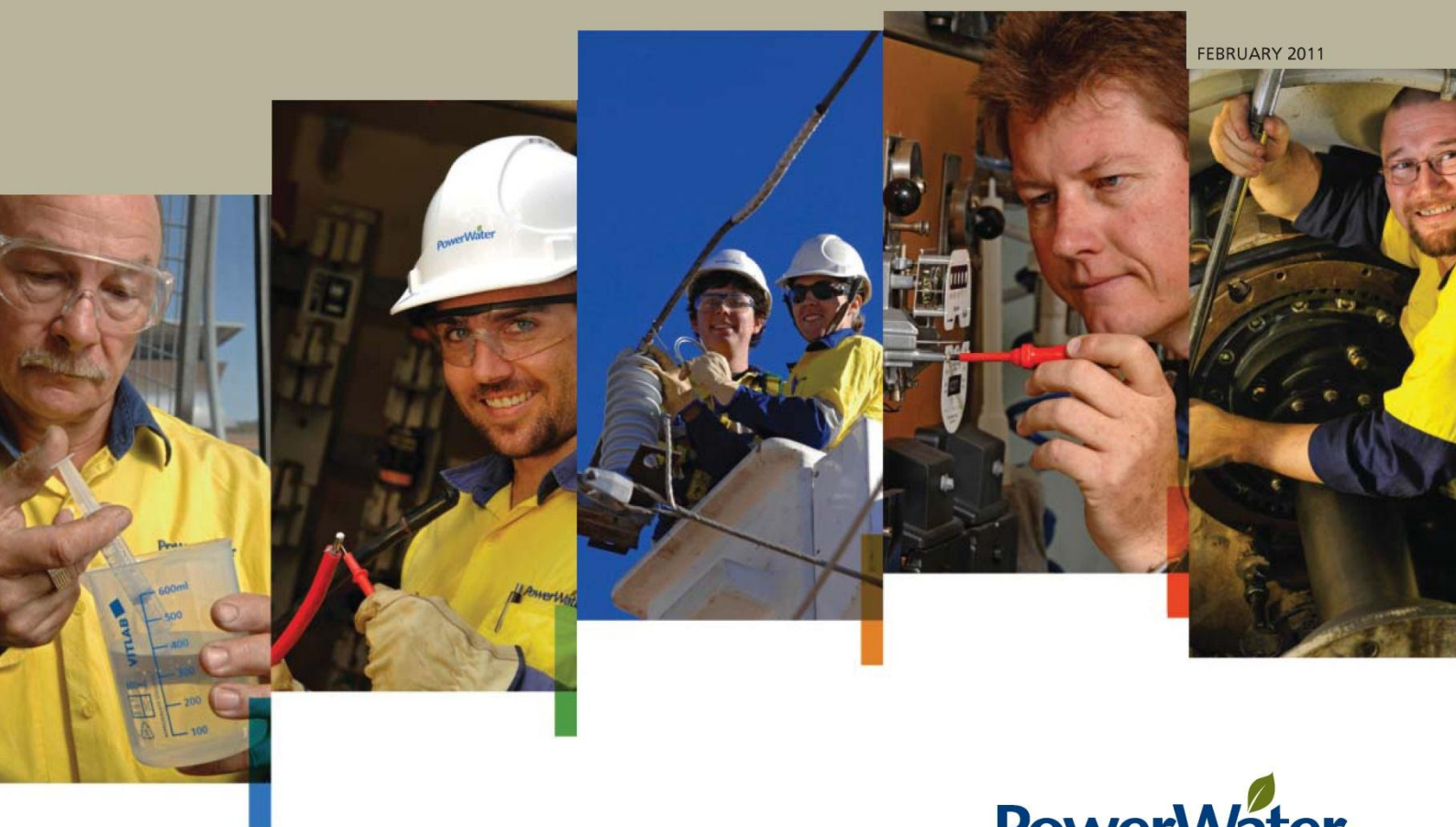


POWER AND WATER CORPORATION

SUPPLEMENTARY PUBLIC ENVIRONMENT REPORT

DUPLICATION OF THE EAST POINT EFFLUENT RISING MAIN

FEBRUARY 2011



PowerWater

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Appendix M	East Point Outfall Monitoring Data 2011
Appendix N	PWC's Trade Waste Guidelines

Abbreviations

Abbreviation	Description
%	Percentage
°C	Degrees centigrade
AAPA	Aboriginal Area Protection Authority
AASS	Actual Acid Sulphate Soils
ADWF	Average Dry Weather Flow
AHD	Australian Height Datum
AHU	Aquatic Health Unit
ANZECC	Australia and New Zealand Environment Conservation Council
API	Aerial Photo Interpretation
ASS	Acid Sulphate Soils
ASSMP	Acid Sulphate Soils Management Plan
BOD	Biochemical Oxygen Demand
CAS	Chemical Assisted Sedimentation
CDU	Charles Darwin University
CEMP	Construction Environmental Management Plan
CFU	Colony Forming Units
CWMP	Construction waste Management Plan
DCC	Darwin City Council
DH	NT Department of Health
DHAC	Darwin Harbour Advisory Committee
EIA	Environmental Impact Assessment
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPO	East Point Outfall
ERM	Effluent Rising Main
EQO	Environmental Quality Objectives.
ESCP	Erosion and Sediment Control Plan
GPS	Global Positioning System
IMS	Integrated Management System
ISO	International Standards Organisation
KL	Kilo-litre
Km	Kilometre
Km/h	Kilometres per hour
L/s	Litre per Second
LAT	Lowest Astronomical Tide
LOCP	Larrakeyah Outfall Closure Program

Abbreviations

Abbreviation	Description
m	Meter
m ²	Square Meter
mL	Millilitre
mm	Millimetre
NEPM	National Environment Protection Measure
NIVS	National Vegetation Information System
NOI	Notice of Intent
NRETAS	NT Department Natural Resources, Environment, the Arts and Sport
NT	Northern Territory
NT Minister	The NT Minister for Natural Resources, Environment and Heritage
NTG	Northern Territory Government
OH&S	Occupational Health and Safety
PASS	Potential Acid Sulphate Soils
PER	Public Environmental Report
PWC	Power and Water Corporation
SEWPAC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
The Final PER	The Draft PER together with the Supplement
The Guidelines	Guidelines for the Preparation of a Public Report, Duplication of the East Point Effluent Rising Main and Extension of the EPO, February 2010
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
WQO	Water Quality Objectives

SECTION 1

Introduction



1 Introduction

1.1 Background

The Proponent, Power and Water Corporation (PWC), propose to construct a duplicate Effluent Rising Main (ERM) at East Point, extending from the Ludmilla Wastewater Treatment Plant (WWTP) to a terminal manhole at the landward end of the East Point Outfall (EPO).

The title of the proposal is the “*East Point Effluent Rising Main Duplication Project*”, which will hereafter be referred to as the Proposed Development.

The Proposed Development is one element of a wider Larrakeyah Outfall Closure Program (LOCP), which includes closure of the Larrakeyah outfall, diversion of the Larrakeyah catchment, and upgrading the Ludmilla WWTP. The LOCP supports the elimination of untreated sewerage discharges to Darwin Harbour from the Larrakeyah sewerage outfall, with untreated discharges replaced by treated effluent discharged from the Ludmilla WWTP via an ERM (the Proposed Development) and the outfall at East Point.

The primary objective of the Proposed Development is to increase the hydraulic capacity of the discharge mains from Ludmilla Wastewater Treatment Plant to the East Point Outfall as a result of increased flows diverted from the Larrakeyah catchment. A capacity increase is also proposed at Ludmilla WWTP due to the planned closure of the Larrakeyah outfall, in accordance with the LOCP. As a part of this project sewerage previously discharged through the Larrakeyah outfall will be diverted to the Ludmilla WWTP. Construction of the diversion pipework from the Larrakeyah outfall to the Ludmilla WWTP is currently underway.

The Project Manager for the proposed development is Mr Steve McKenzie, General Manager and can be contacted at:

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Fax: 08 8923 9546
Email: eastpointoutfall@powerwater.com.au

1.2 Purpose of the Supplementary PER

A draft Public Environmental Report (PER) was prepared to provide information on the Proposed Development (PWC, 2011a) and made available for public review between 12 November and 12 December 2011. Twelve written submissions were received during this review period (see **Section 9, Summary of Consultation and Submissions Received**). This supplementary report to the draft PER (hereafter refer to as the ‘Supplement’) was prepared to account for the questions, concerns, comments and suggestions received during the public review period and to finalise the draft PER.

This supplementary report to the draft PER was prepared between 15 December 2011 and 31 January 2012.

1 Introduction

1.3 Issues Outside the Scope of the PER

1.3.1 Replacement of the East Point Outfall

The draft PER was based on the Department of Natural Resources, Environment, The Arts and Sport (NRETAS) *Guidelines for Preparation of a Public Environmental Report: Duplication of the East Point Effluent Rising Main and Extension of the East Point Outfall, Darwin, NT, February 2010* (the Guidelines).

PWC sought and obtained approval to vary the proposal by separating the East Point ERM (Stage 1) and proposed extension of the EPO (Stage 2). Accordingly, the draft PER (PWC, 2011a) and this Supplement to the draft PER only address those elements of the Guidelines applicable to the Proposed Development, i.e. duplicating the East Point ERM. Requirements associated with the EPO replacement project will be addressed separately once NRETAS provides a decision on the Notice of Intent (NOI) submitted for the EPO replacement project.

1.3.2 Upgrades to the Ludmilla WWTP

Several respondents have enquired to the proposed upgrades of the Ludmilla WWTP, as discussed under Section 2.4 of the draft PER (PWC, 2011a). The Ludmilla WWTP was subject to formal assessment in October 1998, with an assessment report published in December 1998 (SKM, 1998; NRETAS, 1998). The proposed Ludmilla WWTP upgrades detailed in the 1998 assessment are incorporated into PWC planning processes and will be considered as part of the continual improvement of the Ludmilla WWTP using principles of commercial viability and environmental sustainability.

Elements associated with the upgrade are discussed in both the draft PER and this Supplement, to support decision making and to provide background information. **Section 2.7, Comment 19 (NRETAS)** provides further contextual information regarding upgrades to the Ludmilla WWTP.

1.3.3 Comment 36, NRETAS

Final (or preferred) method of installation of the outfall

Not applicable to this proposal

Noted.

1.3.4 Comment 37, NRETAS

Quantity, methods and location for disposal of dredge material

Not applicable to this proposal

Noted.

1 Introduction

1.3.5 Comment 38, NRETAS

Justification for the location of the outfall and any modelling used to justify its location;

Not applicable to this proposal

Noted.

1.3.6 Comment 39, NRETAS

An assessment of heritage objects potentially occurring within the disturbance corridor for the outfall (a side scan sonar is recommended for sea floor surveys)

Not applicable to this proposal

Noted.

1.3.7 Comment 63, NRETAS

Alternative dredge methods considered and dredge spoil disposal locations

Not applicable to this proposal

Noted.

1.4 Summary of Responses and Structure of the Supplement

The draft PER was made available for public review between 12 November and 12 December 2011, with advertisements notifying interested parties of the Proposed Development and locations where the draft PER could be accessed. Section 9 of the draft PER (PWC, 2011a) and **Section 9, Public Involvement and Consultation** of this Supplement provide further information on the community consultation and communications strategy.

Persons wishing to comment on the draft PER were invited to make submissions to the Environmental Heritage Division, NRETAS at eia.nretas@nt.gov.au or to PWC at eastpointoutfall@powerwater.com.au.

Upon receipt, each submission was reviewed, and questions, concerns, comments or suggestions were documented in **Table A-1 of Appendix A, Responses to the draft PER**. A number was assigned to each response to assist in identification and tracking of responses. Copies of the original submissions from respondents are also included under **Appendix A, Responses to the draft PER**. The following respondents provided comment:

- Anthony Waite, NT WorkSafe
- Bill Stuchbery, Darwin Harbour Advisory Committee
- George Roussos
- Huy Nguyen, Department of Health, Medical Entomology Unit
- Ian Hollingsworth, Horizon Environmental
- Justin Tutty, Environment Centre of the Northern Territory
- Lauren Firby, Department of Lands and Planning, Road Network Division
- Matt Darcey, NRETAS

1 Introduction

- Peter Rogers, Department of Health
- Pinky Spencer, Environmental Worrier
- Rebecca Lee, NT Department of Primary Industry
- Stephen Reynolds, CDU.

Chapter headings in this Supplement match those presented in the draft PER. Sub-headings have been used to refer to unique issues under the responses received from each respondent. An abbreviation and number was assigned to each comment to assist in identifying answers to responses by respondents, see **Table A-1 of Appendix A, Responses to the draft PER.**

Numerous responses to the draft PER were found to cover the same topic. Accordingly, this Supplement cross references sections where a similar comment has already been addressed or where further information relating to the comment can be found. Statements provided by respondents were also noted in the supplementary.

1.5 General Comments

1.5.1 Comment 1 (NRETAS)

These comments on the Effluent Rising Main PER should be addressed in the Supplement along with other comments from government agencies and public submissions.

Background

The current PER is to install a duplicate rising main through East Point to a terminal manhole where the East Point outfall (EPO) commences. The PER includes some details of related actions, such as the diversion of sewerage to, and upgrades of, the Ludmilla Waste Water Treatment Plant (WWTP). Upgrades to the WWTP are now proposed to be primary treated, with chemically assisted sedimentation (a reduction in standard to the 1998 proposal), and will be discharged through the existing EPO, until a \$40 million outfall extension can be constructed (after formal environmental assessment of the EPO by the NT and Commonwealth governments).

An environmental improvement and cost benefit approach was provided by PWC in 2008 for the closure of the Larrakeyah outfall, however this did not include the 1998 proposal for returning treated effluent to Larrakeyah, and it is unknown whether there would be improved environmental and social outcomes from this alternative compared to the current proposal. This option should be discussed as an alternative in the PER Supplement, as well as justification for the proposed approach compared to the 1998 approach.

Following the split assessment approach of the ERM and EPO projects, key risks identified in the 2010 Final PER Guidelines for the East Point effluent rising main and extension of the East Point outfall project are required to be addressed for the ERM assessment, except for issues relating only to the construction and operation of the proposed EPO. The PER has been assessed against these Guidelines and resulted in the following comments below and in Table 1.

1 Introduction

Noted, this Supplement to the draft PER was prepared to address comments, made by respondents in response to the draft PER (PWC, 2011a). Comments are tabulated in **Table A-1 of Appendix A, Responses to the draft PER.**

SECTION 2

Description of the Proposed Development



2 Description of the Proposed Development

2.1 Comment 8 (NRETAS)

Please discuss how the Darwin Harbour Strategy (Darwin Harbour Advisory Committee, 2010) will be incorporated into the proposal?

There is strong correlation between PWC's approach to environmental management (PWC, 2012a) and the five goals of the Darwin Harbour Strategy (DHAC, 2012a), which are further described below.

Goal 1: Maintain a Healthy Environment

Management of occupational health and safety (OH&S), quality, and the environment at PWC is undertaken in accordance with an Integrated Management System (IMS). The IMS is a mechanism by which PWC's environmental interactions are systematically managed. Operation of the PWC IMS is externally certified to meet the relevant international/Australian standards (AS 4801 for occupational health and safety; ISO 9001 for quality; ISO 14001 for environmental management).

The PWC IMS and commitments detailed in the draft PER (PWC, 2011a), set out the framework, objectives and targets for sound and responsible environmental management, OH&S performance, and quality delivery for the Proposed Development.

Aspects of the environment potentially impacted by PWC activities and the Proposed Development are to be monitored and documented. The environmental performance of PWC for this project can thus be reviewed and audited. The level of environmental management stringency applied to the Proposed Development will be detailed in the construction contract, and will meet or exceed the standards that currently apply to PWC.

PWC uses three objectives as a basis for its environmental performance:

- 100% compliance with legal and statutory obligations
- Zero environmental incidents causing environmental harm and operating within licence conditions
- Zero extreme environmental risks at any PWC facility.
- Within PWC's IMS, the Environment, Quality, Health and Safety Policy aims to prevent pollution and minimise any adverse effects PWC's operations may have on the environment.

Goal 2: To Support Recreational Use and Enjoyment of the Environment

PWC recognise the recreational value of Darwin Harbour and East Point Reserve. The Proposed Development will have unavoidable and short term impact to recreational activities at East Point during the construction of the Proposed Development. PWC is committed to reinstating impacted infrastructure at East Point, post construction of the Effluent Rising Main.

PWC are committed to replacing the existing EPO, which will further support this goal by enhancing the recreational amenity and aesthetic values at East Point.

2 Description of the Proposed Development

Goal 3: To Ensure That Development is Implemented in an Ecologically Sustainable Manner

The National Strategy for Ecological Sustainable Development (ESD) list national principals for ecologically sustainable development (NRETAS, 2011b; ESDSC, 1992; Preston, 2006), highlighting

- The principle of sustainable use
- The principle of integration
- The precautionary principle
- Inter-generational and intra generational equity
- Conservation of biological diversity and ecological integrity
- Internalisation of external environmental costs.

PWC recognise the importance of these principles. One of PWC's key objectives in the Statement of Corporate Intent 2011-12 is to 'Demonstrate leadership in the delivery of environmentally sustainable operations and activities' (PWC, 2011) and develop various strategies and mitigation measures under the guidance of the aforementioned principles. Commitments, management and mitigations strategies are discussed in the draft PER (PWC, 2011a) and this Supplement. See **Appendix G, Commitments Register** for additional information.

Goal 4: To Protect Cultural Values and Heritage

In order to ensure protection of cultural values and heritage, a survey of the cultural environment was undertaken to evaluate the presence of archaeological significant sites. The survey did not identify any archaeological material along the Proposed Development corridor (Crassweller, 2009).

In addition, an application to the Aboriginal Area Protection Authority (AAPA) for authorisation of the upgrade of the WWTP and sewerage pumping station was obtained by PWC. The AAPA certificates are attached as Appendix I to the draft PER (PWC, 2011a).

Goal 5: To Foster Community Awareness, Industry Partnerships and Stewardship of the Darwin Harbour Region

Public involvement and consultation was discussed in Section 9 of the draft PER (PWC, 2011a), and was supported by the *East Point Outfall Extension and Rising Main Duplication Communication Strategy*, (PWC 2011b), attached as **Appendix F, ERM Duplication Communication Strategy**.

2.2 Comment 9 (NRETAS)

In regards to testing the rising main (p. 30) please provide volumes of hydro test waters, disposal plans, use of dyes or any other chemicals.

The ERM will be approximately 3,200 m in length and will require 1.5 ML to disinfect the pipe.

2 Description of the Proposed Development

The PWC Disinfection Procedure is highlighted in Section 6.10 of the PWC Construction Master Specifications (**Appendix D, Construction Master Specifications**). The disinfection process uses 12.5% Sodium Hypochlorite solution dosed at 100 ppm in potable water.

The disposal of the hydrostatic test water would be managed by the contractor and included in the Construction Environmental Management Plan. The carrier pipe will be DN750 DICL (Ductile Iron Cement Lined) that will be coated with a bitumen type paint to prevent erosion.

Disposal of all disinfection and flushing water would be to the sea under controlled conditions, where resultant water would be free of any major contaminants, with a chlorine residual of 0 ppm.

2.3 Comment 11 (NRETAS)

The figure 2-5 on page 34 is incorrectly labelled.

The correct caption for Figure 2-5 in the draft PER (PWC, 2011a) is “Figure 2-5, Schematic of key treatment process units of the upgraded Ludmilla WWTP” not “Figure 2-5, Proposed Alignment for the Duplicated Effluent Rising Main”.

2.4 Comment 12 (NRETAS)

Table 2-1 has incorrect values for E. coli concentration (i.e. 4×10^6 , not 4×10^6).

Table 2-1 provides updated values for *E. coli* concentrations and supersedes Table 2-1 in Section 2.4.1 of the draft PER (PWC, 2011a).

Table 2-1 Ludmilla WWTP Influent Water Quality Parameters 2005-2009

Parameter	Average (mg/L)	Median (mg/L)	90%ile (mg/L)
pH	7.1	7.1	7.4
BOD	165	150	290
TSS	265	165	640
<i>E. coli</i>	4×10^6 (cfu/100mL)	4×10^6 (cfu/100mL)	1×10^7 (cfu/100mL)
Total Nitrogen	45	45	65
Free Ammonia	30	35	40
Total Phosphorus	7.5	7	11.5
Orthophosphate	5	5	8

2 Description of the Proposed Development

2.5 Comment 15 (NRETAS)

There is no mention of the level of treatment (i.e. the PER does not specify that the Ludmilla upgrade will result in primary treatment).

There is an outline of the current waste characteristics (such as pH, BOD, TSS, nitrogen etc.) and also the quality requirements of their previous waste discharge licenses (discussed as current, but have in fact expired), but not the expected future characteristics of the discharge.

How this guideline could be met:

- *The level of treatment of sewerage would need to be specified and described (i.e. primary, secondary or tertiary).*
- *It would be essential to know the expected characteristics of the discharged waste (pH, Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and temperature as a start).*

It is expected that the following characteristics will be achieved following the Ludmilla WWTP upgrade, as summarised in the table below (**Table 2-2**)

Table 2-2 Expected Effluent Characteristics for the Ludmilla WWTP

Assessable Parameter	Units	Median	90%ile
pH	-	-	>6
BOD	mg/L	90	165
TSS	mg/L	65	90
<i>E. coli</i>	cfu/100 mL	80	1×10 ⁴
Total Nitrogen	mg/L	39	45
Free Ammonia	mg/L		
Total Phosphorus	mg/L	2.5	4.5

The Ludmilla Wastewater Treatment Plant will be upgraded to an advanced primary treatment level. This level of treatment includes the unit processes summarised below, and shown in **Figure 2-1**. Also refer **Section 8.18, Comment 89 (NRETAS)** for additional information.

Screening

The influent sewerage water is to be screened via a dual cam step screen (a part of the screen system), removing large gross pollutants such as cans, rags, sticks, plastic packets etc. carried in the sewerage stream. The screen comprises two thin vertical stainless steel plates shaped like steps; the plates rotate in an elliptical motion alternating across the width of the channel opening forming the step screen face.

The rotating plates rotate in an upright motion. As the plates gyrate, debris is collected on the face of the screen, and is lifted to the subsequent steps with every rotating

2 Description of the Proposed Development

motion. Solids are thus transferred to the discharge point, where they are washed and brushed into storage hopper for disposal at landfill. The continuous motion of rotating steps provides self-cleaning for the screening surface, eliminating the need for additional cleaning devices such as brushes and spray bars.

The spacing of the step screen plates in this instance will be 5 mm. Because the spacing openings are so small, solids collect on the face of the screen, creating a screening carpet that further enhances the solids capture of the step screen.

Grit Removal

The current process includes a grit chamber, where the velocity of the incoming wastewater is adjusted to allow the settlement of sand, grit, stones, and other small particulate matter. This material is removed into a storage hopper and disposed of at landfill.

Disinfection

The purpose of disinfection in the treatment is to substantially reduce the number of microorganisms in the effluent to be discharged back into the environment. The primary form of disinfection used at the plant is chlorine dosing, as further discussed under **Section 2.2, Comment 9 (NRETAS)**.

Coagulation

The addition of a coagulant and polymer assists with the agglomeration of suspended solids in the effluent, including nutrients, and subsequently assists with settling of these flocs in the Chemically Assisted Sedimentation (CAS) tanks. The removal of suspended solids through flocculation results in a level of nutrient and pathogen reduction.

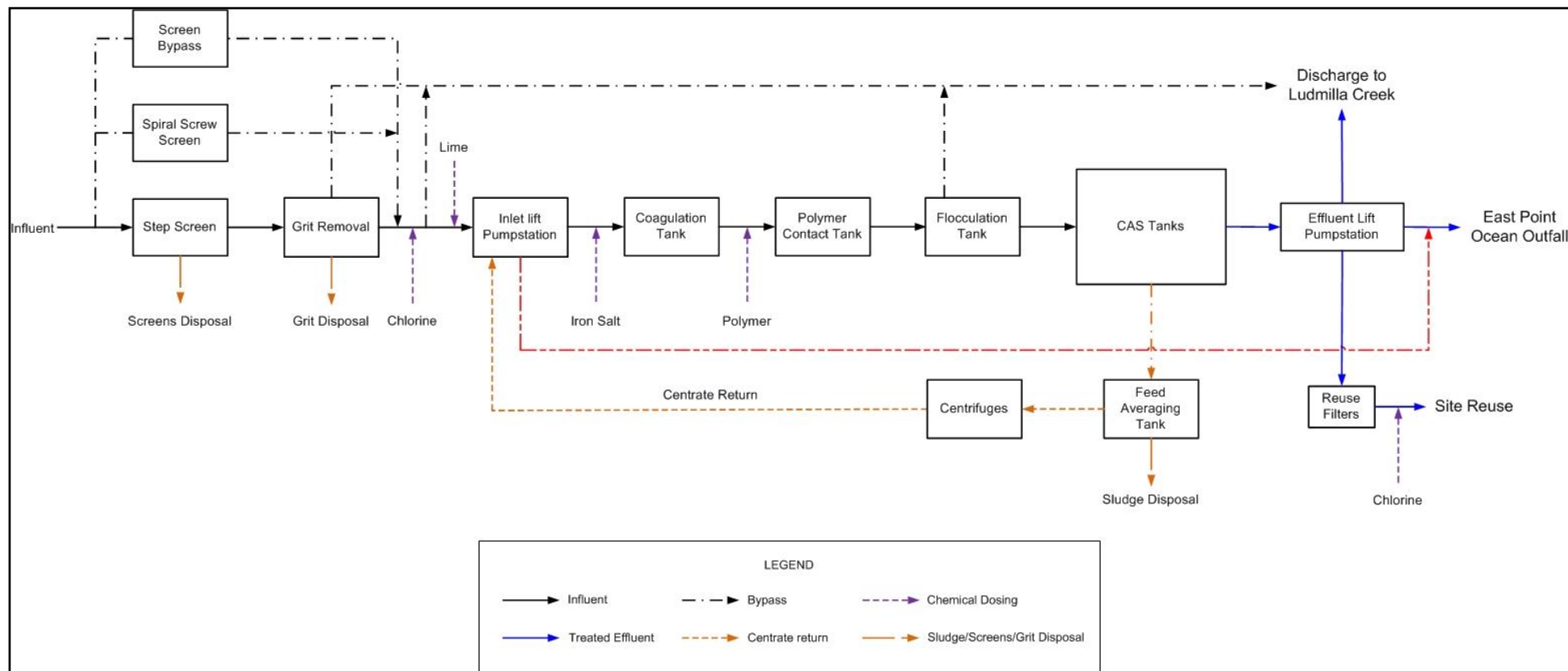
Settling

The settling of the agglomerated flocs occur in large CAS tanks. The CAS tanks are equipped with mechanically driven scrapers that continually drive the collected sludge towards a sump in the base of the tank, where it is pumped to sludge treatment facilities.

Dewatering

Dewatering of the sludge occurs through a series of centrifuges. This process involves the use of the centrifugal force for the sedimentation of mixtures, in which the more-dense components of the mixture migrate away from the axis of the centrifuge, while less-dense components of the mixture migrate towards the axis. The remaining leachate is then recycled back into the existing process.

2 Description of the Proposed Development



Source: PWC, 2011a

Figure 2-1 Schematic of Key Treatment Process Units of the Upgraded Ludmilla WWTP

2 Description of the Proposed Development

2.6 Comment 17 (NRETAS)

The PER mentions that modelling has been commissioned for the associated EPO extension project, not for the project under consideration. Modelling is again mentioned in the Preliminary Risk Analysis, but is not discussed.

How this guideline could be met:

- *A discussion on what modelling has been/will be undertaken for the project, including limitations, assumptions, calibration etc. (use existing data if appropriate). Of particular interest would be Harbour-wide hydrodynamic modelling and water quality modelling.*
 - *Limitations would need to include a definition of what is considered Harbour-wide. For instance is Darwin Harbour Advisory Committee's definition used (from Charles Point to Gunn Point)?*
- *Identify (quantifiable if possible) some of the main uncertainties associated with the modelling and scenarios.*

The Darwin Harbour hydrodynamic model has existed in various forms since 2001. Charles Darwin University (CDU) acquired the model from NRETAS in 2005 and, under funding from PWC, continues to develop it for research and wastewater management. The hydrodynamic model now includes a water quality module that can be used to determine mixing zones associated with effluent discharges.

The Darwin Harbour model includes the main harbour water body, mud flats and tributaries and extends to a curved line between Charles Point and Lee Point. A second model, covering Buffalo Creek is being developed and may enable extension of the harbour model into Shoal Bay in the future. Although geographically adjacent, the models differ significantly in their hydrodynamic description and modelling methodology therefore varies.

Specific field studies have contributed to empirical parameters used in the model, for example the tracer study carried out at East Point in July 2010 (Valentine *et al.*, 2011). This is of high value given that field data collection and monitoring in Darwin Harbour has been sparse due to the small population and relatively pristine environment.

A full description of the hydrodynamic and water quality model used, its limitations, assumptions, development processes, calibration and application is provided in **Appendix B1, Hydrodynamic Modelling of Darwin Harbour, 2005 – 2010, History, Development & Interpretation, Report No. 4**. The model has been applied to the current outfall location at East Point for effluent discharge scenarios to allow comparison of pre- and post-Larrakeyah diversion and treatment plant upgrade (refer **Appendix B2, Hydrodynamic Modelling of Darwin Harbour, Modelling Results**). The model has also been used by NT Government as an environmental planning and decision making tool (Fortune, 2009).

2 Description of the Proposed Development

2.7 Comment 19 (NRETAS)

It appears that because the Ludmilla WWTP is being upgraded already, the PER has not taken this point any further. In light of the modified treatment level since the upgrade was assessed in 1998, justification should be provided on why upgrading the sewerage treatment to secondary or tertiary treatment levels has not proceeded.

How this guideline could be met:

- *Discuss what potential upgrades could be implemented at the Ludmilla WWTP that would result in better environmental outcomes, including upgrading to secondary or tertiary treatment.*

A conceptual proposal to transfer all wastewater from the Larrakeyah catchment to the Ludmilla WWTP was first presented and assessed in the 1990's (SKM, 1998; NRETAS, 1998). Under that concept, the transferred wastewater was to be treated at an upgraded Ludmilla WWTP prior to discharge at Larrakeyah outfall. The proposal also included opportunistic reuse along a return pipeline to Larrakeyah.

A subsequent proposal, the "Larrakeyah Outfall Closure Plan" (LOCP) was developed in 2008 following a NT Government commitment in 2006 to close Larrakeyah Outfall. The LOCP is described in Section 2.1 and Section 2.2 of the draft PER (PWC, 2011a) and included specific proposals to duplicate the East Point ERM, upgrade the treatment process at Ludmilla WWTP and extend the East Point Outfall. Closure of the Larrakeyah Outfall became a condition of Waste Discharge Licence 149 (Larrakeyah) in 2006. A copy of this Licence is included in **Appendix E, Waste Discharge Licenses**. The LOCP was submitted to NRETAS in 2008 for consideration and feedback.

PWC has been working to meet its Waste Discharge Licence obligations by delivering the LOCP. PWC has communicated its intentions and actions through information fact sheets, government and stakeholder briefings, media releases and interviews.

Under this Plan, Ludmilla WWTP is being upgraded to adopted standards for treatment capacity in order to account for transferred flows from Larrakeyah and increasing flows due to population growth in both catchments. The upgrade of the Ludmilla WWTP was outlined in the LOCP and represents continued utilisation of the current approved and licenced treatment process at Ludmilla. Further information is provided under **Section 0, Comment 15 (NRETAS)** and **Section 8.6, Comment 18 (NRETAS)**.

2.8 Comment 22 (NRETAS)

Provide an overall layout of the proposed project, including final location and siting of works and facilities if known or preferred option.

Addressed - Nothing further required.

Noted, no additional information provided. A final design for the Proposed Development has not yet been approved.

2 Description of the Proposed Development

The location of the Proposed Development has been selected due to the following:

- No impacts on areas of cultural significance, see archaeology and Heritage assessment in Appendix H and AAPA Certificate C2009/249 in Appendix I of the draft PER (PWC, 2011a)
- Reduced impacts to listed significant or threatened species and communities
- Reduction in the amount of land clearing required, the Proposed Development will require the clearing, ranging from Open Forest, Woodlands and Coastal Monsoon Vine Forest (see **Section 4.4.2, Terrestrial Ecology**).

2.9 Comment 23 (NRETAS)

“A detailed construction program has not been developed at this stage”, however there is a broad overview of the timeframes expected (construction to take place in the dry season of 2012 and be finished before the onset of the wet season).

How this guideline could be better met:

- *Prepare a few different schedules or timelines for different possible scenarios.*
 - *Possible scenarios should consider schedules with and without the related outfall extension project.*

A preliminary construction program for the Proposed Development is presented in **Figure 2-2**. The construction program shows three phases, commencing in the fourth quarter (Q4) of 2011 and completing in Q4 of 2012. Phase 1: Concept and Detailed Design is planned to be completed by February 2012 followed by Phase 2: Construction Documentation, including procurement and assessment completed by July 2012. Construction is scheduled to commence in the first quarter (Q1) of 2012 and is planned for completion by October 2012.

2.10 Comment 25 (NRETAS)

Design layout and standards, including drainage, roads, buildings, process descriptions, outfall alignments, discharge points etc. PWC has adopted Water Services Association of Australia codes for construction, and details on the design layout are provided.

Information appears adequate.

Noted, no additional information provided.

2.11 Comment 26 (NRETAS)

Design limitations imposed by site characteristics (including adjacent land use). Considerations on design limitations are included.

Noted, no additional information provided.

2 Description of the Proposed Development

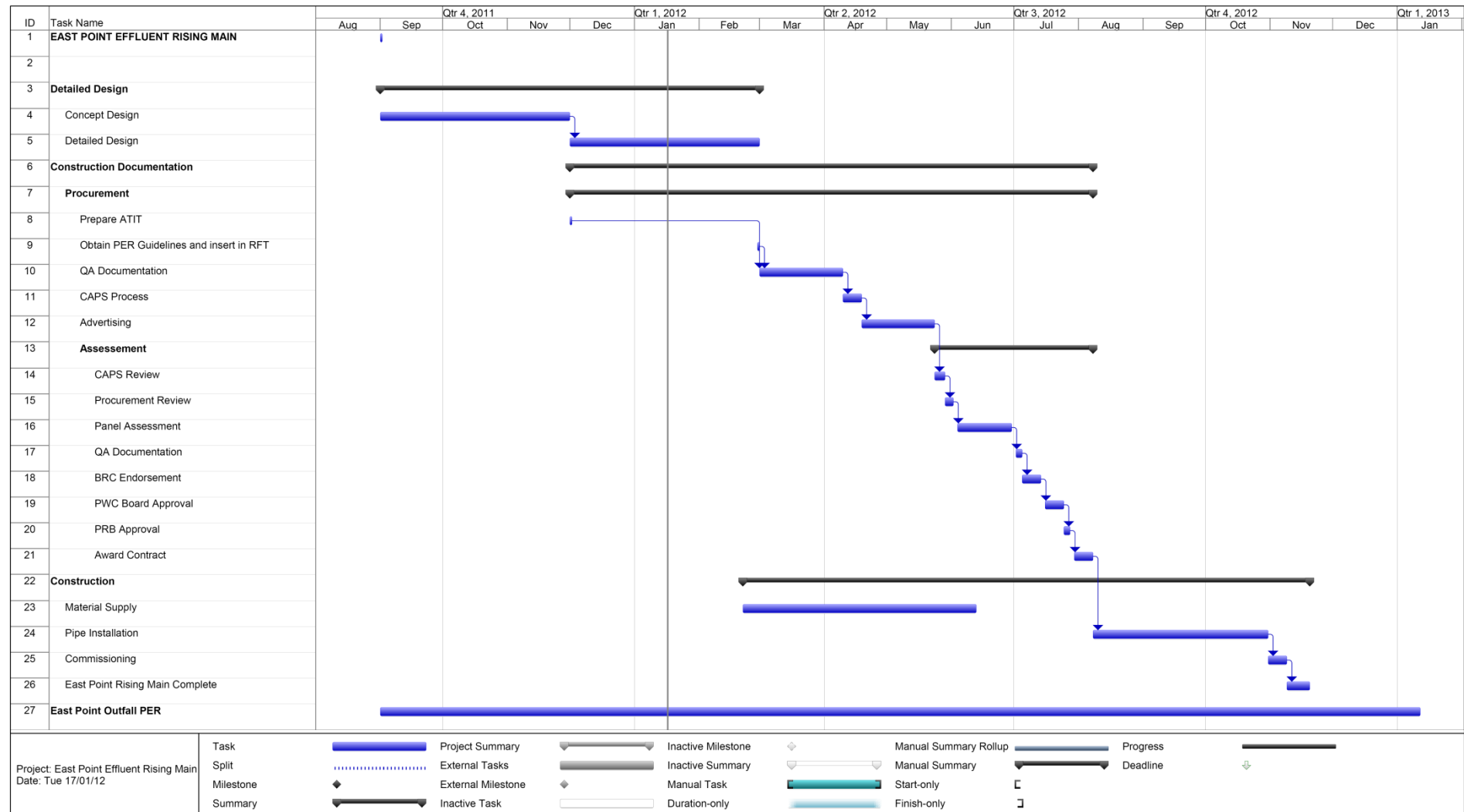


Figure 2-2 Preliminary Construction Program - Proposed Duplicated East Point ERM

2.12 Comment 27 (NRETAS)

Tenure/s under which the proposal would be held, any planning issues, and any Native Title issues. Addressed - Nothing further required.

Noted, no additional information provided.

2.13 Comment 28 (NRETAS)

Relevant National and Northern Territory legislation, standards, codes of conduct and guidelines. Addressed - Nothing further required.

Noted, no additional information provided.

2.14 Comment 30 (NRETAS)

Expected lifetime of the proposal.

Addressed - Nothing further required.

Noted, no additional information provided.

2.15 Comment 31 (NRETAS)

Rehabilitation objectives for the site beyond the intended use have not been discussed. No expected lifetime or use of the rising main was provided. It is unclear if the rising main would be left in situ in the event of future mains installed.

The Proposed Development caters for anticipated growth in the Darwin City Centre, Darwin Inner Suburbs and Darwin Northern Suburbs precincts over the next 20 years (PWC, 2011a). The existing rising main will be used as a duty standby providing redundancy (PWC, 2011a). Closure of the proposed development is currently not considered. PWC will notify the NRETAS in accordance with the waste discharge license (WDL150-1) (NRETAS, 2011a) if operation of the proposed development ceases. Under the WDL, PWC is obliged to develop a decommissioning and rehabilitation plan in consultation with NRETAS at least 60 days prior to permanent cessation of operations.

