

Power and Water Corporation

Report for Bathymetric and Benthic Survey of the Proposed East Point Outfall

Part One Project Summary

January 2009



Photo: East Point foreshore and existing sewage outfall at low tide



Contents

Executive Summary	1
1. Introduction	3
1.1 Summary	3
2. Bathymetric Survey Summary	6
2.1 East Point Survey	6
2.2 Larrakeyah Survey	6
3. Benthic Survey Summary	7
3.1 The Stakeholder Workshop	7
3.2 East Point Survey	7
3.3 Larrakeyah Survey	8
4. Engineering recommendations	9
4.1 Engineering recommendations of design matters based on bathymetry and high value sites	9
Figure Index	
Figure 1 East Point Bathymetric and Benthic Study Area	4
Figure 2 Larrakeyah Bathymetric Study Area	5



Executive Summary

GHD Pty Ltd (GHD) was engaged by Power and Water Corporation (PWC) in October 2008 to undertake two studies related to the planned extension of the East Point sewage outfall:

1. An extensive bathymetric survey of the area in proximity to the planned extension of the East Point outfall; and
2. A targeted benthic survey along proposed pipeline alignment, and at remote and nearby reference sites.

A bathymetric survey of the Larrakeyah sewage outfall was also undertaken.

The bathymetric survey was undertaken over nine days, and provided 1 m and 2 m grids of 3D bathymetric data for Larrakeyah and East Point, respectively. The detailed topography is provided in 1 m contours and the sounding files have been plotted to 1:5000 (hardcopy provided with report). These data have been provided in chart datum and mAHD formats.

The bathymetric survey at East Point identified various substrate types within the 815 ha of the study area. The 3D bathymetric figure identified two sets of regular shaped sand waves, the most easterly and inshore (CH 700-1300 m) are suspected to be mobile. The offshore (CH 2700-3000 m) are less likely to be highly mobile with established benthic communities present on the peaks and troughs of the sand waves. The divers later confirmed both these structures to be sand waves. Scattered rocks and patches of reef or rock structures were identified to the south of the proposed pipeline alignment into the northern area of the East Point Marine Reserve.

The bathymetric survey at Larrakeyah identified one dominating substrate type within the 4 ha of the study area. The seabed fell as the distance from shore increased. The data collected did not indicate any scarring caused by the discharge of the outfall to the area surrounding. The obvert of the pipeline sits above the level of the surrounding seabed by an average of approximately 40 cm.

The results of the bathymetric survey were used to inform the scope of the benthic survey, that is, a proposed pipeline alignment option was identified for survey, along with both nearby and remote reference sites for comparison.

The benthic survey at East Point was undertaken over seven days with benthic gathered:

- ▶ Along the principal pipeline route option;
- ▶ Adjacent to the principal pipeline route option (to check alignment variation options);
- ▶ At nearby and remote reference sites (to provide comparison); and
- ▶ At previous benthic survey sites (to compare data from previous studies).

The benthic survey results confirm that the proposed pipeline route option exhibits generally low benthic diversity and abundance. The area surveyed along the proposed pipeline alignment does not seem to be unique habitat, and is of lower conservation significance than the other sites surveyed (East Point Marine Reserve, South Shell Island and Weed Reef). The proposed pipeline alignment lacks a reef structure and is subject to strong tidal currents. This results in large areas of mobile sand waves that constrain the establishment of benthic organisms.



A benthic survey of Larrakeyah was not undertaken because of high concentrations of suspended faecal matter and high current velocities. Anecdotal evidence (and video evidence viewed by GHD divers in November 2008) collected by Tek Ventures (pers com November 2008) during 2008 indicated that there were very few benthic organisms present in the immediate vicinity of the pipeline. The substrate was covered in soft silt material and there was no obvious substrate scarring from the pipeline. GHD did not dive at this site. Professional divers from Tek Ventures provided this information.

The bathymetric and benthic survey results for East Point identified the following substrate conditions along the principal pipeline route option:

- ▶ CH 0 to 700 m – fine to medium sands and small patches of coffee rock reef closer to shore;
- ▶ CH 700m – 1300 m – highly mobile medium to coarse sands with little to no benthos colonised;
- ▶ CH 1300 – 2700 m – fine silts in a deep channel with little current and very few benthic organisms;
- ▶ CH 2700 to 3000 m – large coarse sand waves with some benthos (mobility of sand is unknown); and
- ▶ CH 3085 m – proposed location of outfall 5 (A8).

