Appendix 9

Nearshore marine water quality and sediment study

REPORT

Ichthys Gas Field Development Project

Nearshore Marine Water Quality and Sediment Study

Prepared for

INPEX Browse, Ltd.

Level 22
100 St Georges Terrace
PERTH WA 6000
Australia

11 August 2009

INPEX Document No. C036-AH-REP-0026

Project Manager:	Paul Everson Project Marine Environmental Scientist	URS Australia Pty Ltd Level 3, 20 Terrace Road East Perth WA 6004 Australia T: 61 8 9326 0100 F: 61 8 9326 0296	
Project Director:	Ian Baxter Principal Marine Environmental Scientist		
Authors:	Paul Everson Project Marine Environmental Scientist	Date:	11 August 2009
		Reference:	42907057-1982 : R1382 (DK:M&C3034)
		Status:	Final: Rev 1
	Luke Skinner Marine Environmental Scientist		

This report may be cited as follows:

URS Australia Pty Ltd. 2009. *Ichthys Gas Field Development Project: nearshore marine water quality and sediment study*. Report prepared for INPEX Browse, Ltd., Perth, Western Australia.

Table of Contents

Table of Contents

Tables, Figures, Appendices

Tables (in text)

Tables (attached)

Tables, Figures, Appendices

Figures (in text)

Figures (attached)

Appendices

List of Abbreviations

ANOVA	analysis of variance
ASS	acid sulphate soils
BGL	below ground level
BTEX	benzene, toluene, ethylbenzene and xylene compounds
Bq	Becquerels
cm	Centimetre
DO	Dissolved oxygen
NRETAS	Department of Natural Resources, Environment, The Arts and Sport
EIS	environmental impact statement
GPS	global positioning system
kg	Kilogram
L	Litre
LAT	lowest astronomical tide
LNG	liquefied natural gas
LPG	liquefied petroleum gas
M	Molar
m	Metre
mg	Milligram
mm	Millimetre
MMbbl	million barrels
MOF	Module offloading facility
NATA	National Association of Testing Authorities
NODGDM	National Ocean Disposal Guidelines for Dredged Material
NTU	nephelometric turbidity units
OCP	organochlorine pesticides
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl

Tables, Figures, Appendices

pH	a measure of the acidity or alkalinity of a solution
ppt	parts per thousand
PQL	practical quantitation limit
PSD	particle side distribution
QA/QC	quality assurance/quality control
RSD	relative standard deviation
RPD	relative percentage difference
sPOCAS	suspension peroxide oxidation combined acidity and sulfate
TBT	Tributyltin
TCF	trillion cubic feet
TKN	total Kjeldahl nitrogen
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSS	total suspended solids
UCL	total suspended solids
%	Percentage
^{o}C	degrees Celsius
µg	Microgram

Executive Summary

INPEX Browse, Ltd. (INPEX) proposes to develop the natural gas and associated condensate contained in the Ichthys Field in the Browse Basin. For the Ichthys Gas Field Development Project, INPEX intends to install offshore facilities for the extraction of natural gas and condensate at the Ichthys Field and a gas export pipeline from the field to onshore facilities at Blaydin Point near Darwin in the Northern Territory. An onshore gas-processing plant and product loading jetty will be constructed at a site zoned for industrial development on Blaydin Point.

Construction of the project will require the installation of a pipeline through Darwin Harbour to a shore crossing on Wickham Point (Middle Arm) and the dredging of a shipping channel, berthing pocket, turning basin and Module Offloading Facility (MOF) in East Arm.

The purpose of this study was to develop a baseline understanding of both water quality and sediment characteristics over that part of Darwin Harbour that may be affected by construction activities.

Seven water quality sampling sites were located in Middle Arm and East Arm. Water quality monitoring, involving in situ analysis of turbidity, salinity, temperature, pH and dissolved oxygen, and laboratory analysis to determine total suspended solids was undertaken during both dry and wet seasons and during spring and neap tides. Overall, water quality within Darwin Harbour is known to be affected to varying degrees by season, location within the harbour and tidal conditions (Padovan 2003) and results from this survey have shown similar influences.

To determine sediment quality, both surface and subsurface sediments were collected by Van Veen grab, piston core and geotechnical coring, in Middle and East Arm. Sediments were analysed for a range of parameters including metals, hydrocarbons, tributlytin, pesticides, radionuclides, acid sulphate potential and particle size distribution.

Sediment sample results were assessed against the relevant guidelines provided in the National Ocean Disposal Guidelines for Dredged Material (Environment Australia 2002). 95% upper confidence limit (95% UCL) calculations for sediment quality results were all below NODGDM guidelines, with the exception of arsenic, concentrations of which are known to be naturally elevated in Darwin Harbour. Further analysis of arsenic has shown that only a small fraction is bioavailable and the presence of arsenic is unlikely to cause adverse effects on marine organisms.

The potential for sediments to generate acid were assessed against the Guidelines for Sampling and Analysis of Lowland Acid Sulphate Soils (ASS) in Queensland (1998). Sites in East Arm, the pipeline route and the shore crossing were identified as potential risk areas based on the site specific ASS risk criteria. These samples have the potential to generate acidity if they are brought to the surface and exposed to oxygen, as would occur for onshore disposal of sediments. The generation of acidity may mobilise metals present in these sediments. However, if sediments remain underwater or are kept saturated during transport and following disposal, as is the case for offshore disposal, the acid production and associated mobilisation of metals is not significant.

Introduction Section 1

INPEX Browse, Ltd. (INPEX) proposes to develop the natural gas and associated condensate contained in the Ichthys Field in the Browse Basin at the western edge of the Timor Sea about 200 km off Western Australia's Kimberley coast. The field is about 850 km west-south-west of Darwin in the Northern Territory.

The two reservoirs which make up the field are estimated to contain 12.8 tcf (trillion cubic feet) of sales gas and 527 MMbbl (million barrels) of condensate. INPEX will process the gas and condensate to produce liquefied natural gas (LNG), liquefied petroleum gas (LPG) and condensate for export to overseas markets.

For the Ichthys Gas Field Development Project (the Project), the company plans to install offshore facilities for the extraction of the natural gas and condensate at the Ichthys Field and a subsea gas pipeline from the field to onshore facilities at Blaydin Point in Darwin Harbour in the Northern Territory. A two-train LNG plant, an LPG fractionation plant, a condensate stabilisation plant and a product loading jetty will be constructed at a site zoned for development on Blaydin Point. Around 85% of the condensate will be extracted and exported directly from the offshore facilities while the remaining 15% will be processed at and exported from Blaydin Point.

In May 2008 INPEX referred its proposal to develop the Ichthys Field to the Commonwealth's Department of the Environment, Water, Heritage and the Arts and the Northern Territory's Department of Natural Resources, Environment and the Arts. The Commonwealth and Northern Territory ministers responsible for environmental matters both determined that the Project should be formally assessed at the Environmental Impact Statement (EIS) level to ensure that potential impacts associated with the Project are identified and appropriately addressed.

Assessment will be undertaken in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) and the *Environmental Assessment Act* (NT) (EA Act). It was agreed that INPEX should submit a single EIS document to the two responsible government departments for assessment.

URS Australia Pty Ltd was commissioned to carry out environmental work associated with INPEX's preparation of the EIS and this technical report, INPEX Confidential Environmental Study: Marine Water Quality and Sediment Study, was prepared in part fulfilment of that commission.

1.1 Background

As part of the project an onshore gas processing plant and product loading jetty will be constructed at Blaydin Point. Construction of the project will require the installation of a pipeline through Darwin Harbour to a pipeline shore crossing on Wickham Point in Middle Arm and the dredging of a shipping channel, berthing pocket, turning basin and Module Offloading Facility (MOF) in East Arm.

The purpose of this study was to develop an understanding of both water quality and sediment characteristics that may be affected by construction activities, including excavation/dredging in East Arm and Middle Arm of Darwin Harbour.

Water quality surveys were undertaken in various seasonal and tidal conditions to develop a baseline which reflects temporal and spatial changes within the harbour. Water quality studies provide background to current conditions, input to the dredge plume modelling and a baseline for future operational effects monitoring.

Sediment quality surveys were undertaken in accordance with the National Ocean Disposal Guidelines for Dredged Material (Environment Australia 2002) hereafter known as “the Guidelines”, and the INPEX Geotechnical and Chemical Analysis Programme. The aim of the study was to characterise both surface and subsurface sediments within the harbour to assess the suitability for dredging and to determine disposal options, as well as providing a baseline for future operational effect monitoring.

The study areas were located within Darwin Harbour and are shown in Figure 1 (attached). These areas include

- Water quality – East Arm in the vicinity of Blaydin Point where the majority of the dredging will take place, in Middle Arm near the pipeline shore crossing and in the main water body of Darwin Harbour.
- Marine sediments – around Blaydin Point, Wickham Point, and the main body of Darwin Harbour where excavation of the seabed is proposed, along with nearby surrounding areas.

The data generated during all surveys are presented in this report and are used to describe water and sediment quality of the harbour environment to provide input to the Environmental Impact Statement (EIS); provide preliminary data as an input to the hydrodynamic modelling of Darwin Harbour; and an input to the setting of water quality criteria for future potential dredging operations.

1.2 Objectives

The objectives of the water quality program were to:

- Develop a baseline understanding of water quality characteristics that may be affected by dredging and seasonal variation (measuring turbidity, suspended solids, dissolved oxygen, temperature, pH and salinity) in East Arm and Middle Arm of Darwin Harbour.

The objectives of the sediment sampling program were to:

- Provide sufficient data to characterise physical and chemical properties of the sediment to be dredged.
- Provide sufficient data to assess the suitability of the sediment for unconfined ocean disposal, in accordance with the Guidelines.
- Establish whether dredged sediment type and sediment chemistry are compatible with surface sediments at the proposed spoil disposal area.
- Provide data on physical sediment properties for use in representing sediment behaviour in plume prediction modelling.
- Obtain data to provide the basis for an assessment of water column effects associated with sediment resuspension from dredging and disposal, and exposure of ‘fresh’ sediment surfaces in excavation cuts.

A desktop literature review of relevant studies was undertaken in relation to both water and sediment quality monitoring to ensure that all sampling and analysis was undertaken in accordance with standard protocols and to ensure that the data collected could be compared to existing applicable guidelines (Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Guideline 4) (ANZECC 2000a), Australian Guidelines for Water Quality Monitoring and Reporting (Guideline 7) (ANZECC 2000b) and the Guidelines for sediment quality (NODGDM, 2002). A sampling and analysis plan (Geotechnical Survey and Chemical Analysis Program, Document No DEV-HSE-RP-009) for sediment assessment was informally reviewed and agreed upon by the Department of Natural Resources, Environment, The Arts and Sport (NRETAS) (Daniel Hazell Pers. Coms.).

2.1 Marine Water Quality Assessment

Seven water quality sampling sites were identified within an area extending from Channel Island (Middle Arm), around Wickham Point and along Blaydin Point (East Arm) as providing representative coverage of the study area (Figure 2 attached). These sample locations were placed both up and downstream of the proposed development, with further sites located near areas identified as biologically productive, and hence ecologically sensitive, which potentially could be at risk from water quality changes.

2.1.1 Sampling methodology

In both of the wet (early April 2008), and the dry (August 2008) seasons, surveys were conducted on every other day over a two week sampling period. Between these two intensive seasonal surveys, surveys were conducted on a fortnightly basis. Sampling was conducted on one day per fortnight (on spring tides), designed to capture water quality data under uniform conditions and further develop the baseline of water quality in the area.

Both physical water column profiling and water sampling were conducted from the vessel MV *Northern Exile* or MV *Dolphin Diver* over a 10 hour period to capture both high and low tidal periods at each site. Water quality meter readings were taken from just below the surface down to 1 m above the seafloor, being careful not to disturb the bottom sediments. Instrumentation used consisted of both MANTA and YSI Multiprobe water quality measuring units (specifications for both can be found in Appendices A and B respectively). Measurements were taken every two seconds as the instrument was lowered through the water column, resulting in data being obtained approximately every 0.25 m. The water quality parameters recorded were temperature, conductivity, salinity, pH, dissolved oxygen (DO) and turbidity (NTU).

Using a Niskin bottle water sampling device, samples were also taken in the water column 1 m below the surface and 1 m above the seafloor. The samples (up to 2 L depending on suspended matter present) were filtered in the field using pre-weighed 0.45 micron glass fibre filter papers. The filtrate and filter paper were chilled in the field and then frozen within 12 hours. They were then air freighted to the Marine and Freshwater Research Laboratory, Murdoch University, Perth, a National Association of Testing Authorities (NATA) qualified laboratory, where they were analysed for Total Suspended Solids (TSS). TSS is a measurement of both inorganic material such as silts, clay and sand, together with organic material such as algae and other biological matter present in suspension in water bodies.

2.1.2 Limitations

The MANTA water quality instrumentation was replaced halfway through the programme with an YSI water quality probe due to repeated erroneous results being recorded for NTU. Calibrations were carried out by field personnel together with commercial environmental equipment personnel (Ecoenvironmental, Perth) between surveys, but repeated failure of the instrument in the field led to its replacement. Gaps in NTU data occurred on the following dates:

- 22 April 2008,
- 7 May 2008,
- 21 May 2008 (partial loss of data),
- 20 June 2008, and
- 1 July 2008.

These data losses represent less than 5% of the total data acquired and do not compromise the integrity of the programme.

2.2 Marine Sediment Quality

During this sediment study, surface (<0.5 m Below Ground Level [BGL]) and subsurface (>0.5 BGL) sediments were sampled within the potential area of disturbance. Surface sediments were sampled from a total of 151 sites, during three sampling events. Subsurface sediments were sampled from a total of 18 sites, 16 sites during geotechnical drilling and two sites during piston coring (Figures 3, 4 and 5 attached).

The first survey, in March 2008, was an opportunistic programme that took advantage of a hydrographical survey being conducted at that time. Sampling was undertaken from the vessel MV *Northern Exile* using a Van Veen grab with a gape of 0.15 m^2. Surface samples were obtained from 28 sites in all, comprising nine sites located along the proposed pipeline route, and 19 sites in East Arm.

The second survey, in June 2008, was a dedicated pilot sediment survey also undertaken from the vessel MV *Northern Exile* using a Van Veen grab with a gape of 0.15 m^2. Surface samples were taken from 38 sites concentrating on three nearshore areas comprising three sites at the proposed jetty location to the east of Wickham Point, nine sites at the pipeline shore crossing location on the west side of Wickham Point and 26 sites around the perimeter of Blaydin Point, in the vicinity of the proposed module offloading facility.

After the completion of the first two surface sediment surveys the Geotechnical Survey and Chemical Analysis Program document (Document No. DEV-HSE-RP-0009) was created which reviewed information obtained from the first two surveys and outlined the proposed scope for further studies required to meet the objectives of the sediment sampling program.

The third survey, in November 2009 was a dedicated sediment survey, which used a combination of piston corer (to gather surface and subsurface samples) and Van Veen grab (with a gape of 0.25 m^2), onboard the vessel MV *First Class.* Surface sediment sampling was undertaken at 20 sites located along the proposed pipeline route and 59 sites in the shipping channel, turning basin and module offloading facility areas in East Arm. The piston corer was also successfully used to at retrieve subsurface sediments (>0.5 mBGL) at two sites (East Arm, Site 41EA and Pipeline Route, Site 123P)

In addition to the two subsurface sites sampled with the piston corer, subsurface sediments were sampled at 16 sites thorough East Arm, the proposed pipeline route and the shore crossing (Figures 3, 4 and 5 attached) during September and October 2008 in conjunction with a geotechnical investigation conducted using a conventional jack-up drill rig.

2.2.1 Sample collection

For the first and second surface sediment sampling event a Van Veen grab with a gape of 0.15 m^2 was operated using a hand winch and davit. For the third surface sediment sampling event a larger grab with a gape of 0.25 m^2 was operated via a hydraulic winch and crane. Once the grabs were retrieved onboard the vessel the jaws were opened in a pre-cleaned area and sediments were transferred to a stainless steel mixing bowl for photographing and homogenisation. Sediments were then transferred into appropriate laboratory supplied sampling containers.

For the third surface sediment sampling event a piston corer was used in addition to grab sampling, as unconsolidated sediments were expected to be present at depths greater than 0.5 m. Piston coring was chosen in preference to grab sampling as it can sample unconsolidated surface sediments to a depth of approximately 1.5 m below the seafloor. The piston corer consisted of a 50 kg clump weight suspended below a 300 kg piston core with a 2.5 m long barrel. Once the clump weight reached the seafloor, a trigger mechanism was released allowing the piston to free-fall approximately six metres before reaching the sediment surface. The barrel was capped with a cutter and catching tool to retain the sample, and was lined with 110 mm diameter disposable polycarbonate tubing. Once the polycarbonate liner had been removed the core length was measured and the sample transferred into a stainless steel mixing bowl for photographing and homogenisation. If the core sample was longer than 80 cm it was sub-sampled from 0-0.5 m and 0.5 m to the bottom of the core. Table 1 (attached) provides information on the sampling location, sampling method and sediment descriptions for surface sediments.

Subsurface sediment samples were also collected from a jack-up rig during the geotechnical programme by conventional borehole drilling using 90mm diameter stainless steel split-sleeve tubes. Cores were retrieved to the rig deck for opening and routine logging procedures in accordance with AS 172-1993. Cores were opened and then photographed. The depth and visual descriptions of sediment overlying consolidated substrata were recorded. Table 2 (attached) provides information on the sample location, depth and characteristics. Recovered cores were subsampled at 1.5 m intervals (i.e. 0.5–1.5 m, 1.5–3.0 m and 3.0–9.0 m), with subsamples being made up from a composite of equal parts of the 1.5 m interval.

Prior to commencement of all sampling operations, an area of the support vessel was designated for sample handling. Potential contaminant sources in the vicinity of this area (e.g. galvanised or oily surfaces) were covered with appropriate material to reduce the potential for sample contamination.

During all sediment sampling programs field personnel wore disposable latex gloves during sampling to minimise the potential for sample contamination by residues (e.g. hydrocarbons, sunscreen, etc.). Sterile Teflon plastic spatulas were used where direct contact with the sample was necessary. Smoking was not permitted in the vicinity of, or upwind from, the designated sample processing area.

Where possible during sediment sampling, the vessel was anchored and engines turned off. When anchoring was not possible, due to tidal currents and the location of sampling sites being close to shorelines, vessel exhaust systems were kept downwind of sampling areas by driving the vessel into the prevailing winds.

Sampling equipment was decontaminated between sites by thorough cleaning in seawater. If clayey sediments were encountered, then dilute hydrochloric acid solution was used to clean the sampling equipment, which was then rinsed with seawater prior to use at the next site.

2.2.2 Limitations

During the third surface sediment sampling survey conducted in November 2008, piston core sampling was attempted at 60 of the 79 sites, as the remaining sites were too shallow to utilise the piston coring equipment. Out of these 60 sites, samples were retrieved from 20 sites, using the piston corer, including two sites yielding samples deeper than 0.5m. The remaining sites were sampled utilising the Van Veen grab to collect surface sediments. The lack of success with the piston corer was attributed to a combination of factors including strong tides that may have cause the barrel of the piston to strike the sea bed on an angle (causing the piston to topple over instead of penetrating the sediment) and substrate type (coarse sands, shell grit, gravels and rock). At sites where piston coring was unsuccessful, the Van Veen grab was used to collect surface sediments. In the event that both methods were unsuccessful, a new site was chosen from the previously identified sites from the INPEX Geotechnical Survey and Chemical Analysis Program plan.

Environmental sediment samples were gathered from 16 of the 18 geotechnical bore hole sampling locations.

2.2.3 Sample storage and transport

All sediments collected during the sampling programs were stored on ice, before being frozen on the day of collection. Sediments collected during the March and June sampling events were then transported frozen to Perth by air, while sediments collected in the November sampling event transported to Perth by road in refrigerated transport. Once in Perth samples were forwarded to NATA accredited laboratory ALS Perth for analysis. Subsurface samples were transported frozen by air to the Sydney office of ALS. The unique sample code for each sediment sample was recorded on a field data sheet and entered onto a URS chain of custody (CoC). Field data sheets were retained by URS for sample cross-referencing, while the CoC accompanied the samples to the receiving laboratory.

2.2.4 Sampling locations

Due to the large number of sediment sampling sites, Darwin Harbour has been split up into three areas for the purposes of this report. East Arm, which had 109 surface sampling sites is shown in Figure 3 (attached). East Arm includes the proposed berthing pocket, turning basin and departure channel as well as the module offloading facility area. Pipeline locations, shown in Figure 4 (attached), had 30 surface sampling sites and finally Figure 5 (attached) shows the sampling locations for the 11 pipeline shore crossing sampling sites. Sampling site location, sampling method and sediment descriptions for East Arm, pipeline and pipeline shore crossing locations can be found in the Tables section attached to this report (Tables 1, 2 and 3 respectively).

The first and second surface sediment sampling events were pilot studies used to determine if sediments were likely to be above the Guideline values for any parameter(s). As outlined in the Guidelines, the number of sampling locations for the third surface sampling event was determined by the volume of sediment to be dredged, to ensure sufficient sampling in each area to adequately characterise the sediments.

Subsurface sediments were also sampled in East Arm (13 sites), the pipeline route (four sites) and the pipeline shore crossing area (one site) (attached Figures 3, 4 and 5 respectively). Data for each subsurface sample including site location, sample depth and sample description is presented in Table 4 (attached).

Surface sediment sampling sites have been labelled with a postfix of EA in East Arm, P in the pipeline and SC in the pipeline shore crossing, while subsurface sampling sites were given a postfix of EASS in East Arm, PSS in the pipeline and SCSS in the pipeline shore crossing.

2.2.5 Sample analysis

In the initial (March 2008) and subsequent (June 2008) survey programmes, samples were analysed for a range of parameters that are known, or might on the basis of known inputs, potentially occur at measurable levels in Darwin Harbour. The parameters included, a suite of metals occurring both naturally and as a result of potential contamination (iron, manganese, cobalt, manganese, aluminium, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc), tributyltin (TBT), nutrients (nitrogen and phosphorus), total organic carbon (TOC), total petroleum hydrocarbons (TPH), polynuclear aromatic hydrocarbons (PAHs) and benzene, toluene, ethylbenzene and xylene compounds (BTEX).

During the geotechnical survey, undertaken between September and October 2008, samples were only analysed for acid sulphate potential (ASS) and metals, as the undisturbed sediment samples were collected from depths at which the risk of anthropogenic contamination (e.g. by hydrocarbons) was not considered significant.

In the final survey (November 2008) a broader range of analyses, which included a range of organochlorine pesticides (OCP), polychlorinated biphenyls (PCBs) and radionuclides (sum of gross alpha and gross beta) were undertaken to confirm the earlier assumptions made regarding potential contamination of the sediments. Metals, TBT, TPH and TOC were also analysed.

All surface sediments were also assessed for ASS and for the physical characteristic particle size distribution (PSD). Subsurface sediments were not assessed for PSD in this study as it was done by the geotechnical contractor. Table 2-1 below gives a summary of the sediment chemical analysis undertaken.

Table 2-1 Summary of sediment chemical analysis conducted

Sampling Event	Sampling Method	Target sediment	Metals	TPH	PAH	BTEX	Pesti-cides	ASS	TBT	Radio-nuclides
March 2008	Grab	Unconsoli-dated	✓	✓	✓	✓		✓		
June 2008	Grab	Unconsoli-dated	✓	✓	✓	✓		✓		
September to October 2008	Geotechnic-al drilling	Subsurface	✓					✓		
November 2008	Piston core/grab	Unconsoli-dated	✓	✓	✓		✓	✓	✓	✓

2.2.6 Acid sulfate soil assessment

Samples were analysed for ASS using both the sPOCAS (suspension Peroxide Oxidation Combined Acidity and Sulfate) suite and Chromium suite methodologies. Both methods give an indication of the potential for sediments to oxidise to produce sulphuric acid and the potential for the sediments and or marine water to prevent the formation of acid through neutralisation and/or of carbonaceous sediment and/or alkaline water. The methods are discussed in further detail in Appendix C.

The sPOCAS method of assessing the sulphide content or the acid producing potential of ASS can lead to an over estimate of the sulphide content in some sediments, particularly organic rich sediments and clays. The over estimate occurs due to interference with forms of sulphur other than inorganic sulphide (e.g. organic sulphur) and loss sulphur do to degassing or retention of sulphur in other minerals.

At the INPEX site, sediments are dominated by sand and silt, with some organic matter and clay. In the more organic rich and clay dominated sediments, the acid producing potential measured using the sPOCAS method may be over-estimated due to the interference of organic acids. However, although the results of the sPOCAS analyses for these samples may be over estimated and hence overly conservative, the results are still thought to give an indication of the potential for sediments to be acid generating, and therefore can still be used to highlight areas of risk.

The main ASS consideration arising from the proposed dredging and disposal works are:

- The potential for acidic conditions to develop if the material is exposed to oxygen as a result of onshore disposal following dredging.
- The potential for self neutralisation of any acid produced, via the presence of any carbonate content (shells, calcrete, calcareous silt) within the dredged sediment.

Sediment samples were initially screened using a texture based criteria assuming that in any one sample location greater than 1000 tonnes of material would be removed. The criteria are summarised in Table 2-2 below.

Table 2-2 Texture based action criteria (summarised from Guidelines for Sampling and Analysis of Lowland Acid Sulphate Soils in Queensland (Ahern, 1998))

Type of Material		Action Criteria if more than 1000 tonnes of material is disturbed	
		Existing + Potential Acidity	
Texture Range (McDonald et al. 1990)	Approximate clay content (%)	Equivalent Sulfur (%S) (oven-dry basis)	Equivalent acidity (mol H+/tonne) (oven-dry basis)
Coarse Texture Sands to loamy sand	≤5	0.03	18
Medium texture Sandy loams to light clays	5-40	0.03	18
Fine texture (medium to heavy clays and silty clays)	≥40	0.03	18

If samples had the sum of existing and potential acidity less than the criteria, the samples were assigned a low ASS risk. If samples had the sum of existing and potential acidity greater than the criteria, they were screened against site specific ASS risk criteria to determine if further investigation and/or management were required.

A site specific ASS risk matrix was developed to highlight areas where sediments have the potential to produce acid if the materials are exposed to oxygen as a result of disposal onshore. The amount of acid neutralisation capacity (ANC) present in each sample was assessed against the sum of existing and potential acidity in the sample to determine if the sample was classified as low risk or potential risk based on the site specific ASS criteria. Given the large volume of material to be disturbed, the potential for samples to generate acidity was based on the most conservative assumption that less than 10,000 tonnes of sediment would be removed from the vicinity of each of the sample sites (Ahern 1998). The site specific risk matrix is outlined in Table 2.3.

Table 2-3 Site specific ASS risk matrix for surface and sub-surface sediments sampled from March 2008 to November 2008

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

Samples that are classified as potential ASS risk based on the site specific criteria require further investigation and/or management if disturbed and disposed of on land (NR&M 2002).

2.2.7 Quality assurance / quality control (QA/QC)

Procedures to maintain high QA/QC standards were implemented throughout the sampling programmes, including sampling procedures, handling, storage and transporting of samples, decontamination procedures and record keeping. Following recommended quality assurance/quality control practices from the Guidelines the following QA/QC samples were taken:

- field blind duplicates and triplicates
- field rinse blanks
- trip blanks and
- laboratory split samples

All laboratories used to analyse samples implemented standard NATA QA/QC programmes whilst undertaking analysis. Results were compared against sediment quality criteria from the Guidelines.

2.2.8 Statistical analysis

For each analyte, the mean and 95% Upper Confidence Limit (95%UCL) concentrations were calculated using ProUCL (Version 4.0) which is computer software developed by the United States Environmental Protection Agency (USEPA) for calculating UCLs based on environmental data sets. ProUCL calculates the most reliable 95% UCL value based on the specific distribution of data points within each data set, thereby accounting for normally distributed, gamma distributed and non-normally distributed data that are commonly encountered in environmental data. For data sets that appeared normally distributed the Student's t-Test was used to calculate the 95% UCLs. At sites where field triplicate and duplicate samples had been collected and where laboratory duplicates or re-analysis had been undertaken, the data point for that set was represented by the mean concentration of the samples. This was undertaken to maintain even representation from each location when calculating the mean concentration and 95% UCL values. For samples with concentrations less than the laboratory Practical Quantitation Limits (PQLs) (the lowest concentration at which analytes can be accurately be measured), the concentration has been taken as the PQL for statistical analysis.

2.2.9 Data validation

The primary objective of the data validation process is to ensure that the reported data can be used to achieve the project objectives. Analytical data were thoroughly checked by the laboratory prior to release. URS subsequently checked the analytical data against the data quality objectives of the project – comparing requested detection limits against PQLs, calculating Relative Percentage Differences (RPDs) and Relative Standard Deviations (RSDs) for field duplicates and triplicates, respectively, and comparing RPDs and RSDs with guideline recommendations.

Comparison of duplicates/triplicates through RPDs and RSDs may identify analytical results that appear to be unrealistically high (or low) and might prompt a request to the laboratory to reanalyse the samples as a further check of precision, or result in categorisation of those results as ‘estimates only’. High RPD/RSD values can also be an indication of high heterogeneity of sediment contaminant levels at the sample locations, or can result from widely varying characteristics of the sediments, such as particle size distribution and/or organic content.

3.1 Water Quality

The complete data set gathered from the water quality surveys can be found on the DVD copy of this report. A summary of the data obtained is presented in the following discussion. The mean was calculated from the data collected from the top one metre and bottom one metre of the water column.

Maximal ranges in data distribution for the entire data set collected from the sampling programme together with mean values for each parameter are presented in the following tables.

Table 3-1 Minimum, maximum and mean values of water quality parameters recorded in the wet season

	Temp° C	Salinity (ppt)	pH	DO%	NTU	TSS (mg/L)
Mean	30.6	29	8.1	87.8	10.5	14.1
Minimum	29.3	19.1	7.8	74.4	0.5	1.6
Maximum	32.7	30.6	8.4	103.0	73.6	54

Table 3-2 Minimum, maximum and mean values of water quality parameters recorded in the dry season

	Temp° C	Salinity (ppt)	pH	DO%	NTU	TSS (mg/L)
Mean	24.5	35.5	8.4	93.3	3.0	14.0
Minimum	23.5	35.0	8.3	87.8	0.0	2.0
Maximum	25.3	36.3	8.5	101.0	20.0	40.0

A comparison of water quality in East Arm was enabled by using data gathered at sites three, five and seven, located at NW Wickham Point, middle of East Arm south of East Arm Port and east of Blaydin Point, respectively. These three positions, representing the mouth of East Arm (site three), middle of the arm (site five) and the upper reaches of the arm (site seven) are shown in Figure 3-1 below.

The mean of each of the parameters obtained from each of these sites was calculated over the top one metre and bottom one metre of the water column for the full survey period and from both the wet and dry season intensive sampling surveys to give overall indications of the conditions present.

Section 3 Results and Discussion

Figure 3-1 Water Quality Sampling Locations 3, 5 and 7

3.1.1 Temperature

Water temperature at the seven sites surveyed ranged from 23.5 to 32.7ºC, with an average temperature of 27ºC. Comparison between the three sites over both the wet and dry seasons found that the water temperature was elevated by about 5ºC in the wet season. These distinct seasonal variations in sea surface temperature have been shown in previous studies of Darwin Harbour (e.g. Michie et al. 1991). A small temperature range (<1^{o}C) was observed across sites as a result of either water column position (surface or bottom) or tidal flow (ebb or flood). Similar spatial uniformity within Darwin Harbour has also been found to occur at sites located both in the upper reaches of Middle arm and close to Darwin CBD (Michie et al. 1991).