The specific goals for rehabilitating the ERM are as follows:

- Achievement of acceptable land use suitability – Rehabilitation will aim to create a stable landform with a post-project land use capability similar to that prior to disturbance.

Rehabilitation objectives include:

- Develop a decommissioning and rehabilitation plan in consultation with NRETAS, sixty days prior to the closure of the rising main
- Leaving the existing and proposed rising main in-situ after operations cease
- Remove above ground infrastructure associated with the Proposed Development, i.e. ERM.

2 Description of the Proposed Development

Existing Effluent Rising Main

- The existing DN600 ERM will be stood down and left *in situ*. PWC will maintain the existing rising main to be used as a duty stand by alternative. The refurbishment of the rising main will extend its life for at least another 50 years.

Proposed Effluent Rising Main

- The rising main will be supplied in accordance to the product manual (**Appendix C, PWC Product Manual**) and will be a Ductile Iron Cement Lining (DICL) and will be wrapped in a Denso product to provide it with additional protection. The rising main is expected to have a 100 year life.

2.16 Comment 34 (NRETAS)

“A detailed construction program has not been developed at this stage”, however there is a broad overview of the timeframes expected (construction to take place in the dry season of 2012 and be finished before the onset of the wet season).

How this guideline could be met:

- Prepare a few different schedules or timelines for different possible scenarios.*

A construction program for the Proposed Development is shown in **Figure 2-2 of Section 2.9, Comment 23 (NRETAS)**. The only alternative scenario that may be considered viable, given the closure of the Larrakeyah Outfall, is to obtain approval for the Proposed Development and the proposed EPO extension / replacement project under one PER, i.e. not splitting the assessment as discussed under the Section 1.3.2 of the draft PER (PWC, 2011a). This approach has significant time implications as it will delay the Proposed Development by at least 1 year (see **Figure 2-3**).

ID	Task Name	Q3 11				Q4 11				Q1 12				Q2 12				Q3 12				Q4 12				Q1 13				Q2 13				Q3 13				Q4 13			
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec												
1	Technical studies in support of the PER																																								
2	Developing the PER																																								
3	Detailed engineering design																																								
4	Construction of the EPO and ERM																																								
5	Closure of the Larrakeyah Outfall													◆																											

Figure 2-3 Alternative Timing

PWC considers the Proposed Development as the only viable option given remaining time to comply with the directive to close the Larrakeyah Outfall (PWC, 2011a; NRETAS, 2006).

2 Description of the Proposed Development

2.17 Comment 35 (NRETAS)

Final (or preferred) designs and materials of the rising main and outfall.

Addressed - Nothing further required.

Noted, no additional information requested.

2.18 Comment 40 (NRETAS)

There are suggestions throughout Section 2.3.2 of possible methods and construction materials for the rising main, however nothing is conclusive and there is no direct explanation for the choices in terms of efficacy and longevity.

How this guideline could be met:

- *Add a paragraph to Section 2.3.2 explaining how the construction methods and materials chosen ensure efficacy and longevity.*

The design of the ERM will be undertaken in-line with the NT Supplement to the Water Services Association of Australia - Codes and constructed in accordance with the PWC Water Supply and Sewerage Construction Master Specification (**Appendix D, Construction Master Specifications**). All materials used for the project will comply with PWC Water and Sewerage Products Manual.

2.19 Comment 41 (NRETAS)

This guideline is missing text, and should have read “Cross sectional diagrams of the sediment/soil stratigraphy in the areas where there is a higher risk of spill or infrastructure failure (such as pipeline joins) to assist in defining exposure pathways for risk assessment purposes”.

How this guideline could be met:

- *Provide diagrams and discussion on potential pathways for effluent spills in the construction corridor of the rising main.*

The construction of the ERM will be consistent with the PWC Water Supply and Sewerage Construction Master Specification (**Appendix D, Construction Master Specifications**), which includes the type of excavation methodology and bedding details (see Section 2.3.2 of the draft PER [PWC, 2011a]). It is expected that the depth of the trench will not exceed 2.5 m with the distance from the obvert (top) of the pipe to the finished surface level being no less than 750 mm. The disposal of the hydrostatic test water would be managed by the contractor and included in the Construction Environmental Management Plan. The carrier pipe will be DN750 DICL (Ductile Iron Cement Lined) that will be coated with a bitumen type paint to prevent erosion.

As part of the commissioning phase, and prior to any effluent entering the ERM, the pipeline will be fully tested with potable water. In the event effluent is discharged into the construction corridor it will be limited to the existing trench, drainage structures and low lying areas. Construction materials used for the Proposed Development are highly

2 Description of the Proposed Development

resilient, durable and coupled with a rigorous testing programme prior to commissioning the pipeline.

The rising main will be supplied in accordance to the product manual (**Appendix C, PWC Product Manual**) and will be a Ductile Iron Cement Lined wrapped in a Denso product for additional protection.

Figure 4-1 in the draft PER (PWC, 2011a) shows the topography of East Point.

2.20 Comment 47 (NRETAS)

Construction workforce numbers expected.

Addressed - Nothing further required

Noted, no additional information provided.

2.21 Comment 49 (NRETAS)

There is limited discussion on the effluent treatment process, upgrade to Ludmilla is stated and the treatment process is partially discussed. Overflow events (into Ludmilla Creek) and their likelihood are not discussed.

How this guideline could be met:

- *Discuss exactly what is involved in the treatment process.*
- *Discuss whether the upgraded capacity of Ludmilla will be sufficient, when Larrakeyah's effluent is diverted, so as to avoid discharge events into Ludmilla Creek.*

The treatment process has been discussed in some detail in **Section 2.15, Comment 15 (NRETAS)**.

The current Average Dry Weather Flows (ADWF) for the plant is 9.5 ML/day with the pending diversion from Larrakeyah it is expected to increase to 12.5 ML/day. The plant is currently designed to treat approximately 3 x ADWF, that is a maximum throughput of 28.5 ML/day. When the plant flows exceed this level there are discharge events into Ludmilla Creek. These events only occur during the wet season when there are high rainfall events and peak wet weather flows into the WWTP Plant exceed 28.5 ML/day.

The upgraded plant has been hydraulically designed to treat 5 x the ADWF for a 2030 horizon. As stated above with the diversion the 2012 ADWF is expected to be 12.5 ML/day. It is anticipated that this will increase to an ADWF of 17.5 ML/day by 2030. Once the plant upgrade is completed in 2012, it will have the capacity to hydraulically treat peak flows of 87.5 ML/day. Flows over 87.5 ML/day (extreme wet weather events) will require bypass of the treatment system, however plant reconfiguration will result in treated effluent being discharged to Ludmilla Creek rather than untreated. Untreated bypass will be directed to the outfall. This is a 300% improvement in the hydraulic capacity of the plant that will require significant peak wet weather events before discharge occurs into Ludmilla Creek.

2 Description of the Proposed Development

2.22 Comment 50 (NRETAS)

There is limited information on the characteristics of the waste before and after discharge. There is a table listing the influent characteristics, however effluent characteristics are only discusses in terms of what the previous waste discharge licence allowed (i.e. not the actual characteristics). As far as heavy metals and chemical contaminants are concerned the PER states that the discharge will not include any industrial wastes.

How this guideline could be met:

- *Provide and discuss data that demonstrates the characteristics of the effluent that is currently being discharged.*
- *It would be extremely useful to have data on heavy metals and chemicals; this would, if nothing else, ensure that no contaminants are entering the waste water system.*

The expected effluent discharge quality to be achieved is provided in

Table 2-2, under Section 0, Comment 15 (NRETAS). Please also refer to the effluent quality summary tables in the PWC modelling report enclosed in **Appendix B2, Hydrodynamic Modelling of Darwin Harbour, Modelling Results.**

2.23 Comment 54 (NRETAS)

The expected volumes and capacity of the upgrades are addressed and it is explained that the upgrades will be able to manage future population growth for the next 20 years. However, it would be important to discuss the expected volumes of effluent if population growth projections are correct.

How this guideline could be met:

- *Considering population growth is acknowledged add a paragraph discussing the impacts of population growth and the associated effluent discharge increases on the environment.*
- *Particularly nutrient loading, chemicals, pH etc.*

The treatment plant upgrade is designed to cater for sewerage loads until 2030. **Table 2-3** presents data extrapolated to consider population growth and resultant sewerage increases for the catchment. Note that this ERM proposal only includes impact assessment in relation to the existing outfall and not for long term population growth.

2 Description of the Proposed Development

Table 2-3 Expected Effluent Flow Characteristics for the Ludmilla WWTP

Assessable Parameter	2011	2016	2021	2026	2030
Ludmilla Catchment Population	33,300	35,900	38,700	41,700	44,200
Larrakeyah Catchment Population	9,400	10,100	10,900	11,700	12,400
Total Catchment Population	42,700	46,000	49,600	53,400	56,600
Ludmilla ADWF (kL/day)	9,500	10,800	11,600	12,500	13,300
Larrakeyah ADWF (kL/day)	3,000	3,200	3,500	3,800	4,000
Total (kL/day)	12,500	14,000	15,100	16,300	17,300

2.24 Comment 55 (NRETAS)

No discussion of future potential for expansion is offered.

How this guideline could be met:

- *Discuss the possibility of future diversions and what impacts this could have on the environment.*

There are currently no plans by PWC to divert any additional sewerage catchments to Ludmilla WWTP.

2.25 Comment 99 (DHAC)

On behalf of DHAC I wish to raise our general concern regarding the lack of information and modelling to address the potential environmental impact of using the existing outfall following the duplication of the rising main, given the significant additional discharge diverted from the previous Larrakeyah outfall through East Point.

See the responses under **Section 2.6, Comment 17 (NRETAS)** and also **Section 8, Modelling, Marine Water and Sediment Monitoring Program** of this Supplement. These sections present modelling and other information regarding the potential environmental impact of using the existing outfall, following the duplication of the rising main.

The DHAC also seeks clarification of the timing and process, particularly related to the extension of the outfall, and the results of the testing to determine the preferred discharge point, undertaken by Professor Eric Valentine.

The modelling methodology is described in Appendix B. Further modelling results, and discussion on the selection of a preferred outfall location will be addressed in the EPO PER.

2.26 Comment 105 (DH)

The PER does not detail the history of the Larrakeyah Outfall Closure Program with respect to why the outfall is being decommissioned.

2 Description of the Proposed Development

The project history is provided under Section 2.1 of the draft PER (PWC, 2011a). The LOCP was first published in 2008, and factsheets in relation to the LOCP has been publically available on the PWC internet site www.powerwater.com.au since 2009.

The LOCP forms part of Power and Water's broader Darwin Region Sewerage Strategy and supports the elimination of untreated sewage discharges to the Darwin Harbour (PWC, 2008a).

Will the Larrakeyah Outfall be completely decommissioned? If so then when?

PWC have a waste discharge licence (WDL 149-01) issued by NRETAS to continue to discharge from the Larrakeyah Outfall until 31 May 2012. Once this licence expires it is not expected that PWC will continue to discharge through the Larrakeyah Outfall. PWC propose to leave the existing infrastructure associated with the Larrakeyah Outfall *in situ*. Waste discharge licenses for the Larrakeyah Outfall (WDL 149-01) and the Ludmilla WWTP (WDL 150-01), are provided in **Appendix E, Waste Discharge Licenses**.

The PER does not demonstrate why the option for diverting treated sewerage from the Ludmilla WWTP to the existing Larrakeyah Outfall is not considered. The NRETAS Report on the Larrakeyah Sewerage Outfall, Darwin Harbour, August 2006 states that the 'risk from the Larrakeyah Outfall is low and the Larrakeyah Outfall is considered to be an effective outfall due to its long length of 800 metres, giving an effective buffer to the main shoreline recreation areas. It is also effective because the outfall is located at 14 metres depth in marine waters.'

Refer to **Section 2.7, Comment 19 (NRETAS)** of this Supplement.

Will there be any sewerage discharges from the existing wet weather overflow from the Ludmilla WWTP once the effluent rising main is commissioned?

As previously discussed in **Section 2.21, Comment 49 (NRETAS)** the upgraded plant has been hydraulically designed to treat 5 x ADWF for a 2030 horizon. That is with the diversion the 2012 design is ADWF 12.5 ML/day and at 2030 ADWF is 17.5 ML/day. With the plant upgrade expected to be completed in 2012, it will have the capacity to hydraulically treat peak flows of 87.5 ML/day. Flows over 87.5 ML/day (extreme wet weather events) will require bypass of the treatment system, however plant reconfiguration will result in treated effluent being discharged to Ludmilla Creek rather than untreated. Untreated bypass will be directed to the outfall. This is a 300% improvement in the hydraulic capacity of Ludmilla WWTP and will require significant peak wet weather events before discharge occurs into Ludmilla Creek.

The sanitary surveys of Darwin recreational water bodies conducted by the Department of Health in 2010 determined the Sanitary Inspection Categories for East Point area and the CBD coastal areas as moderate risk. The construction of the effluent rising main will not reduce the risk because:

- *The reliability of the Ludmilla WWTP to continually achieve high levels of treatment cannot be guaranteed, especially with wet season 'event' overflows from the Ludmilla WWTP directly into Ludmilla Creek.*
-

2 Description of the Proposed Development

- *The Close proximity of the East Point Outfall cannot guarantee sufficient mixing of discharged wastewater at low tides.*
- *Discharges from the East Point Outfall are continuous and clearly visible.*

Noted, no further information required.

*It is noted that the scope of the PER excludes the planned upgrade to Ludmilla WWTP which 'centres on expansion of the existing Chemically Assisted Sedimentation (CAS) process with design capacity sufficient for project demand growth.' DoH needs to be reassured that the upgrade to the Ludmilla WWTP will achieve the median and 90th Percentile E. coli counts for combined Larakeyah and Ludmilla effluent as listed in **Table 6.6** of the PER, i.e. 10³ cfu/100 mL and 10⁴ cfu/ 100 mL, respectively.*

- *How effective will the changes to the Ludmilla WWTP disinfection regime be on reducing the bacterial load discharged at the existing East Point Outfall?*

The disinfection unit process will be upgraded as part of the total Ludmilla WWTP upgrade in order to achieve its operational requirements under the Waste Discharge Licence (WDL 150-01). A copy of the new Waste Discharge Licence WDL150-01 is enclosed in **Appendix E, Waste Discharge Licenses**. The expected effluent is provided in **Table 2-2**, in **Section 0, Comment 15 (NRETAS)**.

The PER should provide more information about the modelling mentioned on page 97, which states that 'the bacteria levels, at the proposed discharge concentration of 10³ cfu/100 mL will be diluted to a concentration below the water quality trigger value immediately after discharge, i.e. in the immediate vicinity of the outfall.'

Please see the responses under **Section 2.6, Comment 17 (NRETAS)** and also **Section 8, Modelling, Marine Water and Sediment Monitoring Program**.

Copies of the *Hydrodynamic Modelling of Darwin Harbour, 2005 – 2010, History, Development & Interpretation, Report No. 4* (Valentine et al., 2011) and the *East Point Outfall, Mixing Zone determination using hydrodynamic and water quality modelling* (PWC, 2012b) are attached under **Appendix B, Hydrodynamic and Water Quality Modelling**.

Is there a contingency plan in the event Ludmilla WWTP upgrade and the Effluent Rising Main are not commissioned concurrently?

The Larakeyah outfall WDL expires on 31 May 2012. PWC recognise that it has a challenging program ahead to ensure a further licence extension is not required. The only viable contingency is to request a further licence extension for the Larakeyah Outfall. This will be done in consultation with NRETAS and a request to extend the expiry for the Larakeyah outfall WDL will be made if required. However, this is not currently being considered.

Upon closure of the Larakeyah Outfall, how will Power and Water Corporation manage the possible public and media perception that CBD effluent is only being redirected to another harbour location, especially one which is highly visible at low tide and has a poor mixing zone?

2 Description of the Proposed Development

The public involvement and consultation was discussed in Section 9 of the draft PER (PWC, 2011a), supported by the *East Point Outfall Extension and Rising Main Duplication Communication Strategy*, (PWC, 2011b), attached as **Appendix F, EPO and ERM Duplication Communication Strategy** and **Section 9, Public Involvement and Consultation** of the Supplement.

The communication strategy was developed to meet the needs of the PER Guidelines and aims to ensure regular and accurate information is supplied to all stakeholders (including the public), via a number of mediums that will help increase awareness among the target audience.

2.27 Comment 106 (Environmental Warrior)

The environmental impacts associated with increased volumes of sewerage discharged (prior to the upgrade of the East Point Outfall) will definitely have some environmental impact. Should the East Point Outfall extension not proceed then under which mechanism will this potential environmental impact be assessed?

Potential environmental impacts associated with the increased discharge of treated effluent through the existing EPO are discussed in the draft PER (PWC, 2011a) and this Supplement.

The PER indicates that the “The primary objective of the Proposed Development is to increase both the hydraulic and treatment capacity of Ludmilla WWTP, necessary due to the planned closure of the Larrakeyah outfall”. How then the LWWTP upgrade component of the project is not included for assessment in either the East Point Rising Main duplication or East Point Outfall extension projects.

The primary objective of the Proposed Development is to increase the hydraulic capacity of the discharge mains from Ludmilla Wastewater Treatment Plant to the East Point Outfall as a result of increased flows diverted from the Larrakeyah catchment.

Upgrade of the Ludmilla WWTP was subject to formal assessment in October 1998, with an assessment report published in December 1998 (SKM, 1998; NRETAS, 1998). Please refer see **Section 1.3, Issues Outside the Scope of the PER** and **Section 2.7, Comment 19 (NRETAS)**.

The PER on numerous occasions refers to secondary effluent at Ludmilla WWTP, however it is my understanding that the effluent discharged from LWWTP currently is enhanced primary treated effluent. There is no treatment train which significantly removes nutrients (nitrogen or phosphorous) nor BOD other than through chemically aided sedimentation (a primary treatment process). It is also my understanding that the LWWTP upgrade is increasing the hydraulic capacity of the treatment plant and optimising current treatment performance through minor process changes (such as changes to chemical dosing, hydraulic and mixing efficiencies etc).

Noted. Please refer to **Section 0, Comment 15 (NRETAS)** providing additional information on the proposed upgrade to the Ludmilla WWTP.

2 Description of the Proposed Development

Since there is no assessment of the LWWTP included in the PER's, and limited reference in the NOI or guidelines I can only assume that the works are being completed under the Environmental Assessment Report for the PER for the Ludmilla WWTP and Associated Facilities conducted in 1998. This project included the following scope of works:

"The major components of the proposal include: the augmentation of the Ludmilla WWTP; pipelines to transfer wastewater from Larrakeyah and the Central Business District to the Ludmilla WWTP; tertiary filtration and disinfection arrangements to produce high quality effluent for reuse; effluent pumping stations and pipelines to convey effluent to the Larrakeyah outfall; increased capacity of East Point outfall and the possible extension of the East Point outfall."

If this is the case, then I fail to see how a minor number of elements from the 1998 PER can be selected for implementation without committing to the remaining elements of the proposal, especially when it is those elements that provide the most significant aspects of environmental protection – that is an increase in treatment, production of effluent for re-use, decrease in volumes of effluent disposed of (through a recycling scheme) and discharge of treated (as opposed to raw) sewerage through the deep Larrakeyah Outfall. Furthermore, in the 13 years since the submission of the 1998 PER technology improvements, community expectations and increased levels of regulation throughout the rest of Australia and the developed world have significantly increase. To continue using such an out-dated document is totally inappropriate and exposes the Darwin Harbour environment to significant and long term risk.

The PER also refers to the Larrakeyah Outfall Closure Plan - this is the plan that should be assessed in the EIA process, not just one minor component of that plan.

In summary I think the process used to assess this project is totally inappropriate, the level of detail in the East Point Rising Main Duplication is inadequate and assessing the project discreetly (and prior to the East Point Outfall PER, without assessment of the LWWTP upgrade) is just ridiculous.

Noted, the draft PER (PWC, 2011a) and this Supplement are based on the Department of Natural Resources, Environment, The Arts and Sport (NRETAS) *Guidelines for Preparation of a Public Environmental Report: Duplication of the East Point Effluent Rising Main and Extension of the East Point Outfall, Darwin, NT, February 2010* (the Guidelines). As previously indicated upgrades to the Ludmilla WWTP were subject to assessment in 1998. Please refer to **Section 1.3, Issues Outside the Scope of the PER** and **Section 2.7, Comment 19 (NRETAS)**.

2.28 Comment 107 (ECNT)

ECNT are satisfied that the likely risks and impacts have been adequately identified, and will be managed appropriately.

Noted.

2 Description of the Proposed Development

ECNT have often warned of the shortcomings of piecemeal assessment, that may at times risk significant considerations falling through the cracks of successive modular assessment; that may mask the significance of cumulative impacts; and that may overburden assessment of later stages with the weight of inevitability presented by previous approvals.

In this instance, ECNT are very much aware that, despite reference to marine environment in the guidelines, the draft Report does not discuss marine values, risks or impacts – including the Aquatic Life Reserve. Indeed, at this point we are uninformed about the parameters of the outfall extension. It is not yet clear whether the depth, turbidity and ecological structure of the new outfall will make an acceptable location for the increased effluent once the Larrakeyah sewerage is redirected to the Ludmilla plant. Recognising that this proposal in itself presents no specific risk to marine environments, ECNT will be keen to ensure that these considerations are given adequate attention at a later stage.

Of far greater concern is the assessment of the diluted proposal to upgrade the Ludmilla Wastewater Treatment Plant.

ECNT queries why PAWA did not, in accordance with clause 14A of the Administrative Procedures of the Environmental Assessment Act, formally advise the Minister of any changes to the proposal for determination of whether or not further environmental impact assessment is required. Indeed, this very mechanism was employed to divorce the outfall extension component from the rising main duplication. ECNT recommend that the variations to the original Ludmilla upgrade PER are great enough to call into question whether the entire Larrakeyah closure program still offers a net environmental benefit.

The 1998 PER for Ludmilla Wastewater Treatment Plant described:

“upgrading the level of treatment at the Ludmilla plant to biological secondary treatment (with a proportion of the flow receiving tertiary treatment”, and specifically identified that:

“The CAS option is not really compatible with the Darwin sewerage strategy, which envisages long term reuse of effluent produced by the Ludmilla WWTP”.

Yet the closure program has since been watered down to merely offer enhanced primary treatment. Rather than upgrading the level of treatment, the closure program seems to have been redefined around the objective of increasing capacity. As such, the current plan is significantly different to that referred to in the SKM 1998 PER. But the list of project alternatives in this Draft Report does not even encompass discussion of the original configuration of the Ludmilla WWTP upgrade. Neither is adequate consideration given to the alternative of transferring some effluent from the upgraded Ludmilla WWTP to the Larrakeyah outfall – this clear alternative is merely dismissed on policy grounds, without any discussion of the likely environmental benefit.

ECNT recognise that the proposal to chemically treat the sewerage that is currently dumped at Larrakeyah removes the hazard from Larrakeyah. But in the absence of details regarding the parameters of the outfall extension, it is not clear what greater hazard may be presented at the new Ludmilla outfall, with or without the proposed outfall extension. It appears that the upgrade is proceeding ahead of any indication of

2 Description of the Proposed Development

the parameters of the eventual Waste Discharge License under which the upgraded infrastructure will operate.

No information is provided to allow consideration of the net environmental benefit to the harbour as a whole. Yet it is clear that we will not see the benefits promised in the SKM1998 PER, including reuse of tertiary treated effluent.

ECNT sees little harm in the proposal to duplicate the rising main at East Point. But we do recommend that this step in the process be recognised as an opportunity to better define the revised Larrakeyah closure program. Even at this late stage, it would be useful to reconsider the environmental benefit of pumping treated effluent back to Larrakeyah, and it is certainly not too soon to discuss the net environmental costs and benefits this program presents to Darwin Harbour as a whole.

ECNT sees little harm in the proposal to duplicate the rising main at East Point. But we do recommend that this step in the process be recognised as an opportunity to better define the revised Larrakeyah closure program. Even at this late stage, it would be useful to reconsider the environmental benefit of pumping treated effluent back to Larrakeyah, and it is certainly not too soon to discuss the net environmental costs and benefits this program presents to Darwin Harbour as a whole.

Noted, as previously discussed the draft PER (PWC, 2011a) and this Supplement are based on the Department of Natural Resources, Environment, The Arts and Sport (NRETAS) *Guidelines for Preparation of a Public Environmental Report: Duplication of the East Point Effluent Rising Main and Extension of the East Point Outfall, Darwin, NT, February 2010* (the Guidelines). Upgrades to the Ludmilla WWTP were subject to assessment in 1998 and are not considered part of this PER. Please refer to **Section 1.3, Issues Outside the Scope of the PER** and **Section 2.7, Comment 19 (NRETAS)**.

SECTION 3

Alternatives



3 Alternatives

3.1 Comment 58 (NRETAS)

Ongoing measures proposed to minimise the potential for mosquito breeding on site and any off site locations that may be affected by the proposal.

Addressed - Nothing further required.

Noted, no additional information requested.

3.2 Comment 59 (NRETAS)

Not proceeding with the proposal.

Addressed - Nothing further required.

Noted, no additional information requested.

3.3 Comment 60 (NRETAS)

Alternatives to discharging such as recycling water (effluent reuse) has not been addressed.

How this guideline could be met:

- *Discuss what alternatives are available to discharging effluent, such as effluent reuse and recycling waste water.*

There are no new effluent reuse proposals currently under consideration by PWC for the Darwin region, however recycling may still occur as part of future upgrade at Leanyer/Sanderson, Palmerston or Ludmilla WWTPs. Any reuse scheme would need to meet the principles of commercial viability and environmental sustainability. It should be noted that whilst effluent reuse and recycling of wastewater can result in a reduction in discharge on a seasonal basis, it is unlikely to be an alternative to discharge in the Darwin climate, particularly in the wet season when re-use demand is likely to be low and discharge volumes high.

3.4 Comment 61 (NRETAS)

Alternative pipeline materials and installation options.

Addressed - Nothing further required

Noted, no additional information requested.

3.5 Comment 62 (NRETAS)

The PER discussion was restricted to East Point as the only location for a new outfall and no other locations considered.

- *Options for alternate locations should be raised so that justification of a duplicate rising main to East Point can be made.*

3 Alternatives

PWC propose to construct a duplicate rising main from the Ludmilla WWTP to a terminal manhole connecting it to the existing East Point outfall.

A discussion on alternative discharge locations is presented in the 1998 *PER for the Ludmilla Wastewater Treatment Plant and Associated Facilities* (SKM, 1998), which considered three alternative discharge locations:

- Option 1 - discharge through the Larrakeyah outfall
- Option 2 - discharge to the Ludmilla Creek
- Option 3 - discharge through the East Point outfall.

Option 1 and 2 were discounted by PWC, since closure of the Larrakeyah outfall is a priority NT Government policy initiative (NRETAS, 2006) and continued discharge into Ludmilla Creek is not considered a viable alternative due to environmental constraints / impacts of discharging effluent into this environment. Option 3 proposed to discharge treated effluent through the EPO, recognising it is in shallow water and that the performance could be improved by extending the EPO. PWC recognised this and submitted a proposal to NRETAS and the Commonwealth for extending or replacing the existing EPO (URS, 2009; NRETAS, 2010a; PWC, 2011a). Refer **Section 1.3, Issues Outside the Scope of the PER** and Section 1.3 of the draft PER (PWC, 2011a) for further information in this regard.

3.6 Comment 65 (NRETAS)

Alternative environmental management techniques for moderate or higher risk impacts has not been addressed.

How this guideline could be met:

- *Add a paragraph to Section 3 (Alternatives) that offers alternative Environmental management techniques, with specific reference to moderate and high risk impacts.*

Environmental management techniques are addressed in detail in Section 7.1 of the draft PER (PWC, 2011a). Management techniques considered in the draft PER (PWC, 2011a) and the Supplementary are considered the most appropriate mechanisms to manage potential environmental impacts.

Realistic alternatives to those proposed in the draft PER (PWC, 2011a) and the Supplement are not available due to the intrinsic nature of the Proposed Development. Risk levels will likely increase if unrealistic alternative mitigation measures are applied. Construction of the Proposed Development is considered relatively routine for PWC, with mitigation measures proven to be appropriate during past projects.

SECTION 4

Existing Environment



4 Existing Environment

4.1 Comment 2 (NRETAS)

Acid Sulphate Soils

The PER provides statements on best practice acid sulphate soil management across the site. It also provides liming rates based on Chromium Reducible Sulphur (CRS) results from soils on sites. A commitment to a detailed documented acid sulphate soil management plan is also provided. Dependant on the proposed scale of works such a plan should be reviewed and approved in writing by a suitably qualified independent third party auditor such as a suitably qualified environmental consultant.

Noted, PWC will appoint a suitably qualified environmental consultant to review the Acid Sulphate Soil Management Plan (ASSMP). **Section 7.6, Comment 73 (NRETAS)** provides further information on acid sulphate soils management and the proposed framework for developing this plan. The ASSMP will also be submitted to NRETAS for review.

4.2 Comment 6 (NRETAS)

Species and ecosystems

In relation to the impact assessment on the marine environment there are a number of issues that require further discussion in the supplement. The issues relate to:

- *Increased wastewater discharge from Ludmilla WWTP*
- *Risk assessment of nutrient discharge*
- *Water quality and sediment monitoring program.*

The Draft PER has ignored the potential risks and impacts on the marine environment from the interim scenario where there is an early closure of Larrakeyah, coupled with the incomplete construction of the Ludmilla WWTP resulting in continued effluent discharge at the current EPO. The Preliminary Risk assessment only provides very brief discussion of potential risk. The following issues need to be addressed in the supplement:

- *Risks to benthic community health (notably coral and seagrass) and marine mega fauna from increased nutrient and toxicant output within an intertidal area, including EPBC listed species, and*
- *Risks to marine ecosystems from potential raw sewerage discharge into Ludmilla Creek during high rainfall periods.*

A recent aerial survey (October 2011) conducted by NRETAS has identified a large seagrass meadow between East Point and Nightcliff. The meadow is found approximately below the 0.2 m LAT. Its extent on the seaward side is unknown; however, Appendix 3 of the 2009 ERM and EPO NOI reports seagrass at depths of -3.1 and -5.7 m AHD just north of East Point (sites A2, B3 respectively).

Further, bathymetric surveys conducted on behalf of PWC (presented in Appendix 2 of the 2009 NOI) indicate that sand waves have seemingly created a sedimentary

4 Existing Environment

basin in which the current EPO discharges into. Prior to the construction of the new outfall there is the likelihood that discharge of particulate organic matter and flocculants from the existing EPO may accumulate in this sedimentary basin. This may create similar environmental conditions as in Buffalo Creek (i.e. anoxic layer), resulting in a deterioration of sediment health and its ability maintain healthy benthic communities (infauna and/or epifauna/flora). This should be discussed further in the supplement, with responses based on valid justification.

The impacts on benthic habitats from waste water discharge from the current EPO will need to be closely monitored until the new outfall pipeline within the marine environment is completed. As a consequence, the supplement should include discussion on a broader scope for the water quality and benthic monitoring program to include monitoring of benthic community and sediment health, or valid justification of why the current proposed program is sufficient. Currently the monitoring program is designed only to monitor impacts from a human health perspective whereby two species of mollusc are sampled for contaminants, due to them being sessile and filter feeders.

The Draft PER includes a risk assessment of the increased discharge into the marine environment and a water quality and marine monitoring (physicochemical) program. However, the Draft PER does not provide any background information on the marine environment from either a physical or biological perspective. And, although the risk assessment chapter does provide some of the nutrient loading data, the draft PER does not provide adequate information in Existing Environment (Section 4). The following topics require further discussion and validation in the supplement:

- *Hydrodynamic modelling and mixing zone characteristics, nutrient and flocculation characteristics and likely transport/sedimentation of flocculent and macerated material; determine the zone of influence for each impact parameter.*
- *Background information on (1) the water quality conditions in Darwin Harbour, (2) pre- construction discharge characteristics (e.g. nutrient loads for dissolved, particular and flocculent matter and overflow events) and (3) post-construction discharge characteristics (e.g. nutrient loads for dissolved, particular and flocculent matter and overflow events).*
- *Describe the physical environmental and biological environment within the zone of influence, including EPBC listed species.*

Please refer **Section 0, Comment 15 (NRETAS)** and **Section 2.6, Comment 17, (NRETAS)** for additional information on modelling results associated with the additional discharge. **Appendix B** also provides further information in support of the hydrodynamics.

Further information on the Marine and Terrestrial Ecology is provided in **Section 4, Existing Environment** and **Section 5, Potential Impacts**, in particular please refer to **Section 4.4, Comment 20 (NRETAS)** and **Section 4.5, Comment 21 (NRETAS)**.

EPBC listed marine species that are both known or could potentially occur in the area are discussed in **Section 4.5, Comment 21 (NRETAS)**. Potential impacts are discussed in **Section 6.9, Comment 84 (NRETAS)**.

4 Existing Environment

Benthic habitat communities surrounding the existing EPO and the greater Darwin Harbour are identified in **Section 6.9, Comment 84 (NRETAS)**. Potential impacts upon the communities identified are also discussed in this Section.

Additional marine and benthic assessment is proposed to be undertaken in 2012 as part of the separate environmental assessment of the extension replacement of the EPO.

Marine water quality modelling and proposed monitoring are addressed throughout **Section 8, Modelling, Marine Water and Sediment Monitoring Program** and **Appendix B, Hydrodynamic and Water Quality Modelling**.

- *Provide a risk assessment for existing benthic community types (including, coral, seagrass and soft bottom communities (infauna and epifauna)).*

Please refer to **Section 4.4, Comment 20 (NRETAS)** and **Section 6.9, Comment 84 (NRETAS)** of this Supplement. Additional benthic assessment is proposed to be undertaken in 2012 as part of the separate environmental assessment of the extension replacement of the EPO.

4.3 Comment 7 (NRETAS)

East Point Recreation Reserve contains patches of two sensitive or significant vegetation types as classified under the 2010 NT Land Clearing Guidelines; monsoon vine forest, and mangrove vegetation communities. Monsoon forest patches are significant as they cover only 0.2% (2700 km²) of the NT landscape, but contain 13% (604 species) of all known Territory flora. Mangrove communities are significant as they support a distinctive suite of species, and are important as nursery sites for many fish species and provide for important physical processes. The pipeline is to be located on mostly cleared areas and a relatively small area of existing monsoon forest and mangroves (approx. 0.5 ha) will be cleared.

A number of threatened or significant plant and animal species are reported in the PER as occurring, or potentially occurring, in or near East Point Recreation Reserve. No systematic flora and fauna surveys were conducted along the proposed corridor of the effluent rising main, or broader East Point Reserve. Data was limited to observation records only. Therefore all threatened and significant flora and fauna may not have been identified.

Please also see **Section 4.4, Comment 20 (NRETAS)** and **Section 4.5, Comment 21 (NRETAS)** of this Supplement for additional information.

As reported in the PER it is accepted that two sensitive habitats (as defined by the Northern Territory Land Clearing Guidelines (NRETAS, 2010b) the monsoon vine forest, and mangrove vegetation communities, and a number of threatened or significant plant and animal species are known to occur or potentially occur in or near East Point Recreation Reserve.

4 Existing Environment

An initial terrestrial flora and fauna assessment was undertaken for the proposed duplication of the ERM corridor on 25 to 31 May 2011. The initial assessment of the flora and fauna utilised existing data and rapid assessment type surveys to describe the terrestrial flora and fauna of the site, and evaluate the likely presence and habitat suitability of flora and fauna species considered to be of conservation significance within the project area. Field observations were undertaken in order to update and verify existing data and provide specific information relating to the project site.

PWC considered that this level of assessment was adequate, given that:

- Information is available on the area.
- The proposed ERM corridor (10 m in width) will result in clearing of approximately three (3) hectares (ha) of terrestrial vegetation, of which 2.54 ha (85%) is classified as disturbed and urban areas with regrowth.
- The route of the duplicate ERM corridor will primarily follow the route of the existing ERM corridor.
- Diversions to this route have been made, where practical to redirect the pipeline through disturbed urban parkland (Community 5) to further reduce impacts on:
 - Coastal Monsoon Vine Forest Communities (Community 1)
 - Low to Mid, Mixed Species Closed Forest to Open Forest (Community 2)
 - Low to Mid, Mixed Species Open Woodland (Community 3).

Whilst it is noted that the vegetation communities of East Point are an important component of the East Point Reserve as a refuge for local fauna in the greater landscape matrix (Franklin *et al.*, 2010), and that listed species do occur in the area it is also noted that:

- The Coastal Monsoon Vine Forest Community within the proposed ERM corridor is a modified rainforest community largely comprised of regrowth through self-seeding and supplementary plantings by DCC between 1974 and 1984 (Franklin *et al.*, 2010) and as a result is floristically simplified. This is bordered by managed urban parkland, management tracks and the Model Aeroplane Club grounds.
- The Mixed Species Open Forest and patches of Mixed Species Open Woodland regrowth and revegetation within the corridor are in poor ecological condition and are generally disturbed with evidence of weeds and impacts from adjacent urban land uses.
- The area of impact on the *Ceriops tagal* Mangrove Forest will be limited to the edge of this vegetation community. Mangrove habitats directly adjacent to the existing sewage rising main, Ludmilla Waste Treatment Plant and urban areas are already impacted to some degree by edge effects. However, despite these impacts, the Mangrove Forest area continues to support a suite of mangrove and wetland specialist fauna species, including small numbers of listed migratory shorebirds (Noske 1996; Clay and Andersen 1996).

4 Existing Environment

A review of the existing literature and subsequent field observations and assessments undertaken to verify existing information in the field, indicate that the proposed duplicate ERM corridor will pass through five vegetation communities:

- Community 1: Coastal Monsoon Vine Forest
- Community 2: Low to Mid, Mixed Species Closed Forests
- Community 3: Low to Mid High, Mixed Species Open Woodland to Woodland
- Community 4: Mangrove Forest
- Community 5: Disturbed Areas with Regrowth.

Table 4-1 below, from Section 5.2.1 of the draft PER (PWC, 2011a), provides the details of the disturbance of the vegetation communities as calculated in ArcGIS. The table illustrates that the majority of the Proposed Development corridor will pass through disturbed urban parkland and development areas with regrowth (Community 5).

Again, it is noted that the area proposed for the construction of the Proposed Development was specifically selected to minimise the potential for significant native vegetation, and to divert the proposed route where practical, through disturbed urban parkland.