The sand waves at CH 700 to 1300 m were between 1-3 m high and at CH 2700 to 3000 were up to 6 m high. These structures may represent a significant construction and operational constraint to the proposed outfall extension. It is recommended that additional sonar/dive work be undertaken in the dry season of 2009 to confirm the mobility of the sand waves.

The deeper hole at CH 1300 to 2700, where the divers observed fine silts and a lower current, may represent a constraint to the operation of the proposed outfall extension. It is recommended that further investigations be undertaken to determine the behaviour of currents in this area. The currents may impact on dispersal of treated wastewater and may lead to the accumulation of sediment.

The benthic study identified low occurrences of sea grasses (*Halophila decipiens*) at two of the 25 sites observed during the study. Cover is less than 25% at site B3 and less than 1% at site A2.

Two green turtles (*Chelonia mydas*) were observed during the benthic survey and anecdotal information suggests that they are common in the harbour and the East Point region. No dugong were sited during the works. Darwin Harbour does not maintain a large population of dugong (Bayliss 1986). Within Darwin Harbour small areas of seagrass that dugongs are known to exploit are located adjacent to Mandorah, Casuarina Beach and Fannie Bay (Acer Vaughan, 1993). It is unlikely that any substantial population of dugong is feeding on the small seagrass patches at sites B3 and A2.

The results of GHD's studies provide PWC with data to improve and progress the hydrodynamic modelling of potential outfall sites at East Point, and the confidence to move forward with its environmental assessment process and preliminary engineering design of the outfall extension.



1. Introduction

1.1 Summary

GHD Pty Ltd (GHD) was engaged by Power and Water Corporation (PWC) in October 2008 to undertake two studies related to the planned extension of the East Point sewage outfall:

1. An extensive bathymetric survey of the area in proximity to the planned extension of the East Point outfall (Figure 1); and
2. A targeted benthic survey along proposed pipeline route, and at remote and nearby reference sites (Figure 1).

The objectives of the bathymetric survey were to:

- Provide detailed bathymetric data to input into the hydrodynamic model developed by PWC to model the dispersal of treated wastewater discharged to the Darwin Harbour via the East Point outfall;
- Inform the scope of the benthic survey through identification of potential pipeline route options; and
- Provide preliminary substrate information along potential pipeline route options.

The objectives of the benthic survey were to:

- Determine the diversity and density of benthos (and hence rate their value) along the proposed pipeline route options;
- Identify remote and nearby reference sites and survey their benthos for comparison with proposed pipeline route benthos; and
- Confirm preliminary substrate information along potential pipeline route options.

