2.0	<1.0	3.6	4.6	3.5
Zinc	7440-66-6	1.0	mg/kg	7.2	2.1	9.0	8.6	3.4
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	0.02	0.01	0.02	<0.01	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.100	mg/kg	0.315	0.153	0.379	0.282	0.115
EK061G: Total Kjeldahl Nitrogen as N								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	260	150	200	240	190
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	20	mg/kg	260	150	200	240	190
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	437	649	393	542	535
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.13	0.10	0.13	0.09	0.09
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)fluoranthene	205-99-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SBF-42	Export 3	Export-64	Export-11	Export-16
				Client sampling date / time: 26-JUN-2009 15:00	26-JUN-2009 15:00	26-JUN-2009 15:00	27-JUN-2009 15:00	27-JUN-2009 15:00
				EP0903809-006	EP0903809-007	EP0903809-008	EP0903809-009	EP0903809-010
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
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
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
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**82.5**	**81.6**	**82.4**	**80.1**	**82.3**
2-Chlorophenol-D4	93951-73-6	0.1	%	**84.3**	**83.4**	**83.4**	**80.8**	**84.5**
2.4.6-Tribromophenol	118-79-6	0.1	%	**84.1**	**86.8**	**83.0**	**97.9**	**86.3**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**80.2**	**81.6**	**83.4**	**83.9**	**81.9**
Anthracene-d10	1719-06-8	0.1	%	**89.0**	**66.4**	**96.0**	**91.6**	**97.1**
4-Terphenyl-d14	1718-51-0	0.1	%	**90.3**	**102**	**110**	**93.3**	**103**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**113**	**116**	**106**	**103**	**115**
Toluene-D8	2037-26-5	0.1	%	**89.2**	**92.0**	**83.5**	**78.9**	**95.4**
4-Bromofluorobenzene	460-00-4	0.1	%	**94.3**	**91.0**	**83.8**	**80.8**	**95.9**
EP090S: Organotin Surrogate								
Tripropyltin	----	0.1	%	**113**	**67.5**	**102**	**141**	**121**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-23	Export-36	Export-39	Export-49	Export-56
				Client sampling date / time: 28-JUN-2009 15:00	18-JUN-2009 15:00	18-JUN-2009 15:00	19-JUN-2009 15:00	19-JUN-2009 15:00
				EP0903809-011	EP0903809-012	EP0903809-013	EP0903809-014	EP0903809-015
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	**11.9**	**16.5**	**28.6**	**31.7**	**33.2**
EG020-SD: Total Metals in Sediments by ICPMS								
Arsenic	7440-38-2	1.00	mg/kg	**5.91**	**6.53**	**7.27**	**4.54**	**4.58**
Cadmium	7440-43-9	0.1	mg/kg	**0.2**	**0.1**	**0.1**	**0.1**	**0.1**
Chromium	7440-47-3	1.0	mg/kg	**13.7**	**17.6**	**24.7**	**13.6**	**16.1**
Copper	7440-50-8	1.0	mg/kg	**1.2**	<1.0	<1.0	<1.0	<1.0
Cobalt	7440-48-4	0.5	mg/kg	**0.8**	**0.6**	**0.7**	**0.5**	**0.6**
Lead	7439-92-1	1.0	mg/kg	**1.7**	**3.4**	**1.7**	<1.0	<1.0
Nickel	7440-02-0	1.0	mg/kg	**4.0**	<1.0	<1.0	**1.5**	**1.6**
Zinc	7440-66-6	1.0	mg/kg	**3.4**	**17.7**	**3.4**	**3.1**	**3.1**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	<0.01	<0.01	<0.01	**0.01**	**0.01**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.100	mg/kg	**0.159**	**0.257**	**0.434**	**0.146**	<0.100
EK061G: Total Kjeldahl Nitrogen as N								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**190**	**170**	**170**	**200**	**440**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	20	mg/kg	**190**	**170**	**170**	**200**	**440**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**517**	**442**	**526**	**916**	**1400**
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	**0.08**	**0.08**	**0.12**	**0.20**	**0.17**
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)fluoranthene	205-99-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-23	Export-36	Export-39	Export-49	Export-56
				Client sampling date / time: 28-JUN-2009 15:00	18-JUN-2009 15:00	18-JUN-2009 15:00	19-JUN-2009 15:00	19-JUN-2009 15:00
				EP0903809-011	EP0903809-012	EP0903809-013	EP0903809-014	EP0903809-015
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
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
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
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**87.7**	**81.8**	**82.7**	**87.1**	**82.0**
2-Chlorophenol-D4	93951-73-6	0.1	%	**89.4**	**83.7**	**84.8**	**89.6**	**84.4**
2.4.6-Tribromophenol	118-79-6	0.1	%	**89.7**	**86.4**	**80.0**	**91.2**	**88.4**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**89.0**	**81.5**	**83.1**	**85.3**	**83.9**
Anthracene-d10	1719-06-8	0.1	%	**103**	**88.3**	**99.4**	**95.8**	**87.5**
4-Terphenyl-d14	1718-51-0	0.1	%	**106**	**109**	**104**	**96.7**	**93.5**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**118**	**108**	**114**	**109**	**108**
Toluene-D8	2037-26-5	0.1	%	**96.3**	**86.5**	**87.3**	**83.0**	**83.0**
4-Bromofluorobenzene	460-00-4	0.1	%	**102**	**88.0**	**85.9**	**80.7**	**81.4**
EP090S: Organotin Surrogate								
Tripropyltin	----	0.1	%	**119**	**114**	**98.1**	**98.4**	**93.1**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-53	Cal-28	Cal-38	Tor-43	Tor-44
				Client sampling date / time: 19-JUN-2009 15:00	05-JUL-2009 15:00	03-JUL-2009 15:00	05-JUL-2009 15:00	05-JUL-2009 15:00
				EP0903809-016	EP0903809-017	EP0903809-018	EP0903809-019	EP0903809-020
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	32.1	46.5	36.9	37.2	49.3
EG020-SD: Total Metals in Sediments by ICPMS								
Arsenic	7440-38-2	1.00	mg/kg	1.86	<1.00	<1.00	1.98	<1.00
Cadmium	7440-43-9	0.1	mg/kg	<0.1	0.2	0.2	0.4	0.2
Chromium	7440-47-3	1.0	mg/kg	15.2	15.2	12.5	23.5	11.4
Copper	7440-50-8	1.0	mg/kg	<1.0	10.4	10.3	20.4	10.7
Cobalt	7440-48-4	0.5	mg/kg	<0.5	3.6	4.2	8.2	4.4
Lead	7439-92-1	1.0	mg/kg	1.1	3.1	2.7	5.7	3.2
Nickel	7440-02-0	1.0	mg/kg	<1.0	11.4	12.9	26.2	15.0
Zinc	7440-66-6	1.0	mg/kg	2.3	29.0	23.3	52.1	27.2
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	0.01	0.03	0.03	0.19	0.03
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.100	mg/kg	0.332	0.159	0.341	0.255	0.523
EK061G: Total Kjeldahl Nitrogen as N								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	340	1170	990	780	640
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	20	mg/kg	340	1170	990	780	640
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	1390	689	463	480	517
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.19	0.65	0.90	0.91	0.61
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b)fluoranthene	205-99-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-53	Cal-28	Cal-38	Tor-43	Tor-44
				Client sampling date / time: 19-JUN-2009 15:00	05-JUL-2009 15:00	03-JUL-2009 15:00	05-JUL-2009 15:00	05-JUL-2009 15:00
				EP0903809-016	EP0903809-017	EP0903809-018	EP0903809-019	EP0903809-020
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
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
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
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**84.7**	**82.7**	**86.1**	**70.7**	**77.8**
2-Chlorophenol-D4	93951-73-6	0.1	%	**86.8**	**80.5**	**90.7**	**66.7**	**72.6**
2.4.6-Tribromophenol	118-79-6	0.1	%	**95.8**	**87.7**	**89.4**	**89.5**	**98.0**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**84.3**	**80.5**	**87.4**	**68.9**	**70.5**
Anthracene-d10	1719-06-8	0.1	%	**73.0**	**89.1**	**92.1**	**69.7**	**87.5**
4-Terphenyl-d14	1718-51-0	0.1	%	**102**	**93.3**	**103**	**84.6**	**91.4**
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**114**	**97.5**	**95.3**	**102**	**75.8**
Toluene-D8	2037-26-5	0.1	%	**81.9**	**80.2**	**73.6**	**77.2**	**79.1**
4-Bromofluorobenzene	460-00-4	0.1	%	**83.7**	**78.5**	**75.2**	**78.8**	**77.4**
EP090S: Organotin Surrogate								
Tripropyltin	----	0.1	%	**118**	**103**	**83.9**	**114**	**121**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: Tor-45	Tor-53	Tor-54	Tor-55	----
				Client sampling date / time: 04-JUL-2009 15:00	04-JUL-2009 15:00	03-JUL-2009 15:00	04-JUL-2009 15:00	----
				EP0903809-021	EP0903809-022	EP0903809-023	EP0903809-024	----
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	**47.4**	**27.0**	**39.5**	**28.7**	----
EG020-SD: Total Metals in Sediments by ICPMS								
Arsenic	7440-38-2	1.00	mg/kg	<1.00	<1.00	<1.00	<1.00	----
Cadmium	7440-43-9	0.1	mg/kg	**0.2**	**0.1**	**0.2**	**0.1**	----
Chromium	7440-47-3	1.0	mg/kg	**6.3**	**3.8**	**3.7**	**3.6**	----
Copper	7440-50-8	1.0	mg/kg	**5.8**	<1.0	**3.0**	**2.6**	----
Cobalt	7440-48-4	0.5	mg/kg	**2.3**	**0.5**	**1.4**	**1.1**	----
Lead	7439-92-1	1.0	mg/kg	**1.8**	<1.0	**1.3**	<1.0	----
Nickel	7440-02-0	1.0	mg/kg	**5.8**	<1.0	**3.6**	**2.9**	----
Zinc	7440-66-6	1.0	mg/kg	**11.7**	**11.5**	**7.5**	**5.0**	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	**0.02**	<0.01	**0.01**	**0.01**	----
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.100	mg/kg	**0.228**	**0.171**	**0.223**	<0.100	----
EK061G: Total Kjeldahl Nitrogen as N								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	**700**	**170**	**280**	**40**	----
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	20	mg/kg	**700**	**170**	**280**	**40**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**350**	**337**	**376**	**220**	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	**0.41**	**0.12**	**0.26**	**0.28**	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(b)fluoranthene	205-99-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: Tor-45	Tor-53	Tor-54	Tor-55	----
				Client sampling date / time: 04-JUL-2009 15:00	04-JUL-2009 15:00	03-JUL-2009 15:00	04-JUL-2009 15:00	----
				EP0903809-021	EP0903809-022	EP0903809-023	EP0903809-024	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	<0.5	<0.5	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	10	mg/kg	<10	<10	<10	<10	----
C10 - C14 Fraction	----	50	mg/kg	<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
C29 - C36 Fraction	----	100	mg/kg	<100	<100	<100	<100	----
EP090: Organotin Compounds								
Monobutyltin	78763-54-9	1	µgSn/kg	<1	<1	<1	<1	----
Dibutyltin	1002-53-5	1	µgSn/kg	<1	<1	<1	<1	----
Tributyltin	56573-85-4	0.5	µgSn/kg	<0.5	<0.5	<0.5	<0.5	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**78.0**	**80.0**	**85.8**	**103**	----
2-Chlorophenol-D4	93951-73-6	0.1	%	**72.4**	**77.0**	**90.9**	**90.2**	----
2.4.6-Tribromophenol	118-79-6	0.1	%	**101**	**72.3**	**102**	**98.5**	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**69.5**	**69.1**	**85.5**	**60.6**	----
Anthracene-d10	1719-06-8	0.1	%	**91.6**	**76.4**	**102**	**97.3**	----
4-Terphenyl-d14	1718-51-0	0.1	%	**94.7**	**94.6**	**109**	**95.3**	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**87.0**	**87.2**	**105**	**83.2**	----
Toluene-D8	2037-26-5	0.1	%	**83.2**	**85.8**	**77.2**	**82.9**	----
4-Bromofluorobenzene	460-00-4	0.1	%	**84.0**	**86.4**	**78.1**	**84.2**	----
EP090S: Organotin Surrogate								
Tripropyltin	----	0.1	%	**132**	**121**	**88.0**	**115**	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: SBF-43 Top	SBF-43 Middle	SBF-43 Bottom	SBF-44 Top	SBF-44 Middle
				Client sampling date / time: 25-JUN-2009 15:00	25-JUN-2009 15:00	25-JUN-2009 15:00	25-JUN-2009 15:00	25-JUN-2009 15:00
				EP0903809-025	EP0903809-026	EP0903809-027	EP0903809-028	EP0903809-029
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**18**	**15**	**18**	**12**	**28**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.170**	**0.177**	**0.180**	**0.177**	**0.170**
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	**0.0008**	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.009**	**0.009**	**0.012**	**0.011**	**0.012**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	**0.005**	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	**0.012**	**0.011**	**0.015**	**0.012**	**0.011**
Zinc	7440-66-6	0.005	mg/L	**0.104**	**0.029**	<0.025	**0.041**	**0.032**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	**0.17**	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.04**	**0.08**	**0.03**	**0.01**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.04**	**0.08**	**0.03**	**0.01**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.9**	**0.9**	**1.3**	**0.6**	<0.5
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**0.9**	**0.9**	**1.4**	**0.6**	<0.5
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: SBF-44 Bottom	SBF-41 Top	SBF-41 Middle	SBF-41 Bottom	SBF-42 Top
				Client sampling date / time: 25-JUN-2009 15:00	07-JUN-2009 15:00	07-JUN-2009 15:00	07-JUN-2009 15:00	23-JUN-2008 15:00
				EP0903809-030	EP0903809-031	EP0903809-032	EP0903809-033	EP0903809-034
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**32**	**20**	**20**	**18**	**53**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.178**	<0.005	<0.005	<0.005	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.013**	**0.011**	**0.012**	**0.012**	**0.013**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	**0.011**	**0.008**	**0.009**	**0.006**	**0.006**
Zinc	7440-66-6	0.005	mg/L	**0.069**	**0.084**	**0.036**	**0.063**	**0.045**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.10**	<0.01	**0.04**	**0.06**	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.10**	<0.01	**0.04**	**0.06**	<0.01
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.6**	**0.6**	**0.6**	**0.6**	**0.9**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**0.6**	**0.6**	**0.6**	**0.7**	**0.9**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: SBF-42 Middle Client sampling date / time: 23-JUN-2008 15:00 EP0903809-035	SBF-42 Bottom 23-JUN-2008 15:00 EP0903809-036	Export-4 Top 23-JUN-2009 15:00 EP0903809-037	Export-4 Middle 23-JUN-2009 15:00 EP0903809-038	Export-4 Bottom 23-JUN-2009 15:00 EP0903809-039
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**43**	**44**	**40**	**27**	**41**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	**0.185**	**0.184**	**0.183**
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.013**	**0.013**	**0.013**	**0.013**	**0.013**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	**0.006**	**0.006**	**0.011**	**0.011**	**0.011**
Zinc	7440-66-6	0.005	mg/L	**0.106**	**0.117**	**0.025**	**0.088**	**0.056**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	**0.31**	**0.16**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.01**	**0.05**	<0.01	**0.02**	**0.05**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.01**	**0.05**	<0.01	**0.02**	**0.05**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.7**	<0.5	**0.8**	**0.5**	<0.5
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**0.7**	<0.5	**0.8**	**0.5**	<0.5
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-64 Top	Export-64 Middle	Export-64 Bottom	Export 11 Top	Export-11 Middle
				Client sampling date / time: 25-JUN-2009 15:00	25-JUN-2009 15:00	25-JUN-2009 15:00	03-JUN-2009 15:00	03-JUN-2009 15:00
				EP0903809-040	EP0903809-041	EP0903809-042	EP0903809-043	EP0903809-044
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**29**	**34**	**23**	**32**	**34**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.182**	**0.178**	**0.183**	<0.005	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.014**	**0.016**	**0.014**	**0.013**	**0.014**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	**0.011**	**0.011**	**0.010**	<0.005	**0.005**
Zinc	7440-66-6	0.005	mg/L	**0.041**	**0.087**	**0.048**	**0.054**	**0.076**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	**0.33**	<0.10	**0.42**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.01**	**0.04**	<0.01	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.01**	**0.04**	<0.01	<0.01
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.5	**0.7**	**0.7**	**1.6**	**0.6**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	<0.5	**0.7**	**0.7**	**1.6**	**0.6**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	**9.05**	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	**0.02**	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-11 Bottom Client sampling date / time: 03-JUN-2009 15:00 EP0903809-045	Export-16 Top 22-JUN-2009 15:00 EP0903809-046	Export-16 Middle 22-JUN-2009 15:00 EP0903809-047	Export-16 Bottom 22-JUN-2009 15:00 EP0903809-048	Export-23 Top 20-JUN-2009 15:00 EP0903809-049
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**37**	**35**	**56**	**13**	**9**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	**0.186**	**0.187**	**0.188**	**0.186**
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.012**	**0.013**	**0.011**	**0.013**	**0.014**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	**0.005**	**0.010**	**0.010**	**0.010**	**0.009**
Zinc	7440-66-6	0.005	mg/L	**0.074**	**0.034**	**0.061**	**0.052**	**0.055**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.05**	<0.01	**0.02**	**0.01**	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.05**	<0.01	**0.02**	**0.01**	<0.01
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.7**	**1.3**	**0.9**	**1.1**	**0.6**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**0.8**	**1.3**	**0.9**	**1.1**	**0.6**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-23 Middle Client sampling date / time: 20-JUN-2009 15:00 EP0903809-050	Export-23 Bottom 20-JUN-2009 15:00 EP0903809-051	Export-70 Top 17-JUN-2009 15:00 EP0903809-052	Export-70 Middle 17-JUN-2009 15:00 EP0903809-053	Export-70 Bottom 17-JUN-2009 15:00 EP0903809-054
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**48**	**51**	**17**	**26**	**33**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.185**	**0.191**	<0.005	<0.005	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.013**	**0.013**	**0.014**	**0.014**	**0.088**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	**0.009**	**0.010**	**0.006**	**0.006**	**0.005**
Zinc	7440-66-6	0.005	mg/L	**0.039**	**0.045**	**0.050**	**0.054**	**0.072**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.72**	<0.10	<0.10	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.01**	<0.01	<0.01	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.01**	<0.01	<0.01	<0.01
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.6**	**1.1**	**0.6**	**0.5**	**0.7**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**0.6**	**1.1**	**0.6**	**0.5**	**0.7**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-76 Top Client sampling date / time: 17-JUN-2009 15:00 EP0903809-055	Export-76 Middle 17-JUN-2009 15:00 EP0903809-056	Export-76 Bottom 17-JUN-2009 15:00 EP0903809-057	Export-36 Top 16-JUN-2009 15:00 EP0903809-058	Export-36 Middle 16-JUN-2009 15:00 EP0903809-059
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**47**	**33**	**38**	**32**	**26**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.013**	**0.012**	**0.013**	**0.014**	**0.015**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	**0.005**	**0.006**	<0.005	<0.005	<0.005
Zinc	7440-66-6	0.005	mg/L	**0.050**	**0.107**	**0.050**	**0.067**	**0.067**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	**0.01**	<0.01	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	**0.01**	<0.01	<0.01
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.5	**1.3**	**0.5**	**1.0**	**15.2**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	<0.5	**1.3**	**0.5**	**1.0**	**15.2**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-36 Bottom	Export-39 Top	Export-39 Middle	Export-39 Bottom	Export-49 Top
			Client sampling date / time	16-JUN-2009 15:00	10-JUN-2009 15:00	10-JUN-2009 15:00	10-JUN-2009 15:00	09-JUN-2009 15:00
				EP0903809-060	EP0903809-061	EP0903809-062	EP0903809-063	EP0903809-064
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**16**	**34**	**38**	**36**	**91**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.014**	**0.014**	**0.013**	**0.013**	**0.012**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	7440-66-6	0.005	mg/L	**0.063**	**0.069**	**0.057**	**0.089**	**0.067**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.01**	**0.01**	<0.01	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.01**	**0.01**	<0.01	<0.01
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.6**	**0.5**	**1.2**	<0.5	<0.5
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**0.6**	**0.5**	**1.2**	<0.5	<0.5
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-49 Middle	Export-49 Bottom	Export-56 Top	Export-56 Middle	Export-56 Bottom
				Client sampling date / time: 09-JUN-2009 15:00	09-JUN-2009 15:00	06-JUN-2009 15:00	06-JUN-2009 15:00	06-JUN-2009 15:00
				EP0903809-065	EP0903809-066	EP0903809-067	EP0903809-068	EP0903809-069
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**6**	**34**	**20**	**30**	**14**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.001
Cadmium	7440-43-9	0.0001	mg/L	**0.0009**	<0.0005	<0.0005	<0.0005	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.001
Copper	7440-50-8	0.001	mg/L	**0.016**	**0.013**	**0.014**	**0.014**	**0.004**
Lead	7439-92-1	0.001	mg/L	**0.007**	<0.005	<0.005	<0.005	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.008**	<0.005	<0.005	<0.005	<0.001
Zinc	7440-66-6	0.005	mg/L	**0.053**	**0.067**	**0.037**	**0.063**	**0.007**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.02**	**0.01**	**0.01**	**0.01**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.02**	**0.01**	**0.01**	**0.01**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.5	**0.6**	<0.5	<0.5	<0.5
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	<0.5	**0.6**	<0.5	<0.5	<0.5
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	**0.24**	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-52 Top	Export-52 Middle	Export-52 Bottom	Cal-28 Top	Cal-28 Middle
				Client sampling date / time: 06-JUN-2009 15:00	06-JUN-2009 15:00	06-JUN-2009 15:00	05-JUL-2009 15:00	05-JUL-2009 15:00
				EP0903809-070	EP0903809-071	EP0903809-072	EP0903809-073	EP0903809-074
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**14**	**18**	**34**	**15**	**28**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	<0.005	**0.183**	**0.186**
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.011**	**0.013**	**0.015**	**0.013**	**0.013**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	**0.010**	**0.005**	<0.005
Nickel	7440-02-0	0.001	mg/L	<0.005	<0.005	**0.006**	**0.009**	**0.009**
Zinc	7440-66-6	0.005	mg/L	**0.044**	**0.045**	**0.082**	**0.036**	**0.032**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.01**	**0.02**	**0.01**	**0.02**	**0.26**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.01**	**0.02**	**0.01**	**0.02**	**0.26**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.5	**9.0**	**0.7**	**0.7**	**21.0**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	<0.5	**9.0**	**0.7**	**0.7**	**21.3**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**0.01**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Cal-28 Bottom	Cal-30 Top	Cal-30 Middle	Cal-30 Bottom	Cal-31 Top
				Client sampling date / time: 05-JUL-2009 15:00	06-JUL-2009 15:00	06-JUL-2009 15:00	06-JUL-2009 15:00	06-JUL-2009 15:00
				EP0903809-075	EP0903809-076	EP0903809-077	EP0903809-078	EP0903809-079
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**19**	**6**	**14**	**17**	**30**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.180**	**0.189**	**0.189**	**0.187**	**0.188**
Cadmium	7440-43-9	0.0001	mg/L	**0.0005**	**0.0010**	**0.0009**	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	**0.005**	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.010**	**0.016**	**0.015**	**0.012**	**0.013**
Lead	7439-92-1	0.001	mg/L	<0.005	**0.006**	**0.006**	<0.005	**0.005**
Nickel	7440-02-0	0.001	mg/L	**0.010**	**0.010**	**0.012**	**0.009**	**0.008**
Zinc	7440-66-6	0.005	mg/L	**0.121**	**0.108**	**0.031**	**0.037**	**0.038**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	**0.13**	<0.10	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.46**	**0.02**	**0.38**	**0.51**	**0.02**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.46**	**0.02**	**0.38**	**0.51**	**0.02**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.6**	**0.5**	<0.5	**0.7**	**0.6**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**1.0**	**0.6**	<0.5	**1.2**	**0.6**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	**0.08**	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	**0.02**	<0.01	<0.01	**0.02**	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Cal-31 Middle Client sampling date / time: 06-JUL-2009 15:00 EP0903809-080	Cal-31 Bottom 06-JUL-2009 15:00 EP0903809-081	Tor-44 Top 05-JUL-2009 15:00 EP0903809-082	Tor-44 Middle 05-JUL-2009 15:00 EP0903809-083	Tor-44 Bottom 05-JUL-2009 15:00 EP0903809-084
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**7**	**32**	**30**	**35**	**28**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.185**	**0.194**	**0.189**	**0.190**	**0.190**
Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	7440-48-4	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	7440-50-8	0.001	mg/L	**0.012**	**0.012**	**0.011**	**0.012**	**0.012**
Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	7440-02-0	0.001	mg/L	**0.008**	**0.008**	**0.007**	**0.008**	**0.007**
Zinc	7440-66-6	0.005	mg/L	**0.028**	**0.044**	**0.257**	**0.083**	**0.062**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	**0.33**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.42**	**0.49**	**0.02**	**0.37**	**0.48**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.42**	**0.49**	**0.02**	**0.37**	**0.48**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.8**	**0.7**	**0.6**	**2.8**	**0.9**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**1.2**	**1.2**	**0.7**	**3.1**	**1.4**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	**0.01**	**0.02**	<0.01	**0.02**	**0.02**

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	24.0	113
2-Chlorophenol-D4	93951-73-6	23.0	134
2.4.6-Tribromophenol	118-79-6	19.0	122
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	30.0	115
Anthracene-d10	1719-06-8	27.0	133
4-Terphenyl-d14	1718-51-0	18.0	137
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	70.0	130
Toluene-D8	2037-26-5	70.0	130
4-Bromofluorobenzene	460-00-4	70.0	130
EP090S: Organotin Surrogate			
Tripropyltin	----	34	108

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EP0904270**	Page	: 1 of 12
Client	: **GARDLINE MARINE SCIENCES P/L**	Laboratory	: Environmental Division Perth
Contact	: ANDREW CAMPBELL	Contact	: Michael Sharp
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Project	: 7905	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 2184		
C-O-C number	: ----	Date Samples Received	: 31-JUL-2009
Sampler	: ----	Issue Date	: 26-AUG-2009
Site	: ----		
		No. of samples received	: 34
Quote number	: EP-005-09 V3	No. of samples analysed	: 34

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

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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.