Table 4-1 Areas of clearing and disturbance of each vegetation community (1 to 5)

Vegetation Community	Map unit	Cleared (ha)	Potentially disturbed (ha)	Total (ha)
Community 1: Coastal Monsoon Vine Forest	12	0.034	0.081	0.115
Community 2: Low to Mid, Mixed Species Closed Forests	6	0.363	0.379	0.742
Community 3: Low to Mid High, Mixed Species Open Woodland to Woodland	13	0.652	0.686	1.338
Community 4: Mangrove Forest	4	0.056	0.078	0.134
Community 5: Disturbed Areas with Regrowth	16	1.893	1.8	3.696
<i>Total Terrestrial Vegetation</i>	-	2.94	2.95	5.89
<i>Total Vegetation Marine Component</i>	-	0.056	0.078	0.134
Total Area	-	2.99	3.03	6.02

Coastal Monsoon Vine Forest Habitat

The Proposed Development corridor will traverse very small areas of regrowth Coastal Monsoon Vine Forest which covers approximately 0.632 ha. Franklin *et al.* (2010) identified the narrow band of Monsoon Vine Forest, located adjacent to the proposed pipeline corridor, as predominantly self-seeded regrowth with supplementary plantings at the eastern end. This area is within the vicinity of the significant remnant Monsoon Vine Forest at East Point; however it remains floristically simplified and has been contained by ongoing management of the East Point Reserve such as slashing. This vegetation community is a modified coastal rainforest community. Naturalised exotic trees are present with some enrichment planting of local native species.

4 Existing Environment

The overall area of Monsoon Vine Forests located within or adjacent to the Proposed Development corridor is very small. Whilst this vegetation community is unlikely to be providing significant habitat for wildlife, it is an important component of the East Point Reserve as a refuge for local fauna populations such as the Agile Wallaby (*Macropus agilis*) and Rainbow Pitta (*Pitta iris*) in the greater landscape matrix (Franklin *et al.*, 2010).

The proposed area to be cleared along the ERM alignment (refer **Table 4-1**) represents a marginal area of the Monsoon Vine Forests in the NT landscape, i.e. less than 0.0001% of the 270 000 ha (NTG, 2011). It is noted that the total rainforest estate in the Territory is divided into 15 000 patches, ranging between 1 ha and 4 000 ha with a median size of 3.6 ha (NTG, 2011). Further fragmentation from land clearing is considered a threat (NTG, 2011). Therefore, proposed activities associated with the Proposed Development will be managed to minimise disturbance of the Monsoon Vine Forests as far as practically possible.

Mangrove / Saline Wetland Habitats

Mangrove and salt marsh / saline wetland habitats within and surrounding the Proposed Development corridor support a number of listed migratory marine birds and shorebirds. Under EPBC significance criteria (SEWPAC, 2009) the larger Ludmilla Creek mangrove areas qualify as important habitat for migratory species listed under the EPBC Act 1999. These areas also support a range of other mangrove specialist fauna species (Noske, 1996; Clay and Andersen 1996).

A very small area of *Ceriops tagal* Mangrove Forest is likely to be impacted by the pipeline development and the area of impact will be limited to the edge of this vegetation community. The overall impacts on this habitat are likely to be lessened because of this, as it is likely that core areas of Mangrove Forest that will not be impacted by the pipeline, are of greater significance for wildlife (Noske, 1996; Clay and Andersen, 1996).

Management Commitments

The *Northern Territory Land Clearing Guidelines* (NRETAS, 2010b) state that applications to clear in coastal areas, or in areas subject to tidal influence (e.g. floodplain systems associated with tidal rivers and creeks, Coastal Monsoon Vine Thickets and Mangroves), must be supported by additional information, such as:

- Potential, or expected, impacts of the land clearing on sensitive or fragile coastal landscapes and the steps taken to reduce and manage risks.

It is proposed the areas of disturbance will be managed as per PWCs Land Management Procedure (2008) and areas that are disturbed during construction activities, will be progressive rehabilitated, with suitable species, with due consideration of the requirements of fauna species that will potentially recolonise these areas.

4 Existing Environment

The works area will be levelled to the required gradient using graders, backhoes and bulldozers. Topsoil removed from pipeline routes during construction will be stockpiled and replaced during rehabilitation. Some vegetation will be stockpiled for re-spreading as part of the restoration process. Large trees will be preserved wherever practicable.

Proposed management and mitigation measures are discussed further in **Section 8.17, Comment 87**.

Errata

Erratum to the Draft PER (PWC, 2011a): Please note the paragraph below was incorrectly included in Section 4.2.2 of the draft PER (PWC, 2011a). *‘The flora survey recorded a total of 76 flora species of which two sensitive / significant vegetation types (Senna alata [Candle bush] and Senna obtusifolia [Sicklepod]) were identified according to the Northern Territory Land Clearing Guidelines (NRETAS, 2010b).’*

This text should list the Monsoon Vine Forest and the Mangrove Forest as the significant vegetation types as per the text above. *Senna alata* and *Senna obtusifolia* are later recorded as declared weed species observed during the field assessments (Refer to Section 4.2.8 of the PER).

4.4 Comment 20 (NRETAS)

There is no mention that recognised experts were consulted in relation to EPBC listed threatened and migratory species. Nor was there evidence that the reports and studies that were referenced in relation to relevant species negated the need for expert consultation. Field surveys did not suggest that experts were consulted on methodology, timing or scope.

How this guideline could be met:

- *Discuss what expert consultation was undertaken, its scope and any recommendations given. If recognised experts were not engaged;*
 - *Consult with recognised experts in relation to EPBC listed threatened species.*
- *If recognised experts were not engaged, evidence demonstrating that the methodology, timing and scope of the field surveys were adequate is required. Possible options include;*
 - *Seeking expert advice on the methodology, timing and scope of the field surveys, or*
 - *Seeking peer review of the field surveys.*
- *Consultation should focus on marine species, such as the Dugong, Dolphins, and Turtles.*

The following section provides supplementary information to Section 4.2 of the draft PER (PWC, 2011a) and should be read in conjunction with the aforementioned draft PER.

4 Existing Environment

4.4.1 Marine Ecology

Whilst there is no mention of consultation with recognised experts on EPBC listed marine species, it is noted that Carol Palmer of NRETAS attended the Project hazard identification and assessment workshop. No field surveys for EPBC listed marine species were undertaken, however, a further benthic habitat mapping will be undertaken as part of the PER for the proposed EPO as recommended by Tony Griffiths of NRETAS (Pers. Coms., file note D2011/178919).

It was considered that existing information sources (Palmer, 2010; INPEX, 2011a) provided adequate information for the purposes of assessing the potential impacts of the continued use of the existing EPO. Consolidated sighting data for EPBC listed marine species were obtained from NRETAS on 23 January 2012 and these have also been taken into account in addressing **Section 4.4, Comment 21 (NRETAS)**, **Section 6.9, Comment 84 (NRETAS)** and **Section 8, Modelling, Marine Water and Sediment Monitoring Program**.

4.4.2 Terrestrial Ecology

An initial terrestrial flora and fauna assessment was undertaken for the proposed duplication of the ERM corridor in May 2011 by URS. This utilised existing data and surveys to:

- Describe the terrestrial flora and fauna of the site, and
- Evaluate the likely presence and habitat suitability of flora and fauna species considered to be of conservation significance within the project area.

Field observations (methodologies described below and reported in Section 4.5.2) were also undertaken over a period of five days by a qualified botanist in order to update and verify existing data and provide specific information related to the existence of significant habitats of the project site. The aim was to identify areas that may warrant further field investigation or targeted trapping.

Given that the ERM is a routine project with a small footprint, in an area that is largely previously disturbed, together with the available existing information, it was considered that a full survey with trapping and other methods was not warranted unless significant habitat was present. This also aligns with the approach discussed with Tony Griffiths of NRETAS on 19 April 2011 (Pers. coms., file note D2011/178919). In particular:

- The proposed ERM corridor (approximately 10 m in width) will result in clearing of approximately 3 ha of terrestrial vegetation, of which 2.54 ha (85%) is classified as disturbed and urban areas with regrowth. The clearing of undisturbed land is thus less than 0.5 ha.
- The route of the duplicate ERM corridor will primarily follow the route of the existing ERM corridor.
- Diversions to this route have been made, where practical, to redirect the pipeline through disturbed urban parkland (Community 5) to further reduce impacts on:
 - Coastal Monsoon Vine Forest Communities (Community 1)
 - Low to Mid, Mixed Species Closed Forest to Open Forest (Community 2)
 - Low to Mid, Mixed Species Open Woodland (Community 3).

4 Existing Environment

Whilst it is noted that the vegetation communities of East Point are an important component of the East Point Reserve as a refuge for local fauna in the greater landscape matrix (Franklin *et al.*, 2010), it is also noted that:

- The Coastal Monsoon Vine Forest Community within the proposed ERM corridor is a modified rainforest community largely comprised of regrowth through self-seeding and supplementary plantings by Darwin City Council (DCC) between 1974 and 1984 (Franklin *et al.*, 2010) and as a result is floristically simplified. This is bordered by managed urban parkland, management tracks and the Model Aeroplane Club grounds.
- The Mixed Species Open Forest and patches of Mixed Species Open Woodland regrowth and revegetation within the corridor are in poor ecological condition and are generally disturbed with evidence of weeds and impacts from adjacent urban land uses.
- The area of impact on the *Ceriops tagal* Mangrove Forest will be limited to the edge of this vegetation community.

The existing ERM corridor, the proposed route of the duplicate ERM corridor, recorded vegetation communities and the location of flora and fauna assessment and check sites (discussed below) are illustrated in **Figure 4-1**. The disturbance area, flora and fauna assessment methodologies and expert review of the methodology are discussed below.

Plate 4-1 to **Plate 4-5** shows examples of the typical vegetation communities encountered along the Proposed Development alignment.



Source: PWC, 2011a

Plate 4-1 Community 1: Coastal Monsoon Vine Forest

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Source: PWC, 2011a

Plate 4-2 Community 2: Low to Mid - mixed Species Closed to Open Forest



Source: PWC, 2011a

Plate 4-3 Community 3: Low to Mid - mixed Species Open Woodland

4 Existing Environment



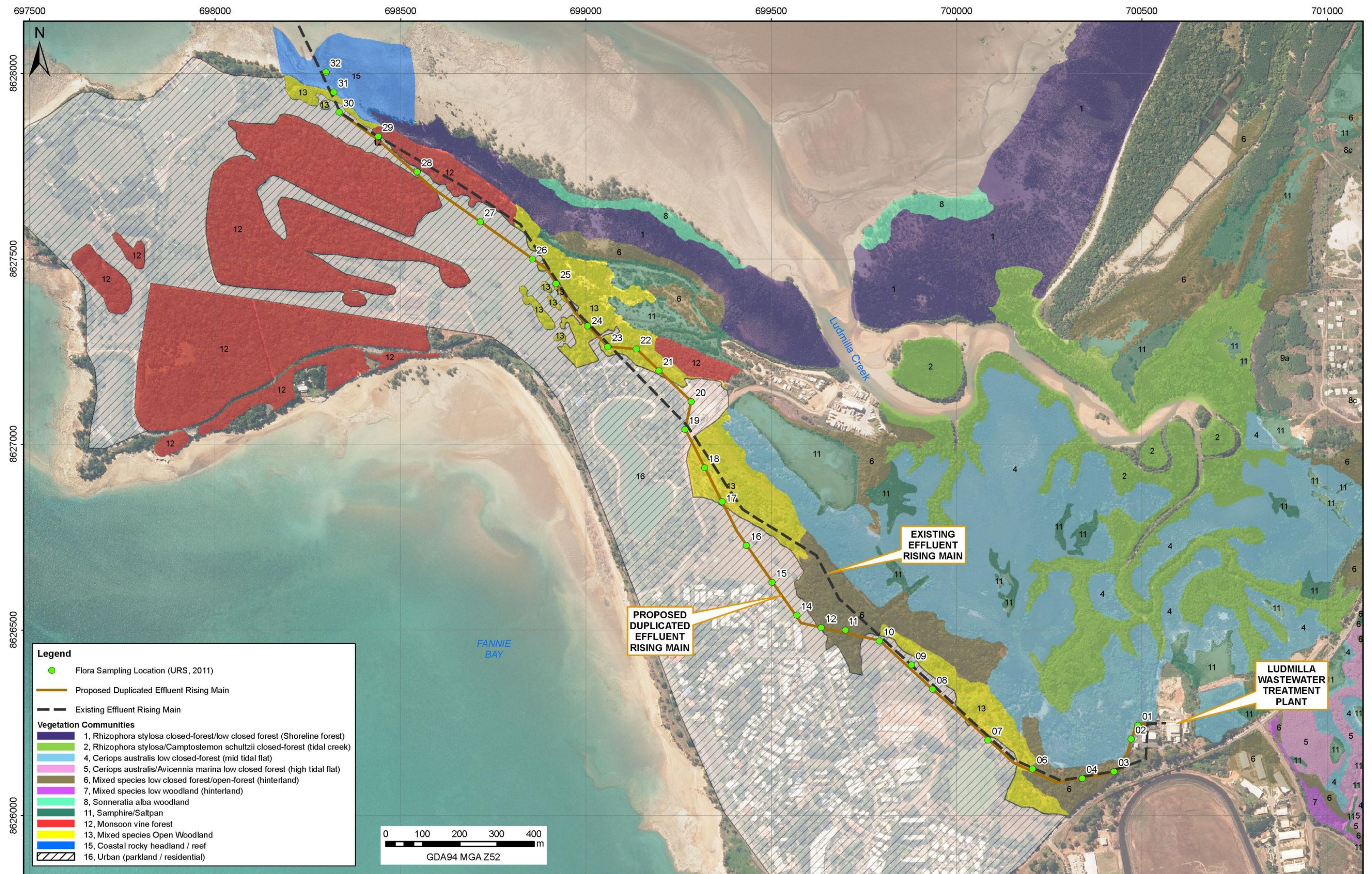
Source: PWC, 2011a

Plate 4-4 Community 4: Mangrove Forest



Source: PWC, 2011a

Plate 4-5 Community 5: Urban (Parkland; Development Sites)



4 Existing Environment

Disturbance Area

The Proposed Development corridor (10 m in width) will result in clearing of approximately 3 ha of terrestrial vegetation, of which 2.54 ha (85%) is classified as Community 5 disturbed and urban areas with regrowth. The clearing of undisturbed land is less than 0.5 ha; this includes the clearing and potential disturbance of a small area of Mangrove Forest (0.05 – 0.13 ha). The potential disturbance to vegetation and soil resulting from the clearing and construction activities (measured at 5 m either side of the 10 m corridor) have also been calculated using GIS (Table 4-2). This table illustrates that the majority of the Proposed Development corridor will pass through disturbed urban parkland and development areas with regrowth (Community 5).

Table 4-2 Areas of Clearing and Disturbance of Each Vegetation Community (1 to 5)

Vegetation Community	Map unit	Cleared (ha)	Potentially disturbed (ha)	Total (ha)
Community 1: Coastal Monsoon Vine Forest	12	0.034	0.081	0.115
Community 2: Low to Mid, Mixed Species Closed Forests	6	0.363	0.379	0.742
Community 3: Low to Mid High, Mixed Species Open Woodland to Woodland	13	0.652	0.686	1.338
Community 4: Mangrove Forest	4	0.056	0.078	0.134
Community 5: Disturbed Areas with Regrowth	16	1.893	1.8	3.696
<i>Total Terrestrial Vegetation</i>	-	<i>2.94</i>	<i>2.95</i>	<i>5.89</i>
<i>Total Vegetation Marine Component</i>	-	<i>0.056</i>	<i>0.078</i>	<i>0.134</i>
Total Area	-	2.99	3.03	6.02

Note: The column 'Potential disturbance' includes estimates of the additional area of potential disturbance to vegetation and soil resulting from the clearing and construction activities (measured at 5 m either side of the 10 m corridor). This has been included to clearly depict the maximum and minimum areas of disturbance.

Table 4-3 provides a comparison between the total areas of clearing and the estimated community sizes at East Point (see **Figure 4-1**). **Figure 4-2** provides a graphical comparison of the estimated community size shown in **Figure 4-1** and the estimated area of clearing along the proposed development corridor.

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Table 4-3 Areas of Clearing and Disturbance vs. Total Area of Communities at East Point

Vegetation Community	Map unit	Area Disturbed (ha)	Est. Community size (ha)	% Disturbance vs. Community Size
Community 1: Coastal Monsoon Vine Forest	12	0.12	45.0	0.26%
Community 2: Low to Mid, Mixed Species Closed Forests	6	0.74	31.7	2.34%
Community 3: Low to Mid High, Mixed Species Open Woodland to Woodland	13	1.34	16.7	8.03%
Community 4: Mangrove Forest	4	0.13	62.9	0.21%
Community 5: Disturbed Areas with Regrowth	16	3.70	130.6	2.83%

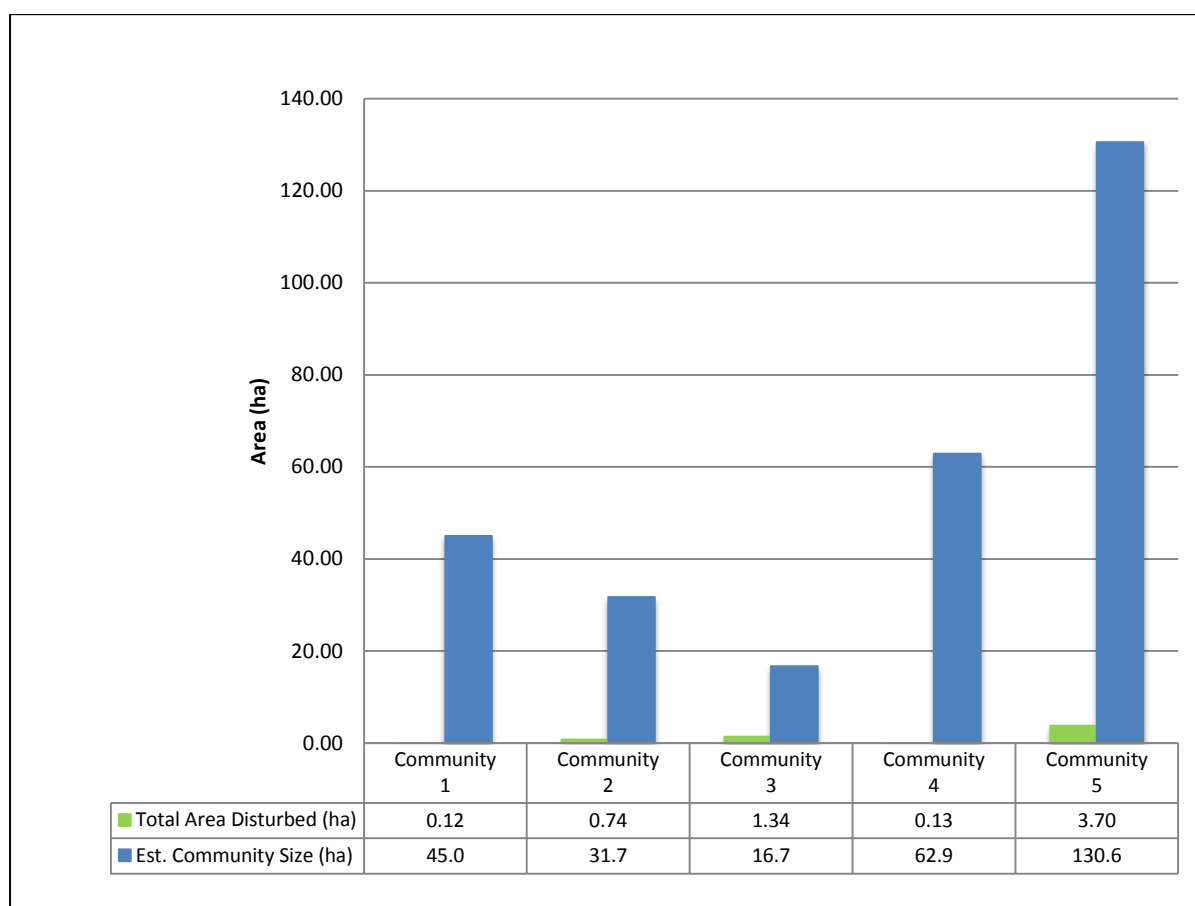


Figure 4-2 Comparison between Area Disturbed and Estimated Community Size

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Flora and Fauna Assessment Methodologies

Review of existing data

Existing databases (including NTG databases) and reports listing critically endangered, endangered and vulnerable flora and fauna species recorded in the surrounding areas were reviewed, and a search of the *EPBC Act 1999* protected matter databases for the East Point – Ludmilla Creek Area was undertaken (SEWPAC, 2011). A copy of the NT Government Data / NT NRM Snapshot East Point Darwin, 2011 and the East Point – Ludmilla Creek EPBC Protected Matters Report, 2011 are attached in **Appendix J, NT NRM Snapshot June 2011** and **Appendix K, EPBC Protected Matters Report**, respectively.

Field assessments

Boundaries of the Proposed Development corridor were identified from maps, diagrams, aerial photographs and flagged boundaries on-site. Specific locations along the Proposed Development corridor were acquired with a Global Positioning System (GPS) and aerial photo interpretation (API) was used to determine sites that covered recognisable terrestrial vegetation assemblages, regrowth and disturbed areas. The information obtained was then ground-truthed in the field.

The assessment targeted species that potentially occur in the vicinity of the Proposed Development corridor, including:

- Flora and fauna species identified in a review of previous ecological studies undertaken in the East Point / Darwin area and other data sources
- Species listed in threatened categories under Commonwealth and NT legislation
- Migratory / marine bird species listed under Commonwealth legislation.

Flora assessment methodology

As described above the terrestrial vegetation within the Proposed Development corridor and surrounding area predominantly consists of:

- Disturbed areas bordering managed urban parkland
- Regrowth patches of Mixed Species Open Woodland and Monsoon Vine Forest (both planted and natural)
- Mangrove Forest.

The field assessment targeted areas identified from mapping as remnant bushland, significant vegetation types and known habitat for scheduled species. As the vegetation in the study area is dominated by disturbed and managed urban parkland areas and patches of regrowth vegetation, a 'check-site' method, as described by Brocklehurst *et al.* (2007), was utilised to determine whether vegetation at specific sites satisfied established criteria to qualify as specific vegetation communities. The location of all assessment and check sites is shown in **Figure 4-1**.

The assessment of plant communities involved reviewing:

- Historical data, aerial imagery and reports (Franklin *et al.*, 2010).
- Existing mapping data (Brocklehurst *et al.*; National Vegetation Information System [NVIS]).
- Surveys to describe the terrestrial flora and fauna of the site.

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Assessment sites were established within all vegetation units and at additional sites where vegetation patterns on aerial photos varied.

Check sites were used to ground-truth mapping data where appropriate. The methodology for check sites is described in the *Northern Territory Guidelines and Field Methodology for Vegetation Survey and Mapping* (Brocklehurst *et al.*, 2007). Check sites are less detailed and used to characterise vegetation once a sufficient number of full characterisation sites have been recorded for a particular vegetation community. A basal sweep was undertaken to determine species dominance. Cover and height values are estimated or measured for two to three dominant species in either the dominant or all strata/sub strata. Location information was also recorded. It is noted that check sites can also be used to validate mapping prior to full characterisation site sampling.

The conservation status of each species was recorded for reporting. Taxonomic classification was undertaken according to the Mabberley Classification system (Mabberley, 2008), recently adopted by the NT Herbarium.

An inventory of declared weed species for each survey site was recorded.

Fauna assessment methodology

A dry season assessment of the fauna species was limited to general observational (birds and mammals) surveys conducted at various times (dawn, throughout the day and evening searches) utilising binoculars and spotlighting, and subsequent identification.

Counts of shore birds were focussed on a broader area to provide an assessment of adjacent terrestrial and mangrove habitats. Shorebird counts were conducted at dawn and dusk over a seven day period at the proposed ocean outfall site (see site 32 along the proposed ERM). The survey method was designed to provide general avian information including presence and distribution data.

Diurnal and nocturnal birds, wetland and riparian birds and shorebirds were targeted during the assessments. EPBC listed migratory bird species were also targeted.

Observations of feral animals during the field survey were recorded and descriptions of any signs of impact to site conditions were also recorded.

Data collation and reporting

Once all fauna identifications and data entry were completed, species lists were compiled and fauna and vegetation communities / habitats were identified / verified against existing data and described.

Assessment limitations

Some flora species were not identified to species level due to the timing of the assessments (i.e. no fruit or flowers present or deciduous species without any leaves, flowers or fruit present). However it is considered that these individuals represented very few species and did not impact on the ability to describe the plant communities.

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The initial fauna assessment was limited to dry season observational records and literature review. Assessments did not include the Coastal Rocky Reef / Headland Community at the western most end of the Proposed Development corridor.

As the migratory bird counts were undertaken in May, most migratory birds were not present. This is discussed further below in relation to the Expert Review. Wader counts were undertaken when most northern hemisphere migrants are not present in the Darwin Region (Pers. comm. Paul Barden, EMS, January 2012). Subsequent to preparation of the draft PER (PWC, 2011a), data has been obtained for the area from the Shorebirds 2020 Group (2011). Preliminary analysis of this data has been included in this Supplement and has been documented in more detail in **Section 4.5, Comment 21 (NRETAS)**.

Mangrove communities in the tidal reaches of the Proposed Development corridor were not investigated as part of the survey to advise this review. Mangrove Forests that occur along the Proposed Development corridor were 'checked', and broad information is included on these communities based on Brocklehurst and Edmeades (1996).

Specific searches and trapping for terrestrial vertebrates other than mammals and birds were not conducted as part of the assessment, due to lack of significant habitat identified during the field survey. Reptilian species recorded were only those observed.

Expert Review

In response to the comments regarding consultation with recognised experts, the methodologies above were reviewed by and discussed with Fauna Specialist, Paul Barden, Ecological Management Services (EMS). On review it was noted that the methodology used is similar to what would be considered appropriate for a rapid assessment for such a project, rather than a full EIS-style survey with trapping and other methods. Other matters arising from the expert review and subsequent discussions are included below:

- **Targeted surveys:** Specific targeted surveys of migratory and marine species should be undertaken in the appropriate season, as this appears to be the most significant fauna issue at the site. Wader surveys were undertaken when most northern hemisphere migrants are potentially not present in the Darwin Region. As noted in the Survey Limitations discussion above, most migratory birds would not have been present in May.

There are limitations in comparing data obtained for the Darwin Harbour area, particularly in relation to migratory birds, as the habitats of the Darwin Harbour are different from those along the northern Darwin Coastline. It would be more relevant to provide a review of the northern Darwin Shorebirds 2020 (2011) data, which includes surveys conducted between February 1984 and October 2011 of known migratory bird habitats in the Darwin Region. In response, preliminary analysis of the data contained in the Shorebirds 2020 (2011) Database has been included in this Supplement (refer **Section 4.5, Comment 21 (NRETAS)**).

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- **Preferred timing for works:** Works should be avoided during the southern hemisphere summer. It is noted in Section 7.3.1 of the draft PER (PWC, 2011a) that it is proposed that significant works in the vicinity of areas where migratory shorebirds are known to occur will be undertaken in the dry season when most northern hemisphere migrants are absent (i.e. May – August). It is noted that the period of disturbance associated with construction activities will be limited in duration.

As described in response to **Section 8.17, Comment 87 (NRETAS)**, impacts on migratory birds will be reduced if works are undertaken at this time. It is noted that some juveniles and adult migratory shorebirds may remain over this time, and some birds that are in poor condition may return to the northern Australian coastline without completing the full migration. There are also likely to be non-migratory (marine) birds present at the site during this period. .

- **Sediment disturbance and deposition impacts:** The potential for sediment disturbance and deposition impacts on feeding substrates need to be assessed and managed. It is noted that in Section 7.3.1 of the draft PER (PWC, 2011a), strict controls on sedimentation or other impacts that may impact shorebird feeding sites are proposed in order to limit areas of disturbance and impacts on existing habitats.

As described in response to **Section 8.17, Comment 87 (NRETAS)** operational measures will be put in place to control sediment and other discharges that may impact shorebird foraging areas adjacent to the project area. An Erosion, Sedimentation and Drainage Management Plan (ESDMP) will be prepared for the Proposed Development in accordance with the *PWC Land Management Procedure* (2008). Please refer to the draft outline of the ESDMP in **Section 7.2, Comment 45 (NRETAS)**.

- **Population counts:** The comments about populations of migratory shorebirds need to be revised with reference to the long term Shorebird 2020 (2011) count data. Single count (time period) totals for particular species should be reviewed to:
 - Assess whether they trigger any thresholds identified in the *EPBC Act policy statement 3.21* (Significant Impact Guidelines for 36 Migratory Shorebird Species) criteria for nationally significant migratory shorebirds habitats (DEHWA, 2009a)
 - Provide an indication of aggregated roosting bird numbers in the local area.

It is noted that the preliminary analysis of the data contained in the Shorebirds 2020 (2011) database in response to **Section 4.5, Comment 21 (NRETAS)** indicated that the known count sites in surrounding areas, although not internationally important, meet criteria for national significance. Further information on this can be found in response to **Section 4.5, Comment 21 (NRETAS)**.

- This species is identified as potentially occurring in local habitats **Table 4-6** in response to **Section 4.5, Comment 21 (NRETAS)**. As stated above, assessments of Mangrove Forests that occur along the Proposed Development corridor were limited to 'checks' and broad information is included on these communities based on Brocklehurst and Edmeades (1996). It is noted that as discussed in **Section 4.3, Comment 7 (NRETAS)** the area of impact on Mangrove Forest will be limited to the edge of this vegetation community.

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The *Northern Territory Land Clearing Guidelines* (NRETAS, 2010b) state that applications to clear in coastal areas, or in areas subject to tidal influence (e.g. floodplain systems associated with tidal rivers and creeks, Coastal Monsoon Vine Thickets and Mangroves), must be supported by additional information, such as:

- Potential, or expected, impacts of the land clearing on sensitive or fragile coastal landscapes and the Steps taken to reduce and manage risks.

It is proposed that disturbance will be limited to the construction phase and the areas of disturbance will be managed as per *PWCs Land Management Procedure* (see Appendix J, Power and Water Land Management Procedure [PWC, 2011a]). Areas that are disturbed during construction activities, will be progressively rehabilitated, with suitable species, with due consideration of the requirements of fauna species that will potentially recolonise these areas.

Prior to construction PWC or its contractor will undertake a walk over of the Proposed Development alignment prior to clearing to inspect for fauna and nesting areas. A specified environmental representative from the construction contractor will be on site during construction for daily visual inspections. If fauna is found, the NT Parks and Wildlife will be informed to relocate the fauna. The aforementioned specifically relates to those species identified **Table 4-6** in **Section 4.5.2, Terrestrial Ecology**.

It is noted that the Water Mouse (*Xeromys myoides*) appears on the EPBC data search and although it is unlikely to occur at the site, the mangroves along Ludmilla Creek have been mapped as potential habitat (DEWHA, 2009b). It is also noted that the area of suitable habitat intersected by the project footprint appears extremely limited.

4.4.3 Consulting Experts

The various technical experts were consulted in the development of the draft PER (PWC, 2011a) and the Supplement, including:

- Carol Palmer, Scientific Officer, NRETAS
- Ian Baxter, Senior Principal Marine Environmental Scientist, URS
- Julie Carpenter, Principal Environmental Scientist, URS
- Maria van der Geest, Senior Consultant – Ecology, URS
- Paul Bardon, Ecologist, Ecological Management Services
- Peter Collins, Senior Consultant Marine Ecologist
- Tony Griffiths, Director Marine Biodiversity, NRETAS.

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4.5 Comment 21 (NRETAS)

Many EPBC listed threatened and migratory species found in the field surveys are not described any further. Maps were not provided for where EPBC listed threatened and migratory species were found.

How this guideline could be met:

- Describe the EPBC listed threatened and migratory species found in the area, especially those found through the field surveys or identified as likely to be found by recognised experts.
- It would also be useful to describe the species, especially marine; species identified on the EPBC Database Search as “Known to occur”, “Breeding known to occur” or “Roosting known to occur”.

Include maps of where EPBC listed species are found.

4.5.1 Marine Ecology

This following should be read with **Section 6.9, Comment 84 (NRETAS)**, which provides additional information on Marine Communities of Darwin Harbour, the Proposed Development area, potential impacts and bioaccumulation. An EPBC protected matters database search (**Appendix K, EPBC Protected Matters Report June 2011**) along the proposed development corridor (including a 1 km buffer) identified 12 threatened and vulnerable marine species which have the potential to be impacted upon by the proposed works (**Table 4-4**). They comprise two marine mammals, six marine reptiles and four species of cartilaginous fish listed as migratory species; and three species of sawfish, which are also listed as vulnerable under the *TPWC Act*. Other marine species that fall under less critical conservation categories such as listed cetaceans, migratory species or near threatened species, which are listed as potentially occurring in Darwin Harbour, are presented in **Table 4-5**.

Table 4-4 Threatened Marine Species that may be present within Darwin Harbour

Scientific name	Common name	EPBC Act	TPWC Act	IUCN	Bonn Convention	CITES
Cetaceans: Whales						
<i>Balanoptera musculus</i>	Blue whale	E (M)	-	E	I	I
<i>Megaptera novaeangliae</i>	Humpback whale	V (M)	-	LC	I	I
Reptiles						
<i>Caretta caretta</i>	Loggerhead turtle	E (M)	E	E	I	I
<i>Chelonia mydas</i>	Green turtle	V (M)	-	E	I	I
<i>Dermochelys coriacea</i>	Leatherback turtle	E (M)	V	CE	I	I
<i>Eretmochelys imbricata</i>	Hawksbill turtle	V (M)	-	CE	I	I
<i>Lepidochelys olivacea</i>	Pacific ridley turtle	E (M)*	-	V	I	I
<i>Natator depressus</i>	Flatback turtle	V (M)*	-	DD	-	I
Cartilaginous Fish: Sharks						
<i>Pristis clavata</i>	Dwarf sawfish	V	V	CE	-	-
<i>Pristis microdon</i>	Freshwater sawfish	V	V	CE	-	II
<i>Pristis zijsron</i>	Green sawfish	V	V	CE	-	-
<i>Rhincodon typus</i>	Whale shark	V (M)	-	V	II	II

M: Migratory under EPBC Act, V: Vulnerable, E: Endangered, LC: Least Concern, CE: Critically Endangered, DD: data deficient, -: not listed, I: listed under appendix I, II: Listed under Appendix II. * Breeding known to occur within area according to EPBC threatened species list.

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Table 4-5 Potential other Migratory and Listed Marine Mammals and Marine Reptile Species

Scientific name	Common name	EPBC Act	IUCN Red List	Bonn Convention	TPWC Act (NT)
Cetaceans					
<i>Balaenoptera edeni</i>	Bryde's whale	Migratory	DD	II	-
<i>Delphinus delphis</i>	Common dolphin	Listed	LC	-	-
<i>Grampus griseus</i>	Risso's dolphin	Listed	LC	-	-
<i>Orcaella brevirostris</i> *	Irrawaddy dolphin	Migratory	V	I	-
<i>Orcinus orca</i>	Killer whale	Migratory	DD	II	-
<i>Sousa chinensis</i>	Indo-Pacific humpback dolphin	Migratory	NT	II	-
<i>Stenella attenuata</i>	Spotted dolphin	Listed	LC	-	-
<i>Tursiops aduncus</i>	Spotted bottlenose dolphin	Migratory	DD	II	-
<i>Tursiops truncatus s. str.</i>	Bottlenose dolphin	Listed	LC	-	-
Sirenians					
<i>Dugong dugon</i>	Dugong	Migratory	V	-	-
Reptile					
<i>Crocodylus porosus</i>	Saltwater crocodile	Migratory	LC	II	-

*: *Orcaella heinsohni* (Australian snubfin dolphin)

Whales

Humpback whales migrate to northern Australia from June to August but rarely venture as far northeast as Darwin Harbour. Bryde's whales and killer whales are not known to occur within Darwin Harbour, though the false killer whale (*Pseudorca crassidensis*) was opportunistically sighted four times south of Larrakeyah (Darwin Harbour) during dolphin surveys conducted between March 2008 and February 2010 (Palmer, 2010). The latter species is not EPBC listed, though all cetaceans in Australian waters are protected under the *EPBC Act*.

Whale species within Darwin Harbour and the surrounding area are unlikely to be impacted upon by the proposed development as the vast majority of the works will be located outside of the marine environment. Minor clearing and works will be conducted within mangrove forests. However, these works will only require the removal of approximately 0.056ha mangroves, which accounts for about 0.05% of the total area of mangrove forests within the surrounding community.

Water quality, Acid Sulfate Soils (ASS), erosion and sediment both during and post construction will be mitigated via approved management plans. These management plans are a contractual obligation and must be approved by PWC prior to the start of the works.

Dolphins

The following three species of coastal dolphins are regularly recorded throughout Darwin Harbour:

- Australian snubfin (*Orcaella heinsohni*)
- Indo-Pacific humpback (*Sousa chinensis*)
- Indo-Pacific bottlenose (*Tursiops aduncus*).

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Recent studies indicate that these three species of dolphins appear to have resident groups in Darwin Harbour. Breeding and the raising of calves is also known to occur within the Harbour (Palmer, 2010). The Australian snubfin dolphin is a newly described species and refers to the North Eastern Australian populations of the Irrawaddy dolphin (*Orcaella brevirostris*) listed under the *EPBC Act*.

Surveys conducted between 2008 and 2010 found these species occur throughout the Harbour. However, the Indo-Pacific bottlenose and Australian snubfin are most abundant in the north and northwest of the Harbour. The most commonly sighted dolphin was the humpback (354 records) followed by the bottlenose (252) and the snubfin (33) (Palmer 2010). Average school sizes for both the Indo-Pacific humpback and snubfin was three individuals. Bottlenose dolphins had an average school size of six and occurred in water ranging from 0.7 m to 25 m in depth (Palmer, 2010).

Additional surveys conducted between January and March 2011 in the south-east of the Project area (Middle Arm and West Arm of Darwin Harbour) identified all three dolphin species (INPEX, 2011b).

The following dolphin species are also listed under the EPBC Act and may occur within Darwin Harbour (please refer **Table 4-5**):

- Common dolphin (*Delphinus delphis*);
- Risso's dolphin (*Grampus griseus*); and
- Spotted dolphin (*Stenella attenuate*).

Dugongs

Small numbers of dugongs are known to occur within Darwin Harbour. However, the vast majority of the NT dugong population is located in the Gulf of Carpentaria and to the northwest of the Tiwi Islands (Bayliss, 1986; Bayliss and Freeland 1989). Dugongs have previously been sighted feeding on seagrass meadows located adjacent to Mandorah, Casuarina Beach and Fannie Bay (Acer Vaughan, 1993). Darwin Harbour dugongs are also known to feed on macroalgae and have been observed to forage at Channel Island in Middle Arm (Whiting, 2002).

Recent dugong sightings have been recorded opportunistically during dolphin surveys conducted in Darwin Harbour between February 2008 and March 2010. Sightings have also occurred in Fannie Bay, Mandorah, Lee Point and near Stuart Park (Palmer, 2010). The report does not specify the numbers of individuals observed in each sighting.