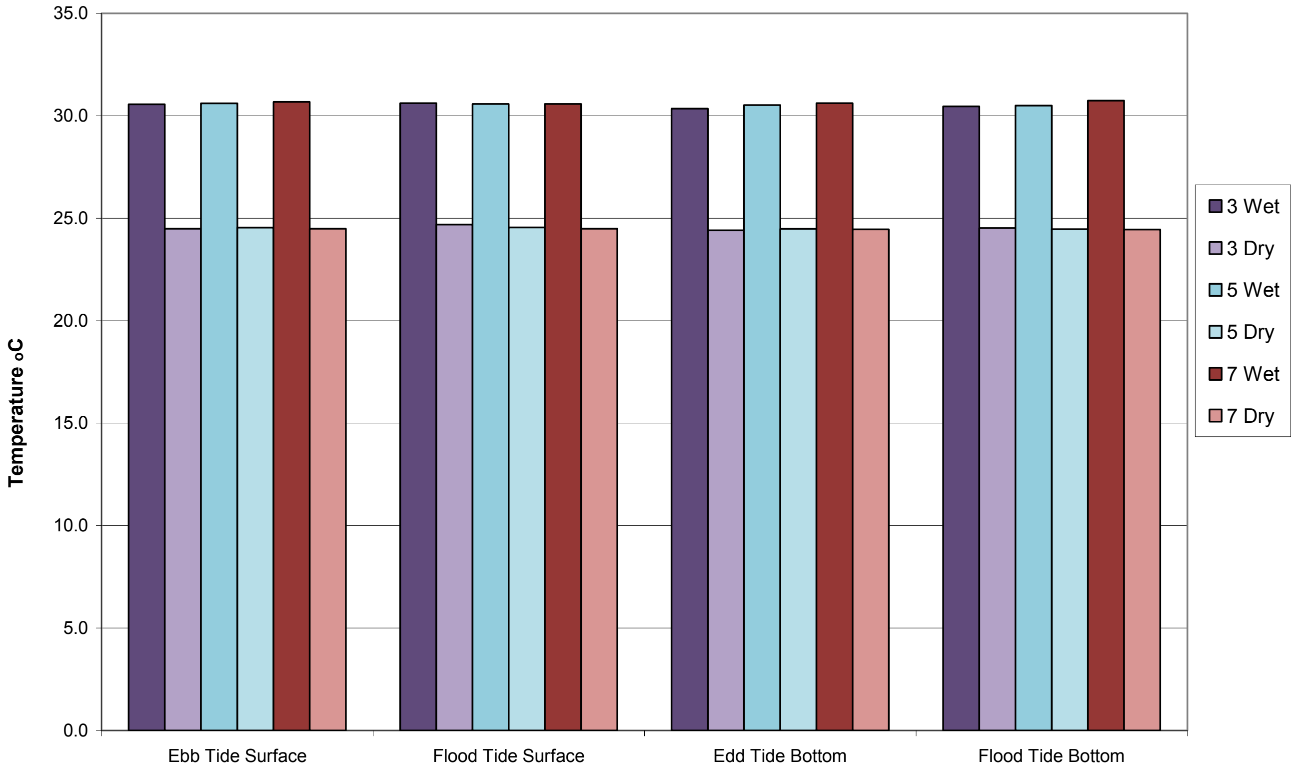


Chart 3-1 Water temperature comparison among sites 3, 5 and 7

3.1.2 Salinity

Salinity recorded during the survey period ranged from 19.1 to 36.3 ppt. Average salinity within the harbour was 32.7 ppt. Salinity in the dry season was higher than that in the wet season, with slightly higher salinity upstream (site seven), compared to downstream (site three). This gradient of salinity was reversed in the wet season with higher salinity being found in the harbour and a decrease in salinity upstream, as could be expected with rainfall input. These variations in salinity according to location within the harbour and season have also been previously reported (Michie et al, 1991, Padovan 1997). No significant difference in salinity levels was observed between sites as a response to water column position or tidal state.

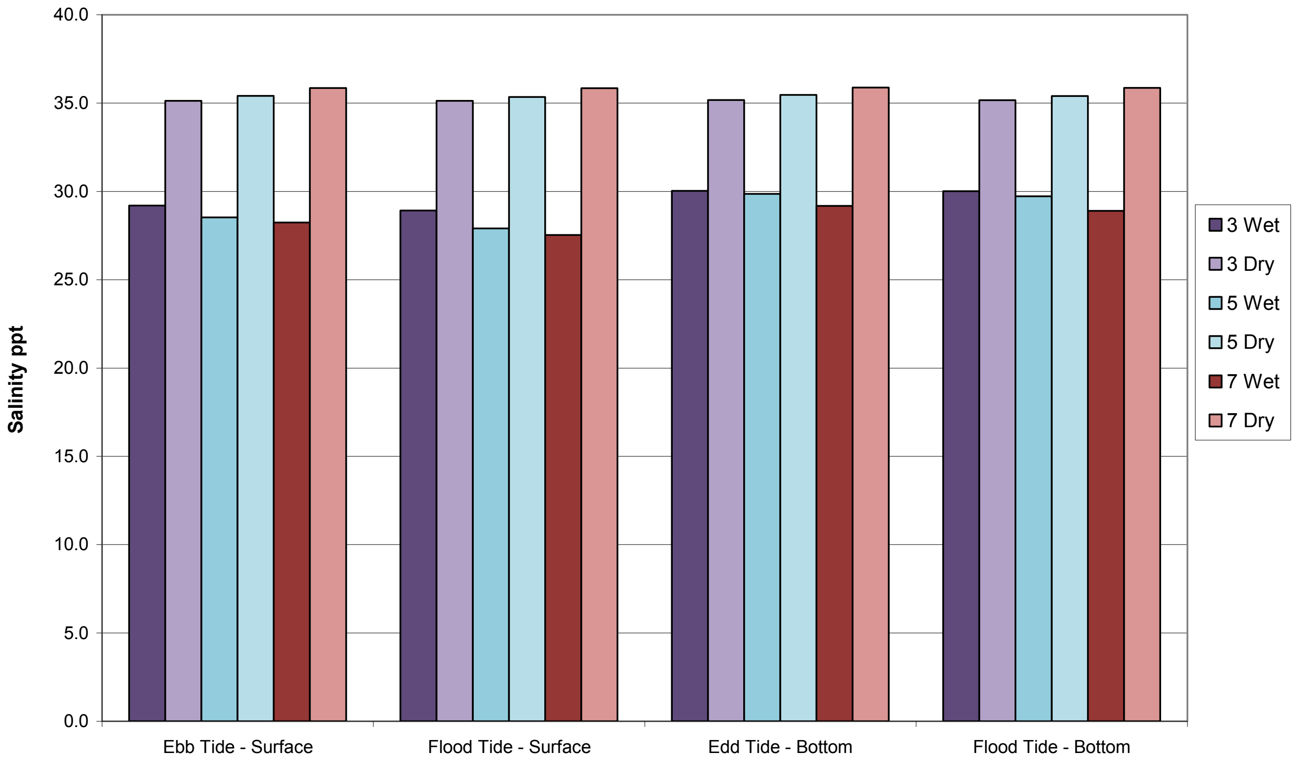


Chart 3-2 Water salinity comparison among sites 3, 5 and 7

3.1.3 pH

The mean pH was 8.4, with a range from 7.8 to 9.2. In the upper reaches of the harbour, mean pH levels were found to be lower (more acidic), with pH levels increasing (becoming more alkaline) within the main body of the harbour in both the wet and dry season sample events. The pH of harbour waters has been previously found to remain within the same ranges (8.3 – 8.6 pH units, Padovan 1997) with a slight decrease in pH (~0.3 units) found further upstream during dry season conditions (Parry and Munksgaard 1996a, DIPE unpublished data). The lower pH level upstream could be attributable to the natural low pH level of fresh water input from rivers. No significant difference resulting from water column position or tidal state was observed.

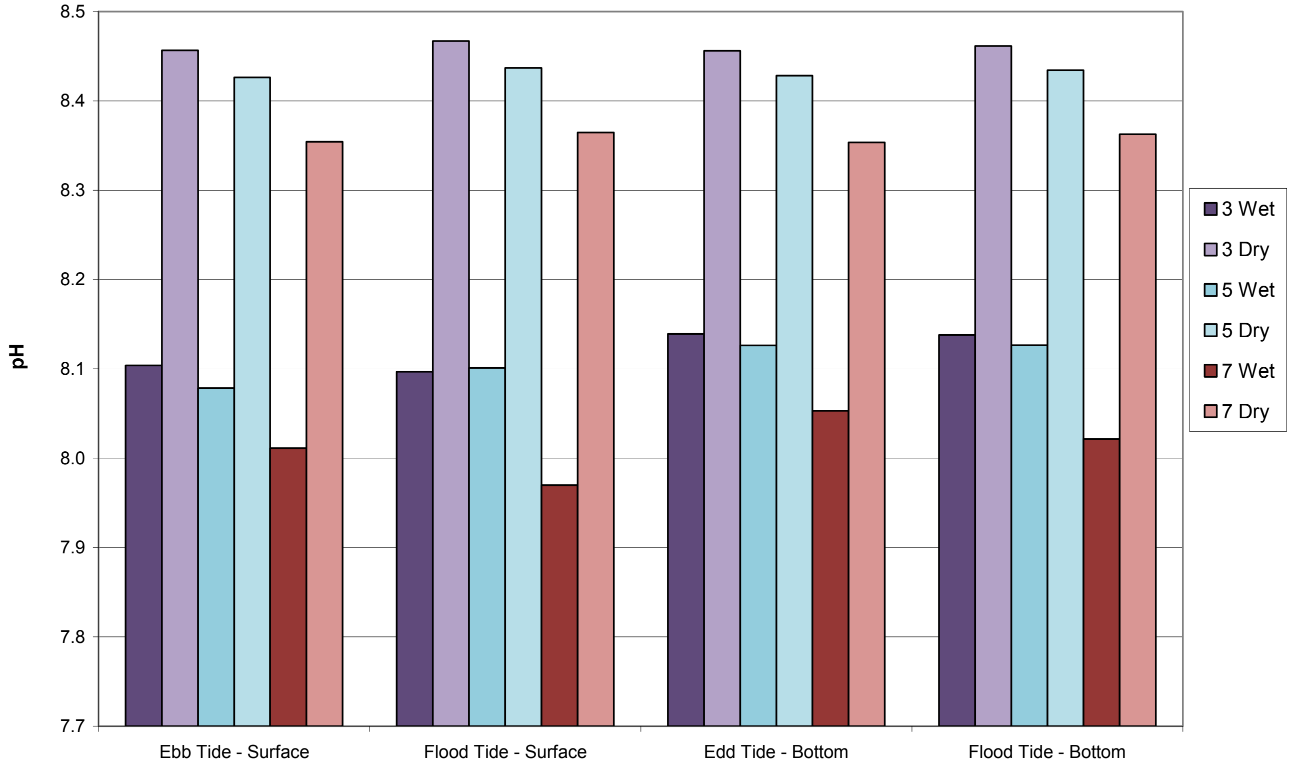


Chart 3-3 Water pH comparison among sites 3, 5 and 7

3.1.4 Dissolved oxygen

The percentage saturation of oxygen (DO%) ranged from 74.4 to 119.3%, with an average saturation of 93%. Overall DO% was found to be higher in the dry season and in the main body of the harbour, with decreasing saturation further upstream. These lower DO% levels could be attributable to the usual presence of more organic matter upstream which takes up oxygen, and the absence of waves which reduces oxygenation. An exception to this is in the middle of the harbour (site three) where DO% was higher in the wet season than in the dry, which could be attributable to greater wind exposure at the site, increasing oxygenation. DO% was also found to be higher towards the surface than at the bottom of the water column. No significant difference was observed between flood and ebb tides. Typical harbour water DO% levels have been found by Padovan (1997) to be 84% saturation.

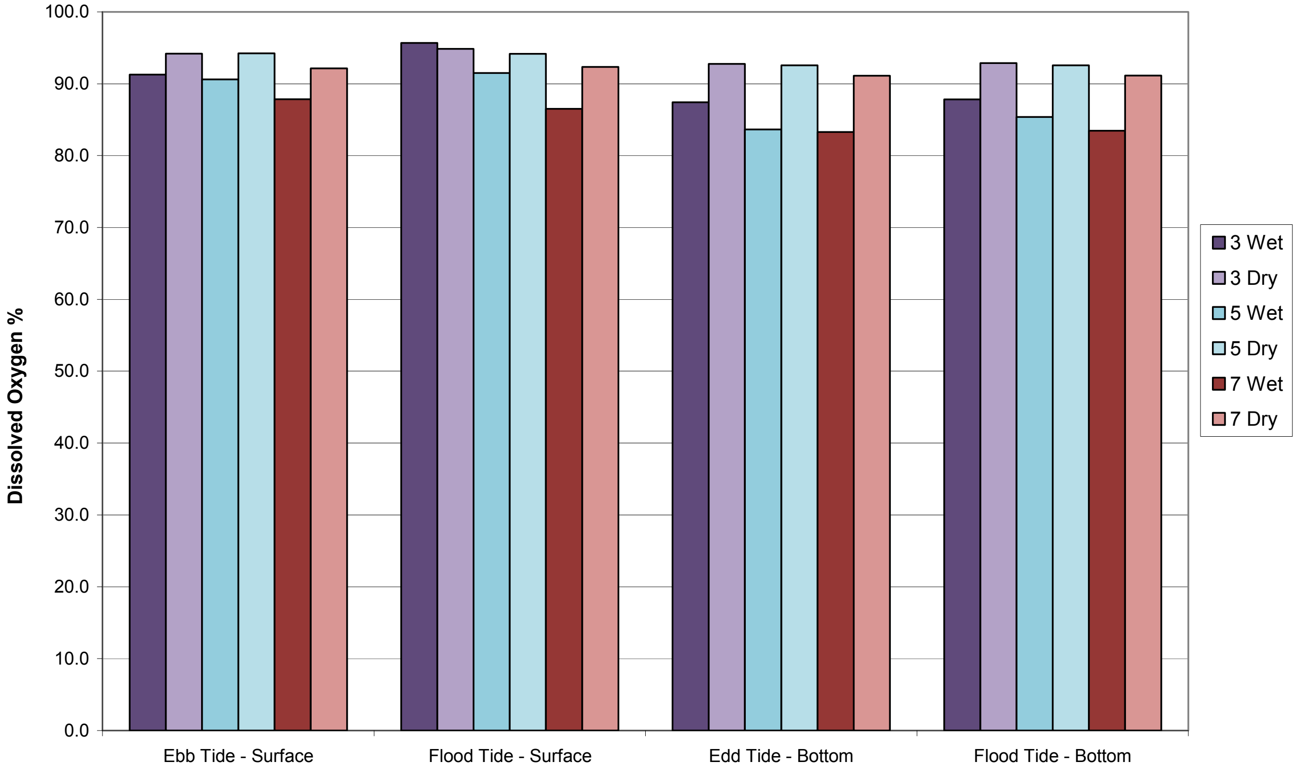


Chart 3-4 Water dissolved oxygen comparison among sites 3, 5 and 7

3.1.5 Turbidity

Levels of NTU recorded ranged from 0.0 – 73.6 NTU, with a mean reading of 6.9 NTU. These values were consistent with readings obtained in shallow tropical estuarine embayments elsewhere. Higher NTU values were found at the bottom of the water column than at the surface, with higher levels also being recorded in the wet season when compared to the dry. During ebb tides NTU levels were higher upstream than in the harbour. During flood tides at the bottom of the water column, NTU levels decreased further upstream in comparison to the harbour readings. Surface NTU levels on flood tides were also slightly lower upstream than in the harbour with the exception of site five where there were elevated levels.

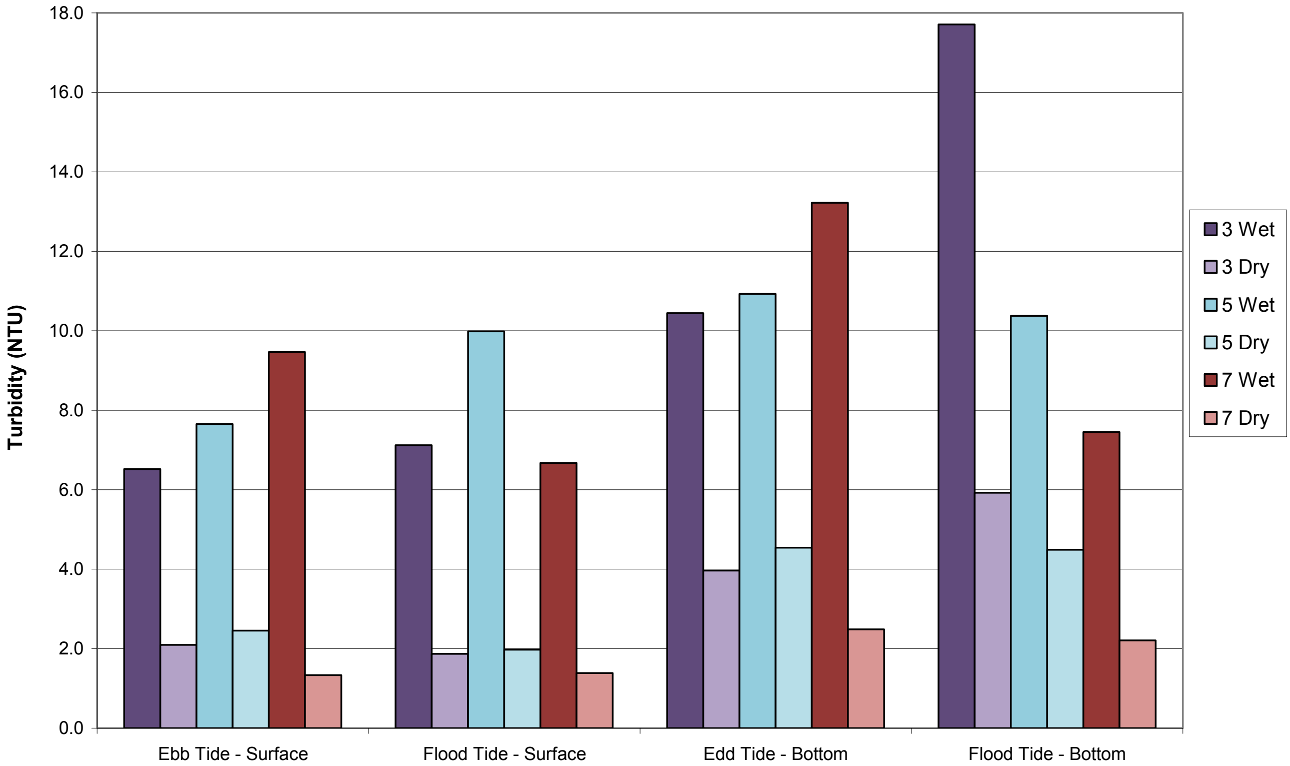


Chart 3-5 Water NTU comparison among sites 3, 5 and 7

3.1.6 Total suspended solids

TSS levels ranged from 1.5 to 83 mg/L, with an average of 14.6 mg/L. Elevated TSS levels were found to occur in the wet season at the bottom of the water column on a flood tide at all sites. Highest mean TSS values were found at site seven which is located near the proposed module offloading facility. TSS values were higher at the bottom of the water column than at the surface. Generally harbour waters had less suspended solids than the upper arm. There was also found to be no clear distinction between wet and dry season TSS levels at the surface.

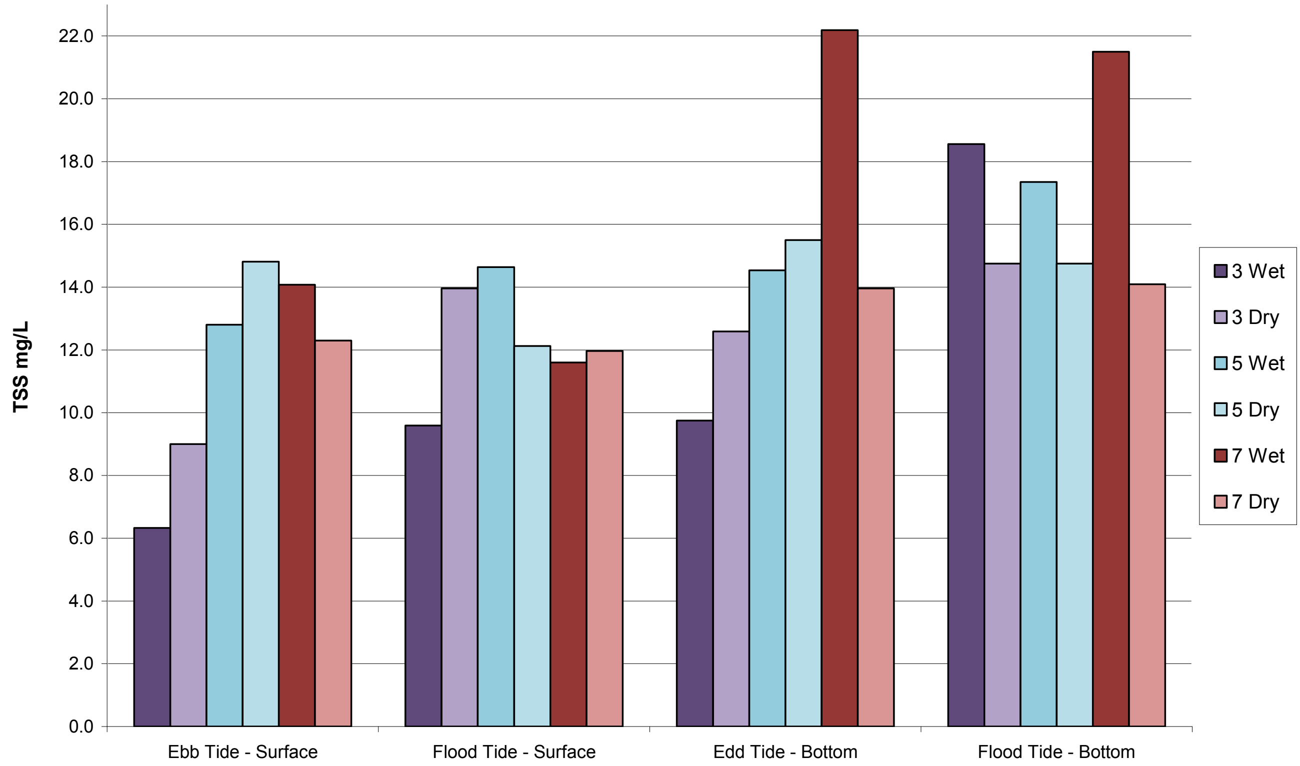


Chart 3-6 Total suspended solids (TSS) comparison among sites 3, 5 and 7

3.1.7 Comparison to other previous water quality studies

Previous investigations into water quality in Darwin Harbour have been less numerous than those for sediment quality (Padovan 2003), resulting in gaps in data for certain areas including Middle and East Arm. Overall water quality within Darwin Harbour is known to be affected by varying degrees by season, location within the harbour and tidal conditions (Padovan 2003) and results from this survey have produced a similar pattern.

3.2 Sediment Analysis

A summary of the analytical data is presented in the tables section attached to this report. These include relevant screening levels (concentrations below which toxic effects on organisms are not expected) and maximum levels (concentrations at which toxic effects on organisms are probable if the contaminant is in a biologically available form), as well as mean and 95% UCL calculations. Original laboratory reports are included in PDF format in the DVD copy of this report.

3.2.1 Metals

Metal levels in the sediments have been compared to the Guidelines. The Guidelines present screening levels and maximum levels, for all metals analysed with the exception of aluminium, cobalt, iron, magnesium and manganese for which no guidelines have been recommended.

Metals concentrations were found to be similar thorough the three sampling areas in East Arm, pipeline and pipeline shore crossing. The mean and 95% UCL was calculated for all surface sediment samples in Darwin Harbour, and are shown in Table 3-3 below. Mean and 95% UCLs calculations were below the relevant screening levels, with the exception of arsenic, which had exceedances in all areas.

Table 3-3 Mean and 95% UCL calculations of metals in all samples

Metal	Sb	As	Cd	Cr	Co	Cu	Fe	Pb	Mn	Ni	Hg	Zn
Unit	mg/kg											
Screening[a]	2.0	20.0	1.5	80.0	NG	65.0	NG	50.0	NG	21.0	0.15	200.0
Maximum[b]	25.0	70.0	10.0	370.0	NG	270.0	NG	220.0	NG	52.0	1.0	410.0
Mean	0.4	34.5	<1.0	41.2	4.4	5.7	31331	9.4	302.3	5.5	0.015	12.0
95%UCL	0.5[d]	37.2[d]	NA	45.1[d]	4.7[j]	6.1[d]	33752[d]	10.05[d]	324.2[d]	5.9[d]	0.018[e]	12.82[c]

Notes:

a: NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected (exceedences highlighted in yellow)

b: NODGDM maximum concentration (EA 2002) - Concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form (exceedences highlighted in green)

c: Data are lognormal and the UCL was calculated using 95% H-UCL

d: Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method

e: Data are normally distributed and the UCL was calculated using Student's t-Test method

NA: Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation

NG: No Guideline

Section 3 Results and Discussion

Generally these results are consistent with the findings of Parry and Munksgaard (1997), who examined heavy metal concentrations in Darwin Harbour. Overall the concentrations of metals in Darwin Harbour are low when compared to concentrations measured overseas, with the exception of arsenic, for which the concentrations are a reflection of the local geology, rather than anthropogenic sources (Padovan, 2003).

East Arm Surface Sediments

Generally the concentrations of metals in surface sediments in East Arm were below the relevant screening levels, with the exception of arsenic, chromium and mercury (Table 5 attached).

The screening level of 20 mg/kg for arsenic was exceeded in the majority of samples, with the maximum level (70 mg/kg) being exceeded in 6 samples. The highest recorded concentration of arsenic was 137 mg/kg at site EA11, which was the most northerly sampling site from Blaydin Point. The concentration of arsenic does not appear to have a predictable distribution in the three sampling areas. However, sites nearest East Arm Wharf were consistently above the screening level. The mean (33.3 mg/kg) and 95% UCL (37.8 mg/kg) for arsenic exceeds the screening level however, bioavailability testing using 1M HCL digest on eight sediment samples in East Arm showed that arsenic is unlikely to be toxic in the marine environment as only a very small proportion is bioavailable. The majority of samples analysed reported concentrations below 1 mg/kg.

Ten samples exceeded the screening level for chromium (80 mg/kg), with a maximum concentration recorded at site 101EA (288 mg/kg) which is located in close proximity to East Arm Wharf. All concentrations for chromium were below the maximum level of 370 mg/kg. Both the calculated mean (40.1 mg/kg) and 95% UCL (45.4 mg/kg) were below the screening level.

The reported concentration of mercury exceeded the screening level of 0.15 mg/kg at sites 90EA (0.25 mg/kg) and 104EA (0.17 mg/kg). However, the mean (0.02 mg/kg) and 95% UCL (0.02 mg/kg) were both below the screening level.

East Arm subsurface sediments

Metals were below the relevant screening levels for subsurface sediments in East Arm, with the exception of arsenic and nickel (Table 6 attached)

Arsenic exceeded the screening level (20 mg/kg) in five samples, with a maximum concentration recorded at a depth of between 4.0-9.0 mBGL at site 9EASS (57.1 mg/kg). Both the mean (12.9 mg/kg) and 95%UCL (18.0 mg/kg) were below the screening level.

The reported concentration of nickel slightly exceeded the screening level (21 mg/kg) between 3.0-3.5 mBGL at site 2EASS (23.2 mg/kg). The mean (5.8 mg/kg) and 95% UCL (7.7 mg/kg) were both well below the screening level.

Pipeline surface sediments

Both arsenic and chromium exceeded relevant screening levels in surface sediments along the proposed pipeline route (Table 7 attached).

The concentration of arsenic exceeded the screening level (20 mg/kg) in the majority of samples and exceeded the maximum level (70 mg/kg) at five sites, with a maximum recorded at site 134P (86.6 mg/kg). All sites that exceeded the maximum level are located around the midway point of the pipeline route. The mean (42.0 mg/kg) and 95% UCL (55.4 mg/kg) exceed the screening level but are below the maximum level. As in East Arm, two samples from the pipeline route were analysed for an estimation of the bioavailability of arsenic using a 1M HCL digestion. This analysis again showed that only a small proportion of arsenic is bioavailable.

The reported concentration of chromium exceeded the screening level (80 mg/kg) at three sites. However, the mean (44.1 mg/kg) and the 95% UCL (67.88 mg/kg) were both below the screening level.

Pipeline subsurface sediments

All subsurface samples in the pipeline route had reported concentrations of metals were below the relevant guidelines (Table 8 attached), with the exception of arsenic at 0.5 mBGL at site 17PSS. However, the mean (6.1 mg/kg) and 95% UCL (11.5 mg/kg) were both below the screening level (20 mg/kg).

Pipeline Shore Crossing surface sediments

All surface samples in the shore crossing area had concentrations of metals below the relevant guidelines (Table 9 attached), with the exception of arsenic (20.1 mg/kg) which was marginally above the screening level (20 mg/kg). All mean and 95% UCL calculations were well below the relevant screening levels.

Pipeline Shore Crossing subsurface sediments

Three subsurface sediment samples were analysed from one borehole in the shore crossing area. Due to the small number of samples, there was insufficient data to calculate 95% UCLs. All reported concentrations of metals were below the relevant guidelines for this borehole, with the exception of arsenic from 3 mBGL (24.4 mg/kg) (Table 10 attached).

3.2.2 Organic compounds

Generally the reported concentrations of organic contaminants in sediments were below the laboratory PQLs. This is consistent with previous studies by Dames and Moore (1993) that assessed PAH, TPH, PCB and OCP concentrations in Darwin harbour, in which all were found to be below the laboratory levels of detection.

Total Organic Carbon (TOC)

Surface sediments were analysed for TOC to allow organic contaminants to be normalised to 1% TOC, as outlined in Section 3.10.2 of the Guidelines (EA, 2002). The mean concentration of TOC in East Arm and the Pipeline Route was approximately 0.3%. The mean for TOC in the pipeline shore crossing area (0.5%) was slightly higher (Tables 11, 12 and 13 attached).

Tributlytin (TBT)

Tributyltin was not detected in any sample from any site (Tables 11, 12 and 13 attached)

Total Petroleum Hydrocarbons (TPH)

Total petroleum hydrocarbons were reported below the PQL in the majority of samples (Tables 11, 12 and 13 attached). Hydrocarbons were not detected in any samples in the pipeline shore crossing area. In East Arm, some low concentrations were reported, with maximums of 10.0 mg/kg (site 104EA) for C_{10}-C_{14}, 42 mg/kg for C_{15}-C_{28} (site 104EA) and 24 mg/kg for C_{29}-C_{36} fractions (site 59EA). Similar results were recorded in the Pipeline route with maximums of 5.0 mg/kg (site134P), 31.0 mg/kg and 31.0 mg/kg (site 131P) for C_{10}-C_{14}, C_{15}-C_{28} and C_{29}-C_{36} fractions respectively.

Benzene, Toluene, Ethylbenzene and Xylene compounds (BTEX)

All results for BTEX compounds were reported below laboratory PQLs. Results for BTEX compounds can be seen in the laboratory reports in PDF format on the DVD copy of this report.

Polynuclear Aromatic Hydrocarbons (PAHs)

Results for PAHs in surface sediments in East Arm, pipeline route and pipeline shore crossing can be seen in Tables 14, 15 and 16 respectively (attached). PAHs were reported below the PQL at the majority of sites. The only exceedance of a screening level was for acenaphthene (16 ug/kg) at pipeline route site 111P (20 µg/kg). The highest total of all PAHs was recorded at East Arm site 65EA (138 µg/kg), however this was still well below the screening level of 4,000 mg/kg. All calculated mean and 95% UCLs were below the relevant screening levels in all areas.

Polychlorinated Biphenyls (PCBs)

Total concentrations of PCBs were reported below the laboratory PQL in all samples from all sites and therefore have not been displayed in summary tables. Original laboratory reports for PCBs can be found of the DVD copy of this report

Organochlorine Pesticides (OCPs)

OCPs were reported below the laboratory PQLs in all samples. Results for OCPs can be seen in the laboratory reports in PDF format on the DVD copy of this report.

3.2.3 Nutrients

Summaries of surface sediment results for nutrients in East Arm, the pipeline route and the pipeline shore crossing area can be found in Tables 17, 18 and 19 respectively (attached). As there are no NODGDM guidelines for nutrients, the results are not reported against guidelines, rather the data contributes to the understanding of baseline concentrations within the harbour. Generally the concentration of nitrite and nitrate as N (a measure of soluble, oxidised forms of nitrogen) was very low thorough the harbour and forms an insignificant proportion of the total nitrogen pool. Sediments in the pipeline route had the highest average (0.28 mg/kg), while sediments in the pipeline shore crossing had the lowest mean (<0.1).

Mean concentrations of Total Kjeldahl Nitrogen (TKN) (a measure of the sum of organic nitrogen, ammonia and ammonium) was highest along the pipeline route (581 mg/kg) and lowest in East Arm (355.6 mg/kg).

Mean concentrations for total phosphorus ranged from 314.5 mg/kg (pipeline) to 508.5 mg/kg (East Arm), which is within the range reported by Parry *et al.* (2002) in a similar study.

Total sulphur ranged from 0.18% (pipeline route) to 0.8% (East Arm).

3.2.4 Particle size distribution (PSD)

Particle size distribution results for surface sediments showed considerable variation across all areas. PSD analysis for subsurface sediments was carried out as part of a geotechnical investigation and is not included in this report.

Surface sediments in East Arm were generally comprised of larger grained sediments, with clay and silt only accounting for 16.5% of the total (Table 20 attached). Similar results were recorded in the pipeline route, with silt and clay accounting for 19.0% of sediments (Table 21 attached). In contrast sediments in the pipeline shore crossing area were generally comprised of small particles (Table 22 attached). Clay, silt and fine sand accounted for over 85% of the dry weight of sediments in this area.

3.2.5 Radionuclides

Results for total radionuclide activity (sum of gross alpha and gross beta) were all reported well below the screening level of 35 Bq/g. The calculated 95% UCL value was 0.821 Bq/g for East Arm sediments and 0.725 Bq/g for sediments along the proposed pipeline route. The 95% UCL could not be calculated for sediments in the pipeline shore crossing area as only one sample was analysed. However, the activity of the sample in this area (0.207 Bq/g) was well below the screening level. Therefore, the measured sediment radionuclide activity is not considered of concern for dredging and sediment disturbing activities.

3.2.6 Acid sulphate soils (ASS)

Surface sediments, East Arm

Soil textures ranged from fine to coarse, with material including sands, gravels, clays, silts, shell fragments, organic matter, and benthic organisms. The oxidisable sulphur content of the samples ranged from <0.02 to 1.50%S. The acid neutralizing capacity ranged from 0.06 to 54.40%S equivalent. A total of 54 surface sediment sites were classified as potential risk areas based on the site specific ASS risk matrix out of 109 sites sampled. The locations of the samples are shown on Figure 6 (attached).