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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 insuffient 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 date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

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

- **EG020SD (Total Metals) Sample EP0904270-003(Slope-24) shows poor matrix spike recovery for Cadmium, Copper, Lead and Zinc due to matrix interference. Confirmed by re-extraction and re-analysis.**
- **EK061G, EK067G: LOR for Total Phosphorus, Total Kjeldahl Nitrogen was raised due to matrix effects.**
- **TBT: Sample Cal-29 shows poor matrix spike recovery. Insufficient sample for re-extraction and re-analysis.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: Export-70	Cal-29	Slope-24	Cal-41	Tor-58
				Client sampling date / time: 19-JUL-2009 15:00	05-JUL-2009 15:00	20-JUL-2009 15:00	21-JUL-2009 15:00	22-JUL-2009 15:00
				EP0904270-001	EP0904270-002	EP0904270-003	EP0904270-004	EP0904270-005
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	20.2	60.6	52.4	55.4	53.2
EG020-SD: Total Metals in Sediments by ICPMS								
Arsenic	7440-38-2	1.00	mg/kg	6.67	1.60	<1.00	<1.00	<1.00
Cadmium	7440-43-9	0.1	mg/kg	0.2	0.3	0.2	0.3	0.2
Chromium	7440-47-3	1.0	mg/kg	23.0	19.6	17.2	11.6	12.8
Copper	7440-50-8	1.0	mg/kg	1.1	16.2	11.6	11.0	8.2
Cobalt	7440-48-4	0.5	mg/kg	0.9	5.6	3.3	4.0	3.1
Lead	7439-92-1	1.0	mg/kg	2.1	4.1	2.6	3.3	2.4
Nickel	7440-02-0	1.0	mg/kg	2.6	22.7	12.3	16.0	12.4
Zinc	7440-66-6	1.0	mg/kg	4.4	35.0	30.8	25.5	20.1
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.01	mg/kg	0.01	0.05	0.03	0.04	0.03
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.100	mg/kg	0.357	0.254	0.147	0.437	0.364
EK061G: Total Kjeldahl Nitrogen as N								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	260	1900	1570	350	840
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	20	mg/kg	260	1900	1570	350	840
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	441	641	464	322	369
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	0.02	%	0.08	0.81	0.80	0.40	0.41
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
EP090: Organotin Compounds								
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	%	110	76.3	105	102	107
Toluene-D8	2037-26-5	0.1	%	90.5	85.4	90.0	87.9	89.9
4-Bromofluorobenzene	460-00-4	0.1	%	86.7	75.2	81.5	78.3	80.2
EP090S: Organotin Surrogate								
Tripropyltin	----	0.1	%	113	102	103	102	110

Analytical Results

Sub-Matrix: SOIL				Client sample ID	Cal-31	Cal-30	----	----	----
				Client sampling date / time	21-JUL-2009 15:00	20-JUL-2009 15:00	----	----	----
Compound	CAS Number	LOR	Unit		EP0904270-006	EP0904270-007	----	----	----
EA055: Moisture Content									
^ Moisture Content (dried @ 103°C)	----	1.0	%		58.6	65.9	----	----	----
EG020-SD: Total Metals in Sediments by ICPMS									
Arsenic	7440-38-2	1.00	mg/kg		<1.00	1.38	----	----	----
Cadmium	7440-43-9	0.1	mg/kg		0.3	0.3	----	----	----
Chromium	7440-47-3	1.0	mg/kg		15.8	21.2	----	----	----
Copper	7440-50-8	1.0	mg/kg		14.2	17.8	----	----	----
Cobalt	7440-48-4	0.5	mg/kg		4.9	6.3	----	----	----
Lead	7439-92-1	1.0	mg/kg		3.9	4.5	----	----	----
Nickel	7440-02-0	1.0	mg/kg		19.8	24.5	----	----	----
Zinc	7440-66-6	1.0	mg/kg		30.9	37.5	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.01	mg/kg		0.04	0.05	----	----	----
EK059G: NOX as N by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.100	mg/kg		0.374	0.617	----	----	----
EK061G: Total Kjeldahl Nitrogen as N									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		1190	1500	----	----	----
EK062: Total Nitrogen as N									
^ Total Nitrogen as N	----	20	mg/kg		1190	1500	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		396	478	----	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	0.02	%		0.73	0.78	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	----	----	----
C10 - C14 Fraction	----	50	mg/kg		<50	<50	----	----	----
C15 - C28 Fraction	----	100	mg/kg		<100	<100	----	----	----
C29 - C36 Fraction	----	100	mg/kg		<100	<100	----	----	----
EP090: Organotin Compounds									
Tributyltin	56573-85-4	0.5	µgSn/kg		<0.5	<0.5	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		101	73.5	----	----	----
Toluene-D8	2037-26-5	0.1	%		82.6	87.9	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		79.8	76.7	----	----	----
EP090S: Organotin Surrogate									
Tripropyltin	----	0.1	%		86.0	90.3	----	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Cal-29 Top	Cal-29 Middle	Cal-29 Bottom	Slope-24 Top	Slope-24 Middle
				Client sampling date / time: 20-JUL-2009 15:00	20-JUL-2009 15:00	20-JUL-2009 15:00	20-JUL-2009 15:00	20-JUL-2009 15:00
				EP0904270-008	EP0904270-009	EP0904270-010	EP0904270-011	EP0904270-012
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**22**	**23**	**32**	**38**	**26**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	7440-47-3	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cobalt	7440-48-4	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	7440-50-8	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	7440-02-0	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	7440-66-6	0.005	mg/L	**0.057**	**0.066**	<0.050	<0.050	<0.050
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.09**	**0.14**	**0.23**	<0.01	**0.15**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.09**	**0.14**	**0.23**	<0.01	**0.15**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.4**	**1.2**	**1.0**	**1.3**	**1.2**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**1.4**	**1.4**	**1.2**	**1.3**	**1.4**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	**0.03**	**0.05**	<0.01	**0.03**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Slope-24 Bottom Client sampling date / time: 20-JUL-2009 15:00 EP0904270-013	Cal-33 Top 22-JUL-2009 15:00 EP0904270-014	Cal-33 Middle 22-JUL-2009 15:00 EP0904270-015	Cal-33 Bottom 22-JUL-2009 15:00 EP0904270-016	Cal-41 Top 21-JUL-2009 15:00 EP0904270-017
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**14**	**30**	**38**	**42**	**17**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	7440-47-3	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cobalt	7440-48-4	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	7440-50-8	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	7440-02-0	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	7440-66-6	0.005	mg/L	**0.072**	<0.050	<0.050	<0.050	<0.050
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	**0.16**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.17**	<0.01	**0.08**	**0.34**	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.17**	<0.01	**0.08**	**0.34**	<0.01
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.2**	**1.4**	**1.6**	**1.4**	**1.5**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**1.4**	**1.4**	**1.7**	**1.7**	**1.5**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	**0.03**	<0.01	**0.01**	**0.05**	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Cal-41 Middle Client sampling date / time: 21-JUL-2009 15:00 EP0904270-018	Cal-41 Bottom 21-JUL-2009 15:00 EP0904270-019	Tor-57 Top 22-JUL-2009 15:00 EP0904270-020	Tor-57 Middle 22-JUL-2009 15:00 EP0904270-021	Tor-57 Bottom 22-JUL-2009 15:00 EP0904270-022
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**28**	**14**	**25**	**26**	**20**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	7440-47-3	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cobalt	7440-48-4	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	7440-50-8	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	7440-02-0	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	7440-66-6	0.005	mg/L	<0.050	**0.061**	<0.050	<0.050	<0.050
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	**0.49**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.18**	**0.31**	**0.02**	**0.07**	**0.17**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.18**	**0.31**	**0.02**	**0.07**	**0.17**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.3**	**1.6**	**1.6**	**1.5**	**1.5**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**1.4**	**2.0**	**1.6**	**1.6**	**1.6**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	**0.03**	**0.05**	<0.01	**0.01**	**0.03**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Tor-58 Top	Tor-58 Middle	Tor-58 Bottom	Cal-38 Top	Cal-38 Middle
				Client sampling date / time: 22-JUL-2009 15:00	22-JUL-2009 15:00	22-JUL-2009 15:00	21-JUL-2009 15:00	21-JUL-2009 15:00
				EP0904270-023	EP0904270-024	EP0904270-025	EP0904270-026	EP0904270-027
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**30**	**12**	**31**	**25**	**34**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	7440-47-3	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cobalt	7440-48-4	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	7440-50-8	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	7440-02-0	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	7440-66-6	0.005	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	**0.24**	<0.10	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.03**	**0.17**	<0.01	**0.26**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.03**	**0.17**	<0.01	**0.26**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.2**	**1.7**	**1.4**	**1.4**	**1.4**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**1.2**	**1.7**	**1.6**	**1.4**	**1.7**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.20**	<0.05	**0.10**	<0.05	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	**0.03**	<0.01	**0.04**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Cal-38 Bottom	Slope-22 Top	Slope-22 Middle	Slope-22 Bottom	Slope-16 Top
			Client sampling date / time	21-JUL-2009 15:00	22-JUL-2009 15:00	22-JUL-2009 15:00	22-JUL-2009 15:00	22-JUL-2009 15:00
				EP0904270-028	EP0904270-029	EP0904270-030	EP0904270-031	EP0904270-032
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**8**	**26**	**26**	**39**	**42**
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chromium	7440-47-3	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Cobalt	7440-48-4	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Copper	7440-50-8	0.001	mg/L	<0.010	**0.011**	**0.011**	**0.010**	**0.011**
Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel	7440-02-0	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Zinc	7440-66-6	0.005	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	<0.10	**0.10**	<0.10
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.18**	<0.01	**0.06**	**0.20**	<0.01
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.18**	<0.01	**0.06**	**0.20**	<0.01
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.09**	**0.08**	<0.05	<0.05	**0.11**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	**0.03**	<0.01	**0.01**	**0.03**	<0.01

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: Slope-16 Middle	Slope-16 Bottom	----	----	----
				Client sampling date / time: 22-JUL-2009 15:00	22-JUL-2009 15:00	----	----	----
				EP0904270-033	EP0904270-034	----	----	----
EA025: Suspended Solids								
^ Suspended Solids (SS)	----	1	mg/L	**36**	**51**	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.010	<0.010	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.010	<0.010	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.011**	**0.012**	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.010	<0.010	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.050	<0.050	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.10	<0.10	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.04**	**0.17**	----	----	----
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.04**	**0.17**	----	----	----
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.5	<0.5	----	----	----
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	<0.5	<0.5	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	----	0.01	mg/L	**0.01**	**0.03**	----	----	----

Surrogate Control Limits

Sub-Matrix: **SOIL**

Compound	CAS Number	Recovery Limits (%) Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	70.0	130
Toluene-D8	2037-26-5	70.0	130
4-Bromofluorobenzene	460-00-4	70.0	130
EP090S: Organotin Surrogate			
Tripropyltin	----	34	108

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EP0903859**	Page	: 1 of 7
Client	: **GARDLINE MARINE SCIENCES P/L**	Laboratory	: Environmental Division Perth
Contact	: ANDREW CAMPBELL	Contact	: Michael Sharp
Address	: Unit 2, 22 Blackly Row Cockburn Central Perth, WA 6164	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: andrew.campbell@gardline.co.uk	E-mail	: michael.sharp@alsenviro.com
Telephone	: 08 9499 6850	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: #7905	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 1897		
C-O-C number	: ----	Date Samples Received	: 13-JUL-2009
Sampler	: ----	Issue Date	: 20-AUG-2009
Site	: ----		
		No. of samples received	: 84
Quote number	: EP-005-09 V3	No. of samples analysed	: 24

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.

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- General Comments
- Analytical Results

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Signatories

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Signatories	*Position*	*Accreditation Category*

General Comments

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

- **Radiological data analysed by ALS (Czech Republic) under CAI report number CS0903503.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: SBF-43	SBF-44	Slope-16	Slope-22	SBF-41
				Client sampling date / time: 26-JUN-2009 15:00	26-JUN-2009 15:00	26-JUN-2009 15:00	26-JUN-2009 15:00	26-JUN-2009 15:00
				EP0903859-001	EP0903859-002	EP0903859-003	EP0903859-004	EP0903859-005
Radionucleides / Activity								
Radium 226	----	1.0	Bq/kg DW	**8.0**	**7.5**	**16.0**	**13.0**	**6.8**
Radium 228	----	1.0	Bq/kg DW	**7.9**	**6.3**	**10.4**	**9.1**	**5.9**

Analytical Results

Sub-Matrix: SOIL				Client sample ID	SBF-42	Export-3	Export-64	Export-11	Export-16
				Client sampling date / time	26-JUN-2009 15:00	26-JUN-2009 15:00	[15-JUL-2009]	27-JUN-2009 15:00	27-JUN-2009 15:00
Compound	CAS Number	LOR	Unit		EP0903859-006	EP0903859-007	EP0903859-008	EP0903859-009	EP0903859-010
Radionucleides / Activity									
Radium 226	----	1.0	Bq/kg DW		**9.7**	**15.0**	**8.7**	**6.7**	**8.0**
Radium 228	----	1.0	Bq/kg DW		**12.5**	**2.1**	**11.7**	**5.8**	**3.6**

Analytical Results

Sub-Matrix: SOIL				Client sample ID	Export-23	Export-36	Export-39	Export-49	Export-56
				Client sampling date / time	28-JUN-2009 15:00	18-JUN-2009 15:00	18-JUN-2009 15:00	19-JUN-2009 15:00	19-JUN-2009 15:00
Compound	CAS Number	LOR	Unit		EP0903859-011	EP0903859-012	EP0903859-013	EP0903859-014	EP0903859-015
Radionucleides / Activity									
Radium 226	----	1.0	Bq/kg DW		**7.7**	**4.4**	**3.9**	**5.2**	**7.1**
Radium 228	----	1.0	Bq/kg DW		**3.5**	**2.7**	**2.7**	**4.1**	**4.5**

Analytical Results

Sub-Matrix: SOIL				Client sample ID	Export-53	Cal-28	Cal-38	Tor-43	Tor-44
				Client sampling date / time	19-JUN-2009 15:00	05-JUL-2009 15:00	03-JUL-2009 15:00	05-JUL-2009 15:00	05-JUL-2009 15:00
Compound	CAS Number	LOR	Unit		EP0903859-016	EP0903859-017	EP0903859-018	EP0903859-019	EP0903859-020
Radionucleides / Activity									
Radium 226	----	1.0	Bq/kg DW		**6.8**	**25.0**	**37.0**	**30.0**	**26.0**
Radium 228	----	1.0	Bq/kg DW		**4.7**	**12.7**	**20.0**	**20.0**	**17.0**

Analytical Results

Sub-Matrix: SOIL				Client sample ID	Tor-45	Tor-53	Tor-54	Tor-55	----
				Client sampling date / time	04-JUL-2009 15:00	04-JUL-2009 15:00	03-JUL-2009 15:00	04-JUL-2009 15:00	----
Compound	CAS Number	LOR	Unit		EP0903859-021	EP0903859-022	EP0903859-023	EP0903859-024	----
Radionucleides / Activity									
Radium 226	----	1.0	Bq/kg DW		**13.0**	**23.0**	**11.0**	**12.0**	----
Radium 228	----	1.0	Bq/kg DW		**4.2**	<1.0	**8.4**	**7.1**	----

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EP0904269**	Page	: 1 of 4
Client	: **GARDLINE MARINE SCIENCES P/L**	Laboratory	: Environmental Division Perth
Contact	: ANDREW CAMPBELL	Contact	: Michael Sharp
Address	: Unit 2, 22 Blackly Row Cockburn Central Perth, WA 6164	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: andrew.campbell@gardline.co.uk	E-mail	: michael.sharp@alsenviro.com
Telephone	: 08 9499 6850	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: 7905	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 2184		
C-O-C number	: ----	Date Samples Received	: 31-JUL-2009
Sampler	: ----	Issue Date	: 09-SEP-2009
Site	: ----		
		No. of samples received	: 34
Quote number	: ----	No. of samples analysed	: 7

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.

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- General Comments
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Signatories

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Signatories	*Position*	*Accreditation Category*

General Comments

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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

- **Radiological data analysed by ALS (Czech Republic) under CAI report number CS0903819.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: Export 70 Client sampling date / time: 19-JUL-2009 15:00 EP0904269-001	Cal 29 05-JUL-2009 15:00 EP0904269-002	Slope 24 20-JUL-2009 15:00 EP0904269-003	Cal 41 21-JUL-2009 15:00 EP0904269-004	Tor 58 22-JUL-2009 15:00 EP0904269-005
Radionucleides / Activity								
Radium 226	----	1	Bq/kg DW	**3.3**	**31.0**	**24.0**	**31.0**	**16.0**
Radium 228	----	1	Bq/kg DW	**2.4**	**11.0**	**12.0**	**10.0**	**8.0**

Analytical Results

Sub-Matrix: SOIL			Client sample ID	Cal 31	Cal 30	----	----	----
			Client sampling date / time	21-JUL-2009 15:00	20-JUL-2009 15:00	----	----	----
Compound	CAS Number	LOR	Unit	EP0904269-006	EP0904269-007	----	----	----
Radionucleides / Activity								
Radium 226	----	1	Bq/kg DW	**38.0**	**52.0**	----	----	----
Radium 228	----	1	Bq/kg DW	**12.0**	**18.0**	----	----	----

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EP0904855**	Page	: 1 of 6
Amendment	: **1**		
Client	: **GARDLINE MARINE SCIENCES P/L**	Laboratory	: Environmental Division Perth
Contact	: PAUL NICHOLS	Contact	: Michael Sharp
Address	: Unit 2, 22 Blackly Row Cockburn Central Perth, WA 6164	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: paul.nichols@gardline.co.uk	E-mail	: michael.sharp@alsenviro.com
Telephone	: ----	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: Ex EP0903859 #7905	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 27-AUG-2009
Sampler	: ----	Issue Date	: 11-SEP-2009
Site	: ----		
		No. of samples received	: 13
Quote number	: EP-005-09 V3	No. of samples analysed	: 13

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

- **Radiological data analysed by ALS (Czech Republic) under CAI report number CS0904110.**

Analytical Results

Sub-Matrix: SOIL				Client sample ID	SBF-43	Slope-16	Slope-22	SBF-41	SBF-42
				Client sampling date / time	26-JUN-2009 15:00	26-JUN-2009 15:00	26-JUN-2009 15:00	26-JUN-2009 15:00	26-JUN-2009 15:00
Compound	CAS Number	LOR	Unit		EP0904855-001	EP0904855-002	EP0904855-003	EP0904855-004	EP0904855-005
Radionucleides / Activity									
Thorium 228	----	1.0	Bq/kg DW		**7.9**	**10.4**	**9.1**	**5.9**	**12.5**

Analytical Results

Sub-Matrix: SOIL			Client sample ID	Export-64	Export-11	Cal-38	Tor-43	Tor-44
			Client sampling date / time	15-JUL-2009 15:00	27-JUN-2009 15:00	03-JUL-2009 15:00	05-JUL-2009 15:00	05-JUL-2009 15:00
Compound	CAS Number	LOR	Unit	EP0904855-006	EP0904855-007	EP0904855-008	EP0904855-009	EP0904855-010
Radionucleides / Activity								
Thorium 228	----	1.0	Bq/kg DW	**11.7**	**5.8**	**20.0**	**20.0**	**17.0**

Analytical Results

Sub-Matrix: SOIL			Client sample ID	Tor-45	Tor-54	Tor-55	----	----
			Client sampling date / time	04-JUL-2009 15:00	03-JUL-2009 15:00	04-JUL-2009 15:00	----	----
Compound	CAS Number	LOR	Unit	EP0904855-011	EP0904855-012	EP0904855-013	----	----
Radionucleides / Activity								
Thorium 228	----	1.0	Bq/kg DW	**4.2**	**8.4**	**7.1**	----	----

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EP0905121**	Page	: 1 of 5
Amendment	: **1**		
Client	: **GARDLINE MARINE SCIENCES P/L**	Laboratory	: Environmental Division Perth
Contact	: PAUL NICHOLS	Contact	: Michael Sharp
Address	: Unit 2, 22 Blackly Row Cockburn Central Perth, WA 6164	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: paul.nichols@gardline.co.uk	E-mail	: michael.sharp@alsenviro.com
Telephone	: ----	Telephone	: +61-8-9209 7655
Facsimile	: ----	Facsimile	: +61-8-9209 7600
Project	: Ex EP0904269 #7905	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 08-SEP-2009
Sampler	: ----	Issue Date	: 10-SEP-2009
Site	: ----		
		No. of samples received	: 6
Quote number	: EP-005-09 V3	No. of samples analysed	: 6

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- **Radiological data analysed by ALS (Czech Republic) under CAI report number CS0904298.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID	CAL 29	SLOPE 24	CAL 41	TOR 58	CAL 31
				Client sampling date / time	05-JUL-2009 15:00	20-JUL-2009 15:00	21-JUL-2009 15:00	22-JUL-2009 15:00	21-JUL-2009 15:00
					EP0905121-001	EP0905121-002	EP0905121-003	EP0905121-004	EP0905121-005
Radionucleides / Activity									
Thorium 228	----	1.0	Bq/kg DW		**18.0**	**17.0**	**15.0**	**14.0**	**21.0**

Analytical Results

Sub-Matrix: **SOIL**				Client sample ID	**CAL 30**	----	----	----	----
				Client sampling date / time	20-JUL-2009 15:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EP0905121-006**	**----**	**----**	**----**	**----**
Radionucleides / Activity									
Thorium 228	----	1.0	Bq/kg DW		**24.0**	----	----	----	----

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No.	: AUSL22_W/090717
		Quote No.	: QT-01534
		Order No.	: 264381
		Date Sampled	: 25-JUN-2009
		Date Received	: 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015371	SBF-43 TOP	WATER 25/06/09
W09/015372	SBF-43 MID	WATER 25/06/09
W09/015373	SBF-43 BOTM	WATER 25/06/09
W09/015374	SBF-44 TOP	WATER 25/06/09

Lab Reg No.	Units	W09/015371	W09/015372	W09/015373	W09/015374	Method
Sample Reference		SBF-43 TOP	SBF-43 MID	SBF-43 BOTM	SBF-44 TOP	
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 25-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015375	SBF-44 MID	WATER 25/06/09
W09/015376	SBF-44 BOTM	WATER 25/06/09
W09/015377	SBF-41 TOP	WATER 25/06/09
W09/015378	SBF-41 MID	WATER 25/06/09

Lab Reg No.	Units	W09/015375	W09/015376	W09/015377	W09/015378	Method
Sample Reference		SBF-44 MID	SBF-44 BOTM	SBF-41 TOP	SBF-41 MID	
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	0.003	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 25-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015379	SBF-41 BOTM	WATER 25/06/09
W09/015380	SBF-42 TOP	WATER 26/06/09
W09/015381	SBF-42 MID	WATER 26/06/09
W09/015382	SBF-42 BOTM	WATER 26/06/09

Lab Reg No.	Units	W09/015379	W09/015380	W09/015381	W09/015382	Method
Sample Reference		SBF-41 BOTM	SBF-42 TOP	SBF-42 MID	SBF-42 BOTM	
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 25-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015383	EXPORT 4TOP	WATER 26/06/09
W09/015384	EXPORT 4MID	WATER 26/06/09
W09/015385	EXPORT 4BOT	WATER 26/06/09
W09/015386	EXP 64 TOP	WATER 25/06/09

Lab Reg No.	Units	W09/015383	W09/015384	W09/015385	W09/015386	Method
Sample Reference		EXPORT 4TOP	EXPORT 4MID	EXPORT 4BOT	EXP 64 TOP	
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 26-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015387	EXP 64 MID	WATER 25/06/09
W09/015388	EXP 64 BOTM	WATER 25/06/09
W09/015389	EXP 11 TOP	WATER 23/06/09
W09/015390	EXP 11 MID	WATER 23/06/09

Lab Reg No.		W09/015387	W09/015388	W09/015389	W09/015390	
Sample Reference	Units	EXP 64 MID	EXP 64 BOTM	EXP 11 TOP	EXP 11 MID	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 26-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015391	EXP 11 BOTM	WATER 23/06/09
W09/015392	EXP 16 TOP	WATER 22/06/09
W09/015393	EXP 16 MID	WATER 22/06/09
W09/015394	EXP 16 BOTM	WATER 22/06/09

Lab Reg No.	Units	W09/015391	W09/015392	W09/015393	W09/015394	Method
Sample Reference		EXP 11 BOTM	EXP 16 TOP	EXP 16 MID	EXP 16 BOTM	
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 22-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015395	EXP 23 TOP	WATER 22/06/09
W09/015396	EXP 23 MID	WATER 20/06/09
W09/015397	EXP 23 BOTM	WATER 20/06/09
W09/015398	EXP 70 TOP	WATER 17/06/09

Lab Reg No.	Units	W09/015395	W09/015396	W09/015397	W09/015398	Method
Sample Reference		EXP 23 TOP	EXP 23 MID	EXP 23 BOTM	EXP 70 TOP	
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 17-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015399	EXP 70 MID	WATER 17/06/09
W09/015400	EXP 70 BOTM	WATER 17/06/09
W09/015401	EXP 76 TOP	WATER 17/06/09
W09/015402	EXP 76 MID	WATER 17/06/09