No suitable dugong foraging habitat has been recorded in the immediate vicinity of the proposed development or the existing EPO. Recent habitat mapping within Darwin Harbour recorded potential dugong habitat as being areas of seagrass (2 520 ha) and mixed community reef (247 ha) that would likely have macroalgae present (INPEX, 2011a).

It is unlikely the works will impact sea grass meadows as the majority of the known seagrass habitat is located north of the Project between Nightcliff and Lee Point, and to the south of the Project area in Fannie Bay (**Figure 4-3**) (adapted from INPEX, 2011a). Data from NRETAS (provided on 16 January 2012) depicted minor

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extensions of the seagrass area between East Point and Nightcliff that was mapped by INPEX (2011a).

Mixed reef habitat is located around East Point (GHD, 2009), but the largest areas in the harbour extends deep into West Arm, and Middle Arm, across the entrance to East Arm and surrounds Old Man Rock (off Casuarina Beach) (please refer **Figure 4-3**, adapted from INPEX, 2011a).

The proposed development will require minor works within mangrove forests along the coastal margin, therefore it is unlikely the works will impact sea grass meadows within close proximity of the proposed works. Potential impacts caused by water quality, erosion and sediment will be controlled both during and post construction by individual management plans which are a contractual requirement and must be submitted to PWC for approval prior to the start of the works.

Sea Turtles

Three species of marine turtles use Darwin Harbour regularly: the green turtle (*Chelonia mydas*), flatback turtle (*Natator depressus*) and the hawksbill turtle (*Eretmochelys imbricata*). The loggerhead turtle (*Caretta caretta*) and the Pacific Ridley turtle (*Lepidochelys olivacea*) are suspected to be infrequent users. The leatherback turtle (*Dermochelys coriacea*) is considered to be an oceanic species and is unlikely to occur in Darwin Harbour (Whiting, 2002).

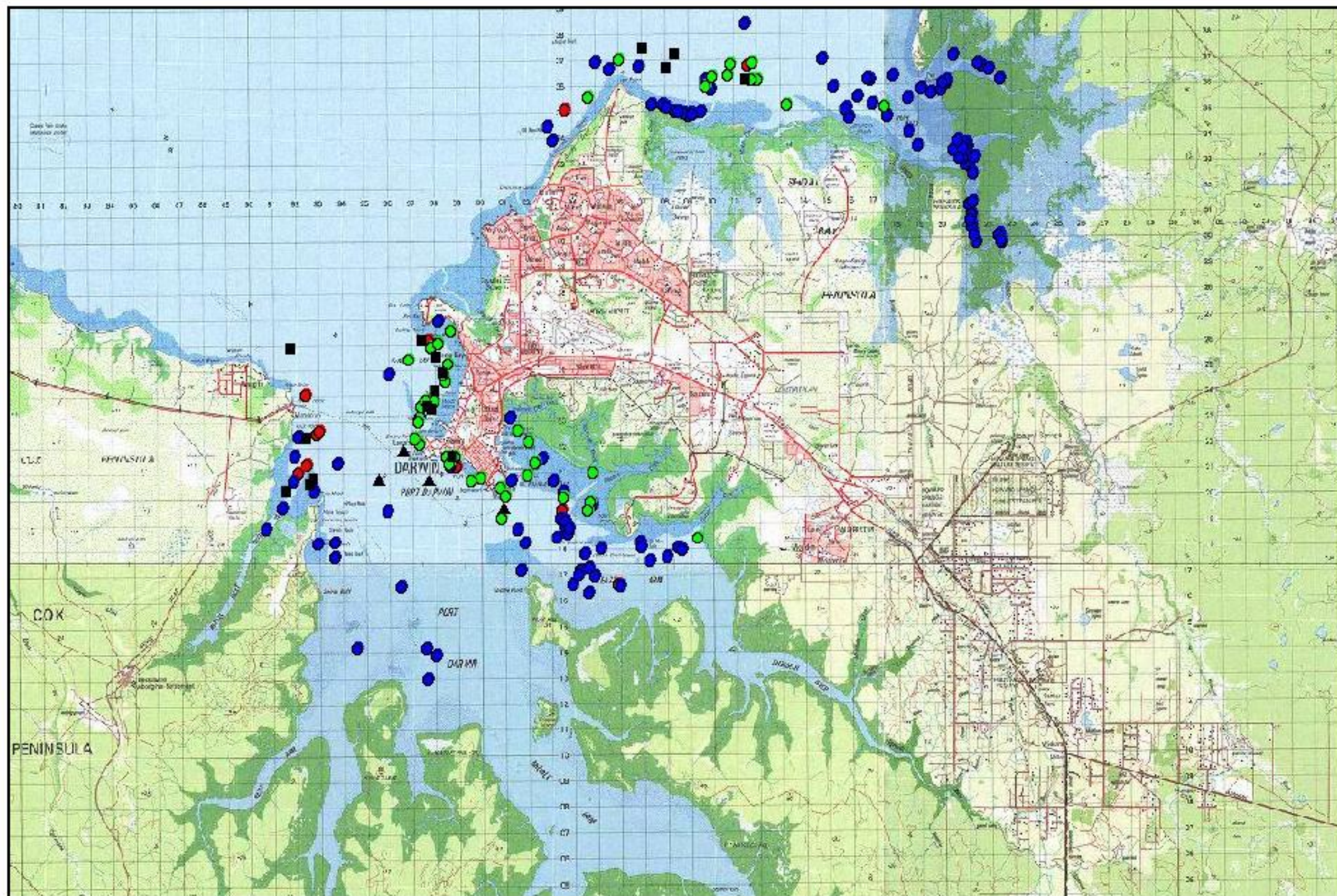
Nesting beaches for sea turtles are mostly concentrated from the western end of Melville Island to near the Queensland border (Chatto, 1998). There are no nesting beaches for sea turtles in the vicinity of the existing EPO or in most of Darwin Harbour, as mangroves and mudflats do not provide suitable nesting grounds (DLP, 2011), so turtles in the Harbour are more likely to be foraging. The nearest nesting beach is used by the flatback turtle and is located in the Casuarina Coastal Reserve 6 to 7 km north of the Harbour.

Potential turtle foraging habitats have been mapped for Darwin Harbour (INPEX, 2011). Flatback and hawksbill turtles forage on the filter feeder communities which are extensive in Darwin Harbour (estimated to cover 7,912 ha). The hawksbill turtle also forages on seagrass (an estimated 2,520 ha in Darwin Harbour) and macroalgal communities (estimated 247 ha) in addition to filter feeders. Green turtles forage amongst seagrass, macroalgal and fringing mangrove communities (estimated 1,743 ha). Whilst incidental observations of green turtles have been made within the East Point Aquatic Life Reserve (GHD 2009), no suitable foraging habitats have been recorded in the immediate vicinity of the existing EPO.

Fish

Although they are listed on the EPBC protected matters database as potential inhabitants, there are no records in the MAGNT database of dwarf sawfish (*Pristis clavata*), freshwater sawfish (*Pristis microdon*) and green sawfish (*Pristis zijsron*) occurring in Darwin Harbour. From this it can be inferred that the majority of Darwin Harbour does not represent favoured sawfish habitat. The whale shark (*Rhincodon typus*) is a highly migratory species that principally frequents Ningaloo Reef and the Coral Sea in Western Australia; it is not known to occur within Darwin Harbour.

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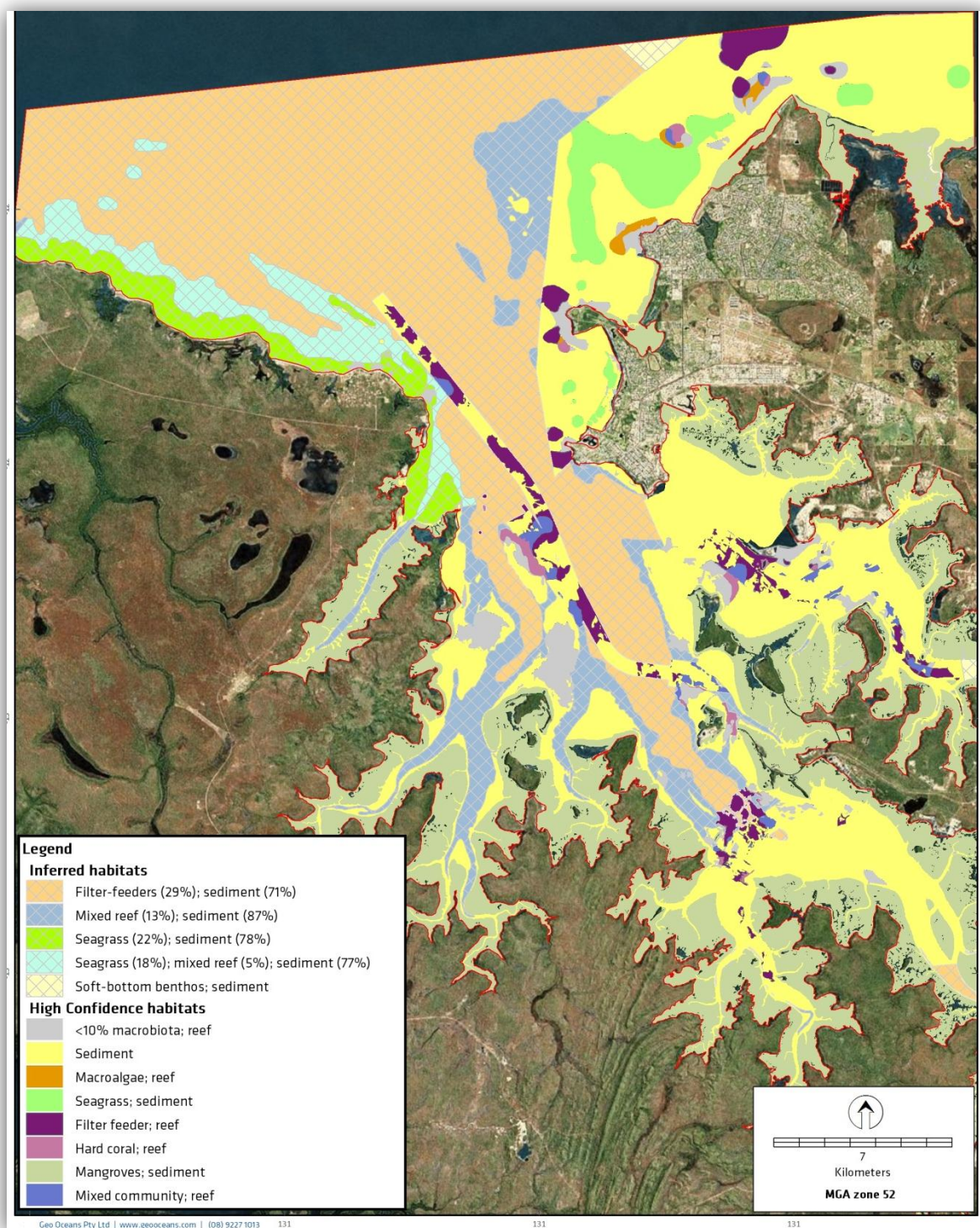


Source: Palmer, 2010

Note: Blue Circles = Sousa, Red Circles = Orcaella, Green Circles = Tursiops, Black Square = Dugong, Black Triangle = False Killer Whale.

Figure 4-3 All Observation (Transect and Opportunistic Sightings) of Marine Mammals in Darwin Harbour (March 2007 to February 2010)

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Source: INPEX, 2011a

Figure 4-4 Benthic Habitat Distribution Map of Darwin Harbour

4 Existing Environment

4.5.2 Terrestrial Ecology

Assessments of the presence and likely occurrence of EPBC listed threatened and migratory species used to advise the production of the draft PER (PWC, 2011a) were obtained through:

- An initial field assessment
- A review of the EPBC Protected Matters database and the NT Government databases via an NT NRM Snapshot report).
- A review of known habitat preferences and existing data which include:
 - Aerial imagery.
 - Darwin coastal bioregional assessment (Baker *et al.*, 2005).
 - East Arm Wharf Precinct Environmental Impact Statement (Acer Vaughn, 1993).
 - Existing mapping data (Brocklehurst *et al.*, 1996).
 - History of the East Point monsoon forest (Franklin *et al.*, 2010).
 - Online zoological collections of Australian Museums (OZCAM) records.

Subsequent to preparing the PER migratory shorebird count data has been obtained from the Shorebirds 2020 Subgroup of Birdlife Australia (2011) for surveys conducted between February 1984 and October 2011 of known migratory bird habitats in the Darwin Region.

A number of listed species were found to potentially occur or are known to occur in the area. Particular reference is drawn to the results of the review of the migratory Shorebird 2020 Subgroup data, which indicates that most north-western section of ERM will run through an area that meets the *EPBC Act policy statement 3.21 (Significant Impact Guidelines for 36 Migratory Shorebird Species)* criteria for nationally significant migratory shorebirds habitats. This data also indicates that other sites within the local area support nationally significant numbers of shorebirds.

It is also noted that as stated in the PER components of the East Point Reserve act as a refuge for local fauna populations such as the Agile Wallaby (*Macropus agilis*) and Rainbow Pitta (*Pitta iris*) within the greater landscape matrix (Franklin *et al.*, 2010). The conservation status of the Agile Wallaby (*Macropus agilis*) under Commonwealth and NT legislation is 'Least Concern', however it is noted that Darwin City Council (DCC) has been managing the Agile Wallaby population at East Point Reserve to ensure their long term conservation since 1989. The management program aims to maintain a viable population of Agile Wallabies at East Point by maintaining and enhancing the habitat, reducing threats to the population, monitoring the population and raising public awareness of the Agile Wallaby (DCC, 2011). Throughout the construction and rehabilitation phases of the project PWC will comply with the *East Point Reserve Agile Wallaby Management Plan* (DCC, 2012a) as well as other DCC plans such as the *East Point Reserve Management Plan* (DCC, 2012b) and the *Draft Weed Management Plan* (DCC, 2012c).

Full details of the initial field assessment, and the data and literature review findings in relation to EPBC listed threatened and migratory species is included below. As noted in **Section 4.3, Comment 7 (NRETAS)** the impact on these species will be minimal for the following reasons:

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- The proposed ERM corridor (10 m in width) will result in clearing of approximately 3 ha, of which 2.54 ha (85%) is classified as disturbed and urban areas with regrowth (see **Table 4-2** under **Section 4.4.2, Terrestrial Ecology**)
- The route of the duplicate ERM corridor will primarily follow the route of the existing ERM corridor, shown in Figure 2-2 and Appendix C of the draft PER (PWC, 2011a)
- Diversions to this route have been made, where practical to redirect the pipeline through disturbed urban parkland (Community 5) to further reduce impacts on:
 - Coastal Monsoon Vine Forest Communities (Community 1)
 - Low to Mid, Mixed Species Closed Forest to Open Forest (Community 2)
 - Low to Mid, Mixed Species Open Woodland (Community 3).

It is considered that these impacts can be effectively managed by PWC through the application of management measures, including:

- Disturbance to these areas will be limited to the construction phase and the areas of disturbance will be managed as per *PWC's Land Management Procedure* (see Appendix J, Power and Water Land Management Procedure [PWC, 2011a])
- Areas that are disturbed during construction activities will be progressively rehabilitated.
- Ground disturbance and potential impacts on adjacent areas of mangrove and tidal habitats, particularly areas where migratory birds and marine birds forage and roost will be kept to a minimum
- Significant construction works in the vicinity of this area will be undertaken in the dry season when most northern hemisphere migrants are absent (May – August).

Proposed management and mitigation measures are discussed further in **Section 8.17, Comment 87 (NRETAS)**.

Field Observations

No listed flora were observed during the initial field assessments along the route of the proposed ERM duplication, however two sensitive / significant vegetation types according to the *Northern Territory Land Clearing Guidelines* (NRETAS, 2010b) were identified; the Monsoon Vine Forest and the Mangrove Forest communities.

The fauna assessment recorded two listed terrestrial fauna species:

- Yellow-spotted Monitor - *Varanus panoptes* - Vulnerable *TPWC Act 2000*
- Bush Stone-curlew - *Burhinus grallarius* – Near Threatened *TPWC Act 2000*

Marine and wetland bird species were also recorded during the fauna assessment, which included bird counts conducted at dawn and dusk over a seven day period at the proposed ocean outfall site (see site 32 along the proposed ERM). This area is a rocky reef consisting of small rock pools at low tide and is inundated at high tide. Shore-line mangroves (*Rhizophora stylosa*) occur within the vicinity of the ocean outfall (approximately 100 m distant). Other coastal habitats that occur within the vicinity of the proposed ocean outfall site are sandy beach and small vegetated dune systems.

4 Existing Environment

The *EPBC Act 1999* listed species recorded during field observations included the following listed migratory wetland and marine species Common Greenshank (*Tringa nebularia*), Marsh Sandpiper (*Tringa stagnatilis*), Rainbow Bee-eater (*Merops ornatus*), Fork Tailed Swift (*Apus pacificus*), Brahminy Kite (*Haliastur indus*), Spangled Drongo (*Dicrurus bracteatus*), Forest Kingfisher (*Todiramphus macleayii*), Whistling Kite (*Haliastur sphenurus*), Beach Stone-curlew (*Esacus neglectus*), Tree Martin (*Hirundo nigricans*) and Common Tern (*Sterna hirundo*).

Erratum to the draft PER (PWC, 2011a), Appendix F-6: The following paragraph was incorrectly reported in Section 'Table Appendix F-6 Fauna species recorded in the Proposed Development corridor area' in Appendix F of the draft PER (PWC, 2011a).

'The recorded species listed migratory wetland and marine species Common Greenshank (Tringa nubularia), Beach Stone-Curlew and the Rainbow Bee-eater. Other non-listed species recorded included Brahminy Kite (Haliastur indus), Eastern Reef Egret (Egretta sacra), Striated Heron (Butorides striatus) and Common Tern (Sterna hirundo).'

As a result of this review it is also noted that the following species were also recorded in working field notes:

- Marsh Sandpiper (*Tringa stagnatilis*)
- Tree Martin (*Hirundo nigricans*).

Field data and relevant sections of the PER have been reviewed and the text in the paragraph directly above this correction should be submitted in its place.

It is noted that due to the nature of the proposal the field work undertaken to support these assessments was designed to provide an initial rapid assessment and based on observations only and was not intended to be interpreted as a full flora and fauna survey (refer **Section 4.4, Comment 20 [NRETAS]**). Where information could not be verified from field notes it has been included above for completeness. Review of this data by Paul Barden, Migratory Bird Specialist and Ecologist, from EMS (pers. Comm. January 2011), indicated that none of the above species observed were unusual and all species documented are likely or known to occur in the East Point area.

Listed fauna species recorded during the initial flora and fauna assessments along the proposed ERM duplication corridor and their corresponding listings are shown in **Table 4-6**. Note: No listed flora species were identified.

4 Existing Environment

Table 4-6 Listed Fauna Species Recorded during Flora and Fauna Observations along the Proposed ERM Duplication Corridor

Common Name	Scientific Name	EPBC Act 1999	TPWC Act 2000
Yellow-spotted Monitor	<i>Varanus panoptes</i>		Vulnerable
Bush Stone-curlew	<i>Burhinus grallarius</i>		Near Threatened
Common Greenshank	<i>Tringa nebularia</i>	Migratory / Marine	
Marsh Sandpiper	<i>Tringa stagnatilis</i>	Migratory / Marine	
Fork Tailed Swift	<i>Apus pacificus</i>	Marine / Migratory	
Common Tern	<i>Sterna hirundo</i>	Migratory / Marine	
Rainbow Bee-eater	<i>Merops ornatus</i>	Migratory	
Tree Martin	<i>Hirundo nigricans</i>	Marine	
Brahminy Kite	<i>Haliastur indus</i>	Marine	
Spangled Drongo	<i>Dicrurus bracteatus</i>	Marine	
Forest Kingfisher	<i>Todiramphus macleayii</i>	Marine	
Whistling Kite	<i>Haliastur sphenurus</i>	Marine	
Beach Stone-curlew	<i>Esacus neglectus</i>	Marine	

Existing Data for East Point and Surrounding Area

Existing databases and reports listing critically endangered, endangered and vulnerable flora and fauna species recorded for East Point and surrounding areas were reviewed. A copy of the NT Government Data / NT NRM Snapshot East Point Darwin, 2011 and the East Point – Ludmilla Creek EPBC Protected Matters Report, 2011, which were produced as part of the existing data review are attached in **Appendix J, NT NRM Snapshot June 2011** and **Appendix K, EPBC Protected Matters Report**, respectively.

The search of the Northern Territory Government (NTG) databases (**Appendix J, NT NRM Snapshot June 2011**) for the area lists fifteen threatened terrestrial / freshwater species that may occur or have been recorded in the area (**Appendix J, NT NRM Snapshot June 2011**).

The search of the *EPBC Act 1999* protected matter databases (June 2011) for the East Point – Ludmilla Creek area (**Appendix K, EPBC Protected Matters Report**) identified eight threatened terrestrial / freshwater species that may occur or have been recorded in the area (pages 3-4, **Appendix K, EPBC Protected Matters Report**). In addition, the *EPBC Act 1999* Protected Matters Report (June 2011) lists 52 migratory species that are known to occur or potentially occur in the East Point area (**Appendix K, EPBC Protected Matters Report**, pages 9 - 11).

It is important to note that some of these records of threatened species are historical or are generated from data from the wider region. In addition to the listed species recorded in the initial assessment (**Table 4-6** above) and based on existing data and known habitat preferences, 9 threatened terrestrial fauna species have been recorded as occurring in local habitats and are listed in **Table 4-7**.

Not all species listed in the aforementioned tables may be encountered during construction of the Proposed Development. Accordingly a walk over of the proposed alignment will be conducted prior to clearing to inspect for fauna and nesting areas.

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A specified environmental representative from the construction contractor will be on site during construction for daily visual inspections. If fauna is found, the NT Parks and Wildlife will be informed to relocate the fauna.

Table 4-7 Listed Threatened Flora and Fauna Species Recorded in Surrounding Areas

Scientific / Common Name	EPBC Act 1999	TPWC Act 2000	Data Source	Habitat
<i>Cycas armstrongii</i>		V	1	Grassy Woodland on yellow and red earths, well drained sites
Merten's Water Monitor <i>Varanus mertensi</i>		V	1, 5	Swamp forest and riparian habitats
Atlas Moth <i>Attacus wardii</i>		E	1	Monsoon Vine Forests and riparian rainforest habitats
Masked Owl <i>Tyto novaehollandiae kimberli</i>	V	V	1, 3	Tall Open Forest, Monsoon Vine Forest
Northern Quoll <i>Dasyurus hallucatus</i>	E	CE	1, 2, 3, 4, 5	Open Forest and Woodlands
Northern Phascogale <i>Phascogale pirata</i>		V	1, 2, 3	Eucalypt Forest and Woodlands
Brush-tailed Rabbit-rat <i>Conilurus penicillatus</i>	V	V	2, 3	Open Forests and Woodlands
Bare-rumped Sheath-tailed Bat <i>Saccolaimus saccolaimus</i>	CE		1, 3	Tall Open Forest and Woodlands in the coastal lowlands
Water Mouse <i>Xeromys myoides</i>	V	DD	2, 3	Mangroves and adjacent vegetation, freshwater wetlands

Conservation Status: CE = Critically Endangered E = Endangered, V = Vulnerable, DD = Data Deficient

Data sources:

1 = NT Government Data/NT NRM Snapshot East Point Darwin, 2011

2 = East Point – Ludmilla Creek EPBC protected matters report, 2011

3 = Baker *et al.* (2005) Darwin Coastal Bioregional Assessment

4 = East Arm Wharf Precinct EIS (Acer Vaughn, 1993)

5 = Online Zoological Collections of Australian Museums (OZCAM) records

East Point Shorebird 2020 Data

Subsequent to preparing the PER migratory shorebird count data has been obtained from the Shorebirds 2020 Subgroup of Birdlife Australia (2011) for surveys conducted between February 1984 and October 2011 of known migratory bird habitats in the Darwin Region. This consisted of an extraction from the Shorebirds 2020 Database. Data for the East Point area was recorded under three categories:

- East Point A
- East Point B
- East Point – Entire Area
- Spot on Marine Claypan.

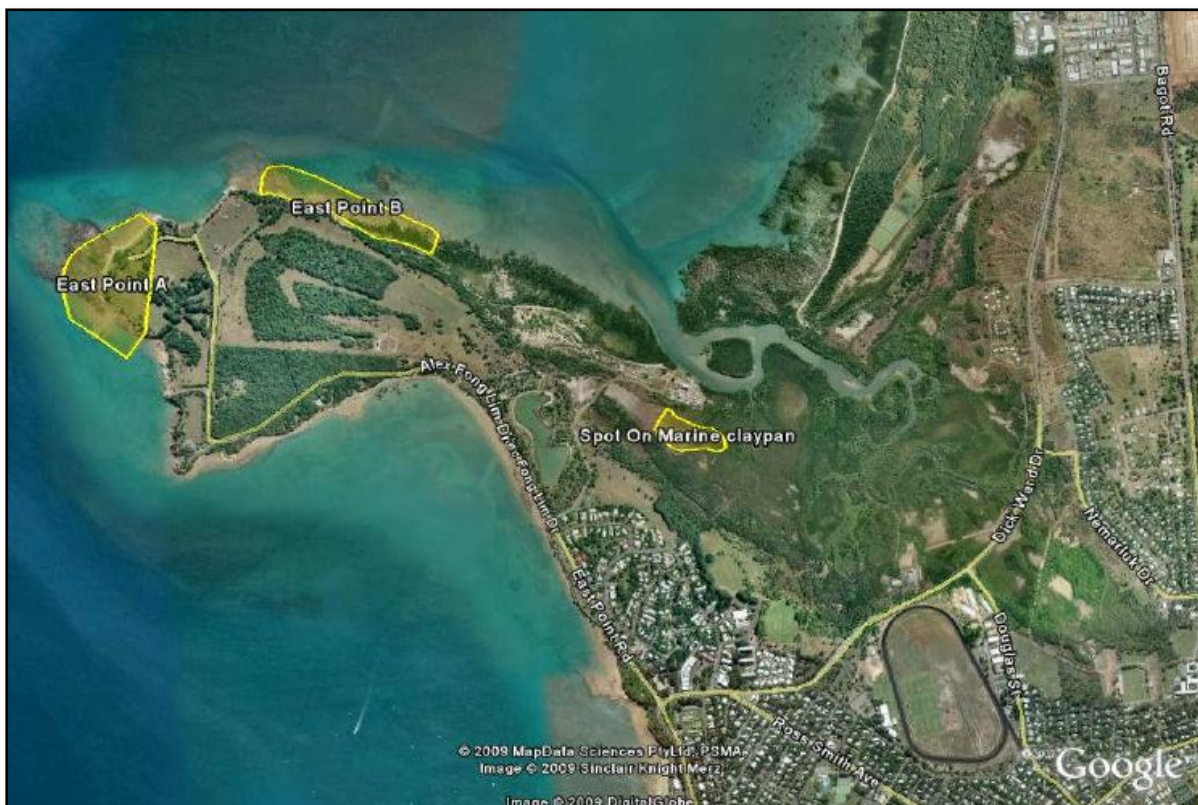
Note: East Point – Entire Area was recorded as a separate count by a separate observer for the entire area and is therefore a different dataset from the datasets for areas A and B.

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No information was obtained on survey methodologies or data verification, so no comments can be made on the validity of this data. It is considered that this dataset may represent the most comprehensive migratory bird dataset for the East Point area and hence a preliminary assessment of this data has been undertaken and included in this response.

Maps showing the location of known Shorebird 2020 observation sites at East Point and surrounding areas are contained in **Figure 4-6** and **Figure 4-7**. **Figure 4-5** shows the known roosting sites in the East Point area, these are labelled as East Point A, East Point B and Spot on Marine Claypan (hereafter referred to as Ludmilla Marine Claypan).

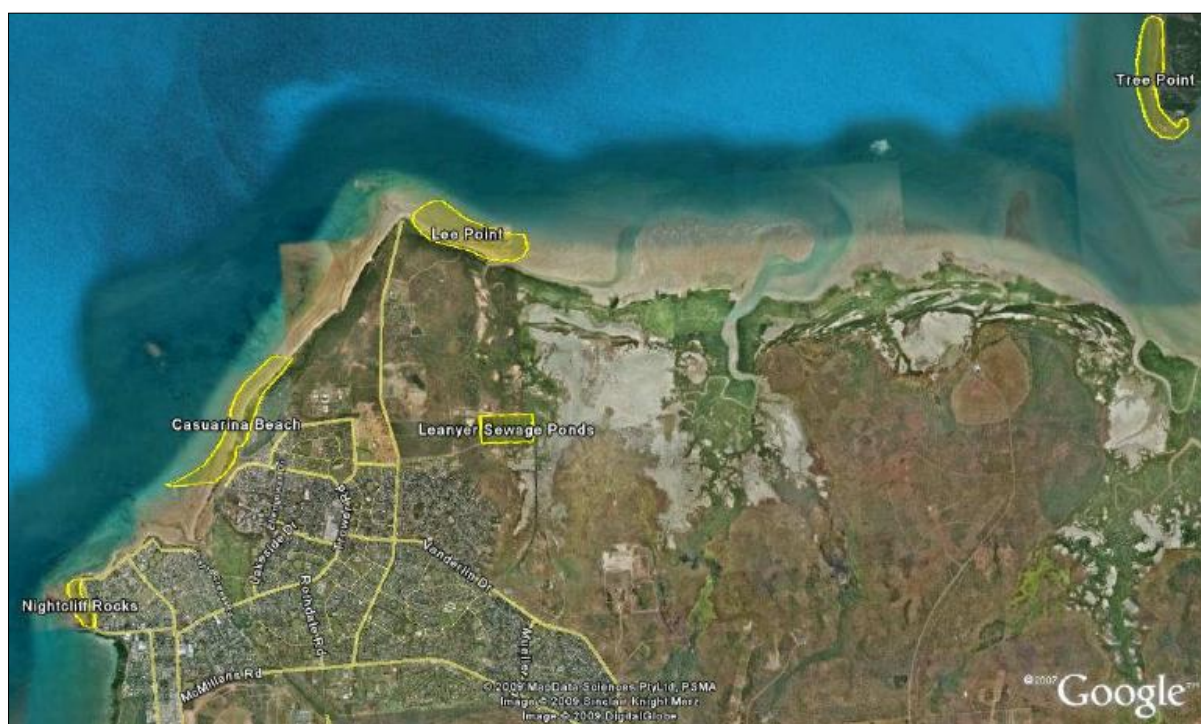
Figure 4-6 and **Figure 4-7** show other known roosting areas in North Darwin and Darwin Harbour. They include, Nightcliff Rocks, Casuarina Beach, Leanyer Sewerage Ponds, Lee Point, Tree Point and Darwin Harbour.



Source: Shorebirds 2020 Subgroup of Birdlife Australia

Figure 4-5 Identified Observation Sites in East Point Area

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Source: Shorebirds 2020 Subgroup of Birdlife Australia, 2011

Figure 4-6 Identified Observation Sites in North Darwin Area



Source: Shorebirds 2020 Subgroup of Birdlife Australia, 2011

Figure 4-7 Identified Observation Sites in Darwin Harbour Area

4 Existing Environment

Listed *EPBC Act 1999* migratory and marine species, as well as *TPWC Act 2000* listed species that were recorded in the Shorebirds 2020 Database for the East Point area and Ludmilla Marine Claypan are included in **Table 4-8**.

Table 4-8 EPBC Listed Migratory and Marine Species and TPWC Listed Species Recorded in the Shorebirds 2020 Dataset for the East Point Area and Ludmilla Marine Claypan

Common Name	Scientific Name	EPBC Act 1999	TPWC Act 2000
Australian White Ibis	<i>Threskiornis molucca</i>	x	
Bar-tailed Godwit	<i>Limosa lapponica</i>	x	
Beach Stone-curlew	<i>Esacus neglectus</i>	x	
Black-tailed Godwit	<i>Ephippiorhynchus asiaticus</i>	x	
Brown Booby	<i>Sula leucogaster</i>	x	
Bush Stone-curlew	<i>Burhinus grallarius</i>	x	x
Caspian Tern	<i>Hydroprogne caspia</i>	x	
Common Greenshank	<i>Tringa nebularia</i>	x	
Common Sandpiper	<i>Actitis hypoleucos</i>	x	
Common Tern	<i>Sterna hirundo</i>	x	
Crested Tern	<i>Thalasseus bergii</i>	x	
Eastern Curlew	<i>Numenius madagascariensis</i>	x	
Eastern Great Egret	<i>Egretta sacra</i>	x	
Eastern Osprey	<i>Pandion cristatus</i>	x	
Eastern Reef Egret	<i>Ardea modesta</i>	x	
Great Knot	<i>Calidris tenuirostris</i>	x	
Greater Sand Plover	<i>Charadrius leschenaultii</i>	x	
Grey Plover	<i>Pluvialis squatarola</i>	x	
Grey-tailed Tattler	<i>Tringa brevipes</i>	x	
Gull-billed Tern	<i>Gelochelidon nilotica</i>	x	
Lesser Sand Plover	<i>Charadrius mongolus</i>	x	
Little Egret	<i>Egretta garzetta</i>	x	
Little Tern	<i>Sternula albifrons</i>	x	
Pacific Golden Plover	<i>Pluvialis fulva</i>	x	
Radjah Shelduck	<i>Tadorna radjah</i>	x	
Red Knot	<i>Calidris tenuirostris</i>	x	
Red-capped Plover	<i>Charadrius ruficapillus</i>	x	
Red-necked Stint	<i>Calidris ruficollis</i>	x	
Ruddy Turnstone	<i>Arenaria interpres</i>	x	
Sacred Kingfisher	<i>Todiramphus sanctus</i>	x	
Sanderling	<i>Calidris alba</i>	x	
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	x	
Silver Gull	<i>Chroicocephalus novaehollan</i>	x	
Striated Heron	<i>Butorides striatus stagnatilis</i>	x	
Terek Sandpiper	<i>Xenus cinereus</i>	x	
Whimbrel	<i>Numenius phaeopus</i>	x	
Whiskered Tern	<i>Chlidonias hybrida</i>	x	
White-winged Black Tern	<i>Chlidonias leucopterus</i>	x	

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Comparisons of the count data contained in the data extraction from the Shorebirds 2020 Database with flyway population estimates (Bamford *et al.*, 2008 and Delany & Scott, 2006 in EMS 2011) for the species listed in the *EPBC Act policy statement 3.21 (Significant Impact Guidelines for 36 Migratory Shorebird Species)* (DEHWA, 2009a) are included in **Table 4-9** through **Table 4-12** for East Point A, East Point B, East Point – Entire Area and Ludmilla Marine Claypan, respectively. This data shows that the sites, although not internationally important, meet criteria for national significance.

The Ramsar Convention criteria state that a wetland should be considered internationally important if it (Bamford *et al.*, 2008):

- Regularly supports 20,000 or more
- Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

The analysis indicates that the data recorded in the dataset for East Point A, East Point B, East Point – Entire Area and the Ludmilla Marine Claypan site do not exceed the international criteria for supporting at least 1% of the flyway population of a single migratory shorebird species or regularly supporting more than 20,000 waterbirds.

A site is recognised as a significant staging site for a species if at least one migration period count is equal to or greater than 0.25% of the estimated flyway population size (Bamford *et al.* 2008, in EMS 2011). Based on a preliminary review of the Shorebirds 2020 Database data for counts undertaken in April (northern staging period), none of the migratory shorebird species present within the study area were present in significant numbers (0.25% of the flyway estimate or greater) during the East Asian – Australasian Flyway northern migration staging period.

EPBC Act policy statement 3.21 (Significant Impact Guidelines for 36 Migratory Shorebird Species) provides a set of criteria for determining the importance of habitat for migratory shorebirds in Australia (DEHWA, 2009a), which rates a site as important habitat if:

- The site is identified as internationally important under Ramsar.
- The site supports at least 0.1% of the flyway population of a single migratory shorebird species.
- At least 2000 migratory shorebirds.
- At least 15 shorebird species.

Comparisons of the in the Shorebirds 2020 Database count data for the East Point area and Ludmilla Marine Claypan with 0.1% flyway population estimates (Bamford *et al.* 2008 and Delany & Scott 2006 in EMS 2011) are included in **Table 4-9** through **Table 4-12**. These tables indicate which of the species recorded in the Shorebirds 2020 Database and listed in the *EPBC Act policy statement 3.21* exceed the 0.1% flyway population criteria. Species identified as exceeding the 0.1% flyway population at each site include:

- East Point A
 - Greater Sand Plover (*Charadrius leschenaultia*)

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- East Point B
 - Lesser Sand Plover (*Charadrius mongolus*)
 - Greater Sand Plover (*Charadrius leschenaultia*)
 - Whimbrel (*Numenius phaeopus*)
 - Grey-tailed Tattler (*Tringa brevipes*)
 - Great Knot (*Calidris tenuirostris*)
 - Ruddy Turnstone (*Arenaria interpres*)
- East Point – Entire Area
 - Greater Sand Plover (*Charadrius leschenaultia*)
 - Grey-tailed Tattler (*Tringa brevipes*)
- Ludmilla Marine Clay Pan
 - Lesser Sand Plover (*Charadrius mongolus*)
 - Greater Sand Plover (*Charadrius leschenaultia*)
 - Whimbrel (*Numenius phaeopus*)
 - Great Knot (*Calidris tenuirostris*).

Greater than 2,000 migratory shorebirds were recorded at Ludmilla Clay Pan on 18 January 2011 (a total of 2731, which included 2,370 Great Knots [*Calidris tenuirostris*]). A similar number was recorded at a separate count on the same day at the same location (a total of 2,210 which included 1,960 Great Knots [*Calidris tenuirostris*]).

East Point B, East Point- Entire Area and Ludmilla Marine Claypan were also found to meet the EPBC Act policy statement 3.21 national criteria in that:

- Fifteen of the listed shorebird species were recorded at East Point - Entire Area and Ludmilla Claypan
- Sixteen of the listed shorebirds were listed at East Point B
- Fourteen species were recorded at East Point A.

Management Implications

The proposed ERM Corridor runs through the most western section of the area marked as East Point B on the Shorebirds 2020 survey map. Based on the preliminary analysis of the Shorebird 2020 Database this site meets the EPBC Act policy statement 3.21 (Significant Impact Guidelines for 36 Migratory Shorebird Species) criteria for nationally significant migratory shorebirds habitats. In order to minimise disturbance to this area it is proposed that:

- Ground disturbance and potential impacts on adjacent areas of mangrove and tidal habitats, particularly areas where migratory birds and marine birds forage and roost will be kept to a minimum.
- Significant construction works in the vicinity of this area will be undertaken in the dry season when most northern hemisphere migrants are absent (May – August).