Subsurface sediments, East Arm

Soil textures ranged from fine to coarse, with material including sands, gravels, clays, silts, shell fragments, organic matter, and siltstone up to a depth of 3.5m. The oxidisable sulphur content of the samples ranged from <0.02 to 3.52%S. The acid neutralising capacity ranged from 0.10 to 18.60%S equivalent. The majority of the samples were categorised as low risk based on the site specific ASS risk matrix. A total of six subsurface sediment sites were classified as potential risk, out of 13 sites sampled. The samples identified as potential risk in this region were 3EASS_1.5-3.0m, 4EASS_0.5-1.5 m, 10EASS_3.0m, 11EASS_1.5-3.0m, 12EASS_0.5-1.5m, 12EASS_3.0-9.0m, 13EASS_2.5-3.0m, and 13EASS_3.0-3.5 m. The locations of the samples are shown on Figure 6 (attached).

Surface sediments, Pipeline

Soil textures ranged from fine to coarse, with material including sands, gravels, clays, silts, shell fragments, organic matter, and benthic organisms. The oxidisable sulphur content of the samples ranged from <0.02 to 0.36%S. The acid neutralizing capacity ranged from 11.4 to 50.90%S equivalent. The majority of samples were categorised as low risk based on the site specific ASS risk matrix. A total of 8 surface sediment sites were classified as potential risk, out of 30 sites sampled. The samples identified as potential risk in this area include sites 113P, 119P, 120P, 122P, 125P, 126P, 131P and 133P. The sampling location is shown of Figure 7 (attached).

Subsurface sediments, Pipeline

Soil textures ranged from fine to medium, with material including clay, clayey sand, and sandy silt. The oxidisable sulphur content of the samples ranged from <0.02 to 0.02%S. The acid neutralizing capacity ranged from 0.09 to 3.77%S equivalent. Only one site was categorized as potential risk based on the site specific ASS risk matrix was (123P_0.5-1.0m) out of four sites sampled. The location of this sampling site is shown in Figure 7 (attached).

Surface sediments, Shore Crossing

Soil textures ranged from fine to medium, with material including grey silts, brown sands, and some gravels and shell fragments. The oxidisable sulphur content of the samples ranged from 0.03 to 0.25%S. The acid neutralizing capacity ranged from 22.4 to 54.1%S equivalent. Only one site (151SC) was categorized as potential risk based on the site specific ASS risk matrix, out of 11 sites sampled in the pipeline shore crossing. The location of this site is shown in Figure 8 (attached).

Subsurface sediments, Shore Crossing

Soil textures were fine, with material including silt, clay, and organic matter. The oxidisable sulphur content of the samples ranged from 0.52 to 0.97%S. The acid neutralizing capacity was only recorded for one sample at 13.60% sulphur. Based on the site specific ASS risk matrix all three samples from the only subsurface sampling site in the shore crossing area (18CSSS) were classified as potential risk. The sampling location is shown on Figure 8 (attached).

3.3 Quality Assurance/Quality Control

In accordance with the Guidelines, RPDs and RSDs were calculated for the all duplicate and triplicate samples to assess the variability between results. As all results for OCPs, PCBs and BTEX compounds were below the laboratory PQLs, RPDs and RSDs were not calculated for these compounds.

Metals

RPD and RSD calculations for metals are shown in Table 1 of Appendix D (Data validation). It can be seen that some calculations were above the guideline for RPDs (35%) and RSDs (50%), prompting reanalysis in samples from sites 63EA, 78EA and 121P. After reanalysis, antimony at site 63EA and chromium at site 78EA still exceeded recommended RPD/RSD guidelines, indicating that these results should be viewed only as estimates, as prescribed in the Guidelines. However, as these metals were well below the relevant screening levels there is no implication for data interpretation.

RPD calculations from a subsurface sample at site 9EASS exceeded 35% for the majority of metals, indicating that sediment is highly heterogeneous and the results should only be viewed as an estimation of metal concentration.

Organics

The calculated RPD and RSD values for TOC, TBT and TPH were all below the guidelines.

Nutrients

Calculated RPD and RSD values exceeded the RPD/RSD guideline values for TKN at sites 10EA, 22EA and 33EA, total nitrogen at sites 10EA, 22EA and 33EA, and total phosphorus at sites 10 EA and 22EA. These samples were not reanalysed due to short holding times on nutrients. There are no criteria for sediment nutrients and the data are provided as a contribution to the establishment of baseline sediment nutrient levels in Darwin Harbour.

Conclusion Section 4

The data presented in this report describe water and sediment quality in Darwin Harbour prior to the construction of the Ichthys Gas Field Development Project.

Seven water quality sampling sites were identified in Middle Arm and East Arm and water quality assessment involving in situ analysis of turbidity, salinity, temperature, pH and dissolved oxygen, and laboratory analysis to determine total suspended solids during both dry and wet seasons and during spring and neap tides were undertaken. Water quality within Darwin Harbour is known to be affected by varying degrees by season, location within the harbour and tidal conditions (Padovan 2003) and results from this survey have produced a similar pattern to previous studies.

Surface sediments were collected at 151 sites in East Arm, the proposed pipeline route and associated pipeline shore crossing area. Overall, sediment quality showed no indication of contamination above the adopted guidelines for metals, organic contaminants and radionuclides, with the exception of arsenic. Elevated concentrations of arsenic have previously been attributed to local geological influence and are not thought to be attributed to anthropogenic sources (Padovan, 2003). Further analysis of total arsenic concentrations has shown that only a small fraction is bioavailable and is unlikely to cause adverse effects on marine organisms.

The potential for sediments to generate acid were assessed against the Guidelines for Sampling and Analysis of Lowland Acid Sulphate Soils (ASS) in Queensland (1998). As shown in Figures 6, 7 and 8, sites in East Arm, the pipeline route and the shore crossing were identified as potential risk areas based on the site specific ASS risk criteria. These sediments have the potential to generate acidity if they are disposed of on land. The generation of acidity could then mobilise metals present in the sediments, increasing metal bioavailability and increase increasing metal concentration in water.

If, however, the sediments remain underwater or are kept saturated during transport and following disposal, as is the case for the proposed offshore disposal, acid production is not significant. Metal bioavailability will also remain low and is therefore unlikely to cause any adverse effects on marine organisms.

Based on the above findings, it is concluded that the objectives of the water and sediment quality programs have been met.

Ahern, C.R., Ahern, M.R. and Powlee, B. 1998. *Guidelines for Sampling and Analysis of Lowland Acid Sulphate Soils (ASS) in Queensland 1998.* QASSIT, Department of Natural Resources, Resource Sciences Center, Indooroopilly.

Ahern, C.R., McElnea, A.E.,andSullivan, L.A. 2004. *Acid Sulphate Soils Laboratory Methods Guidelines.* Queensland Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia.

ANZECC 2000a, National Water Quality Management Strategy. Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Guideline 4). Australian and New Zealand Environment and Conservation Council.

ANZECC 2000b, National Water Quality Management Strategy. Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting (Guideline 7). Australian and New Zealand Environment and Conservation Council.

Dames and Moore 1993. Darwin South baseline studies Stage 1 – contaminants. Report for the Department of Transport and Works and Department of Lands, Housing and Local Government, September 1993

Environment Australia (EA) 2002. *National Ocean Disposal Guidelines for Dredged Materials.* Environment Australia, Commonwealth of Australia, Canberra

Michie, M.G., Grey, D.L. and Griffin, R.K. 1991. Sea water salinity and temperature measurements in the Darwin Harbour area 1972 – 1978. Department of Primary Industries and Fisheries, Darwin NT May 1991.

Padovan, A.V. 1997. The water quality of Darwin Harbour, October 1990 – November 1991. Water Quality Branch, Water Resources Division, Department of Lands, Planning and Environment, NT Government, Report No. 34/1997D December 1997.

Padovan, A.V. 2003. Darwin Harbour water and sediment quality. Marine and Estuarine Environments of Darwin Harbour. Proceedings of the Darwin Harbour Public Presentations, February 2003.

Parry, D.L. and Munksgaard, N.C. 1996. Monitoring of water at Blessers Creek, Darwin Harbour, 16/10/95 to 18/1 96. Report by Northern Territory University for Power and Water Authority, January 1996.

Parry, D.L. and Munksgaard, N.C. 1997. Heavy metals, arsenic and grain size analysis of surface sediments collected July 1993 from Darwin Harbour, Northern Territory, Australia. Northern Territory University Report, July 1997

Parry, D.L., Munksgaard, N.C., Foti, F., Langeveld, M. and Gilmore, R. 2002. Monitoring a tropical estuary for impacts of urbanisation. NHT Coast and Clean Seas Project No. 9703, April 2002.

Queensland Department of Natural Resources and Mines (NR&M) 2002, Queensland Acis Sulfate Soil Technical Manual, Soil Management Guidelines (Version 3.8).

Warren, J.H. 2001. Sediment Quality of Ports and Marinas in Darwin Harbour. Environment and Heritage Division, Department of Lands, Planning and Environment. October 2001.

Section 6 Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of INPEX Browse, Ltd. and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works, and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared in between August 2008 and August 2009, and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Tables

Table 1: Surface sediment sampling sites for East Arm, Darwin Harbour

Site ID	Sample ID	Date	Time	Longitude	Latitude	Duplicate/ Triplicate	Sampling Method	Sediment samples taken
1 EA	1	07-Mar-08	12:00	130 51.262'	12 29.015'		Van Veen Grab	Grey/brown, veneer of some gravel over silt and fine sand, homogenous complex, no shell, no biota, no odour. Generators running will contaminate sample.
2 EA	2	07-Mar-08	12:30	130 52.128'	12 29.970'		Van Veen Grab	Grey/brown sand, homogenous, no shell fragments, no biota, generators running.
3 EA	3	07-Mar-08	13:40	130 52.410'	12 29.333'		Van Veen Grab	Brown medium- coarse sand, no silt, shell fragments throughout, no biota, generators running.
4 EA	4	07-Mar-08	14:10	130 52.473'	12 30.131'		Van Veen Grab	Thin sand veneer over grey, very fine silt, no shells, no biota, some leaves, generators running.
5 EA	5	07-Mar-08	14:20	130 53.641'	12 30.621'		Van Veen Grab	Shell grit and brown sand veneer over grey fine silt, no biota, generators running.
6 EA	6	07-Mar-08	15:15	130 53.441'	12 30.155'		Van Veen Grab	Partially cloud, low tide. In coming tide, brown sand veneer over fine grey silt, shell fragments, no biota, generators running.
7 EA	13	08-Mar-08	12:15	130 53.409'	12 30.328'		Van Veen Grab	Brown sand veneer, grey to light brown silt, shall fragments present. Rotting plant material found, black material in sample, no biota, generators running.
8 EA	14	08-Mar-08	13:15	130 54.455'	12 29.565'		Van Veen Grab	Brown sand veneer (thin) over, homogeneous grey silt. No shell, some small plant material (looked living), generators running.
9 EA	15	08-Mar-08	13:30	130 55.235'	12 30.101'		Van Veen Grab	Coarse brown/ red sand, shall fragments present, no biota, generators running.
10 EA	16.1	08-Mar-08	13:45	130 55.368'	12 30.280'	Duplicate	Van Veen Grab	Light brown sand veneer over grey silt, no biota, generators running.
11 EA	17	08-Mar-08	14:05	130 55.281'	12 29.501'		Van Veen Grab	Thin gravel veneer over light grey silt. Shell fragments, no biota, generators running.
12 EA	18	08-Mar-08	14:20	130 55.422'	12 30.221'		Van Veen Grab	Homogeneous red/brown coarse sand. No shells, no biota, generators running.
13 EA	19	08-Mar-08	14:50	130 56.367'	12 30.585		Van Veen Grab	Coarse brown sand veneer, fine grey/brown silt. No shell, no biota, generators running.
14 EA	20	08-Mar-08	15:00	130 55.453'	12 30.408'		Van Veen Grab	Shelly, gravelly grit over fine grey silt, some shell fragments, biota including sponge and coral, generators running.
15 EA	21.1	08-Mar-08	15:30	130 55.334'	12 30.354'	Triplicate	Van Veen Grab	Thin course brown sand veneer, grey fine silt, shell fragments, no biota, generators running.
16 EA	25	15-Mar-08	14:20	130 53.517'	12 30.426'		Van Veen Grab	Fine grey/ brown silt. No shells, no biota, some black organic material (possible ASS), generators running.
17 EA	26	15-Mar-08	14:35	130 54.303'	12 30.406'		Van Veen Grab	Fine grey/ brown silt, no shells, no biota, no ASS, generators running.
18 EA	27.1	15-Mar-08	14:50	130 54.414'	12 30.330'	Triplicate	Van Veen Grab	Brown thin sand veneer over grey silt, shells present, no biota, generators running.
19 EA	28	15-Mar-08	15:20	130 54.396'	12 30.260'		Van Veen Grab	Brown sand (medium to coarse), shell grit, no biota, generators running.
20 EA	D10	12-Jun-08	8:57	130 55.057'	12 30.494		Van Veen Grab	Light grey silt with fine sand and shell fragments - no veneers
21 EA	D11	12-Jun-08	9:25	130 54.962'	12 30.508'		Van Veen Grab	Gravel/shell fragments with grey silt and fine sand
22 EA	D12	12-Jun-08	9:50	130 54.798'	12 30.683'	Duplicate	Van Veen Grab	Light brown silt veneer over dark brown/grey silt. No biota/smell/shell fragments
23 EA	D13	12-Jun-08	10:07	130 54.588'	12 30.816'	Triplicate	Van Veen Grab	Light brown silt veneer over dark brown/grey silt. No smell/shell fragments, with bioturbation
24 EA	D14	12-Jun-08	10:55	130 54.387'	12 30.470'		Van Veen Grab	Light brown silt veneer over light grey fine sand with shell fragments and gravel
25 EA	D15	12-Jun-08	11:15	130 54.724'	12 30.874'		Van Veen Grab	Light brown silt veneer over light grey fine sand with shell fragments and gravel
26 EA	D16	12-Jun-08	11:33	130 54.872'	12 30.792'		Van Veen Grab	Light brown silt veneer over light grey fine sand, gravel and large presence of shell fragments
27 EA	D17	13-Jun-08	8:30	130 55.831'	12 30.753'		Van Veen Grab	Thin brown veneer over fine grey silt with course gravel, fine sand and broyozoan/sponge, some large rock fragments.
28 EA	D18	13-Jun-08	9:05	130 55.726'	12 30.832'	Triplicate	Van Veen Grab	Grey silt with abundant gravel (coarse) shell fragments and small component of fine sand.
29 EA	D19	12-Jun-08	12:30	130 55.246'	12 30.414'		Van Veen Grab	Brown silt veneer over grey silt and fine/medium sand with gravel and shell fragments
30 EA	D20	13-Jun-08	9:40	130 55.588'	12 30.697'		Van Veen Grab	Grey silt with gravel (coarse) shell fragments and small component of fine sand.
31 EA	D21	13-Jun-08	9:55	130 55.727'	12 30.616'		Van Veen Grab	Large gravel, brown/grey high silt component, ascidian and polychaetes present
32 EA	D22	13-Jun-08	10:39	130 55.626'	12 30.468'		Van Veen Grab	Brown/grey silt with coarse gravel and shell fragments, fine/medium sand
33 EA	D23	13-Jun-08	10:58	130 55.517'	12 30.569'	Triplicate	Van Veen Grab	Thin brown veneer over coarse gravel and grey with silt component. Included crab and sand dollar
34 EA	D24	13-Jun-08	12:10	130 55.480'	12 30.326'		Van Veen Grab	Coarse gravel and brown fine medium sane in a grey silt matrix
35 EA	D25	13-Jun-08	13:25	130 55.439'	12 30.330'		Van Veen Grab	Coarse gravel and brown fine medium sane in a grey silt matrix
36 EA	D26	13-Jun-08	13:52	130 55.513'	12 30.784'		Van Veen Grab	Brown veneer over grey silt and fine sand, shell fragments and organic material.
37 EA	D27	14-Jun-08	8:28	130 55.303'	12 30.268'	Triplicate	Van Veen Grab	Light brown gravel/shell fragments in a fine silt/sand matrix, seapens and bryozoan
38 EA	D28	14-Jun-08	8:55	130 55.126'	12 30.318'		Van Veen Grab	Light brown silt veneer over grey silt/fine sand with some gravel, no shell fragments or biota
39 EA	D29	14-Jun-08	9:12	130 54.966'	12 30.413'		Van Veen Grab	Coarse sand broken shell with small grey silt component
40 EA	D30	14-Jun-08		130 54.803'	12 30.504'		Van Veen Grab	Brown veneer over grey silt with gravel and shell fragments.
41 EA	D31	14-Jun-08	9:50	130 54.649'	12 30.608'		Van Veen Grab	Light brown veneer over grey silt/sand homogeneous matrix, very few shell fragments, some light grey clay.
42 EA	D32	14-Jun-08	10:14	130 54.223'	12 30.693'		Van Veen Grab	Thin light brown veneer over light grey silt with gravel.
43 EA	D33	14-Jun-08	10:30	130 54.320'	12 30.789'		Van Veen Grab	Coarse brown sand and small gravel - light brown veneer, silt grey component and shell fragments
44 EA	D34	14-Jun-08	10:45	130 54.419'	12 30.884'		Van Veen Grab	Light brown silt veneer over grey silt/shell fragments, fine sand and small amount of clay
45 EA	D35	17-Jun-08	10:50	130 55.006'	12 30.697'		Van Veen Grab	Light brown veneer and dark grey silts. Low bioturbation over very hard pavement, rendering grab sample impossible.
46 EA	D36	17-Jun-08	11:30	130 55.156'	12 30.622'		Van Veen Grab	Silt and sand pockets within larger boulders and gravel, light brown veneer over grey sandy silts. No grab would be possible due to substrate makeup. Decision made to undertake samples next day by road at low tide due to vessel restrictions
47 EA	D37	18-Jun-08	12:05	130 55.413'	12 30.652'		Shore Based Sampling	Light brown veneer over sand and silt in pockets between cobbles, gravel on hard pavement, 4cm penetration.
48 EA	D38	18-Jun-08	12:20	130 55.299'	12 30.539'		Van Veen Grab	Light brown veneer over sand and silt in pockets between cobbles, gravel on hard pavement, 4cm penetration.
49 EA	21	25-Nov-08	10:30	130 53.546'	12 30.041'		Piston Core	Brown coarse sand with shell grit. Uniform texture with no stratification
50 EA	22	25-Nov-08	10:46	130 53.659'	12 30.374'		Piston Core	Grey sandy clay, with an increasing clay content. No shells or biota
51 EA	23	25-Nov-08	15:44	130 55.877'	12 30.849'		Piston Core	Grey soft sediment with sand and gravel above yellow and red mottled clay
52 EA	24	25-Nov-08	16:05	130 56.038'	12 30.876'		Piston Core	Grey coarse sand with silt and clay. Some small shell fragments
53 EA	25	26-Nov-08	8:40	130 54.486'	12 30,568		Piston Core/Van Veen Grab	Grey sandy silt, No shell fragments
54 EA	26	26-Nov-08	9:00	130 54.430'	12 30.490'		Piston Core/Van Veen Grab	Grey sandy silt, with some shell fragments. No biota
55 EA	27	26-Nov-08	9:10	130 54.373'	12 30.414'	Triplicate	Piston Core/Van Veen Grab	Veneer of coarse red sand above grey sandy silt. Some shell fragments and biota
56 EA	28	26-Nov-08	10:28	130 54.112'	12 30.458'		Piston Core/Van Veen Grab	Veneer of coarse red sand above grey sandy silt, with some dark grey patches. Some shell fragments and biota
57 EA	29	26-Nov-08	10:35	130 54.088'	12 30.409'		Piston Core/Van Veen Grab	Veneer of brown sandy silt above a grey sand silt.
58 EA	30	26-Nov-08	10:45	130 53.861'	12 30.352'		Piston Core/Van Veen Grab	Veneer of cares red/brown sand above a sandy gravel with some silt. Shell fragments
59 EA	31	26-Nov-08	11:00	130 53.746'	12 30.407'		Piston Core/Van Veen Grab	Uniform grey sandy clay with some shell fragments

Table 1: Surface sediment sampling sites for East Arm, Darwin Harbour

Site ID	Sample ID	Date	Time	Longitude	Latitude	Duplicate/ Triplicate	Sampling Method	Sediment samples taken
60 EA	32	26-Nov-08	11:07	130 53 696'	12 30.201'		Piston Core/Van Veen Grab	Grey gravely sand with some silt and shells. No biota
61 EA	33	26-Nov-08	11:21	130 53.949'	12 30.101		Van Veen Grab	Grey gravely sand with some silt and shells. No biota
62 EA	34	26-Nov-08	11:41	130 53.619	12 30.128'		Van Veen Grab	Shell grit and coarse sand
63 EA	35	26-Nov-08	12:15	130 53.483'	12 30 095'	Duplicate	Piston Core/Van Veen Grab	Red/brown coarse sand and shell grit.
64 EA	36	26-Nov-08	12:35	130 52.151'	12 30.152'		Piston Core/Van Veen Grab	Grey silty sand with gravel, rock, biota and shell fragments
65 EA	37	26-Nov-08	13:30	130 53.110'	12 30.216'		Piston Core/Van Veen Grab	Grey silty clay over dense clay. Some shell fragments, no biota
66 EA	38	26-Nov-08	13:49	130 53.092'	12 30.078'		Piston Core/Van Veen Grab	Grey gravely silty sand with rock and shell fragments
67 EA	39	26-Nov-08	14:08	130 53.145	12 29.917'	Triplicate	Piston Core/Van Veen Grab	Coarse orange/brown sand, with some grey silt and large proportion of shell grit
68 EA	40	26-Nov-08	14:55	130 54.045'	12 30.279'		Van Veen Grab	Coarse red/brown sand with shell fragments
69 EA	-	26-Nov-08	15:17	130 54.651'	12 30.445'		Van Veen Grab	Two attempts: Rubble rock and coral with some living biota including a brittle sea star. No Sample
70 EA	-	26-Nov-08	15:45	130 54.826'	12 30.499'		Van Veen Grab	Two attempts: Rubble rock and coral with some living biota including a brittle sea star. No Sample
71 EA	41 (0-0.5)	27-Nov-08	3:45	130 55.959'	12 30.782'		Piston Core	Coarse grey sand with shell fragments. Uniform particular size through the core
72 EA	42	27-Nov-08	4:45	130 55.959'	12 30.646'		Piston Core	Fine brown/grey sand with some silt and clay. Some pockets of higher clay content
73 EA	43	27-Nov-08	5:00	130 56.081'	12 30.648'		Piston Core	Fine grey sand with small shell fragments
74 EA	44	27-Nov-08	5:30	130 55.724'	12 30.565'		Piston Core	Grey sandy gravel with silt and shell fragments above dense green/grey clay. Note: due to the plasticity of the clay, homogenisation in the field was not possible for this sample.
75 EA	45	27-Nov-08	5:57	130 55.699'	12 30.292'		Piston Core	Fine grey sand with some silt and shell fragments.
76 EA	46	27-Nov-08	6:40	130 56.173'	12 30.792'		Piston Core	Fine grey sand with some silt. Small amount of shell fragments. Uniform consistency
77 EA	47	27-Nov-08	10:00	130 55.888'	12 30.713'		Piston Core	Grey gravely sand with some clay, over a layer of stiff orange/brown/red clay. Note: due to the plasticity of the clay, homogenisation in the field was not possible for this sample.
78 EA	48	27-Nov-08	11:48	130 54.867'	12 30.238'	Duplicate	Piston Core	Brown/grey coarse sand with some gravel and shell fragments
79 EA	49	28-Nov-08	6:20	130 52.093'	12 29.365'		Piston Core	Grey gravely sand with silt, above a layer of brown and green/grey mottled sandy clay
80 EA	50	28-Nov-08	6:45	130 55.446'	12 30.635'		Van Veen Grab	Coarse brown sand with gravel and shell fragments. Note: Area was too shallow to use the piston core.
81 EA	51	28-Nov-08	6:55	130 55.468'	12 30.730'		Van Veen Grab	Grey silty clay with sand and shell fragments and biota. High organic content
82 EA	52	28-Nov-08	7:05	130 55.531'	12 30.706'		Van Veen Grab	Thin veneer of fine brown sand above fine grey sand with some shell fragments and biota, including worms.
83 EA	53	28-Nov-08	7:37	130 55.605'	12 30.336'	Triplicate	Piston Core/Van Veen Grab	Brown coarse sand with shell fragments above grey/black coarse sand with silt. Some decomposing organic matter.
84 EA	54	28-Nov-08	8:58	130 55.725'	12 30.399'		Piston Core/Van Veen Grab	Coarse brown sand and shell grit. Some black decomposing matter.
85 EA	55	28-Nov-08	9:05	130 55.842'	12 30.496		Piston Core/Van Veen Grab	Coarse brown orange sand and shell grit. No biota
86 EA	56	28-Nov-08	9:47	130 55.937'	12 30.901'	Triplicate	Piston Core/Van Veen Grab	Gravelly sand with silt and shell fragments. No biota, some decaying organic material.
87 EA	57	28-Nov-08	9:56	130 55.997'	12 30.938'		Piston Core/Van Veen Grab	Grey gravely sand with silt and clay. Some pockets with increased clay content and decaying organic matter.
88 EA	58	28-Nov-08	10:11	130 54.809'	12 30.361'		Piston Core/Van Veen Grab	Grey medium grained sand with silt. Uniform texture, with some small shell fragments.
89 EA	59	28-Nov-80	10:20	130 54.825'	12 30.238'		Van Veen Grab	Grey gravely sand with some silt and shells. Biota including worms
90 EA	60	28-Nov-08	10:45	130 54.676'	12 30.184'		Van Veen Grab	Veneer of brown fine grained sand above grey fine grained sand, No Biota
91 EA	61	28-Nov-08	10:56	130 54.663'	12 30.294'		Piston Core/Van Veen Grab	Grey gravely sand with some silt. Some shell fragments, no biota
92 EA	62	28-Nov-08	11:15	130 54.301'	13 30.426'		Piston Core/Van Veen Grab	Coarse brown/orange sand with shell grit.
93 EA	63	28-Nov-08	11:29	130 54.279'	12 30.477'		Piston Core/Van Veen Grab	Fine grained grey silty sand with some small shell fragments
94 EA	64	28-Nov-08	12:52	130 54.279'	12 30.477'	Triplicate	Piston Core/Van Veen Grab	Fine grained grey sand with a light brown veneer of brown fine grained sand. Some small shell fragments.
95 EA	65	28-Nov-08	13:20	130 53.748'	12 30.288'		Piston Core/Van Veen Grab	Grey gravely sand with some silt and shell fragments.
96 EA	66	28-Nov-08	13:44	130 53.539'	12 30.040'		Piston Core/Van Veen Grab	Coarse brown orange sand and shell grit. Uniform consistency
97 EA	67	28-Nov-08	14:05	130 52.873'	12 29.986'		Piston Core/Van Veen Grab	Rocky gravel with grey silt and fine sand. Some shell fragments.
98 EA	68	28-Nov-08	14:20	130 52.937'	12 29.821'		Piston Core/Van Veen Grab	Brown medium grained sand and shell grit. Some patches with black medium grained sand.
99 EA	69	29-Nov-08	6:26	130 54.750'	12 30.409'		Piston Core/Van Veen Grab	Brown coarse sand with grey silt and gravel. Small shell fragments, no biota. Three attempts to get the required amount of sediment to sample. First attempt collected rubble, with some algae and biota. Second attempt collected some sandy sediment however, not enough for a sample.
100 EA	70	29-Nov-08	6:50	130 53.281'	12 30.017'		Piston Core/Van Veen Grab	Brown/red veneer of gravely sand above a grey sandy silt. Some shell fragments, no biota.
101 EA	71	29-Nov-08	7:00	130 53.059'	12 29.988'		Piston Core/Van Veen Grab	Rocky gravel with some grey silty sand. Biota including soft coral. First attempt collected rock, hard and soft corals, crabs and worms.
102 EA	72	29-Nov-08	7:30	130 52.760'	12 29.790'		Piston Core/Van Veen Grab	Brown sandy gravel with rock above grey sandy gravel. Some small shell fragments, no biota. First attempt collected rocky gravel - Not sufficient to sample.
103 EA	73	29-Nov-08	7:43	130 52.594'	12 29.770'		Piston Core/Van Veen Grab	Grey sandy gravel with rock and silt. First attempt collected one large rock with encrusting biota - Not sufficient to sample
104 EA	74	29-Nov-08	8:00	130 52.520'	12 29.512'	Triplicate	Van Veen Grab	Grey sandy gravel with rock and silt. Some shell fragments, no biota
105 EA	75	29-Nov-08	8:40	130 52.593'	12 29.662'		Piston Core/Van Veen Grab	Veneer of brown gravely sand above grey rocky gravel, with sand and silt. Some shells, no biota.
106 EA	76	29-Nov-08	9:05	130 52.431'	12 29.551'		Piston Core/Van Veen Grab	Veneer of brown gravely sand above grey rocky gravel, with sand and silt. Some shells, no biota.
107 EA	77	29-Nov-08	9:43	130 52.375'	12 29.448'	Duplicate	Van Veen Grab	Grey gravel with rock, sand and silt. Some shell fragments, no biota.
108 EA	78	29-Nov-08	10:05	130 52.307'	12 29.551'		Piston Core/Van Veen Grab	Grey gravel with rock, sand and silt. Some shell fragments and biota
109 EA	79	29-Nov-08	10:30	130 52.159'	12 29.378'		Van Veen Grab	Brown/red veneer of gravel above grey gravel with rock, sand and silt. Some shell fragments and biota

Note: Where both methods were used, the sample was collected using the Van Veen Grab
At sites where sampling comprised multiple attempts, the location of the actual sampling site is provided.
ASS Acid Sulfate Soil

Table 2: Surface sediment sampling sites for the proposed pipeline route, Darwin Harbour

Site ID	Sample ID	Date	Time	Longitude	Latitude	Duplicate/ Triplicate	Sampling Method	Sediment samples taken
110 P	7	08-Mar-08	9:00	130 52.117'	12 32.174'		Van Veen Grab	Course grain sand veneer over grey silt, small shell fragments, some black/ leaf material, generator running
111 P	8	08-Mar-08	9:10	130 52.176'	12 32.172'		Van Veen Grab	Fine grey silt, brown silt fines, no shell, black organic material (possible ASS), generators running.
112 P	11	08-Mar-08	10:00	130 51.282'	12 32.235'		Van Veen Grab	Shell and brown sand veneer over grey fine silt, shell fragments, no ASS material, generators running.
113 P	12.1	08-Mar-08	10:45	130 49.584'	12 31.435'	Triplicate	Van Veen Grab	Coarse sand veneer over grey silt, shell fragments, generators running.
114 P	22	09-Mar-08	13:55	130 48.468'	12 29.412'		Van Veen Grab	Light brown/red coarse sand, homogenous, shall fragments, some biota, generators running
115 P	23	09-Mar-08	14:15	130 48.313'	12 28.467'		Van Veen Grab	Light brown/red shell grit and coarse sand. No biota, generators running
116 P	24	12-Mar-08	15:50	130 47.902'	12 26.451'		Van Veen Grab	Light brown shell gravel, coarse, no biota, generators running, some large fragments (3-6 cm).
117 P	1	22-Nov-08	18:00	130 48.796'	12 29.389'		Piston Core	Grey silty sand, with silt layer at 20 - 35 cm, some shell fragments, gravel and rock. No biota
118 P	-	22-Nov-08	18:29	130 48.525'	12 29.816'		Van Veen Grab	No Sample
119 P	2	23-Nov-08	6:45	130 38.943'	12 29.698'		Piston Core	Grey/green mottled clay, with veneer of sand/gravel. No biota
120 P	3	23-Nov-08	7:10	130 49.217'	12 30,273'		Piston Core	Grey sandy gravel, over a red clayey gravel. No shell fragments or biota
121 P	4	23-Nov-08	8:50	130 50.068'	12 31.795'	Duplicate	Piston Core	Grey/green mottled clay overlain by sandy gravely clay. No shell fragments or biota
122 P	5	23-Nov-08	10:10	130 50.173'	12 31.853'		Piston Core	Grey clay with sand and gravel. Soft mud with no shell fragments or biota. Two attempts required to recover sample.
123 P	6(0-0.5)	23-Nov-08	10:55	130 50.379'	12 31.910'		Piston Core	Grey sand with gravel and clay. Some shell fragments, no biota
124 P	7	23-Nov-08	12:30	130 51.153'	12 31.889	Triplicate	Piston Core	Grey sand with gravel and clay. Some shell grit, no biota
125 P	8	24-Nov-08	6:40	130 48.750'	12 29.263'		Piston Core/Van Veen Grab	Grey sandy silt with gravel and rock. No shell or biota
126 P	9	24-Nov-08	7:20	130 48.186'	12 28.117'		Piston Core/Van Veen Grab	First attempt: Some sand and shell grit. Biota including soft coral. Second Attempt: Gravely rock with silty sand, shell fragments and soft corals.
127 P	-	24-Nov-08	8:10	130 47.936'	12 27.679'		Van Veen Grab	No recovery of sample
128 P	10	24-Nov-08	8:17	130 47.584'	12 27.312'		Piston Core/Van Veen Grab	Red gravely rock with grey silty sand. Some shells, no biota.
129 P	11	24-Nov-08	8:35	130 47.441	12 27.108'		Piston Core/Van Veen Grab	Rocky gravel, with coarse red/brown sand. Shell fragments, no biota.
130 P	-		8:56	130 46.149	12 25.458'		Van Veen Grab	Red/brown rock with encrusting biota - No Sample
131 P	12	24-Nov-08	9:45	130 46.060	12 25.371'	Triplicate	Piston Core/Van Veen Grab	Grey rocky gravely silt. Some encrusting biota noted.
132 P	-	24-Nov-08	10:20	130 48.557	12 28.807'		Van Veen Grab	Rock covered with encrusting biota, located on a shoal - No sample
133 P	13	24-Nov-08	10:39	130 49.144'	12 30.158'	Duplicate	Piston Core/Van Veen Grab	Grey gravely sandy silt, with dark grey patched. Shell fragments and biota including worms and small octopus.
134 P	14	24-Nov-08	11:05	130 49.414'	12 30.644		Piston Core/Van Veen Grab	Grey sandy gravel with silt and clay. Biota including crabs and worms.
135 P	15	24-Nov-08	11:25	130 49.708'	12 31.281'		Piston Core/Van Veen Grab	Grey sandy gravel with silt and clay. Some shell fragments and biota including worms.
136 P	16	24-Nov-08	12:45	130 49.296'	12 30.451'		Piston Core/Van Veen Grab	Grey/red soft sandy gravel, some biota and shell fragments.
137 P	17	24-Nov-08	13:30	130 49.503	12 30,847		Piston Core/Van Veen Grab	Veneer of red coarse sand over grey silty clay. Shell fragments, no biota
138 P	18	24-Nov-08	13:35	130 49.921	12 31.601'		Piston Core/Van Veen Grab	Grey clay with some shell fragments. No biota
139 P	19	24-Nov-08	13:55	130 50.926'	12 32.015'		Piston Core/Van Veen Grab	Red/grey sand with gravel and shell fragments. Biota including a crab
140P	10	08-Mar-08	9:40	130 51.389'	12 32.141'		Van Veen Grab	Very fine brown to grey silt, homogenous. No shells, generators running.