Lab Reg No.	Units	W09/015399	W09/015400	W09/015401	W09/015402	Method
Sample Reference		EXP 70 MID	EXP 70 BOTM	EXP 76 TOP	EXP 76 MID	
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 22-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015403	EXP 76 BOTM	WATER 17/06/09
W09/015404	EXP 36 TOP	WATER 16/06/09
W09/015405	EXP 36 MID	WATER 16/06/09
W09/015406	EXP 36 BOTM	WATER 16/06/09

Lab Reg No.		W09/015403	W09/015404	W09/015405	W09/015406	
Sample Reference	Units	EXP 76 BOTM	EXP 36 TOP	EXP 36 MID	EXP 36 BOTM	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 22-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015407	EXP 36 TOP	WATER 10/06/09
W09/015408	EXP 36 MID	WATER 10/06/09
W09/015409	EXP 36 BOTM	WATER 10/06/09
W09/015410	EXP 49 TOP	WATER 09/06/09

Lab Reg No. / Sample Reference	Units	W09/015407 EXP 36 TOP	W09/015408 EXP 36 MID	W09/015409 EXP 36 BOTM	W09/015410 EXP 49 TOP	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	0.002	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	0.003	< 0.001	0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 22-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015411	EXP 49 MID	WATER 09/06/09
W09/015412	EXP 49 BOTM	WATER 09/06/09
W09/015413	EXP 56 TOP	WATER 06/06/09
W09/015414	EXP 56 MID	WATER 06/06/09

Lab Reg No. / Sample Reference	Units	W09/015411 EXP 49 MID	W09/015412 EXP 49 BOTM	W09/015413 EXP 56 TOP	W09/015414 EXP 56 MID	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No.	: AUSL22_W/090717
		Quote No.	: QT-01534
		Order No.	: 264381
		Date Sampled	: 22-JUN-2009
		Date Received	: 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015415	EXP 56 BOTM	WATER 06/06/09
W09/015416	EXP 52 TOP	WATER 05/07/09
W09/015417	EXP 52 MID	WATER 05/07/09
W09/015418	EXP 52 BOTM	WATER 05/07/09

Lab Reg No.		W09/015415	W09/015416	W09/015417	W09/015418	
Sample Reference	Units	EXP 56 BOTM	EXP 52 TOP	EXP 52 MID	EXP 52 BOTM	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	0.002	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 22-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015419	CAL-28TOP	WATER 05/07/09
W09/015420	CAL-28MID	WATER 05/07/09
W09/015421	CAL-28BOTM	WATER 05/07/09
W09/015422	CAL-30TOP	WATER 06/07/09

Lab Reg No.		W09/015419	W09/015420	W09/015421	W09/015422	
Sample Reference	Units	CAL-28TOP	CAL-28MID	CAL-28BOTM	CAL-30TOP	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 22-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015423	CAL-30MID	WATER 06/07/09
W09/015424	CAL-30BOTM	WATER 06/07/09
W09/015425	CAL-31TOP	WATER 06/07/09
W09/015426	CAL-31MID	WATER 06/07/09

Lab Reg No.		W09/015423	W09/015424	W09/015425	W09/015426	
Sample Reference	Units	CAL-30MID	CAL-30BOTM	CAL-31TOP	CAL-31MID	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090717 : QT-01534 : 264381 : 22-JUN-2009 : 17-JUL-2009
Attention	: Joshua Rees	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/015427	CAL-31BOTM	WATER 06/07/09
W09/015428	TOR-44TOP	WATER 05/07/09
W09/015429	TOR-44MID	WATER 05/07/09
W09/015430	TOR-44BOTM	WATER 05/07/09

Lab Reg No.	Units	W09/015427	W09/015428	W09/015429	W09/015430	Method
Sample Reference		CAL-31BOTM	TOR-44TOP	TOR-44MID	TOR-44BOTM	
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

24-JUL-2009

Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

NATA
ACCREDITED FOR
TECHNICAL
COMPETENCE

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Accreditated for compliance with ISO/IEC 17025.
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Results relate only to the sample(s) tested.

PO Box 1246 Bentley DC WA 6983 Tel: +61 8 9368 8400 Fax: +61 8 9368 8499 www.measurement.gov.au

RE-ISSUED REPORT OF ANALYSIS

Report No. RN749909

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No.	:	AUSL22_W/090804
		Quote No.	:	QT-01534
		Order No.	:	247585
		Date Sampled	:	21-JUL-2009
		Date Received	:	4-AUG-2009
Attention	: Michael Sharp	Sampled By	:	CLIENT
Project Name	:			
Your Client Services Manager	: David Lynch	Phone	:	(08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/016947	Cal 29 Top	WATER 21/07/09
W09/016948	Cal 29 Mid	WATER 21/07/09
W09/016949	Cal 29 Bott	WATER 21/07/09
W09/016950	Slope 24Top	WATER 20/07/09

Lab Reg No.		W09/016947	W09/016948	W09/016949	W09/016950	
Sample Reference	Units	Cal 29 Top	Cal 29 Mid	Cal 29 Bott	Slope 24Top	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

W09/016947
to W09/016973

Volume of sample passed through filter papers (used to calculate chlorophyll results)

assumed to be 1 L as per sample labels on the zip lock bags.

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

13-AUG-2009

RE-ISSUED REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No.	: AUSL22_W/090804
		Quote No.	: QT-01534
		Order No.	: 247585
		Date Sampled	: 21-JUL-2009
		Date Received	: 4-AUG-2009
Attention	: Michael Sharp	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/016951	Slope 24Mid	WATER 21/07/09
W09/016952	Slope 24Bott	WATER 20/07/09
W09/016953	Cal 33 Top	WATER 22/07/09
W09/016954	Cal 33 Mid	WATER 22/07/09

Lab Reg No.		W09/016951	W09/016952	W09/016953	W09/016954	
Sample Reference	Units	Slope 24Mid	Slope 24Bott	Cal 33 Top	Cal 33 Mid	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

13-AUG-2009

RE-ISSUED REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No.	: AUSL22_W/090804
		Quote No.	: QT-01534
		Order No.	: 247585
		Date Sampled	: 21-JUL-2009
		Date Received	: 4-AUG-2009
Attention	: Michael Sharp	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/016955	Cal 33 Bott	WATER 22/07/09
W09/016956	Cal 41 Top	WATER 21/07/09
W09/016957	Cal 41 Mid	WATER 21/07/09
W09/016958	Cal 41 Bott	WATER 21/07/09

Lab Reg No.		W09/016955	W09/016956	W09/016957	W09/016958	
Sample Reference	Units	Cal 33 Bott	Cal 41 Top	Cal 41 Mid	Cal 41 Bott	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

13-AUG-2009

RE-ISSUED REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090804 : QT-01534 : 247585 : 21-JUL-2009 : 4-AUG-2009
Attention	: Michael Sharp	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/016959	Tor 57 Top	WATER 22/07/09
W09/016960	Tor 57 Mid	WATER 22/07/09
W09/016961	Tor 57 Bott	WATER 22/09/09
W09/016962	Tor 58 Top	WATER 22/11/09

Lab Reg No.	Units	W09/016959	W09/016960	W09/016961	W09/016962	Method
Sample Reference		Tor 57 Top	Tor 57 Mid	Tor 57 Bott	Tor 58 Top	
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

13-AUG-2009

RE-ISSUED REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090804 : QT-01534 : 247585 : 21-JUL-2009 : 4-AUG-2009
Attention	: Michael Sharp	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/016963	Tor 58 Mid	WATER 22/01/10
W09/016964	Tor 58 Bott	WATER 22/03/10
W09/016965	Cal 38 Top	WATER 22/05/10
W09/016966	Cal 38 Mid	WATER 22/07/10

Lab Reg No. Sample Reference	Units	W09/016963 Tor 58 Mid	W09/016964 Tor 58 Bott	W09/016965 Cal 38 Top	W09/016966 Cal 38 Mid	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

13-AUG-2009

RE-ISSUED REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No. Quote No. Order No. Date Sampled Date Received	: AUSL22_W/090804 : QT-01534 : 247585 : 21-JUL-2009 : 4-AUG-2009
Attention	: Michael Sharp	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/016967	Cal 38 Bott	WATER 22/09/10
W09/016968	Slope 22 Top	WATER 22/11/10
W09/016969	Slope 22Mid	WATER 22/01/11
W09/016970	Slope 22Bott	WATER 22/03/11

Lab Reg No. Sample Reference	Units	W09/016967 Cal 38 Bott	W09/016968 Slope 22 Top	W09/016969 Slope 22Mid	W09/016970 Slope 22Bott	Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177
Chlorophyll Volume	mL	1000	1000	1000	1000	WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

13-AUG-2009

RE-ISSUED REPORT OF ANALYSIS

Client	: AUSTRALIAN LABORATORY SERVICES PTY LTD 10 HOD WAY MALAGA WA 6090	Job No.	: AUSL22_W/090804
		Quote No.	: QT-01534
		Order No.	: 247585
		Date Sampled	: 21-JUL-2009
		Date Received	: 4-AUG-2009
Attention	: Michael Sharp	Sampled By	: CLIENT
Project Name	:		
Your Client Services Manager	: David Lynch	Phone	: (08) 9368 8400

Lab Reg No.	Sample Ref	Sample Description
W09/016971	Slope 16Top	WATER 22/05/11
W09/016972	Slope 16Mid	WATER 22/07/11
W09/016973	Slope 16Bott	WATER 22/07/09

Lab Reg No. Sample Reference	Units	W09/016971 Slope 16Top	W09/016972 Slope 16Mid	W09/016973 Slope 16Bott		Method
Inorganics						
Chlorophyll A	mg/L	< 0.001	< 0.001	< 0.001		WL177
Chlorophyll B	mg/L	< 0.001	< 0.001	< 0.001		WL177
Chlorophyll C	mg/L	< 0.001	< 0.001	< 0.001		WL177
Chlorophyll Volume	mL	1000	1000	1000		WL177
Pheophytin A	mg/L	< 0.001	< 0.001	< 0.001		WL177

David Lynch, Section Manager
Inorganics - WA
Accreditation No. 2474

13-AUG-2009

Unless notified to the contrary, the above samples will be disposed of one month from the reporting date.

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

This report is issued in accordance with NATA's accreditation requirements.
Accreditated for compliance with ISO/IEC 17025.
This report shall not be reproduced except in full.
Results relate only to the sample(s) tested.

This Report supersedes reports: RN749830

APPENDIX F – PARTICLE SIZE ANALYSIS

Analysis Report

CSIRO

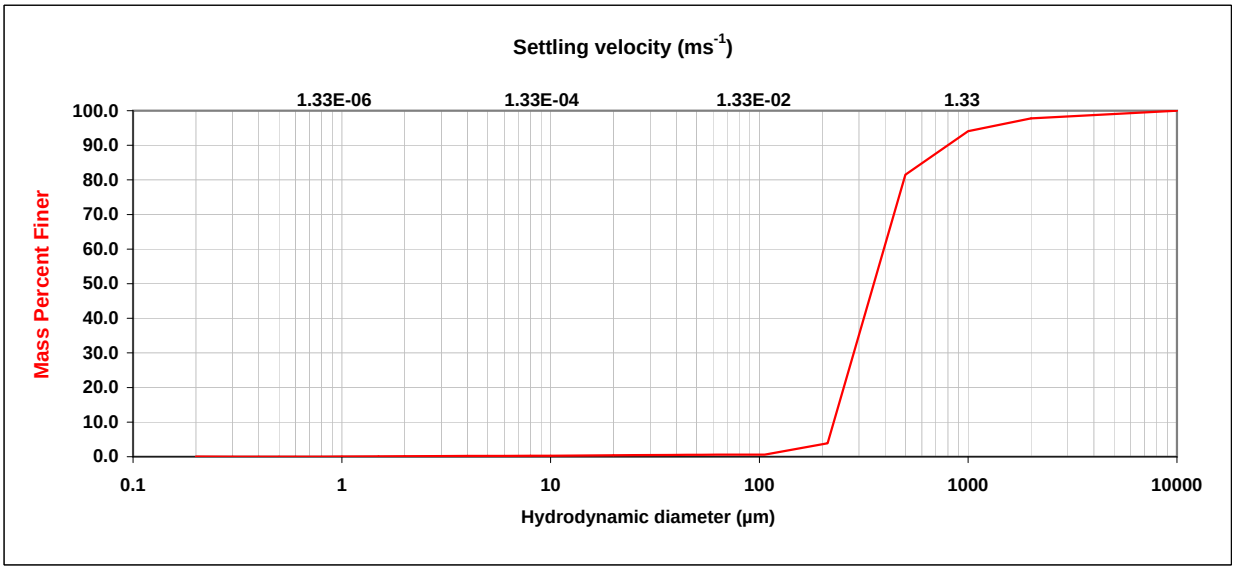
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-007 Export-3
Report No:	R0911386
PAS ID No:	P62657

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	2.20	1.62E+02	5.00	4.00	0.02	9.14E-05
2000.00	1000.00	3.70	1.02E+01	4.00	3.00	0.03	5.53E-05
1000.00	500.00	12.60	2.54E+00	3.00	2.00	0.06	2.82E-05
500.00	212.00	77.60	5.72E-01	2.00	1.50	0.04	1.38E-05
212.00	106.00	3.30	1.14E-01	1.50	1.00	0.04	7.05E-06
106.00	75.00	0.01	3.70E-02	1.00	0.80	0.02	3.66E-06
75.00	63.00	0.01	2.15E-02	0.80	0.60	0.02	2.21E-06
63.00	53.00	0.01	1.52E-02	0.60	0.50	0.00	1.37E-06
53.00	45.00	0.02	1.08E-02	0.50	0.40	0.00	9.14E-07
45.00	38.00	0.02	7.77E-03	0.40	0.30	0.00	5.53E-07
38.00	25.00	0.08	4.48E-03	0.30	0.00	-0.03	2.82E-07
25.00	20.00	0.04	2.28E-03				
20.00	10.00	0.10	1.02E-03				
10.00	8.00	0.03	3.66E-04				
8.00	6.00	0.03	2.21E-04				
6.00	5.00	0.02	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	700
d (0.8)	500
d (0.5)	350
d(0.1)	230

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

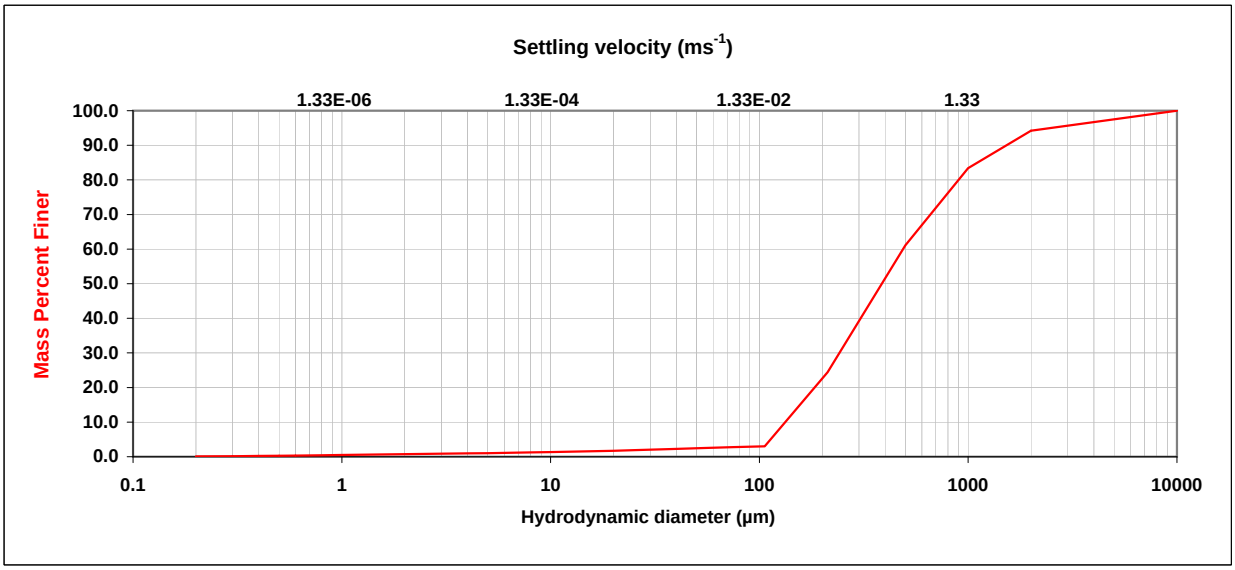
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-009 Export-11
Report No:	R0911386
PAS ID No:	P62659

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	5.80	1.62E+02	5.00	4.00	0.08	9.14E-05
2000.00	1000.00	10.80	1.02E+01	4.00	3.00	0.09	5.53E-05
1000.00	500.00	22.30	2.54E+00	3.00	2.00	0.13	2.82E-05
500.00	212.00	36.70	5.72E-01	2.00	1.50	0.10	1.38E-05
212.00	106.00	21.40	1.14E-01	1.50	1.00	0.13	7.05E-06
106.00	75.00	0.23	3.70E-02	1.00	0.80	0.07	3.66E-06
75.00	63.00	0.12	2.15E-02	0.80	0.60	0.10	2.21E-06
63.00	53.00	0.15	1.52E-02	0.60	0.50	0.06	1.37E-06
53.00	45.00	0.16	1.08E-02	0.50	0.40	0.06	9.14E-07
45.00	38.00	0.15	7.77E-03	0.40	0.30	0.07	5.53E-07
38.00	25.00	0.32	4.48E-03	0.30	0.00	0.07	2.82E-07
25.00	20.00	0.15	2.28E-03				
20.00	10.00	0.40	1.02E-03				
10.00	8.00	0.10	3.66E-04				
8.00	6.00	0.13	2.21E-04				
6.00	5.00	0.07	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	1500
d (0.8)	890
d (0.5)	390
d(0.1)	140

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

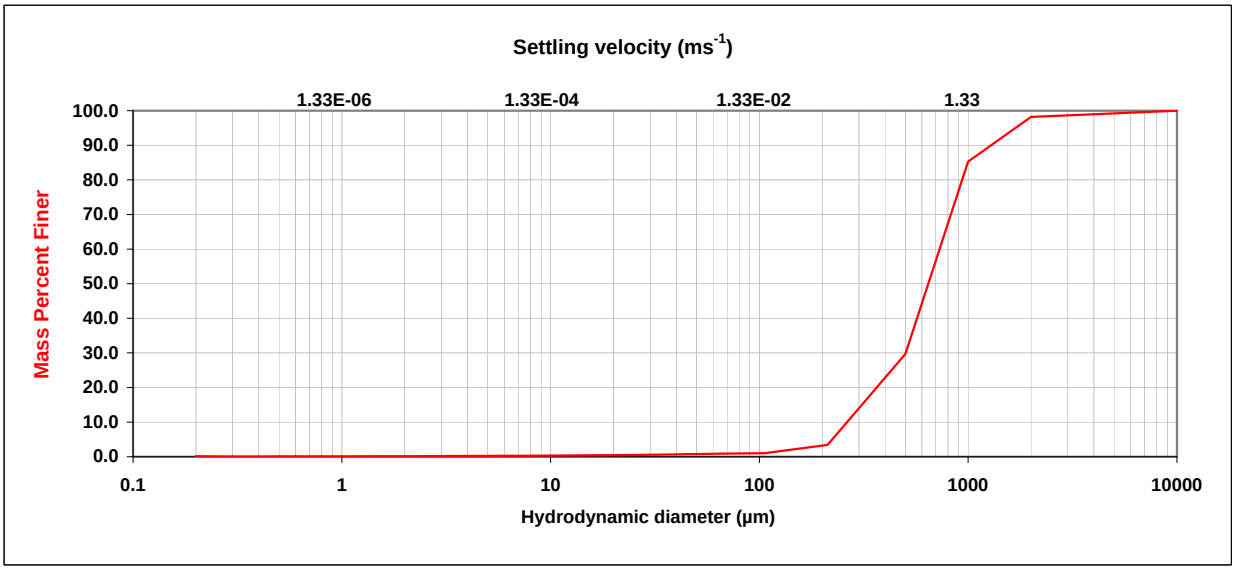
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-010 Export-16
Report No:	R0911386
PAS ID No:	P62660

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.5 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.08	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.14	µm
Liquid viscosity:	0.716	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	1.80	1.08E+02	5.00	4.00	0.02	6.09E-05
2000.00	1000.00	12.90	6.77E+00	4.00	3.00	0.03	3.69E-05
1000.00	500.00	55.60	1.69E+00	3.00	2.00	0.03	1.88E-05
500.00	212.00	26.30	3.81E-01	2.00	1.50	0.01	9.21E-06
212.00	106.00	2.40	7.61E-02	1.50	1.00	0.03	4.70E-06
106.00	75.00	0.07	2.46E-02	1.00	0.80	0.02	2.44E-06
75.00	63.00	0.06	1.43E-02	0.80	0.60	0.01	1.47E-06
63.00	53.00	0.08	1.01E-02	0.60	0.50	0.01	9.10E-07
53.00	45.00	0.07	7.22E-03	0.50	0.40	0.01	6.09E-07
45.00	38.00	0.07	5.18E-03	0.40	0.30	0.01	3.69E-07
38.00	25.00	0.13	2.99E-03	0.30	0.00	-0.07	1.88E-07
25.00	20.00	0.05	1.52E-03				
20.00	10.00	0.13	6.77E-04				
10.00	8.00	0.03	2.44E-04				
8.00	6.00	0.04	1.47E-04				
6.00	5.00	0.02	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	1150
d (0.8)	890
d (0.5)	650
d(0.1)	290

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

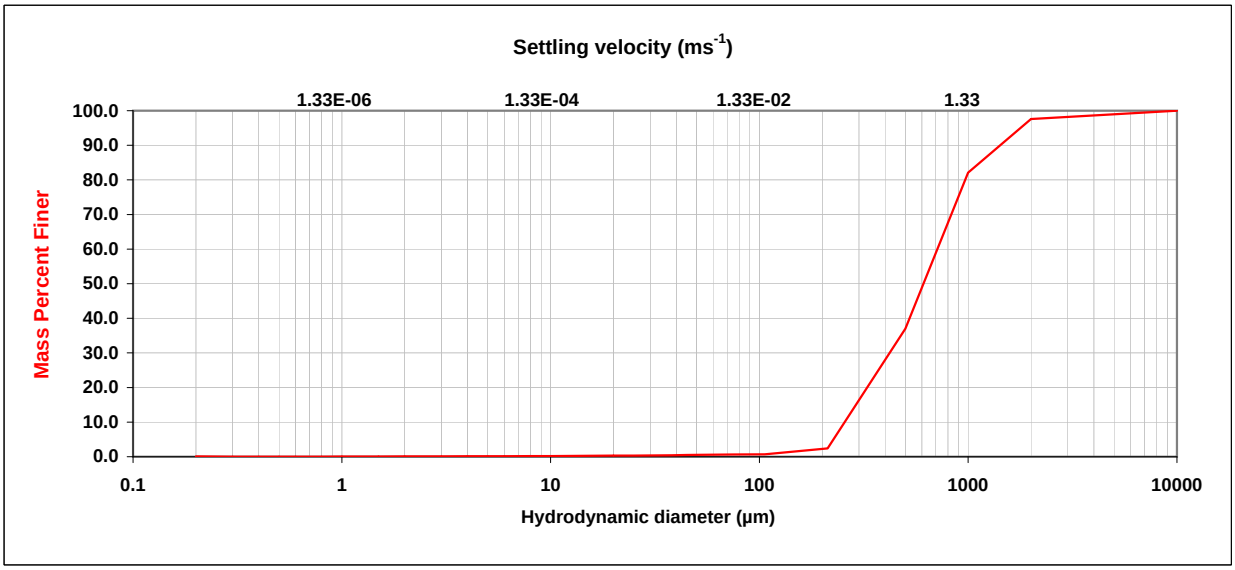
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-011 Export-23
Report No:	R0911386
PAS ID No:	P62661

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	2.40	1.62E+02	5.00	4.00	0.02	9.14E-05
2000.00	1000.00	15.50	1.02E+01	4.00	3.00	0.02	5.53E-05
1000.00	500.00	45.10	2.54E+00	3.00	2.00	0.02	2.82E-05
500.00	212.00	34.60	5.72E-01	2.00	1.50	0.01	1.38E-05
212.00	106.00	1.70	1.14E-01	1.50	1.00	0.03	7.05E-06
106.00	75.00	0.03	3.70E-02	1.00	0.80	0.01	3.66E-06
75.00	63.00	0.05	2.15E-02	0.80	0.60	0.01	2.21E-06
63.00	53.00	0.07	1.52E-02	0.60	0.50	0.00	1.37E-06
53.00	45.00	0.06	1.08E-02	0.50	0.40	0.00	9.14E-07
45.00	38.00	0.05	7.77E-03	0.40	0.30	0.00	5.53E-07
38.00	25.00	0.09	4.48E-03	0.30	0.00	-0.08	2.82E-07
25.00	20.00	0.04	2.28E-03				
20.00	10.00	0.10	1.02E-03				
10.00	8.00	0.03	3.66E-04				
8.00	6.00	0.03	2.21E-04				
6.00	5.00	0.02	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	1300
d (0.8)	950
d (0.5)	600
d(0.1)	270