It is noted that disturbance to these areas will be limited to the construction phase and the areas of disturbance will be managed as per *PWCs Land Management Procedure* (see Appendix J, Power and Water Land Management Procedure [PWC, 2011a]). Areas that are disturbed during construction activities will also be progressively rehabilitated. Proposed management and mitigation measures are discussed further in **Section 8.17, Comment 87 (NRETAS)**.

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Errata

Erratum to the Draft PER (PWC, 2011a): The first paragraph in Section F.1.3 Threatened flora and fauna species recorded in surrounding areas, incorrectly referenced Table Appendix F-7 as containing the results of a review of existing databases and reports listing critically endangered, endangered and vulnerable flora and fauna species recorded in the surrounding areas. **Table 4-7** should have been included and referenced in this paragraph.

Erratum to the Draft PER (PWC, 2011a): The following paragraph was incorrectly reported in Section 'Table Appendix F-6 Fauna species recorded in the Proposed Development corridor area' in Appendix F of the draft PER (PWC, 2011a). '*The recorded species listed migratory wetland and marine species Common Greenshank (Tringa nubularia), Beach Stone-Curlew and the Rainbow Bee-eater. Other non-listed species recorded included Brahminy Kite (Haliastur indus), Eastern Reef Egret (Egretta sacra), Striated Heron (Butorides striatus) and Common Tern (Sterna hirundo).*' As a result of this review it is also noted that the following species were also recorded in working field notes:

- Marsh Sandpiper (*Tringa stagnatilis*)
- Tree Martin (*Hirundo nigricans*).

Field data and relevant sections of the PER have been reviewed and the text in the paragraph directly above this correction should be submitted in its place.

Clarification to the Draft PER (PWC, 2011a): It is noted that Table Appendix F-6 indicated that the only amphibian species listed as threatened under NT Legislation, the Howard River Toadlet (*Uperoleia daviesae*), is known to occur in the Palmerston area. This species was not detected in the study area and there appears during initial field assessments to be no or extremely limited suitable habitat for this species within area. No amphibian surveys were conducted as part of this assessment and it is noted that surveys for this species would need to be undertaken in the wet season to properly assess its presence or absence (Pers. comm. Paul Barden, EMS, February 2012). This species is not listed as potentially occurring in the area in the NTG database search contained in **Appendix J, NT NRM Snapshot June 2011**, or other sources reviewed to advise this assessment, and therefore has not been included in **Table 4-7**.

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Table 4-9 Listed Migratory Shorebird Threshold Criteria Indicating Site Significance based on Shorebirds 2020 (2011) Count Data for East Point A

Common Name	Scientific Name	EPBC Migratory Wetland/ Marine Species	Shorebirds 2020 Max Single count East Point A	Bamford <i>et al.</i> 2008			Delany & Scott 2006 ¹		DEWHA 2009	Max Count Exceeds EPBC Draft Sig Impact Guidelines 0.1% Threshold
				Flyway Estimate	1% of the Flyway Estimate	Staging 0.25% of the Flyway Estimate	WPE4 Population Estimate	WPE4 1% Threshold	EPBC Draft Sig Impact Guidelines 0.1% Threshold	
Grey Plover	<i>Pluvialis squatarola</i>	X	2	125 000	1250	313	125 000	1300	125	
Lesser Sand Plover	<i>Charadrius mongolus</i>	X	22	140 000	1400	350	40 000	400	40	
Greater Sand Plover	<i>Charadrius leschenaultii</i>	X	185	110 000	1100	275	100 000	1000	100	↑
Black-tailed Godwit	<i>Limosa limosa</i>	X	36	160 000	1600	400	160 000	1600	160	
Whimbrel	<i>Numenius phaeopus</i>	X	12	100 000	1000	250	55 000	550	55	
Far Eastern Curlew	<i>Numenius madagascariensis</i>	X	8	38 000	380	95	38 000	380	38	
Common Greenshank	<i>Tringa nebularia</i>	X	1	60 000	600	150	100 000	1000	100	
Terek Sandpiper	<i>Xenus cinereus</i>	X	25	60 000	600	150	50 000	500	50	
Common Sandpiper	<i>Actitis hypoleucos</i>	X	15	25 000 - 100 000	250	63	50 000	500	50	
Grey-tailed Tattler	<i>Tringa brevipes</i>	X	56	50 000	500	125	40 000	400	40	
Great Knot	<i>Calidris tenuirostris</i>	X	206	375 000	3750	938	380 000	3800	380	
Red Knot	<i>Calidris tenuirostris</i>	X	5	220 000	2200	550	220 000	2200	220	
Sanderling	<i>Calidris alba</i>	X	0	22 000	220	55	315 000	3200	320	
Red-necked Stint	<i>Calidris ruficollis</i>	X	82	325 000	3250	813	160 000	1600	160	
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	X	0	160 000	1600	400	180 000	1800	180	
Ruddy Turnstone	<i>Arenia interpres</i>	X	37	35 000	350	88		1000	35	

Note 1: Source: EMS 2011

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Table 4-10 Listed Migratory Shorebird Threshold Criteria Indicating Site Significance based on Shorebirds 2020 (2011) count data for East Point B

Common Name	Scientific Name	EPBC Migratory Wetland/ Marine Species	Shorebirds 2020 Max Single count East Point B	Bamford <i>et al.</i> 2008			Delany & Scott 2006 ¹		DEWHA 2009 EPBC Draft Sig Impact Guidelines 0.1% Threshold	Max Count Exceeds EPBC Draft Sig Impact Guidelines 0.1% Threshold
				Flyway Estimate	1% of the Flyway Estimate	Staging 0.25% of the Flyway Estimate	WPE4 Population Estimate	WPE4 1% Threshold		
Grey Plover	<i>Pluvialis squatarola</i>	X	27	125 000	1250	313	125 000	1300	125	
Lesser Sand Plover	<i>Charadrius mongolus</i>	X	120	140 000	1400	350	40 000	400	40	↑
Greater Sand Plover	<i>Charadrius leschenaultii</i>	X	170	110 000	1100	275	100 000	1000	100	↑
Black-tailed Godwit	<i>Limosa limosa</i>	X	98	160 000	1600	400	160 000	1600	160	
Whimbrel	<i>Numenius phaeopus</i>	X	62	100 000	1000	250	55 000	550	55	↑
Far Eastern Curlew	<i>Numenius madagascariensis</i>	X	3	38 000	380	95	38 000	380	38	
Common Greenshank	<i>Tringa nebularia</i>	X	1	60 000	600	150	100 000	1000	100	
Terek Sandpiper	<i>Xenus cinereus</i>	X	14	60 000	600	150	50 000	500	50	
Common Sandpiper	<i>Actitis hypoleucos</i>	X	7	25 000 - 100 000	250	63	50 000	500	50	
Grey-tailed Tattler	<i>Tringa brevipes</i>	X	56	50 000	500	125	40 000	400	40	↑
Great Knot	<i>Calidris tenuirostris</i>	X	1362	375 000	3750	938	380 000	3800	380	↑
Red Knot	<i>Calidris tenuirostris</i>	X	14	220 000	2200	550	220 000	2200	220	
Sanderling	<i>Calidris alba</i>	X	2	22 000	220	55	315 000	3200	320	
Red-necked Stint	<i>Calidris ruficollis</i>	X	55	325 000	3250	813	160 000	1600	160	
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	X	1	160 000	1600	400	180 000	1800	180	
Ruddy Turnstone	<i>Arenia interpres</i>	X	50	35 000	350	88	31 000	1000	35	↑

Note 1: Source: EMS 2011

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Table 4-11 Listed Migratory Shorebird Threshold Criteria Indicating Site Significance based on Shorebirds 2020 (2011) Count data for East Point – Entire Area

Common Name	Scientific Name	EPBC Migratory Wetland/ Marine Species	Shorebirds 2020 Max Single count East Point – Entire Area	Bamford <i>et al.</i> 2008			Delany & Scott 2006 ¹		DEWHA 2009	Max Count Exceeds EPBC Draft Sig Impact Guidelines 0.1% Threshold
				Flyway Estimate	1% of the Flyway Estimate	Staging 0.25% of the Flyway Estimate	WPE4 Population Estimate	WPE4 1% Threshold	EPBC Draft Sig Impact Guidelines 0.1% Threshold	
Grey Plover	<i>Pluvialis squatarola</i>	X	25	125 000	1250	313	125 000	1300	125	
Lesser Sand Plover	<i>Charadrius mongolus</i>	X	33	140 000	1400	350	40 000	400	40	
Greater Sand Plover	<i>Charadrius leschenaultii</i>	X	157	110 000	1100	275	100 000	1000	100	↑
Black-tailed Godwit	<i>Limosa limosa</i>	X	3	160 000	1600	400	160 000	1600	160	
Whimbrel	<i>Numenius phaeopus</i>	X	15	100 000	1000	250	55 000	550	55	
Far Eastern Curlew	<i>Numenius madagascariensis</i>	X	7	38 000	380	95	38 000	380	38	
Common Greenshank	<i>Tringa nebularia</i>	X	3	60 000	600	150	100 000	1000	100	
Terek Sandpiper	<i>Xenus cinereus</i>	X	27	60 000	600	150	50 000	500	50	
Common Sandpiper	<i>Actitis hypoleucos</i>	X	11	25 000 - 100 000	250	63	50 000	500	50	
Grey-tailed Tattler	<i>Tringa brevipes</i>	X	55	50 000	500	125	40 000	400	40	↑
Great Knot	<i>Calidris tenuirostris</i>	X	209	375 000	3750	938	380 000	3800	380	
Red Knot	<i>Calidris tenuirostris</i>	X	32	220 000	2200	550	220 000	2200	220	
Sanderling	<i>Calidris alba</i>	X	2	22 000	220	55	315 000	3200	320	
Red-necked Stint	<i>Calidris ruficollis</i>	X	61	325 000	3250	813	160 000	1600	160	
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	X	0	160 000	1600	400	180 000	1800	180	
Ruddy Turnstone	<i>Arenia interpres</i>	X	34	35 000	350	88	31 000	1000	35	

Note 1: Source: EMS 2011

4 Existing Environment

Table 4-12 Listed Migratory Shorebird Threshold Criteria Indicating Site Significance based Shorebirds 2020 (2011) Count Data for Ludmilla Marine Claypan

Common Name	Scientific Name	EPBC Migratory Wetland/ Marine Species	Shorebirds 2020 Max Single count Ludmilla Marine Claypan	Bamford <i>et al.</i> 2008			Delany & Scott 2006 ¹		DEWHA 2009	Max Count Exceeds EPBC Draft Sig Impact Guidelines 0.1% Threshold
				Flyway Estimate	1% of the Flyway Estimate	Staging 0.25% of the Flyway Estimate	WPE4 Population Estimate	WPE4 1% Threshold	EPBC Draft Sig Impact Guidelines 0.1% Threshold	
Grey Plover	<i>Pluvialis squatarola</i>	X	35	125 000	1250	313	125 000	1300	125	
Lesser Sand Plover	<i>Charadrius mongolus</i>	X	40	140 000	1400	350	40 000	400	40	↑
Greater Sand Plover	<i>Charadrius leschenaultii</i>	X	139	110 000	1100	275	100 000	1000	100	↑
Black-tailed Godwit	<i>Limosa limosa</i>	X	145	160 000	1600	400	160 000	1600	160	
Whimbrel	<i>Numenius phaeopus</i>	X	99	100 000	1000	250	55 000	550	55	↑
Far Eastern Curlew	<i>Numenius madagascariensis</i>	X	21	38 000	380	95	38 000	380	38	
Common Greenshank	<i>Tringa nebularia</i>	X	9	60 000	600	150	100 000	1000	100	
Terek Sandpiper	<i>Xenus cinereus</i>	X	4	60 000	600	150	50 000	500	50	
Common Sandpiper	<i>Actitis hypoleucos</i>	X	2	25 000 - 100 000	250	63	50 000	500	50	
Grey-tailed Tattler	<i>Tringa brevipes</i>	X	6	50 000	500	125	40 000	400	40	
Great Knot	<i>Calidris tenuirostris</i>	X	2370	375 000	3750	938	380 000	3800	380	↑
Red Knot	<i>Calidris tenuirostris</i>	X	180	220 000	2200	550	220 000	2200	220	
Sanderling	<i>Calidris alba</i>	X	1	22 000	220	55	315 000	3200	320	
Red-necked Stint	<i>Calidris ruficollis</i>	X	2	325 000	3250	813	160 000	1600	160	
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	X	0	160 000	1600	400	180 000	1800	180	
Ruddy Turnstone	<i>Arenia interpres</i>	X	32	35 000	350	88	31 000	1000	35	

Note 1: Source: EMS 2011

4.6 Comment 44 (NRETAS)

Vegetation types, extent and locations are provided in sufficient detail throughout the PER. Vegetation clearing, preparatory works and earthmoving are discussed.

The specific locations of compounds, lay-down and turn around areas are not described.

How this guideline could be met:

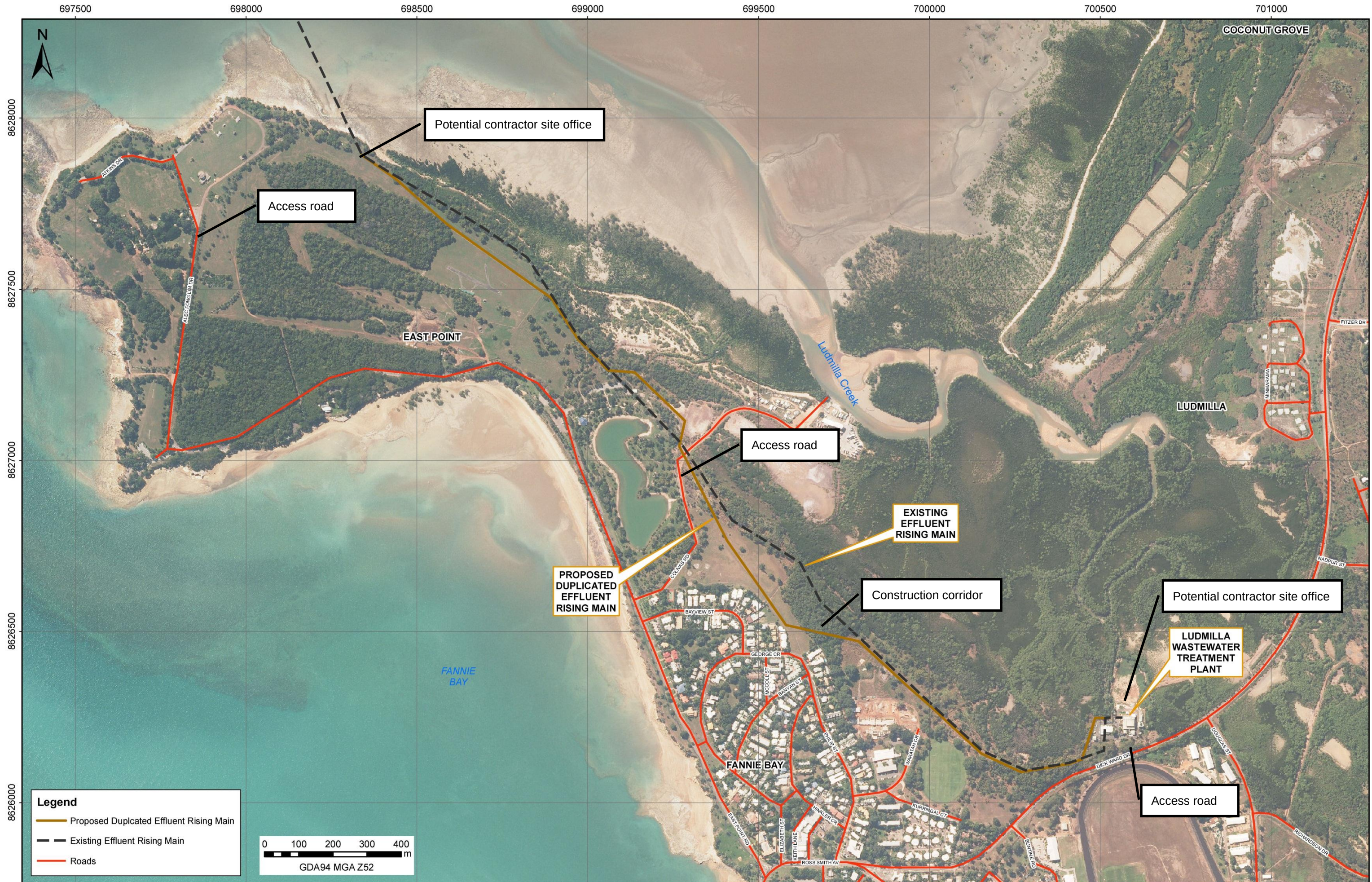
- *Map and describe the chosen location for compounds, lay-down and turn around areas and discuss why the sites were chosen and how the mitigate impacts on sensitive vegetation.*

Location of temporary site facilities must be done in consultation with Darwin City Council, the contractor (to be appointed) and PWC prior to commencing with construction. Accordingly, chosen location for compounds, lay-down and turn around areas cannot be provided at this time.

Typical temporary facilities required during construction of the Proposed Development are listed in Section 2.3.2 of the draft PER (PWC, 2011a), with potential locations for such infrastructure described below and shown in **Figure 4-8**:

- Site office and ablution facilities may be located at the Ludmilla WWTP or near the terminal manhole at East Point.
- Access to the construction corridor (approximately 10 m) will be via Dick Ward Drive, Colivas Road and Alec Fong Lim Drive.
- Construction material, excavated soils and construction equipment will be sited along the construction corridor, inside the 10m construction corridor or designed areas identified in consultation with Darwin City Council, PWC and the contractor.

PWC is committed to minimise the area of disturbance, particularly areas of Mangrove and Coastal Monsoon Forest Communities (PWC, 2011a). To limit potential impacts to sensitive vegetation, PWC further commits to temporary site facilities (e.g. compounds, lay-down and turn around areas) outside these areas, noting that clearing activities may impact on these vegetation communities. However, the corridor selected takes this into account (PWC, 2011a).



Source: Adapted from PWC, 2011a

Figure 4-8 Temporary Facilities during Construction of the Proposed Development

4.7 Comment 57 (NRETAS)

The Geotechnical Investigation along Proposed Alignment (Appendix D) identifies that 6 out of 10 test sites have the potential to be 'Mildly Aggressive' in corroding concrete piles. However the corrosive nature of soils along the proposed rising main corridor is not discussed.

How this guideline could be met:

- *Add a paragraph or section addressing the durability of the pipeline materials, especially considering the presence of marine, mangrove, and acid sulphate environments.*
 - *What are the consequences and impacts, if the pipes are corroded, on the environment?*
 - *How can this be mitigated?*

The rising main will be supplied in accordance to the product manual (**Appendix C, PWC Product Manual**) and will be a Ductile Iron Cement Lined wrapped in a Denso product for additional protection. The rising main is expected to have a 100 year life.

4.8 Comment 71 (NRETAS)

Discuss the soil/sediment types within the project footprint including actual and potential acid sulphate soils and existing levels of erosion and other disturbances.

Addressed - Nothing further required.

Noted, no additional information requested.

4.9 Comment 72 (NRETAS)

Provide details of any limiting properties of soil and substrate types and land units in the project footprint including consideration of acid generation.

Addressed - Nothing further required.

Noted, no additional information requested.

4.10 Comment 86 (NRETAS)

Benthic habitat mapping is not provided.

How this guideline could be met:

- *After defining the expected area of potential impact on sensitive marines species (see previous guideline) provide benthic habitat mapping in and around the area (it is possible to use existing data and mapping, if available).*

A benthic habitat assessment was completed in 2009; see **Appendix H, GHD Benthic Report**. Further benthic habitat work has been commissioned by PWC as part of the Stage 2 Public Environmental Report of the proposed extension/replacement of the EPO and includes benthic mapping of the area of potential impact.

4 Existing Environment

4.11 Comment 100 (DH Medical Entomology)

The accepted abbreviation for the genus name Culex is 'Cx.'

- *When at the beginning of a sentence the genus name is spelt out in full e.g. Aedes.*
- *Genus and species names should be italicised.*

Noted, Erratum will be made to the draft PER (PWC, 2011a) and supporting documentations.

4.12 Comment 102 (DH Medical Entomology)

Appendix P - Draft Biting Insect Management Plan (BIMP) - Section P.2.2: Second paragraph, second sentence, 'Whelan et Al,' should read 'Whelan et al.'

Noted, the following erratum is made to Appendix P of the draft PER (PWC, 2011a): Whelan et Al should read Whelan et al.

4.13 Comment 103 (DH Medical Entomology)

Murray Valley encephalitis:

- *The reference cited 'Whelan 1997' may perhaps been taken from an ME annual branch report in the same year? If so should be cited appropriately.*

Noted, the following erratum is made to Appendix P of the draft PER (PWC, 2011a):

Whelan P.I., 1997, *Problems mosquito species in the Top End of the NT – Pest and vector status, habitat and breeding sites*, Medical Entomology Branch, Department of Health and Community Services.

An updated reference list is provided in **Section 10.1, Comment 13 (NRETAS)**.

Malaria:

- *The reference cited 'Whelan 1995' is not in the list of references.*

An updated reference list is provided in **Section 10.1, Comment 13 (NRETAS)**.

Erratum to the draft PER (PWC, 2011a): The following reference should be included to the reference list: Whelan, P.I., 1995, *Biting insect investigation Darwin South Stage II*, Department of Health and Community Services, Darwin NT.

- *'Anopheles' should be italicised consistently in this section.*

Erratum to the draft PER (PWC, 2011a), Appendix P: 'Anopheles' should be read as 'Anopheles'

- *'East Arm' should read 'East Point'?*

Erratum to the draft PER (PWC, 2011a), Appendix P: 'East Arm' should read 'East Point'

4 Existing Environment

4.14 Comment 92 (Ian Hollingsworth)

The document lacks the project detail needed and the environmental detail needed on topographic analysis and soil properties to make an accurate environmental assessment of significant risks, or propose effective environmental management measures.

The comment is noted; however the Proponent disagrees with the opinion expressed.

Section 4.1.4 Soils begins with a paragraph on the soils of the area that is nonsense. The description of soils then refers to small scale land unit mapping that is inappropriate to assess environmental impact, while the acid sulfate soil risk assessment is not based on sampling designed to address the volume being disturbed or the potential risks.

Erratum to the draft PER (PWC, 2011a), Section 4.1.4 (PWC, 2011a): DELETE: 'Soils of the East Point area typically consist of Tenosols, which are soils that do not fit the requirements of any other soil orders of the Australian Soil Classification (Northcote et al., 1968)'.

A review of Section 4.1.4, Soils in the draft PER (PWC, 2011a) was conducted by Ben Parry, an Engineering Geologist with Cardno Ullman & Nolan. The following amendment was provided by Mr Parry:

The surface soils of the East Point area, as defined on Northern Territory Geological Survey map EXTRACT GEOLOGY OF THE OUTER DARWIN AREA, consist of costal alluvium (mud, silt and clay) and laterite gravels (pisolithic and nodular duracrust/fericrete). The underlying rock unit in the area is claystone/sandstone of the Darwin Formation. Soil and rock types vary in composition and strength along the project corridor, with four distinct subsurface materials identified. The general stratigraphic sequence is as follows (Cardno Ullman & Nolan, 2010):

- *A surface layer of alluvium comprising loose to dense, gravels, silts and sands with thickness ranging from 0.2 to 0.5 m. Loose, clayey sand and soft clay, deposited in a shallow marine or mangrove type environment, was encountered in some locations at the Ludmilla WWTP end of the Proposed Development alignment.*
- *The underlying material was predominately a layer of laterite comprising medium dense to very dense, silty or clayey, sandy gravel. The thickness of the laterite varied from approximately 0.2 to 0.9 m.*
- *Underlying unit of residual soil / extremely weathered rock, varying in composition from soft–hard clay to loose–very dense sand and gravel.*
- *Underlying very low to moderate strength, highly weathered porcellanite rock. The depth of the porcellanite layer was generally indicated borehole refusal.*

Fill materials comprising loose to very dense, silty or clayey sandy gravel to depths ranging from 0.75 to 2.0 m have been identified at some locations along the Proposed Development alignment (Cardno Ullman & Nolan, 2010).

Soils within the project area include deep loamy massive earths, gravelly yellow massive earths, shallow very gravelly yellow massive earths and intertidal area characterised by loose silty and pebbly sand over soft mangrove clay (Douglas Partners, 1998).

4 Existing Environment

Sulfate has been the System International spelling since the 1970's.

PWC recognise that nomenclature for SO_4^{2-} is 'sulfate' according to the *Nomenclature of Inorganic Chemistry, IUPAC Recommendations 2005* (Connelly et al., 2005). However, the draft PER (PWC, 2011a) and the Supplement were prepared to align with the Guidelines (NRETAS, 2010a), which use the nomenclature 'sulphate'.

I do not believe the acid sulfate soil risk assessment presented in Table 7.1 and there is no supporting specialist report to justify it.

The comment is noted; however the Proponent disagrees with the opinion expressed.

PWC commissioned specialist contractor Cardno, Ullman & Nolan, who are recognised experts in the field of geotechnical investigations to undertake both a geotechnical investigation and acid sulphate soil investigation along the alignment for the Proposed Development.

Technical reports from Cardno Ullman & Nolan were attached to the draft PER (PWC, 2011a) as Appendix D, Geotechnical Investigation and Appendix E, Acid Sulphate Soil Investigation. The risk assessment was informed by these reports.

Draft sediment and erosion control and acid sulfate management plans need to be presented that reflect detail appropriate to construction plans and well established professional practice.

Noted, please refer to **Section 7.2, Comment 45 (NRETAS)** and **Section 7.7, Comment 73 (NRETAS)** for a discussion on sediment and erosion control and acid sulphate soils management respectively.

More generally, there are typographic errors (from line 2 in the Executive Summary) and poor expression (particularly relating to the limited scope of this assessment with respect to the formal guidelines) and referencing inaccuracies that make the impact assessment process difficult to follow or believe.

The environmental consultants being used need to have credible professional qualifications and to conform to accepted professional practice.

This PER and the recent EIS for the Darwin Port Corporation set very low standards for the environmental assessment in the NT reducing it to a bureaucratic process with little requirement for reasonable assessment or management of environmental impact. This is particularly of concern given the high risk locations of these projects on the coastal fringe.

Noted.

SECTION 5

Potential Impacts



5 Potential Impacts

5.1 Comment 10 (NRETAS)

In Table 6-8 please use SI numbering (i.e. 22508×10^9 should be 2.25×10^{13} , etc) to allow numbers to be compared.

Table 5-1 presents daily loading to East Point as discussed under Section 6.6, Risk Assessment: Upgraded Ludmilla WWTP and Existing East Point Outfall of the draft PER (PWC, 2011a). The aforementioned table provides updated SI numbering as documented in Table 6-8 of the draft PER (PWC, 2011a).

Table 5-1 Daily Loading to East Point

	Total N kg/day	Total P kg/day	<i>E. coli</i> cfu/day
Larrakeyah WWTP (existing)	156	21	2.25×10^{13}
Ludmilla WWTP (existing)	380	50.35	7.6×10^9
Total (existing)	536	71.35	2.2508×10^{13}
Proposed Combined	487.5	31.25	1.25×10^{11}

5.2 Comment 32 (NRETAS)

Are there potential impacts relating to fishing, diving or wildlife watching? Will fishing and diving sites be put off limits because of the greater dispersion area from the outfall? PWC also notes that there will be approx. 10 people employed for the construction work and that there will not be any long term socio-economic impacts.

How this guideline could be met:

- *List and discuss any other potential economic impacts;*
 - *If no further economic impacts are identified, draw attention to this fact.*

There are no further economic impacts associated with the proposed project, other than discussed in the draft PER (PWC, 2011a). The project value is expected to be approximately \$8,000,000.00 and will create a number of employment opportunities for Territorians.

The proposed development is considered to have minimal impacts on recreational fishing and diving, with some short term disruption to wildlife watching along the corridor for the Proposed Development.

5 Potential Impacts

5.3 Comment 33 (NRETAS)

The cumulative impacts from future discharge are not discussed. Even when future discharge volumes are considered, no future forecasting, taking population growth, is provided.

How this guideline could be met:

- *Discuss the cumulative impacts of discharging effluent;*
 - *Consider future discharge volumes, taking into consideration population growth.*
- *Discuss the cumulative impact within both the immediate outfall area and harbour wide.*
 - *When examining the immediate area, it would be imperative to discuss how combining the two outfalls and the subsequent increase in localised volume will affect the marine environment.*
- *In considering cumulative impacts, consideration should also look at which, if any, species could be impacted from bioaccumulation?*

Population growth and resultant sewerage increases are discussed in **Section 2.23, Comment 54 (NRETAS)**, with the expected characteristics of effluent from the Ludmilla WWTP provided in **Section 0, Comment 15 (NRETAS)**.

Modelling of discharges based on current loads is presented in **Appendix B, Hydrodynamic and Water Quality Modelling**. that the increased discharge volumes due to future growth, and the potential impacts arising there from, will be addressed as part of the linked EPO extension PER.

Concentrations of heavy metals and bacteria in the wastewater are predicted to remain unchanged, while total phosphorus will be significantly reduced, with some reduction expected in total nitrogen. The area impacted by increased load arising from the increased volume of wastewater discharged is highly dependent on the initial mixing characteristics at the selected outfall location and hence cannot be predicted until a preferred site for the extended outfall is selected. Please refer to **Section 1.3, Issues Outside the Scope of the PER** and **Section 2.7, Comment 19 (NRETAS)** for additional information related to the proposed East Point Outfall Expansion project and the Ludmilla WWTP.

The potential impacts on marine species and the effects of bioaccumulation are discussed in **Section 6.9, Comment 84 (NRETAS)**.

5.4 Comment 42 (NRETAS)

Odour is recognised as a potential environmental impact, however because of the distance between areas PWC has identified Acid Sulphate Soils and residential premises the impact of odour is considered low and therefore not discussed further. Odours emitting from the existing outfall caused by additional effluent were not discussed.

5 Potential Impacts

How this guideline could be met:

- *Add a paragraph to Section 5.1.5 detailing whether odours at the existing outfall will impact on recreational users of East Point Reserve or the nearby offshore waters.*

There will be no additional odours expected from the diverted flows. The current Ludmilla WWTP upgrade includes a new odour control management system upgrade (\$1,000,000) that will be designed to operate continuously and reduce odour emissions from the plant and effluent to the surrounding environment.

5.5 Comment 56 (NRETAS)

A detailed preventative maintenance program will be developed. A list of measures that will be included is provided. This guideline should also consider the long term disruption and potential future impacts along the rising main corridor.

How this guideline could be met:

- *In Section 2.3.3 or Section 5 (Potential Impacts) discuss what maintenance activities might be required throughout the lifespan of the rising main and what impacts these may have on the environment.*

The proposed ERM is designed as a low maintenance facility. Based on experience with similar pipelines and design criteria applied minimal maintenance will be required. A preventative maintenance program will be developed (see Section 2.3.3 of the draft PER [PWC, 2011a]) following available guidelines such as National Resource Management Council (NRMMC) (2004). No long term disruption to activities or significant environmental impacts is envisaged. The existing ERM will act as a duty standby allowing maintenance to be complete without disruption to services.

Maintenance programs may include assessment of sewer corrosion externally by aggressive groundwater and internally by sulphates producing sulphuric acid, although this is considered a low risk. Inspections of sewers can involve closed circuit TV (CCTV) inspection of sewer pipes to identify and record blockages, cracks, tree roots and accumulated sediment. Maintenance holes and overflow structures are visually inspected for defects, possibly aided by mirrors on an adjustable pole. The pipes from overflow structures are checked for obstructions and the performance of any gas check valve is also checked.

Sewer maintenance techniques include (as described in NRMMC [2004]):

- Root cutting using a remotely operated cutting tool inserted at maintenance holes
- Chemical cleaning to reduce root infestation
- Removal of blockages by rodding
- Sewer flushing to remove accumulated sediment.

SECTION 6

Preliminary Risk Analysis



6 Preliminary Risk Analysis

6.1 Comment 51 (NRETAS)

Limited information is provided on nutrient loads. However, attempting to compare current loads and predicted loads is impossible, as the data, in tables 6.7 & 6.8, is exactly the same yet supposedly represents different information.

How this guideline could be met:

- *When discussing nutrient and other discharge loads, it is important to not focus on the harbour-wide loading but the localised loading at East Point.*
 - *For instance, is the loading at Ludmilla going to increase? If so what effects will this have on the surrounding environment where effluent is discharged?*
- *Discuss the effect that the change in nutrient load at Ludmilla will have on the marine environment.*
- *Data should always be clearly displayed, including raw data, labelled correctly and include maps that show the area of influence.*

Due to a report production error, Table 6-7 was duplicated in the draft PER (PWC, 2011a). **Table 6-1** presents updated daily loadings for the existing, and predicted combined pre-upgrade and combined post-upgrade discharges from the EPO.

Table 6-1 Daily Loading to East Point – Typical (Median) Flows

	Volume ML/day	Total N kg/day	Total P kg/day	<i>E. coli</i> cfu/day
Ludmilla WWTP (existing)	9.5	324.9	46.6	7.6×10^9
Combined effluent (pre upgrade)	12.5	427.5	61.3	1×10^{10}
Combined effluent (post upgrade)	12.5	375	34.3	1×10^{10}

It is not anticipated that the concentrations of heavy metals or other toxicants will increase; however, the loading to East Point will increase in line with the anticipated increase in volume: 9.5 ML/day rising to 12.5 ML/day, hence a 32% increase.

Modelling of the above scenarios (PWC, 2012b) shows an increase in the area of impact (nutrient levels exceeding guidelines) during the period when the combined flows occur prior to the completion of upgrades to Ludmilla WWTP. Following completion of the upgrade, the area in which elevated nutrient levels occur will be marginally greater in the case of nitrogen and smaller in the case of phosphorus. The appropriate avenue for managing increased nutrient levels prior to the completion of the Ludmilla WWTP upgrade is through the Waste Discharge Licence.

For further information, a copy of PWC, 2012b is provided as **Appendix B, Hydrodynamic and Water Quality Modelling**.

6 Preliminary Risk Analysis

6.2 Comment 66 (NRETAS)

Many potential risks have been identified; however there is a lack of discussion on these risks.

How this guideline could be met:

- *In the Risk Assessment section provide a discussion of each of the risks, the likelihood of the risk and the potential impact of the risk if it was to occur.*
 - *If particular risks are identified to be of special concern to the public, discuss these and make note of the public significance.*

Risk was discussed under Section 6 of the draft PER (PWC, 2011a).

6.2.1 Overview to the Risk Assessment Approach

The risk management approach for the PWC risk assessment is based on the RISQUE method (Bowden *et al.*, 2001), which is a widely accepted approach to risk management. It often involves the use of a multi-disciplinary “expert panel” for assessing the probabilities and consequences associated with potential risk events (PWC, 2011a).

This approach was selected because it is essentially simple and is able to assess (on a relatively even basis) risks associated with social, environmental, engineering and economic issues and events. It was decided that an alternative, simulation approach sometimes used by the RISQUE method, was not appropriate for the Project.

Highly complex systems involving feedback mechanisms and multi-faceted inter-relationships, such as many of the environmental components, have been incorporated into the risk assessment through the use of a team of subject matter specialists.

In general terms, the RISQUE method is a cyclical process based on the Australia and New Zealand Standard for Risk Management (AS 4360) framework.

The risk assessment methodology was discussed under Sections 6.2.2 to 6.3.2 of the draft PER (PWC, 2011a), describing interpretation of risk, dealing with uncertainty, estimating likelihoods and consequences.

6.2.2 Risk Register

The events risk register is a list of events that could result in impacts and potential impacts from implementation of the Proposed Development. This register was developed to include the public perception of potential risks (refer Table 6-3 of the draft PER [PWC, 2011a]). The risk registers for the construction period and operation period are attached as **Appendix I, Risk Register**.

6.2.3 Potential Risk Events

The draft PER (PWC, 2011a) identified potential risk events describing the risk for each risk event stated as a “risk quotient”, which is the ‘likelihood’ of the event occurring multiplied by the ‘consequence’ level if the event were to occur.

6 Preliminary Risk Analysis

Known impacts are derived from events for which it is practically certain that they will occur at some stage during the life of the project. The chance that these events and their consequential impacts will occur is effectively 100% (or 1). The only real uncertainty lies in the magnitude of impacts when the event occurs. Known impacts on the wider environment from a project need to be identified and reduced to levels that are as low as reasonably practical.

Potential impacts are derived from events that may or may not occur due to project activities. These events are known as risk events. For risk events there is uncertainty as to whether the event will occur in addition to the uncertainty of impact magnitude. The level of risk posed by a project can often be reduced by implementing actions that reduce the likelihood of the risk event occurring and / or actions that mitigate the level of impact if the event were to occur.

Figure 6-1 is a graphical representation of the overall risk profile, showing the risk events with a total risk above 0.001. Two events were identified as known impacts (red) and nine events were identified as potential (blue) risk events, as described in Section 6.5.2 of the draft PER (PWC, 2011a).

The risk level posed by four of these potential events lies within one half order of magnitude of the target risk level for a single event. The three highest potential risk events (ERM 59 Acid sulphate soils, ERM 72 Loss of rehabilitated area and ERM 67 Itinerants) lie just below the target risk level followed by 'ERM 60 Heritage damage'. 'ERM 83 Habitat loss', 'ERM 63 Disruption to services', 'ERM 86 Traffic nuisance' and 'ERM 66 Temporary bypasses' pose a relatively low risk with the remaining potential risk events considered as negligible.