Note: Where both methods were used, the sample was collected using the Van Veen Grab
At sites where sampling comprised multiple attempts, the location of the actual sampling site is provided.

ASS Acid Sulfate Soil

Table 3: Surface sediment sampling sites for the shore crossing, Darwin Harbour

Site ID	Sample ID	Date	Time	Longitude	Latitude	Duplicate/ Triplicate	Sampling Method	Sediment samples taken
141 SC	9	08-Mar-08	9:25	130 52.267'	12 32.163'		Van Veen Grab	Thin brown sand veneer over dark grey silt. Whole shells present, generators running, No ASS material.
142 SC	20	24-Nov-08	14:10	130 52.236'	12 32.133'		Piston Core/Van Veen Grab	Grey silty clay with fine sand. Shell fragments, no biota
143 SC	1D	11-Jun-08	9:05	130 52.475'	12 32.284'		Van Veen Grab	Light grey silt, homogeneous, light brown veneer, full successful grab, slightly anoxic
144 SC	2D	11-Jun-08	9:18	130 52.485'	12 32.149'		Van Veen Grab	Light grey silt, homogeneous, light brown veneer, full successful grab, slightly anoxic smell
145 SC	3D	11-Jun-08	9:32	130 52.497'	12 32.014'		Van Veen Grab	Light grey silt, homogeneous, light brown veneer, full successful grab, slightly anoxic, crab and worm present
146 SC	4D	11-Jun-08	11:13	130 52.362'	12 32.004'		Van Veen Grab	Light brown veneer over light grey silt homogeneous matrix
147 SC	5D	11-Jun-08	11:28	130 52.350'	12 32.138'		Van Veen Grab	Very fine sand, light brown veneer over light grey silt
148 SC	6D	11-Jun-08	11:40	130 52.339'	12 32.273'		Van Veen Grab	Very fine sand, light brown veneer over light grey silt
149 SC	7D	11-Jun-08	12:00	130 52.285'	12 31.994'		Van Veen Grab	Very fine sand, light brown veneer over light grey silt
150 SC	8D	11-Jun-08	13:45	130 52.213'	12 32.128'		Van Veen Grab	Very fine sand, light brown veneer over light grey silt
151 SC	9D	11-Jun-08	13:32	130 52.203'	12 32.263'		Van Veen Grab	Thin light brown veneer over coarse grey gravel in a grey silt matrix

Note: Where both methods were used, the sample was collected using the Van Veen Grab
At sites where sampling comprised multiple attempts, the location of the actual sampling site is provided.
ASS Acid Sulfate Soil

Table 4: Subsurface sampling location descriptions

SITE ID	Sample ID	Area	DATE	Sample Depth (mBGL)	Latitude	Longitude	Seabed Level (mLAT)	Sediment Description
1EASS	NSBH08_1.5-1.95_8/09/2008	East Arm	08-Sep-08	1.5-1.95	12 30.270'	130 54.396'	0.3	Grey-brown silt
	NSBHO8_3.5-3.95_9/09/2008		09-Sep-08	3.5-3.95				Clayey silt. Reddish brown
2EASS	NSBH10_0.5-1.5_6/09/2008	East Arm	06-Sep-08	0.5-1.5	12 30.314'	130 54.507'	0.5	Silt- light grey with red/purple & yellow layers. Fine
	NSBH10_1.5-3.0_6/09/2008		06-Sep-08	1.5-3.0				Fine silt, grey with organic matter. Some clay
	NSBH10_3.0-13.5_6/09/2008		06-Sep-08	3.0-13.5				Clayey silt, grey with orange/brown. Some red friable rock
3EASS	NSBH12_1.5-3.0	East Arm	16-Oct-08	1.5-3.0	12 30.421'	130 55.324'	0.9	NA
	NSBH12_3.0-5.25		16-Oct-08	3.0-5.25				NA
4EASS	NSBH13_0.5-1.5_20/10/2008	East Arm	20-Oct-08	0.5-1.5	12 30.441'	130 55.285'	2.0	Silty mud, grey with organic matter. >2 m rock
5EASS	DCBHO1_0.5-1.5_25/09/08	East Arm	25-Sep-08	0.5-1.5	12 30.289'	130 52.110'	-13.7	Grey/brown silt and red brown rock
	DCBHO1_2.0-3.0_25/09/08		25-Sep-08	1.5-3.0				Grey/brown silt and red brown rock
6EASS	No Sample	East Arm	23-Sep-08	-	12 29.278'	130 52.237'	-5.1	No sample taken due to rocky substrate
7EASS	DCBHO3_0.6-1.5_24/09/08	East Arm	24-Sep-08	3	12 29.435'	130 52.345'	-11.4	Clayey silt, red/brown. Medium size rocks
8EASS	DCBHO4_1.0-1.5_27/09/08	East Arm	27-Sep-08	1.0-1.5	12 30.070'	130 52.579'	-13.2	Siltstone, white and mottled red/brown
	DCBHO4_2.5_27/09/08		27-Sep-08	1.5-2.5				Moist/wet siltstone, white and mottled red/brown
9EASS	DCBHO5_4.0-9.0_22/09/08	East Arm	22-Sep-08	1.5-3.0	12 30.079'	130 53.248'	-3.5	Silty sand with some clay, light yellow to grey contains shell fragments.
10EASS	DCBHO6_6.0-9.0_21/09/08	East Arm	21-Sep-08	3	12 30.180'	130 54.023'	-1.6	Sandy silt with some clay and shell, increase clay with depth.
11EASS	DCBHO7_4.0-17.0_26/09/08	East Arm	26-Sep-08	1.5-3.0	12 30.153'	130 54.490'	0.5	Sandy silt, fine with some shell fragments
12EASS	DCBHO8_0.5-1.5_19/09/08	East Arm	19-Sep-08	0.5-1.5	12 30.115'	130 54.402'	-4.0	Grey silt, mud
	DCBHO8_1.5-3.0_19/09/08		19-Sep-08	1.5-3.0				Grey silt, mud
	DCBHO8_3.0-9.0_19/09/08		19-Sep-08	3.0-9.0				Sandy clay. > 9 m phyllite rock
13EASS	DCBHO9_1.6-2.0	East Arm	20-Oct-08	1.6-2.0	12 30.110'	136 55.060'	NA	Fine sand, dark grey
	DCBHO9_2.5-3.0		20-Oct-08	2.5-3.0				Medium to coarse sand, some gravel
	DCBHO9_3.0-3.5		20-Oct-08	3.0-3.5				Gravel. >3.5 m siltstone and phyllite rock
71EASS	41(0.5-1)	East Arm	27-Nov-08	0.5-1	12 30.782'	130 55.959'	NA	Coarse grey sand with shell fragments
14PSS	No Sample	Pipeline	11-Oct-08	-	12 32.040'	130 50.528'	-9.0	No sample taken due to rocky substrate
15PSS	PLBHO3_0.5-1.5	Pipeline	10-Oct-08	0.5-1.5	12 28.478'	130 48.330'	-6.0	Clay, reddish and mottled grey
	PLBHO3_1.5-3.0		10-Oct-08	1.5-3.0				Clayey sand, red-brownish
	PLBHO3_3.0-		10-Oct-08	3				Sandy silt, red/grey/brown
16PSS	PLBHO4_1.5-3.0	Pipeline	08-Oct-08	1.5-3.0	12 27.427'	130 47.555'	-4.0	Coarse gravel
	PLBHO4_3.0-6.5		08-Oct-08	3.0-6.5				Medium to coarse brown/pale grey with clay
17PSS	PLBHO5_0.5	Pipeline	09-Oct-08	0.5	12 26.081'	130 46.369'	-5.0	Red brown clayey silt
	PLBHO5_4.0-10.0		09-Oct-08	4.0-10.0				Sandy silt, grey/yellow with fragments of reddish material, increasing clay content with increasing depth
123PSS	6(0.5-1)	Pipeline	23-Nov-08	0.5-1	12 31.910'	130 50.379'	NA	Grey sand with gravel and clay. Some shell fragments
18SCSS	PLBHO1_0.5-1.5	Shore Crossing	11-Oct-08	0.5-1.5	12 32.081'	130 52.207'	2.0	Grey silt mud
	PLBHO1_1.5-3.0		13-Oct-08	1.5-3.0				Grey silt mud, organic matter
	PLBHO1_3.0-		13-Oct-08	3				Silt brown yellow, organic material , brown red clay >8 m

mBGL meters Below Ground Level
mLAT meters Lowest Astronomical Tide

		Moisture Content	Antimony Sb	Arsenic As	Arsenic[t] As[t]	Cadmium Cd	Chromium Cr	Cobalt Co	Copper Cu	Iron Fe	Lead Pb	Manganese Mn	Nickel Ni	Silver Ag	Mercury Hg	Zinc Zn
	UNIT	%	mg/kg													
	PQL[a]	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.01	0.1
	Screening[b]		2.0	20.0	20.0	1.5	80.0	NG	65.0	NG	50.0	NG	21.0	1.0	0.15	200.0
	Maximum[c]		25.0	70.0	70.0	10.0	370.0	NG	270.0	NG	220.0	NG	52.0	3.7	1	410.0
Site ID	Sample ID															
1EA	1	21.4	0.3	54.0	<1.0	<1.0	44.0	7.0	<5.0	40600.0	10.0	346.0	6.0	<2	<0.01	17.0
2EA	2	30.4	<0.1	19.0	-	<1.0	17.0	3.0	<5.0	14900.0	5.0	199.0	4.0	<2	<0.01	12.0
3EA	3	28.4	0.4	38.0	1.2	<1.0	9.0	3.0	<5.0	15400.0	<5.0	524.0	<2.0	<2	<0.01	<5
4EA	4	45.8	<0.1	15.0	-	<1.0	31.0	6.0	<5.0	19100.0	8.0	217.0	7.0	<2	0.01	18.0
5EA	5	30.9	<0.1	26.0	-	<1.0	27.0	5.0	<5.0	26600.0	8.0	266.0	5.0	<2	<0.01	14.0
6EA	6	38.9	0.3	45.0	1.1	<1.0	34.0	8.0	<5.0	38900.0	10.0	542.0	6.0	<2	<0.01	14.0
7EA	13	40.9	<0.1	15.0	-	<1.0	24.0	4.0	<5.0	18100.0	6.0	218.0	5.0	<2	<0.01	14.0
8EA	14	31.3	<0.1	23.0	-	<1.0	16.0	3.0	<5.0	17800.0	<5.0	162.0	3.0	<2	<0.01	9.0
9EA	15	21.0	0.5	40.0	<1.0	<1.0	18.0	5.0	<5.0	30600.0	<5.0	389.0	2.0	<2	<0.01	6.0
10EA	16.1[d]	36.9	<0.1	16.0	-	<1.0	18.0	4.0	<5.0	15800.0	6.0	178.0	4.0	<2	<0.01	12.0
10EA	16.2[d]	38.1	<0.1	14.0	-	<1.0	18.0	4.0	<5.0	14500.0	5.0	177.0	4.0	<2	<0.01	12.0
11EA	17	26.6	0.3	137.0	<1.0	<1.0	56.0	10.0	<5.0	116000.0	26.0	485.0	5.0	<2	<0.01	12.0
12EA	18	17.8	0.4	28.0	<1.0	<1.0	11.0	3.0	<5.0	16000.0	<5.0	396.0	<2.0	<2	<0.01	<5
13EA	19	26.4	0.1	21.0	-	<1.0	14.0	3.0	<5.0	15400.0	<5.0	140.0	<20	<2	<0.01	8.0
14EA	20	29.0	0.1	41.0	1.1	<1.0	41.0	5.0	<5.0	39600.0	10.0	172.0	5.0	<2	<0.01	16.0
15EA	21.1[e]	27.3	0.3	47.0	-	<1.0	33.0	5.0	<5.0	37200.0	7.0	155.0	3.0	<2	<0.01	8.0
15EA	21.2[e]	26.7	0.2	63.0	-	<1.0	39.0	7.0	<5.0	47400.0	8.0	258.0	4.0	<2	<0.01	10.0
15EA	21.3[e]	27.3	0.2	43.0	-	<1.0	28.0	4.0	<5.0	37800.0	7.0	156.0	3.0	<2	<0.01	10.0
16EA	25	44.4	<0.1	17.0	-	<1.0	17.0	4.0	<5.0	14300.0	7.0	320.0	4.0	<2	0.02	15.0
17EA	26	49.2	<0.1	14.0	-	<1.0	31.0	6.0	6.0	19000.0	10.0	244.0	8.0	<2	0.01	24.0
18EA	27.1[e]	32.0	<0.1	18.0	-	<1.0	25.0	3.0	<5.0	17700.0	6.0	178.0	3.0	<2	<0.01	11.0
18EA	27.2[e]	28.3	0.2	23.0	-	<1.0	51.0	3.0	<5.0	33900.0	8.0	204.0	2.0	<2	<0.01	8.0
18EA	27.3[e]	29.6	0.3	24.0	-	<1.0	67.0	4.0	<5.0	38500.0	9.0	182.0	3.0	<2	<0.01	10.0
19EA	28	29.5	0.6	36.0	-	<1.0	15.0	4.0	<5.0	20300.0	<5.0	627.0	2.0	<2	<0.01	<5
20EA	D10	31.9	<0.1	11.3	-	<0.1	14.8	3.5	2.0	11700.0	5.3	152.0	3.2	<0.1	<0.01	9.9
21EA	D11	30.3	0.1	25.7	-	<0.1	23.6	4.6	1.9	21900.0	6.8	225.0	3.8	<0.1	<0.01	9.6
22EA	D12.1[d]	42.4	<0.1	17.4	-	<0.1	26.5	5.4	3.5	23800.0	9.3	408.0	5.4	<0.1	0.01	17.4
22EA	D12.2[d]	41.1	<0.1	12.6	-	<0.1	22.0	5.5	3.1	16700.0	7.4	404.0	5.3	<0.1	<0.01	16.0
23EA	D13.1[e]	42.9	<0.1	12.6	-	<0.1	17.4	4.5	2.8	10800.0	6.7	178.0	4.6	<0.1	0.01	13.9
23EA	D13.2[e]	47.1	<0.1	12.7	-	<0.1	23.6	5.5	3.7	13000.0	8.1	247.0	6.0	<0.1	<0.01	18.2
23EA	D13.3[e]	42.9	<0.1	13.8	-	<0.1	19.7	4.8	2.9	12000.0	7.4	228.0	4.7	<0.1	0.01	14.8
24EA	D14	38.6	<0.1	10.6	-	0.1	13.5	3.8	2.2	9340.0	6.2	232.0	3.3	<0.1	<0.01	11.9
25EA	D15	33.8	<0.1	14.2	-	<0.1	12.5	4.0	1.8	9590.0	5.5	217.0	3.0	<0.1	<0.01	10.2
26EA	D16	25.4	<0.1	7.2	-	<0.1	7.8	3.1	1.2	5760.0	3.2	131.0	2.0	<0.1	<0.01	7.6
27EA	D17	32.5	0.1	31.2	-	<0.1	57.0	7.7	3.7	36400.0	12.2	210.0	7.3	<0.1	0.02	16.1
28EA	D18.1[e]	22.0	0.2	46.4	-	<0.1	71.1	6.1	2.1	46800.0	9.8	184.0	4.2	<0.1	<0.01	9.0
28EA	D18.2[e]	24.8	0.3	45.4	-	<0.1	50.0	8.0	3.2	45600.0	10.2	190.0	4.6	<0.1	<0.01	10.7
28EA	D18.3[e]	22.3	0.3	55.2		<0.1	85.0	8.3	3.3	57000.0	10.5	211.0	5.0	<0.1	<0.01	10.7
29EA	D19	22.0	0.1	8.3	-	<0.1	11.6	1.4	1.1	9210.0	2.6	50.3	1.3	<0.1	<0.01	4.9
30EA	D20	25.0	0.4	63.9	-	<0.1	55.7	7.7	2.1	58000.0	11.2	222.0	4.0	<0.1	<0.01	7.8
31EA	D21	30.9	0.2	44.2	-	<0.1	57.3	6.7	3.5	46400.0	12.4	179.0	5.4	<0.1	<0.01	12.8
32EA	D22	22.4	0.5	68.0	-	<0.1	72.3	14.0	3.4	57700.0	10.6	189.0	5.1	<0.1	<0.01	10.2
33EA	D23.1[e]	25.9	0.3	52.7	-	<0.1	90.4	7.5	2.8	49800.0	10.0	203.0	4.8	<0.1	<0.01	10.1
33EA	D23.2[e]	20.2	0.2	46.7	-	<0.1	35.7	4.9	2.0	35400.0	7.2	147.0	3.3	<0.1	<0.01	8.6
33EA	D23.3[e]	25.0	0.5	68.5	-	<0.1	57.3	7.2	2.8	53700.0	10.1	188.0	4.2	<0.1	<0.01	8.7
34EA	D24	21.6	0.3	49.2	-	<0.1	53.7	7.5	2.8	52500.0	11.4	224.0	4.2	<0.1	<0.01	9.8
35EA	D25	27.7	0.3	72.1	-	<0.1	58.4	8.2	2.7	59800.0	12.7	244.0	5.6	<0.1	<0.01	12.4
36EA	D26	32.9	<0.1	7.3	-	<0.1	16.0	3.8	2.5	9220.0	5.4	99.4	4.1	<0.1	<0.01	11.7
37EA	D27.1[e]	20.4	0.4	61.8	-	<0.1	62.1	6.8	1.9	55300.0	10.7	266.0	3.9	<0.1	<0.01	8.2
37EA	D27.2[e]	21.3	0.5	48.9	-	<0.1	127.0	7.4	3.4	74500.0	16.7	274.0	4.8	<0.1	<0.01	11.0
37EA	D27.3[e]	20.2	0.4	60.7	-	<0.1	58.6	7.5	2.2	58600.0	11.7	277.0	3.8	<0.1	<0.01	8.3
38EA	D28.1[d]	26.1	0.2	27.2	-	<0.1	27.6	3.9	1.8	23100.0	5.8	164.0	3.0	<0.1	<0.01	7.8
38EA	D28.2[d]	25.0	0.3	32.4	-	<0.1	44.8	4.4	1.9	28800.0	6.7	144.0	3.1	<0.1	<0.01	7.2
39EA	D29	22.7	0.2	21.6	-	<0.1	23.2	3.2	1.6	20400.0	3.6	150.0	2.3	<0.1	<0.01	6.0
40EA	D30	28.5	0.2	25.6	-	<0.1	44.2	8.1	3.0	27500.0	7.9	224.0	5.0	<0.1	<0.01	11.1
41EA	D31	45.0	<0.1	13.0	-	<0.1	24.0	6.0	3.5	16000.0	8.1	298.0	6.3	<0.1	<0.01	17.3
42EA	D32	28.9	0.2	21.2	-	<0.1	78.2	6.1	5.8	42200.0	10.1	236.0	5.7	<0.1	<0.01	10.1
43EA	D33	21.3	0.2	20.7	-	<0.1	40.2	2.6	1.6	19200.0	3.7	143.0	2.2	<0.1	<0.01	6.0
44EA	D34	37.6	<0.1	13.8	-	<0.1	16.8	4.7	2.7	11300.0	6.1	193.0	4.5	<0.1	<0.01	12.4
45EA	D35	51.8	<0.1	10.4	-	<0.1	27.6	5.7	4.5	15700.0	8.6	156.0	7.4	<0.1	0.01	22.7
46EA	D36	30.5	0.1	11.2	-	<0.1	45.0	2.9	8.2	31600.0	12.8	80.2	3.9	<0.1	<0.01	45.1
47EA	D37	25.7	<0.1	9.2	-	<0.1	27.9	2.6	2.3	17300.0	4.7	56.3	3.0	<0.1	<0.01	12.7
48EA	D38	19.6	0.2	8.6	-	<0.1	21.4	0.7	1.2	13200.0	2.8	10.0	0.6	<0.1	<0.01	4.4
49EA	21	30.3	<0.5	44.7	-	<0.1	16.9	1.2	4.2	17300.0	3.6	822.0	2.6	<0.1	0.03	4.0
50EA	22	32.9	<0.5	15.2	-	<0.1	26.6	6.5	4.9	19000.0	7.9	150.0	7.4	<0.1	0.02	13.9
51EA	23	22.0	<0.5	34.4	-	<0.1	49.1	5.3	9.0	46000.0	13.3	205.0	6.6	<0.1	<0.01	13.4
52EA	24	27.1	0.7	22.8	-	<0.1	18.9	2.7	8.4	15600.0	4.6	108.0	6.9	<0.1	<0.01	8.5
53EA	25	37.0	<0.5	24.0	-	<0.1	56.0	3.2	6.6	32200.0	10.4	388.0	5.8	<0.1	<0.01	11.8
54EA	26	34.7	<0.5	20.8	-	<0.1	75.9	3.2	7.6	29400.0	10.8	301.0	6.8	<0.1	0.01	12.0
55EA	27	23.6	<0.5	18.6	-	<0.1	33.7	1.6	4.2	16000.0	4.6	250.0	2.8	<0.1	<0.01	6.0
55EA	T5	25.4	<0.5	20.4	-	<0.1	48.5	2.5	4.3	18400.0	4.9	299.0	3.7	<0.1	<0.01	8.3
55EA	T6	24.4	<0.5	18.4	-	<0.1	15.1	1.7	3.6	13100.0	3.8	252.0	2.5	<0.1	<0.01	5.8
56EA	28	34.2	<0.5	20.9	-	<0.1	18.7	2.4	4.2	15100.0	5.7	235.0	4.0	<0.1	0.01	7.4
57EA	29	23.6	<0.5	20.2	-	<0.1	19.7	2.7	4.7	18100.0	4.9	408.0	3.8	<0.1	<0.01	7.0
58EA	30	26.6	<0.5	23.0	-	<0.1	36.9	2.8	5.2	20200.0	5.1	454.0	4.3	<0.1	0.01	8.4
59EA	31	46.9	<0.5	18.5	-	<0.1	34.8	4.4	7.0	19100.0	8.4	258.0	8.9	<0.1	0.01	14.1
60EA	32	24.8	0.8	46.2	-	<0.1	54.2	2.0	6.6	57000.0	23.9	407.0	5.4	<0.1	<0.01	7.0
61EA	33	24.0	<0.5	26.6	-	<0.1	66.7	3.2	4.3	25800.0	6.0	775.0	3.5	<0.1	0.02	5.9
62EA	34	16.8	0.7	58.8	-	<0.1	29.8	1.9	6.4	27400.0	6.7	626.0	4.0	<0.1	<0.01	4.1
63EA	35[d]	27.7	7.4	110.0	-	<0.1	29.4	4.6	8.7	31800.0	5.7	1050.0	5.6	<0.1	<0.01	6.5
63EA	QC03[d]	22.0	0.6	57.1	-	<0.1	16.9	1.6	5.6	20400.0	4.1	844.0	3.6	<0.1	<0.01	4.0
64EA	36	34.8	<0.5	53.1	-	<0.1	75.4	7.5	9.5	74600.0	21.1	376.0	11.0	<0.1	<0.01	22.4
65EA	37	45.0	<0.5	15.2	-	<0.1	41.9	6.5	7.6	26100.0	10.7	240.0	11.2	<0.1	<0.01	18.4
66EA	38	28.9	<0.5	24.9	-	<0.1	45.3	3.6	8.5	27700.0	9.2	258.0	7.1	<0.1	0.01	13.6
67EA	39[e]	30.2	<0.5	50.3	-	<0.1	32.8	1.9	5.6	25800.0	7.0	299.0	4.9	<0.1	0.02	6.2
67EA	T7[e]	27.7	0.6	64.6	-	<0.1	39.3	3.4	6.3	45700.0	12.5	433.0	4.6	<0.1	<0.01	7.4
67EA	T8[e]	22.8	0.9	70.0	-	<0.1	60.7	3.0	7.2	60100.0	23.6	431.0	5.1	<0.1	<0.01	6.6
68EA	40	25.3	1.0	63.9	-	<0.1	17.9	1.1	5.6	20500.0	3.7	1240.0	2.6	<0.1	<0.01	3.6
71EA	41 (0-0.5)	19.8	1.1	27.8	-	<0.1	40.8	3.0	5.0	35000.0	5.1	314.0	3.5	<0.1	<0.01	6.8

Table 5: Summary of surface sediment results for metals in East Arm

Site ID	Sample ID	Moisture Content	Antimony Sb	Arsenic As	Arsenic[t] As[t]	Cadmium Cd	Chromium Cr	Cobalt Co	Copper Cu	Iron Fe	Lead Pb	Manganese Mn	Nickel Ni	Silver Ag	Mercury Hg	Zinc Zn
	UNIT	%	mg/kg													
	PQL[a]	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.01	0.1
	Screening[b]		2.0	20.0	20.0	1.5	80.0	NG	65.0	NG	50.0	NG	21.0	1.0	0.15	200.0
	Maximum[c]		25.0	70.0	70.0	10.0	370.0	NG	270.0	NG	220.0	NG	52.0	3.7	1	410.0
72EA	42	29.7	<0.5	16.5	-	<0.1	14.7	1.7	3.4	13500.0	3.3	167.0	2.8	<0.1	<0.01	8.5
73EA	43	30.6	<0.5	16.0	-	<0.1	17.3	2.5	4.0	14100.0	6.0	210.0	3.7	<0.1	0.01	10.9
74EA	44	34.7	<0.5	14.3	-	0.8	17.6	13.5	4.1	18400.0	7.4	76.0	3.5	<0.1	0.04	15.6
75EA	45	23.7	<0.5	17.9	-	<0.1	18.9	2.2	3.8	14100.0	3.7	128.0	3.3	<0.1	<0.01	6.9
76EA	46	46.9	<0.5	17.3	-	<0.1	28.9	4.0	6.3	17600.0	8.3	205.0	7.1	<0.1	0.01	12.9
77EA	47	19.2	<0.5	38.8	-	<0.1	47.2	12.4	12.2	76600.0	18.4	505.0	11.8	<0.1	0.01	16.3
78EA	48[d]	25.2	1.0	48.7	-	<0.1	97.8	2.3	5.1	53400.0	7.7	195.0	3.0	<0.1	<0.01	8.9
78EA	QC04[d]	25.8	0.6	25.0	-	<0.1	19.8	<1.0	4.0	14200.0	4.0	155.0	1.6	<0.1	<0.01	3.7
79EA	49	25.4	<0.5	36.0	-	<0.1	75.2	7.4	11.6	69300.0	14.7	209.0	14.1	<0.1	0.01	30.7
80EA	50	16.8	0.6	12.4	-	<0.1	44.3	3.1	2.1	28900.0	3.8	90.0	2.0	<0.1	<0.01	6.4
81EA	51	38.2	<0.5	11.9	-	<0.1	14.5	2.4	5.2	9370.0	5.2	79.0	4.0	<0.1	0.02	9.8
82EA	52	22.5	<0.5	9.1	-	<0.1	13.9	1.5	2.4	9080.0	3.1	54.0	2.0	<0.1	<0.01	5.8
83EA	53[e]	21.6	<0.5	26.9	-	<0.1	16.5	2.4	4.6	24000.0	4.2	233.0	3.6	<0.1	<0.01	7.7
83EA	T9[e]	20.0	<0.5	30.2	-	<0.1	26.6	3.0	5.9	24700.0	6.3	271.0	3.5	<0.1	<0.01	7.7
83EA	T10[e]	20.2	<0.5	35.2	-	<0.1	20.8	2.3	5.0	24000.0	3.9	323.0	3.2	<0.1	<0.01	5.3
84EA	54	21.5	0.5	36.6	-	<0.1	17.8	2.5	6.0	24900.0	5.0	557.0	2.8	<0.1	0.04	6.5
85EA	55	20.6	<0.5	25.9	-	<0.1	14.0	1.4	3.2	15300.0	3.2	241.0	1.6	<0.1	<0.01	5.3
86EA	56[e]	31.6	<0.5	57.4	-	<0.1	55.2	7.3	10.5	59900.0	14.4	310.0	9.4	<0.1	0.01	21.4
86EA	T11[e]	37.8	<0.5	56.6	-	<0.1	62.0	8.6	17.2	78500.0	27.4	329.0	12.4	<0.1	<0.01	31.6
86EA	T12[e]	31.7	<0.5	56.7	-	<0.1	42.9	7.5	10.8	57000.0	12.9	289.0	9.6	<0.1	<0.01	23.7
87EA	57	32.6	<0.5	38.0	-	<0.1	61.5	8.1	10.5	57000.0	15.9	209.0	10.3	<0.1	0.01	27.5
88EA	58	30.0	<0.5	17.2	-	<0.1	16.1	1.7	3.4	13200.0	4.3	175.0	2.5	<0.1	<0.01	7.2
89EA	59	34.7	<0.5	46.9	-	<0.1	49.5	4.0	6.6	65100.0	10.8	241.0	5.0	<0.1	0.01	10.0
90EA	60	27.6	<0.5	19.6	-	<0.1	17.7	2.1	3.8	14000.0	4.6	378.0	3.3	<0.1	0.25	8.2
91EA	61	26.0	<0.5	51.5	-	<0.1	123.0	2.7	9.5	86100.0	18.2	311.0	5.1	<0.1	0.02	9.3
92EA	62	20.0	0.6	44.4	-	<0.1	23.6	1.6	5.5	21300.0	4.3	882.0	2.8	<0.1	0.01	4.7
93EA	63	29.7	<0.5	15.3	-	<0.1	26.2	2.6	4.0	16100.0	4.9	185.0	4.1	<0.1	0.03	10.0
94EA	64[e]	27.8	<0.5	17.3	-	<0.1	29.8	2.8	3.9	13900.0	4.8	246.0	4.0	<0.1	0.04	8.5
94EA	T13[e]	29.0	<0.5	20.8	-	<0.1	24.2	2.6	5.0	17100.0	5.8	342.0	4.5	<0.1	<0.01	8.5
94EA	T14[e]	31.6	<0.5	19.9	-	<0.1	25.9	3.0	4.8	17600.0	6.3	368.0	4.2	<0.1	<0.01	9.5
95EA	65	27.5	<0.5	23.9	-	<0.1	28.6	5.4	4.8	24000.0	6.8	318.0	4.7	<0.1	<0.01	8.1
96EA	66	29.8	0.7	57.1	-	<0.1	33.4	1.5	5.4	22600.0	6.1	680.0	3.3	<0.1	<0.01	4.8
97EA	67	33.1	<0.5	41.2	-	<0.1	43.6	3.3	7.3	29300.0	10.8	297.0	5.8	<0.1	0.01	13.7
98EA	68	30.8	0.6	39.7	-	<0.1	14.5	1.3	4.0	16900.0	4.3	412.0	2.0	<0.1	0.02	4.5
99EA	69	25.5	<0.5	20.5	-	<0.1	13.2	1.4	3.4	12800.0	4.0	182.0	2.6	<0.1	0.04	6.3
100EA	70	24.7	0.9	55.6	-	<0.1	84.9	2.4	5.9	45600.0	18.1	314.0	4.9	<0.1	0.02	7.8
101EA	71	36.9	0.7	50.1	-	<0.1	288.0	3.4	32.8	80800.0	25.8	340.0	8.0	<0.1	0.01	16.9
102EA	72	28.8	<0.5	72.5	-	<0.1	82.4	3.4	9.6	53500.0	13.9	391.0	7.0	<0.1	0.01	13.3
103EA	73	33.4	<0.5	73.8	-	<0.1	65.5	3.5	9.2	50000.0	14.0	1090.0	7.0	<0.1	0.03	13.0
104EA	74[e]	29.6	<0.5	58.8	-	<0.1	61.2	3.4	8.6	60300.0	15.2	491.0	7.7	<0.1	0.17	13.8
104EA	T15[e]	31.9	<0.5	80.1	-	<0.1	22.2	3.4	9.0	45000.0	9.0	398.0	8.0	<0.1	<0.01	14.4
104EA	T16[e]	29.7	<0.5	66.6	-	<0.1	73.1	5.3	10.6	73900.0	16.9	375.0	10.7	<0.1	<0.01	18.9
105EA	75	33.7	<0.5	65.7	-	<0.1	63.8	3.7	9.6	57900.0	16.5	405.0	8.1	<0.1	0.05	16.9
106EA	76	24.9	0.80	47.3	-	<0.1	101.0	8.8	10.6	90900.0	22.5	362.0	11.0	<0.1	0.02	21.4
107EA	77[d]	36.4	<0.5	15.6	-	<0.1	47.0	5.5	7.9	22700.0	8.2	200.0	9.6	<0.1	0.02	18.3
107EA	QC05[d]	45.2	<0.5	18.2	-	<0.1	39.8	7.0	8.4	26400.0	10.7	255.0	9.6	<0.1	0.01	22.9
108EA	78	35.9	<0.5	62.4	-	<0.1	90.8	4.4	12.5	62600.0	19.2	362.0	8.8	<0.1	<0.01	17.6
109EA	79	34.5	<0.5	63.6	-	<0.1	53.8	4.3	7.3	36900.0	11.4	245.0	7.5	<0.1	<0.01	16.0
		Mean	0.5	33.3	1.1	0.3	40.1	4.4	5.4	31503.0	9.0	302.3	5.0	0.4	0.02	11.5
		95% UCL	0.6[j]	37.8[j]	N/A	N/A	45.4[j]	4.9[h]	6.1[j]	34914.0[j]	10.0[h]	335.9[j]	5.6[h]	N/A	0.02[s]	12.7[h]

a Practical Quantitation Limit (detection limit)
b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
d Field duplicate
e Field triplicate
f Analysed using a 1M HCL digest for an estimation of the bioavailable proportion of arsenic
h Data are lognormal and the UCL was calculated using 95% H-UCL
j Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method
s Data are normally distributed and the UCL was calculated using Student's t-Test method
t Analysis undertaken using a mild acid digest to estimate the bioavailable proportion
NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG No Guideline
\- Not Analysed