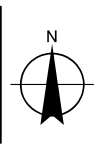
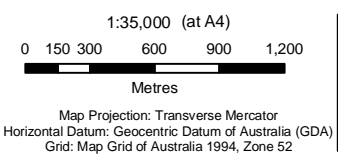
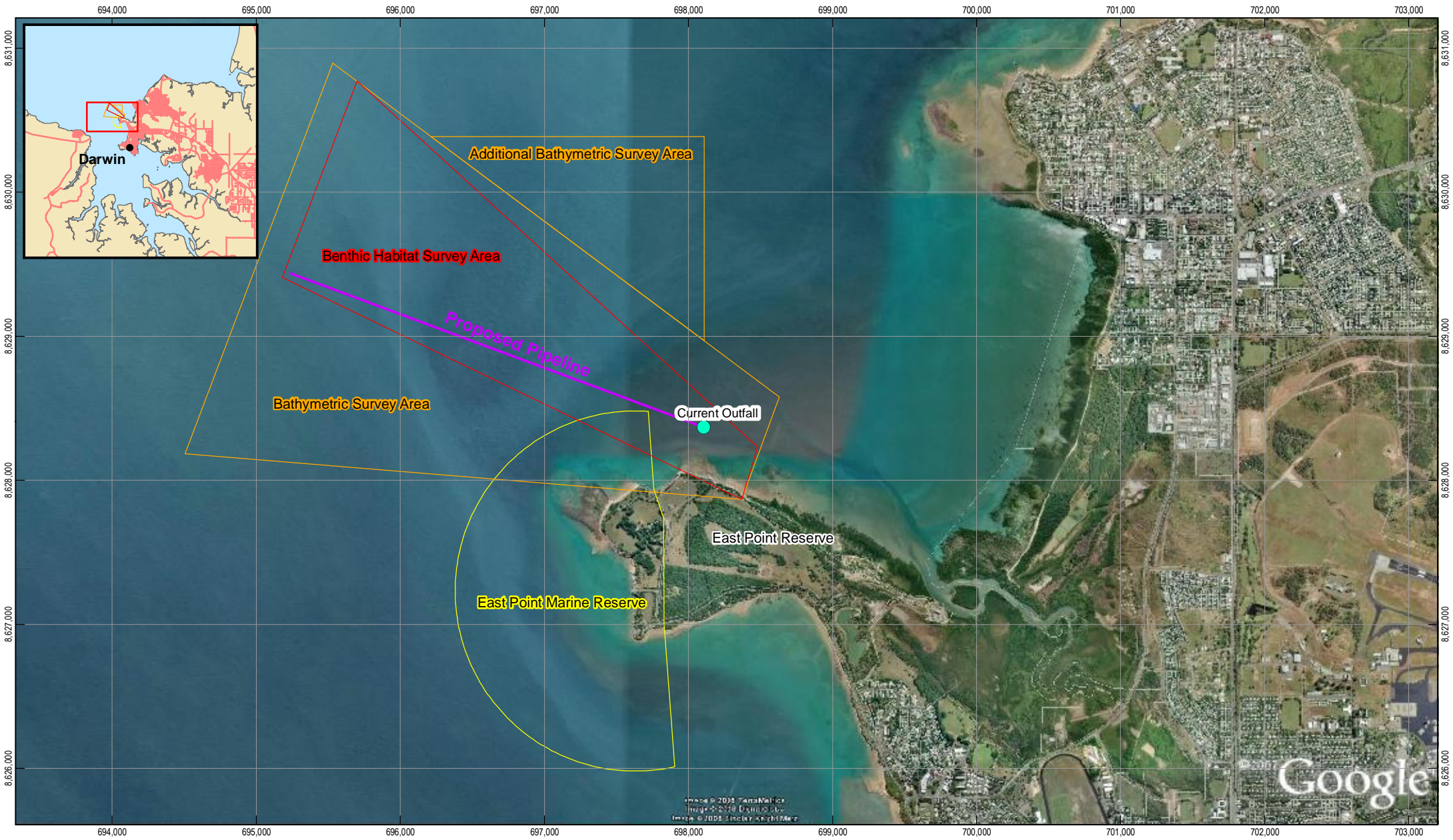
A bathymetric survey of the Larrakeyah sewage outfall (Figure 2) was undertaken to:

- Provide detailed bathymetric data to input into the hydrodynamic model developed by PWC to model the dispersal of treated wastewater discharged to the Darwin Harbour via the Larrakeyah Point outfall; and
- Inform the scope of a potential benthic survey through identification of substrate that may support the existence of benthos.

A stakeholder workshop was held on 5 November 2008 following the first half of the bathymetric survey. The focus of the benthic survey was based on the proposed pipeline alignment nominated by PWC. This was designated during the workshop in consultation with stakeholders using data obtained from the bathymetric survey.

The entire report is provided in three sections:

- ▶ Part One – Project Summary;
- ▶ Part Two – The Bathymetric Survey Report; and
- ▶ Part Three – The Benthic Survey Report.



LEGEND	
	Proposed Pipeline Alignment
	Benthic Habitat Survey Area
	Bathymetric Survey Area
	East Point Marine Reserve



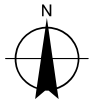
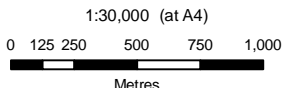
Power and Water Corporation
 Proposed East Point Outfall, Bathymetric and Benthic Survey