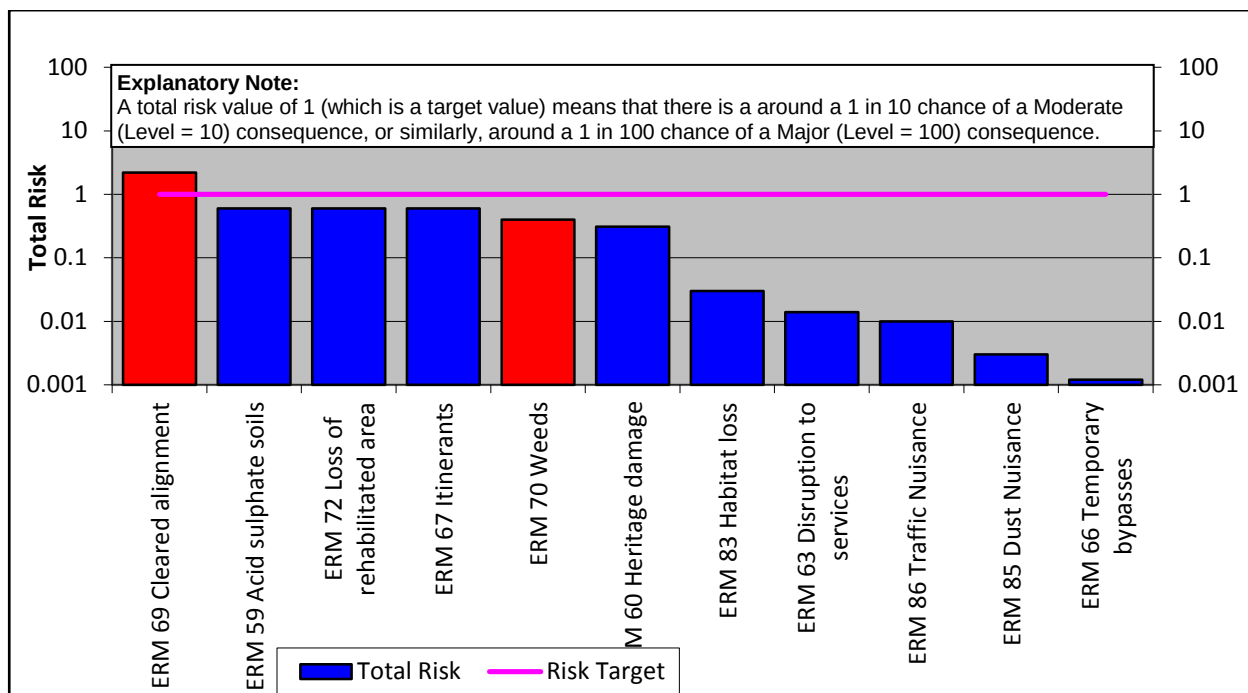


Figure 6-1 Overall Potential Impacts (Risk) Profile

6 Preliminary Risk Analysis

Potential impacts associated with the Proposed Development are discussed in Section 5 of the draft PER (PWC, 2011a). A summary of each risk event and proposed mitigation measure are provided below, supported by a risk register for the construction period and operation period are attached as **Appendix I, Risk Register**.

- **Clearing of Alignment:** The Proposed Development requires clearing along the Proposed Development corridor as discussed under **Section 4.4, Comment 20 (NRETAS)** and **Section 4.5, Comment 21 (NRETAS)**. As discussed in the aforementioned, the Proposed Development corridor will result in clearing of between 3 ha and 6 ha, including a small area of undisturbed land (less than 0.5 ha) and Mangrove Forest (0.12 ha) (see **Table 4-2**).

The proposed area to be cleared along the ERM alignment (refer **Table 4-1**) represents a marginal area of the Monsoon Vine Forests in the NT landscape, i.e. less than 0.0001% of the 270 000 ha (NTG, 2011). It is noted that the total rainforest estate in the Territory is divided into 15 000 patches, ranging between 1 ha and 4 000 ha with a median size of 3.6 ha (NTG, 2011). Further fragmentation from land clearing is considered a threat (NTG, 2011). Therefore, proposed activities associated with the Proposed Development will be managed to minimise disturbance of the Monsoon Vine Forests as far as practically possible.

Also see vegetation clearing – Destruction of vegetation and loss of habitat, below.

- **Acid sulphate soils:** An investigation into the occurrence of ASS along the Proposed Development corridor identified four locations of ASS (see Section 4.1.4, Soils of the draft PER [PWC, 2011a]). Construction will take place in areas with known ASS and the likelihood of encountering ASS is relatively high in the identified locations. Potential activities that may contribute to ASS oxidising include:
 - Excavation may bring ASS to the surface
 - Stockpiling of material containing ASS
 - Heavy machinery used in the construction process may cause gouging and turning of the subsoils (Cardno Ullman & Nolan, 2011).

Without treatment excavated and/or stockpiled ASS could result in the release of acidic leachate into the surrounding environment. Exposure of material containing ASS to rainfall is the most likely to release acidic leachate, which may impact stormwater, surface soils and the marine environment. Acid leachate may also present health risk if dermal contact or ingestion occurs.

To mitigate the potential for oxidation of ASS an Acid Sulphate Soils Management Plan (ASSMP) will be prepared in accordance with the Land Management Procedure (See Section 7.2.1 of the draft PER [PWC, 2011a] and **Section 7.6, Comment 73 [NRETAS]**).

- **Loss of Rehabilitated Area:** Areas of recent rehabilitated (i.e., tree planting by the Friends of East Point) adjacent to Colivas Road is likely to be impacted during construction, as smaller areas of vegetation is likely to be cleared along the corridor. PWC has committed to rehabilitate areas, with suitable species, that are disturbed during construction activities, with due consideration of the requirements of fauna species that will potentially recolonise these areas.

6 Preliminary Risk Analysis

- **Itinerants:** East Point and in particular the East Point Reserve is frequented by itinerants staying illegally within proximity of the Proposed Development corridor. During construction, itinerants may be exposed to activities that may result in injury. As the Proposed Development will be clearly sign posted and where appropriate delineated to prevent unauthorised access it is less likely for this event to occur. The delineation may include fencing and barricades around trenching and heavy machinery to prevent unauthorised access.
- **Growth and spread of weed species:** The construction of the Proposed Development could potentially spread weeds already present at the East Point Reserve, thus having a negative impact through the invasion and replacement of native plant species. This could modify the existing habitats for native animals and in a larger scheme may have a negative impact on ecosystem functions, such as nutrient and water cycles, in addition to changing fire regimes. Measures will be implemented to minimise the potential introduction and / or spread of weeds during construction and rehabilitation. It is noted that both PWC and DCC have current weed management programs and procedures that involve regular weed treatment. An assessment of the weed risks in the study area will be undertaken to prioritise management responses in line with PWCs Land Management Procedure and DCCs current weed management program, which will involve inspection, identification and control of weeds.
- **Heritage damage:** A discussion on the cultural heritage is provided in see Section 4.5.3, Cultural Heritage of the draft PER (PWC, 2011a). No archaeological sites or objects were located during a survey along the development corridor. None of the features in the East Point Military Precinct, which is a protected Registered Heritage Site, will be disturbed by the project. The features in proximity of the Proposed Development corridor are highly unlikely to be disturbed by the project as they are either behind an existing fence or are well signed and very visible. The closest WWII feature of the Singapore Post located on a rocky ridge at the edge of the coast line and is approximately 50 m east of the proposed alignment (Crassweller, 2009). Areas of Cultural Heritage are demarcated in Figure 4-9 of draft PER (PWC, 2009) and will be documented in the CEMP. No construction activities will be allowed in proximity these areas.
- **Fire (Habitat Loss & Public Safety):** Fire, as a result of refuelling, during both construction and operations stages would have a property impact due to damage to infrastructure and natural habitats. Possible personnel injury and/or fatality with economic and public health and safety risk. The PWC Land Management Procedure (Appendix J of the draft PER [PWC, 2011a]) covers land management practices that are to be undertaken by PWC on all lands managed by PWC. It applies to new projects and existing facilities. Relevant land management parameters covered by this procedure include fire management.
- **Disruption to Wastewater Services:** The Proposed Development intersects the existing effluent rising main at various locations. This risk event relates to damage of the existing effluent rising main, resulting in an inability to discharge effluent through the EPO and subsequent discharge into the Ludmilla Creek due to this interruption.

6 Preliminary Risk Analysis

Damage to the existing rising main will be mitigated by conducting thorough clearance prior to digging and careful excavation around the existing rising main. In the event of damage to the existing rising main discharge will be ceased until repairs can be made to the pipeline. NRETAS will be notified of any incidence resulting in the potential discharge of effluent to the Ludmilla Creek.

- **Traffic Nuisance:** The Proposed Development will intersect Colivas Road and require the establishment of a temporary diversion during construction activities. Interruption to traffic along Colivas Road will be minimal and limited to construction activities.
- **Dust:** Dust may be generated during construction of the Proposed Development, due to site clearing activities, loss of vegetation, excavation and handling of soils, rock breaking, wind erosion from disturbed areas and material stockpiles, site grading activities and vehicle movements. It is anticipated that the resultant dust impacts from construction activities would be localised and predominantly affect land-users in close proximity to the Proposed Development corridor, typically residential premises and recreational users of East Point.

Dust from construction activities is likely to be more a nuisance impact and is considered to have a negligible impact on human health. Furthermore, dust resulting from construction activities will be managed through dust suppression measures, such as wetting reducing ambient levels.

- **Temporary bypasses:** The Proposed Development will have a short term impact on recreational users and residents at East Point, as the proposed pipeline will intersect Colivas Road and a section of the East Point bicycle track. A temporary diversion will be installed at Colivas Road and a portion of the East Point bicycle track will be closed for an extended period during construction, adversely impacting on recreational users wishing to use the north-eastern section of the East Point bicycle track. The Proposed Development will not impact on other areas of recreational use at East Point Reserve. Once construction is complete, both Colivas Road and the East Point bicycle track will be reinstated.
- **Land owners:** Land ownership of East Point rests to a large extent with DCC, a variety of stakeholders and leaseholders, including the Fannie Bay Equestrian Club, Larrakia Nation Aboriginal Corporation, Royal Australian Artillery Association, Pee Wee's at the Point, East Point Aero modellers Club and the NT Government. The northern coastal strip of mangrove habitat is vacant Crown land (DCC, 2009a; DCC 2009b). The construction of the Proposed Development will occur within a new PWC easement. The Proposed Development aligns with current and future land-use planning and no changes to zoning or land-use are required. Permission will be gained from the respective property owners prior to construction. Nearby recreational and residential users will also be informed.

Impacts on adjacent land-use are considered minimal and limited to construction and maintenance activities. After rehabilitation and once vegetation is re-established after construction of the Proposed Development management of areas above the Proposed Development will revert to the property owner.

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- **Existing infrastructure damage:** The Proposed Development will traverse an area from the Ludmilla WWTP to the EPO, which is largely undeveloped cleared areas, designated as Public Open Space or Community Purpose. Services and infrastructure directly impacted by the Proposed Development (see Section 5.3 of the draft PER [PWC, 2011a]) include:
 - Existing effluent rising main from Ludmilla WWTP to the East Point outfall, which will be retained as support infrastructure although regular flow through the pipeline will cease once the Proposed Development is commissioned)
 - The East Point Bicycle track along the north-eastern section of East Point Reserve
 - Colivas Road adjacent to East Point Reserve and Lake Alexander
 - East Point reserve, used for recreational purposes
 - Areas of recent rehabilitated (i.e. tree planting by the Friends of East Point) adjacent to Colivas Road.

Access to the rising main alignment will be limited during construction of the Proposed Development. The proposed alignment intersects the East Point bike path. Use of the bike path will therefore be restricted for a short period during the construction phase. The bicycle path will be reinstated once construction in that area is complete, and any nearby construction zones do not pose a safety risk to path users.

There would be no traffic impact associated with the Proposed Development during the operational phase aside from occasional maintenance vehicle (utilities / light trucks / excavators) movements along the alignment itself, and occasional deliveries of materials to the construction site.

- **Creation of ponds (mosquitoes):** The construction of the Proposed Development could potentially create more breeding sites for mosquitoes due to the creation scrapes, trenching, site clearing and reclamation, storm water drains and water discharge sites, and inappropriate storage of artificial receptacles and materials that could pond water. Therefore, it is important to minimise the extent of stagnant water during the construction process by drainage to avoid ponding of water. Refer Section 7.3.2 of the draft PER (PWC, 2011a) for additional information.
- **Post construction public safety:** The pipeline trench will be filled by returning the remaining excavated material (if suitable) or suitable imported fill once the pipeline is installed. Clean up and rehabilitation measures will be applied to the effluent rising main corridor and access tracks in consultation with the relevant land holder/owner. Generally clean up and rehabilitation will involve removal of foreign material (construction material and waste), surface contouring, re-spreading topsoil, re-spreading vegetation. In certain areas a low 'formed camber' of material may be allowed to remain over the trench line to allow for possible subsidence. Given that the pipeline will be underground, land users are able to resume previous land use activities on top of the pipeline provided that this does not include excavation or building activities.

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- **CO₂ and other emissions:** In addition to dust, relatively minor emissions of oxides of carbon (CO_x), oxides of nitrogen (NO_x) and oxides of sulphur (SO_x) are expected as a result of the operation of machinery and support vehicles during construction of the Proposed Development. Construction is expected to take 12 weeks. During this period an estimated 15,000 kL of diesel may be used, thus equating to the emission of 40.5 t carbon dioxide equivalents (CO_{2-e}). After the completion of the work no further impacts from emissions are expected.
- **Generation of wastes and inappropriate disposal of wastes:** Wastes produced during construction are likely to be:
 - Steel and plastic off-cuts
 - Excess concrete and bitumen
 - Felled timber and excess spoil
 - Packaging materials
 - General refuse.

It will be a condition of the construction contract that all wastes are delivered to a licensed landfill for reuse and/or disposal as appropriate, unless an alternative reuse is identified, for example, excess spoil and mulched vegetation may be used elsewhere if suitable sites can be found.

- **Storm surge:** The occurrence of a storm surge (with unforeseen impacts), as a consequence of a low pressure system, cannot be ignored during the wet season; however, the construction period of the Proposed Development is scheduled during the dry season where the likelihood of storm surges to occur is low.
- **Vegetation clearing - Destruction of vegetation and loss of habitat:** A significant portion of the Proposed Development corridor of the ERM has been previously disturbed. The alignment for the ERM was selected to minimise the potential for clearing of vegetation.

The following potential impacts to native flora and fauna have been identified in the current Land Management Procedure and as a result of the survey undertaken to advise this assessment:

- Loss of habitat, habitat degradation or further fragmentation due to clearing of areas for the development of infrastructure and access tracks.
- Decreased surface and groundwater quality, or altered flow, as a result of construction and maintenance activities impacting on riparian habitats.
- Impacts on surrounding habitats due to erosion and sediment deposition from construction activities.
- Potential introduction or spread of weed and naturalised vegetation and pests from vegetation clearing / disturbance and use of vehicles and machinery on site.

To control and minimise impacts of the proposal on terrestrial flora and fauna, the ERM alignment will avoid trees as far as possible. The construction contracts will contain specific provisions requiring protection of vegetation near the proposed alignment. Topsoil will be respread to promote rehabilitation of disturbed areas.

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- **Vegetation clearing and construction – Noise:** Noise will be generated during the construction phase of the project, primarily through the operation of equipment such as excavators, trucks and light vehicles. Noise from clearing and trenching is expected to be short term and of minimal intensity. Noise shall be controlled by requiring the construction contractor to adhere to the NRETAS Noise Guidelines for Development Sites.
- **Fuel spill:** Construction may require the on-site storage and use of small volumes of various chemicals (mainly fuels and lubricants). Chemical and fuels will be stored in appropriate, secure containers away from waterways. Chemical/fuel handling will be minimised in vicinity of waterways and drainage lines. A manifest and MSDSs of all chemicals stored and used for the project will be maintained on site. Spill clean-up equipment appropriate to the type and quantities of chemicals used will be kept on site. In the event of a spill, Power and Water's *Hazard, Incident Recording, Reporting and Investigation Procedure* will be implemented.
- **Disposal of hydrotest water:** The effluent rising main will be approximately 3,200 m in length and will require 1,500,000 litres to disinfect the pipe. PWC Disinfection Procedure is highlighted in Section 6.10 of the Power and Water Hydraulic Mastertext. The disinfection process uses 12.5% Sodium Hypochlorite solution dosed at 100 ppm. Approximately 1,300 litres of 12.5% Sodium Hypochlorite will be required. All disinfection and flushing water will be disposed of offsite with the disposal protocol to be included in the contractor CEMP.
- **Trench settlement:** The pipeline trench will be backfilled using the remaining excavated material, if suitable or suitable imported fill once the pipeline is installed. The fill material will be compacted and tested to ensure that there will be no subsidence. Clean up and rehabilitation measures will be applied to the effluent rising main corridor and access tracks in consultation with the relevant land holder/owner. Generally clean up and rehabilitation will involve removal of foreign material (construction material and waste), surface contouring, re-spreading topsoil, re-spreading vegetation. In certain areas a low 'formed camber' of material may be allowed to remain over the trench line to allow for possible subsidence. Given that the pipeline will be underground, land users are able to resume previous land use activities on top of the pipeline provided that this does not include excavation or building activities.
- **Seasonal effects:** To initiate the construction of the effluent rising main during the wet season, could have several negative impacts, as the effects of rain could extend the construction period, thus extending the period of inconvenience to the public, more effort has to be undertaken to minimise the development of mosquito breeding sites from water pooling, it is likely that groundwater would fluctuate significantly under seasonal influences and run-off and sedimentation is increased during the wet season. For these reasons, the construction activities will be restricted to the dry season.

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- **Unauthorised access:** Individuals accessing the construction unauthorised may be exposed to activities that may result in injury. The Proposed Development will be clearly sign posted and where appropriate delineated to prevent unauthorised access. This may include fencing and barricades around trenching and heavy machinery.
- **Soil erosion:** Erosion of soil is a natural phenomenon that can be accelerated by site preparation and excavation activities during construction activities. Factors that can increase the potential for erosion include:
 - Removal of vegetation or other ground cover.
 - Exposure to forces such as flowing water or strong winds.
 - Increased slope.
 - Erosivity of soil.

The Proposed Development is traversing an area that is mostly flat, with a gradient varying between 1 and 3 % (DCC, 2009a; DCC 2009b) with a low erosion potential along the alignment (see Table 4-2 of the draft PER [PWC, 2011a]). However, the erosion potential along the alignment may increase due to the conflicting factors of very low slope and exposed soils and fill material used during construction. Some runoff generated within the catchment is directed to the receiving environment through drainage channels. Nonetheless runoff from site may interact with workings, mobilise sediment and leading to erosion. The potential for sedimentation and erosion is further increased due to terrain disturbance during construction and rehabilitation activities post construction. Potential impacts resulting from site preparation, excavation and construction activities, which must be appropriately managed, include:

- Soil erosion as result of high rainfall and subsequent pump out of trenches and excavations.
- Mobilised sediment and sediment accumulating in the receiving environment.

The potential for soil erosion is mainly associated with site preparation and excavation activities (i.e. construction activities). The construction contractor will therefore prepare the ESCP as a section of the CEMP. It will describe measures which will be undertaken by the contractor/s during construction of the Proposed Development to reduce the potential for soil erosion occurring, and to manage the potential impacts of any unavoidable soil erosion. Impact prevention and management measures specified by the ESCP are as described in Section 7.2.2 of the draft PER (PWC, 2011a) and **Section 7.7, Comment 74 (NRETAS)** of this Supplement.

- **Open excavation:** Open excavations will occur during the construction phase and will have a short term impact on recreational users and residents. As the Proposed Development proceeds, excavation areas will be rehabilitated. As the Proposed Development will be clearly sign posted, fenced, and where appropriate, delineated to prevent unauthorised access it is less likely for this event to pose a risk to recreational users and residents. The delineation may include fencing and barricades around trenching and heavy machinery to prevent unauthorised access.

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- **Wallaby population:** Whilst the Coastal Monsoon Vine Forest community is unlikely to be providing significant habitat for wildlife, it provides habitat within the East Point Reserve for local fauna populations, such as the Agile Wallaby. The overall area of Monsoon Vine Forests located within, or adjacent to, the Proposed Development corridor is very small and the community is bordered by managed urban parkland, management tracks and the Model Aeroplane Club grounds. Areas of disturbance, particularly areas of Mangrove and Coastal Monsoon Forest communities, will be minimised. Clearing of vegetation for construction and operational activities associated with the Proposed Development will be undertaken in accordance with the NRETAS Northern Territory Land Clearing Guidelines (NRETAS, 2010b). Wherever possible, PWC will seek to identify opportunities to rehabilitate previously disturbed areas as part of the Proposed Development.
- **Aboriginal sacred sites:** No impacts on cultural heritage are envisaged associated with the Proposed Development (see Section 4.5.3, Cultural Heritage of the draft PER [PWC, 2011a]). If subsurface archaeological material is uncovered during construction, work will cease and Heritage Conservation Services will be contacted for advice.
- **Natural disasters:** In the event of a natural disaster, such as earthquakes and tsunamis, that are seasonally unpredictable, the magnitude of impacts cannot be foreseen. The impacts from more predictable seasonal events, such as cyclones, can be kept to a minimal by restricting the construction phase to the dry season. Construction of the Proposed Development is scheduled during the dry season to minimise the impacts from wet weather.
- **Drain crossings:** The construction of the Proposed Development could damage drain crossings, which potentially could lead to sedimentation in the event of heavy rain. Once construction is complete, drains will be reinstated.
- **Decommissioning of existing rising main:** The duplicated effluent rising main will become the primary rising main transporting effluent from Ludmilla WWTP to the EPO. The existing pipeline will be used for redundancy to the new effluent rising main, when maintenance is required.
- **Pipeline rupture:** There is a potential risk of rupture of the existing rising main during construction of the Proposed Development; however, the alignment of the Proposed Development was selected to minimise potential impacts on the existing effluent rising main from Ludmilla WWTP to the East Point outfall. Material for the effluent rising main will be in accordance to the product manual (**Appendix C, PWC Product Manual**) and will be a Ductile Iron Cement Lining, providing an expected to have a 100 year life and minimising the potential for pipeline rupture under normal operating conditions. In the event of a rupture in the effluent rising main PWC will implement its emergency response procedure (included as Appendix M in the draft PER [PWC, 2011a]).
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6.2.4 Concerns Raised by the Public

Respondents included members of the public, see **Section 1.4, Summary of Responses and Structure of the Supplement**. Comments received from the public as part of the consultation process are addressed in this supplement as referenced in **Appendix A, Responses to the Draft PER**.

6.3 Comment 67 (NRETAS)

Quantify (where possible) and rank risks so that the reasons for proposed management responses are clear.

Addressed - Nothing further required

Noted, no additional information requested.

6.4 Comment 68 (NRETAS)

The uncertainty about risks is not provided.

How this guideline could be met:

- *Discuss the uncertainty surrounding the risks that have been identified and effectiveness of the controls and mitigation methods discussed.*

Section 6.2.2 of the draft PER (PWC, 2011a) provides a description of 'What is Risk', followed by a discussion on dealing with uncertainty. It states that:

"As risk is a concept used to describe events that may or may not occur, and for which the scale of potential impacts cannot be accurately predicted, there is always inherent uncertainty associated with the estimation of risk.

Considering the two-dimensional nature of risk (likelihood x consequence), there are two key types of uncertainty in any estimation of risk:

- *Uncertainty in the estimated likelihood of an event occurring.*
- *Uncertainty in the magnitude of the event consequences.*

The underlying cause of the uncertainty itself may be a result of a combination of issues such as lack of historical information for similar situations, uncertainty in scientific knowledge, natural variability, or uncertainty due to assumptions inherent in technical models or calculations used for forecasts and predictions. In assessing and measuring uncertainty, one must take into account each of the assumptions made and the extent of its validity".

The risk assessment assumed that effective controls and mitigation measures, as discussed in Section 7 of the draft PER (PWC, 2011a), will be implemented. This was reflected in estimating 'likelihoods' and 'consequences' during the risk assessment process.

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6.5 Comment 69 (NRETAS)

The benefits of the project are described in terms of treatment of sewerage, ceasing discharge of untreated sewerage, and improving hydraulic capacity of the Ludmilla WWTP to reduce overflows into Ludmilla Creek. However, the risk assessment does not discuss any problems in achieving these goals, merely impacts if the proposal goes ahead.

Noted, no additional information requested. The principal goal of the risk assessment was to consider environmental, social and financial impacts and potential risks posed by the project during construction, commissioning and operation of the development. Please see **Section 6.4, Comment 68 (NRETAS)** regarding uncertainty about risks.

6.6 Comment 70 (NRETAS)

Discuss the residual risks and their consequences expected to be borne by the community, providing better understanding of equity issues. Residual risks were not discussed except in Appendix O on Risk Profile Procedure.

Risk is a condition resulting from the prospect of an event occurring and the magnitude of its consequence. Therefore, risk is an intrinsic combination of likelihood of an event and its associated consequences occurring (PWC, 2011a).

Closure for the Proposed Development is currently not considered and a closure plan will be developed prior to closure of the Proposed Development, identifying potential risk.

In terms of the Proposed Development residual risk is interpreted as the risk or danger of a risk event following the implementation of controls and mitigation measures during construction and operational phases. As previously indicated the risk assessment for the Proposed Development assumed that effective controls and mitigation measures will be implemented.

Risk quotient for risk events identified in the draft PER and **Appendix I, Risk Register** provide a numerical value that describes the potential risk posed by an event. **Figure 6-1 in Section 6.2, Comment 66 (NRETAS)** is a graphical representation of the overall risk profile, showing the risk events with a total risk above 0.001.

6.7 Comment 75 (NRETAS)

It is noted that the proposed action is not to change the outfall location and as such there is no plan to change the location of the mixing zone. However, due to the proposed increase in effluent discharge volume and different effluent characteristics, it is imperative that the mixing zone is properly understood so as to avoid the risk of long term impacts.

Maps, depicting the dispersion area of the discharged waste at the existing and outfall location, indicates a relatively small area of expansion with the proposed additional discharge volume. However the two maps are shown at different scales, so a proper

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analysis is difficult. (Section 6.6: Risk Assessment: Upgraded Ludmilla WWTP and Existing East Point Outfall, pp. 94-96).

How this guideline could be met:

- *Conduct and/or describe the results from hydrodynamic modelling of Darwin Harbour and discuss the dilution and mixing zone characteristics at the outfall location (it is possible to use existing data and modelling if available).*
- *Discuss the changes in area of the dispersion and mixing zone, including the predicated area that will be affected.*

A full description of the hydrodynamic and water quality model used, its limitations, assumptions, development processes, calibration and application is provided in **Appendix B1, Hydrodynamic Modelling of Darwin Harbour, 2005 – 2010, History, Development & Interpretation, Report No. 4.**

The model has been applied to the current outfall location at East Point for effluent discharge scenarios to allow comparison of pre- and post-Larrakeyah diversion and treatment plant upgrade (refer **Attachment B2, Hydrodynamic Modelling of Darwin Harbour, Modelling Results**).

Power and Water Corporation is committed to extend the East Point Outfall to further reduce potential impacts associated with effluent discharge. Extending the outfall is currently subject to an Environmental Assessment.

Please also see the responses under **Section 2.6, Comment 17 (NRETAS)** and also **Section 8, Modelling, Marine Water and Sediment Monitoring Program** of this Supplement, as the sections are discussing information and modelling regarding the potential environmental impact of using the existing outfall following the duplication of the rising main.

- *Provide an argument as to why the discharge location is still appropriate considering the different discharge volumes and qualities.*

Refer **Section 3.5, Comment 62.**

- *If/when presenting maps to demonstrate the differences in the dispersion area ensure the scales are the same so as to enable better comparisons.*

Noted.

6.8 Comment 77 (NRETAS)

Water quality of treated effluent is not discussed in sufficient detail. While the daily loading to Darwin Harbour (Section 6.6) is part of the picture, to properly understand the issue much more water quality indicators would need to be considered. Currently, the indicators for the water quality, although not explicitly stated, are nitrogen, phosphorus and E. coli levels.

The Draft Water and Sediment Monitoring Program outlines a range of metals that will be monitored. It would be useful to then discuss metals in water quality of treated effluent.

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Section 6.6 states that ‘the combined discharge will not include any industrial waste’. Is this the definitive statement on Trade Wastes?

How this guideline could be met:

- *In addition to the daily loading on Darwin Harbour, discuss water quality parameters such as pH, Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and temperature.*
- *Include heavy metal indicators in this discussion.*
- *It would be important to consider both the dry and wet season qualities.*
- *Make explicit what indicators are to be used.*

Refer discussions under:

- **Section 2.4, Comment 12 (NRETAS)**
 - **Section 2.5, Comment 15 (NRETAS)**
 - **Section 5.1, Comment 10 (NRETAS)**
 - **Section 8, Modelling, Marine Water and Sediment Monitoring Program.**
-
- *Considering that the guidelines look heavily into Trade Wastes more information on Trade Wastes should be provide.*

PWC currently employs a Trade Waste Management System for all its trade waste customers. PWC will accept trade waste into the sewerage system provided the discharger holds a Power and Water approval to discharge to sewer and complies with the conditions of the approval and the Trade Waste Code.

This is further discussed under **Section 8.12, Comment 79 (NRETAS)**; **Section 8.13, Comment 81 (NRETAS)** and **Section 8.14, Comment 82 (NRETAS)** for further information on the PWC Trade Waste Management System.

6.9 Comment 84 (NRETAS)

No in-depth consideration for Coastal Dolphins or marine habitats.

There appears to be a suggestion that the reduced phosphorus will mean reduced nutrient enrichment and less likelihood of algal proliferation (NB. Nitrogen will increase by 28%) and that the only impact the proposal might have on the marine environment is the nutrient levels.

The very fact that there will be an increased volume of discharge would suggest greater sediment, toxicity, heavy metals and turbidity. These should all be considered in terms of their impacts on species.

How this guideline could be met:

- *Describe what marine species may be/are likely to be in the vicinity of the outfall (or downstream from the outfall – where harbour currents take the effluent).*
 - *What impacts are expected on each species?*
 - *This should include habitat (e.g. sea grass meadows);*

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- *Bioaccumulation is another area within this guideline that could be important if identified by appropriate experts.*

Coastal dolphins are discussed in the response to **Section 4.5, Comment 21 (NRETAS)**.

Marine and benthic habitat communities within the vicinity of the existing EPO were surveyed by GHD (2009) using video sampling of targets sites by divers. The GHD (2009) reports were not included in the PER due to the assessment of the extension replacement of the EPO being split from the East Point Effluent Rising Main component in August 2011. The GHD (2009) reports have been included in the supplement (**Appendix H, GHD Benthic Report**) and its findings have been summarised below. Marine and benthic habitat communities addressed in the Supplement within the greater Darwin Harbour region were surveyed by Geo Oceans (INPEX, 2011).

It should be noted that additional benthic habitat mapping is proposed to be undertaken in 2012 as part of the assessment of the extension replacement of the EPO. This will include mapping of the proposed outfall extension alignment, the intertidal area around the existing EPO, the East Point Aquatic Life Reserve and the area between East Point and Nightcliff to further explore the extent of the seagrass beds shown in INPEX (2011) and NRETAS (2012). The same survey methods and habitat classifications will be employed as for the INPEX EIS (2011) and additional benthic habitat mapping of East Arm Wharf by Geo Oceans.

6.9.1 Marine Communities of Darwin Harbour

The marine ecology of Darwin Harbour is heavily influenced by the physical conditions prevalent in the Harbour, which determine where and to what extent the different types of marine communities occur. Darwin Harbour is a drowned river valley system, with a large tidal range of over 7.5 metres, producing currents up to 2.5 metres per second (DLP, 2011).

The exposed headlands exhibit rocky intertidal areas, and protected bays are characterised by extensive intertidal mangrove communities. In the subtidal areas, rocky or mud flats predominate, depending on the degree of exposure to water movement. The sides of the main drainage channels are generally rocky, but the substrate varies from exposed pavement, sometimes covered with a thin layer of sand, to sediment beds of gravel through to silt (DLP, 2011).

The marine benthic communities of Darwin Harbour are complex and diverse, and can exhibit high variability across small spatial scales. Marine habitat mapping reveals a number of distinct ecological communities (**Figure 4-4**), including soft sediment communities, filter feeder communities, hard coral communities, seagrass beds, rocky intertidal and subtidal habitats, and mangrove communities.

Soft sediment communities

Approximately 80% of Darwin Harbour is covered by soft substrates (McKinnon *et al.*, 2006). These soft substrates consist of mud and muddy-sand in the intertidal, and of varying fractions of mud and sand in the subtidal, with coarser sediments within the

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deeper parts of the channels of the Harbour. Studies have shown that the soft sediment areas in the northern part of the Harbour typically comprise more than 60% fine sand, while those in East Arm and Middle Arm have around 50% fine sand. The central Harbour and West Arm typically have a greater proportion of coarse sand and granules (approximately 30% each) and approximately 25% of fine sand (AECOM, 2011). Darwin Harbour is a geomorphological stage where sediments are deposited in low current areas, and is thus slowly filling in (Smit, 2003).

The physical and biotic structure of soft substrates is three-dimensional and governed by grain-size, oxygen state and sediment chemistry. The rate of sediment chemistry processes (e.g. carbon, nitrogen and sulfur cycles) and the fauna and flora composition in and on the sediment are linked, but this complex process is largely unknown for the Darwin Harbour region (Smit, 2003).

The intertidal soft sediment areas generally support a low species diversity and high number of individuals of some species. Polychaete worms dominate the intertidal communities, while the more diverse subtidal communities have crustaceans, echinoderms and sponges in addition to polychaetes (Smit, 2003; INPEX, 2010). It has been estimated that Darwin Harbour has approximately 600 polychaete species (most of which are undescribed), 1,000 crustacean species and over 900 species of molluscs (McKinnon *et al.*, 2006). Sites surveyed in Darwin Harbour revealed that amphipods (30%) and polychaetes (27%) were the most abundant subtidal infauna taxa and a total of 17 families of infauna recorded (INPEX, 2010). There are 86 species of foraminiferans that have been recorded for Darwin Harbour, but less than half of these are found on soft substrates (Smit, 2003).

Filter feeder communities

Filter feeders, or suspension feeders, are animals that feed by filtering seawater to extract their food, which mainly consists of plankton. Filter feeders include animals from a wide variety of groups such as sponges, corals, bivalve molluscs (e.g. clams and mussels), bryozoans, ascidians, crustaceans, echinoderms (e.g. crinoids) and marine worms. Species from all of these groups occur in Darwin Harbour. They are either benthic (living on the substrate) or infaunal (living within the sediments).

Filter feeders are present in a range of habitats in Darwin Harbour: filter feeder reefs, mixed community reefs and on soft substrates. A benthic habitat map constructed by Geo Oceans (2011) estimated that filter feeders occupy 7,612 ha in Darwin Harbour (**Figure 4-4**). The high confidence component (1,384 ha) includes filter feeder reefs (1,258 ha) and 29% filter feeder surface cover within the mixed community reef category (126 ha). The inferred habitat component includes 6,240 ha of the filter feeder/sediment category and 250 ha from the mixed reef/sediment category. Filter feeder distribution is expected to cover approximately 30% of the substrate in the inferred habitats. It is expected that they would be much denser on filter feeder reefs, especially at depths greater than 5 m (AECOM, 2011).

Based on these calculations, filter feeders would occupy approximately 10% of Darwin Harbour (**Figure 4-4**). Filter feeder communities are present from the intertidal zone to 30 m below Lowest Astronomical Tide (LAT). The relative abundance of filter feeders

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increases with depth and they dominate the biological communities at depths greater than 5 m (Geo Oceans, 2011).

The filter feeder communities in Darwin Harbour are diverse assemblages, dominated by sponges and soft corals. They are estimated to include 50 species of soft corals, 65 species of sea whips and 56 species of sponges (McKinnon *et al.*, 2006). The number of sponge species is potentially much higher, as McKinnon estimated that only 10% of sponge species have been described for the region (2006). The relatively low species representation of soft corals and gorgonians (sea whips and sea fans) can be attributed to a combination of factors such as turbidity, sedimentation, light availability, wave and flow exposure, and steepness of reefs (Fabricius & Alderslade, 2001). Areas with high currents and shelter from wave action are more suitable for sea whips and sea fans.

Sponges are commonly found on hard substrates, often in areas where corals cannot establish, and display a particular affinity to the transition areas between hard substrates and soft substrates (Smit, 2003). Sponges are also found on soft substrates where they may be buried, and they often offer shelter and habitats to small fish, amphipods, brittle stars, polychaetes and shrimp (Smit, 2003). Little is known about their longevity.

Soft corals are also sessile filter feeders that can reproduce both sexually and asexually, with asexually being the dominant mode of reproduction. It can lead to localised high density patches (AECOM, 2011). Sexual reproduction can include both internal and external larval development, and most species require a hard substrate for the larvae to settle (Smit, 2003). Sea pens are known to reproduce on soft substrates using root-like structures (Smit, 2003).

Seagrass

Seagrass has a limited distribution in Darwin Harbour and its mapping is relatively recent and incomplete; Smit (2003) reported that the seagrass distribution was not well-known within Darwin Harbour. The most extensive known areas are located north of East Point, between Nightcliff and Lee Point, particularly at Casuarina Beach (INPEX, 2010). Small seagrass patches are found between East Point and Nightcliff and in Fannie Bay, south of East Point (**Figure 4-4**). Substantial seagrass meadows are not known to occur further south than in Fannie Bay (INPEX, 2010). These seagrass communities are dominated by *Halodule* spp. (e.g. *Halodule uninervis*) with *Halophila* spp. (i.e. *H. decipiens*, *H. spinulosa* and *H. ovalis*) and *Syringodium* spp. Most seagrasses are within the lower subtidal zone (0–1 m below LAT) with sparse communities extending to -3 m LAT (Geo Oceans, 2011).

Seagrasses cover approximately 2,520 ha of Darwin Harbour; this comprises 1,734 ha of seagrass located predominantly between Fannie Bay and Lee Point, and 786 ha of inferred seagrass habitat (Geo Oceans, 2011). Seagrass habitat would cover approximately 3% of Darwin Harbour if seagrass inferred habitat is included in calculations (Geo Oceans, 2011).

Seagrasses are known to provide a relatively complex habitat for a number of fish larvae and marine invertebrates, and a food source for grazers such as dugong and

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some marine turtles. They also contribute to maintaining sediment stability with their complex root system.

Macroalgae

Macroalgae in Darwin Harbour are generally found in the low intertidal and shallow subtidal zones. Macroalgae are typically absent at depths greater than -5 m LAT, with the greatest abundance recorded from the intertidal zone down to -2 m LAT (Geo Oceans, 2011). Survey results have shown that they are present in the reef communities between Fannie Bay and Shoal Bay (Geo Oceans, 2011). They have been reported at East Point reef and Weed Reef (Smit, 2003) and other recent habitat mapping (Geo Oceans, 2011) shows three macroalgae dominated reefs between Nightcliff and Lee Point (north of East Point) (**Figure 4-4**).

It is estimated that 0.3% of Darwin Harbour (247 ha) supports macroalgae, comprised of known macroalgal reefs (134 ha); macroalgae within known mixed community reefs (35 ha); an estimated 69 ha in inferred mixed reef-sediment habitats; and an estimated 9 ha in inferred seagrass-mixed reef habitats (**Figure 4-4**) (Geo Oceans, 2011).

Macroalgal abundance varies seasonally, with desiccation-resistant turf algae dominating in October-December when the tidal range is at its greatest. During the dry season, when tidal ranges are smaller, larger macroalgae are more abundant (INPEX 2010). Species occurring in macroalgal habitats include the brown algae *Sargassum* and *Padina* spp., along with foliose red algae (*Laurencia* spp.), green algae (*Caulerpa*, *Ulva* and *Udotea* spp.) and the calcareous greenalgae (*Halimeda* spp.) (INPEX, 2010).