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

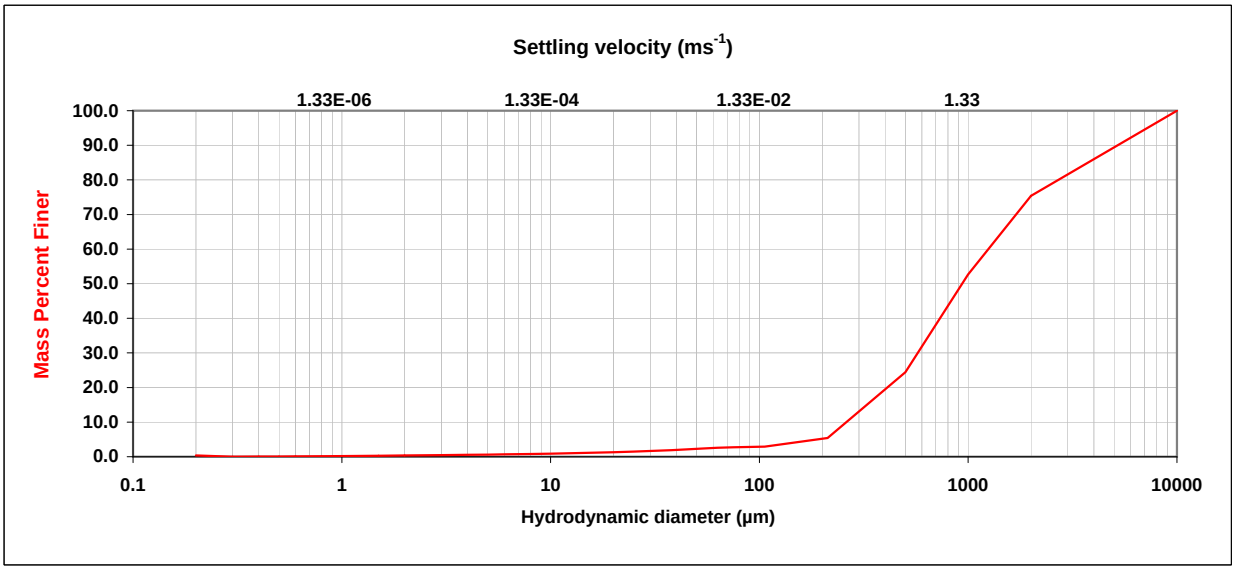
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-012 Export-36
Report No:	R0911386
PAS ID No:	P62662

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	24.60	1.08E+02	5.00	4.00	0.07	6.09E-05
2000.00	1000.00	22.70	6.77E+00	4.00	3.00	0.06	3.69E-05
1000.00	500.00	28.30	1.69E+00	3.00	2.00	0.12	1.88E-05
500.00	212.00	19.00	3.81E-01	2.00	1.50	0.08	9.21E-06
212.00	106.00	2.50	7.61E-02	1.50	1.00	0.09	4.70E-06
106.00	75.00	0.16	2.46E-02	1.00	0.80	0.05	2.44E-06
75.00	63.00	0.15	1.43E-02	0.80	0.60	0.05	1.47E-06
63.00	53.00	0.21	1.01E-02	0.60	0.50	0.02	9.10E-07
53.00	45.00	0.23	7.22E-03	0.50	0.40	0.02	6.09E-07
45.00	38.00	0.23	5.18E-03	0.40	0.30	0.03	3.69E-07
38.00	25.00	0.44	2.99E-03	0.30	0.00	-0.35	1.88E-07
25.00	20.00	0.17	1.52E-03				
20.00	10.00	0.41	6.77E-04				
10.00	8.00	0.10	2.44E-04				
8.00	6.00	0.11	1.47E-04				
6.00	5.00	0.07	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	3500
d (0.8)	2300
d (0.5)	900
d(0.1)	270

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

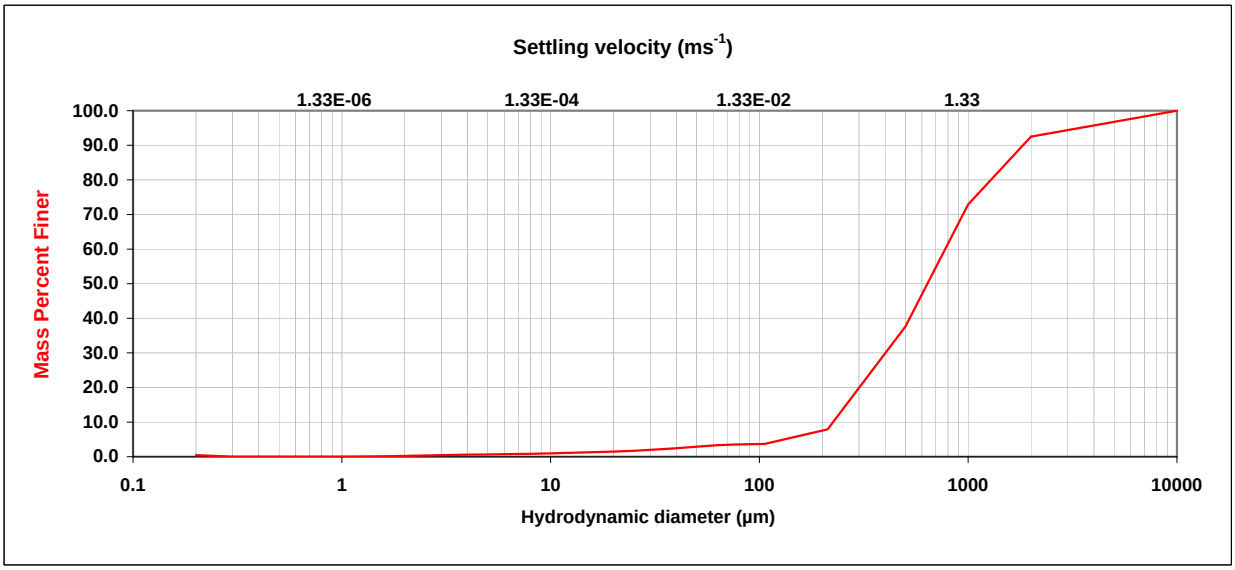
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-013 Export-39
Report No:	R0911386
PAS ID No:	P62663

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.06	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	7.50	1.08E+02	5.00	4.00	0.07	6.09E-05
2000.00	1000.00	19.60	6.77E+00	4.00	3.00	0.10	3.69E-05
1000.00	500.00	35.30	1.69E+00	3.00	2.00	0.26	1.88E-05
500.00	212.00	29.70	3.81E-01	2.00	1.50	0.11	9.21E-06
212.00	106.00	4.20	7.61E-02	1.50	1.00	0.10	4.70E-06
106.00	75.00	0.16	2.46E-02	1.00	0.80	0.00	2.44E-06
75.00	63.00	0.22	1.43E-02	0.80	0.60	0.00	1.47E-06
63.00	53.00	0.29	1.01E-02	0.60	0.50	0.00	9.10E-07
53.00	45.00	0.32	7.22E-03	0.50	0.40	0.00	6.09E-07
45.00	38.00	0.33	5.18E-03	0.40	0.30	0.00	3.69E-07
38.00	25.00	0.64	2.99E-03	0.30	0.00	-0.44	1.88E-07
25.00	20.00	0.25	1.52E-03				
20.00	10.00	0.52	6.77E-04				
10.00	8.00	0.11	2.44E-04				
8.00	6.00	0.13	1.47E-04				
6.00	5.00	0.07	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	1800
d (0.8)	1200
d (0.5)	650
d(0.1)	230

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

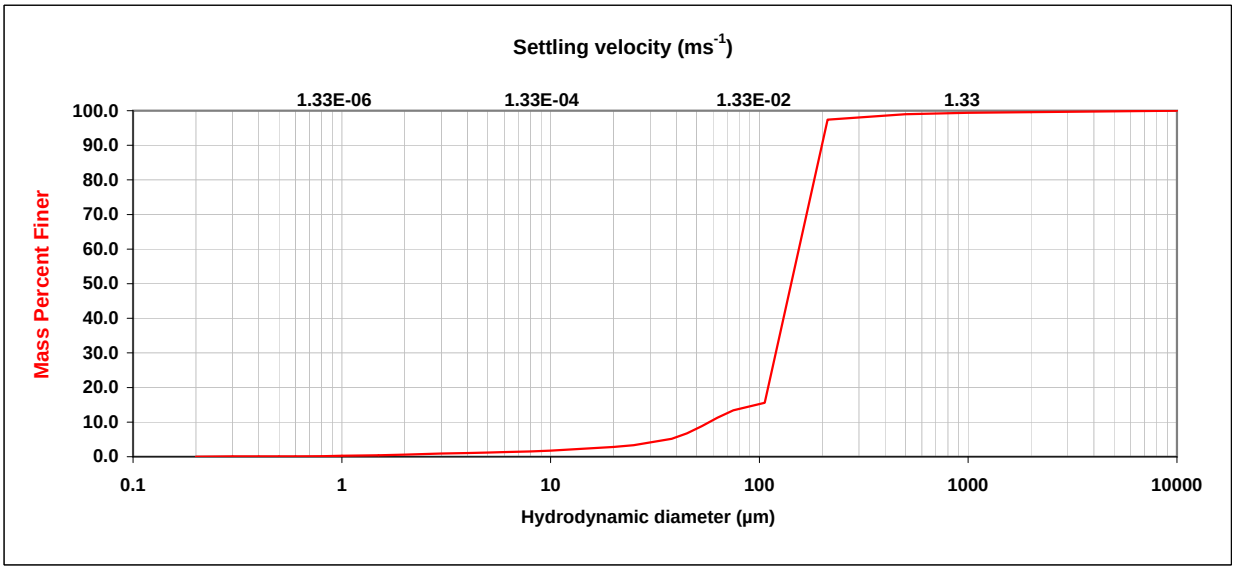
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-014 Export-49
Report No:	R0911386
PAS ID No:	P62664

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.06	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.40	1.08E+02	5.00	4.00	0.14	6.09E-05
2000.00	1000.00	0.20	6.77E+00	4.00	3.00	0.16	3.69E-05
1000.00	500.00	0.40	1.69E+00	3.00	2.00	0.33	1.88E-05
500.00	212.00	1.60	3.81E-01	2.00	1.50	0.17	9.21E-06
212.00	106.00	81.80	7.61E-02	1.50	1.00	0.16	4.70E-06
106.00	75.00	2.20	2.46E-02	1.00	0.80	0.14	2.44E-06
75.00	63.00	2.14	1.43E-02	0.80	0.60	0.02	1.47E-06
63.00	53.00	2.42	1.01E-02	0.60	0.50	0.02	9.10E-07
53.00	45.00	2.07	7.22E-03	0.50	0.40	0.02	6.09E-07
45.00	38.00	1.58	5.18E-03	0.40	0.30	0.00	3.69E-07
38.00	25.00	1.87	2.99E-03	0.30	0.00	0.08	1.88E-07
25.00	20.00	0.51	1.52E-03				
20.00	10.00	1.05	6.77E-04				
10.00	8.00	0.22	2.44E-04				
8.00	6.00	0.20	1.47E-04				
6.00	5.00	0.12	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	1800
d (0.8)	1200
d (0.5)	650
d(0.1)	230

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

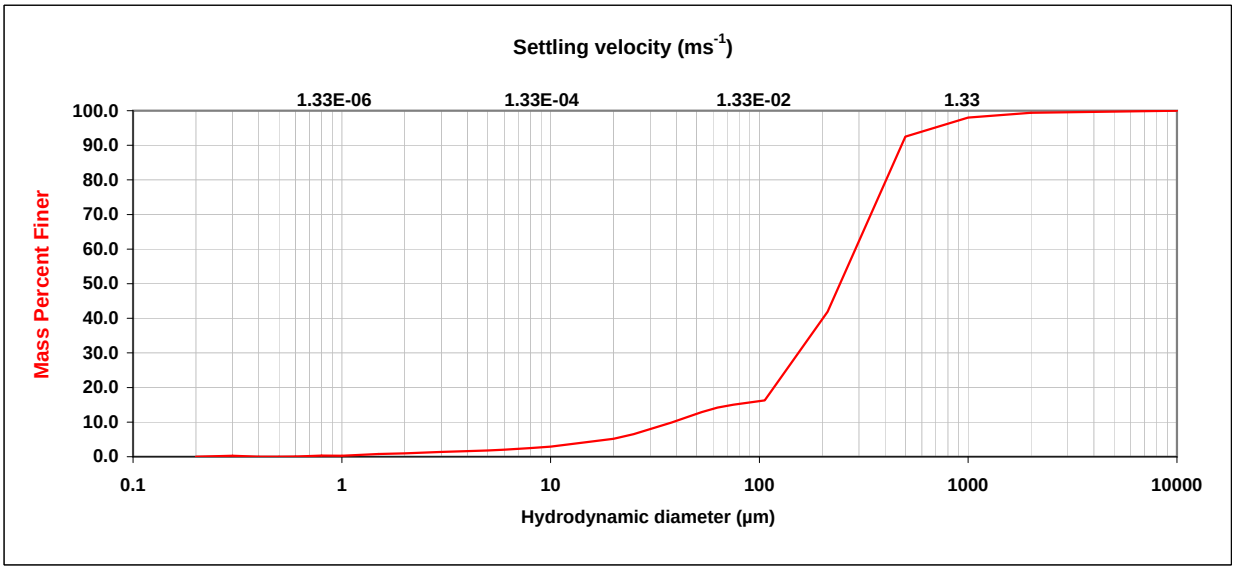
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EEP0903809-16 Export-53
Report No:	R0911386
PAS ID No:	P62666

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.60	1.08E+02	5.00	4.00	0.21	6.09E-05
2000.00	1000.00	1.40	6.77E+00	4.00	3.00	0.24	3.69E-05
1000.00	500.00	5.50	1.69E+00	3.00	2.00	0.37	1.88E-05
500.00	212.00	50.60	3.81E-01	2.00	1.50	0.23	9.21E-06
212.00	106.00	25.60	7.61E-02	1.50	1.00	0.51	4.70E-06
106.00	75.00	1.26	2.46E-02	1.00	0.80	-0.07	2.44E-06
75.00	63.00	0.86	1.43E-02	0.80	0.60	0.28	1.47E-06
63.00	53.00	1.27	1.01E-02	0.60	0.50	0.03	9.10E-07
53.00	45.00	1.47	7.22E-03	0.50	0.40	0.00	6.09E-07
45.00	38.00	1.56	5.18E-03	0.40	0.30	-0.26	3.69E-07
38.00	25.00	3.37	2.99E-03	0.30	0.00	0.28	1.88E-07
25.00	20.00	1.30	1.52E-03				
20.00	10.00	2.30	6.77E-04				
10.00	8.00	0.42	2.44E-04				
8.00	6.00	0.42	1.47E-04				
6.00	5.00	0.23	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	470
d (0.8)	390
d (0.5)	250
d(0.1)	40

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

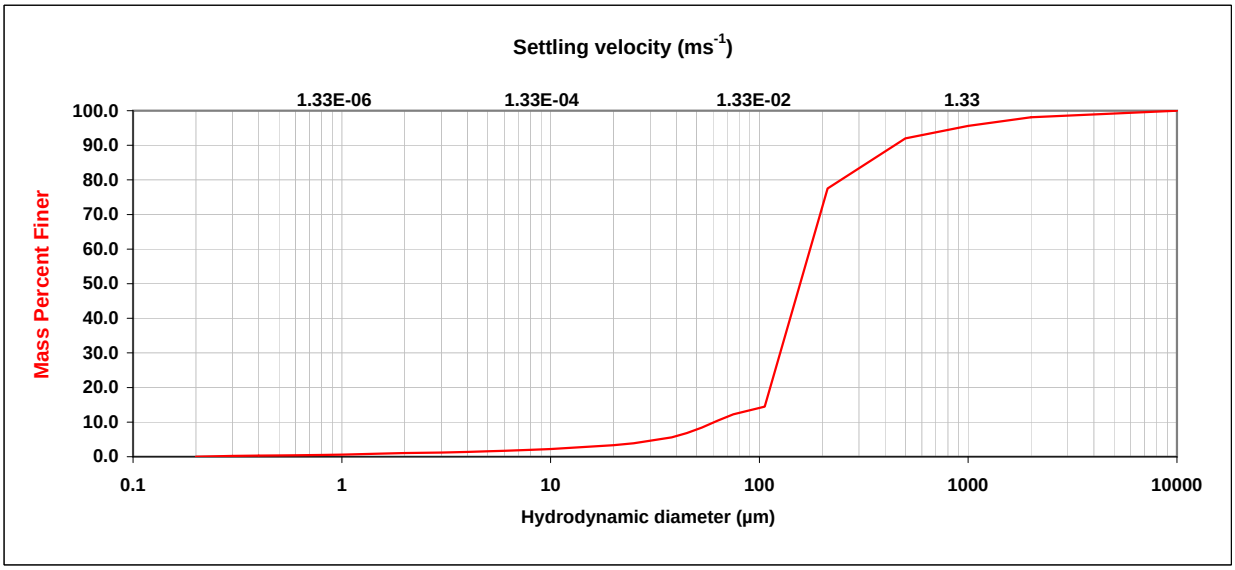
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-015 Export-56
Report No:	R0911386
PAS ID No:	P62665

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	1.90	1.08E+02	5.00	4.00	0.17	6.09E-05
2000.00	1000.00	2.50	6.77E+00	4.00	3.00	0.19	3.69E-05
1000.00	500.00	3.60	1.69E+00	3.00	2.00	0.17	1.88E-05
500.00	212.00	14.50	3.81E-01	2.00	1.50	0.15	9.21E-06
212.00	106.00	63.00	7.61E-02	1.50	1.00	0.28	4.70E-06
106.00	75.00	2.25	2.46E-02	1.00	0.80	0.13	2.44E-06
75.00	63.00	1.86	1.43E-02	0.80	0.60	0.09	1.47E-06
63.00	53.00	1.96	1.01E-02	0.60	0.50	0.04	9.10E-07
53.00	45.00	1.61	7.22E-03	0.50	0.40	0.04	6.09E-07
45.00	38.00	1.23	5.18E-03	0.40	0.30	0.07	3.69E-07
38.00	25.00	1.71	2.99E-03	0.30	0.00	0.25	1.88E-07
25.00	20.00	0.54	1.52E-03				
20.00	10.00	1.12	6.77E-04				
10.00	8.00	0.25	2.44E-04				
8.00	6.00	0.26	1.47E-04				
6.00	5.00	0.15	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	400
d (0.8)	220
d (0.5)	150
d(0.1)	60

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

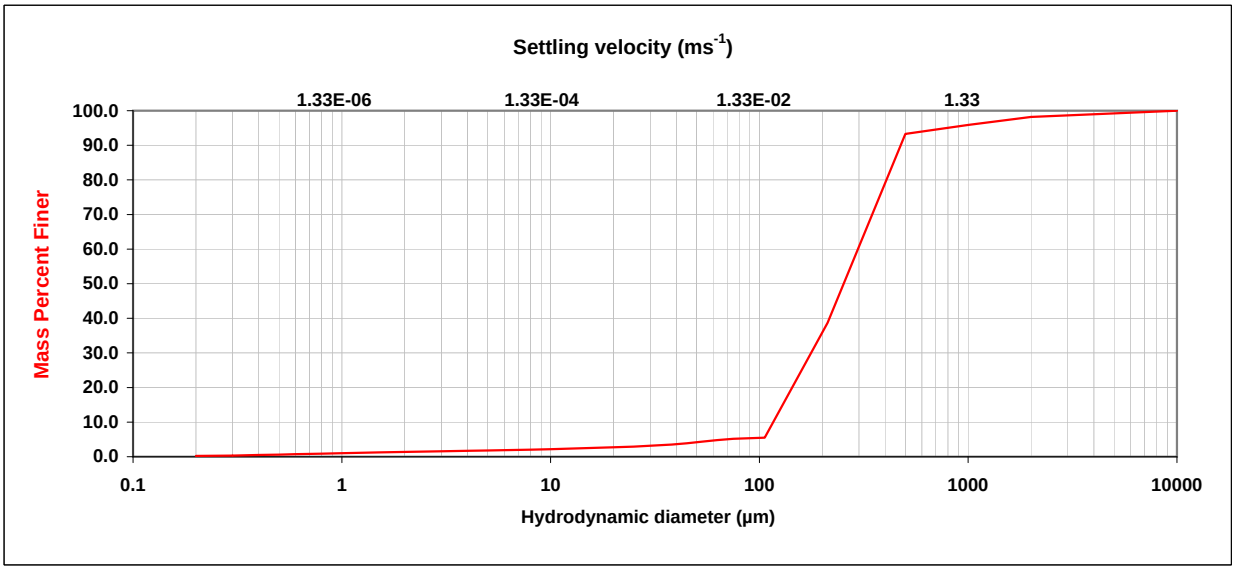
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-008 Export-64
Report No:	R0911386
PAS ID No:	P62658

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	1.80	1.62E+02	5.00	4.00	0.11	9.14E-05
2000.00	1000.00	2.30	1.02E+01	4.00	3.00	0.13	5.53E-05
1000.00	500.00	2.60	2.54E+00	3.00	2.00	0.19	2.82E-05
500.00	212.00	54.60	5.72E-01	2.00	1.50	0.14	1.38E-05
212.00	106.00	33.20	1.14E-01	1.50	1.00	0.22	7.05E-06
106.00	75.00	0.30	3.70E-02	1.00	0.80	0.13	3.66E-06
75.00	63.00	0.38	2.15E-02	0.80	0.60	0.17	2.21E-06
63.00	53.00	0.46	1.52E-02	0.60	0.50	0.10	1.37E-06
53.00	45.00	0.46	1.08E-02	0.50	0.40	0.13	9.14E-07
45.00	38.00	0.40	7.77E-03	0.40	0.30	0.17	5.53E-07
38.00	25.00	0.58	4.48E-03	0.30	0.00	0.07	2.82E-07
25.00	20.00	0.20	2.28E-03				
20.00	10.00	0.53	1.02E-03				
10.00	8.00	0.14	3.66E-04				
8.00	6.00	0.15	2.21E-04				
6.00	5.00	0.09	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	470
d (0.8)	390
d (0.5)	260
d(0.1)	120

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

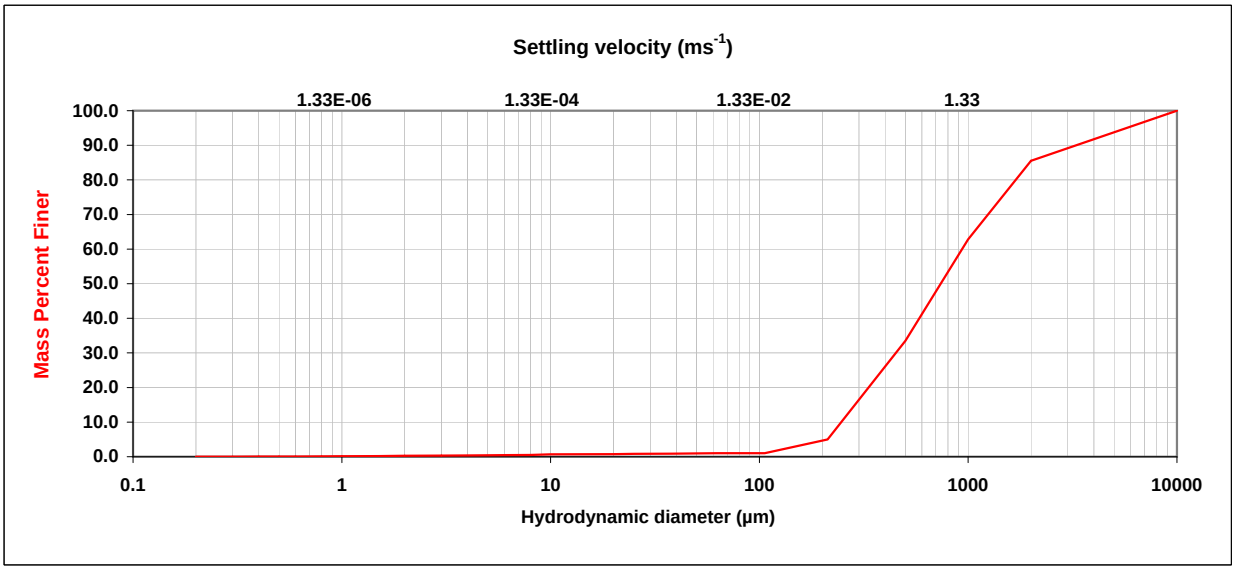
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0904270-001 - Export-70
Report No:	R0911416
PAS ID No:	P62833

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	14.50	1.08E+02	5.00	4.00	0.04	6.09E-05
2000.00	1000.00	22.70	6.77E+00	4.00	3.00	0.04	3.69E-05
1000.00	500.00	29.30	1.69E+00	3.00	2.00	0.08	1.88E-05
500.00	212.00	28.50	3.81E-01	2.00	1.50	0.09	9.21E-06
212.00	106.00	4.00	7.61E-02	1.50	1.00	0.04	4.70E-06
106.00	75.00	0.00	2.46E-02	1.00	0.80	0.05	2.44E-06
75.00	63.00	0.00	1.43E-02	0.80	0.60	0.02	1.47E-06
63.00	53.00	0.02	1.01E-02	0.60	0.50	0.02	9.10E-07
53.00	45.00	0.03	7.22E-03	0.50	0.40	0.01	6.09E-07
45.00	38.00	0.05	5.18E-03	0.40	0.30	0.01	3.69E-07
38.00	25.00	0.05	2.99E-03	0.30	0.20	0.01	1.88E-07
25.00	20.00	0.12	1.52E-03	0.20	0.00	0.00	3.01E-08
20.00	10.00	0.05	6.77E-04				
10.00	8.00	0.16	2.44E-04				
8.00	6.00	0.04	1.47E-04				
6.00	5.00	0.06	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	2500
d (0.8)	1700
d (0.5)	750
d(0.1)	250.0