Table 5: Summary of surface sediment results for metals in East Arm

Table 6: Summary of subsurface sediment results for metals in East Arm

Site ID	Sample ID	Depth (m BGL)	Moisture Content	Aluminium	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Silver	Mercury	Zinc
		UNIT		mg/kg													
		PQL[a]		0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.1	0.01	0.1
		Screening[b]	%	NG	20.0	1.5	80.0	NG	65.0	NG	50.0	NG	NG	21.0	1.0	0.15	200.0
		Maximum[c]	1	NG	70.0	10.0	370.0	NG	270.0	NG	220.0	NG	NG	52.0	3.7	1	410.0
		1.5-1.95	11.9	2690.0	5.7	<0.1	25.9	0.5	2.7	24700.0	3.0	620.0	17.0	<0.1	<0.1	0.01	4.1
1EASS	NSBH08	3.5-3.95	17.0	2060.0	5.7	<0.1	33.2	1.6	7.0	24900.0	10.3	2000.0	253.0	4.6	<0.1	0.02	19.6
		0.5-1.5	14.6	2790.0	5.6	<0.1	8.8	3.8	1.7	3180.0	2.4	430.0	<10	3.1	<0.1	<0.01	20.4
		1.5-3.0	12.9	970.0	<1.00	<0.1	1.3	0.5	1.6	480.0	1.1	290.0	<10	<1.0	<0.1	<0.01	3.1
2EASS	NSBH10	3.0-3.5	16.0	1850.0	1.9	<0.1	20.8	12.4	52.2	25400.0	12.9	500.0	62.0	23.2	<0.1	<0.01	48.7
		1.5-3.0	39.7	9010.0	14.4	<0.1	37.3	6.9	5.5	32500.0	8.3	3460.0	123.0	6.4	<0.1	<0.01	9.9
3EASS	NSBH12	3-5.25	28.5	3770.0	1.3	<0.1	11.6	10.9	10.2	33200.0	8.4	2230.0	98.0	12.1	0.3	<0.01	38.8
4EASS	NSBH13	0.5-1.5	35.5	5520.0	6.9	<0.1	18.2	15.8	3.4	19800.0	4.9	2460.0	141.0	6.1	<0.1	<0.01	8.6
		0.5-1.5	19.2	1730.0	<1.0	<0.1	1.8	<0.5	<1.0	1610.0	<1.0	820.0	<10	<1.0	<0.1	<0.01	2.0
5EASS	DCBH01	2.0-3.0	16.3	730.0	<1.0	<0.1	<1..0	<0.5	3.0	1380.0	1.0	480.0	<10	<1.0	<0.1	0.01	2.0
7EASS	DCBH03	0.6-1.5	22.7	4460.0	1.8	<0.1	9.3	3.9	25.1	21200.0	1.9	1300.0	15.0	7.5	<0.1	0.01	28.3
		2.5	16.6	460.0	<1.0	<0.1	<1.0	<0.5	<1.0	130.0	<1.0	360.0	<10	<1.0	<0.1	<0.01	<1.0
8EASS	DCBH04	1.0-1.5	18.2	920.0	<1.0	<0.1	1.3	<0.5	<1.0	220.0	1.7	520.0	<10	<1.0	<0.1	<0.01	1.0
	DCBH05	4.0-9.0	25.0	13000.0	18.1	<0.1	40.9	3.8	6.1	28500.0	15.9	3850.0	77.0	3.6	<0.1	<0.1	9.0
9EASS	QC09	4.0-9.0	24.9	10700.0	57.1	<0.1	30.3	5.6	13.5	54400.0	33.7	3410.0	161.0	4.2	<0.1	<0.1	10.1
10EASS	DCBH06	6.0-9.0	20.2	1210.0	7.9	<0.1	10.8	1.6	16.8	23200.0	4.0	610.0	13.0	9.7	<0.1	<0.1	45.6
11EASS	DCBH07	4.0-17	18.4	6540.0	19.8	<0.1	20.6	13.3	5.3	26600.0	10.1	4020.0	185.0	10.3	<0.1	<0.01	20.5
		0.5-1.5	27.9	6180.0	34.6	<0.1	24.8	5.9	2.6	17500.0	5.4	6840.0	466.0	5.7	<0.1	0.1	9.8
		1.5-3.0	27.7	3820.0	32.9	<0.1	45.9	5.0	2.5	21200.0	5.2	5390.0	394.0	4.1	<0.1	<0.1	8.8
12EASS	DCBH08	3.0-9.0	24.2	3720.0	4.4	<0.1	23.5	13.6	21.1	41500.0	7.3	3150.0	135.0	14.4	0.1	<0.1	71.9
		1.6-2.0	33.5	2670.0	15.6	<0.1	12.6	2.8	5.1	12500.0	3.2	5110.0	120.0	2.6	0.4	<0.01	6.8
		2.5-3.0	34.5	8440.0	14.6	<0.1	23.9	5.4	2.9	15900.0	6.2	7770.0	191.0	6.1	<0.1	<0.01	12.3
13EASS	DCBH09	3.0-3.5	39.5	7470.0	35.6	<0.1	24.2	28.0	3.7	19600.0	7.1	6860.0	441.0	10.1	<0.1	<0.01	21.3
71EASS	41(0.5-1)	0.5-1	23.6	NA	23.6	<0.1	14.1	2.0	4.2	18200.0	2.6	NA	361.0	2.1	<0.1	<0.01	4.1
		Mean		4379.0	12.9	<0.1	18.4	6.0	8.2	19492.0	6.6	2717.0	136.8	5.8	0.1	0.02	17.0
		95% UCL		7544.0[h]	18.0[j]	N/A	23.0[s]	8.4[j]	17.46[h]	24326[s]	12.7[h]	3565.0[j]	188.2[j]	7.7[j]	N/A	0.03[j]	43.18[h]

a Practical Quantitation Limit (detection limit)
b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
h Data are lognormal and the UCL was calculated using 95% H-UCL
j Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method
s Data are normally distributed and the UCL was calculated using Student's t-Test method
NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG No Guideline
\- Not Analysed
Note: For calculation of mean and 95% UCL <PQL was taken as PQL
At sites where field duplicates and triplicates were taken, the data point for that site was represented by the mean concentration in all samples

Table 7: Summary of surface sediment results for metals in the pipeline route

Site ID	Sample ID	Moisture Content	Antimony Sb	Arsenic As	Arsenic[f] As	Cadmium Cd	Chromium Cr	Cobalt Co	Copper Cu	Iron Fe	Lead Pb	Manganese Mn	Nickel Ni	Silver Ag	Mercury Hg	Zinc Zn
	UNIT	%	mg/kg													
	PQL[a]	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.01	0.1
	Screening[b]		2.0	20.0	20.0	1.5	80.0	NG	65.0	NG	50.0	NG	21.0	1.0	0.15	200.0
	Maximum[c]		25.0	70.0	70.0	10.0	370.0	NG	270.0	NG	220.0	NG	52.0	3.7	1	410.0
110P	7	27.4	0.1	25.0	<1.0	<1.0	39.0	4.0	<5.0	31500.0	9.0	172.0	5.0	<2.0	<0.01	14.0
111P	8	43.2	<0.1	10.0	-	<1.0	23.0	5.0	<5.0	14200.0	8.0	209.0	6.0	<2.0	0.01	17.0
112P	11	29.2	<0.1	27.0	-	<1.0	34.0	5.0	<5.0	25000.0	6.0	228.0	6.0	<2.0	<0.01	13.0
113P	12.1[e]	53.7	<0.1	12.0	-	<1.0	37.0	8.0	6.0	21600.0	10.0	306.0	11.0	<2.0	0.01	25.0
113P	12.2[e]	59.0	<0.1	18.0	-	<1.0	46.0	8.0	7.0	28100.0	12.0	417.0	12.0	<2.0	0.02	28.0
113P	12.3[e]	57.2	0.2	17.0	2.8	<1.0	39.0	6.0	6.0	25800.0	11.0	402.0	9.0	<2.0	0.02	22.0
114P	22	22.2	0.2	39.0	-	<1.0	10.0	2.0	<5.0	15900.0	<5.0	309.0	<2	<2.0	<0.01	<5.0
115P	23	10.4	0.4	54.0	-	<1.0	13.0	4.0	<5.0	25900.0	7.0	330.0	3.0	<2.0	<0.01	<5.0
116P	24	18.4	0.2	24.0	-	<1.0	9.0	<2	<5.0	8220.0	<5.0	267.0	2.0	<2.0	<0.01	<5.0
117P	1	28.3	<0.5	58.1	-	<0.1	33.7	3.7	10.6	32400.0	12.4	252.0	11.2	<0.1	<0.01	19.2
119P	2	28.0	<0.5	22.8	-	<0.1	32.0	6.6	8.1	25900.0	13.2	135.0	12.6	<0.1	0.01	15.8
120P	3	31.6	<0.5	84.2	-	0.1	121.0	8.0	10.1	54500.0	36.6	337.0	13.5	<0.1	0.01	24.7
121P	4[d]	42.5	<0.5	23.3	-	<0.1	33.7	4.3	7.6	21400.0	8.8	168.0	10.0	<0.1	0.02	16.2
121P	QC01[d]	45.0	<0.5	33.2	-	<0.1	43.3	5.2	10.0	28600.0	11.9	339.0	13.5	<0.1	<0.01	20.9
122P	5	47.0	<0.5	45.7	-	<0.1	80.0	6.6	9.3	64000.0	26.5	324.0	12.0	<0.1	0.01	18.5
123P	6 (0-0.5)	43.3	<0.5	18.4	-	<0.1	27.7	3.7	6.5	16200.0	7.3	212.0	7.9	<0.1	0.04	13.4
124P	7[e]	40.4	<0.5	43.3	-	<0.1	38.0	3.3	8.0	32400.0	9.7	355.0	8.6	<0.1	0.01	11.9
124P	T1[e]	34.8	<0.5	40.5	-	<0.1	39.8	3.9	6.8	31600.0	8.9	305.0	7.0	<0.1	<0.01	9.3
124P	T2[e]	35.0	<0.5	40.2	-	<0.1	54.9	5.5	8.5	47400.0	12.1	298.0	8.3	<0.1	<0.01	15.8
125P	8	38.5	<0.5	73.6	-	<0.1	89.2	2.6	18.7	67700.0	26.5	401.0	11.7	<0.1	0.01	18.9
126P	9	23.7	<0.5	31.6	-	<0.1	34.8	2.4	4.1	22900.0	10.2	201.0	5.0	<0.1	<0.01	8.3
128P	10	28.4	<0.5	27.9	-	<0.1	28.3	2.8	5.3	16600.0	7.0	300.0	6.3	<0.1	0.01	8.2
129P	11	19.6	<0.5	21.0	-	<0.1	28.6	1.5	3.2	14400.0	5.1	277.0	4.0	<0.1	0.03	3.7
131P	12	32.1	<0.5	34.5	-	<0.1	201.0	3.3	4.3	40600.0	14.4	206.0	6.6	<0.1	0.02	9.6
131P	T3	31.5	<0.5	37.1	-	<0.1	88.8	5.3	5.1	55700.0	19.7	350.0	8.4	<0.1	<0.01	11.6
131P	T4	31.0	<0.5	35.6	-	<0.1	70.7	3.1	6.2	33000.0	10.3	312.0	6.5	<0.1	<0.01	11.3
133P	13[d]	27.2	<0.5	84.2	-	<0.1	66.8	2.1	8.8	56700.0	19.6	526.0	7.6	<0.1	<0.01	9.2
133P	QC02[d]	28.5	<0.5	82.8	-	<0.1	72.6	2.2	8.3	61100.0	21.5	371.0	7.2	<0.1	<0.01	9.9
134P	14	34.6	<0.5	86.6	-	<0.1	43.6	3.0	9.6	42800.0	11.9	512.0	8.9	<0.1	0.02	11.1
135P	15	26.2	0.5	58.8	-	<0.1	49.5	3.1	9.0	47600.0	13.0	556.0	6.8	<0.1	0.02	11.3
136P	16	33.1	<0.5	82.8	-	<0.1	49.4	2.4	7.6	34600.0	11.1	460.0	6.8	<0.1	0.01	10.3
137P	17	33.3	<0.5	55.1	-	<0.1	47.5	3.2	7.9	34200.0	9.8	324.0	7.5	<0.1	0.01	13.2
138P	18	32.0	<0.5	26.0	-	<0.1	34.0	3.9	7.4	26600.0	10.6	298.0	8.7	<0.1	0.04	13.8
139P	19	31.3	<0.5	49.1	-	<0.1	24.8	2.5	6.9	17200.0	5.8	734.0	5.9	<0.1	<0.01	8.4
140P	10	46.4	<0.1	9.0	-	<1	26.0	6.0	<5.0	16100.0	8.0	255.0	7.0	<2.0	0.01	19.0
		Mean	0.3	42.0	N/A	N/A	44.1	3.9	6.6	31249.0	11.7	325.1	7.2	N/A	0.011	12.8
		95% UCL	0.3[j]	55.4[h]	N/A	N/A	57.88[h]	4.5[h]	7.8[h]	38691.0[h]	15.19[h]	371.8[h]	8.6[s]	N/A	0.015[s]	14.83[s]

a	Practical Quantitation Limit (detection limit)
b	NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c	NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
d	Field duplicate
e	Field triplicate
f	Analised using a 1M HCL digest for an estimation of the bioavailable proportion of aresnic
h	Data are lognormal and the UCL was calculated using 95% H-UCL
j	Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method
s	Data are normally distributed and the UCL was calculated using Student's t-Test method
NA	Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG	No Guideline
-	Not Analysed

Table 8: Summary of subsurface sediment results for metals in Pipline route

Site ID	Sample ID	Depth (m BGL)	Moisture Content	Aluminium	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Nickel	Silver	Mercury	Zinc
		UNIT		mg/kg													
		PQL[a]		0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.1	0.01	0.1
		Screening[b]	%	NG	20.0	1.5	80.0	NG	65.0	NG	50.0	NG	NG	21.0	1.0	0.15	200.0
		Maximum[c]	1	NG	70.0	10.0	370.0	NG	270.0	NG	220.0	NG	NG	52.0	3.7	1	410.0
15PSS	PLBHO3	0.5-1.5	18.6	8730.0	6.3	<0.1	46.9	2.5	14.1	84400.0	27.6	27.6	143.0	2.4	0.2	0.02	3.9
		1.5-3.0	16.8	3710.0	1.6	<0.1	10.1	<0.5	2.9	28200.0	5.5	5.5	<10	<1.0	<0.1	<0.01	2.3
		3	15.7	8140.0	<1.0	<0.1	26.3	6.0	28.7	29200.0	26.4	26.4	153.0	16.3	<0.1	<0.01	60.1
16PSS	PLBHO4	1.5-3.0	18.3	4250.0	2.7	<0.1	31.5	<0.5	5.5	43100.0	13.2	13.2	10.0	<1.0	0.1	<0.01	2.2
		3.0-6.5	11.5	7690.0	<1.0	<0.1	14.8	5.2	7.0	14400.0	7.2	7.2	80.0	10.6	<0.1	0.01	42.0
17PSS	PLBHO5	0.5	19.2	7620.0	23.6	<0.1	132.0	6.0	10.0	157000.0	13.6	13.6	121.0	6.0	0.3	<0.01	21.1
		4.0-10	23.0	9040.0	1.0	<0.1	23.2	6.5	13.2	27200.0	9.2	9.2	115.0	16.4	<0.1	<0.01	64.1
123PSS	6(0.5-1)	0.5-1	21.3	NA	12.4	<0.1	52.0	3.9	6.5	21100.0	8.8	NA	190.0	6.0	<0.1	0.01	8.0
		Mean		7026.0	6.1	<0.1	42.1	3.8	11.0	50575.0	13.9	14.7	102.1	7.3	0.106	0.01	25.5
		95% UCL		8604.0[s]	11.5[j]	N/A	68.28[j]	5.9[s]	16.42[s]	118657.0[j]	19.64[s]	21.2[s]	146.6[s]	11.68[s]	0.169	NA	43.1[s]

a Practical Quantitation Limit (detection limit)
b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
h Data are lognormal and the UCL was calculated using 95% H-UCL
j Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method
s Data are normally distributed and the UCL was calculated using Student's t-Test method
NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG No Guideline
\- Not Analysed

Table 9: Summary of surface sediment results for metals in the shore crossing

		Moisture Content	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Nickel	Silver	Mercury	Zinc
			Sb	**As**	**Cd**	**Cr**	**Co**	**Cu**	**Fe**	**Pb**	**Mn**	**Ni**	**Ag**	**Hg**	**Zn**
	UNIT	%	mg/kg												
	PQL[a]	1	0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.01	0.1
	Screening[b]		2.0	20.0	1.5	80.0	NG	65.0	NG	50.0	NG	21.0	1.0	0.15	200.0
	Maximum[c]		25.0	70.0	10.0	370.0	NG	270.0	NG	220.0	NG	52.0	3.7	1	410.0
Site ID	**Sample ID**														
141SC	9	35.5	<0.1	17.0	<1	19.0	4.0	<5	18800.0	6.0	187.0	5.0	<2.0	<0.01	12.0
142SC	20	32.7	<0.5	11.6	<0.1	16.2	1.8	4.6	10800.0	5.2	276.0	4.1	<0.1	0.02	8.8
143SC	D1	42.8	<0.1	14.5	<0.1	24.4	7.0	3.5	14900.0	8.4	270.0	6.5	<0.1	0.02	17.6
144SC	D2	50.4	<0.1	12.8	<0.1	28.0	7.2	3.9	15400.0	9.1	280.0	7.7	<0.1	0.01	20.7
145SC	D3	41.9	<0.1	10.3	<0.1	18.0	5.1	2.4	12200.0	6.5	262.0	4.7	<0.1	<0.01	13.0
146SC	D4	39.0	<0.1	12.7	<0.1	18.8	6.7	2.4	12600.0	6.7	338.0	5.3	<0.1	<0.01	15.8
147SC	D5	38.0	<0.1	10.3	<0.1	14.8	4.6	2.0	10100.0	5.5	278.0	3.8	<0.1	<0.01	11.4
148SC	D6	41.3	<0.1	10.0	0.1	16.6	4.5	2.4	10800.0	6.4	307.0	4.3	<0.1	<0.01	11.5
147SC	D7	31.4	<0.1	11.8	0.1	15.9	5.5	2.1	11800.0	6.0	336.0	4.4	<0.1	<0.01	12.0
150SC	D8	37.1	<0.1	11.2	0.1	14.7	4.4	2.0	10600.0	6.0	335.0	4.1	<0.1	<0.01	10.4
151SC	D9	45.8	0.2	20.1	<0.1	70.2	9.5	7.8	40500.0	15.6	192.0	12.6	<0.1	0.01	26.6
		Mean	N/A	12.9	0.1	23.3	5.5	3.3	15318.0	7.4	278.3	5.7	N/A	0.01	14.5
		95% UCL	N/A	14.7[s]	N/A	32.1[s]	6.8[s]	4.5[s]	20102.0[j]	9.1[s]	306.7[s]	7.2[s]	N/A	0.014[s]	17.6[s]

a Practical Quantitation Limit (detection limit)
b NODDMG screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
d Field duplicate
e Field triplicate
h Data are lognormal and the UCL was calculated using 95% H-UCL
j Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method
s Data are normally distributed and the UCL was calculated using Student's t-Test method
NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG No Guideline
\- Not Analysed

Table 10: Summary of subsurface sediment results for metals in the shore crossing

Site ID	Sample ID	Depth (m BGL)	Moisture Content	Aluminium	Arsenic	Cadmium	Chromium	Copper	Cobalt	Iron	Lead	Magnesium	Manganese	Nickel	Silver	Mercury	Zinc
		UNIT		mg/kg													
		PQL[a]		0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.1	0.01	0.1
		Screening[b]	%	NG	20.0	1.5	80.0	65.0	NG	NG	50.0	NG	NG	21.0	1.0	0.15	200.0
		Maximum[c]	1	NG	70.0	10.0	370.0	270.0	NG	NG	220.0	NG	NG	52.0	3.7	1	410.0
18SCSS	PLBHO1	0.5-1.5	30.1	8140	14.6	<0.1	21.7	2.8	6.2	16600	6.5	13300	264	6.4	<0.1	<0.01	11.8
		1.5-3.0	48.4	22200	19.8	<0.1	52.4	9.1	12.3	35000	17.1	8690	113	14.4	<0.1	<0.01	23.2
		3	37.5	10200	24.4	<0.1	38.1	5.4	3.7	27200	9.8	2820	57	5.1	<0.1	<0.01	11.1
		Mean		7026.0	19.6	<0.1	37.4	5.8	7.4	26266.7	11.1	8270.0	144.7	8.6	<0.1	<0.01	15.4

a Practical Quantitation Limit (detection limit)
b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG No Guideline
Note: Due to the low sample number 95% UCLs could not be calculated for this area
For calculation of mean and 95% UCL <PQL was taken as PQL
At sites where field duplicates and triplicates were taken, the data point for that site was represented by the mean concentration in all samples

Table 11: Summary of surface sediment results for organic compounds in East Arm

		TOC	TBT	Total Petroleum Hydrocarbons				Total PCBs
				C_6 - C_9 Fraction	C_{10} - C_{14} Fraction	C_{15} - C_{28} Fraction	C_{29} - C_{36} Fraction	
	UNIT	%	µgSn/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg
	PQL[a]	0.02	0.5	10	50/3	100/3	100/5	5
	Screening[b]	NG	5	NG	NG	NG	NG	23
	Maximum[c]	NG	70	NG	NG	NG	NG	NG
Site ID	**Sample ID**							
1EA	1	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
2EA	2	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
3EA	3	0.1	<0.5	<10.0	<50.0	<100.0	<100.0	-
4EA	4	0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
5EA	5	0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
6EA	6	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
7EA	13	0.8	<0.5	<10.0	<50.0	<100.0	<100.0	-
8EA	14	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
9EA	15	0.1	<0.5	<10.0	<50.0	<100.0	<100.0	-
10EA	16.1[d]	0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
10EA	16.2[d]	0.4	<0.5	<10.0	<50.0	<100.0	<100.0	-
11EA	17	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
12EA	18	0.1	<0.5	<10.0	<50.0	<100.0	<100.0	-
13EA	19	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
14EA	20	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
15EA	21.1[e]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
15EA	21.2[e]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
15EA	21.3[e]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
16EA	25	1.0	<0.5	<10.0	<50.0	<100.0	<100.0	-
17EA	26	0.8	<0.5	<10.0	<50.0	<100.0	<100.0	-
18EA	27.1[e]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
18EA	27.2[e]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
18EA	27.3[e]	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
19EA	28	0.1	<0.5	<10.0	<50.0	<100.0	<100.0	-
20EA	D10	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
21EA	D11	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
22EA	D12.1[d]	0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
22EA	D12.2[d]	0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
23EA	D13.1[e]	0.7	<0.5	<10.0	<50.0	<100.0	<100.0	-
23EA	D13.2[e]	0.6	<0.5	<10.0	<50.0	<100.0	<100.0	-
23EA	D13.3[e]	0.7	<0.5	<10.0	<50.0	<100.0	<100.0	-
24EA	D14	0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
25EA	D15	0.4	<0.5	<10.0	<50.0	<100.0	<100.0	-
26EA	D16	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
27EA	D17	0.4	<0.5	<10.0	<50.0	<100.0	<100.0	-
28EA	D18.1[e]	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
28EA	D18.2[e]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
28EA	D18.3[e]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
29EA	D19	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
30EA	D20	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
31EA	D21	0.4	<0.5	<10.0	<50.0	<100.0	<100.0	-
32EA	D22	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
33EA	D23.1[e]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
33EA	D23.2[e]	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
33EA	D23.3[e]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
34EA	D24	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
35EA	D25	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
36EA	D26	0.7	<0.5	<10.0	<50.0	<100.0	<100.0	-
37EA	D27.1[e]	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
37EA	D27.2[e]	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
37EA	D27.3[e]	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
38EA	D28.1[d]	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
38EA	D28.2[d]	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
39EA	D29	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-
40EA	D30	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
41EA	D31	0.6	<0.5	<10.0	<50.0	<100.0	<100.0	-
42EA	D32	0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
43EA	D33	0.2	<0.5	<10.0	<50.0	<100.0	<100.0	-

Table 11: Summary of surface sediment results for organic compounds in East Arm

Site ID	Sample ID	TOC	TBT	Total Petroleum Hydrocarbons C_6 - C_9 Fraction	C_{10} - C_{14} Fraction	C_{15} - C_{28} Fraction	C_{29} - C_{36} Fraction	Total PCBs
	UNIT	%	µgSn/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg
	PQL[a]	0.02	0.5	10	50/3	100/3	100/5	5
	Screening[b]	NG	5	NG	NG	NG	NG	23
	Maximum[c]	NG	70	NG	NG	NG	NG	NG
Site ID	**Sample ID**							
44EA	D34	0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
45EA	D35	1.1	<0.5	<10.0	<50.0	<100.0	<100.0	-
46EA	D36	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
47EA	D37	0.3	<0.5	<10.0	<50.0	<100.0	<100.0	-
48EA	D38	0.1	<0.5	<10.0	<50.0	<100.0	<100.0	-
49EA	21	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
50EA	22	0.9	<0.5	-	<3.0	21.0	16.0	<5.0
51EA	23	0.3	<0.5	-	<3.0	<3.0	<5.0	<5.0
52EA	24	0.4	<0.5	-	<3.0	<3.0	<5.0	<100
53EA	25	0.4	<0.5	-	<3.0	17.0	10.0	<5.0
54EA	26	0.4	<0.5	-	4.0	20.0	12.0	<5.0
55EA	27	0.3	<0.5	-	<3.0	13.0	7.0	<5.0
55EA	T5	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
55EA	T6	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
56EA	28	0.4	<0.5	-	<3.0	23.0	14.0	<100
57EA	29	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
58EA	30	0.3	<0.5	-	<3.0	16.0	10.0	<5.0
59EA	31	0.6	<0.5	-	<3.0	32.0	24.0	<5.0
60EA	32	0.2	<0.5	-	4.0	14.0	9.0	<5.0
61EA	33	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
62EA	34	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
63EA	35[d]	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
63EA	QC03[d]	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
64EA	36	0.3	<0.5	-	6.0	26.0	9.0	<5.0
65EA	37	0.5	<0.5	-	<3.0	<3.0	<5.0	<5.0
66EA	38	0.4	<0.5	-	5.0	24.0	14.0	<5.0
67EA	39[e]	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
67EA	T7[e]	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
67EA	T8[e]	0.1	<0.5	-	<3.0	9.0	<5.0	<5.0
68EA	40	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
71EA	41 (0-0.5)	0.5	<0.5	-	<3.0	<3.0	<5.0	<5.0
72EA	42	0.3	<0.5	-	<3.0	<3.0	<5.0	<5.0
73EA	43	0.5	<0.5	-	<3.0	<3.0	<5.0	<5.0
74EA	44	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
75EA	45	0.3	<0.5	-	<3.0	<3.0	<5.0	<5.0
76EA	46	1.3	<0.5	-	<3.0	13.0	10.0	<5.0
77EA	47	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
78EA	48[d]	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
78EA	QC04[d]	0.1	<0.5	-	<3.0	13.0	<5.0	<5.0
79EA	49	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
80EA	50	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
81EA	51	0.7	<0.5	-	<3.0	11.0	8.0	<100
82EA	52	0.3	<0.5	-	<3.0	8.0	<5.0	<100
83EA	53[e]	0.3	<0.5	-	<3.0	20.0	<5.0	<5.0
83EA	T9[e]	0.2	<0.5	-	<3.0	12.0	9.0	<5.0
83EA	T10[e]	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
84EA	54	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
85EA	55	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
86EA	56[e]	0.3	<0.5	-	<3.0	6.0	<5.0	<5.0
86EA	T11[e]	0.5	<0.5	-	<3.0	28.0	14.0	<5.0
86EA	T12[e]	0.3	<0.5	-	<3.0	17.0	<5.0	<5.0
87EA	57	0.4	<0.5	-	<3.0	11.0	7.0	<5.0
88EA	58	0.3	<0.5	-	<3.0	<3.0	<5.0	<5.0
89EA	59	0.3	<0.5	-	<3.0	7.0	5.0	<5.0
90EA	60	0.3	<0.5	-	<3.0	<3.0	<5.0	<5.0
91EA	61	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
92EA	62	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
93EA	63	0.3	<0.5	-	<3.0	<3.0	<5.0	<5.0

Table 11: Summary of surface sediment results for organic compounds in East Arm

Site ID	Sample ID	TOC	TBT	Total Petroleum Hydrocarbons C_6 - C_9 Fraction	C_{10} - C_{14} Fraction	C_{15} - C_{28} Fraction	C_{29} - C_{36} Fraction	Total PCBs
	UNIT	%	µgSn/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg
	PQL[a]	0.02	0.5	10	50/3	100/3	100/5	5
	Screening[b]	NG	5	NG	NG	NG	NG	23
	Maximum[c]	NG	70	NG	NG	NG	NG	NG
94EA	64[e]	0.3	<0.5	-	<3.0	<3.0	<5.0	<5.0
94EA	T13[e]	0.2	<0.5	-	<3.0	13.0	<5.0	<5.0
94EA	T14[e]	0.2	<0.5	-	<3.0	14.0	8.0	<5.0
95EA	65	0.3	<0.5	-	<3.0	<3.0	<5.0	<5.0
96EA	66	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
97EA	67	0.3	<0.5	-	<3.0	<3.0	<5.0	<5.0
98EA	68	0.1	<0.5	-	<3.0	<3.0	<5.0	<5.0
99EA	69	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
100EA	70	0.2	<0.5	-	<3.0	<3.0	<5.0	<5.0
101EA	71	0.4	<0.5	-	<3.0	6.0	<5.0	<5.0
102EA	72	0.2	<0.5	-	<3.0	4.0	<5.0	<5.0
103EA	73	0.3	<0.5	-	<3.0	6.0	<5.0	<5.0
104EA	74[e]	0.3	<0.5	-	<3.0	16.0	<5.0	<5.0
104EA	T15[e]	0.2	<0.5	-	<3.0	14.0	<5.0	<5.0
104EA	T16[e]	0.5	<0.5	-	10.0	42.0	11.0	<5.0
105EA	75	0.3	<0.5	-	<3.0	15.0	<5.0	<5.0
106EA	76	0.2	<0.5	-	<3.0	22.0	<5.0	<5.0
107EA	77[d]	0.3	<0.5	-	<3.0	32.0	19.0	<5.0
107EA	QC05[d]	0.4	<0.5	-	<3.0	24.0	10.0	<5.0
108EA	78	0.3	<0.5	-	<3.0	26.0	<5.0	<5.0
109EA	79	0.3	<0.5	-	<3.0	27.0	12.0	<5.0
	Mean	0.31	<0.5	<10.0	24.60	<51.0	<49.3	<10.1
	95% UCL	0.342[s]	N/A	N/A	N/A	N/A	N/A	N/A

a Practical Quantitation Limit (detection limit)

b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected

c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form

d Field duplicate

e Field triplicate

f Data are lognormal and the UCL was calculated using 95% H-UCL

h Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method

j Data are normally distributed and the UCL was calculated using Student's t-Test method

s Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation

NG No Guideline

NA Not Aplicable

\- Not Analysed

Table 12: Summary of surface sediment results for organic compounds in the proposed pipeline route