Rocky shore communities

Rocky shores consist of coastal cliffs, scree slopes (or talus), and rock bars. Coastal cliffs and talus are distributed along the north side of the Harbour (Smit, 2003), and rocky platforms and rock bars are present along the intertidal areas of East Point. Sandstones and conglomerates form the majority of intertidal rocky platforms (e.g. Weed Reef, Channel Island Reef, Gunn Point Reef, and Old Man Rock in front of Casuarina Beach), and intertidal rocky outcrops (e.g. north of Middle Point). The rocky shore from Fannie Bay to Lee Point typically has less than 10% cover of macrobiota communities in the mid to upper intertidal zones (Geo Oceans, 2011).

Zonation patterns of hard substrates have been described in several studies, and there is a trend towards greater species diversity towards the lower intertidal and subtidal areas (Pope, 1967; Ferns, 1996; Russell and Hewitt, 2000; URS, 2002). Exposed rocks of the intertidal area are mainly colonised by oysters and barnacles, while crevices, holes and the undersides of rocks are colonised by small molluscs (e.g. *Nerita* spp. and *Thais* spp.) and isopod crustaceans. Blue-green algae and diatoms form a dark band across the rock bed of the low intertidal. The lower intertidal is further divided into two zones: an upper zone that is dominated by molluscs, crustaceans, soft corals, sponges, turf and brown algae (e.g. *Padina* spp.); and the lower zone, which is characterised by subtidal species covering the rocks (hard and soft corals, sponges, crustaceans, anemones and macroalgae (Smit, 2003).

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Hard coral communities

Hard coral communities are found from the lower intertidal to -10 m LAT in areas where there are moderate to strong currents, with abundance typically greatest to down to -5 m LAT (Geo Oceans, 2011). A total of 123 species of corals have been recorded in Darwin Harbour (Wolstenholme *et al.*, 1997). These coral species are tolerant to the variable salinity, high turbidity and sedimentation present in Darwin Harbour that may exclude many other coral species.

Hard coral communities have a patchy distribution in Darwin Harbour as they are restricted to hard substrates, which are not the prevalent substrate type in this area. They occur at >10% cover over 219 ha (approximately 0.3%) of Darwin Harbour, and are also present in small numbers on mixed reefs, which cover approximately 65 ha. In inferred mixed reef-sediment habitats it is estimated that they would cover an additional 129 ha. Thus, the estimated total hard coral cover is 0.5% of Darwin Harbour.

Recent habitat mapping of Darwin Harbour shows several areas where hard coral communities are dominant, including Channel Island, South Shell Island, Old Man Rock off Casuarina Beach, Weed Reef, north-east Wickam Point and parts of the East Point Aquatic Life Reserve (GHD, 2009; URS, 2009b). Plater Rock and Stevens Rock also support hard coral communities (Smit, 2003).

The Channel Island coral community is listed on the NT Heritage Register established under the *NT Heritage Conservation Act 1991*. The significance of this community is that it presents a relatively diverse coral assemblage in a ria (drowned river valley) system that has fluctuating salinity and high turbidity (NRETAS, 2002). It had the highest percent coral cover of the communities surveyed by URS (2009b) (which include Plater Rock, Weed Reef, north-east Wickham Point and South Shell Island), reaching 100% in areas and hosting a diversity of 29 coral species.

Hard coral communities of 15–20% surface cover at 0–1.5 m below LAT have been recorded around South Shell Island (in East Arm); their abundance decreased with depth (URS, 2009b; BMT WBM, 2010). Another survey conducted by GHD in 2009 recorded a 24% coral cover on a reef slope with sandy patches at South Shell Island (GHD, 2009). At least 21 species have been recorded at South Shell Island consisting predominantly of faviids and, to a lesser extent, Turbinaria colonies (URS, 2009b). A recent survey of a site at Weed Reef reported an average of 48.5% hard coral cover (GHD, 2009).

Mass coral spawning is not known to have been observed in Darwin Harbour, although many of the species found reproduce by spawning elsewhere in the Indo-Pacific Region (DLP, 2011). Spawning in the NT aquarium has been observed around the full moon of October–November (Territory Wildlife Park, 2006).

Fish

Darwin Harbour supports a wide range of resident benthic and transient pelagic fish species (INPEX, 2010), with the most recent fish survey in the Harbour recording 415 species in Darwin Harbour (Larson and Williams, 1997). These included 31 new species

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records for the Northern Territory. Gobies (66 species), cardinal fish (21 species) and pipefish (18 species) were the dominant families recorded.

Common species recreationally harvested include trevallies (*Caranx* spp.), mackerel (*Scomberomorus semifasciatus*), salmon (*Eleutheronema tetradactylum* and *Polydactylus macrochir*), grunter (*Pomadasys kaakan*) and barramundi (*Lates calcarifer*) (McKinnon *et al.*, 2006). Barramundi is a particularly important commercial and recreational fish species that spawns in river mouths where tides carry the eggs into supralittoral swamps. There are no such swamp systems in Darwin Harbour; the nearest one is located at Shoal Bay, north-east of the Harbour (DoR, 2010).

Most species of coral reef fishes found in Darwin Harbour are of Indo-Malayan origin (Larson, 1987). Food habits of the fish found in Darwin Harbour have been categorised, and 82% of the species found were carnivorous with 50% of these preferring small benthic invertebrates (Larson, 1987). Even though coral communities occupy a relatively small area of the Harbour (an estimated 0.5%), they support the greatest number of species (43.7% of total fish species found in the Harbour) (McKinnon *et al.*, 2006). None of the species of fish found in Darwin Harbour is known to occur only within the Harbour.

There are 28 protected fish species listed under the EPBC Act as “species or species habitat may occur within area” for Darwin Harbour. These all belong to the Syngnathidae family and include: 21 species of pipefish, three species of pipehorse and four species of seahorses (SEWPAC, 2011).

6.9.2 Marine Communities of the Proposed Development Area

In 2008, a bathymetric and benthic habitat survey was undertaken by GHD (2009) to identify benthic communities along the proposed pipeline alignment extending north-west from the existing EPO (**Appendix H, GHD Benthic Report**). The following provides an assessment of the benthic communities within the immediate vicinity of the existing EPO.

Soft sediment communities

The area surrounding the existing EPO is dominated by mud and sand substrates within the intertidal mudflats. At low tide it is possible to walk to the crown of the exposed outfall, an upturned pipe. The end of the outfall is a vertical discharge at approximately neap tide low water level and 2.2 m below mean sea level (SKM, 1998). The area surveyed north-west of the EPO comprised of rippled or consolidated sand, supporting very little epibenthic biota (e.g. worm and crustacean holes) or evidence of substantial infauna (GHD, 2009). Similar communities were recorded on smooth soft sandy mud (with some embedded pebbles). The overall species abundance and diversity was very low and was considered by GHD (2009) to be inferior to other sites of similar habitat in Darwin Harbour.

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Filter feeder communities

The proposed EPO alignment survey area has very low densities of filter feeders, with less than 1% cover observed at each of the eight survey sites (GHD, 2009). The only common benthic organism encountered between the sites was a species of solitary ascidian. Low abundance of filter feeders was recorded at the northern sites along the alignment (GHD, 2009). One site (A7) had a firmer and sandier substratum with numerous small pebbles and low silt content, supporting a low density benthic community (<1% cover) dominated by sponges with some gorgonians, bryozoans and ascidians (GHD, 2009). Site B3, adjacent to the preferred alignment and nearer to shore, had solitary ascidians and a very low abundance of sponges, hydroids and soft corals.

Two reference sites within the East Point Aquatic Life Reserve had higher densities of filter feeders, with 13.6% and 17.9% cover observed. Sponges were the dominant filter feeders within these reference sites, with sponges and gorgonians the most abundant filter feeders at reference sites OUT3 and OUT6 (GHD, 2009). Filter feeders in Darwin Harbour are relatively well represented, and so the community along the proposed EPO alignment is unlikely to be of significance locally or regionally.

Seagrass

Seagrass (*Halophila decipiens*) was recorded at only two sites during the EPO survey (GHD, 2009). Cover of less than 1% was recorded at Site A2, and of 22% at site B3, located just north of the proposed EPO alignment. This species is more abundant to the north of the EPO location, particularly at Casuarina Beach (INPEX, 2010; NRETAS, 2012); and so the limited seagrass at the proposed EPO location is unlikely to be of local or regional significance.

Macroalgae

The 2008 GHD survey reported no macroalgae along the preferred EPO alignment, and less than 2% cover at the two reference sites located in the East Point Aquatic Life Reserve (GHD 2009). A previous survey has recorded macroalgae-dominated communities in East Point Aquatic Life Reserve without providing the specific location within the reserve (Smit, 2003). Based on this information, it is unlikely that any significant macroalgal communities are present around the existing EPO.

Rocky shore communities

A survey of the proposed EPO location did not find any hard substrate or rocky shore communities. The intertidal area off East Point has scattered rocks and areas where the rock layer below the sand is apparent (GHD, 2008). There is a continuous intertidal rocky shoreline around East Point, with rock platforms extending into the East Point Aquatic Life Reserve. These would be expected to support biota communities similar to those present on rocky shorelines elsewhere in the Harbour.

Hard coral communities

6 Preliminary Risk Analysis

No hard corals were recorded at the eight sites surveyed in the proposed EPO corridor, or at the two sites at the potential northern pipeline diversions (GHD, 2009). Hard coral communities were recorded at two reference sites in the East Point Aquatic Life Reserve. Site EPR1, located on a shallow reef slope, had 40% coral cover predominantly consisting of the families *Faviidae* and *Pectiniidae*. Site EPR2 was located deeper, and hard coral covered 1% of mixed sand and reef patches substrate (GHD, 2009).

6.9.3 What Impacts are Expected on Marine Communities

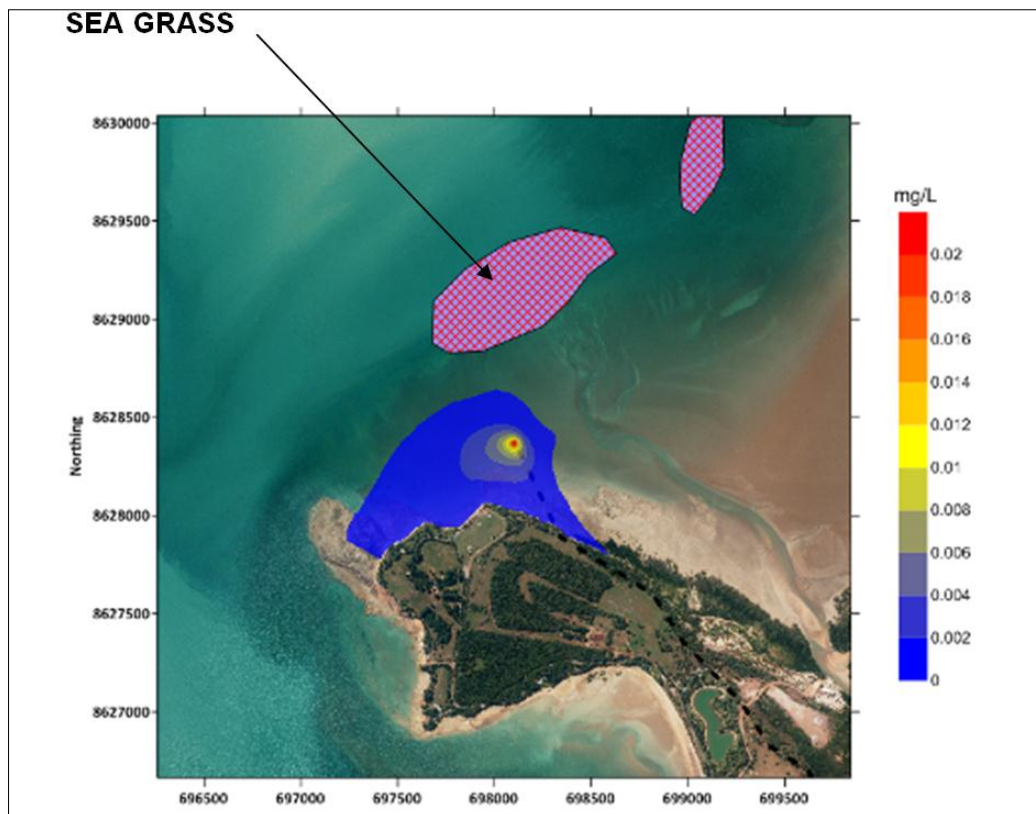
There will be no increase in concentrations, but an increase in load leading to an increase in the size of the dispersion envelopes (refer **Appendix B, Hydrodynamic and Water Quality Modelling**).

Effects of the current and proposed discharge on sediment toxicity and nutrient accumulation/cycling have yet to be evaluated for the East Point Outfall but given the exposed, well flushed location, the potential is considered low (refer information presented under **Section 8.6, Comment 18 (NRETAS)**).

All discharge parameters are at background or below guideline values before reaching the identified seagrass meadows. **Figure 6-2** shows the worst possible case mixing zone (Copper 95th Percentile for Atypical conditions, post-Larrakeyah Diversion and pre-Ludmilla treatment plant upgrade). Hydrodynamic Modelling suggest no direct impact on seagrass meadows (PWC, 2012a).

The marine species that may be/are likely to be in the vicinity of the outfall (or downstream from the outfall) are described under **Section 4.5, Comment 21 (NRETAS)**. None are known to be resident in the vicinity of the outfall but may on occasion pass through the discharge plume and be exposed to low concentrations of substances present in the wastewater.

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Source: PWC, 2012a

Figure 6-2 Sea-grass Beds in Relation to Current Outfall and Mixing Zones

6.9.4 Bioaccumulation

Bioaccumulation is an area that could be important if identified by appropriate experts. While bioaccumulation may be emerging issue of concern for marine species, it is an area that requires extensive research and long-term monitoring and it is therefore considered to be outside specific requirement of this PER. PWC recommends and supports addressing this as part of the Darwin Harbour Integrated Monitoring and Research Program.

There will be no increase in concentrations but an increase in load leading to an increase in the size of the dispersion envelopes (refer **Appendix B, Hydrodynamic and Water Quality Modelling**).

Effects of the current and proposed discharge on sediment toxicity and nutrient accumulation/cycling have yet to be evaluated for the East Point Outfall but given the exposed, well flushed location the potential is considered low (refer **Section 8.6, Comment 18 [NRETAS]**).

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6.10 Comment 88 (NRETAS)

Demonstrating that equipment failure will not cause harm by excess discharge to the environment could have much more space devoted to it in the risk assessment.

How this guideline could be met:

- *Identify what equipment has the potential to fail.*
 - *If failure occurs what are the potential impacts of these, and*
 - *How can these impacts be mitigated.*
-

There are no expected equipment failures anticipated during the construction and operation of the proposed effluent rising main. The selection of appropriate and durable materials of manufacture and construction methodology will further mitigate any potential equipment failure. The existing rising main, which on refurbishment, will provide a duty standby facility that will mitigate any unforeseen equipment failures.

SECTION 7

Mitigation, Management and Monitoring



7 Mitigation, Management and Monitoring

7.1 Comment 43 (NRETAS)

Waste is discussed in Appendix R, however it would be important to discuss construction wastes specifically and how they will be disposed of.

How this guideline could be met:

- *In the PER, discuss how the Waste Minimisation and Disposal Procedure applies specifically to construction wastes.*

The Proposed Development will generate some waste during the construction phase and limited waste generated during operation of the ERM (mostly associated with maintenance activities).

Construction waste will be largely inert, and include excess excavated soil, excess pipe material, steelwork and plastic cut-off, bedding, bitumen, felled timber and packaging materials. No hazardous materials will be stored at the site, other than acid sulphate soils discussed in **Section 7.6, Comment 73 (NRETAS)**.

A Construction Waste Management Plan (CWMP) will be developed by the contractor for the construction activities required, in compliance with PWC's Waste Minimisation and Disposal Procedure (see Appendix R of the draft PER [PWC, 2011a]), which forms part of the CEMP. Construction waste associated with the Proposed Development will be managed according to principles that are environmentally responsible and minimise the amount of waste produced.

The waste management measures to be addressed in the CWMP will include as a minimum recycling and waste disposal facilities, mitigation of waste-related environmental nuisance, and composting of organics where practicable. All solid waste generated during construction and operation of the proposed development will be disposed of at a licensed waste disposal facility. Skips will be provided at construction laydown areas for the duration of construction activities. Additional skips will be provided at work zones. The skips would be used for waste generated by construction activities, and will be emptied / removed by licensed contractors as necessary.

The CWMP will also detail:

- Responsibilities for waste management, collection, disposal, and documentation.
- All chemicals, including fuels, to be stored and / or used on the project site.
- Proposed methods for transportation and storage.
- All government approvals and agreements required and obtained for all waste disposal and management matters.

Skips will be provided along the development corridor for construction waste. These will be emptied regularly by licensed contractors. Smaller bins will also be installed in appropriate locations for miscellaneous domestic waste for disposal of the various waste streams. Waste will be removed from the construction site by the contractor appointed by PWC for the Proposed Development.

7 Mitigation, Management and Monitoring

7.2 Comment 45 (NRETAS)

The Power and Water Land Management Procedure outlines how PWC will manage soil conservation and rehabilitation. The aspect of soil erosion and sedimentation is addressed to a limited extent in Section 7.2.2. This states that an Erosion Sedimentation and Drainage Management Plan will be prepared and an overview of what will be included in this is discussed.

How this guideline could be met:

- *Provide a draft copy of the Erosion Sedimentation and Drainage Management Plan as an Appendix to the PER.*

Similar to the Acid Sulphate Soil Management Plan (refer **Section 7.6, Comment 73 [NRETAS]**), an ESCP will be developed by the contractor responsible for construction of the Proposed Development in consultation with Darwin City Council, PWC and will be submitted to NRETAS for comment. The ESCP will be a guideline to minimise soil erosion on, and sediment from the Proposed Development and provide measures to minimise and manage erosion / sedimentation.

The ESCP will be developed to align with current NT Guidelines, including the:

- Erosion and Sediment Control Guidelines, Built Environment
- Erosion and Sediment Control Guidelines, Service Corridors
- Erosion and Sediment Control Plans, Fact Sheet.

A preliminary draft ESCP is included as **Appendix L, Preliminary Draft Erosion and Sediment Control Plan**.

7.3 Comment 46 (NRETAS)

A Weed Management Plan should be developed to ensure that weeds (such as potentially mission grass, gamba grass, coffee bush and lantana) are controlled during construction and rehabilitation stages.

Addressed - Nothing further required.

Noted, no additional information provided.

7.4 Comment 48 (NRETAS)

Methods used to prevent and control biting insect populations that might occur due to construction works.

Addressed - Nothing further required.

Noted, no additional information provided.

7.5 Comment 64 (NRETAS)

The construction of the ERM component addressed.

7 Mitigation, Management and Monitoring

Water quality issues at the existing outfall remain outstanding as per comments in the main body of the comments on the PER.

Noted, please refer to **Section 2, Description of the Proposed Development** and **Section 8, Modelling, Marine Water and Sediment Monitoring Program**.

7.6 Comment 73 (NRETAS)

Alternative environmental management techniques for moderate or higher risk impacts have not been addressed.

How this guideline could be met:

- *Add a paragraph to Section 3 (Alternatives) that offers alternative Environmental management techniques, with specific reference to moderate and high risk impacts.*

Section 4.1, Comment 2 (NRETAS) of this Supplement recognises PWC's commitment to develop an ASS Management Plan prior to commencing construction activities, including the disturbance of ASS. It requires that such a plan should be reviewed and approved by a suitably qualified independent auditor.

The Acid Sulphate Soil Management Plan (ASSMP) will be designed to cover acid sulphate soil (ASS) management during the construction phase of the Proposed Development, and recommended on-going monitoring, which should form part of PWC's Construction Environmental Management Plan (CEMP). The ASSMP will define strategies to manage activities with the potential to disturb ASS identified by Cardno Ullman and Nolan (2011). The ASSMP will make reference to applicable guidelines and legislation. The framework of the ASSMP is discussed below.

Background to ASS associated with the Proposed Development

The ASSMP make reference to information on ASS, referencing the ASS investigation by Cardno Ullman and Nolan (2011) and the draft PER (2011a).

Guiding Principles

Management of Actual ASS (AASS) and Potential ASS (PASS) will be undertaken in accordance with the following principles (Department of Natural Resources and Mines, 2002):

- The disturbance of AASS / PASS should be avoided wherever possible.
- Where disturbances of AASS / PASS is unavoidable, preferred management strategies are:
 - minimisation of disturbance
 - neutralisation
 - hydraulic separation of sulphides either on its own or in conjunction with dredging
 - strategic reburial (reinterment)
 - other management measures may be considered but must not pose unacceptably high risks.

7 Mitigation, Management and Monitoring

- Works should be performed in accordance with best practice environmental management when it has been demonstrated that the potential impacts of works involving AASS / PASS are manageable to ensure that the potential short and long term environmental impacts are minimised.
- The material being disturbed (including the *in situ* AASS / PASS) and any potentially contaminated waters associated with AASS / PASS disturbance, must be considered in developing a management plan for AASS / PASS and / or in complying with the general environmental duty.
- Receiving marine, estuarine, brackish or fresh waters are not to be used as a primary means of diluting and / or neutralising AASS / PASS or associated contaminated waters.
- Management of disturbed AASS / PASS is to occur if the acid sulphate soil action criteria listed in Table 1 of the Department of Natural Resources and Mines (2002) guidelines is reached or exceeded.
- Stockpiling of untreated ASS above the permanent groundwater table with (or without) containment is not an acceptable long-term management strategy. For example, soils that are to be stockpiled, disposed of, used as fill, placed as temporary or permanent cover on land or in waterways, sold or exported off the treatment site or used in earth bunds, that exceed the ASS action criteria listed in Table 1 of the Department of Natural Resources and Mines (2002) guidelines should be treated / managed.
- The following issues should be considered when formulating ASS environmental management strategies:
 - the sensitivity and environmental values of the receiving environment. This includes the conservation, protected or other relevant status of the receiving environment.
 - whether groundwater and / or surface water are likely to be directly or indirectly affected.
 - the heterogeneity, geochemical and textural properties of soils on-site.
 - the management and planning strategies of Local Government and / or the NTG.

Measurable Targets

Based on the above principles, measurable targets for ASS management are as follows:

- Document evidence of training of relevant site personnel in regard to ASS, who are to be experienced in assessing and managing ASS and other accredited ASS field-testing and sampling courses.
- Delineation and documentation of all ASS material, which may be disturbed by the proposed project.
- Handling and disposal of AASS/PASS as specified by this ASSMP, which may include the following:
 - encounters with ASS during construction and maintenance will be recorded.
 - written records of the quality and volumes of any ASS leachate collected and disposed for the project duration.

7 Mitigation, Management and Monitoring

- photographic and other documentary evidence demonstrating management procedures for ASS materials, including excavations, storage, treatment, reburial and any other activities shall be collected and maintained
- the approximate volume of soil placed in the bunds, the volume of lime added for treatment, the bund locations and off-site disposal information will also be documented.
- Where an incident causes, or may threaten to cause, pollution or environmental nuisance resulting in material or serious environmental harm, PWC will inform NRETAS.

Key Performance Indicators

Key Performance Indicators that demonstrate the successful management of ASS materials during project works may include:

- Documented evidence demonstrating measurable targets have been achieved.
- No release of ASS contaminated groundwater, runoff or leachate into natural waterways.
- No occurrence or corrosion to steel and concrete infrastructure.

Structure of the ASSMP

PWC will require an NRETAS approved ASSMP be in place prior to any excavation of PASS. The ASSMP will provide evidence of practical, achievable and auditable plans to ensure that environmental impacts are minimised. The plan will demonstrate comprehensive monitoring and control of construction and operation impacts and a framework to confirm compliance with approval conditions.

PWC requirements for the ASSMP are provided in Appendix J (PWC Land Management Procedure) of the draft PER (PWC, 2011a). PWC propose the following draft structure for the ASSMP to be developed by the contractor to include, but not be limited to, the following information:

1. Introduction

- Project background demonstrating an appreciation of the risks involved with managing ASS. Specific sensitivities of the construction site and surrounding environment will be identified.
- Previous investigations (Cardno Ullman & Nolan 2010 and 2011) and details of any additional soil and/or water ASS investigations undertaken to support the ASSMP (where applicable)
- Scope of Works

2. Management objective and contingency plan if the selected management strategy fails

3. Existing environment

- Location and land-uses including a current site plan showing any existing infrastructure, local environmentally significant features, stages of the development and ASS risk mapping.

7 Mitigation, Management and Monitoring

- Topography
- Geology
- Hydrogeology and Tidal considerations
- 4. Proposed earthworks and dewatering
- 5. Soils
 - Generalised soil conditions
 - ASS assessment criteria and field monitoring program
- 6. Groundwater
 - Baseline investigations
 - Sampling and analysis protocol
- 7. Assessment of potential environmental impacts
- 8. Assessment of ASS management options
- 9. Dewatering operating strategy
 - Trigger criteria – e.g. pH trigger levels
 - Dewater and receiving water monitoring
 - Transport and treatment methodology
 - Dewatering/water quality reporting
- 10. Earthworks operating strategy
 - Trigger criteria – odour, field assessment
 - Transport and treatment methodology
 - Assessment and reporting of treatment outcomes.

7.7 Comment 74 (NRETAS)

Without a draft Acid Sulphate Soil Management Plan or Erosion and Sediment Control Plan it is difficult to assess how water quality will be protected.

How this guideline could be met:

- *Provide draft copies of both the Acid Sulphate Soil Management Plan and Erosion and Sediment Control Plan.*
- *In Section 7, Mitigation, Management and Monitoring, describe how water quality will be protected.*

An ASSMP will be developed by the contractor and provided to NRETAS for approval prior to construction. PWC requirements for the ASS are provided under Appendix J (PWC Land Management Procedure) of the draft PER (PWC, 2011a). Refer **Section 7.6, Comment 73 (NRETAS)** for additional information on the management of ASS.

An ESCP will be prepared by the contractor and supplied to NRETAS for comment. Refer **Section 7.2, Comment 45 (NRETAS)** for additional information on the ESCP. The erosion, sedimentation and drainage measures as outlined in the final ESCP will be installed before any disturbance of the site occurs.

7 Mitigation, Management and Monitoring

7.8 Comment 97 (NT WorkSafe)

There is no mention of reporting significant chemical spills to relevant organisations (i.e. S.64(b)(iii) of the NT Workplace Health and Safety Act 2007).

As noted above in Section 6.2.4 (ERM 92 Fuel Spill), the construction works may require the on-site storage and use of small volumes of fuels and lubricants. Fuel and chemical handling would be in accordance with good practice, and a manifest and MSDSs of all fuels and chemicals stored and used for the project will be maintained on site.

Spill clean-up equipment appropriate to the type and quantities of chemicals used will be kept on site. In the event of a spill, PWC's Hazard, Incident Recording, Reporting and Investigation Procedure will be implemented.

During operation no chemicals will be used under this project, the operation will involve the pumping of sewage only.

7.9 Comment 98 (NT WorkSafe)

Regulatory Body contact is mentioned only if required. An Emergency Response should link in with the incident reporting system as defined within this document. It is suggested that there is a linkage between incident reporting and Emergency response plans so that the users of the Emergency Procedures will ensure appropriate regulatory bodies are notified where necessary.

This will be addressed in the Contract Safety Management Plan that will be required as part of the tendering process.

7.10 Comment 101 (DH Medical Entomology)

Section 7 – Mitigation, Management and Monitoring – 7.3.2 Biting Insects

Commitments:

Second last point- 'at the wharf' should read 'within the development area' or 'East point'?

Noted, the following erratum is made to 7.3.2 of the draft PER (PWC, 2011a): Second last point- 'at the wharf' should read 'within the development area'.

7.11 Comment 104 (DH Medical Entomology)

There were indications that under various scenarios during the implementation of the rising main, the closure of the Larrakeyah outfall, the upgrade of Ludmilla treatment plant and the delayed construction of the of the new East point outfall, there would likely be frequent wet season overflow discharge of effluent to Ludmilla Creek. What would the management strategy be during these overflow events and will these incorporate a control strategy to prevent adult mosquito emergence?

7 Mitigation, Management and Monitoring

Upgrading the Ludmilla WWTP forms part of PWC management strategy to limit overflow discharge to the Ludmilla Creek, as described under Section 2.4.1 of the draft PER (PWC, 2011a). As previously discussed in **Section 2.21, Comment 49 (NRETAS)** the upgraded plant has been hydraulically designed to treat 5 x ADWF for a 2030 horizon. That is with the diversion the 2012 design is ADWF 12.5 ML/day and at 2030 ADWF is 17.5 ML/day. With the plant upgrade expected to be completed in 2012, it will have the capacity to hydraulically treat peak flows of 87.5 ML/day. Flows over 87.5 ML/day (extreme wet weather events) will require bypass of the treatment system, however plant reconfiguration will result in treated effluent being discharged to Ludmilla Creek rather than untreated. Untreated bypass will be directed to the outfall. This is a 300% improvement in the hydraulic capacity and will require significant peak wet weather events to increase the influent flows to greater than 87.5 ML/day before there are discharge event into Ludmilla Creek.

Management strategies for biting insects are described under Section 7.3.2 of the draft PER (PWC, 2011a), with a draft Biting Insect Management Plan provided as Appendix P to the draft PER (PWC, 2011a). The draft Biting Insect Management Plan will be reviewed in consultation with NRETAS and the Department of Health, Medical Entomology.

The Medical Entomology unit should be notified of any overflow events as extensive mosquito breeding can be supported by nutrient rich water as have been found previously behind the Ludmilla plant, indicated by the results of our routine adult trap and confirmed by subsequent field investigation.

Noted.

SECTION 8

Modelling, Marine Water and Sediment Monitoring Program



8 Modelling, Marine Water and Sediment Monitoring Program

8.1 Comment 3 (NRETAS)

Water quality: Outfall mixing zone, Impacts on species and ecosystems, Impacts on recreation areas.

No information was provided in the PER on the timing of the upgrade at the Ludmilla WWTP, although in recent discussions and presentation by PWC it was stated the upgrade would not be complete until late 2012 (timeframes for the construction program of the ERM and EPO are in Figure 2-3). Please provide details on the timing of works in relation to other construction and operational works. The PER states in Section 2.1 that the Larrakeyah outfall would be closed by October 2011. However, a new Waste Discharge Licence for its operation was issued on 1 November 2011 until end of May 2012. If this closure occurs as proposed, this would mean that upgrades at Ludmilla WWTP are incomplete before 3 ML/day of additional effluent is diverted from Larrakeyah (about 30% more than currently treated at Ludmilla).

Further discussion is required on the environmental implications of this timing and the gap in treatment in relation to the discharge location. The existing outfall is in a very shallow and sometimes exposed location, and the current mixing zone is considered poor to nonexistent. The proposed extension of the EPO is not scheduled to come online until the end of 2013, so there is at least 18 months of additional effluent being discharged at the existing EPO, and for six months this will be poorly treated until the upgrades to Ludmilla WWTP are complete. There is therefore likely to be water quality impacts at the existing site and impacts related to the increased volume, including impacts relating to effluent load on shallow intertidal waters.

Some of the claims stated in the PER are not supported by evidence. For example in section 6.6 it is stated that the combined effluent discharge at the existing outfall is “considered unlikely to lead to long term or irreversible changes in the marine environment”. Please support this statement with quantitative data. Please also provide details on the short term impacts that may occur, including impacts to biota and recreation values. Substantiate the claims with data or models.

There is a lack of discussion of water quality impacts throughout the document. Information is required on potential marine water quality impacts that may be associated with the increased loads associated with this proposal and the current operation. Please present data indicating existing water quality in the existing outfall vicinity.

Please provide specific numbers to support ‘significant reduction’ claims for BOD, TSS, P, and E. coli on page 36. (Actually for E. coli the data in tables 6-5 and 6-6 predict an increase in median E. coli concentration from 80 to 1000 cfu/100 mL.)

Please explain how the dilution of raw sewerage during extreme weather by 5-7 times is a “key aspect of plant performance” (page 36) when the plant is being bypassed and raw sewerage is released to Ludmilla creek? The reduction in nutrients and E. coli is due to dilution – i.e. concentration (mg/L) is reduced but load (kg/day) is the same, or more likely higher as the plant is being bypassed and there is no nutrient removal or disinfection. Also on page 36 it is stated that “accurate predictions of treated effluent quality from the upgraded treatment plant are difficult (to provide)”, yet predictions of

8 Modelling, Marine Water and Sediment Monitoring Program

treated effluent quality are available in section 6? Please clarify if these predictions are accurate.

Provide technical information as to how the upgrade to the Ludmilla WWTP will improve treatment performance. The risk assessment section refers to improvements in phosphorous removal, however a capacity upgrade would not achieve this, the treatment process must be modified – what modifications are proposed? Also explain changes in treatment processes that will result in the projected increase in bacteriological parameters. How are the reductions in N and P achieved that are described in Table 6-6? There is no reference to what is causing this to occur and no mention in the text. Please describe how these reductions will be achieved. It is not clear what the differences between Tables 6-7 and 6-8 are. The figures of total reductions in N and P in the text do not appear to correspond to data presented in these tables.

Identify wet weather bypass points. What (if any) treatment will sewerage receive when bypassed to Ludmilla creek?

The heading for Table 6-6 (p.93) is mislabelled (should be 'predicted', not 'current'). Also please note these levels will only be achieved after the Ludmilla plant upgrade is complete, not if Larrakeyah diversion occurs before plant upgrade is completed (this could be clarified by including diversion and upgrade in the timeline p.31 as suggested above).

On page 94 it is stated that levels of bacteria load will be managed through changes to the disinfection regime. Under what circumstances would levels be managed, and what is the trigger?

The discussion on Lyngbya, phosphorous and nitrogen in Section 6 is largely conjecture and not supported by any data, data analysis, referenced facts, or evidence to support these claims. Please provide:

- *A reference for the Lyngbya information particularly that is P limited in Darwin Harbour - "source NRETAS" is not an adequate reference for a public document. What are other major sources of N (and P) in Darwin Harbour? What are the background concentrations of N and P in Darwin Harbour? How do inputs from Ludmilla WWTP impact on N and P levels in the vicinity of the outfall?*
- *Data analysis (baseline/reference concentrations, inputs, impacted areas, present concentration with current outfall, projected increase with additional inputs proposed) to support the 'conclusion' that the combined outfall will "result in a small additional area of elevated concentrations of effluent parameters about the outfall location". What are the effluent parameters?*
- *The predicted reduction in P concentrations in the vicinity of the outfall.*
- *A reference to the claim that WWTPs are the major source of P in Darwin Harbour, again, "source NRETAS" is not a valid reference.*

In Section 6 (p 92) the statement "It is noted that the combined discharge will not include any industrial waste, i.e. heavy metals or other chemical contaminants," appears to have no data backing these claims, and yet Appendix Q reports that copper, mercury,

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*nickel and zinc levels can exceed ANZECC Guidelines in Ludmilla WWTP effluent. It is likely that there are many businesses operating in the catchment that contribute to Ludmilla WWTP. There is also work (not presented in the PER) of substantial increases in sponge tissue (eg *Spherospongia vagabunda*) on heavy metal accumulations from the Larrakeyah outfall in studies by Charles Darwin University staff (Anna Padovan pers comm. with Aquatic Health Unit). Please provide data or justification on why these pollutants are not included in the PER. Please also provide a catchment map of the whole Ludmilla WWTP catchment identifying sectors such as residential, industrial and commercial.*

Please provide a justification in the supplement for the changed level of treatment of sewerage at the Ludmilla WWTP from the previously assessed (1998) secondary and tertiary treatment level.

In response to the query on the construction program, please refer to **Section 2.9, Comment 23 (NRETAS)** and the program in **Figure 2-2**.

Please refer to **Section 2.5, Comment 15 (NRETAS)** and **Section 2.7, Comment 19 (NRETAS)** for information regarding upgrades to the Ludmilla WWTP, and its expected performance.

In regard to Tables 6.6 and 6.7, please refer to **Section 0, Comment 15 (NRETAS)**. Due to a report production error, Table 6.7 was duplicated in the draft PER (PWC, 2011a). **Table 6-1** of this Supplement presents updated daily loadings for the existing, and predicted combined pre-upgrade and combined post-upgrade discharges from the EPO.

Please refer to **Section 2.6, Comment 17 (NRETAS)** for information regarding modelling and the potential environmental impact of using the existing outfall following the duplication of the rising main. A full description of the hydrodynamic and water quality model used, its limitations, assumptions, development processes, calibration and application is provided in **Appendix B1, Hydrodynamic Modelling of Darwin Harbour, 2005 – 2010, History, Development & Interpretation, Report No. 4**.

The model has been applied to the current outfall location at East Point for effluent discharge scenarios to allow comparison of pre- and post-Larrakeyah diversion and treatment plant upgrade (refer **Attachment B2, Hydrodynamic Modelling of Darwin Harbour, Modelling Results**).

8.2 Comment 4 (NRETAS)

Modelling

There is no information presented in Section 4 on existing modelling of the current environment, and section 6 contains very limited information on some modelling undertaken. Modelling that was provided in Section 6 and Appendix Q was not supported by any details to assist in understanding how it was produced or how the conclusion “discharging the combined Larrakeyah and Ludmilla WWTP (upgraded) effluent streams through the EPO will result in a small additional area of elevated concentration of effluent parameters about the outfall location” was reached.

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Modelling referred to on page 94 provides no details as to what modelling, methods, assumptions, which model, parameterisation etc. has been undertaken, and no data on existing water quality monitoring in the existing outfall vicinity. There is no detailed information presented on existing modelling of the current environment. Appendix Q also has some results on modelling (Plate 3-1) presented, but appears to have no relation or reference to the text. There is no interpretation presented. Please provide details on the following:

- *What modelling program was used?*
- *What is being modelled?*
- *Why was copper used as a parameter and why is it conservative? The only indication that copper was used is provided on the figure itself – no other explanation in the text is provided.*
- *How does copper behave (fate) in marine environments and is this different to nutrients / ammonia or other parameters of interest/concern in effluent?*
- *What was the input parameter (initial concentration)? What factors/conditions/inputs were used in the model?*
- *What is the dilution profile, how was this derived?*
- *Does the discharge velocity change with the new rising main and increased discharge volume compared to existing?*
- *What specific hydrological conditions were used, and justify why these were used (i.e. worst case scenarios)?*
- *Using the plume model, what habitats are impacted and what species would be impacted? How are EPBC listed species impacted?*
- *Will any recreation areas be impacted? Will there be any odour issues for recreation areas or housing?*
- *How is compliance area defined (what standards and parameters)?*
- *Provide data (distance from outfall or area of impact) to support the claim of a 'relatively small' increase in compliance area.*
- *What effect might the increased contaminant loads have on the mixing zone?*
- *What effects might the increased contaminant loads have on marine waters in relation to water quality objectives?*
- *What are the scenario assumptions and conditions?*
- *For Figures 6-2 and 6-3 please use same scale for both figures. Why do these figures differ from plate 3-1 in Appendix Q (this could be explained if the input parameters had been provided).*

Overall the above components are very poorly explained. Some of the claims are not backed up by evidence or stating the source of evidence.