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

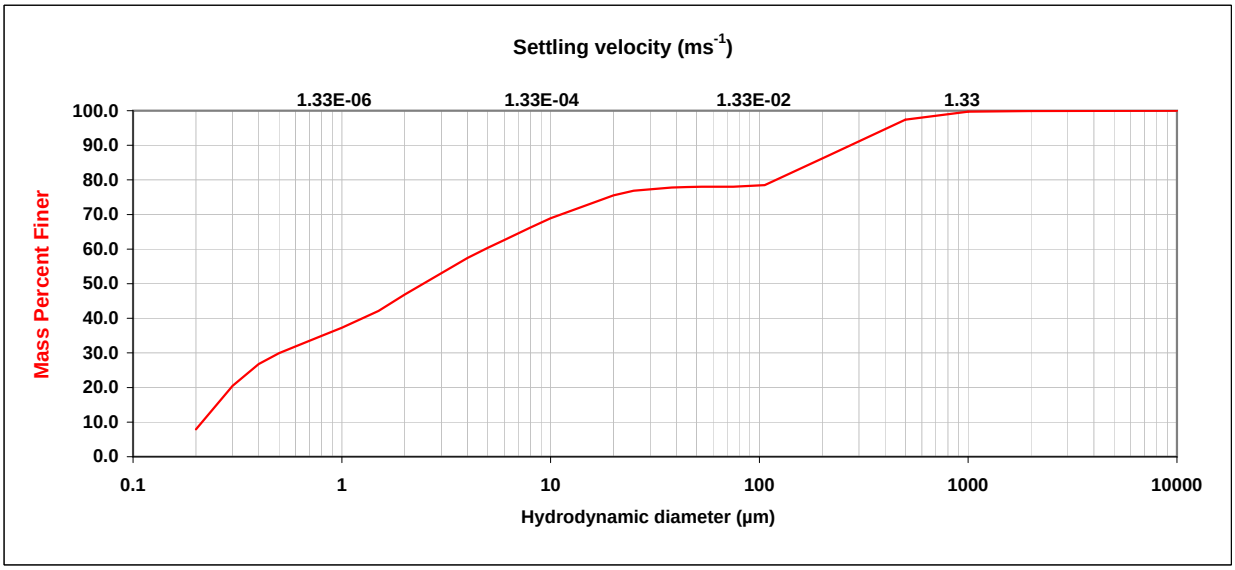
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-17 Cal-28
Report No:	R0911386
PAS ID No:	PP62667

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.08	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.10	1.08E+02	5.00	4.00	2.90	6.09E-05
2000.00	1000.00	0.20	6.77E+00	4.00	3.00	4.40	3.69E-05
1000.00	500.00	2.30	1.69E+00	3.00	2.00	6.20	1.88E-05
500.00	212.00	10.50	3.81E-01	2.00	1.50	4.71	9.21E-06
212.00	106.00	8.40	7.61E-02	1.50	1.00	4.87	4.70E-06
106.00	75.00	0.47	2.46E-02	1.00	0.80	2.36	2.44E-06
75.00	63.00	0.00	1.43E-02	0.80	0.60	3.06	1.47E-06
63.00	53.00	0.00	1.01E-02	0.60	0.50	1.96	9.10E-07
53.00	45.00	0.08	7.22E-03	0.50	0.40	3.14	6.09E-07
45.00	38.00	0.16	5.18E-03	0.40	0.30	6.28	3.69E-07
38.00	25.00	0.94	2.99E-03	0.30	0.00	12.56	1.88E-07
25.00	20.00	1.33	1.52E-03				
20.00	10.00	6.59	6.77E-04				
10.00	8.00	2.67	2.44E-04				
8.00	6.00	3.61	1.47E-04				
6.00	5.00	2.28	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	270
d (0.8)	120
d (0.5)	3
d(0.1)	0

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

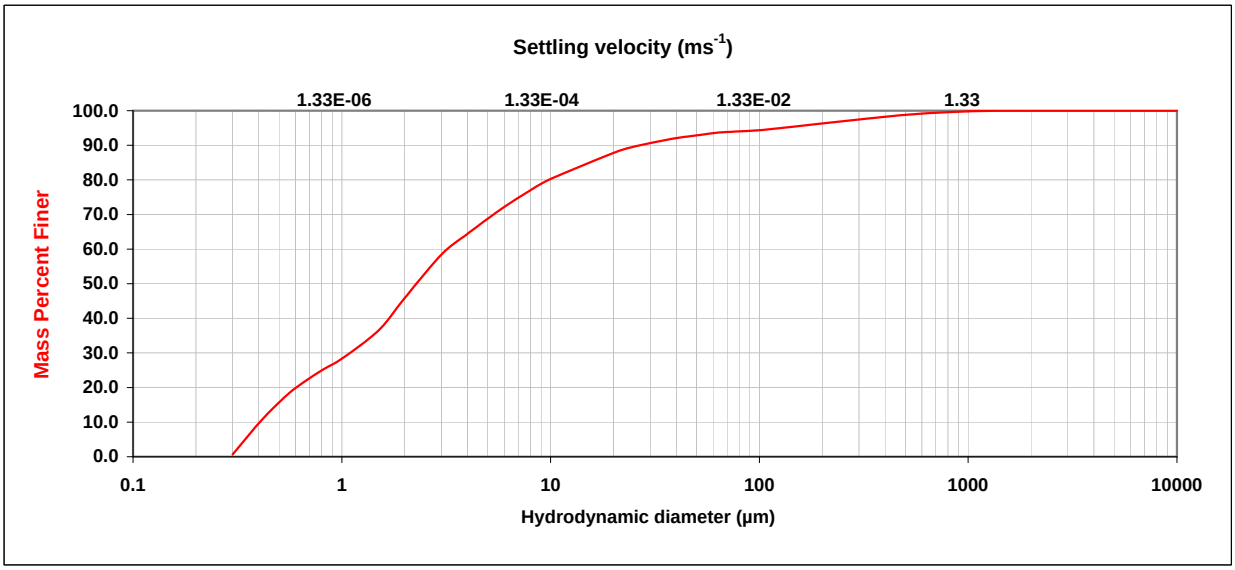
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0904270-002 - Cal-29
Report No:	R0911416
PAS ID No:	P62834

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.06	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.00	1.08E+02	5.00	4.00	4.35	6.09E-05
2000.00	1000.00	0.20	6.77E+00	4.00	3.00	6.05	3.69E-05
1000.00	500.00	1.00	1.69E+00	3.00	2.00	12.57	1.88E-05
500.00	212.00	2.30	3.81E-01	2.00	1.50	9.36	9.21E-06
212.00	106.00	2.00	7.61E-02	1.50	1.00	8.13	4.70E-06
106.00	75.00	0.57	2.46E-02	1.00	0.80	3.40	2.44E-06
75.00	63.00	0.28	1.43E-02	0.80	0.60	5.10	1.47E-06
63.00	53.00	0.57	1.01E-02	0.60	0.50	4.16	9.10E-07
53.00	45.00	0.57	7.22E-03	0.50	0.40	6.05	6.09E-07
45.00	38.00	0.66	5.18E-03	0.40	0.30	8.98	3.69E-07
38.00	25.00	2.27	2.99E-03	0.30	0.00	0.00	6.77E-08
25.00	20.00	1.80	1.52E-03	0.00	0.00	0.66	0.00E+00
20.00	10.00	7.56	6.77E-04				
10.00	8.00	3.21	2.44E-04				
8.00	6.00	4.82	1.47E-04				
6.00	5.00	3.40	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	25
d (0.8)	10
d (0.5)	2
d(0.1)	0.4

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

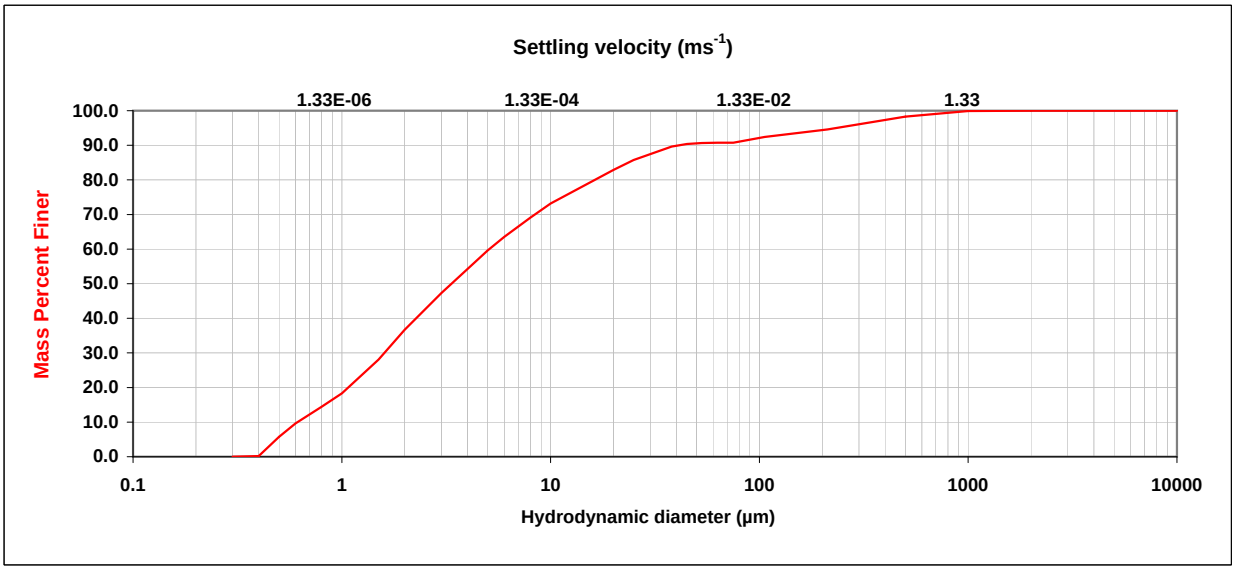
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0904270-007 - Cal-30
Report No:	R0911416
PAS ID No:	P62839

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.00	1.08E+02	5.00	4.00	5.36	6.09E-05
2000.00	1000.00	0.10	6.77E+00	4.00	3.00	6.93	3.69E-05
1000.00	500.00	1.60	1.69E+00	3.00	2.00	10.63	1.88E-05
500.00	212.00	3.70	3.81E-01	2.00	1.50	8.59	9.21E-06
212.00	106.00	2.20	7.61E-02	1.50	1.00	9.79	4.70E-06
106.00	75.00	1.66	2.46E-02	1.00	0.80	3.88	2.44E-06
75.00	63.00	0.00	1.43E-02	0.80	0.60	4.80	1.47E-06
63.00	53.00	0.09	1.01E-02	0.60	0.50	3.88	9.10E-07
53.00	45.00	0.28	7.22E-03	0.50	0.40	5.54	6.09E-07
45.00	38.00	0.74	5.18E-03	0.40	0.30	0.18	3.69E-07
38.00	25.00	3.88	2.99E-03	0.30	0.00	0.00	6.77E-08
25.00	20.00	2.86	1.52E-03	0.00	0.00	0.00	0.00E+00
20.00	10.00	9.70	6.77E-04				
10.00	8.00	4.07	2.44E-04				
8.00	6.00	5.54	1.47E-04				
6.00	5.00	3.97	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	39
d (0.8)	16
d (0.5)	3
d(0.1)	0.6

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

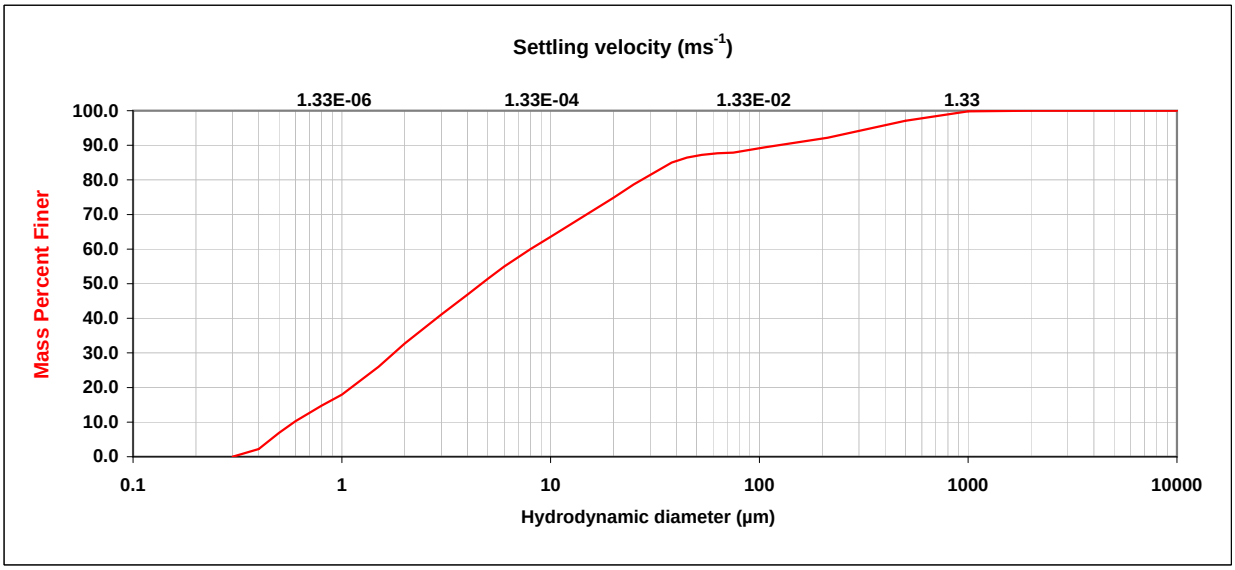
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0904270-006 - Cal-31
Report No:	R0911416
PAS ID No:	P62838

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.7 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.00	1.08E+02	5.00	4.00	4.56	6.09E-05
2000.00	1000.00	0.20	6.77E+00	4.00	3.00	5.72	3.69E-05
1000.00	500.00	2.70	1.69E+00	3.00	2.00	8.40	1.88E-05
500.00	212.00	4.90	3.81E-01	2.00	1.50	6.71	9.21E-06
212.00	106.00	2.80	7.61E-02	1.50	1.00	8.05	4.70E-06
106.00	75.00	1.52	2.46E-02	1.00	0.80	3.22	2.44E-06
75.00	63.00	0.18	1.43E-02	0.80	0.60	4.47	1.47E-06
63.00	53.00	0.45	1.01E-02	0.60	0.50	3.40	9.10E-07
53.00	45.00	0.80	7.22E-03	0.50	0.40	4.65	6.09E-07
45.00	38.00	1.43	5.18E-03	0.40	0.30	2.24	3.69E-07
38.00	25.00	6.35	2.99E-03	0.30	0.00	0.00	6.77E-08
25.00	20.00	3.84	1.52E-03	0.00	0.00	0.00	0.00E+00
20.00	10.00	11.26	6.77E-04				
10.00	8.00	3.58	2.44E-04				
8.00	6.00	5.01	1.47E-04				
6.00	5.00	3.58	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	130
d (0.8)	28
d (0.5)	5
d(0.1)	0.6

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

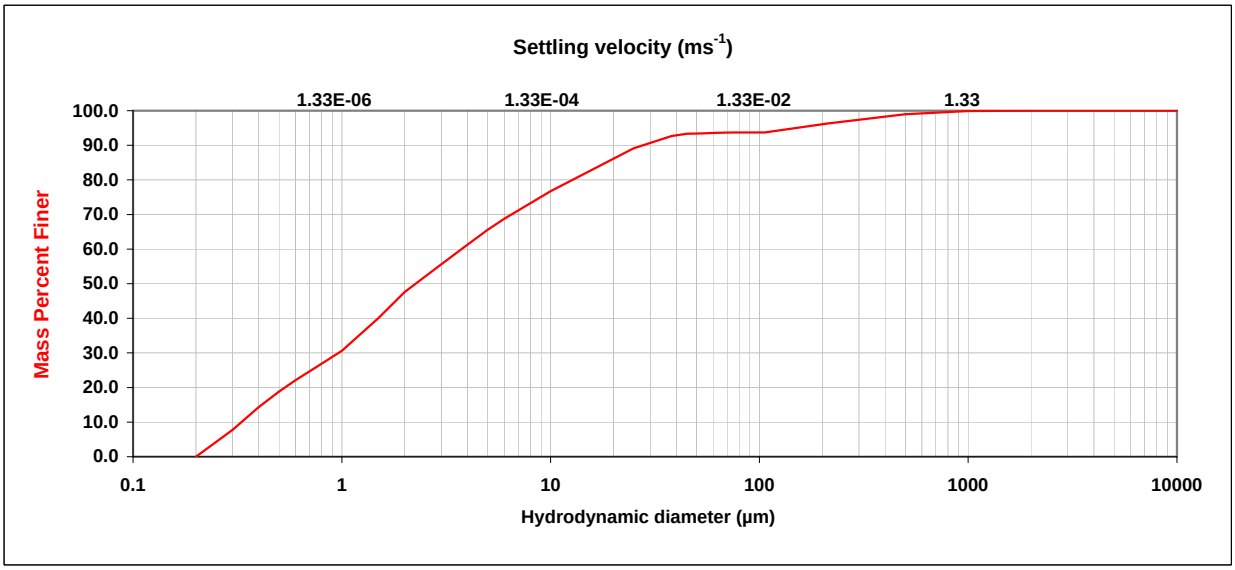
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-018 Cal-38
Report No:	R0911386
PAS ID No:	P62668

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.08	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.00	1.08E+02	5.00	4.00	4.31	6.09E-05
2000.00	1000.00	0.10	6.77E+00	4.00	3.00	5.62	3.69E-05
1000.00	500.00	0.90	1.69E+00	3.00	2.00	8.06	1.88E-05
500.00	212.00	2.70	3.81E-01	2.00	1.50	7.50	9.21E-06
212.00	106.00	2.60	7.61E-02	1.50	1.00	9.46	4.70E-06
106.00	75.00	0.00	2.46E-02	1.00	0.80	3.75	2.44E-06
75.00	63.00	0.09	1.43E-02	0.80	0.60	4.78	1.47E-06
63.00	53.00	0.19	1.01E-02	0.60	0.50	3.28	9.10E-07
53.00	45.00	0.09	7.22E-03	0.50	0.40	4.50	6.09E-07
45.00	38.00	0.66	5.18E-03	0.40	0.30	6.56	3.69E-07
38.00	25.00	3.56	2.99E-03	0.30	0.00	7.78	1.88E-07
25.00	20.00	3.00	1.52E-03				
20.00	10.00	9.37	6.77E-04				
10.00	8.00	3.47	2.44E-04				
8.00	6.00	4.50	1.47E-04				
6.00	5.00	3.19	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	28
d (0.8)	13
d (0.5)	2
d(0.1)	0

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

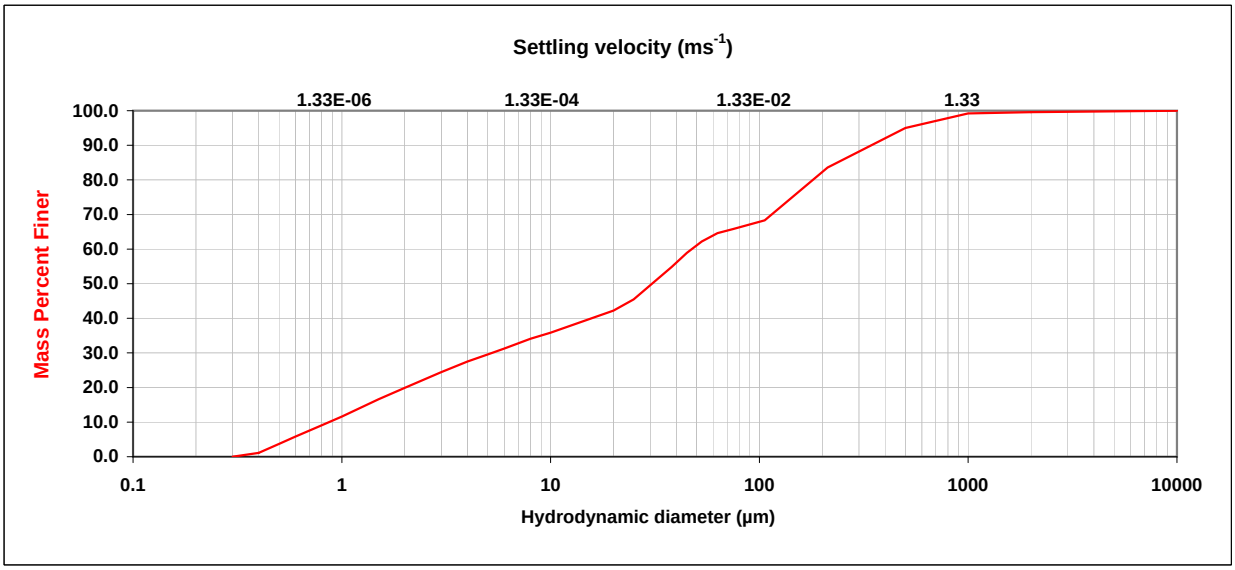
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0904270-004 - Cal-41
Report No:	R0911416
PAS ID No:	P62836

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.40	1.08E+02	5.00	4.00	2.05	6.09E-05
2000.00	1000.00	0.40	6.77E+00	4.00	3.00	3.07	3.69E-05
1000.00	500.00	4.20	1.69E+00	3.00	2.00	4.58	1.88E-05
500.00	212.00	11.40	3.81E-01	2.00	1.50	3.28	9.21E-06
212.00	106.00	15.30	7.61E-02	1.50	1.00	4.99	4.70E-06
106.00	75.00	2.46	2.46E-02	1.00	0.80	2.53	2.44E-06
75.00	63.00	1.23	1.43E-02	0.80	0.60	3.28	1.47E-06
63.00	53.00	2.39	1.01E-02	0.60	0.50	2.12	9.10E-07
53.00	45.00	3.28	7.22E-03	0.50	0.40	2.60	6.09E-07
45.00	38.00	4.10	5.18E-03	0.40	0.30	1.09	3.69E-07
38.00	25.00	9.36	2.99E-03	0.30	0.00	0.00	6.77E-08
25.00	20.00	3.28	1.52E-03	0.00	0.00	0.00	0.00E+00
20.00	10.00	6.35	6.77E-04				
10.00	8.00	1.78	2.44E-04				
8.00	6.00	2.80	1.47E-04				
6.00	5.00	1.71	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	315
d (0.8)	180
d (0.5)	30
d(0.1)	0.9

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

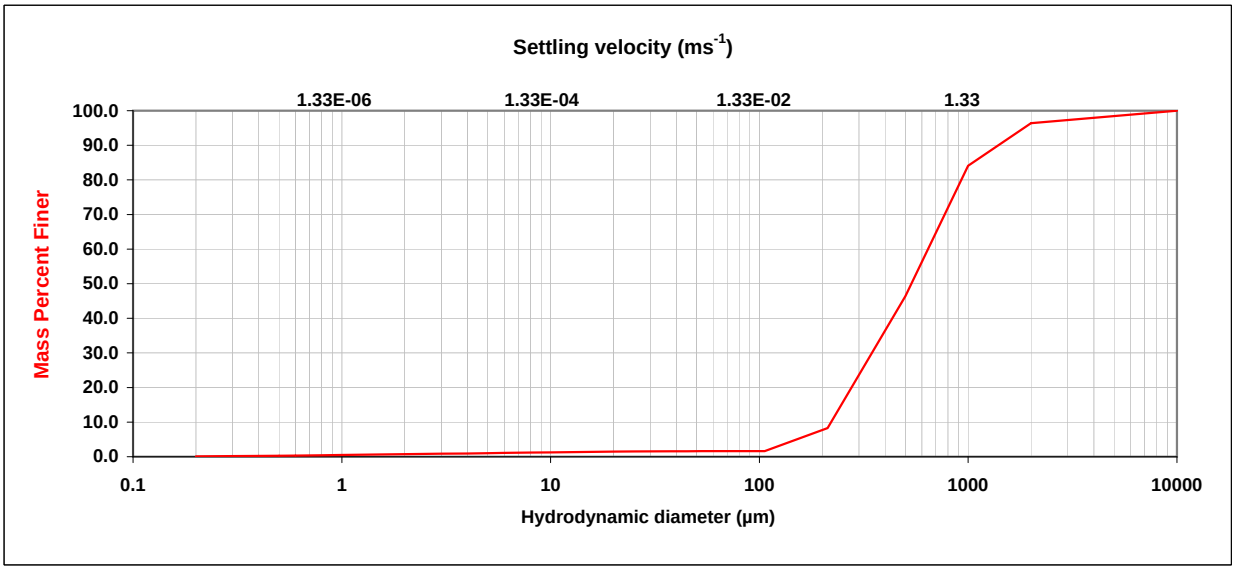
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-005 SBF-41
Report No:	R0911386
PAS ID No:	P62655

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.08	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	3.60	1.62E+02	5.00	4.00	0.08	9.14E-05
2000.00	1000.00	12.30	1.02E+01	4.00	3.00	0.09	5.53E-05
1000.00	500.00	37.70	2.54E+00	3.00	2.00	0.12	2.82E-05
500.00	212.00	38.10	5.72E-01	2.00	1.50	0.09	1.38E-05
212.00	106.00	6.70	1.14E-01	1.50	1.00	0.13	7.05E-06
106.00	75.00	0.00	3.70E-02	1.00	0.80	0.08	3.66E-06
75.00	63.00	0.00	2.15E-02	0.80	0.60	0.10	2.21E-06
63.00	53.00	0.00	1.52E-02	0.60	0.50	0.05	1.37E-06
53.00	45.00	0.01	1.08E-02	0.50	0.40	0.05	9.14E-07
45.00	38.00	0.01	7.77E-03	0.40	0.30	0.03	5.53E-07
38.00	25.00	0.06	4.48E-03	0.30	0.00	0.12	2.82E-07
25.00	20.00	0.06	2.28E-03				
20.00	10.00	0.21	1.02E-03				
10.00	8.00	0.06	3.66E-04				
8.00	6.00	0.10	2.21E-04				
6.00	5.00	0.07	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	1300
d (0.8)	900
d (0.5)	530
d(0.1)	220