Job Number: 43-21461
 Revision: A
 Date: 02 FEB 2009

The Bathymetric & Benthic Study Area

Figure 1

G:\43\21461\CADD\GIS\PROJECTS\FINAL\PART_1\Figure_1_Bathymetric&Benthic_Study_Area.mxd
 Level 5, 66 Smith Street Darwin NT 0800 T 61 8 8982 0100 F 61 8 8981 1075 E W www.ghd.com.au
 © 2009. While GHD has taken care to ensure the accuracy of this product, GHD and DATA SUPPLIER(S) make no representations or warranties about its accuracy, completeness or suitability for any particular purpose. GHD and DATA SUPPLIER(S) cannot accept liability of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way and for any reason.
 Data source: Benthic Habitat Survey Area Data from PowerWater Corporation, Bathymetric survey area data from PowerWater Corporation, Northern Territory Coastline data from Northern Territory Government, Reserve Data from GHD, Imagery Obtained from Google Earth Pro, WARNING Google Earth Imagery is not Orthorectified Created by:sdwoodger



LEGEND

- Proposed Outfall Locations
- Existing Outfall Main
- Bathymetric Survey Area



CLIENTS | PEOPLE | PERFORMANCE

PowerWater Corporation
Proposed East Point Outfall, Bathymetic and Benthic Survey

Job Number	43-21461
Revision	A
Date	02 FEB 2009

The Larrakeyah Study Area

Figure 2

G:\43\21461\CADD\GIS\PROJECTS\FINAL\PART_1\Figure_5_Larrakeyah_Study_Area.mxd
 © 2009. While GHD has taken care to ensure the accuracy of this product, GHD and DATA SUPPLIER(S) make no representations or warranties about its accuracy, completeness or suitability for any particular purpose. GHD and DATA SUPPLIER(S) cannot accept liability of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way and for any reason.
 Data source: Bathymetric Survey Area Data, Outfall data and pipeline data from PowerWater Corporation, Northern Territory Coastline Data, Cadastre data and Roads data from Northern Territory Government, Imagery Obtained from Google Earth Pro, WARNING Google Earth Imagery is not Orthorectified and Locations of Existing Outfalls and Outfall Mains is inaccurate and hence for demonstration purposes only Created by: sdwoodger
 Level 5, 66 Smith Street Darwin NT 0800 T 61 8 8982 0100 F 61 8 8981 1075 E W www.ghd.com.au



2. Bathymetric Survey Summary

2.1 East Point Survey

The East Point bathymetric survey was undertaken from 26 October 2008 through to 3 November 2008. The investigation area was defined by PWC as the area identified as the 'bathymetric survey area' provided with the tender documents (drawing number B08-1731) and replicated for this survey as Figure 1.

The objectives of the survey were to:

- ▶ Conduct a bathymetric survey using side-scan sonar providing sufficient vertical resolution to inform both hydrodynamic modelling and detailed benthic habitat investigations; and to
- ▶ Identify target sites within the smaller benthic habitat survey area to undertake video sampling of the benthic habitat.

The bathymetric data were collected according to a 2 m grid. This effectively means that any object smaller than 2 m would not be identified on the 3D bathymetric overlay or the detailed topography. The 3D bathymetric figure identified two sets of regular shaped sand waves, the most easterly and inshore (CH 700-1300 m) are suspected to be mobile. The offshore (CH 2700-3000 m) are less likely to be highly mobile with established benthic communities present on the peaks and troughs of the sand waves. The divers later confirmed both these structures to be sand waves. Scattered rocks and patches of reef or rock structures were identified to the south of the proposed pipeline alignment into the northern area of the East Point Marine Reserve. Areas that appear flat or featureless on the 3D bathymetry figure are likely to indicate compacted sand, although exposed areas of flat rock were observed in the intertidal (inshore) area during the low tides.

The detailed topography was processed and presented with 1 m contours with bathymetry in both metres Australian Height Datum (AHD) and Chart Datum (Part Two – Bathymetric Report).

The detailed survey methods and results are outlined in Part Two – Bathymetric Report of this report.

2.2 Larrakeyah Survey

The Larrakeyah bathymetric survey was undertaken on 3 November 2008. The investigation area was defined by PWC as the area identified as the 'bathymetric survey area' provided by PWC (drawing number B08-6946) and replicated for this survey as Figure 2.

The objectives of the survey were to:

- ▶ Conduct a bathymetric survey using side-scan sonar providing sufficient vertical resolution to inform both hydrodynamic modelling and detailed benthic habitat investigations.

The Larrakeyah Outfall study area is an area of approximately 4 ha ranging in depth from approximately 18 m in the south west corner, to 14 m in the north east corner.