Site ID	Sample ID	TOC	TBT	BTEX					Total Petroleum Hydrocarbons				Total PCBs
				Benzene	Toluene	Ethylbenzene	meta- & para Xylene	ortho-Xylene	C_6 - C_9 Fraction	C_{10} - C_{14} Fraction	C_{15} - C_{28} Fraction	C_{29} - C_{36} Fraction	
	UNIT	%	µgSn/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	µg/kg
	PQL[a]	0.02	0.5	0.2	0.5	0.5	0.5	0.5	10	50/3	100/3	100/5	5
	Screening[b]	NG	5	n/a	n/a	n/a	n/a	n/a	NG	NG	NG	NG	23
	Maximum[c]	NG	70	n/a	n/a	n/a	n/a	n/a	NG	NG	NG	NG	NG
Site ID	Sample ID												
110P	7	0.54	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
111P	8	0.67	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
112P	11	0.30	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
113P	12.1[e]	0.68	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
113P	12.2[e]	0.53	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
113P	12.3[e]	0.71	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
114P	22	0.08	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
115P	23	0.06	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
116P	24	0.04	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0	-
117P	1	0.21	<0.5	-	-	-	-	-	-	<3.0	7.0	<5	<5.0
119P	2	0.09	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
120P	3	0.17	<0.5	-	-	-	-	-	-	<3.0	12.0	<5.0	<5.0
121P	4[d]	0.47	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
121P	QC01[d]	0.40	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
122P	5	0.57	<0.5	-	-	-	-	-	-	<3.0	11.0	5.0	<5.0
123P	6 (0-0.5)	0.29	<0.5	-	-	-	-	-	-	<3.0	15.0	10.0	<5.0
124P	7[e]	0.41	<0.5	-	-	-	-	-	-	<3.0	6.0	<5.0	<5.0
124P	T1[e]	0.29	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
124P	T2[e]	0.28	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
125P	8	0.27	<0.5	-	-	-	-	-	-	4.0	10.0	<5.0	<5.0
126P	9	0.16	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
128P	10	0.15	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
129P	11	0.11	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
131P	12	0.25	<0.5	-	-	-	-	-	-	<3.0	8.0	<5.0	<5.0
131P	T3	0.17	<0.5	-	-	-	-	-	-	<3.0	11.0	<5.0	<5.0
131P	T4	0.17	<0.5	-	-	-	-	-	-	<3.0	31.0	31.0	<5.0
133P	13[d]	0.16	<0.5	-	-	-	-	-	-	<3.0	<3.0	0.0	<5.0
133P	QC02[d]	0.12	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
134P	14	0.21	<0.5	-	-	-	-	-	-	5.0	16.0	6.0	<5.0
135P	15	0.20	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
136P	16	0.26	<0.5	-	-	-	-	-	-	4.0	13.0	<5.0	<5.0
137P	17	0.23	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
138P	18	0.43	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
139P	19	0.20	<0.5	-	-	-	-	-	-	<3.0	<3.0	<5.0	<5.0
140P	10	0.58	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10	<50.0	<100.0	<100.0	-
	Mean	0.29	<0.5	N/A	N/A	N/A	N/A	N/A	<10.0	<16.2	<32.9	<32.1	<5.0
	95% UCL	0.31[j]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20.6[j]	42.3[j]	44.0[j]	N/A

a Practical Quantitation Limit (detection limit)

b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected

c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form

d Field duplicate

e Field triplicate

h Data are lognormal and the UCL was calculated using 95% H-UCL

j Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method

s Data are normally distributed and the UCL was calculated using Student's t-Test method

NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation

NG No Guideline

\- Not Analysed

Table 13: Summary of surface sediment results for organic compounds in the shore crossing

Site ID		TOC	TBT	BTEX					Total Petroleum Hydrocarbons			
				Benzene	Toluene	Ethylbenzene	meta- & para-Xylene	ortho-Xylene	C_6 - C_9 Fraction	C_{10} - C_{14} Fraction	C_{15} - C_{28} Fraction	C_{29} - C_{36} Fraction
	UNIT	%	µgSn/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	PQL[a]	0.02	0.5	0.2	0.5	0.5	0.5	0.5	10/na	50/3	100/3	100/5
	Screening[b]	NG	5	n/a	n/a	n/a	n/a	n/a	NG	NG	NG	NG
	Maximum[c]	NG	70	n/a	n/a	n/a	n/a	n/a	NG	NG	NG	NG
Site ID	Sample ID											
141SC	9	0.37	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
142SC	20	<0.5	-	-	-	-	-	-	<10.0	<50.0	<100.0	<100.0
143SC	D1	0.73	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
144SC	D2	0.83	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
145SC	D3	0.48	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
146SC	D4	0.4	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
147SC	D5	0.32	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
148SC	D6	0.48	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
147SC	D7	0.37	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
150SC	D8	0.3	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
151SC	D9	0.48	<0.5	<0.2	<0.5	<0.5	<0.5	<0.5	<10.0	<50.0	<100.0	<100.0
	Mean	0.48	<0.5	N/A	N/A	N/A	N/A	N/A	<10.0	<50.0	<100.0	<100.0
	95% UCL	0.57[s]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

a Practical Quantitation Limit (detection limit)

b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected

c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form

h Data are lognormal and the UCL was calculated using 95% H-UCL

j Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method

s Data are normally distributed and the UCL was calculated using Student's t-Test method

NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation

NG No Guideline

\- Not Analysed

Table 14: Summary of surface sediment results for PAHs in East Arm

Site ID	Sample ID	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(e) pyrene	Benzo(a) pyrene	Perylene	Benzo(g.h.i) perylene	Dibenz(a.h) anthracene	Indeno (1.2.3.cd) pyrene	Coronene	Sum of PAHs
	UNIT	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PQL[a]	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4
	Screening[b]	160	70	44	16	19	240	85	600	665	261	384	n/a	n/a	n/a	430	n/a	n/a	63	n/a	n/a	4,000
	Maximum[c]	2,100	670	640	500	540	1,500	1,100	5,100	2,600	1,600	2,800	n/a	n/a	n/a	1,600	n/a	n/a	260	n/a	n/a	45,000
1EA	1	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
2EA	2	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
3EA	3	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
4EA	4	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
5EA	5	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
6EA	6	6	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
7EA	13	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
8EA	14	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
9EA	15	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
10EA	16.1[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
10EA	16.2[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
11EA	17	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
12EA	18	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
13EA	19	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
14EA	20	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
15EA	21.1[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
15EA	21.2[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
15EA	21.3[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
16EA	25	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
17EA	26	<5	<5	<4	<4	<4	6	<4	<4	5	<4	<4	5	<4	<4	5	<4	5	<4	<4	<5	<5
18EA	27.1[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
18EA	27.2[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
18EA	27.3[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
19EA	28	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
20EA	D10	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
21EA	D11	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
22EA	D12.1[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
22EA	D12.2[d]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
23EA	D13.1[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
23EA	D13.2[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
23EA	D13.3[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
24EA	D14	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
25EA	D15	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
26EA	D16	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
27EA	D17	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
28EA	D18.1[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
28EA	D18.2[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
28EA	D18.3[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
29EA	D19	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
30EA	D20	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
31EA	D21	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
32EA	D22	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
33EA	D23.1[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
33EA	D23.2[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
33EA	D23.3[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
34EA	D24	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
35EA	D25	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
36EA	D26	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
37EA	D27.1[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
37EA	D27.2[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
37EA	D27.3[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
38EA	D28.1[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
38EA	D28.2[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
39EA	D29	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
40EA	D30	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
41EA	D31	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
42EA	D32	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5

Table 14: Summary of surface sediment results for PAHs in East Arm

Site ID	Sample ID	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(e) pyrene	Benzo(a) pyrene	Perylene	Benzo(g.h.i) perylene	Dibenz(a.h) anthracene	Indeno (1.2.3.cd) pyrene	Coronene	Sum of PAHs
	UNIT	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PQL[a]	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4
	Screening[b]	160	70	44	16	19	240	85	600	665	261	384	n/a	n/a	n/a	430	n/a	n/a	63	n/a	n/a	4,000
	Maximum[c]	2,100	670	640	500	540	1,500	1,100	5,100	2,600	1,600	2,800	n/a	n/a	n/a	1,600	n/a	n/a	260	n/a	n/a	45,000
Site ID	Sample ID																					
43EA	D33	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
44EA	D34	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
45EA	D35	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
46EA	D36	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
47EA	D37	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
48EA	D38	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
49EA	21	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
50EA	22	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
51EA	23	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
52EA	24	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
53EA	25	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
54EA	26	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
55EA	27	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
55EA	T5	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
55EA	T6	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
56EA	28	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
57EA	29	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
58EA	30	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
59EA	31	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
60EA	32	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
61EA	33	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
62EA	34	<5	<5	<4	<4	<4	**8**	<4	**22**	**15**	**10**	**8**	**6**	<4	<4	**6**	<4	**4**	<4	**5**	<5	**85**
63EA	35[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
63EA	QC03[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
64EA	36	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
65EA	37	<5	<5	<4	<4	<4	**10**	<4	**31**	**25**	**17**	**13**	**10**	<4	**4**	**10**	<4	**9**	<4	**8**	<5	**138**
66EA	38	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
67EA	39[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
67EA	T7[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
67EA	T8[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
68EA	40	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
71EA	41 (0-0.5)	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
72EA	42	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
73EA	43	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
74EA	44	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
75EA	45	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
76EA	46	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
77EA	47	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
78EA	48[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
78EA	QC04[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
79EA	49	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
80EA	50	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
81EA	51	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
82EA	52	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
83EA	53[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
83EA	T9[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
83EA	T10[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
84EA	54	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
85EA	55	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
86EA	56[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
86EA	T11[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
86EA	T12[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
87EA	57	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
88EA	58	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
89EA	59	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
90EA	60	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
91EA	61	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
92EA	62	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4

Table 14: Summary of surface sediment results for PAHs in East Arm

Site ID	Sample ID	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(e) pyrene	Benzo(a) pyrene	Perylene	Benzo(g.h.i) perylene	Dibenz(a.h) anthracene	Indeno (1.2.3.cd) pyrene	Coronene	Sum of PAHs
	UNIT	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PQL[a]	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4
	Screening[b]	160	70	44	16	19	240	85	600	665	261	384	n/a	n/a	n/a	430	n/a	n/a	63	n/a	n/a	4,000
	Maximum[c]	2,100	670	640	500	540	1,500	1,100	5,100	2,600	1,600	2,800	n/a	n/a	n/a	1,600	n/a	n/a	260	n/a	n/a	45,000
Site ID	Sample ID																					
93EA	63	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
94EA	64[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
94EA	T13[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
94EA	T14[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
95EA	65	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
96EA	66	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
97EA	67	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
98EA	68	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
99EA	69	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
100EA	70	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
101EA	71	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
102EA	72	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
103EA	73	<5	<5	<4	<4	<4	**5**	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	**5**
104EA	74[e]	<5	<5	<4	<4	<4	**7**	<4	**4**	**6**	<4	**5**	<4	<4	<4	<4	<4	<4	<4	<4	<5	**22**
104EA	T15[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
104EA	T16[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
105EA	75	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
106EA	76	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
107EA	77[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
107EA	QC05[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
108EA	78	<5	<5	<4	<4	<4	**9**	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	**9**
109EA	79	<5	<5	<4	<4	<4	**7**	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	**7**
	Mean	5.0	N/A	4.0	4.0	4.0	4.1	4.0	4.3	4.3	4.1	4.1	4.1	4.0	4.0	4.1	4.0	4.1	4.0	4.0	N/A	6.2
	95% UCL	N/A	N/A	N/A	N/A	N/A	4.3[s]	N/A	4.7[s]	4.5[s]	4.3[s]	4.2[s]	4.2[s]	4.0[s]	4.0[s]	4.2[s]	N/A	N/A	N/A	N/A	N/A	8.1[s]

a Practical Quantitation Limit (detection limit)
b NODGMD screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c NODGMD maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
d Field duplicate
e Field triplicate
f Analised using a 1M HCL digest for an estimation of the bioavailable proportion of aresnic
h Data are lognormal and the UCL was calculated using 95% H-UCL
j Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method
s Data are normally distributed and the UCL was calculated using Student's t-Test method
NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG No Guideline
\- Not Analysed

Table 15: Summary of surface sediment results for PAHs in the Pipeline route

Site ID	Sample ID	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(e) pyrene	Benzo(a) pyrene	Perylene	Benzo(g.h.i) perylene	Dibenz(a.h) anthracene	Indeno (1.2.3.cd) pyrene	Coronene	Sum of PAHs
	UNIT	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PQL[a]	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4
	Screening[b]	160	70	44	16	19	240	85	600	665	261	384	NG	NG	NG	430	NG	NG	63	NG	NG	4,000
	Maximum[c]	2,100	670	640	500	540	1,500	1,100	5,100	2,600	1,600	2,800	NG	NG	NG	1,600	NG	NG	260	NG	NG	45,000
Site ID	Sample ID																					
110P	7	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
111P	8	8	<5	<4	20	15	21	5	4	4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
112P	11	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
113P	12.1[e]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
113P	12.2[e]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
113P	12.3[e]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
114P	22	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
115P	23	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
116P	24	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
117P	1	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
119P	2	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
120P	3	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
121P	4[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
121P	QC01[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
122P	5	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
123P	6 (0-0.5)	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
124P	7[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
124P	T1[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
124P	T2[e]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
125P	8	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
126P	9	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
128P	10	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
129P	11	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
131P	12	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
131P	T3	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
131P	T4	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
133P	13[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
133P	QC02[d]	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
134P	14	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
135P	15	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
136P	16	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
137P	17	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
138P	18	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
139P	19	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
140P	10	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<4
	Mean	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	95% UCL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

a Practical Quantitation Limit (detection limit)
b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
d Field duplicate
e Field triplicate
NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG No Guideline

Table 16: Summary of surface sediment results for PAHS in Shore Crossing area

Site ID		Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(e) pyrene	Benzo(a) pyrene	Perylene	Benzo(g.h.i) perylene	Dibenz(a.h) anthracene	Indeno (1.2.3.cd) pyrene	Coronene	Sum of PAHs
	UNIT	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PQL[a]	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	4
	Screening[b]	160	70	44	16	19	240	85	600	665	261	384	n/a	n/a	n/a	430	n/a	n/a	63	n/a	n/a	4,000
	Maximum[c]	2,100	670	640	500	540	1,500	1,100	5,100	2,600	1,600	2,800	n/a	n/a	n/a	1,600	n/a	n/a	260	n/a	n/a	45,000
Site ID	**Sample ID**																					
141SC	9	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
142SC	20	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
143SC	D1	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
144SC	D2	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
145SC	D3	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
146SC	D4	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
147SC	D5	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
148SC	D6	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
147SC	D7	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
150SC	D8	<5	<5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
151SC	D9	<5	<5	<4	4	<4	<4	<4	<4	5	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<5	<5
	Mean	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	95% UCL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

a Practical Quantitation Limit (detection limit)
b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
d Field duplicate
e Field triplicate
h Data are lognormal and the UCL was calculated using 95% H-UCL
j Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method
s Data are normally distributed and the UCL was calculated using Student's t-Test method
NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG No Guideline
\- Not Analysed

Table 17: Summary of surface sediment results for nutrients in East Arm

Site ID	Sample ID	Nitrite+Nitrate as N (Sol.)	Total KjN as N	Total Nitrogen as N	Total Phosphorus as P	Total Sulphur as S
	UNIT	mg/kg	mg/kg	mg/kg	mg/kg	%
	PQL[a]	0.1	20	20	2	0.01
	Screening[b]	n/a	n/a	n/a	n/a	n/a
	Maximum[c]	n/a	n/a	n/a	n/a	n/a
1EA	1	<0.1	70.0	70.0	763.0	0.1
2EA	2	<0.1	360.0	360.0	404.0	0.1
3EA	3	0.6	210.0	210.0	419.0	0.1
4EA	4	<0.1	550.0	550.0	460.0	0.2
5EA	5	<0.1	420.0	420.0	333.0	0.2
6EA	6	<0.1	200.0	200.0	198.0	0.1
7EA	13	<0.1	370.0	370.0	252.0	0.3
8EA	14	<0.1	230.0	230.0	238.0	0.1
9EA	15	0.1	50.0	50.0	343.0	0.1
10EA	16.1[d]	0.1	360.0	360.0	228.0	0.2
10EA	16.2[d]	<0.1	220.0	220.0	115.0	0.2
11EA	17	<0.1	60.0	260.0	852.0	0.2
12EA	18	0.1	40.0	40.0	435.0	0.0
13EA	19	<0.1	220.0	220.0	336.0	0.1
14EA	20	0.2	350.0	350.0	1050.0	0.1
15EA	21.1[e]	<0.1	170.0	170.0	356.0	0.2
15EA	21.2[e]	<0.1	180.0	180.0	772.0	0.3
15EA	21.3[e]	<0.1	280.0	280.0	650.0	0.3
16EA	25	<0.1	620.0	620.0	312.0	0.6
17EA	26	<0.1	680.0	680.0	336.0	0.3
18EA	27.1[e]	<0.1	320.0	320.0	944.0	0.2
18EA	27.2[e]	<0.1	140.0	140.0	620.0	0.2
18EA	27.3[e]	<0.1	170.0	170.0	488.0	0.6
19EA	28	0.2	50.0	50.0	353.0	0.1
20EA	D10	<0.1	340.0	340.0	272.0	0.2
21EA	D11	<0.1	470.0	470.0	557.0	0.2
22EA	D12.1[d]	<0.1	550.0	550.0	444.0	0.2
22EA	D12.2[d]	<0.1	370.0	370.0	303.0	0.3
23EA	D13.1[e]	<0.1	460.0	460.0	364.0	0.3
23EA	D13.2[e]	<0.1	770.0	800.0	371.0	0.3
23EA	D13.3[e]	<0.1	600.0	600.0	440.0	0.3
24EA	D14	<0.1	430.0	430.0	380.0	0.4
25EA	D15	<0.1	460.0	460.0	576.0	0.3
26EA	D16	<0.1	170.0	170.0	175.0	0.2
27EA	D17	<0.1	600.0	600.0	840.0	0.1
28EA	D18.1[e]	<0.1	260.0	260.0	697.0	0.1
28EA	D18.2[e]	<0.1	220.0	220.0	566.0	0.1
28EA	D18.3[e]	<0.1	300.0	300.0	928.0	0.1
29EA	D19	<0.1	130.0	130.0	153.0	0.1
30EA	D20	0.1	260.0	260.0	1130.0	0.3
31EA	D21	0.2	550.0	550.0	903.0	0.1
32EA	D22	0.2	280.0	280.0	826.0	0.2
33EA	D23.1[e]	0.1	270.0	270.0	730.0	0.3
33EA	D23.2[e]	0.1	1000.0	1000.0	563.0	0.6
33EA	D23.3[e]	0.1	190.0	190.0	798.0	0.6

Table 17: Summary of surface sediment results for nutrients in East Arm

Site ID	Sample ID	Nitrite+Nitrate as N (Sol.)	Total KjN as N	Total Nitrogen as N	Total Phosphorus as P	Total Sulphur as S
	UNIT	mg/kg	mg/kg	mg/kg	mg/kg	%
	PQL[a]	0.1	20	20	2	0.01
	Screening[b]	n/a	n/a	n/a	n/a	n/a
	Maximum[c]	n/a	n/a	n/a	n/a	n/a
34EA	D24	<0.1	890.0	890.0	774.0	0.1
35EA	D25	0.2	880.0	880.0	1120.0	0.1
36EA	D26	0.2	550.0	550.0	185.0	0.5
37EA	D27.1[e]	0.1	130.0	130.0	894.0	0.1
37EA	D27.2[e]	0.2	170.0	170.0	948.0	0.2
37EA	D27.3[e]	0.1	100.0	100.0	884.0	0.1
38EA	D28.1[d]	0.1	210.0	210.0	357.0	0.1
38EA	D28.2[d]	0.1	200.0	200.0	490.0	0.2
39EA	D29	0.1	120.0	120.0	441.0	0.1
40EA	D30	0.1	280.0	280.0	402.0	0.3
41EA	D31	0.2	640.0	640.0	444.0	0.2
42EA	D32	0.1	280.0	280.0	325.0	0.2
43EA	D33	0.1	140.0	140.0	256.0	0.2
44EA	D34	0.1	450.0	450.0	395.0	0.3
45EA	D35	0.2	1170.0	1170.0	315.0	0.3
46EA	D36	0.1	580.0	580.0	265.0	0.1
47EA	D37	0.1	510.0	510.0	172.0	0.1
48EA	D38	0.1	100.0	100.0	93.0	0.1
	Mean	0.1	355.6	359.2	508.5	0.2
	95% UCL	0.13[s]	451.1[s]	449.8[s]	594.0[s]	0.24[s]

a Practical Quantitation Limit (detection limit)

b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected

c NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form

d Field duplicate

e Field triplicate

h Data are lognormal and the UCL was calculated using 95% H-UCL

j Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method

s Data are normally distributed and the UCL was calculated using Student's t-Test method

NA Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation

NG No Guideline

\- Not Analysed

Table 18: Summary of surface sediment results for nutrients in the proposed pipeline route

		Nitrite+Nitrate as N (Sol.)	Total KjN as N	Total Nitrogen as N	Total Phosphorus as P	Total Sulphur as S
	UNIT	mg/kg	mg/kg	mg/kg	mg/kg	%
	PQL[a]	0.1	20	20	2	0.01
	Screening[b]	NG	NG	NG	NG	NG
	Maximum[c]	NG	NG	NG	NG	NG
Site ID	**Sample ID**					
110P	7	<0.10	160.0	160.0	66.0	0.13
111P	8	<0.10	560.0	560.0	278.0	0.23
112P	11	<0.10	330.0	330.0	277.0	0.21
113P	12.1[e]	0.16	1010.0	1010.0	324.0	0.20
113P	12.2[e]	<0.10	1100.0	1100.0	420.0	0.17
113P	12.3[e]	0.22	970.0	970.0	372.0	0.20
114P	22	0.70	180.0	180.0	513.0	0.23
115P	23	1.07	900.0	900.0	231.0	0.14
116P	24	<0.10	140.0	140.0	437.0	0.11
140P	10	<0.10	460.0	460.0	227.0	0.21
	Mean	0.28	581.00	581.00	314.50	0.18
	95% UCL	0.45	802.8	802.8	388.8	0.21

a	Practical Quantitation Limit (detection limit)
b	NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c	NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
d	Field duplicate
e	Field triplicate
h	Data are lognormal and the UCL was calculated using 95% H-UCL
j	Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method
s	Data are normally distributed and the UCL was calculated using Student's t-Test method
NA	Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG	No Guideline
-	Not Analysed

Table 19: Summary of surface sediment results for nutrients in the shore crossing

Site ID		Nitrite+Nitrate as N (Sol.)	Total KjN as N	Total Nitrogen as N	Total Phosphorus as P	Total Sulphur as S
	UNIT	mg/kg	mg/kg	mg/kg	mg/kg	%
	PQL[a]	0.1	20	20	2	0.01
	Screening[b]	NG	NG	NG	NG	NG
	Maximum[c]	NG	NG	NG	NG	NG
Site ID	**Sample ID**					
141SC	9	<0.1	150.0	150.0	144.0	0.19
142SC	20	-	-	-	-	6.18
143SC	D1	<0.1	610.0	610.0	270.0	0.49
144SC	D2	<0.1	490.0	490.0	258.0	0.38
145SC	D3	<0.1	690.0	690.0	372.0	0.30
146SC	D4	<0.1	440.0	440.0	396.0	0.24
147SC	D5	<0.1	520.0	520.0	445.0	0.24
148SC	D6	<0.1	760.0	760.0	485.0	0.22
147SC	D7	<0.1	200.0	200.0	305.0	0.24
150SC	D8	<0.1	350.0	350.0	398.0	0.27
151SC	D9	<0.1	830.0	830.0	440.0	0.16
	Mean	<0.1	504.0	504.0	351.3	0.8
	95% UCL	N/A	602.2[s]	602.2[s]	398.9[s]	1.79[j]

a	Practical Quantitation Limit (detection limit)
b	NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected
c	NODGDM maximum concentration (EA 2002) - concentration at which toxic effects on organisms are probable if contaminant is in a biologically available form
h	Data are lognormal and the UCL was calculated using 95% H-UCL
j	Data are Gamma distributed and the UCL was calculated using the non-parametric Jack-knife method
s	Data are normally distributed and the UCL was calculated using Student's t-Test method
NA	Not Applicable - as data do not follow a discernable distribution, as required for UCL calculation
NG	No Guideline
-	Not Analysed

Table 20: Summary of particle size distribution results for East Arm

% Composition		Clay	Silt	Fine Sand	Medium Sand	Coarse Sand	Gravel	Silt/Clay
Site ID	**Sample ID**	**<4 μ**	**4 - 62 μ**	**62 – 250 μ**	**250 – 500 μ**	**500 – 2000 μ**	**>2000 μ**	**%**
1EA	**D1**	1.2	2.9	9.8	23.5	25.1	37.6	4.0
2EA	**D2**	1.8	3.8	49.6	37.1	3.3	4.5	5.5
3EA	**D3**	0.0	0.0	7.9	26.7	57.4	8.0	0.0
4EA	**D4**	6.4	16.9	31.9	18.1	17.3	9.3	23.4
5EA	**5D**	4.3	10.7	25.3	17.0	17.4	25.4	14.9
6EA	**D6**	1.8	3.9	23.1	20.0	18.5	32.8	5.6
7EA	**13D**	7.3	15.1	42.2	18.3	9.8	7.3	22.4
8EA	**14D**	1.6	4.2	24.2	45.6	20.9	3.5	5.8
9EA	**15D**	0.0	0.0	1.2	47.3	44.9	6.6	0.0
10EA	**16D**	5.4	12.4	46.7	31.6	3.5	0.5	17.8
11EA	**17D**	4.6	10.8	13.1	0.5	23.0	48.1	15.4
12EA	**18D**	0.0	0.0	0.6	20.9	77.6	0.9	0.0
13EA	**19D**	1.6	5.0	20.7	49.2	19.8	3.7	6.7
14EA	**20D**	4.2	11.6	9.3	4.0	21.2	49.8	15.8
15EA	**21.1D**	1.6	4.6	17.0	33.2	23.2	20.4	6.2
16EA	**25D**	4.1	25.4	61.0	0.7	1.4	7.4	29.6
17EA	**26D**	9.1	28.2	45.0	6.7	7.5	3.5	37.3
18EA	**27.1D**	3.4	7.9	33.3	12.9	18.9	23.6	11.3
19EA	**28D**	0.0	0.0	21.9	37.5	37.6	3.0	0.0
20EA	**D10**	3.3	8.2	45.5	24.1	12.4	6.5	11.5
21EA	**D11**	3.3	7.5	19.6	12.4	27.3	30.0	10.8
22EA	**D12**	7.9	18.6	45.1	14.2	9.1	5.1	26.5
23EA	**D13**	7.3	23.6	55.7	6.1	5.3	2.1	30.9
24EA	**D14**	4.5	19.0	54.1	5.4	6.5	10.5	23.5
25EA	**D15**	3.4	11.7	56.9	14.4	8.7	5.0	15.0
26EA	**D16**	2.8	7.8	53.6	20.1	11.7	4.0	10.5
27EA	**D17**	3.7	8.2	4.0	4.4	13.6	66.1	11.9
28EA	**D18**	4.7	9.2	9.7	5.4	29.7	41.4	13.8
29EA	**D19**	5.3	9.9	24.2	18.5	22.3	19.9	15.2
30EA	**D20**	5.1	10.7	16.1	7.0	26.4	34.7	15.8
31EA	**D21**	4.8	11.0	6.2	5.3	13.7	59.1	15.8
32EA	**D22**	3.0	6.9	16.3	16.4	21.8	35.7	9.9
33EA	**D23**	3.9	7.2	16.1	17.4	26.5	28.9	11.1
34EA	**D24**	2.7	5.6	12.7	12.2	24.6	42.2	8.3
35EA	**D25**	4.1	7.6	13.8	9.4	24.9	40.3	11.7
36EA	**D26**	6.5	19.9	39.7	15.3	14.7	3.9	26.4
37EA	**D27**	3.1	6.0	18.3	10.4	25.1	37.2	9.1
38EA	**D28**	4.8	9.5	33.1	14.3	19.7	18.7	14.2
39EA	**D29**	2.6	2.3	35.0	25.6	24.6	9.9	4.9
40EA	**D30**	4.1	7.5	26.6	14.9	19.2	27.7	11.6
41EA	**D31**	13.6	30.7	40.9	4.4	7.1	3.4	44.3
42EA	**D32**	5.4	12.9	14.1	9.6	17.5	40.5	18.3
43EA	**D33**	3.8	6.5	16.4	19.8	44.8	8.7	10.3
44EA	**D34**	10.0	18.9	39.2	1.4	18.3	12.1	28.9
45EA	**D35**	13.1	39.6	26.4	11.6	6.6	2.7	52.7
46EA	**D36**	2.9	4.8	12.0	13.8	18.7	47.8	7.7
47EA	**D37**	8.8	21.6	20.0	13.6	26.9	9.1	30.4
48EA	**D38**	2.5	11.2	9.0	35.2	34.9	7.2	13.7
49EA	**21**	5.0	<1	16.0	46.0	28.0	5.0	5.0
50EA	**22**	13.0	20.0	21.0	2.0	7.0	37.0	33.0
51EA	**23**	6.0	8.0	7.0	7.0	13.0	59.0	14.0
52EA	**24**	13.0	3.0	17.0	37.0	19.0	11.0	16.0
53EA	**25**	29.0	11.0	31.0	10.0	13.0	6.0	40.0
54EA	**26**	20.0	12.0	26.0	11.0	15.0	16.0	32.0
55EA	**27**	10.0	2.0	59.0	10.0	9.0	10.0	12.0
56EA	**28**	14.0	6.0	46.0	17.0	11.0	6.0	20.0
57EA	**29**	9.0	4.0	45.0	17.0	12.0	13.0	13.0