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

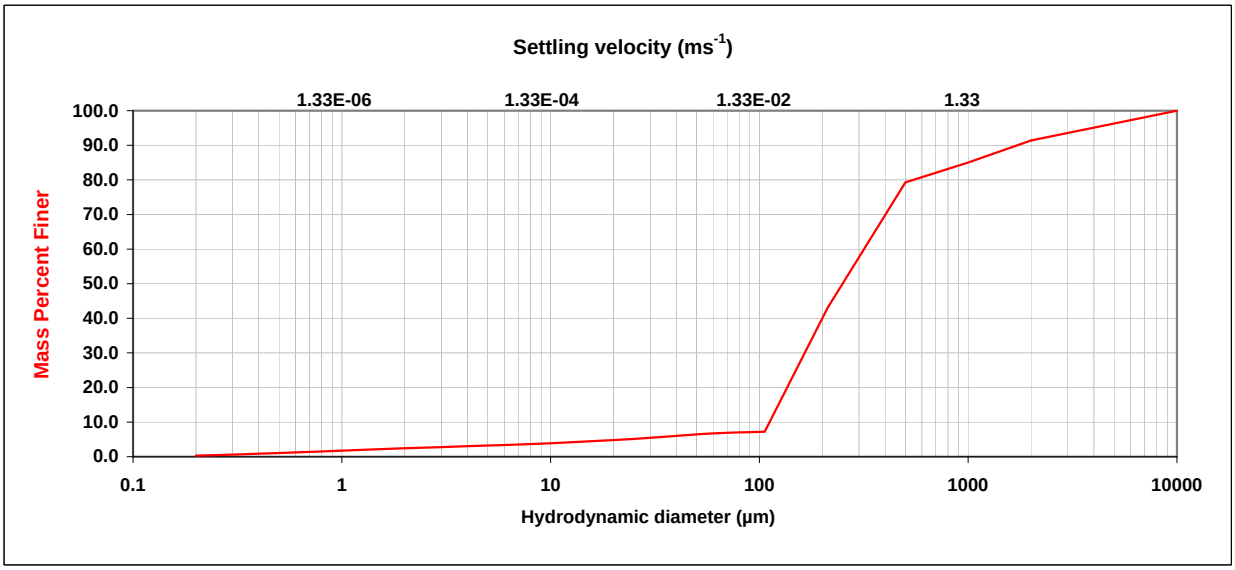
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-006 SBF-42
Report No:	R0911386
PAS ID No:	P62656

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	8.60	1.62E+02	5.00	4.00	0.19	9.14E-05
2000.00	1000.00	6.40	1.02E+01	4.00	3.00	0.25	5.53E-05
1000.00	500.00	5.70	2.54E+00	3.00	2.00	0.35	2.82E-05
500.00	212.00	36.30	5.72E-01	2.00	1.50	0.27	1.38E-05
212.00	106.00	35.80	1.14E-01	1.50	1.00	0.41	7.05E-06
106.00	75.00	0.21	3.70E-02	1.00	0.80	0.22	3.66E-06
75.00	63.00	0.18	2.15E-02	0.80	0.60	0.28	2.21E-06
63.00	53.00	0.26	1.52E-02	0.60	0.50	0.18	1.37E-06
53.00	45.00	0.30	1.08E-02	0.50	0.40	0.22	9.14E-07
45.00	38.00	0.34	7.77E-03	0.40	0.30	0.28	5.53E-07
38.00	25.00	0.78	4.48E-03	0.30	0.00	0.25	2.82E-07
25.00	20.00	0.35	2.28E-03				
20.00	10.00	0.91	1.02E-03				
10.00	8.00	0.23	3.66E-04				
8.00	6.00	0.26	2.21E-04				
6.00	5.00	0.16	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	1700
d (0.8)	500
d (0.5)	255
d(0.1)	115

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

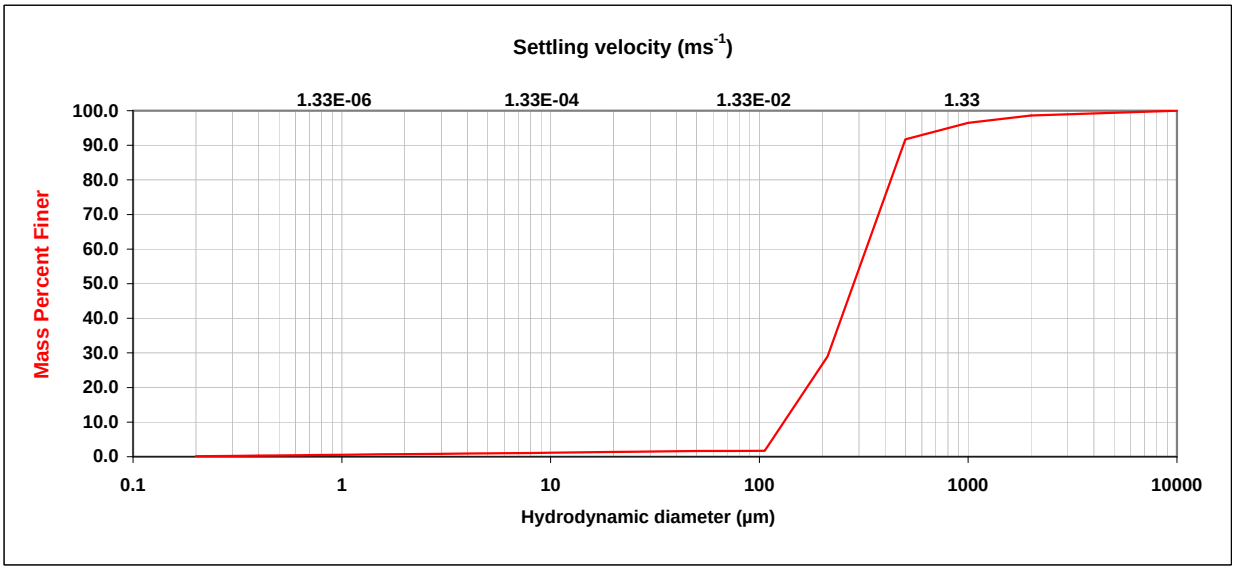
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-001 SBF-43
Report No:	R0911386
PAS ID No:	P62651

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.08	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	1.40	1.62E+02	5.00	4.00	0.06	9.14E-05
2000.00	1000.00	2.10	1.02E+01	4.00	3.00	0.06	5.53E-05
1000.00	500.00	4.80	2.54E+00	3.00	2.00	0.09	2.82E-05
500.00	212.00	62.70	5.72E-01	2.00	1.50	0.07	1.38E-05
212.00	106.00	27.30	1.14E-01	1.50	1.00	0.12	7.05E-06
106.00	75.00	0.03	3.70E-02	1.00	0.80	0.07	3.66E-06
75.00	63.00	0.01	2.15E-02	0.80	0.60	0.08	2.21E-06
63.00	53.00	0.01	1.52E-02	0.60	0.50	0.05	1.37E-06
53.00	45.00	0.02	1.08E-02	0.50	0.40	0.06	9.14E-07
45.00	38.00	0.03	7.77E-03	0.40	0.30	0.07	5.53E-07
38.00	25.00	0.14	4.48E-03	0.30	0.00	0.11	2.82E-07
25.00	20.00	0.08	2.28E-03				
20.00	10.00	0.24	1.02E-03				
10.00	8.00	0.06	3.66E-04				
8.00	6.00	0.07	2.21E-04				
6.00	5.00	0.05	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	490
d (0.8)	400
d (0.5)	290
d(0.1)	140

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

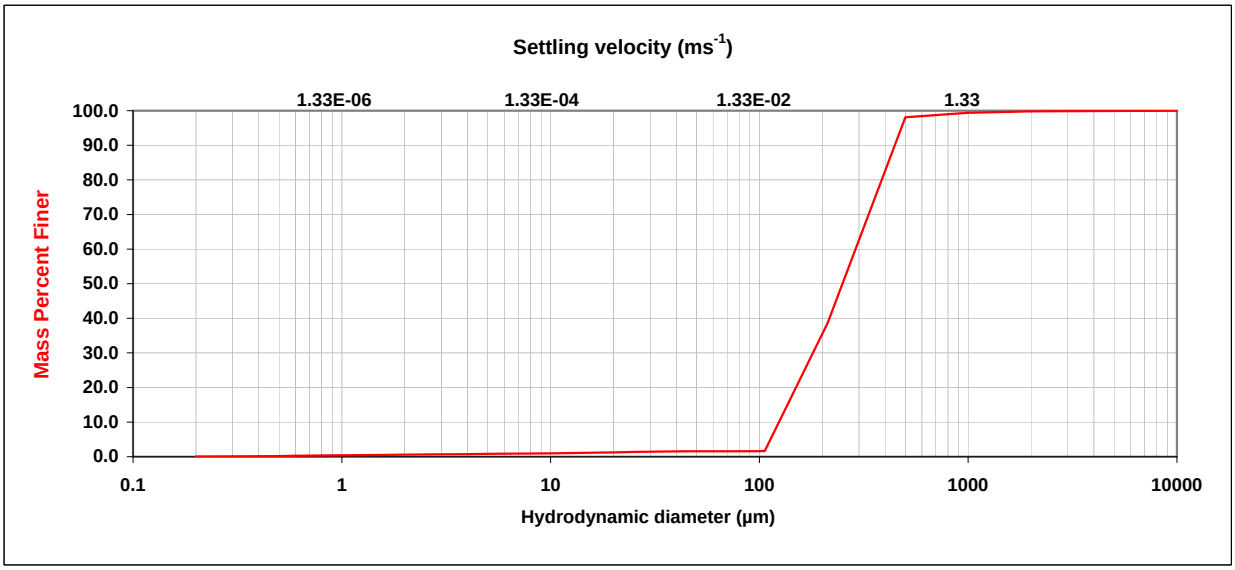
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-002 SBF-44
Report No:	R0911386
PAS ID No:	P62652

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.08	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.20	1.62E+02	5.00	4.00	0.06	9.14E-05
2000.00	1000.00	0.40	1.02E+01	4.00	3.00	0.07	5.53E-05
1000.00	500.00	1.30	2.54E+00	3.00	2.00	0.10	2.82E-05
500.00	212.00	59.50	5.72E-01	2.00	1.50	0.07	1.38E-05
212.00	106.00	37.00	1.14E-01	1.50	1.00	0.11	7.05E-06
106.00	75.00	0.01	3.70E-02	1.00	0.80	0.07	3.66E-06
75.00	63.00	0.01	2.15E-02	0.80	0.60	0.09	2.21E-06
63.00	53.00	0.01	1.52E-02	0.60	0.50	0.05	1.37E-06
53.00	45.00	0.01	1.08E-02	0.50	0.40	0.05	9.14E-07
45.00	38.00	0.03	7.77E-03	0.40	0.30	0.05	5.53E-07
38.00	25.00	0.15	4.48E-03	0.30	0.00	0.06	2.82E-07
25.00	20.00	0.12	2.28E-03				
20.00	10.00	0.28	1.02E-03				
10.00	8.00	0.06	3.66E-04				
8.00	6.00	0.07	2.21E-04				
6.00	5.00	0.05	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	420
d (0.8)	380
d (0.5)	250
d(0.1)	130

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

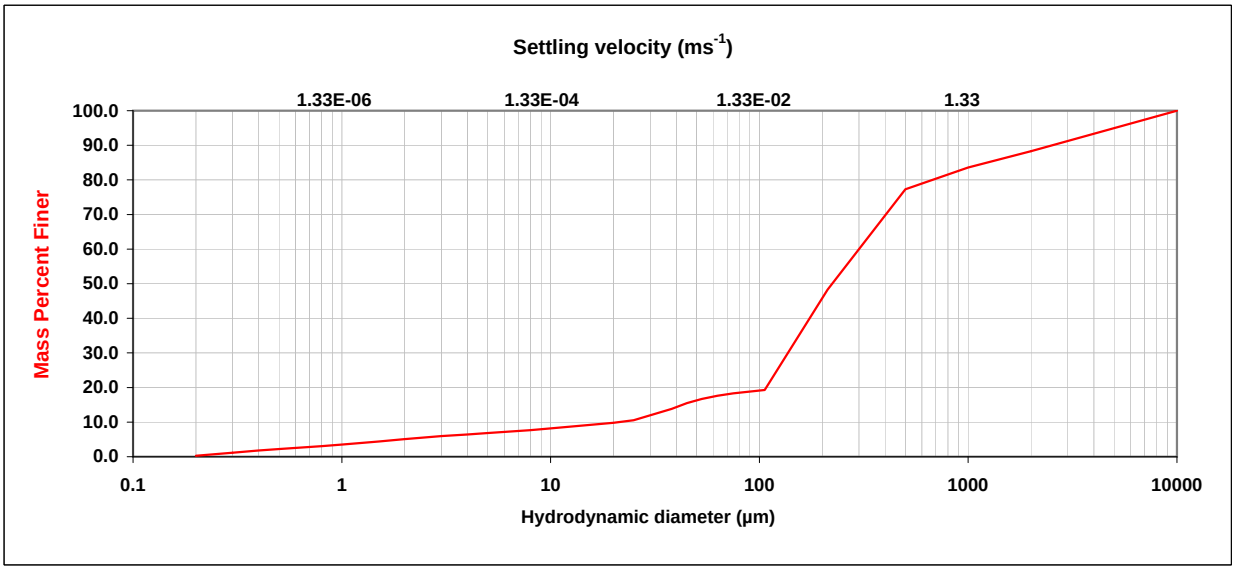
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-003 Slope-16
Report No:	R0911386
PAS ID No:	P62653

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	11.70	1.62E+02	5.00	4.00	0.41	9.14E-05
2000.00	1000.00	4.70	1.02E+01	4.00	3.00	0.48	5.53E-05
1000.00	500.00	6.30	2.54E+00	3.00	2.00	0.87	2.82E-05
500.00	212.00	29.00	5.72E-01	2.00	1.50	0.68	1.38E-05
212.00	106.00	29.00	1.14E-01	1.50	1.00	0.89	7.05E-06
106.00	75.00	1.00	3.70E-02	1.00	0.80	0.46	3.66E-06
75.00	63.00	0.69	2.15E-02	0.80	0.60	0.50	2.21E-06
63.00	53.00	0.89	1.52E-02	0.60	0.50	0.33	1.37E-06
53.00	45.00	1.24	1.08E-02	0.50	0.40	0.42	9.14E-07
45.00	38.00	1.64	7.77E-03	0.40	0.30	0.62	5.53E-07
38.00	25.00	3.28	4.48E-03	0.30	0.00	0.89	2.82E-07
25.00	20.00	0.73	2.28E-03				
20.00	10.00	1.64	1.02E-03				
10.00	8.00	0.50	3.66E-04				
8.00	6.00	0.52	2.21E-04				
6.00	5.00	0.33	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	2600
d (0.8)	600
d (0.5)	220
d(0.1)	23

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

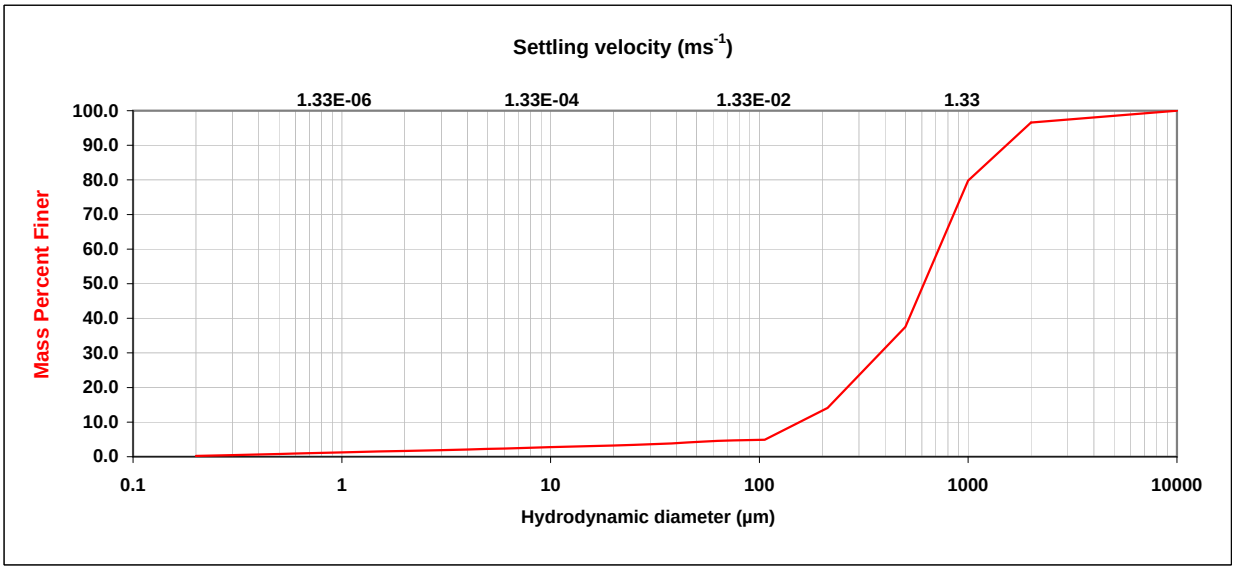
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-004 Slope-22
Report No:	R0911386
PAS ID No:	P62654

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	3.40	1.62E+02	5.00	4.00	0.16	9.14E-05
2000.00	1000.00	16.80	1.02E+01	4.00	3.00	0.19	5.53E-05
1000.00	500.00	42.30	2.54E+00	3.00	2.00	0.24	2.82E-05
500.00	212.00	23.40	5.72E-01	2.00	1.50	0.16	1.38E-05
212.00	106.00	9.20	1.14E-01	1.50	1.00	0.25	7.05E-06
106.00	75.00	0.16	3.70E-02	1.00	0.80	0.15	3.66E-06
75.00	63.00	0.17	2.15E-02	0.80	0.60	0.20	2.21E-06
63.00	53.00	0.22	1.52E-02	0.60	0.50	0.12	1.37E-06
53.00	45.00	0.25	1.08E-02	0.50	0.40	0.15	9.14E-07
45.00	38.00	0.25	7.77E-03	0.40	0.30	0.19	5.53E-07
38.00	25.00	0.45	4.48E-03	0.30	0.00	0.23	2.82E-07
25.00	20.00	0.16	2.28E-03				
20.00	10.00	0.49	1.02E-03				
10.00	8.00	0.17	3.66E-04				
8.00	6.00	0.21	2.21E-04				
6.00	5.00	0.13	1.37E-04				

Derived diameters	Size (µm)
d (0.9)	1450
d (0.8)	1000
d (0.5)	640
d(0.1)	170

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

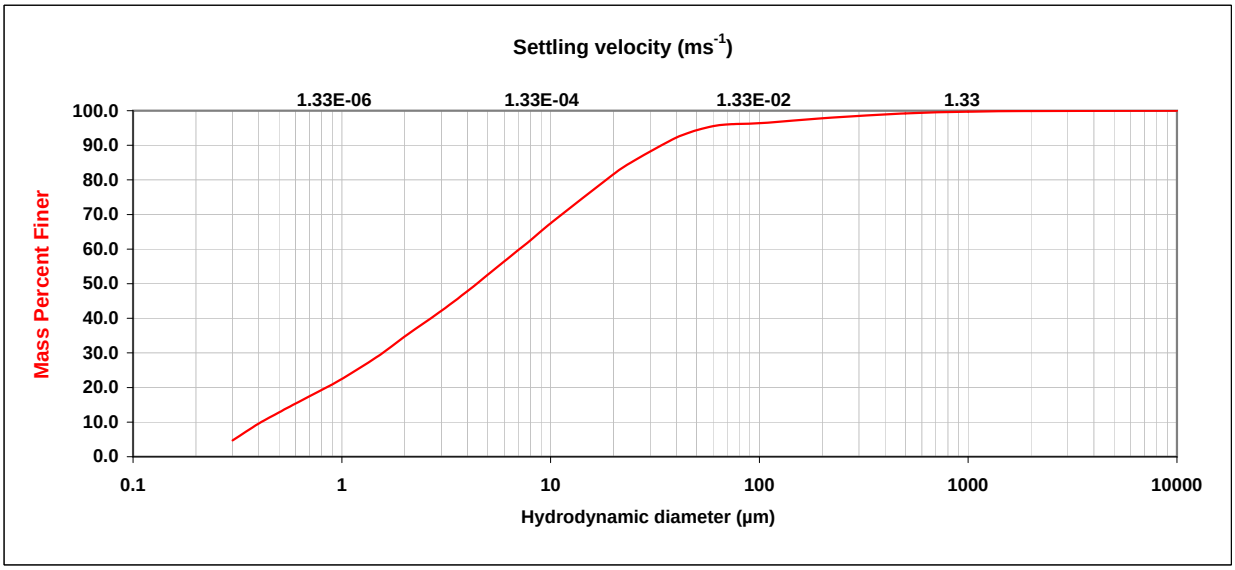
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0904270-003 - Slope-24
Report No:	R0911416
PAS ID No:	P62835

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.10	1.08E+02	5.00	4.00	4.73	6.09E-05
2000.00	1000.00	0.20	6.77E+00	4.00	3.00	5.69	3.69E-05
1000.00	500.00	0.50	1.69E+00	3.00	2.00	7.43	1.88E-05
500.00	212.00	1.30	3.81E-01	2.00	1.50	5.60	9.21E-06
212.00	106.00	1.40	7.61E-02	1.50	1.00	6.66	4.70E-06
106.00	75.00	0.39	2.46E-02	1.00	0.80	3.18	2.44E-06
75.00	63.00	0.39	1.43E-02	0.80	0.60	3.96	1.47E-06
63.00	53.00	0.96	1.01E-02	0.60	0.50	2.51	9.10E-07
53.00	45.00	1.35	7.22E-03	0.50	0.40	3.28	6.09E-07
45.00	38.00	1.83	5.18E-03	0.40	0.30	4.83	3.69E-07
38.00	25.00	6.08	2.99E-03	0.30	0.00	4.73	6.77E-08
25.00	20.00	3.86	1.52E-03	0.00	0.00	0.00	0.00E+00
20.00	10.00	14.19	6.77E-04				
10.00	8.00	4.92	2.44E-04				
8.00	6.00	6.08	1.47E-04				
6.00	5.00	3.86	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	35
d (0.8)	18
d (0.5)	5
d(0.1)	0.4

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

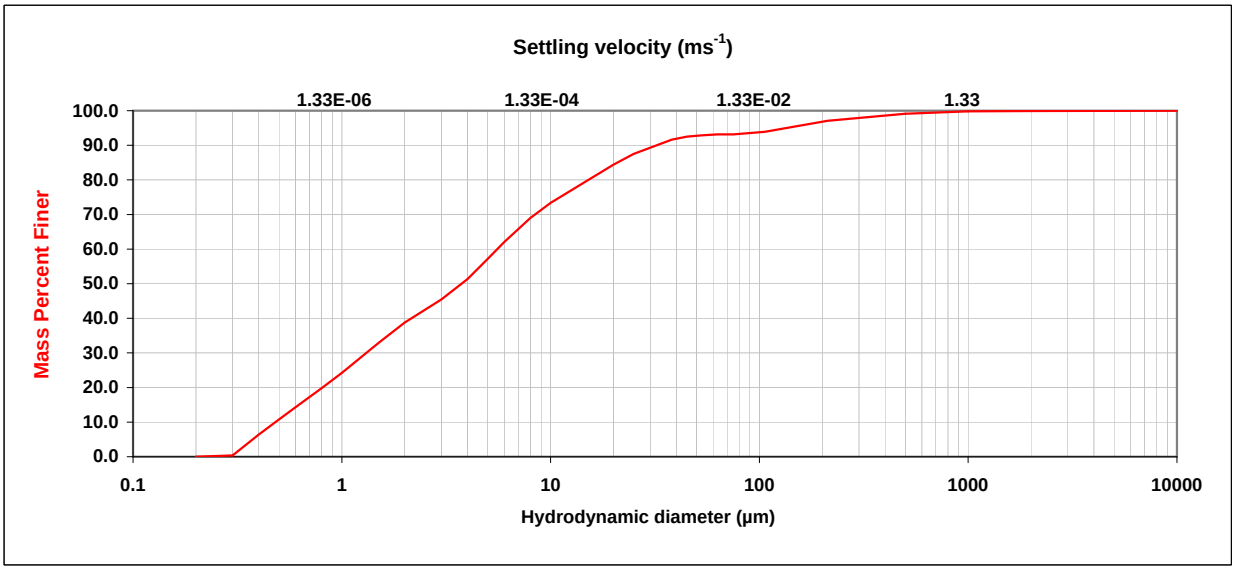
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-019 Tor-43
Report No:	R0911386
PAS ID No:	P62669

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.08	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.10	1.08E+02	5.00	4.00	5.82	6.09E-05
2000.00	1000.00	0.10	6.77E+00	4.00	3.00	5.92	3.69E-05
1000.00	500.00	0.70	1.69E+00	3.00	2.00	6.67	1.88E-05
500.00	212.00	2.00	3.81E-01	2.00	1.50	5.92	9.21E-06
212.00	106.00	3.20	7.61E-02	1.50	1.00	8.64	4.70E-06
106.00	75.00	0.75	2.46E-02	1.00	0.80	4.41	2.44E-06
75.00	63.00	0.00	1.43E-02	0.80	0.60	5.54	1.47E-06
63.00	53.00	0.28	1.01E-02	0.60	0.50	3.47	9.10E-07
53.00	45.00	0.38	7.22E-03	0.50	0.40	4.41	6.09E-07
45.00	38.00	0.85	5.18E-03	0.40	0.30	6.01	3.69E-07
38.00	25.00	4.13	2.99E-03	0.30	0.00	0.38	1.88E-07
25.00	20.00	3.10	1.52E-03				
20.00	10.00	11.08	6.77E-04				
10.00	8.00	4.32	2.44E-04				
8.00	6.00	6.95	1.47E-04				
6.00	5.00	4.88	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	32
d (0.8)	15
d (0.5)	4
d(0.1)	0