The bathymetric survey at Larrakeyah identified one dominating substrate type within the 4 ha of the study area. The seabed fell as the distance from shore increased. The data collected did not indicate any scarring caused by the discharge of the outfall to the area surrounding. The obvert of the pipeline sits above the level of the surrounding seabed by an average of approximately 40 cm.



3. Benthic Survey Summary

3.1 The Stakeholder Workshop

GHD and PWC facilitated a stakeholder workshop on 5 November 2008. The workshop included participants from Charles Darwin University (CDU), and three divisions of the Department of Natural Resources, Environment, The Arts and Sport (NRETAS) (Marine Biodiversity Group (MBG), the Environmental Assessment Group and the Northern Territory Museum and Art Gallery (NTMAG)).

The workshop allowed consultation among the stakeholders regarding benthic studies undertaken during the preliminary stages of the Larrakeyah outfall closure plan. The preliminary bathymetric data was presented to the workshop. Sites for the targeted benthic survey were reviewed in relation to the bathymetry. Reference sites were determined to be Weed Reef, South Shell Island and the East Point Marine Reserve. The proposed pipeline alignment was presented to the stakeholders in conjunction with preliminary mixing zone data for the proposed outfall locations.

The key outcomes of the workshop were:

- ▶ Project understanding for all the stakeholders;
- ▶ A consolidated approach on the benthic sampling methods;
- ▶ An understanding by all stakeholders of the proposed pipeline alignment; and
- ▶ The determination of suitable benthic reference sites within the harbour.

3.2 East Point Survey

The benthic survey was undertaken following the analysis of the preliminary bathymetric data. The benthic survey was undertaken from 4 November to 10 November 2008. The investigation area was defined by PWC as the 'benthic survey area' provided with the tender documents (drawing number B08-1731) and replicated for this survey as Figure 1.

The objectives of the survey were to:

- ▶ Conduct video sampling of target sites within the 'benthic survey area' as identified following the bathymetric survey;
- ▶ To focus the survey on corals, macroalgae and sponges, where required verifying species identification by divers using SCUBA gear;
- ▶ Record incidental surface and subsurface observations of mobile marine fauna during the sampling (e.g. cetaceans, turtles and dugongs);
- ▶ Collect sponge samples from the 'benthic survey area', the East Point Marine Reserve and the Darwin Harbour Reference sites (Weed Reef and South Shell Island);
- ▶ Incorporate the 2007 work and report on the distribution and abundance of species and species assemblages that may constitute habitat of conservation significance;
- ▶ Discuss the biodiversity values of potential outfall locations in comparison to the reference sites; and
- ▶ Consider and comment on preferred outfall design options and construction options to minimise disruption to the benthic habitat of high value site.



The benthic survey confirmed the findings of the bathymetric survey. Large mobile sand-waves, deep muddy holes and shallow sand/mud banks were recorded during the diving works. The area surveyed along the proposed pipeline alignment represents a benthic habitat of lower conservation significance than all other sites surveyed. The proposed pipeline alignment lacked reef structures and was subject to strong tidal currents. The large areas of mobile sands make it difficult for benthic organisms to establish.

The benthic habitat to the south of the proposed pipeline alignment, including the East Point Marine Reserve showed considerably higher diversity, density and percent cover than the proposed pipeline alignment. With the adoption of appropriate environmental management practices it is unlikely these areas will be significantly impacted during construction. These communities should be considered during hydrodynamic modelling, outfall location selection and baseline monitoring in order to predict and monitor potential impacts during operation.

There are no obvious ecological constraints within the footprint of the proposed pipeline alignment. It is likely that the introduction of a solid structure to this generally unconsolidated environment may provide an anchor point for colonisation and lead to an increase in density of benthic organisms in the future.

3.3 Larrakeyah Survey

A benthic survey of Larrakeyah was not undertaken because of the high concentrations of suspended faecal matter and high current velocities. Anecdotal evidence (and video evidence viewed by GHD divers in November 2008) collected by Tek Ventures (pers com November 2008) during 2008 indicated that there were very few benthic organisms present in the immediate vicinity of the pipeline. The substrate was covered in soft silt material and with no obvious substrate scarring from the pipeline. GHD did not dive at this site. Professional divers from Tek Ventures provided this information.