Table 20: Summary of particle size distribution results for East Arm

% Composition		Clay	Silt	Fine Sand	Medium Sand	Coarse Sand	Gravel	Silt/Clay
Site ID	**Sample ID**	**<4 µ**	**4 - 62 µ**	**62 – 250 µ**	**250 – 500 µ**	**500 – 2000 µ**	**>2000 µ**	**%**
58EA	**30**	9.0	6.0	34.0	12.0	10.0	29.0	15.0
59EA	**31**	34.0	12.0	39.0	2.0	5.0	8.0	46.0
60EA	**32**	7.0	5.0	27.0	12.0	0.1	38.0	12.0
61EA	**33**	6.0	3.0	24.0	17.0	0.2	33.0	9.0
62EA	**34**	2.0	1.0	7.0	22.0	39.0	29.0	3.0
63EA	**35**	3.0	<1	8.0	44.0	33.0	11.0	3.0
64EA	**36**	7.0	8.0	10.0	3.0	15.0	57.0	15.0
65EA	**37**	41.0	18.0	34.0	0.0	3.0	3.0	59.0
66EA	**38**	15.0	11.0	22.0	6.0	22.0	24.0	26.0
67EA	**39**	6.0	4.0	14.0	18.0	36.0	22.0	10.0
68EA	**40**	3.0	<1	15.0	49.0	31.0	2.0	3.0
71EA	**41 (0-0.5)**	5.0	<1	4.0	48.0	36.0	8.0	5.0
72EA	**42**	10.0	4.0	60.0	11.0	7.0	8.0	14.0
73EA	**43**	17.0	4.0	68.0	5.0	5.0	1.0	21.0
74EA	**44**	12.0	35.0	12.0	7.0	11.0	23.0	47.0
75EA	**45**	9.0	1.0	56.0	13.0	10.0	11.0	10.0
76EA	**46**	26.0	6.0	61.0	3.0	3.0	1.0	32.0
77EA	**47**	9.0	0.1	10.0	10.0	13.0	46.0	9.1
78EA	**48**	5.0	<1	30.0	21.0	28.0	16.0	5.0
79EA	**49**	14.0	18.0	6.0	3.0	7.0	52.0	32.0
80EA	**50**	4.0	<1.0	16.0	34.0	28.0	19.0	4.0
81EA	**51**	23.0	11.0	27.0	16.0	13.0	10.0	34.0
82EA	**52**	13.0	1.0	33.0	25.0	17.0	11.0	14.0
83EA	**53**	9.0	<1	10.0	33.0	27.0	21.0	9.0
84EA	**54**	5.0	1.0	19.0	30.0	35.0	10.0	6.0
85EA	**55**	5.0	1.0	31.0	28.0	29.0	6.0	6.0
86EA	**56**	12.0	10.0	11.0	9.0	18.0	40.0	22.0
87EA	**57**	6.0	11.0	6.0	7.0	11.0	59.0	17.0
88EA	**58**	15.0	3.0	50.0	5.0	15.0	12.0	18.0
89EA	**59**	8.0	8.0	16.0	4.0	7.0	57.0	16.0
90EA	**60**	17.0	<1	64.0	12.0	5.0	1.0	17.0
91EA	**61**	9.0	4.0	17.0	11.0	21.0	38.0	13.0
92EA	**62**	4.0	<1	21.0	21.0	34.0	21.0	4.0
93EA	**63**	16.0	<1	48.0	16.0	16.0	6.0	16.0
94EA	**64**	14.0	<1	42.0	14.0	10.0	23.0	14.0
95EA	**65**	9.0	<1	33.0	16.0	16.0	25.0	9.0
96EA	**66**	7.0	<1	17.0	37.0	34.0	5.0	7.0
97EA	**67**	10.0	9.0	11.0	6.0	13.0	51.0	19.0
98EA	**68**	6.0	<1	45.0	36.0	10.0	3.0	6.0
99EA	**69**	13.0	5.0	40.0	11.0	15.0	16.0	18.0
100EA	**70**	9.0	3.0	19.0	15.0	17.0	37.0	12.0
101EA	**71**	9.0	7.0	13.0	5.0	14.0	52.0	16.0
102EA	**72**	13.0	2.0	8.0	8.0	26.0	43.0	15.0
103EA	**73**	16.0	7.0	9.0	7.0	28.0	33.0	23.0
104EA	**74**	15.0	9.0	11.0	7.0	23.0	35.0	24.0
105EA	**75**	11.0	9.0	9.0	5.0	17.0	49.0	20.0
106EA	**76**	11.0	9.0	9.0	5.0	20.0	46.0	20.0
107EA	**77**	15.0	13.0	20.0	3.0	5.0	44.0	28.0
108EA	**78**	9.0	12.0	9.0	3.0	11.0	56.0	21.0
109EA	**79**	17.0	14.0	13.0	5.0	14.0	37.0	31.0
Mean		**8.4**	**9.4**	**25.7**	**16.2**	**18.7**	**22.5**	**16.6**

Table 21: Summary of particle size distribution results for the proposed pipeline route

% Composition		Clay	Silt	Fine Sand	Medium Sand	Coarse Sand	Gravel	Silt/Clay
Site ID	**Sample ID**	**<4 μ**	**4 - 62 μ**	**62 – 250 μ**	**250 – 500 μ**	**500 – 2000 μ**	**>2000 μ**	**%**
110P	**D7**	1.8	4.4	15.6	23.4	16.0	38.8	6.2
111P	**8D**	10.8	37.9	49.0	0.8	0.4	1.1	48.7
112P	**11D**	4.1	8.6	25.8	23.4	13.1	24.9	12.8
113P	**12.1D**	12.8	32.9	20.0	3.8	13.1	17.5	45.7
114P	**22D**	0.0	0.0	2.7	16.2	67.4	13.7	0.0
115P	**23D**	0.0	0.0	0.0	0.0	55.2	44.8	0.0
116P	**24D**	0.0	0.0	0.0	0.0	97.7	2.3	0.0
117P	**1**	18.0	5.0	25.0	10.0	17.0	25.0	23.0
119P	**2**	25.0	15.0	34.0	4.0	8.0	14.0	40.0
120P	**3**	7.0	5.0	9.0	9.0	15.0	55.0	12.0
121P	**4**	29.0	10.0	20.0	5.0	11.0	25.0	39.0
122P	**5**	21.0	7.0	23.0	6.0	15.0	28.0	28.0
123P	**6 (0-0.5)**	7.0	4.0	8.0	13.0	6.0	62.0	11.0
124P	**7**	23.0	6.0	25.0	19.0	14.0	13.0	29.0
125P	**8**	12.0	7.0	24.0	8.0	12.0	37.0	19.0
126P	**9**	7.0	4.0	8.0	12.0	22.0	47.0	11.0
128P	**10**	5.0	6.0	8.0	12.0	23.0	46.0	11.0
129P	**11**	2.0	2.0	4.0	6.0	28.0	58.0	4.0
131P	**12**	11.0	8.0	16.0	10.0	17.0	38.0	19.0
133P	**13**	5.0	6.0	9.0	10.0	11.0	59.0	11.0
134P	**14**	8.0	6.0	12.0	17.0	24.0	33.0	14.0
135P	**15**	11.0	4.0	27.0	18.0	25.0	15.0	15.0
136P	**16**	12.0	7.0	13.0	18.0	23.0	27.0	19.0
137P	**17**	14.0	<1	18.0	21.0	32.0	14.0	14.0
138P	**18**	26.0	19.0	20.0	8.0	0.3	0.2	45.0
139P	**19**	10.0	9.0	13.0	15.0	0.1	0.4	19.0
Mean		**10.9**	**8.6**	**16.5**	**11.1**	**21.8**	**28.4**	**19.1**

Table 22: Summary of particle size distribution results for the shore crossing

% Composition		Clay	Silt	Fine Sand	Medium Sand	Coarse Sand	Gravel	Silt/Clay
Site ID	**Sample ID**	**<4 μ**	**4 - 62 μ**	**62 – 250 μ**	**250 – 500 μ**	**500 – 2000 μ**	**>2000 μ**	**%**
142SC	**20**	17.0	21.0	57.0	1.0	1.0	3.0	38.0
143SC	**D1**	10.4	45.5	39.2	0.1	1.5	3.3	55.9
144SC	**D2**	11.8	43.3	40.4	0.0	1.6	2.9	55.1
145SC	**D3**	10.2	36.6	51.8	0.0	0.6	0.9	46.7
146SC	**D4**	6.5	28.7	59.0	0.8	1.3	3.7	35.2
147SC	**D5**	5.5	22.6	69.1	0.0	0.8	2.0	28.1
148SC	**D6**	7.5	30.7	60.6	0.0	0.2	0.7	38.2
149SC	**D7**	4.7	23.2	56.5	1.5	10.6	3.6	27.8
150SC	**D8**	4.2	20.8	73.3	0.1	0.5	1.1	25.0
151SC	**D9**	7.4	17.5	14.0	1.7	5.5	53.9	24.9
Mean		**7.6**	**29.9**	**51.5**	**0.5**	**2.5**	**8.0**	**37.4**

Table 23: Summary of results for radionuclides in East Arm

		Gross Alpha	Gross Beta	Total Activity
	UNIT	Bq/g	Bq/g	Bq/g
	PQL[a]	0.03	0.03	0.03
	Screening[b]	NG	NG	35
Site ID	Sample ID			
49EA	21	0.212	0.098	0.310
50EA	22	0.628	0.294	0.922
51EA	23	1.626	0.972	2.596
52EA	24	0.231	0.095	0.327
53EA	25	0.794	0.409	1.203
54EA	26	0.332	0.144	0.476
55EA	27	0.247	0.109	0.356
56EA	28	0.287	0.130	0.417
57EA	29	0.171	0.066	0.236
58EA	30	0.355	0.169	0.524
59EA	31	0.597	0.281	0.877
60EA	32	0.420	0.192	0.612
61EA	33	0.453	0.205	0.658
62EA	34	0.388	0.186	0.574
63EA	35	0.276	0.132	0.408
64EA	36	0.482	0.219	0.700
65EA	37	0.496	0.232	0.728
66EA	38	0.461	0.227	0.688
67EA	39	0.392	0.175	0.567
68EA	40	0.144	0.075	0.219
71EA	41 (0.0-0.5)	0.245	0.116	0.360
72EA	42	0.290	0.132	0.422
73EA	43	0.328	0.154	0.482
74EA	44	0.682	0.320	1.002
75EA	45	0.389	0.181	0.570
76EA	46	0.511	0.236	0.747
77EA	47	1.016	0.459	1.475
78EA	48	0.313	0.149	0.462
79EA	49	1.261	0.595	1.856
80EA	50	0.255	0.113	0.367
81EA	51	0.137	0.051	0.187
82EA	52	0.062	<0.03	0.074
83EA	53	0.143	0.055	0.197
84EA	54	0.186	0.087	0.273
85EA	55	0.060	<0.03	0.072
86EA	56	0.521	0.239	0.760
87EA	57	0.245	0.082	0.327
88EA	58	0.099	<0.03	0.012
89EA	59	0.632	0.313	0.944
90EA	60	0.226	0.107	0.333
91EA	61	0.222	0.065	0.287
92EA	62	0.221	0.107	0.328
93EA	63	0.117	0.036	0.153
94EA	64	0.140	0.041	0.180
95EA	65	0.241	0.119	0.359
96EA	66	0.060	<0.03	0.072
97EA	67	0.360	0.159	0.519
98EA	68	0.152	0.070	0.222
99EA	69	0.117	0.039	0.155

Table 23: Summary of results for radionuclides in East Arm

Site ID	Sample ID	Gross Alpha	Gross Beta	Total Activity
	UNIT	Bq/g	Bq/g	Bq/g
	PQL[a]	0.03	0.03	0.03
	Screening[b]	NG	NG	35
100EA	70	0.193	0.074	0.267
101EA	71	0.503	0.224	0.727
102EA	72	0.619	0.277	0.896
103EA	73	0.723	0.344	1.068
104EA	74	0.753	0.361	1.114
105EA	75	0.146	0.037	0.183
106EA	76	0.712	0.343	1.055
107EA	77	0.453	0.209	0.662
108EA	78	0.666	0.313	0.979
109EA	79	0.753	0.340	1.093
Mean		0.402	0.199	0.587
95% UCL		0.495[c]	0.274[c]	0.821[c]

a Practical Quantitation Limit (detection limit)

b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected

c Data are lognormal and the UCL was calculated using 95% H-UCL

Table 24: Summary of results for radionuclides in the proposed pipeline route

		Gross Alpha	Gross Beta	Total Activity
	UNIT	Bq/g	Bq/g	Bq/g
	PQL[a]	0.03	0.03	0.03
	Screening[b]	NG	NG	35
Site ID	Sample ID			
117P	1	0.440	0.205	0.645
119P	2	0.523	0.248	0.771
120P	3	0.727	0.334	1.061
121P	4	0.498	0.229	0.727
122P	5	0.714	0.339	1.053
123P	6 (0.0-0.5)	0.393	0.180	0.573
124P	7	0.378	0.176	0.554
125P	8	0.365	0.174	0.539
126P	9	0.476	0.224	0.700
128P	10	0.195	0.090	0.285
129P	11	0.327	0.155	0.482
131P	12	0.128	<0.03	0.153
133P	13	0.375	0.180	0.556
134P	14	0.670	0.345	1.015
135P	15	0.425	0.210	0.635
136P	16	0.273	0.134	0.407
137P	17	0.357	0.170	0.527
138P	18	0.500	0.239	0.738
139P	19	0.182	0.084	0.266
Mean		0.418	0.206	0.615
95% UCL		0.489[c]	0.234[c]	0.725[c]

a Practical Quantitation Limit (detection limit)

b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected

d Data are normally distributed and the UCL was calculated using Student's t-Test method

Table 25: Summary of results for radionuclides in the pipeline shore crossing

		Gross Alpha	Gross Beta	Total Activity
	UNIT	**Bq/g**	**Bq/g**	**Bq/g**
	PQL[a]	**0.03**	**0.03**	**0.03**
	Screening[b]	**NG**	**NG**	**35**
Site ID	**Sample ID**			
142SC	20	0.151	0.056	0.207
Mean		0.151	0.056	0.207

a Practical Quantitation Limit (detection limit)

b NODGDM screening level concentration (EA 2002) - below which toxic effects on organisms are not expected

Figures

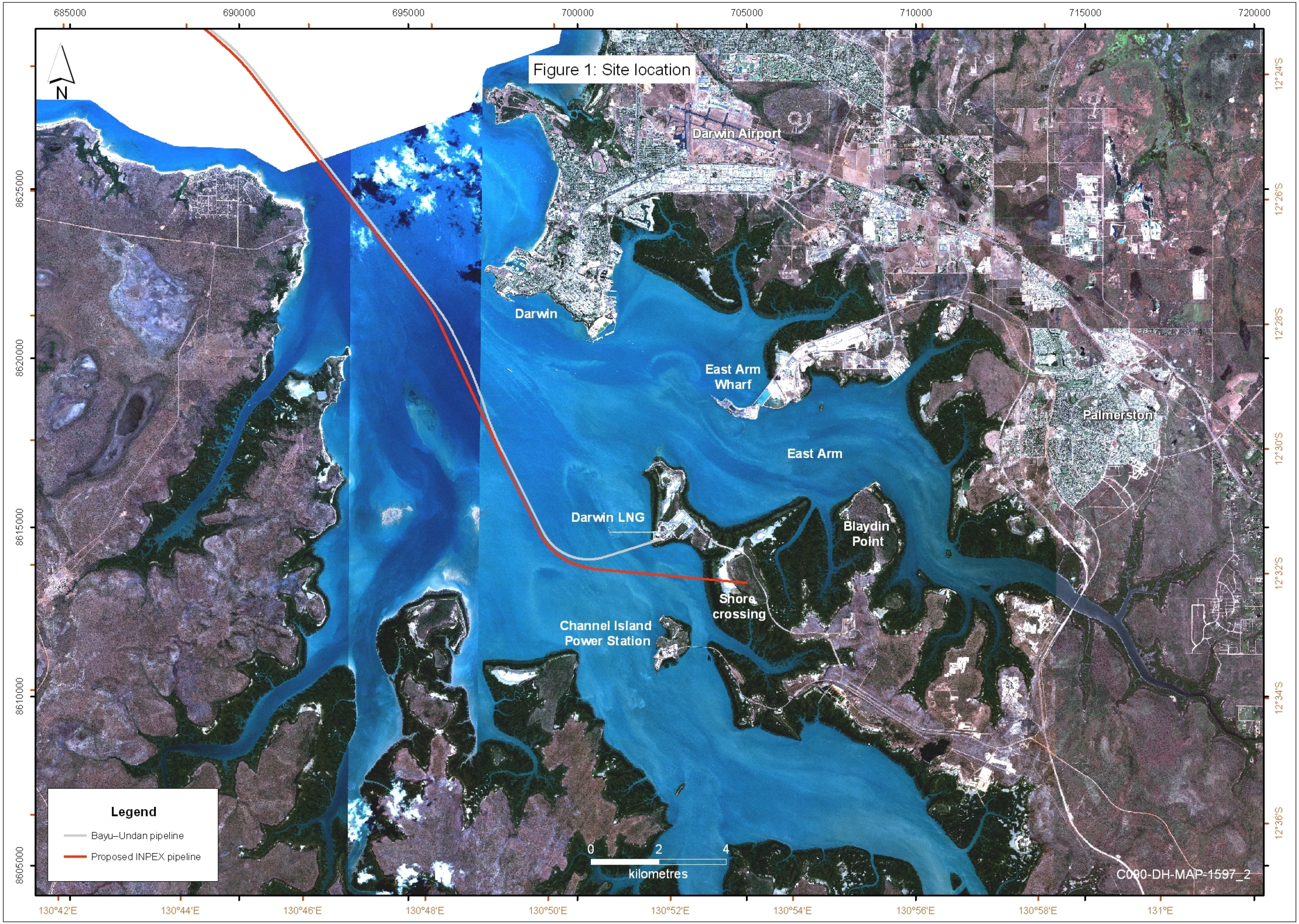


Figure 1: Site location
N
Darwin Airport
Darwin
East Arm
Wharf
Palmerston
East Arm
Darwin LNG
Blaydin
Point
Shore
crossing
Channel Island
Power Station
Legend
Bayu–Undan pipeline
Proposed INPEX pipeline
0
2
4
kilometres
C090-DH-MAP-1597_2
685000
690000
695000
700000
705000
710000
715000
720000
8625000
8620000
8615000
8610000
8605000
12°24'S
12°26'S
12°28'S
12°30'S
12°32'S
12°34'S
12°36'S
130°42'E
130°44'E
130°46'E
130°48'E
130°50'E
130°52'E
130°54'E
130°56'E
130°58'E
131°E

Figure 2: Water quality sampling locations
Legend
Water quality monitoring sites
Proposed Pipeline
N
1
2
3
4
5
6
7
690000
695000
700000
705000
710000
8625000
8620000
8615000
8610000
12°26'S
12°28'S
12°30'S
12°32'S
12°34'S
130°46'E
130°48'E
130°50'E
130°52'E
130°54'E
130°56'E
130°58'E
0
1.5
3
kilometres

Figure 3: East Arm sediment sampling program

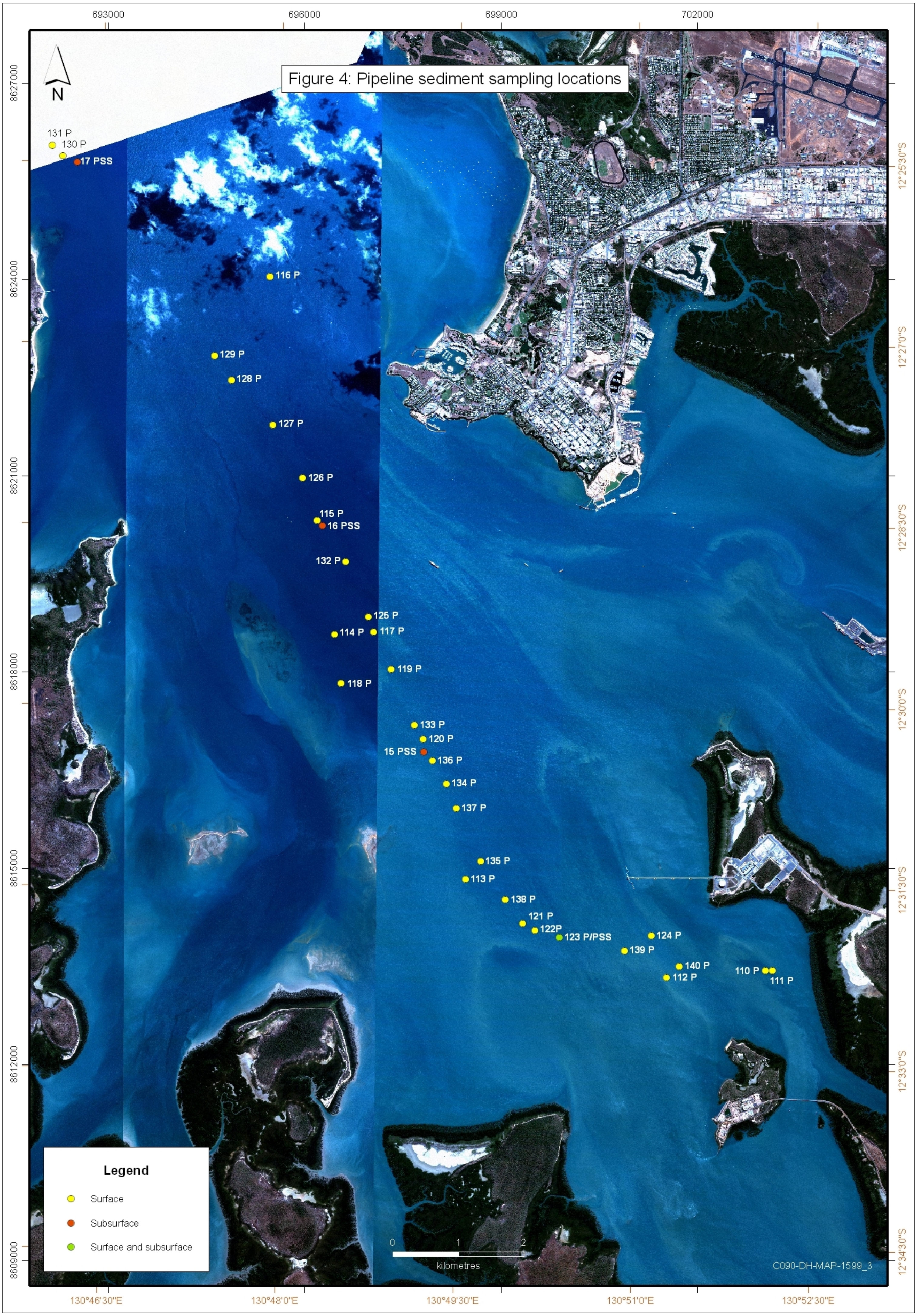


Figure 4: Pipeline sediment sampling locations
N
693000
696000
699000
702000
8627000
8624000
8621000
8618000
8615000
8612000
8609000
12°25'30"S
12°27'0"S
12°28'30"S
12°30'0"S
12°31'30"S
12°33'0"S
12°34'30"S
130°46'30"E
130°48'0"E
130°49'30"E
130°51'0"E
130°52'30"E
131 P
130 P
17 PSS
116 P
129 P
128 P
127 P
126 P
115 P
16 PSS
132 P
125 P
114 P
117 P
119 P
118 P
133 P
120 P
15 PSS
136 P
134 P
137 P
135 P
113 P
138 P
121 P
122P
123 P/PSS
124 P
139 P
140 P
112 P
110 P
111 P
Legend
Surface
Subsurface
Surface and subsurface
0
1
2
kilometres
C090-DH-MAP-1599_3

Figure 5: Pipeline shore crossing sediment sampling locations
N
149sc
146sc
145sc
142sc
18scss
144sc
150sc
147sc
141sc
151sc
143sc
148sc
Legend
Surface
Subsurface
0.5
1
kilometres
C090DH1600 Rev 2
700000
700500
701000
701500
702000
702500
703000
703500
704000
704500
705000
705500
706000
706500
8615500
8615000
8614500
8614000
8613500
8613000
8612500
8612000
8611500
8611000
12°31'0"S
12°31'30"S
12°32'0"S
12°32'30"S
12°33'0"S
130°50'30"E
130°51'0"E
130°51'30"E
130°52'0"E
130°52'30"E
130°53'0"E
130°53'30"E
130°54'0"E


Figure 6: Potential risk sites in East Arm based on site-specific ASS risk criteria
N
Legend
Surface
Subsurface
Dredging area
0
0.5
1
kilometres
C090-DH-MAP-1611_2
702000
703500
705000
706500
708000
709500
711000
8619500
8618000
8616500
8615000
8613500
12°29'0"S
12°30'0"S
12°31'0"S
12°32'0"S
130°51'0"E
130°52'0"E
130°53'0"E
130°54'0"E
130°55'0"E
130°56'0"E
107 EA
104 EA
108 EA
106 EA
105 EA
103 EA
102 EA
97 EA
100 EA
63 EA
62 EA
61 EA
60 EA
64 EA
95 EA
10 EASS
57 EA
56 EA
93 EA
94 EA
54 EA
53 EA
55 EA
18 EA
12 EASS
90 EA
91 EA
89 EA
11 EASS
40 EA
21 EA
39 EA
13 EASS
37 EA
38 EA
10 EA
15 EA
83 EA
84 EA
8 EA
11 EA
42 EA
43 EA
45 EA
22 EA
25 EA
3 EASS
4 EASS
81 EA
82 EA
72 EA
73 EA
27 EA
71 EA
76 EA
51 EA
52 EA
86 EA
87 EA

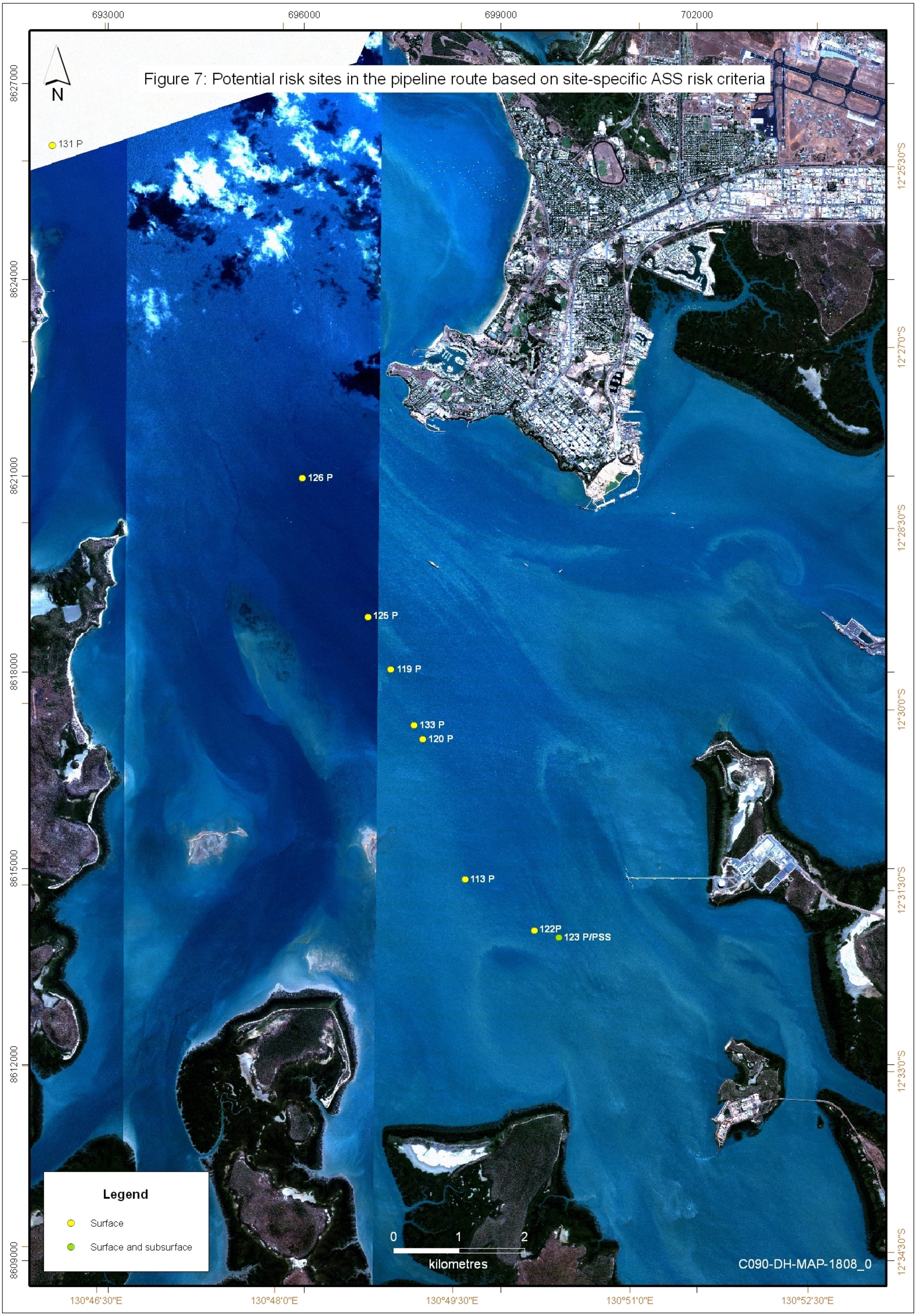


Figure 7: Potential risk sites in the pipeline route based on site-specific ASS risk criteria
N
693000
696000
699000
702000
8627000
8624000
8621000
8618000
8615000
8612000
8609000
12°25'30"S
12°27'0"S
12°28'30"S
12°30'0"S
12°31'30"S
12°33'0"S
12°34'30"S
130°46'30"E
130°48'0"E
130°49'30"E
130°51'0"E
130°52'30"E
131 P
126 P
125 P
119 P
133 P
120 P
113 P
122P
123 P/PSS
Legend
Surface
Surface and subsurface
0
1
2
kilometres
C090-DH-MAP-1808_0

Figure 8: Potential risk sites in the pipeline shore crossing based on site-specific ASS risk criteria

Technical specifications of MANTA water quality logger

Appendix A

Parameter	Range	Resolution	Accuracy
Temperature	-5°C - 50°C	0.01°C	±0.1°C
Dissolved Oxygen (Clark Cell)	0 - 50 mg/l	0.01 mg/L	±0.2 mg/L <= 20 mg/L ±0.6 mg/L > 20 mg/L
Conductivity	0 - 100 mS/cm	4 digits	±1% reading
Salinity	0 - 70 pss	0.01 pss	±1% reading
Turbidity	0 - 3000 NTU	4 digits	<1% reading to 400 NTU <3% reading over 400 NTU
pH	2 - 12 units	0.01 units	±0.2 units
ORP	-999 - 999 mV	1mV	±20mV
Depth - Really Shallow	0 - 10m	0.01m	±0.2% of range
Depth - Shallow	0 - 25m	0.01m	±0.2% of range
Depth - Medium	0 - 50m	0.01m	±0.2% of range
Depth - Deep	0 - 100m	0.01m	±0.2% of range
Stage (vented)	0 - 33 feet	0.001 ft.	±0.005 ft.

- Individual sensor features include:
  - Temperature – industry best accuracy
  - Dissolved Oxygen (Clark Cell) – snap-on DO membranes
  - Conductivity – graphite electrodes in a free flushing system
  - Turbidity – McVan® ANALITE, wipered with sediment rejection
  - pH – easy to clean and hard to break flat glass sensor
  - Stage – industry best accuracy, guaranteed not to drift out of specification for year
- Detachable CableLock™ system
- Cable length range from 2 to 200 meters
- Sensors are field replaceable while protecting internal electronics
- Connects to Eureka's field display unit or other manufacturers' dataloggers
- Extensively tested, designed, and built for harsh field conditions
- Low pricing extends greatest value to customers

eureka™
environmental engineering
512.302.4333

Technical specifications of YSI 6600EDS water quality logger

Appendix B

6600EDS Extended Deployment System

Measure over 10 parameters in severe fouling environments Featuring Patented Clean Sweep® Anti-fouling Technology

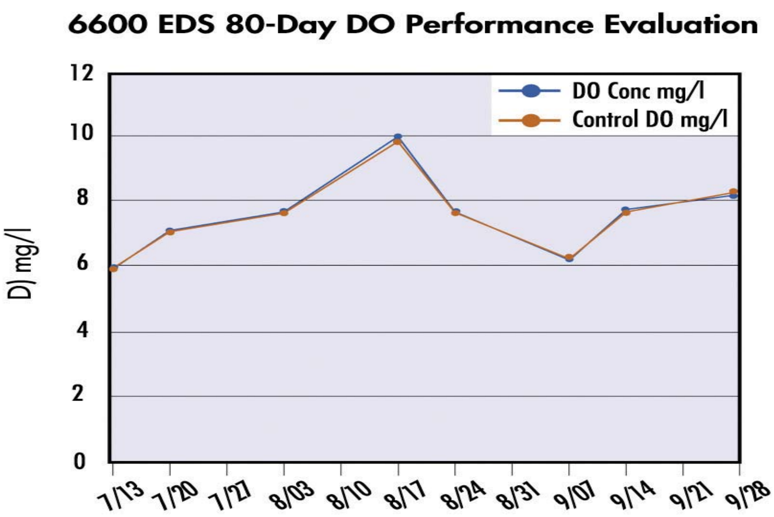
Profile of the 6600EDS depicting (clockwise from bottom) temperature/conductivity, turbidity, Rapid Pulse™ dissolved oxygen, chlorophyll and pH/ORP—all of which (except conductivity) are kept free of fouling by the patented Clean Sweep® universal wiper assembly, as well as individual optical wipers.

Building upon the unprecedented accuracy and reliability of YSI's stirring-independent Rapid Pulse™ dissolved oxygen system, as well as on the improved and proven wiped turbidity sensor, YSI has produced the YSI 6600EDS (Extended Deployment System).

- **Provides unprecedented DO accuracy and longevity in aggressive fouling environments**
- **Patented wiped fouling protection for turbidity, chlorophyll, DO, pH, and ORP sensors**
- **Ideal for extended, long-term deployments**
- **Virtually maintenance free**
- **Sensors are field-replaceable**
- **Integrates with DCPs** (via RS-232 or SDI-12)

A prototype 6600EDS after continuous deployment for 80 days in Buzzards Bay, MA. The sensor in the foreground is the active DO sensor. The sensor at top-right was used as a non-wiped fouling reference. Note extensive fouling by plant and animal species on the non-wiped sensor.

Initial field studies of the YSI 6600EDS show that the system provides unprecedented DO accuracy and longevity in aggressive fouling environments. The 6600EDS was inspected after 80 days of an ongoing deployment performance evaluation. The Rapid Pulse™ DO sensor performed within specifications throughout this deployment without the need for recalibration or cleaning. During this deployment, the instrument was removed once for battery replacement; none of the sensors were cleaned or recalibrated.



Remarkably close agreement (mean error 0.16mg/l) between the continuously deployed sonde and the control measurements was observed throughout an 80-day deployment.

Pure Data for a Healthy Planet.®

Sensor Performance verified by the EPA Environmental Technology Verification Program.*

ETV

www.YSI.com

YSI

To order, or for more info, contact YSI Environmental.