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

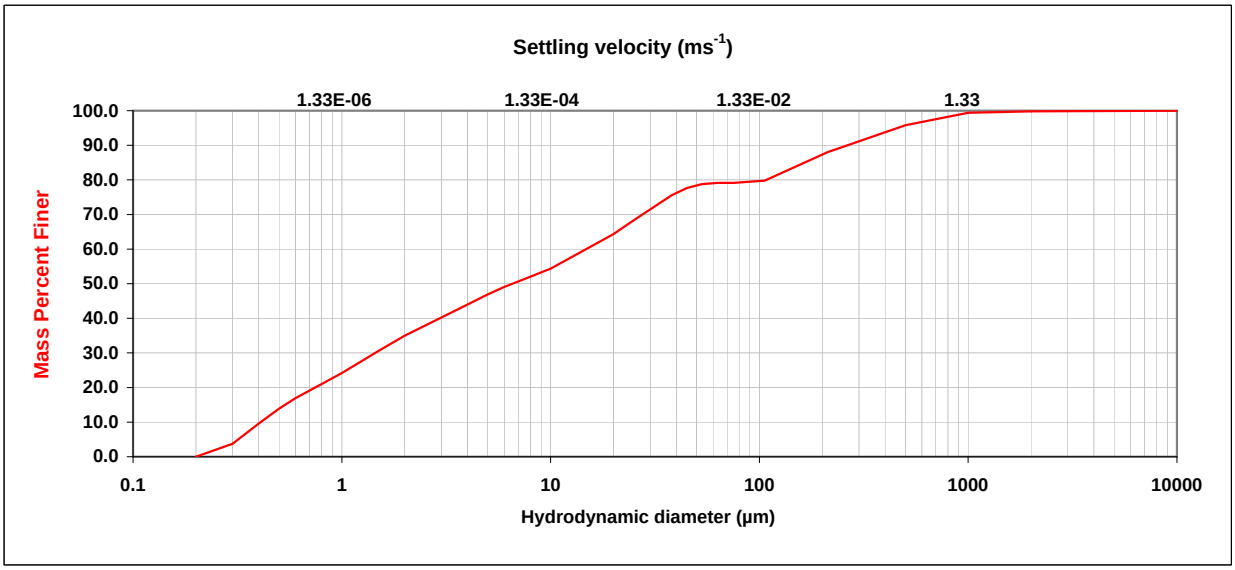
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903803-020 Tor-44
Report No:	R0911386
PAS ID No:	P62670

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.20	1.08E+02	5.00	4.00	2.95	6.09E-05
2000.00	1000.00	0.40	6.77E+00	4.00	3.00	3.75	3.69E-05
1000.00	500.00	3.60	1.69E+00	3.00	2.00	5.27	1.88E-05
500.00	212.00	7.80	3.81E-01	2.00	1.50	4.39	9.21E-06
212.00	106.00	8.20	7.61E-02	1.50	1.00	6.38	4.70E-06
106.00	75.00	0.64	2.46E-02	1.00	0.80	3.19	2.44E-06
75.00	63.00	0.00	1.43E-02	0.80	0.60	4.07	1.47E-06
63.00	53.00	0.40	1.01E-02	0.60	0.50	3.03	9.10E-07
53.00	45.00	1.12	7.22E-03	0.50	0.40	4.31	6.09E-07
45.00	38.00	2.07	5.18E-03	0.40	0.30	5.83	3.69E-07
38.00	25.00	7.26	2.99E-03	0.30	0.00	3.75	1.88E-07
25.00	20.00	3.99	1.52E-03				
20.00	10.00	9.98	6.77E-04				
10.00	8.00	2.31	2.44E-04				
8.00	6.00	2.95	1.47E-04				
6.00	5.00	2.15	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	270
d (0.8)	105
d (0.5)	7
d(0.1)	0

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

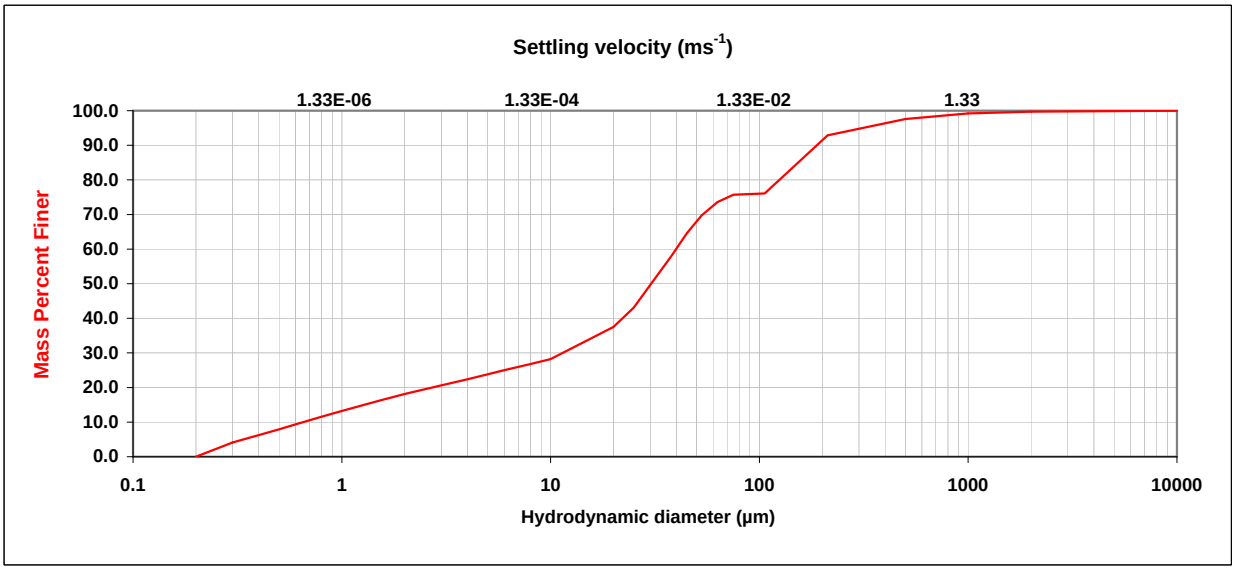
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-021 Tor-45
Report No:	R0911386
PAS ID No:	P62671

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.30	1.08E+02	5.00	4.00	1.45	6.09E-05
2000.00	1000.00	0.50	6.77E+00	4.00	3.00	1.75	3.69E-05
1000.00	500.00	1.60	1.69E+00	3.00	2.00	2.51	1.88E-05
500.00	212.00	4.70	3.81E-01	2.00	1.50	1.98	9.21E-06
212.00	106.00	16.80	7.61E-02	1.50	1.00	2.89	4.70E-06
106.00	75.00	0.38	2.46E-02	1.00	0.80	1.67	2.44E-06
75.00	63.00	2.13	1.43E-02	0.80	0.60	2.21	1.47E-06
63.00	53.00	3.81	1.01E-02	0.60	0.50	1.45	9.10E-07
53.00	45.00	5.17	7.22E-03	0.50	0.40	1.67	6.09E-07
45.00	38.00	6.47	5.18E-03	0.40	0.30	2.13	3.69E-07
38.00	25.00	15.07	2.99E-03	0.30	0.00	4.11	1.88E-07
25.00	20.00	5.56	1.52E-03				
20.00	10.00	9.28	6.77E-04				
10.00	8.00	1.45	2.44E-04				
8.00	6.00	1.75	1.47E-04				
6.00	5.00	1.22	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	180
d (0.8)	125
d (0.5)	30
d(0.1)	1

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

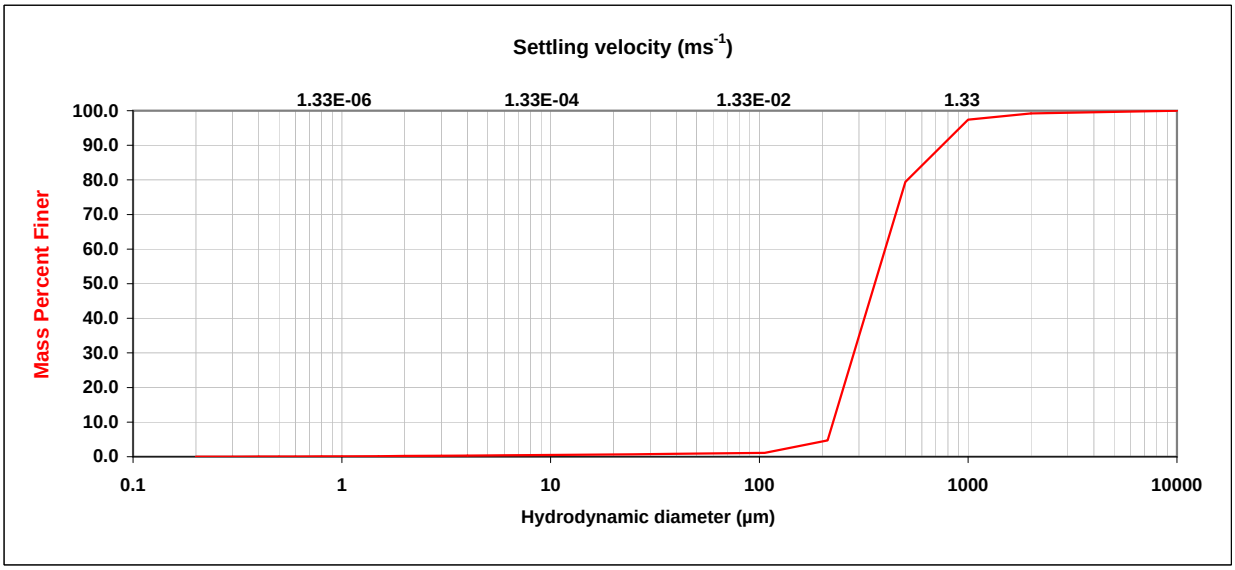
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-022 Tor-53
Report No:	R0911386
PAS ID No:	P62672

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.09	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.08	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.80	1.08E+02	5.00	4.00	0.04	6.09E-05
2000.00	1000.00	1.80	6.77E+00	4.00	3.00	0.05	3.69E-05
1000.00	500.00	18.00	1.69E+00	3.00	2.00	0.07	1.88E-05
500.00	212.00	74.70	3.81E-01	2.00	1.50	0.05	9.21E-06
212.00	106.00	3.60	7.61E-02	1.50	1.00	0.06	4.70E-06
106.00	75.00	0.08	2.46E-02	1.00	0.80	0.03	2.44E-06
75.00	63.00	0.04	1.43E-02	0.80	0.60	0.03	1.47E-06
63.00	53.00	0.05	1.01E-02	0.60	0.50	0.01	9.10E-07
53.00	45.00	0.05	7.22E-03	0.50	0.40	0.01	6.09E-07
45.00	38.00	0.05	5.18E-03	0.40	0.30	0.01	3.69E-07
38.00	25.00	0.12	2.99E-03	0.30	0.00	0.02	1.88E-07
25.00	20.00	0.06	1.52E-03				
20.00	10.00	0.15	6.77E-04				
10.00	8.00	0.05	2.44E-04				
8.00	6.00	0.06	1.47E-04				
6.00	5.00	0.03	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	700
d (0.8)	500
d (0.5)	360
d(0.1)	230

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

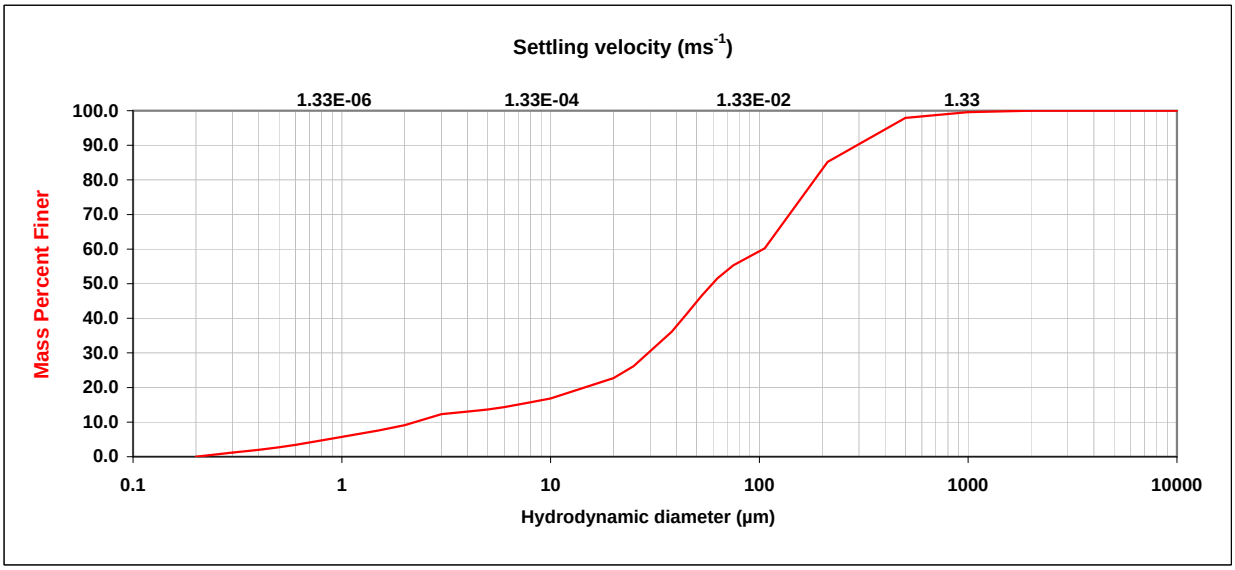
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-023 Tor-54
Report No:	R0911386
PAS ID No:	P62673

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.09	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.08	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.00	1.08E+02	5.00	4.00	0.60	6.09E-05
2000.00	1000.00	0.40	6.77E+00	4.00	3.00	0.78	3.69E-05
1000.00	500.00	1.70	1.69E+00	3.00	2.00	3.19	1.88E-05
500.00	212.00	12.70	3.81E-01	2.00	1.50	1.51	9.21E-06
212.00	106.00	25.00	7.61E-02	1.50	1.00	1.87	4.70E-06
106.00	75.00	4.88	2.46E-02	1.00	0.80	1.02	2.44E-06
75.00	63.00	3.73	1.43E-02	0.80	0.60	1.26	1.47E-06
63.00	53.00	5.00	1.01E-02	0.60	0.50	0.72	9.10E-07
53.00	45.00	5.24	7.22E-03	0.50	0.40	0.72	6.09E-07
45.00	38.00	5.24	5.18E-03	0.40	0.30	0.78	3.69E-07
38.00	25.00	9.93	2.99E-03	0.30	0.00	1.20	1.88E-07
25.00	20.00	3.49	1.52E-03				
20.00	10.00	5.84	6.77E-04				
10.00	8.00	1.14	2.44E-04				
8.00	6.00	1.38	1.47E-04				
6.00	5.00	0.66	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	275
d (0.8)	180
d (0.5)	60
d(0.1)	2

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

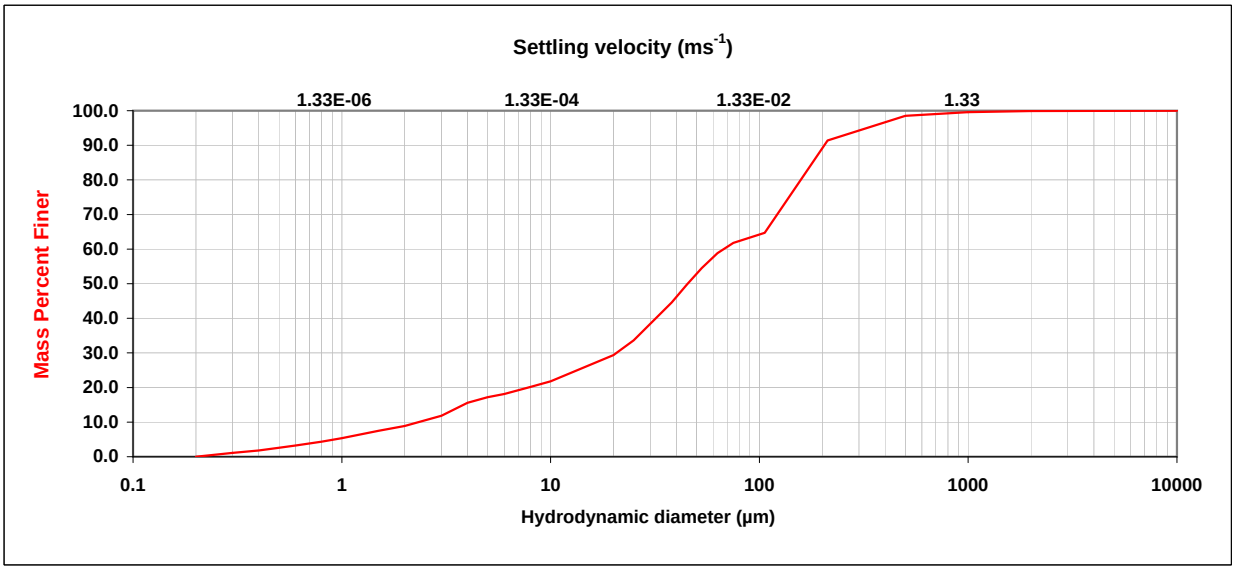
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0903809-024 Tor-55
Report No:	R0911386
PAS ID No:	P62674

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.09	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.09	µm
Liquid viscosity:	0.714	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.10	1.08E+02	5.00	4.00	1.62	6.09E-05
2000.00	1000.00	0.30	6.77E+00	4.00	3.00	3.75	3.69E-05
1000.00	500.00	1.10	1.69E+00	3.00	2.00	2.98	1.88E-05
500.00	212.00	7.10	3.81E-01	2.00	1.50	1.36	9.21E-06
212.00	106.00	26.70	7.61E-02	1.50	1.00	2.14	4.70E-06
106.00	75.00	2.91	2.46E-02	1.00	0.80	1.04	2.44E-06
75.00	63.00	2.98	1.43E-02	0.80	0.60	1.10	1.47E-06
63.00	53.00	4.27	1.01E-02	0.60	0.50	0.65	9.10E-07
53.00	45.00	4.79	7.22E-03	0.50	0.40	0.78	6.09E-07
45.00	38.00	5.18	5.18E-03	0.40	0.30	0.71	3.69E-07
38.00	25.00	10.93	2.99E-03	0.30	0.00	1.10	1.88E-07
25.00	20.00	4.27	1.52E-03				
20.00	10.00	7.57	6.77E-04				
10.00	8.00	1.62	2.44E-04				
8.00	6.00	2.07	1.47E-04				
6.00	5.00	0.91	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	200
d (0.8)	150
d (0.5)	45
d(0.1)	3

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

Analysis Report

CSIRO

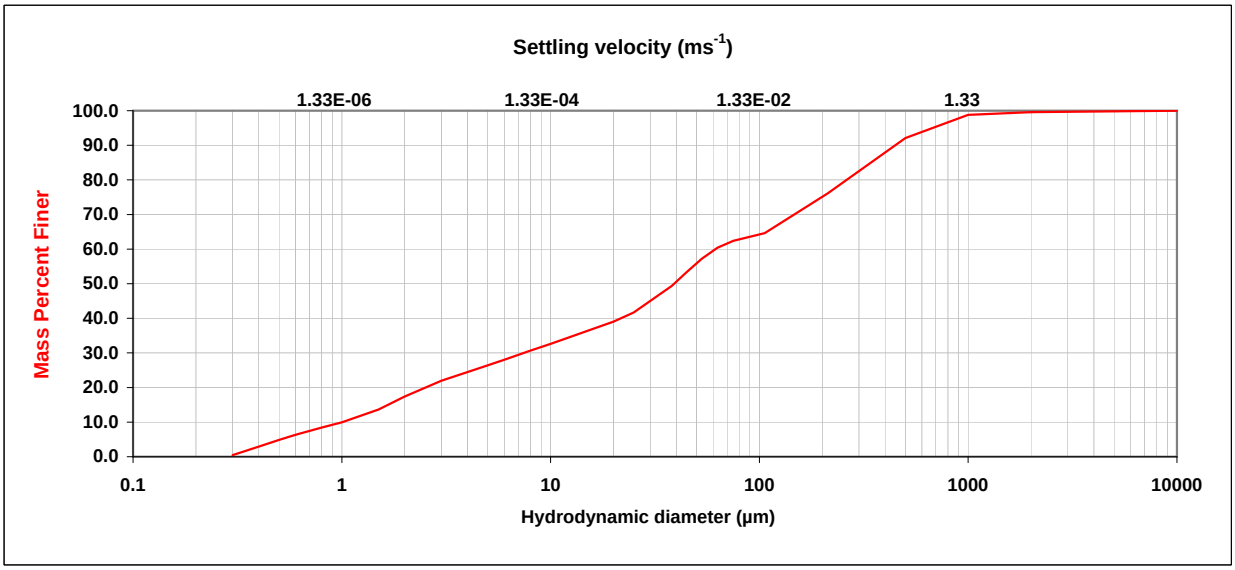
Division of Minerals

Particle Analysis Service

Client:	ALS
Sample name:	EP0904270-005 - Tor-58
Report No:	R0911416
PAS ID No:	P62837

Analysis:	X-ray sedimentation by Sedigraph 5100	**Analysis temp.:**	35.6 ºC
Dispersant:	Water	**Sonication:**	10 min
Additives:	10mL sodium hexametaphosphate	**Concentration:**	5 % w/w

Sample density:	2.650	g/cm^3	**Reynolds No:**	2.1	
Liquid density:	0.994	g/cm^3	**Critical diameter:**	54.07	µm
Liquid viscosity:	0.713	cp			



Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})	Max size (µm)	Min size (µm)	In %	Mean settling velocity* (ms^{-1})
10000.00	2000.00	0.40	1.08E+02	5.00	4.00	1.94	6.09E-05
2000.00	1000.00	0.80	6.77E+00	4.00	3.00	2.52	3.69E-05
1000.00	500.00	6.70	1.69E+00	3.00	2.00	4.59	1.88E-05
500.00	212.00	16.00	3.81E-01	2.00	1.50	3.75	9.21E-06
212.00	106.00	11.50	7.61E-02	1.50	1.00	3.68	4.70E-06
106.00	75.00	2.20	2.46E-02	1.00	0.80	1.55	2.44E-06
75.00	63.00	2.00	1.43E-02	0.80	0.60	2.07	1.47E-06
63.00	53.00	3.17	1.01E-02	0.60	0.50	1.49	9.10E-07
53.00	45.00	3.81	7.22E-03	0.50	0.40	1.94	6.09E-07
45.00	38.00	4.07	5.18E-03	0.40	0.30	2.45	3.69E-07
38.00	25.00	7.69	2.99E-03	0.30	0.00	0.45	6.77E-08
25.00	20.00	2.65	1.52E-03	0.00	0.00	0.00	0.00E+00
20.00	10.00	6.40	6.77E-04				
10.00	8.00	1.94	2.44E-04				
8.00	6.00	2.65	1.47E-04				
6.00	5.00	1.62	9.10E-05				

Derived diameters	Size (µm)
d (0.9)	420
d (0.8)	260
d (0.5)	40
d(0.1)	1.0

Note : Data from 106µm to 2000 µm by wet screening , from 0.2µm to 106µm by Sedimentation

* based on the mean of the size interval and on the the calculations and variables in the 'settling velocity worksheet

APPENDIX G – FAUNAL TAXA LIST

APPENDIX G – FAUNAL TAXA LIST

Phylum Class/Order	Family	Taxa ID	Samples																																									
			Export-4MFB	Export-4MFC	Export-11MFA	Export-11MFB	Export-16MFA	Export-16MFB	Export-23MFA	Export-23MFB	Export-36MFB	Export-36MFC	Export-39MFB	Export-39MFC	Export-49MFA	Export-49MFB	Export-53MFB	Export-53MFC	Export-56MFA	Export-56MFB	Export-64MFA	Export-64MFB	Export-70MFA	Export-70MFB	CAL-28MFA	CAL-28MFB	CAL-29MFA	CAL-29MFB	CAL-30MFA	CAL-31MFB	CAL-31MFC	CAL-38MFA	CAL-38MFB	CAL-41MFA	CAL-41 MFC	SBF-41MFB	SBF-41MFC	SBF-42MFA	SBF-42MFB	SBF-44MFA	SBF-44MFB	SBF-43MFA	SBF-43MFB	Slope-16MFB
Taxa Included In Statistical Analysis																																												
ANNELIDA																																												
Polychaeta	Nephytidae	**PNe1**	4	4															1																									
	Paraonidae	**PPa1**																	1		4	4							1	1				2	1							4		
		PPa2																												1														
	Syllidae	**PSy1**											4						1										2					2								8		
		PSy2																																4										
		PSy3																																	1									
		PSy4																													1				1									
		PSy5			4																																							
		PSy6															4						8															12	4				4	
		PSy7			4	4																			4													4			4			
		PSy8			4								4																										4					
		PSy9																																						4				
		PSy10		4																																								
		PSy11																						4																				
		PSy12																						4																				
		PSy13													3																													
	Dorvelleidae	**PDo1**															8		1	1		4																		4				
		PDo2									4																												4					
	Polynoidae	**PPo1**															4	4		1																			4	4				
	Poecilochaetidae	**PPoe1**														1				2																								
	Magelonidae	**PMa1**													4					1																		4				8	8	
	Goniadidae	**PGo1**										4						4		1																	4		4					
	Pilargidae	**PPi1**																4		1			4																					
	Lumbrineridae	**PLu1**															8	16											1			4							8					
	Maldanidae	**PMal1**												8							4				8	4			1					2					4					
	Trochochaetidae(?)	**PTr1**																										4	1	1										4				
		PTr2																																				4	4					
	Spionidae	**PSp1**																											1		1								4					
		PSp2														7	8	12			4			4				8		1	4	4			2			8	4					
		PSp3																																										
		PSp4		4									4													4				1	2						4	4	16					
		PSp5																							4	8		4				4						4						
		PSp6																																		4			8					
		PSp9																																										
	Unknown	**PUn1**																											1															
		PUn2																																								4		
		PUn3																																										
		PUn4	4																																									
	Glyceridae	**PGl1**																12			4			4										2						4		4		
	Capitellidae	**PCa1**																																2										
	Orbiniidae	**POr1**																																2										
		POr2																																			4							
	Amphinomidae	**PAm1**																																	1									
	Phyllodocidae	**PPh1**																																	1									
		PPh2																																										
	Nereididae	**PNer1**			4	4		4		4			4												4																4			