4. Engineering recommendations

The engineering information provided in this report is based upon limited surface information collected as part of this survey. Geotechnical information has not been collected. Further investigations relating to seabed material properties and geotechnical information should be undertaken and conceptual design should be completed before cost estimates and budgets are considered.

4.1 Engineering recommendations of design matters based on bathymetry and high value sites

The area is subject to strong currents and exposure at low tide to cyclonic wave action. It is assumed that the inshore section to at least three metres below lowest astronomical tide (LAT) will be constructed with pipe obvert at least 1.5 m below finished surface level. This will minimise potential for exposure of the pipe and subsequent wave and debris damage. Thereafter it is possible there may be a minor reduction in cover where the bottom is stable. In more mobile areas (high sand waves) it will be necessary to construct the main at a depth below the lowest expected range of bottom level. Cover in stable deepwater construction may be reduced to a minimum (say 0.5 m) with rockfill cover to minimise potential re-exposure and anchor snagging. Fully or partially exposed installation is feasible provided the pipe is adequately anchored and the risk of anchor snagging is deemed acceptable.

Material used for the pipe will most probably be welded high density poly-ethylene (HDPE) with concrete anchor blocks. Mild steel cement lined (MSCL), glass reinforced plastic (GRP) or reinforced concrete (RC) or polycrete options are available according to cost and construction methods adopted.

Substrate conditions appear generally amenable to dredging. It is noted that no subsurface investigation (probing or auger holes) was conducted as part of this investigation. No firm predictions can be made as to conditions at depth and all comments are made based on surface evidence only.

The inshore section from the existing discharge to 'outfall option 3' was relatively flat and stable. No obvious material based construction issues can be foreseen. The major issues will be dealing with shallow water wave action in the work area, wet dry tidal variation and currents.

The area from near shore (outfall 3) through to outfall 5 has medium to large mobile sand waves requiring deep dredging in free running material to achieve installation in a stable environment. Issues involve large volumes of material to be removed and replaced, wide excavation for stability, potential re-sedimentation with tidal currents hence preference for work during the limited neap period. Backfill may involve a wide rockfill bed to limit bottom mobility over the main if a firm stable bottom is practically and economically too deep to achieve by excavation.

The area of deepwater between outfall 3 and outfall 5 appears relatively flat and stable with no obvious construction issues, other than tidal currents that potentially limit the construction activities to slack water and neaps. The impact of the currents, or lack thereof, within this area of deepwater requires further investigation. These investigations may include hydrodynamic modelling, and field tests including:

- ▶ Dispersion measurement by introduced media, i.e. radio-active isotopes, neutral or slightly negatively buoyant discs or dye; or
- ▶ Establishment of temporary velocity and direction loggers.



Dispersion measurement by introduced media is not likely to be the most effective tool in deep water. Establishment of temporary velocity and direction loggers is likely to be more cost and time efficient if they are established correctly.

Construction activity will probably involve any or all of the following:

- ▶ Velocity and directional studies of the deep area between CH 1300-2700 m to understand the movement of the water at this point;
- ▶ Dredging of a wide battered trench to the required depth;
- ▶ Dumping of aggregate base via clamshell bucket or tremmie (optional);
- ▶ Sinking and positioning of pipe string;
- ▶ Additional anchor weights (optional);
- ▶ Addition of a cover coat of aggregate/rockfill;
- ▶ Replacement of general backfill for deep placement (optional); and
- ▶ Placement of rockfill capping (optional).

General issues identified at this stage are:

- ▶ Acceptable sediment plume dispersion from dredge operation;
- ▶ Acceptable disposal point for dredged material;
- ▶ Construction area for preparation of pipestring;
- ▶ Safe handling of pipe strings in prevailing current/wave environment;
- ▶ Acceptable source of non-contaminating pipe surround and backfill material;
- ▶ Acceptable degree of protection applied to pipe in place;
- ▶ Acceptable dilution/dispersion of discharged waste;
- ▶ Public safety; and
- ▶ Potential sea level rise resulting in any recession of the coastline.



GHD

Level 5, 66 Smith Street Darwin NT 0800
GPO Box 351 Darwin NT 0801
T: (08) 8982 0100 F: (08) 8981 1075 E: drwmail@ghd.com.au

© GHD 2009

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	K Rope L Monteith	W Freeland		W Freeland		03.02.2009