+1 937 767 7241
800 897 4151 (US)
www.ysi.com

YSI Environmental
+1 937 767 7241
Fax +1 937 767 9353
environmental@ysi.com

Endeco/YSI
+1 508 748 0366
Fax +1 508 748 2543
systems@ysi.com

SonTek/YSI
+1 858 546 8327
Fax +1 858 546 8150
inquiry@sontek.com

YSI Gulf Coast
+1 225 753 2650
Fax +1 225 753 8669
environmental@ysi.com

YSI Hydrodata (UK)
+44 1462 673 581
Fax +44 1462 673 582
europe@ysi.com

YSI Middle East (Bahrain)
+973 1753 6222
Fax +973 1753 6333
halsalem@ysi.com

YSI (Hong Kong) Limited
+852 2891 8154
Fax +852 2834 0034
hongkong@ysi.com

YSI (China) Limited
+86 10 5203 9675
Fax +86 10 5203 9679
beijing@ysi-china.com

YSI Nanotech (Japan)
+81 44 222 0009
Fax +81 44 221 1102
nanotech@ysi.com

ISO 9001
ISO 14001
Yellow Springs, Ohio Facility

CE

*Sensors with listed with the ETV logo were submitted to the ETV program on the YSI 6600EDS. Information on the performance characteristics of YSI water quality sensors can be found at www.epa.gov/etv, or call YSI at 800.897.4151 for the ETV verification report. Use of the ETV name or logo does not imply approval or certification of this product nor does it make any explicit or implied warranties or guarantees as to product performance.

YSI incorporated
Who's Minding the Planet?®

Sensor performance verified*

The 6600EDS uses sensor technology that was performance-verified through the US EPA's Environmental Technology Verification Program (ETV). For information on which sensors were performance-verified, look for the ETV logo.

YSI 6600EDS Sensor Specifications

	Range	Resolution	Accuracy
Dissolved Oxygen• % Saturation, 6562 Rapid Pulse™ Sensor* (ETV)	0 to 500%	0.1%	0 to 200%: ±2% of reading or 2% air saturation, whichever is greater; 200 to 500%: ±6% of reading
Dissolved Oxygen• mg/L, 6562 Rapid Pulse™ Sensor* (ETV)	0 to 50 mg/L	0.01 mg/L	0 to 20 mg/L: ± 0.2 mg/L or 2% of reading, whichever is greater; 20 to 50 mg/L: ±6% of reading
Conductivity••, 6560 Sensor* (ETV)	0 to 100 mS/cm	0.001 to 0.1 mS/cm (range dependent)	±0.5% of reading + 0.001 mS/cm
Salinity	0 to 70 ppt	0.01 ppt	±1% of reading or 0.1 ppt, whichever is greater
Temperature, 6560 Sensor* (ETV)	-5 to +50°C	0.01°C	±0.15°C
pH, 6561 Sensor* (ETV)	0 to 14 units	0.01 unit	±0.2 unit
ORP	-999 to +999 mV	0.1 mV	±20 mV
Depth: Deep	0 to 656 ft, 200 m	0.001 ft, 0.001 m	±1 ft, ±0.3 m
Depth: Medium	0 to 200 ft, 61 m	0.001 ft, 0.001 m	±0.4 ft, ±0.12 m
Depth: Shallow	0 to 30 ft, 9.1 m	0.001 ft, 0.001 m	±0.06 ft, ±0.02 m
Depth: Vented Level	0 to 30 ft, 9.1 m	0.001 ft, 0.001 m	±0.01 ft, 0.003 m
Turbidity•, 6136 Sensor* (ETV)	0 to 1,000 NTU	0.1 NTU	±2% of reading or 0.3 NTU, whichever is greater**
Rhodamine•	0-200 µg/L	0.1 µg/L	±5% reading or 1 µg/L, whichever is greater

• Maximum depth rating for all standard optical sensors is 200 feet, 61 m. Turbidity and Rhodamine are also available in a Deep Depth option (0 to 200 m).
•• Report outputs of specific conductance (conductivity corrected to 25° C), resistivity, and total dissolved solids are also provided. These values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (ed 1989).

**In YSI AMCO-AEPA Polymer Standards.

	Range	Detection Limit	Resolution	Linearity
BGA - Phycocyanin•	~0 to 280,000 cells/mL† 0 to 100 RFU	~220 cells/mL§	1 cell/mL 0.1 RFU	$R^2 > 0.9999$**
BGA - Phycoerythrin•	~0 to 200,000 cells/mL† 0 to 100 RFU	~450 cells/mL§§	1 cell/mL 0.1 RFU	$R^2 > 0.9999$***
Chlorophyll•, 6025 Sensor* (ETV)	~0 to 400 µg/L 0 to 100 RFU	~0.1 µg/L§§§	0.1 µg/L Chl 0.1% RFU	$R^2 > 0.9999$****

• Maximum depth rating for all standard optical probes is 200 feet, 61 m. Also available in a Deep Depth option (0 to 200 m).
BGA = Blue-Green Algae
RFU = Relative Fluorescence Units
~ = Approximately

† Explanation of Ranges can be found in the 'Principles of Operation' section of the 6-Series Manual, Rev D.

§ Estimated from cultures of *Microcystis aeruginosa*.
§§ Estimated from cultures *Synechococcus sp*.
§§§ Determined from cultures of *Isochrysis sp.* and chlorophyll *a* concentration determined via extractions.

**Relative to serial dilution of Rhodamine WT (0-400 ug/L).
***Relative to serial dilution of Rhodamine WT (0-8 µg/L).
****Relative to serial dilution of Rhodamine WT (0-500 ug/L).

YSI 6600 Sonde Specifications

Medium	Fresh, sea or polluted water	Software	EcoWatch®
Temperature: Operating	-5 to +50°C	Dimensions: Diameter	3.5 in, 8.9 cm
Temperature: Storage	-10 to +60°C	Length, no depth	19.6 in, 34.3 cm
		Length, depth	21.6 in, 54.9 cm
		Weight, depth and batteries	7 lbs, 3.18 kg
Communications	RS-232, SDI-12	Power: External	12 V DC
		Power: Internal	8 C-size alkaline batteries

Acid sulfate soil assessment methods

Appendix C

Acid sulfate soil assessment methods

Appendix C

Background

Acid Sulfate Soil (ASS) is a common name for naturally occurring clays, muds, sands and gravels rich in the iron sulfide pyrite. When such sediments are exposed to the air by excavation or drainage works (which may lower the ground water table) the iron sulfides react with moisture and oxygen to form sulfuric acid according to the following overall reaction:

$$FeS_2 + \frac{15}{4}O_2 + \frac{7}{2}H_2O \dashrightarrow Fe(OH)_3 + 2\,H_2SO_4$$

The decrease in pH causes iron, aluminium and other heavy metals to become soluble. The flushing or leaching of the disturbed ASS enables the dissolved metals to enter waterways and drains. This can cause significant impact to the environment, engineered structures and human health in the receiving areas.

In natural environments, the iron sulfides in the soil are stable. These are called potential acid sulfate soils (PASS) because they have the potential to produce acidity when disturbed or exposed to air. PASS materials have a pH close to neutral (pH 6.5 – 7.5). PASS materials are only problematic when they are disturbed and exposed to air, typically via excavation, filling or extraction of groundwater. Disturbed PASS material is referred to as actual acid sulfate soils (AASS). AASS are acidic and have a pH of less than 4.

Laboratory Methods

ASS samples are usually analysed for pH before and after peroxide oxidation as an initial screen to determine if ASS laboratory analysis is required. This testing was not carried out on the samples collected for the INPEX project, as all samples were tested for ASS.

Typical ASS laboratory analysis involves one of two methods. The first method is the Chromium suite which includes analysis of Total actual acidity (TAA), Chromium Reducible Sulfur (S_{Cr}), and Acid Neutralising Capacity (ANC). The other method is the Suspension Peroxide Oxidation Combined Acidity and Sulfate (sPOCAS) which includes the analysis of TAA, Peroxide Oxidisable Sulphur (S_{POS}), Titratable Sulphidic Acidity (TSA), and ANC.

The net acidity, or overall potential for a sample to generate acidity, is based on the sum of potential, existing and retained acidity minus the acid neutralising capacity:

Net acidity = Potential Sulphidic Acidity (S_{POS} or S_{Cr}) = Existing Acidity – ANC/Fineness factor (1.5)

where Existing Acidity = TAA + Retained acidity

All methods are accepted chemical methods for the analysis of ASS as outlined in the *Queensland Acid Sulfate Soil Laboratory Methods Guidelines (Version 2.1 – June 2004)*. The results of the combined methods provide detailed information about the nature of the site's acid sulfate soils and assist in the development of a suitable management plan.

Sediment data validation tables

Appendix D

Table 1: Relative Standard Deviation (RSD) and Relative Percentage Difference (RPD) calculations for metals

		Moisture Content (dried @ 103)	Antimony Sb	Arsenic As	Cadmium Cd	Chromium Cr	Cobalt Co	Copper Cu	Iron Fe	Lead Pb	Manganese Mn	Nickel Ni	Silver Ag	Mercury Hg	Zinc Zn
	UNIT	%	mg/kg												
	PQL[a]	1	0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.01	0.1
Site ID	**Sample ID**														
10EA	16.1	36.9	<0.1	16	<1	18	4	<5	15800	6	178	4	<2	<0.01	12
10EA	16.2	38.1	<0.1	14	<1	18	4	<5	14500	5	177	4	<2	<0.01	12
RPD		**3.2%**	**-**	**13.3%**	**-**	**0.0%**	**0.0%**	**-**	**8.6%**	**18.2%**	**0.6%**	**0.0%**	**-**	**-**	**0.0%**
15EA	21.1	27.3	0.3	47	<1	33	5	<5	37200	7	155	3	<2	<0.01	8
15EA	21.2	26.7	0.2	63	<1	39	7	<5	47400	8	258	4	<2	<0.01	10
15EA	21.3	27.3	0.2	43	<1	28	4	<5	37800	7	156	3	<2	<0.01	10
RSD		**1.3%**	**24.7%**	**20.8%**	**-**	**16.5%**	**28.6%**	**-**	**14.0%**	**7.9%**	**31.2%**	**17.3%**	**-**	**-**	**12.4%**
18EA	D27.1	20.4	0.4	62	<0.1	62	7	2	55300	11	266	4	<0.1	<0.01	8
18EA	D27.2	21.3	0.5	49	<0.1	127	7	3	74500	17	274	5	<0.1	<0.01	11
18EA	D27.3	20.2	0.4	61	<0.1	59	8	2	58600	12	277	4	<0.1	<0.01	8
RSD		**2.8%**	**13.3%**	**12.5%**	**-**	**46.7%**	**5.2%**	**31.7%**	**16.3%**	**24.7%**	**2.1%**	**13.2%**	**-**	**-**	**17.3%**
22EA	D12.1	42.4	<0.1	17	<0.1	27	5	4	23800	9	408	5	<0.1	0.01	17
22EA	D12.2	41.1	<0.1	13	<0.1	22	6	3	16700	7	404	5	<0.1	<0.01	16
RPD		**3.1%**	**-**	**32.0%**	**-**	**18.6%**	**1.8%**	**12.1%**	**35.1%**	**22.8%**	**1.0%**	**1.9%**	**-**	**-**	**8.4%**
23EA	D13.1	42.9	<0.1	13	<0.1	17	5	3	10800	7	178	5	<0.1	0.01	14
23EA	D13.2	47.1	<0.1	13	<0.1	24	6	4	13000	8	247	6	<0.1	<0.01	18
23EA	D13.3	42.9	<0.1	14	<0.1	20	5	3	12000	7	228	5	<0.1	0.01	15
RSD		**5.5%**	**-**	**5.1%**	**-**	**15.5%**	**10.4%**	**15.7%**	**9.2%**	**9.5%**	**16.4%**	**15.3%**	**-**	**0.0%**	**14.5%**
28EA	D18.1	22.0	0.2	46	<0.1	71	6	2	46800	10	184	4	<0.1	<0.01	9
28EA	D18.2	24.8	0.3	45	<0.1	50	8	3	45600	10	190	5	<0.1	<0.01	11
28EA	D18.3	22.3	0.3	55	<0.1	85	8	3	57000	11	211	5	<0.1	<0.01	11
RSD		**6.7%**	**21.7%**	**11.0%**	**-**	**25.7%**	**16.0%**	**23.2%**	**12.6%**	**3.5%**	**7.3%**	**8.7%**	**-**	**-**	**9.7%**
33EA	D23.1	25.9	0.3	53	<0.1	90	8	3	49800	10	203	5	<0.1	<0.01	10
33EA	D23.2	20.2	0.2	47	<0.1	36	5	2	35400	7	147	3	<0.1	<0.01	9
33EA	D23.3	25.0	0.5	69	<0.1	57	7	3	53700	10	188	4	<0.1	<0.01	9
RSD		**12.9%**	**45.8%**	**20.1%**	**-**	**45.1%**	**21.8%**	**18.2%**	**20.8%**	**18.1%**	**16.2%**	**18.4%**	**-**	**-**	**9.2%**
37EA	27.1	32.0	<0.1	18	<1	25	3	<5	17700	6	178	3	<2	<0.01	11
37EA	27.2	28.3	0.2	23	<1	51	3	<5	33900	8	204	2	<2	<0.01	8
37EA	27.3	29.6	0.3	24	<1	67	4	<5	38500	9	182	3	<2	<0.01	10
RSD		**6.3%**	**28.3%**	**14.8%**	**-**	**44.5%**	**17.3%**	**-**	**36.4%**	**19.9%**	**7.4%**	**21.7%**	**-**	**-**	**15.8%**

Table 1: Relative Standard Deviation (RSD) and Relative Percentage Difference (RPD) calculations for metals

		Moisture Content (dried @ 103)	Antimony Sb	Arsenic As	Cadmium Cd	Chromium Cr	Cobalt Co	Copper Cu	Iron Fe	Lead Pb	Manganese Mn	Nickel Ni	Silver Ag	Mercury Hg	Zinc Zn
	UNIT	%	mg/kg												
	PQL[a]	1	0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.01	0.1
Site ID	Sample ID														
38EA	D28.1	26.1	0.2	27	<0.1	28	4	2	23100	6	164	3	<0.1	<0.01	8
38EA	D28.2	25.0	0.3	32	<0.1	45	4	2	28800	7	144	3	<0.1	<0.01	7
RPD		**4.3%**	**40.0%**	**17.4%**	**-**	**47.5%**	**12.0%**	**5.4%**	**22.0%**	**14.4%**	**13.0%**	**3.3%**	**-**	**-**	**8.0%**
55EA	27	23.6	<0.50	18.6	<0.1	33.7	1.6	4.2	16000	4.6	250	2.8	<0.1	<0.01	6
55EA	T5	25.4	<0.50	20.4	<0.1	48.5	2.5	4.3	18400	4.9	299	3.7	<0.1	<0.01	8.3
55EA	T6	24.4	<0.50	18.4	<0.1	15.1	1.7	3.6	13100	3.8	252	2.5	<0.1	<0.01	5.8
RSD		**3.7%**	**-**	**5.8%**	**-**	**51.6%**	**25.5%**	**9.4%**	**16.8%**	**12.8%**	**10.4%**	**20.8%**	**-**	**-**	**20.7%**
63EA	35	27.7	7.39	110	<0.1	29.4	4.6	8.7	31800	5.7	1050	5.6	<0.1	<0.01	6.5
63EA	QC03	22	0.57	57.1	<0.1	16.9	1.6	5.6	20400	4.1	844	3.6	<0.1	<0.01	4
63EA	35		<0.50	57.7	<0.1	19.8	2.3	5.1	31000	6	608	3.7	<0.1		5
63EA	QC03		0.6	55.8	<0.1	17.9	3.7	5.5	27400	5.1	639	3.8	<0.1		5
RSD		**22.9%**	**137.7%**	**37.9%**	**-**	**27.3%**	**44.4%**	**26.7%**	**18.8%**	**16.0%**	**26.1%**	**22.8%**	**-**	**-**	**20.1%**
67EA	39	30.2	<0.50	50.3	<0.1	32.8	1.9	5.6	25800	7	299	4.9	<0.1	0.02	6.2
67EA	T7	27.7	0.6	64.6	<0.1	39.3	3.4	6.3	45700	12.5	433	4.6	<0.1	<0.01	7.4
67EA	T8	22.8	0.93	70	<0.1	60.7	3	7.2	60100	23.6	431	5.1	<0.1	<0.01	6.6
RSD		**14.0%**	**30.5%**	**16.5%**	**-**	**33.0%**	**28.1%**	**12.6%**	**39.3%**	**58.9%**	**19.8%**	**5.2%**	**-**	**-**	**9.1%**
78EA	48	25.2	0.98	48.7	<0.1	97.8	2.3	5.1	53400	7.7	195	3	<0.1	<0.01	8.9
78EA	QC04	25.8	0.57	25	<0.1	19.8	<1.0	4	14200	4	155	1.6	<0.1	<0.01	3.7
78EA	48		<0.50	26.4	<0.1	21.1	2.5	4.7	21000	4.1	188	1.3	<0.1		4
78EA	QC04		<0.50	22.8	<0.1	21.3	1.1	2.8	21400	4.2	229	1.3	<0.1		3.6
RSD		**2.4%**	**37.4%**	**39.3%**	**-**	**96.3%**	**38.5%**	**24.3%**	**63.9%**	**36.0%**	**15.8%**	**45.1%**	**-**	**-**	**50.9%**
83EA	53	21.6	<0.50	26.9	<0.1	16.5	2.4	4.6	24000	4.2	233	3.6	<0.1	<0.01	7.7
83EA	T9	20	<0.50	30.2	<0.1	26.6	3	5.9	24700	6.3	271	3.5	<0.1	<0.01	7.7
83EA	T10	20.2	<0.50	35.2	<0.1	20.8	2.3	5	24000	3.9	323	3.2	<0.1	<0.01	5.3
RSD		**4.2%**	**-**	**13.6%**	**-**	**23.8%**	**14.8%**	**12.9%**	**1.7%**	**27.2%**	**16.4%**	**6.1%**	**-**	**-**	**20.1%**
86EA	56	31.6	<0.50	57.4	<0.1	55.2	7.3	10.5	59900	14.4	310	9.4	<0.1	0.01	21.4
86EA	T11	37.8	<0.50	56.6	<0.1	62	8.6	17.2	78500	27.4	329	12.4	<0.1	<0.01	31.6
86EA	T12	31.7	<0.50	56.7	<0.1	42.9	7.5	10.8	57000	12.9	289	9.6	<0.1	<0.01	23.7
RSD		**10.5%**	**-**	**0.8%**	**-**	**18.1%**	**9.0%**	**29.5%**	**17.9%**	**43.7%**	**6.5%**	**16.0%**	**-**	**-**	**20.9%**

Table 1: Relative Standard Deviation (RSD) and Relative Percentage Difference (RPD) calculations for metals

		Moisture Content (dried @ 103)	Antimony Sb	Arsenic As	Cadmium Cd	Chromium Cr	Cobalt Co	Copper Cu	Iron Fe	Lead Pb	Manganese Mn	Nickel Ni	Silver Ag	Mercury Hg	Zinc Zn
	UNIT	%	mg/kg												
	PQL[a]	1	0.1	0.1	0.1	0.1	0.1	0.1	50	0.1	0.1	0.1	0.1	0.01	0.1
Site ID	**Sample ID**														
94EA	64	27.8	<0.50	17.3	<0.1	29.8	2.8	3.9	13900	4.8	246	4	<0.1	0.04	8.5
94EA	T13	29	<0.50	20.8	<0.1	24.2	2.6	5	17100	5.8	342	4.5	<0.1	<0.01	8.5
94EA	T14	31.6	<0.50	19.9	<0.1	25.9	3	4.8	17600	6.3	368	4.2	<0.1	<0.01	9.5
RSD		**6.6%**	**-**	**9.4%**	**-**	**10.8%**	**7.1%**	**12.8%**	**12.4%**	**13.6%**	**20.2%**	**5.9%**	**-**	**-**	**6.5%**
104EA	74	29.6	<0.50	58.8	<0.1	61.2	3.4	8.6	60300	15.2	491	7.7	<0.1	0.17	13.8
104EA	T15	31.9	<0.50	80.1	<0.1	22.2	3.4	9	45000	9	398	8	<0.1	<0.01	14.4
104EA	T16	29.7	<0.50	66.6	<0.1	73.1	5.3	10.6	73900	16.9	375	10.7	<0.1	<0.01	18.9
RSD		**4.3%**	**-**	**15.7%**	**-**	**51.0%**	**27.2%**	**11.3%**	**24.2%**	**30.4%**	**14.6%**	**18.8%**	**-**	**-**	**17.8%**
107EA	77	36.4	<0.50	15.6	<0.1	47	5.5	7.9	22700	8.2	200	9.6	<0.1	0.02	18.3
107EA	QC05	45.2	<0.50	18.2	<0.1	39.8	7	8.4	26400	10.7	255	9.6	<0.1	0.01	22.9
RPD		**21.6%**	**-**	**15.4%**	**-**	**16.6%**	**24.0%**	**6.1%**	**15.1%**	**26.5%**	**24.2%**	**0.0%**	**-**	**66.7%**	**22.3%**
121P	4	42.5	<0.50	23.3	<0.1	33.7	4.3	7.6	21400	8.8	168	10	<0.1	0.02	16.2
121P	QC01	45	<0.50	33.2	<0.1	43.3	5.2	10	28600	11.9	339	13.5	<0.1	<0.01	20.9
121P	4	-	-	-	-	-	-	-	-	-	209	-	-	-	-
121P	QC01	-	-	-	-	-	-	-	-	-	193	-	-	-	-
RSD		**5.7%**	**-**	**35.0%**	**-**	**24.9%**	**18.9%**	**27.3%**	**28.8%**	**30.0%**	**33.6%**	**29.8%**	**-**	**-**	**25.3%**
124P	7	40.4	<0.50	43.3	<0.1	38	3.3	8	32400	9.7	355	8.6	<0.1	0.01	11.9
124P	T1	34.8	<0.50	40.5	<0.1	39.8	3.9	6.8	31600	8.9	305	7	<0.1	<0.01	9.3
124P	T2	35	<0.50	40.2	<0.1	54.9	5.5	8.5	47400	12.1	298	8.3	<0.1	<0.01	15.8
RSD		**8.6%**	**-**	**4.1%**	**-**	**21.0%**	**26.9%**	**11.2%**	**24.0%**	**16.3%**	**9.7%**	**10.7%**	**-**	**-**	**26.5%**
131P	12	32.1	<0.50	34.5	<0.1	201	3.3	4.3	40600	14.4	206	6.6	<0.1	0.02	9.6
131P	T3	31.5	<0.50	37.1	<0.1	88.8	5.3	5.1	55700	19.7	350	8.4	<0.1	<0.01	11.6
131P	T4	31	<0.50	35.6	<0.1	70.7	3.1	6.2	33000	10.3	312	6.5	<0.1	<0.01	11.3
RSD		**1.7%**	**-**	**3.7%**	**-**	**58.7%**	**31.2%**	**18.3%**	**26.8%**	**31.8%**	**25.8%**	**14.9%**	**-**	**-**	**10.0%**
9EASS	DCBH05	42.4	<0.5	18	<0.1	41	4	6	28500	16	77	4	<0.1	0.01	9
9EASS	QC09	41.1	<0.5	57	<0.1	30	6	14	54400	34	161	4	<0.1	<0.01	10
RPD		**3.1%**	**-**	**103.7%**	**-**	**29.8%**	**38.3%**	**75.5%**	**62.5%**	**71.8%**	**70.6%**	**15.4%**	**-**	**-**	**11.5%**

RPD above 35%
RSD above 50%

Table 2: Relative Standard Deviation (RSD) and Relative Percentage Difference (RPD) calculations for organic compounds

				Total Petroleum Hydrocarbons			
		TOC	TBT	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction
	UNIT	%	µgSn/kg	mg/kg	mg/kg	mg/kg	mg/kg
	PQL[a]	0.02	0.5	10	50	100	100
Site ID	**Sample ID**						
10EA	16.1	45.0%	<0.5	<10	<50	<100	<100
10EA	16.2	42.0%	<0.5	<10	<50	<100	<100
RPD		**6.9%**	-	-	-	-	-
15EA	21.1	28.0%	<0.5	<10	<50	<100	<100
15EA	21.2	28.0%	<0.5	<10	<50	<100	<100
15EA	21.3	32.0%	<0.5	<10	<50	<100	<100
RSD		**7.9%**	-	-	-	-	-
18EA	27.1	28.0%	<0.5	<10	<50	<100	<100
18EA	27.2	28.0%	<0.5	<10	<50	<100	<100
18EA	27.3	24.0%	<0.5	<10	<50	<100	<100
RSD		**8.7%**	-	-	-	-	-
22EA	D12.1	46.0%	<0.5	<10	<50	<100	<100
22EA	D12.2	53.0%	<0.5	<10	<50	<100	<100
RPD		**14.1%**	-	-	-	-	-
23EA	D13.1	72.0%	<0.5	<10	<50	<100	<100
23EA	D13.2	62.0%	<0.5	<10	<50	<100	<100
23EA	D13.3	68.0%	<0.5	<10	<50	<100	<100
RSD		**7.5%**	-	-	-	-	-
28EA	D18.1	24.0%	<0.5	<10	<50	<100	<100
28EA	D18.2	27.0%	<0.5	<10	<50	<100	<100
28EA	D18.3	28.0%	<0.5	<10	<50	<100	<100
RSD		**7.9%**	-	-	-	-	-
33EA	D23.1	33.0%	<0.5	<10	<50	<100	<100
33EA	D23.2	24.0%	<0.5	<10	<50	<100	<100
33EA	D23.3	26.0%	<0.5	<10	<50	<100	<100
RSD		**17.1%**	-	-	-	-	-
37EA	D27.1	15.0%	<0.5	<10	<50	<100	<100
37EA	D27.2	19.0%	<0.5	<10	<50	<100	<100
37EA	D27.3	16.0%	<0.5	<10	<50	<100	<100
RSD		**12.5%**	-	-	-	-	-
38EA	D28.1	26.0%	<0.5	<10	<50	<100	<100
38EA	D28.2	24.0%	<0.5	<10	<50	<100	<100
RPD		**8.0%**	-	-	-	-	-
55EA	27	25.0%	<0.5	-	<3	1300.0%	700.0%
55EA	T5	14.0%	<0.5	-	<3	<3	<5
55EA	T6	11.0%	<0.5	-	<3	<3	<5
RSD		**44.2%**	-	-	-	-	-
63EA	35	9.0%	<0.5	-	<3	<3	<5
63EA	QC03	8.0%	<0.5	-	<3	<3	<5
RPD		**11.8%**	-	-	-	-	-
67EA	39	19.0%	<0.5	-	<3	<3	<5
67EA	T7	16.0%	<0.5	-	<3	<3	<5
67EA	T8	11.0%	<0.5	-	<3	900.0%	<5
RSD		**26.4%**	-	-	-	-	-
78EA	48	11.0%	<0.5	-	<3	<3	<5
78EA	QC04	12.0%	<0.5	-	<3	1300.0%	<5
RPD		**8.7%**	-	-	-	-	-

Table 2: Relative Standard Deviation (RSD) and Relative Percentage Difference (RPD) calculations for organic compounds

				Total Petroleum Hydrocarbons			
		TOC	TBT	C6 - C9 Fraction	C10 - C14 Fraction	C15 - C28 Fraction	C29 - C36 Fraction
	UNIT	%	µgSn/kg	mg/kg	mg/kg	mg/kg	mg/kg
	PQL[a]	0.02	0.5	10	50	100	100
Site ID	**Sample ID**						
83EA	53	29.0%	<0.5	-	<3	2000.0%	<5
83EA	T9	22.0%	<0.5	-	<3	1200.0%	900.0%
83EA	T10	17.0%	<0.5	-	<3	<3	<5
RSD		**26.6%**	**-**	**-**	**-**	**35.4%**	**-**
86EA	56	30.0%	<0.5	-	<3	600.0%	<5
86EA	T11	50.0%	<0.5	-	<3	2800.0%	1400.0%
86EA	T12	30.0%	<0.5	-	<3	1700.0%	<5
RSD		**31.5%**	**-**	**-**	**-**	**64.7%**	**-**
94EA	64	25.0%	<0.5	-	<3	<3	<5
94EA	T13	23.0%	<0.5	-	<3	1300.0%	<5
94EA	T14	21.0%	<0.5	-	<3	1400.0%	800.0%
RSD		**8.7%**	**-**	**-**	**-**	**5.2%**	**-**
104EA	74	26.0%	<0.5	-	<3	1600.0%	<5
104EA	T15	20.0%	<0.5	-	<3	1400.0%	<5
104EA	T16	50.0%	<0.5	-	1000.0%	4200.0%	1100.0%
RSD		**49.6%**	**-**	**-**	**-**	**65.1%**	**-**
107EA	77	29.0%	<0.5	-	<3	3200.0%	1900.0%
107EA	QC05	40.0%	<0.5	-	<3	2400.0%	1000.0%
RPD		**31.9%**	**-**	**-**	**-**	**28.6%**	**62.1%**
113P	12.1[e]	68.0%	<0.5	<10	<50	<100	<100
113P	12.2[e]	53.0%	<0.5	<10	<50	<100	<100
113P	12.3[e]	71.0%	<0.5	<10	<50	<100	<100
RSD		**15.1%**	**-**	**-**	**-**	**-**	**-**
121P	4	47.0%	<0.5	-	<3	<3	<5
121P	QC01	40.0%	<0.5	-	<3	<3	<5
RPD		**16.1%**	**-**	**-**	**-**	**-**	**-**
124P	7	41.0%	<0.5	-	<3	600.0%	<5
124P	T1	29.0%	<0.5	-	<3	<3	<5
124P	T2	28.0%	<0.5	-	<3	<3	<5
RSD		**22.1%**	**-**	**-**	**-**	**-**	**-**
131P	12	25.0%	<0.5	-	<3	800.0%	<5
131P	T3	17.0%	<0.5	-	<3	1100.0%	<5
131P	T4	17.0%	<0.5	-	<3	3100.0%	3100.0%
RSD		**23.5%**	**-**	**-**	**-**	**75.0%**	**-**
133P	13	16.0%	<0.5	-	<3	<3	<5
133P	QC02	12.0%	<0.5	-	<3	<3	<5
RPD		**28.6%**	**-**	**-**	**-**	**-**	**-**

RPD above 35%
RSD above 50%

Table 3: Relative Standard Deviation (RSD) and Relative Percentage Difference (RPD) calculations for nutrients

Site ID	Sample ID	Nitrite+Nitrate as N (Sol.)	Total KjN as N	Total Nitrogen as N	Total Phosphorus as P	Total Sulphur as S
	UNIT	mg/kg	mg/kg	mg/kg	mg/kg	%
	PQL[a]	0.1	20	20	2	0.01
10EA	16.1	0.1	360	360	228	0.2
10EA	16.2	<0.1	220	220	115	0.17
RPD		**-**	**48.3%**	**48.3%**	**65.9%**	**16.2%**
15EA	21.1	<0.1	170	170	356	0.24
15EA	21.2	<0.1	180	180	772	0.3
15EA	21.3	<0.1	280	280	650	0.25
RSD		**-**	**29.0%**	**29.0%**	**36.1%**	**12.2%**
18EA	27.1	<0.1	320	320	944	0.2
18EA	27.2	<0.1	140	140	620	0.24
18EA	27.3	<0.1	170	170	488	0.56
RSD		**-**	**45.9%**	**45.9%**	**34.3%**	**59.2%**
22EA	D12.1	<0.1	550	550	444	0.21
22EA	D12.2	<0.1	370	370	303	0.25
RPD		**-**	**39.1%**	**39.1%**	**37.8%**	**17.4%**
23EA	D13.1	<0.1	460	460	364	0.31
23EA	D13.2	<0.1	770	800	371	0.3
23EA	D13.3	<0.1	600	600	440	0.31
RSD		**-**	**25.4%**	**27.6%**	**10.7%**	**1.9%**
28EA	D18.1	<0.1	260	260	697	0.13
28EA	D18.2	<0.1	220	220	566	0.12
28EA	D18.3	<0.1	300	300	928	0.14
RSD		**-**	**15.4%**	**15.4%**	**25.1%**	**7.7%**
33EA	D23.1	0.1	270	270	730	0.28
33EA	D23.2	0.1	1000	1000	563	0.63
33EA	D23.3	0.1	190	190	798	0.59
RSD		**0.0**	**91.7%**	**91.7%**	**17.3%**	**38.3%**
37EA	D27.1	0.1	130	130	894	0.09
37EA	D27.2	0.2	170	170	948	0.15
37EA	D27.3	0.1	100	100	884	0.11
RSD		**43.3%**	**26.3%**	**26.3%**	**3.8%**	**26.2%**
38EA	D28.1	0.1	210	210	357	0.08
38EA	D28.2	0.1	200	200	490	0.23
RPD		**0.0**	**4.9%**	**4.9%**	**31.4%**	**96.8%**
113P	12.1	0.2	1010	1010	324	0.2
113P	12.2	<0.1	1100	1100	420	0.17
113P	12.3	0.2	970	970	372	0.2
RPD		**22.1%**	**6.5%**	**6.5%**	**12.9%**	**9.1%**

RPD above 35%
RSD above 50%