APPENDIX G – FAUNAL TAXA LIST

Phylum Class/Order	Family	Taxa ID	Samples																																										
			Export-4MFB	Export-4MFC	Export-11MFA	Export-11MFB	Export-16MFA	Export-16MFB	Export-23MFA	Export-23MFB	Export-36MFB	Export-36MFC	Export-39MFB	Export-39MFC	Export-49MFA	Export-49MFB	Export-53MFB	Export-53MFC	Export-56MFA	Export-56MFB	Export-64MFA	Export-64MFB	Export-70MFA	Export-70MFB	CAL-28MFA	CAL-28MFB	CAL-29MFA	CAL-29MFB	CAL-30MFA	CAL-31MFB	CAL-31MFC	CAL-38MFA	CAL-38MFB	CAL-41MFA	CAL-41 MFC	SBF-41MFB	SBF-41MFC	SBF-42MFA	SBF-42MFB	SBF-44MFA	SBF-44MFB	SBF-43MFA	SBF-43MFB	Slope-16MFB
Taxa Included In Statistical Analysis																																												
		PNer2															4	16			4	8									1												4	
		PNer3				4	12						4																									4					
		PNer4			4		4																																				
	Sternaspidae	**PSt1**																												2			4										
	Ctenodrilidae	**PCt1**											8																									24	4				
	Opheliidae	**POp1**											4																														
		POp2																																									
	Cirratulidae	**PCi1**											4																														
	Eunicidae	**PEu1**		8									24	40									4	8		4		4								4	12			4			
		PEu2																																									
	Chrysopetalidae	**PCh1**																																									
	Questidae	**PQu1**																				4																					
	Oweniidae	**AOwen1**					4																																				
	Trichobranchidae	**ATrich1**																4																										
	Paralacydoniidae	**APara1**																			4				8								24										
	Scalibregmatidae	**AScal1**																				4																					
	Amphoretidae	**AAmph1**																				4																					
	Acoetidae	**AAco1**																																							4			
	Flabelligeridae	**AFlab1**								4																																	
ARTHROPODA																																												
Malacostraca/ Isopoda	Metaseudidae	**CMe1**																																										
	Metaseudidae	**CMe2**																							4	8	8					12	16										
	Metaseudidae	**CMe3**																												3		4											
	Leptanthuridae	**CLe1**	4	4	8		4	4													4	8	28		4		4			1				2			12	12		4	4		
	Antheluridae	**AAnth1**	4		4													40																									
	Flabellifera (suborde	**CFl1**																												1													
	Sphaeromatidae	**ASpha1**																					4																				
Malacostraca/ Amphipoda	Stilipedidae	**CSt1**																												1													
	Ampeliscidae	**CAm1**																												1	1												
	Ampeliscidae	**CAm2**																12																									
	Phoxocephalidae	**CPh1**																													1				2		4					
	Exoedicerotidae	**CEx1**								8		4			39	32	16									8												8	4				
	Oedicerotidae	**COe1**											4																														
	Leucothoidae	**CLeu1**									4		4																														
	Amathillopsidae	**CAma1**											4																														
	Ampithoidae	**CAmpi1**									4																																
	Platyischnopidae	**APlat1**			8		4	4							1		20				8	4				4	8													4		4	
	Eusiridae	**AEusir1**														9																										
	Liljeborgiidae	**ALilj1**																			8																						
	Stenothoidae	**ASteno1**																			4																						
	Aoridae	**AAori1**																			4																						
		CAmp1											4																								4						
		CAmp2														4	8																										
		CAmp3																4																									

APPENDIX G – FAUNAL TAXA LIST

Phylum Class/Order	Family	Taxa ID	Samples																																										
			Export-4MFB	Export-4MFC	Export-11MFA	Export-11MFB	Export-16MFA	Export-16MFB	Export-23MFA	Export-23MFB	Export-36MFB	Export-36MFC	Export-39MFB	Export-39MFC	Export-49MFA	Export-49MFB	Export-53MFB	Export-53MFC	Export-56MFA	Export-56MFB	Export-64MFA	Export-64MFB	Export-70MFA	Export-70MFB	CAL-28MFA	CAL-28MFB	CAL-29MFA	CAL-29MFB	CAL-30MFA	CAL-31MFB	CAL-31MFC	CAL-38MFA	CAL-38MFB	CAL-41MFA	CAL-41 MFC	SBF-41MFB	SBF-41MFC	SBF-42MFA	SBF-42MFB	SBF-44MFA	SBF-44MFB	SBF-43MFA	SBF-43MFB	Slope-16MFB
Taxa Included In Statistical Analysis																																													
Malacostraca/Cumacea		**CCu1**									4		4		9	4	12							8				4		2	1	4											4		
Malacostraca/	Leptocheliidae	**CTa1**																												1															
Tanaidacea	Pagurapseudidae	**APag1**																																											
Malacostraca/	Upogebiidae	**CUp1**																4																											
Decapoda	Diogenidae	**CDi1**										4																																
	Penaeidae	**CTr1**									4																																	
	Stomatopoda	**AStoma1**		4																																								
		CDe1											4	4	1																													
		De2													3	4	28	20			4																							
		De3														1						4																						
		De4														2	4																											
		CZo												4																														
		Amega1					4		4																																			
Malacostraca		**CUn1**																												1															
		CUn2																													3														
MOLLUSCA																																													
Gastropoda	Buccinidae	**MBu1**																	1																										
	Olividae	**MOl1**												4																														
Bivalvia	Tellinidae	**MTe1**														1			1																										
	Veneridae	**V1**																																											
	Veneridae	**V2**													2																														
	Veneridae	**V3**														1																													
	Veneridae	**V4**																																											
	Veneridae	**V5**																															4											
	Cariidae	**MCar1**													1																														
		MBi2																	1																										
		MBi3																												2					1			4						
Aplacophora		**MAp1**																							4							8	24											
ECHINODERMATA																																													
Ophiuroidea	Ophiuridae	**EOp1**									4	4	4				4	36																	2				4	4				
	Opliiactidae	**EOpli1**																				4																							
Echinoidea	Clypeasteridae	**ECl1**																																		8			8						
		EEchi1																4																											
Asteroidea	Astropectinidae	**EAs1**						4					4																															
NEMERTEA		**N**			4	4	4						4			1	8	8									4						2	1									
SIPUNCULA																																													
Sipunculidea	Phascolionidae	**SPh1**		4									4				8	4						8			4	6	1	1		12		2	4	4	4		4	4			4
	Sipunculidae	**SSi1**		4													4																	1									
Phascolosomatidea	Aspidosiphonidae	**SAs1**																									4		1	1													
CNIDARIA																																												
Anthozoa		**CnAn1**	4																		4																	4	8					

APPENDIX G – FAUNAL TAXA LIST

Phylum Class/Order	Family	Taxa ID	Export-4MFB	Export-4MFC	Export-11MFA	Export-11MFB	Export-16MFA	Export-16MFB	Export-23MFA	Export-23MFB	Export-36MFB	Export-36MFC	Export-39MFB	Export-39MFC	Export-49MFA	Export-49MFB	Export-53MFB	Export-53MFC	Export-56MFA	Export-56MFB	Export-64MFA	Export-64MFB	Export-70MFA	Export-70MFB	CAL-28MFA	CAL-28MFB	CAL-29MFA	CAL-29MFB	CAL-30MFA	CAL-31MFB	CAL-31MFC	CAL-38MFA	CAL-38MFB	CAL-41MFA	CAL-41 MFC	SBF-41MFB	SBF-41MFC	SBF-42MFA	SBF-42MFB	SBF-44MFA	SBF-44MFB	SBF-43MFA	SBF-43MFB	Slope-16MFB
Taxa Included In Statistical Analysis																																												
PLATYHELMINTHES																																												
Turbellaria		**PITu1**						4																														4					
CHORDATA																																												
Ascidiacea		**ChAs1**												4																													
UNKNOWN (worm)		**W1**																8									4							6	1									
UNKNOWN		**Un1**																																										
UNKNOWN		**Un2**										8		4																													
UNKNOWN		**Un3**																																										
UNKNOWN		**Un4**																																										
		Individu	20	36	44	16	36	20	4	16	24	24	100	68	63	67	148	212	7	7	56	44	28	60	36	44	24	44	19	18	16	40	84	26	17	24	32	100	112	40	16	36	20	4
		Taxa	5	8	9	4	7	5	1	3	6	5	19	7	9	12	16	18	7	6	12	10	5	7	6	9	4	9	11	15	10	7	6	10	13	5	6	14	19	10	4	7	4	1
Taxa Excluded From Statistical Analysis																																												
Phylum Class/Order	**Family**	**Taxa ID**	**Export-4MFB**	**Export-4MFC**	**Export-11MFA**	**Export-11MFB**	**Export-16MFA**	**Export-16MFB**	**Export-23MFA**	**Export-23MFB**	**Export-36MFB**	**Export-36MFC**	**Export-39MFB**	**Export-39MFC**	**Export-49MFA**	**Export-49MFB**	**Export-53MFB**	**Export-53MFC**	**Export-56MFA**	**Export-56MFB**	**Export-64MFA**	**Export-64MFB**	**Export-70MFA**	**Export-70MFB**	**CAL-28MFA**	**CAL-28MFB**	**CAL-29MFA**	**CAL-29MFB**	**CAL-30MFA**	**CAL-31MFB**	**CAL-31MFC**	**CAL-38MFA**	**CAL-38MFB**	**CAL-41MFA**	**CAL-41 MFC**	**SBF-41MFB**	**SBF-41MFC**	**SBF-42MFA**	**SBF-42MFB**	**SBF-44MFA**	**SBF-44MFB**	**SBF-43MFA**	**SBF-43MFB**	**Slope-16MFB**
Nematoda		**Ne**				2	5		2	4					1				4					5	1			4	8	4	8					12				4	4	1		4
% Sample Sorted			**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**100**	**100**	**25**	**25**	**100**	**100**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**100**	**100**	**100**	**25**	**25**	**50**	**100**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**

Data has been multiplied to take account of the % of the sample that was sorted

APPENDIX G – FAUNAL TAXA LIST

Phylum Class/Order	Family	Taxa ID	Stations																																																		Total samples	Total stations
			Slope-16MFC	Slope-22MFB	Slope-22MFC	Slope-24MFA	Slope-24MFC	TOR-43MFA	TOR-43MFC	TOR-44MFA	TOR-44MFC	TOR-45MFB	TOR-45MFC	TOR-53MFA	TOR-53MFC	TOR-54MFA	TOR-54MFB	TOR-55MFB	TOR-55MFC	TOR-58MFA	TOR-58MFB	Export-4	Export-11	Export-16	Export-23	Export-36	Export-39	Export-49	Export-53	Export-56	Export-64	Export-70	CAL-28	CAL-29	CAL-30	CAL-31	CAL-38	CAL-41	SBF-41	SBF-42	SBF-43	SBF-44	Slope-16	Slope-22	Slope-24	TOR-43	TOR-44	TOR-45	TOR-53	TOR-54	TOR-55	TOR-58		
Taxa Included In Statistical Analysis																																																						
ANNELIDA																																																						
Polychaeta	Nephytidae	**PNe1**																				8								1																							**9**	**9**
	Paraonidae	**PPa1**					4						4																	1	8				1	1		3			4				4			4					**26**	**26**
		PPa2																																		1																	**1**	**1**
	Syllidae	**PSy1**	4														1										4			1					2			2			8		4							1			**22**	**22**
		PSy2														2		2																				4												2	2		**8**	**8**
		PSy3											4																									1										4					**5**	**5**
		PSy4																																		1		1															**2**	**2**
		PSy5			4																		4																					4									**8**	**8**
		PSy6																											4			8								16	4												**32**	**32**
		PSy7		4																			8										4							4		4		4									**24**	**24**
		PSy8																					4				4													4													**12**	**12**
		PSy9											4			1																										4						4		1			**9**	**9**
		PSy10											4									4																										4					**8**	**8**
		PSy11																														4																					**4**	**4**
		PSy12																														4																					**4**	**4**
		PSy13																										3																									**3**	**3**
	Dorvelleidae	**PDo1**							1				4			1			4										8	2	4											4				1		4		1	4		**28**	**28**
		PDo2													4	2	1	6		2						4														4									4	3	6	2	**23**	**23**
	Polynoidae	**PPo1**																											8	1										4		4											**17**	**17**
	Poecilochaetidae	**PPoe1**									2																	1		2																	2						**5**	**5**
	Magelonidae	**PMa1**																										4		1										4	16												**25**	**25**
	Goniadidae	**PGo1**																								4			4	1									4	4													**17**	**17**
	Pilargidae	**PPi1**															1												4	1		4																		1			**10**	**10**
	Lumbrineridae	**PLu1**														3				2									24						1		4			8										3		2	**42**	**42**
	Maldanidae	**PMal1**					4	1	2							2	1										8				4		12		1			2		4					4	3				3			**41**	**41**
	Trochochaetidae(?)	**PTr1**																																4	1	1						4											**10**	**10**
		PTr2														1																								8										1			**9**	**9**
	Spionidae	**PSp1**					4	1		2			4			1	2	2	4																1	1				4					4	1	2	4		3	6		**26**	**26**
		PSp2					16																					7	20		4	4		8		5	4	2		12					16								**82**	**82**
		PSp3		4		8														2																								4	8							2	**14**	**14**
		PSp4			4						4	2	8			2	4			4	2	4					4						4			3			4	20				4			4	10		6		6	**69**	**69**
		PSp5											4			1					2												12	4			4			4								4		1		2	**31**	**31**
		PSp6		4										4					8																				4	8				4					4		8		**28**	**28**
		PSp9														2	1	2	4																															3	6		**9**	**9**
	Unknown	**PUn1**																																	1																		**1**	**1**
		PUn2								2																															4						2						**6**	**6**
		PUn3										2																																				2					**2**	**2**
		PUn4																				4																															**4**	**4**
	Glyceridae	**PGl1**														1													12		4	4						2			4	4								1			**31**	**31**
	Capitellidae	**PCa1**																																				2															**2**	**2**
	Orbiniidae	**POr1**																																				2															**2**	**2**
		POr2																																					4														**4**	**4**
	Amphinomidae	**PAm1**																																				1															**1**	**1**
	Phyllodocidae	**PPh1**																																				1															**1**	**1**
		PPh2				4	8																																						12								**12**	**12**
	Nereididae	**PNer1**					4														2		8	4	4		4						4									4			4							2	**34**	**34**

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Phylum Class/Order	Family	Taxa ID	Stations																																																Total samples	Total stations
			Slope-16MFC	Slope-22MFB	Slope-22MFC	Slope-24MFA	Slope-24MFC	TOR-43MFA	TOR-43MFC	TOR-44MFA	TOR-44MFC	TOR-45MFB	TOR-45MFC	TOR-53MFA	TOR-53MFC	TOR-54MFA	TOR-54MFB	TOR-55MFB	TOR-55MFC	TOR-58MFA	TOR-58MFB	Export-4	Export-11	Export-16	Export-23	Export-36	Export-39	Export-49	Export-53	Export-56	Export-64	Export-70	CAL-28	CAL-29	CAL-30	CAL-31	CAL-38	CAL-41	SBF-41	SBF-42	SBF-43	SBF-44	Slope-16	Slope-22	Slope-24	TOR-43	TOR-44	TOR-45	TOR-53	TOR-54	TOR-55	TOR-58		
Taxa Included In Statistical Analysis																																																						
		PNer2	4										4																20		12					1					4		4					4					45	45
		PNer3											4			1							4	12			4													4								4		1			29	29
		PNer4					4																4	4																					4								12	12
	Sternaspidae	PSt1						2																												2	4									2							8	8
	Ctenodrilidae	PCt1																									8													28													36	36
	Opheliidae	POp1											4														4																					4					8	8
		POp2			4																																							4									4	4
	Cirratulidae	PCi1																									4																										4	4
	Eunicidae	PEu1					4		1				4				1					8					64					12	4	4					16			4			4	1		4		1			122	122
		PEu2										2																																				2					2	2
	Chrysopetalidae	PCh1														1																																		1			1	1
	Questidae	PQu1														1															4																			1			5	5
	Oweniidae	AOwen1																2						4																											2		6	6
	Trichobranchidae	ATrich1							1																				4																	1							5	5
	Paralacydoniidae	APara1				4				2																					4		8				24								4		2						42	42
	Scalibregmatidae	AScal1																2													4																				2		6	6
	Amphoretidae	AAmph1						1																							4															1							5	5
	Acoetidae	AAco1																																								4											4	4
	Flabelligeridae	AFlab1																							4																												4	4
ARTHROPODA																																																						
Malacostraca/ Isopoda	Metaseudidae	CMe1							2																																					2							2	2
	Metaseudidae	CMe2									2																						4	16			28										2						50	50
	Metaseudidae	CMe3																																	3		4																7	7
	Leptanthuridae	CLe1				4						2				1	2			2		8	8	8							4	36	4	4		1		2		24	4	4			4			2		3		2	118	118
	Antheluridae	AAnth1																				4	4						40																								48	48
	Flabellifera (suborde	CFl1																																		1																	1	1
	Sphaeromatidae	ASpha1						1																								4														1							5	5
Malacostraca/ Amphipoda	Stilipedidae	CSt1																																	1																		1	1
	Ampeliscidae	CAm1														1																			1	1														1			3	3
	Ampeliscidae	CAm2	4																										12														4										16	16
	Phoxocephalidae	CPh1																																		1		2	4														7	7
	Exoedicerotidae	CEx1														1									8	4		71	16				8							12										1			120	120
	Oedicerotidae	COe1																									4																										4	4
	Leucothoidae	CLeu1																								4	4																										8	8
	Amathillopsidae	CAma1																									4																										4	4
	Ampithoidae	CAmpi1																								4																											4	4
	Platyischnopidae	APlat1																					8	8				1	20		12		4	8							4	4											69	69
	Eusiridae	AEusir1																										9																									9	9
	Liljeborgiidae	ALilj1																													8																						8	8
	Stenothoidae	ASteno1																													4																						4	4
	Aoridae	AAori1																													4																						4	4
		CAmp1																									4												4														8	8
		CAmp2																										4	8																								12	12
		CAmp3																											4																								4	4

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Phylum Class/Order	Family	Taxa ID	Slope-16MFC	Slope-22MFB	Slope-22MFC	Slope-24MFA	Slope-24MFC	TOR-43MFA	TOR-43MFC	TOR-44MFA	TOR-44MFC	TOR-45MFB	TOR-45MFC	TOR-53MFA	TOR-53MFC	TOR-54MFA	TOR-54MFB	TOR-55MFB	TOR-55MFC	TOR-58MFA	TOR-58MFB	Export-4	Export-11	Export-16	Export-23	Export-36	Export-39	Export-49	Export-53	Export-56	Export-64	Export-70	CAL-28	CAL-29	CAL-30	CAL-31	CAL-38	CAL-41	SBF-41	SBF-42	SBF-43	SBF-44	Slope-16	Slope-22	Slope-24	TOR-43	TOR-44	TOR-45	TOR-53	TOR-54	TOR-55	TOR-58	Total samples	Total stations
			Stations																																																			
Taxa Included In Statistical Analysis																																																						
Malacostraca/Cumacea		**CCu1**							2							3	2									4	4	13	12			8		4		3	4				4					2				5			**63**	**63**
Malacostraca/	Leptocheliidae	**CTa1**							1							1	1																			1										1				2			**4**	**4**
Tanaidacea	Pagurapseudidae	**APag1**									4																																				4						**4**	**4**
Malacostraca/	Upogebiidae	**CUp1**																		2									4																							2	**6**	**6**
Decapoda	Diogenidae	**CDi1**																								4																											**4**	**4**
	Penaeidae	**CTr1**																								4																											**4**	**4**
	Stomatopoda	**AStoma1**																				4																															**4**	**4**
		CDe1																									8	1																									**9**	**9**
		De2																										7	48		4																						**59**	**59**
		De3																										1			4																						**5**	**5**
		De4																										2	4																								**6**	**6**
		CZo																									4																										**4**	**4**
		Amega1																						4	4																												**8**	**8**
Malacostraca		**CUn1**																																		1																	**1**	**1**
		CUn2																																		3																	**3**	**3**
MOLLUSCA																																																						
Gastropoda	Buccinidae	**MBu1**	4																											1													4										**5**	**5**
	Olividae	**MOl1**																									4																										**4**	**4**
Bivalvia	Tellinidae	**MTe1**																										1		1																							**2**	**2**
	Veneridae	**V1**						1																																						1							**1**	**1**
	Veneridae	**V2**																										2																									**2**	**2**
	Veneridae	**V3**																										1																									**1**	**1**
	Veneridae	**V4**			4																																							4									**4**	**4**
	Veneridae	**V5**																																			4																**4**	**4**
	Cariidae	**MCar1**																										1																									**1**	**1**
		MBi2																												1																							**1**	**1**
		MBi3				4	4		2				4																							2		1		4					8	2		4					**21**	**21**
Aplacophora		**MAp1**					4					4	8			1																	4				32								4			12		1			**53**	**53**
ECHINODERMATA																																																						
Ophiuroidea	Ophiuridae	**EOp1**	4								2					5										8	4		40									2		4		4	4				2			5			**73**	**73**
	Opliiactidae	**EOpli1**																													4																						**4**	**4**
Echinoidea	Clypeasteridae	**ECl1**																																					8	8													**16**	**16**
		EEchi1																											4																								**4**	**4**
Asteroidea	Astropectinidae	**EAs1**																						4			4																										**8**	**8**
NEMERTEA		**N**		12													1						8	4			4	1	16					4				3						12						1			**53**	**53**
SIPUNCULA																																																						
Sipunculidea	Phascolionidae	**SPh1**				4	12	1	1							2	3	2				4					4		12				8	4	6	2	12	2	8	4		8	4		16	2				5	2		**103**	**103**
	Sipunculidae	**SSi1**																				4							4									1															**9**	**9**
Phascolosomatidea	Aspidosiphonidae	**SAs1**														3																		4		2														3			**9**	**9**
CNIDARIA																																																						
Anthozoa		**CnAn1**																				4									4									12													**20**	**20**

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Phylum Class/Order	Family	Taxa ID	Stations																																											Total samples	Total stations
			Slope-16MFC	Slope-22MFB	Slope-22MFC	Slope-24MFA	Slope-24MFC	TOR-43MFA	TOR-43MFC	TOR-44MFA	TOR-44MFC	TOR-45MFB	TOR-45MFC	TOR-53MFA	TOR-53MFC	TOR-54MFA	TOR-54MFB	TOR-55MFB	TOR-55MFC	TOR-58MFA	TOR-58MFB	Export-4	Export-11	Export-16	Export-23	Export-36	Export-39	Export-49	Export-53	Export-56	Export-64	Export-70	CAL-28	CAL-29	CAL-30	CAL-31	CAL-38	CAL-41	SBF-41	SBF-42	SBF-43	SBF-44	Slope-16	Slope-22	Slope-24	TOR-43	TOR-44	TOR-45	TOR-53	TOR-54	TOR-55	TOR-58		
Taxa Included In Statistical Analysis																																																		
PLATYHELMINTHES																																																			
Turbellaria		**PlTu1**																						4															4													**8**	**8**
CHORDATA																																																		
Ascidiacea		**ChAs1**																								4																									**4**	**4**
UNKNOWN (worm)		**W1**																										8				4				7													**19**	**19**
UNKNOWN		**Un1**	4																																							4								**4**	**4**
UNKNOWN		**Un2**																							8	4																									**12**	**12**
UNKNOWN		**Un3**														1																																				**1**	**1**
UNKNOWN		**Un4**															1																																			**1**	**1**
		Individu	24	24	16	28	68	8	13	6	14	12	64	4	4	41	22	18	20	14	6	56	60	56	20	48	168	130	360	14	100	88	80	68	19	34	124	43	56	212	56	56	28	40	96	21	20	76	8	63	38	20	**2258**	**2258**
		Taxa	6	4	4	6	11	7	9	3	5	5	14	1	1	25	14	7	4	6	3	11	10	10	4	10	24	18	26	12	19	10	13	12	11	20	11	20	9	25	10	13	7	8	14	14	8	17	2	30	9	8	**133**	**133**
Taxa Excluded From Statistical Analysis																																																			
Phylum Class/Order	**Family**	**Taxa ID**	**Stations**																																														**Total samples**	**Total stations**
			Slope-16MFC	Slope-22MFB	Slope-22MFC	Slope-24MFA	Slope-24MFC	TOR-43MFA	TOR-43MFC	TOR-44MFA	TOR-44MFC	TOR-45MFB	TOR-45MFC	TOR-53MFA	TOR-53MFC	TOR-54MFA	TOR-54MFB	TOR-55MFB	TOR-55MFC	TOR-58MFA	TOR-58MFB	Export-4	Export-11	Export-16	Export-23	Export-36	Export-39	Export-49	Export-53	Export-56	Export-64	Export-70	CAL-28	CAL-29	CAL-30	CAL-31	CAL-38	CAL-41	SBF-41	SBF-42	SBF-43	SBF-44	Slope-16	Slope-22	Slope-24	TOR-43	TOR-44	TOR-45	TOR-53	TOR-54	TOR-55	TOR-58		
Nematoda		**Ne**	2	2	4		16	4	4				4	4	4	4	4	4	8		4	0	0	7	2	4	0	1	0	4	0	0	6	0	12	12	0	0	12	0	8	1	6	6	16	8	0	4	8	8	12	4	**141**	**141**
		% Sample Sorted	25	25	25	25	25	100	100	50	50	50	25	25	25	100	100	50	25	50	50																																		
Data has been multiplied to take account of the % of the sample that was sorted																																																			