Please provide information on all types of models considered to assess plume dispersion, the advantages and disadvantages of each (including costs) and justification for the selection of the preferred approach. Examples should also be provided depicting cases where the model has been used, the outcomes, any particular problems encountered and how they were resolved. Further clarification is required on the purpose of this model within the context of the PER and the EPO Water, Sediment and Biota Monitoring Program.

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Please refer to **Section 2.6, Comment 17 (NRETAS)** for information regarding modelling and the potential environmental impact of using the existing outfall following the duplication of the rising main. A full description of the hydrodynamic and water quality model used, its limitations, assumptions, development processes, calibration and application is provided in **Appendix B1, Hydrodynamic Modelling of Darwin Harbour, 2005 – 2010, History, Development & Interpretation, Report No. 4**.

The model has been applied to the current outfall location at East Point for effluent discharge scenarios to allow comparison of pre- and post-Larrakeyah diversion and treatment plant upgrade (refer **Attachment B2, Hydrodynamic Modelling of Darwin Harbour, Modelling Results**).

8.3 Comment 5 (NRETAS)

Section 5 - Overall, this section appears to result in a reasonable monitoring program. Further discussion is required on justification of monitoring sites, and why sites closer to beaches e.g. Fannie Bay have not been included. There does not appear to have been presented information on likely or modelled tidal flows, or how proposed monitoring sites have been chosen in relation to modelling results. This should be further discussed in the supplement along with substantiation of whether the current sampling design is sufficient to adequately determine what impacts the proposal may have. The EPO Water, Sediment and Biota Monitoring Program in Appendix Q provides for a multiple lines of evidence approach to assessing potential environmental impacts. It is recommended the addition of near shore sampling points that reflect the plume dispersion model provided in the PER, or any updated model.

The Draft Water and Sediment Monitoring Program presented as Appendix Q to the draft PER (PWC, 2011a) is designed to address a number of potential future discharge locations, and includes monitoring of the existing EPO and surrounds. The number and location of sites selected for monitoring has been determined by the potential outfall locations and the modelled dispersion under atypical (90th percentile) discharge conditions, which determine the likely dispersion of wastewater substances where they may occur at above guideline concentrations. It has been assumed in designing the monitoring program that the number and location of ongoing monitoring sites would be refined once the final outfall location was selected and modelling completed.

Specialised testing of the foreshore water around Fannie Bay beaches in mid-June 2010 by NRETAS indicated that the *E. coli* responsible for elevated bacterial counts appeared not to have been related to the Larrakeyah and Ludmilla outfalls. While sewage outfalls may increase bacteria loads to receiving waters, it is considered that during normal operation, bacteria present in discharge waters would be unlikely to survive in marine waters in sufficient quantity to impact on the water quality of beaches in the region (DHBWQ Task Force, 2011).

PWC will continue to monitor in accordance with the conditions of its WDL, including any amendments, and will continue to publicly report the results. This will include reporting of the results of the expanded monitoring program being undertaken as part of the ERM upgrade and EPO extension.

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Modelling undertaken by PWC as part of these responses (PWC, 2012a) shows that bacteria (*E. coli* and Enterococci) at above guideline levels under existing and proposed future scenarios are not predicted beyond the East Point area. The routine beach health monitoring program, which includes sites to the south (East Point Reserve, Vestey's Beach, Mindil Beach, Little Mindil and Cullen Bay Beach) and north (Nightcliff Beach [2 sites] and Casuarina Beach) of the outfall is considered adequate to address this issue beyond the immediate area of monitoring around the outlet.

PWC propose to review the draft Water and Sediment Monitoring Program, attached as Appendix Q to the draft PER (PWC, 2011a) as part of the PER for the proposed EPO extension / replacement project. The review will be based on additional information and technical reports currently under development of the aforementioned project.

Provisions for data sharing with NRETAS should be outlined in the supplement. Additional monthly and time series water quality data in this area would be very valuable and help inform current monitoring of seagrass and corals by the Marine Biodiversity Unit.

WDL 150-1 (NRETAS, 2011a) makes provision for periodic reporting to the Executive Director, Environment and Heritage Division. PWC will provide to the Executive Director, Environment and Heritage Division, a Quarterly Report including a tabulation of field results and analytical parameters required as a condition of WDL 150-1 (NRETAS, 2011a). Quarterly reporting will be in accordance with the schedule under R3.2 of the WDL 150-1.

8.4 Comment 14 (NRETAS)

It is noted that the explanation of objectives, benefits and justification is addressed quite well. As is the maximum operational and discharge capacity.

However, there appears to be a lack of raw data on the characteristics of the waste before and after treatment. While secondary data is provided in tables and broadly discussed, there is no detail on the seasonal change on the influent and effluent.

The existing monitoring of water quality is tied to the discharge licences and a summary is provided in the Draft Water and Sediment Monitoring Program. This mentions a more intensive water quality monitoring program started in 2010 aimed at obtaining data on the effect of discharge on the marine environment. Raw data is not provided from this program either.

If Harbour wide modelling of water quality has been conducted, there is no discussion within the PER on this.

How this guideline could be met:

- *Raw data, from previous sampling activities, on the characteristics of both the effluent and influent would need to be provided, which would also show the seasonal changes in quality.*
 - *Harbour-wide water quality modelling would need to be discussed, including how previous data has been incorporated.*
-

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Please refer to **Appendix M, East Point Outfall Monitoring Data (2011)** for raw data from sampling activities during 2011.

Note: During a meeting with NRETAS on 12 January 2012 clarification was requested regarding the request for raw data. PWC indicated that this data can be provided subject to confidentiality agreements. Concern was raised regarding the supply of data and the possible “out-of-context” use, i.e. data interpreted without due considerations for statistical anomalies, climate conditions, sampling errors, etc. PWC noted data was provided to NRETAS under the WDL 150-1. See **Section 8.3, Comment 5 (NRETAS)** above. PWC has provided a summary of effluent quality data, including seasonal summaries, in **Appendix B, Hydrodynamic and Water Quality Modelling**.

8.5 Comment 16 (NRETAS)

The area being considered for water quality monitoring is potentially limited, and without a discussion on hydrodynamic modelling, it is not possible to understand whether or not the sites being proposed for monitoring are sufficient for effective Harbour-wide water quality modelling.

How this guideline could be met:

- *Harbour-wide hydrodynamic modelling would be required so as to properly assess whether the proposed ‘Harbour-wide’ water quality monitoring regime is sufficient.*
- *If appropriate, it would be acceptable to draw from existing data and modelling, and discuss how this existing information applies to the Effluent Rising Main proposal.*
- *If the hydrodynamic modelling suggested that more monitoring sites are required, a discussion on where these would be placed and why it is needed.*

PWC and CDU have developed a Harbour-wide hydrodynamic model (refer **Appendix B, Hydrodynamic and Water Quality Modelling**) and participate in a Harbour-wide water quality monitoring program by conducting regular monitoring at and around all PWC outfall locations.

The water quality monitoring program associated with this proposal is restricted to the area of potential impact resulting from discharge at the outfall, as determined by the hydrodynamic modelling. Additional monitoring sites have been identified for monitoring based on habitat surveys (refer Appendix Q, draft Water and Sediment Monitoring Program in draft PER [PWC, 2011a]).

PWC is a stakeholder in the Darwin Harbour Integrated Monitoring and Research Program, which is expected to guide harbour-wide programs in the future.

Modelling undertaken for the existing and proposed East Point Outfalls (refer PWC (2012) enclosed in **Appendix B2, Hydrodynamic Modelling of Darwin Harbour, Modelling Results**) indicates that the area of monitoring is appropriate to both scenarios. It is noted that substances present in the wastewater stream, where detectable, are unlikely to be able to be attributed to a specific source outside of the identified monitoring area.

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8.6 Comment 18 (NRETAS)

Established link between hydrodynamics, sediment, flocculation, and nutrient dynamics within Darwin Harbour at current and future discharge scenarios based on empirical evidence. This is not discussed to any significant extent.

How this guideline could be met:

- *First, Harbour-wide hydrodynamic modelling would be required (use existing data if appropriate)*
- *The current situation would need to be discussed, drawing attention to how the hydrodynamics, sediment, flocculation, and nutrient dynamics operate with current waste discharge volumes and qualities.*

A harbour wide investigation of sediment heavy metal levels was undertaken by (Fortune, 2006). Available sediment data for the East Point area (i.e. not specific to the EPO location) shows no significant elevation in heavy metals relative to other harbour sites. Sediment nutrient investigations indicate that sediment nutrient accumulation has been associated with one tidal creek wastewater outlet (Buffalo Creek) but not with outlets in a well flushed tidal creek (Williams and Wolanski, 2003; Smith & Haese, 2009). The EPO, which is located in an exposed, well flushed section of the outer estuary, is less likely to experience nutrient accumulation. Specific investigation of sediments about the outfall location is proposed as part of the EPO Water Sediment and Biota Monitoring Program (draft PER Appendix Q, Draft Water and Sediment Monitoring Programme [PWC, 2011a]).

- *Future scenarios would need to be discussed, outlining the effects that the change in discharge would have within Darwin Harbour.*
- *Future scenarios should consider future population projections.*

In the short term the net discharge to the Harbour from the EPO will be no greater than the existing discharges from the Ludmilla and Larrakeyah WWTPs. This will include the period up to and beyond the completion date for the Ludmilla WWTP upgrade. Modelling is being undertaken up to the year 2030 for a range of discharge locations and scenarios. This work, which is presently being used to inform the selection of options for the relocation of the EPO extension, will be presented as part of the PER for that project.

- *Modelling and scenarios would need to consider seasonal changes in the hydrodynamics of the harbour and the waste discharge would be essential to understanding the links.*

Please refer to **Appendix B, Hydrodynamic and Water Quality Modelling** for additional information on the modelling and modelling scenarios.

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8.7 Comment 29 (NRETAS)

This guideline was written prior to the Darwin Harbour Advisory Committee's Darwin Harbour Strategy was released in 2010. The management plan is listed in the PER under Section 1.4.3 Other Regulatory Obligations ("It sets out goals, principles and guidelines for all users and stakeholders of Darwin Harbour") but there is no discussion on how this project or the Strategy will operate together.

How this guideline could be met:

- *Discuss how this project fits with the "goals, principles and guidelines" of the Darwin Harbour Strategy for the management of Darwin Harbour.*
- *Water quality issues would be of principal interest.*

The upgrading of the ERM is one component of the proposed works currently being undertaken or proposed by PWC to improve the levels of treatment, and hence the quality, of wastewater discharged to Darwin Harbour from PWC wastewater treatment plants. These include the closure of the Larrakeyah outfall from which untreated effluent was discharged, the upgrading of the Ludmilla WWTP (in progress) and the proposed upgrading of the ERM, and the planned future extension of the EPO to a sub-tidal location with improved dispersion characteristics and lower potential for shoreline impacts.

The process of improving the quality of wastewater discharges is consistent with Goal 1, section 1.4 of the Darwin Harbour Strategy which states:

"Water quality and ecological health of the marine, freshwater and terrestrial catchment environments in the region are to be maintained or, if quality and health have been negatively affected through human activity, improved where possible."

8.8 Comment 52 (NRETAS)

The information about likely fate of suspended solids (transport and sedimentation of flocculent and macerated material) is not clearly available in the PER.

How this guideline could be met:

- *Discuss the likely fate of suspended solids (i.e. what will happen with suspended solids after they enter the marine environment?).*
 - *This may require hydrodynamic modelling to be undertaken (use existing data if appropriate).*

Summarised water quality data for the years 2004 to 2010 for the EPO is presented in PWC (2012b) enclosed in **Appendix B, Hydrodynamic and Water Quality Modelling**. Reported TSS values for the EPO are as described in **Table 8-1**.

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Table 8-1 Reported TSS Values for the EPO

TSS (mg/L)		
All samples	Median	84
	90%ile	153.8
	No. of samples	147
Wet season (Nov-Apr)	Median	62.5
	90%ile	118
	No. of samples	76
Dry season (May-Oct)	Median	105
	90%ile	157
	No. of samples	71

The Environmental Quality Objectives (EQO) for TSS in Darwin Harbour (Aquatic Ecosystem Protection) is: Maintain TSS <10 mg/L. The values reported from the outfall location exceed the guideline by a factor of between 6 and 16.

Modelling of TSS has not been undertaken, however for comparative purposes reference may be made to the modelled dilution envelopes for zinc (current effluent Ludmilla only, atypical flow, which exceeds the water quality guideline by a factor of 6.6) and total nitrogen (combined effluent, post-upgrade, typical flow, which exceeds the water quality guideline by a factor of 68).

The total nitrogen, combined effluent, post-upgrade, typical flow, envelope, which considerably exceeds that for TSS, is the smallest for which a far-field dilution envelope is shown.

Based on the above it can be predicted that wastewater discharged from the outfall will meet the TSS guideline within a short distance of the outfall.

Power and Water has been monitoring water quality at a number of sites around East Point since late 2010. Refer to the Draft Water and Sediment Monitoring Program Appendix Q (PWC, 2011a) for site location. This information, presented in Appendix M, shows that TSS is generally below 10mg/L at all sites away from the current outfall (SLUEP01). Anomalous results in March 2011 are likely to be due to widespread turbidity in the Harbour at that time.

8.9 Comment 53 (NRETAS)

How nutrient loads compare with Darwin Harbour water quality objectives, and if nutrient loads will be improved through current capital works has not been discussed. However the waste discharge licence is discussed. More detail is needed to make a proper assessment of how the nutrient loads compare with the Darwin harbour water quality objectives.

How this guideline could be met:

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- *When discussing water quality, nutrient loads, licence requirements etc, make explicit how they interact (i.e. tie water quality objectives with the projected nutrient loads, BOD, TSS, pH etc).*

It is understood that the Darwin Harbour Water Quality Objectives (WQO) are used as local trigger levels to allow the assessment of water quality, rather than for load-based assessment. There is no specific WQO for BOD and TSS for the area around East Point.

A hydrodynamic model has been used to assess water quality in relation to a number of indicators of the WQO (refer **Appendix B2, Hydrodynamic Modelling of Darwin Harbour, Modelling Results**). Mixing zones for a number of parameters, including nutrient indicators (Total Nitrogen and Total Phosphorous), have been developed to represent the predicted areas around the existing outfall where the management goals of the ambient waters are not achieved.

The Darwin harbour water quality objectives indicate that total maximum pollutant loads for N, P and TSS will be developed through the WQPP for the Darwin Harbour region using catchment loads data and modelling approaches (i.e. they have yet to be determined).

As indicated in the draft PER Table 6-7 (PWC, 2011a), the combined effluent post-upgrade nutrient loading will decrease.

8.10 Comment 76 (NRETAS)

The predicted extent that treated sewerage may drift in currents beyond the mixing zone and if local beaches or recreation areas would be impacted by effluent has not been adequately described in the PER. Modelling provided has not been substantiated, and no discussion on likely impacts beyond the immediate discharge site.

How this guideline could be met:

- *Provide details of modelling results with updated maps.*
- *Provide a discussion on impacts beyond the mixing zone.*

Hydrodynamic modelling has been used to determine mixing zones for relevant operating scenarios for the declared Beneficial Uses of Recreation and Cultural uses.

Mixing zones are defined as explicit areas where the management goals are not achieved. The outer limit of the mixing zone represents where the water quality objectives are met, and therefore the declared Beneficial Uses are maintained.

Please refer to **Appendix B2, Hydrodynamic Modelling of Darwin Harbour, Modelling Results** for a detailed discussion on hydrodynamic modelling and maps of the mixing zones associated with the existing outfall location for relevant operating scenarios.

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The following extract describes the extent of the mixing zones in relation to cultural uses:

Cultural Use – Recreation

Primary contact – There is no mixing zone expected for typical operations for all operating scenarios. There is a mixing zone for *E. coli* for atypical operations which increase slightly for combined catchment discharge scenarios. The zone is small for Red Mode conditions (closed for swimming) and does not encroach on the coastline. For Amber Mode (swimming still permissible with increased monitoring) there is a larger mixing zone for *E. coli* which does reach the coastline however it is confined to the northern side of East Point where there is limited opportunity for primary contact. Levels of *Enterococci* are below trigger levels for all scenarios.

Secondary contact – There is no mixing zone for typical operations for all scenarios. There is an extremely small mixing zone for *E. coli* for atypical operations, which is restricted to the direct vicinity of the outfall.

Cultural Use – Aquatic Foods

There is no mixing zone or impact shown for typical operations. For atypical operations, a mixing zone exists which comes into contact with the coastline. The mixing zone increases slightly for the combined discharge, however the area is restricted to the north side of East Point and does not extend to the intertidal rock-shelf area.

8.11 Comment 78 (NRETAS)

The Draft Water and Sediment Monitoring Program is based on the East Point Effluent Rising Main and extension of the EPO (Appendix Q, p. 16). Hence, much of the monitoring program suggested is in relation to the extension of the EPO, not on the action proposed in this PER.

How this guideline could be met:

- *Discuss how that the Water and Sediment Monitoring Program that has been developed is applicable to the current proposal,*
 - *Include a discussion on how this is still appropriate if the extension of the East Point Outfall does not eventuate.*

While planned around an extension of the EPO, the Draft Water and Sediment Monitoring Program presented as Appendix Q to the draft PER (PWC, 2011a) is designed to address a number of potential future discharge locations, and includes monitoring of the existing EPO and surrounds. This program includes a number of investigations designed to assess the impacts of the existing EPO (water sediment and biota investigations) which could be extended into long term monitoring in the event that the outfall location were to remain unchanged. It has been assumed in designing the program that the number and locations of ongoing monitoring sites would be refined once the final outfall location was selected.

The Draft Water and Sediment Monitoring Program will continue to be updated as further environmental and outfall design data becomes available.

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8.12 Comment 79 (NRETAS)

The Power and Water Corporation 2004 Trade Waste Management System – Trade Waste Acceptance Guidelines for listed wastes are contemporary with current acceptable discharge levels has not been discussed.

How this guideline could be met:

- *It would be necessary to discuss how PWC's Trade Waste guidelines are in line with contemporary practices and standards.*
 - *Possible areas to consider are whether any reviews of the guidelines have taken place or whether there are any international/national trade waste standards that PWC's guidelines are based.*
- *More information on Trade Wastes should be provided, potentially add a paragraph devoted to dealing with Trade Waste.*
 - *If no trade wastes are going to enter the sewerage system, this should be explicitly discussed, including how this is ensured and what monitoring is conducted to ensure this.*

PWC has a separate Trade Waste management system to manage the Trade Waste to sewer (see **Appendix N, PWC's Trade Waste Guidelines**). PWC's Trade Waste guidelines (2004) comply with Australian based standards, including the *Water Supply and Sewerage Services Act* (2000). As an associate member of Water Services Association Australia (WSAA), the industry body supporting the Australian Urban Water Industry, PWC has facilitated collaboration, knowledge sharing, networking and cooperation within the urban water industry of Australia. As part of WSAA, PWC has been associated with implementing standardisation of industry performance monitoring and benchmarking.

Trade Waste is a wastewater generated by commercial, trade, industrial or experimental processes that are discharged to PWC's sewerage system. It may contain chemicals, fats and detergents and typically results from washing, cleaning or rinsing processes.

PWC is currently implementing a comprehensive tracking database of Trade Waste, the 'Trade Waste Database', compiling information regarding permits and agreements, inspection reports and site visits. The Trade Waste Database also has its own risk ranking system to objectively rank the risk of Trade Waste. The perceived risk of a Trade Waste discharge is based on the quantity of Trade Waste discharged, the type of activity/business generating the Trade Waste, the complexity of any pre-treatment equipment, the substances being discharged and the compliance history of the Discharger, and the risk is ranked from 1 to 5, dictating the number of site visits, the length of the licence etc. As an example, a ranking of 1 (highest risk) will dictate site visits every six to eight weeks, whereas a ranking of 5 (lowest risk) will dictate a site visit once a year. The Trade Waste database is adopted from a similar database generated in Victoria.

Where the concentration of a Trade Waste characteristic is found to, or is reasonably likely to exceed the Acceptance Guidelines (see **Appendix N, PWC's Trade Waste**

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Guidelines), on-site treatment equipment, in general, must be installed to pre-treat the trade waste prior to it being discharged to the sewer.

No non-compliant trade waste is discharged into the sewerage system through the existing East Point ERM or the proposed duplication. For a business to discharge trade waste to sewer a permit/agreement must have been issued and constituents of concern must be below limits of permit/agreement. PWC commissioned a program to consult with companies that have the potential to produce trade waste. Where appropriate these companies are being licensed under the PWC Trade Waste Agreements and Permits. Regular inspections and sampling is conducted by PWC to ensure compliance to the Trade Waste Agreements and Permits. In 2011, 750 site visits were undertaken and it is PWC's objective to meet this year's target of 1000 visits. Some non-compliance have been noted and addressed by PWC. The action to non-compliance could be installation of additional pre-treatment equipment and sampling pre- and post-installation undertaken to ensure constituents of concern are below limits before discharge to sewer.

The concentration of any characteristic of the Trade Waste discharge will be determined from representative samples analysed by a NATA accredited laboratory (NTG LabMark Laboratory). Samples must be collected from the actual Trade Waste that is being discharged to Power and Water's Sewerage System, that is, before the connection to the sewer but downstream of any pre-treatment equipment. The frequency of sampling is dependent on the perceived risk of the Trade Waste Discharge. Some Trade Waste characteristics may need to be sampled on a continuous basis by the Discharger (self-monitoring by customer). The perceived risk of a Trade Waste discharge is based on the quantity of Trade Waste discharged, the type of activity generating the Trade Waste, the complexity of any pre-treatment equipment, the substances being discharged and the compliance history of the Discharger (PWC, 2004).

8.13 Comment 81 (NRETAS)

What pollutants (Trade Wastes listed in the Power and Water Trade Waste Management System or listed wastes under the Waste Management and Pollution Control Act) are anticipated to enter the sewerage system as future growth in light industry expands within the Ludmilla WWTP sewerage catchment. Identify which industries discharge which pollutants or Trade Wastes have not been discussed.

How this guideline could be met:

- *It would be necessary to identify what industries and the associated pollutants may enter the sewerage system now and into the future.*
- *If there is a strict policy that prohibits trade waste from entering the system, this should be outlined.*

No non-compliant Trade Waste is currently discharged into the sewerage system through the existing East Point ERM or the proposed duplication. Compliant Trade Waste is below the limits set in the Agreement/Permit before discharged to the sewer.

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A future growth in light industry is not anticipated within the Ludmilla WWTP sewerage catchment. The trend is that light industry moves to less densely populated areas, such as Berrimah and East Arm, as residential areas expand. This is a consequence of the public perception of industries having an impact on the value of residential properties, and the price on land typically increases as area becomes more densely populated. If that is the case, then an increase in food premises is anticipated, thus an increase in food related waste, such as grease trap waste.

If PWC is not certain an application for a permit or agreement can be met, the application is rejected and the trade waste has to be transported to facilities interstate to be treated. As an example PWC does not have the facilities to treat noxious waste, therefore this type of Trade Waste has to be transported interstate (See **Section 9.2, Comment 80 [NRETAS]**).

8.14 Comment 82 (NRETAS)

If any pre-treatment ponds will be used to extract noxious trade wastes from effluent prior to standard treatment techniques or if any effluent improvement programs will be introduced in the NT it has not been discussed.

How this guideline could be met:

- *Describe what, if any, pre-treatment ponds will be used to extract noxious trade wastes from effluent prior to standard treatment.*
- *If no pre-treatment ponds are to be used, discuss how the current treatment techniques, compliance activities, and safe guards are in place to ensure trade waste does not enter the marine environment.*

No non-compliant Trade Waste is currently discharged into the sewerage system through the existing East Point ERM or the proposed duplication. Compliant Trade Waste is below the limits set in the agreement/permit before discharged to the sewer. Ludmilla WWTP does not have the facilities, including pre-treatment ponds, to treat noxious waste.

Therefore, this type of Trade Waste has to be transported interstate to be treated. No permits or agreements will be issued by PWC if the Trade Waste includes noxious waste.

Palmerston WWTP accepts trade waste, such as grease trap waste, in two receiving ponds. PWC is on the 'NT Waste Strategy Steering Committee', its incentive to reduce waste. As an example, PWC is currently reviewing when to stop accepting grease trap waste and businesses generating grease trap waste may need to find an alternative solution to manage their Trade Waste.

The Northern Territory Government is developing a Waste Strategy to achieve the commitment to reduce waste. PWC is participating in the strategy development as a member of the Steering Committee.

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8.15 Comment 83 (NRETAS)

Monitoring of sediment and water quality will be carried out across a range of monitoring sites, and include testing Telescopium and Rock oysters. Monitoring includes;

- *Collection of baseline data*
- *Construction phase surveys*
- *Bi-annual to annual monitoring during operation for three years (and to reviewed at end of this period)*

As described in the draft Water, Sediment and Biota Monitoring Program (see Appendix Q of the draft PER [PWC, 2011a]), monitoring of sediment and water quality will be carried out across a range of monitoring sites, and include testing of *Telescopium* and Rock oysters. Monitoring includes:

- Collection of baseline data
- Construction phase surveys
- Bi-annual to annual monitoring during operation for three years (and be reviewed at end of this period).

The need for toxicity testing will be evaluated on the basis of water and sediment test results.

8.16 Comment 85 (NRETAS)

There are two maps provided that are labelled as demonstrating the conservative dispersion area for both the current volume and the combined volume (after Larrakeyah is diverted to East Point, via Ludmilla WWTP). These two maps are introduced as showing that there will be only a minimal increase in the dispersion area after the effluent is combined. However the maps are deceptive in that they are shown at different scales, so while the area appears not to increase significantly the true scale of the increase is much larger.

There is also a map in the Draft Water and Sediment Monitoring Program of the current typical dispersion area. The current typical dispersion area is by far larger than what is suggested as the conservative area after the effluent discharge is combined. This brings up serious concerns of what is classed as typical and what is conservative (let alone the map scales issue).

How this guideline could be met:

- *Ensure all maps that show the dispersion area are the same scale.*
- *What is actual area expected to be potentially impacted.*
 - *Quantifiable where possible.*

Define what is meant by typical and conservative;

- *When comparing two areas use a percentage to describe the increase.*
- *Discuss the expected area of impact on sensitive marine species.*

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- *This may be far greater than the dispersion area.*

Figures 6-2 and 6-3, presented in Section 6.6 of the draft PER (PWC, 2011a), show the area in which a conservative element, in this case copper, discharged at the existing outfall location is dispersed at the present (9.5 ML/day) and proposed (12.5 ML/day) discharge volume. The edge of the red coloured area is where the concentration meets the ANZECC & ARMCANZ 2000 water quality guidelines under all modelled scenarios (refer **Appendix B2**). It is noted that copper was the only heavy metal present at high enough concentration to generate a far field mixing zone. All other potential toxicants fell below guideline concentrations within the initial mixing zone (i.e. in the immediate vicinity of the outfall location).

Correcting for the difference in scales (shown on the diagrams) the dispersion envelope measured from west to east is 420 m for the existing case and 570 m for the combined discharge case.

Plate 3-1 of the Draft Water and Sediment Monitoring Program shows a typical model output (as opposed to a typical discharge condition) for dispersion from the existing EPO. This figure is again for copper but is based on the predicted flow in 2030, which is approximately 50% higher than the existing combined flow and 100% higher than the existing EPO flow. Again, under these conditions, copper was the only potential toxicant present at concentrations exceeding guideline extending into a far field dispersion zone.

The figure presented as Appendix B to PWC (2012b) - **Appendix B2, Hydrodynamic Modelling of Darwin Harbour, Modelling Results** shows the largest modelled mixing zone in relation to the known distribution of seagrass in the region of East Point. This shows that under modelled conditions all components of the wastewater will be below guideline concentrations before reaching the mapped area of seagrass.

8.17 Comment 87 (NRETAS)

No detail has been provided about the proposed measures to manage and mitigate any identified potential impacts on sensitive threatened and migratory species, with particular focus on management of potential impacts upon (key habitats utilised by) listed threatened species, (measures should also include pest control) and an assessment of the expected or predicted effectiveness of the mitigation measures.

This is a vital concern and much more attention needs to be placed on marine species.

How this guideline could be met:

- *Discuss what species may be impacted.*
- *Discuss what measures are in place to mitigate any potential impacts.*
- *Impacts need to be widely considered, taking into consideration habitat etc.*
- *Once mitigation measures have been identified discuss the predicted effectiveness of the measures.*

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Listed terrestrial species that are both known or could potentially occur in the area, and Shorebirds 2020 data indicating that the area traversed by the most northern section of the proposed ERM duplication corridor is national significant according to the *EPBC Act policy statement 3.21 (Significant Impact Guidelines for 36 Migratory Shorebird Species)* (DEWHA, 2009), are discussed in detail in **Section 4.5, Comment 21 (NRETAS)**.

Section 7, Mitigation, Management and Monitoring of the draft PER (PWC, 2011a) provides information on Mitigation, Management and Monitoring of Impacts of the Proposed ERM duplication and describes PWC's existing Environmental Management Framework. PWC has an integrated management system that is externally certified to meet the relevant international/Australian standards (AS 4801 for occupational health and safety; ISO 9001 for quality; ISO 14001 for environmental management).

Aspects of the environment potentially impacted by PWC activities are monitored and documented, so that the environmental performance of PWC can be reviewed and audited. The level of environmental management stringency applied to the Proposed Development will be detailed in the construction contract and will be required to meet or exceed the standards which currently apply to PWC.

PWC uses three objectives as a basis for its environmental performance:

- 100% compliance with legal and statutory obligations.
- Zero environmental incidents causing environmental harm and operating within licence conditions.
- Zero extreme environmental risks at any PWC facility.

Environmental targets relating to listed species include (but are not limited to):

- Enhance the biodiversity values of land and water that is managed by PWC.
- Protect the ecosystems, plants, and animals that may be vulnerable or endangered.

The Environment, Quality, Health and Safety Policy and supporting objectives and targets inform the development of PWC corporate procedures. Prevention, mitigation and management of potential impacts associated with the Proposed Development would be undertaken in accordance with the existing procedures, proposed mitigation measures and management commitments described in Section 7 of the draft PER (PWC, 2011a).

The following potential impacts that specifically relate to native flora and fauna, including listed species, have been identified in the current *PWC Land Management Procedure* (2008) and as a result of the initial environmental assessment undertaken to advise this assessment:

- Loss of habitat, habitat degradation or further fragmentation due to clearing of areas for the development of infrastructure and access tracks.
- Decreased surface and groundwater quality or altered flow as a result of construction and maintenance activities impacting on riparian habitats.
- Impacts on surrounding habitats due to erosion and sediment deposition from construction activities.
- Potential introduction or spread of weed and naturalised vegetation and pests from vegetation clearing/disturbance and use of vehicles and machinery on site.

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This Procedure covers land management practices that are to be undertaken by PWC on all lands managed by PWC. It applies to new projects and existing facilities. Relevant land management parameters covered by this procedure include:

- Weed management
- Vegetation management
- Fire management.

As described in this procedure PWC recognises that ‘appropriate vegetation management reduces the risk of land degradation such as weed colonisation, wild fire and erosion. It will also generally preserve wildlife in rural and remote areas. Restricting disturbance of vegetation to that within the footprint of a development or facility, and minimising effects on areas immediately surrounding the site will assist good vegetation management’ (PWC, 2008).

The *PWC Land Management Procedure* (2008) states that ‘Project Managers responsible for proposals that require vegetation to be cleared should refer to the Environmental Assessment Process for Projects Procedure to determine potential risks to the environment’. Project Managers are also referred to land clearing guidelines produced by NRETAS for technical advice on planning and undertaking land clearing in the NT and practices to avoid/minimise adverse environmental impact (PWC, 2008)

Throughout the construction and rehabilitation phases of the project PWC will comply with the following DCC plans:

- *East Point Reserve Management Plan* (2009),
- *Draft Weed Management Plan* (2010); and
- *East Point Reserve Agile Wallaby Management Plan* (2005).

Table 8-2 below summarises proposed measures to manage and mitigate any identified potential impacts on listed and migratory species and their habitats, with particular focus on management of potential impacts upon key habitats utilised by listed threatened species, and includes an assessment of the objectives and effectiveness of these measures.

As per PWC’s existing practices, aspects of the environment potentially impacted by the activities associated with the proposed duplication of the ERM will be monitored, monitoring results and records will be documented, and PWC’s environmental performance in relation to the proposed activities will be reviewed and audited.

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Table 8-2 Proposed Measures to Minimise Potential Impacts on Listed and Migratory Species and their Habitats, and Corresponding Assessment of their Objectives and Effectiveness

Proposed Mitigation / Management Measures	Assessment of Objectives / Effectiveness
Minimising the area of mangrove forest areas disturbed for any works.	The area of impact on the mangrove forest will be limited to the edge of this vegetation community. The impacts on terrestrial vegetation and habitat are likely to be lessened because of this, as it is likely that core areas of Mangrove Forest and Mangrove Forest zones not impacted by the pipeline are of greater significance for wildlife (Noske, 1996; Clay and Andersen, 1996). The mangrove habitats directly adjacent to the existing sewerage rising main, Ludmilla WWTP and urban areas are already impacted to some degree by edge effects associated with the land uses including drainage, sedimentation, noise and artificial light. Despite these impacts, the Mangrove Forest area continues to support a suite of mangrove and wetland specialist fauna species, including small numbers of listed migratory shorebirds (Noske, 1996; Clay and Andersen, 1996). It is noted that the mangrove vegetation is connected to larger tracts of remnant mangrove habitat, Ludmilla Creek, to the north and east.
Ensuring that clearing of vegetation for construction and operational activities associated with the Proposed Development will be undertaken in accordance with the NRETAS <i>Northern Territory Land Clearing Guidelines</i> (NRETAS, 2010b). Note: Two sensitive / significant vegetation types identified in these guidelines; the Monsoon Vine Forest and the Mangrove Forest communities, exist within the proposed ERM duplication corridor (and the existing ERM Corridor). Applications will need to be submitted to the NTG to clear these areas.	Whilst it is noted that the vegetation communities of East Point are an important component of the East Point Reserve as a refuge for local fauna in the greater landscape matrix (Franklin <i>et al.</i>, 2010), it is also noted that: • The Coastal Monsoon Vine Forest Community within the proposed ERM corridor is a modified rainforest community largely comprised of regrowth through self-seeding and supplementary plantings by DCC between 1974 and 1984 (Franklin <i>et al.</i>, 2010) and as a result is floristically simplified. This is bordered by managed urban parkland, management tracks and the Model Aeroplane Club grounds. • The Mixed Species Open Forest and patches of Mixed Species Open Woodland regrowth and revegetation within the corridor are in poor ecological condition and are generally disturbed with evidence of weeds and impacts from adjacent urban land uses. The <i>Northern Territory Land Clearing Guidelines</i> (NRETAS, 2010b) state that applications to clear in coastal areas, or in areas subject to tidal influence (e.g. floodplain systems associated with tidal rivers and creeks, Coastal Monsoon Vine Thickets and Mangroves), must be supported by additional information, such as:

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Proposed Mitigation / Management Measures	Assessment of Objectives / Effectiveness
	- Potential, or expected, impacts of the land clearing on sensitive or fragile coastal landscapes and the steps taken to reduce and manage risks. More specific information will be provided on proposed works as part of this application. However it is noted that activities will be undertaken in accordance with existing management frameworks and procedures such as the <i>PWC Land Management Procedure</i> (2008). PWC will comply with the <i>East Point Reserve Agile Wallaby Management Plan</i> (2005) objectives, which include maintaining and enhancing the Wallabies habitat and reducing threats to the population (DCC, 2012) by: - Minimising ground disturbance - Progressively rehabilitating areas of disturbance - Covering open trenches in the evenings. Each of these proposed management initiatives are discussed individually in separate sections of this table,
Wherever possible, PWC will seek to identify opportunities to rehabilitate previously disturbed areas as part of the Proposed Development.	The objective of rehabilitating previously disturbed areas is to enhance the quality of existing habitat and potentially create new ones.
Undertaking significant works in the vicinity of areas where migratory shorebirds in the dry season when most northern hemisphere migrants are absent (May – August).	Impacts will be reduced as most migratory shorebirds will not be present at that time. It is noted that some juveniles and perhaps adults that are not in good condition remain over this time and some birds that are not in good enough condition to make the full migration may turn around and come back.
Strict controls on sedimentation or other impacts that may impact shorebird feeding sites.	The objective of this measure is to limit areas of disturbance and impacts on existing habitats. Operational measures will be put in place to control sediment and other discharges that may impact shorebird foraging areas adjacent to the project area. An Erosion, Sedimentation and Drainage Management Plan (ESDMP) will be prepared for the Proposed Development in accordance with the <i>PWC Land Management Procedure</i> (2008).
Implementing measures to minimise the potential import and / or spread of weeds during construction and rehabilitation. Note: <i>PWCs Land Management Procedure</i> (2008) and DCCs current weed management program, require inspection, identification and control of weeds.	It is considered that Weed Management is required to ensure the protection of native vegetation and sensitive communities and species within the East Point area. PWC and DCC have current weed management programs and procedures that involve regular weed treatment. An assessment of the weed risks in the study area will be undertaken to prioritise management responses in line with <i>PWCs Land Management Procedure</i> (2008) and DCCs current weed management program (Lewis, 2010), which will involve inspection,

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Proposed Mitigation / Management Measures	Assessment of Objectives / Effectiveness
	identification and control of weeds. <i>PWCs Land Management Procedure</i> (2008) includes weed management strategies such as prevention of weed spread through weed hygiene practices, weed assessment and weed control.
Covering the trench each evening to minimise fauna becoming trapped and checking the length of open trench each morning to remove any fauna that has fallen / entered the trench.	This measure is designed to reduce the incidence of injury to fauna from trenching activities.
Putting in place controls to ensure that no cane toad breeding habitats are created during or following construction (e.g. small, still ponded freshwater or brackish areas).	This measure is designed to ensure that there is no increase in the incidence of impact on native fauna from cane toads from the creation of suitable habitats for cane toad numbers to increase.
Progressive rehabilitation of areas, with suitable species, that are disturbed during construction activities, with due consideration of the requirements of fauna species that will potentially recolonise these areas.	The objective of rehabilitating previously disturbed areas is to enhance the quality of existing habitat and potentially create new ones.
Where possible clearing operations will include: • Stockpiling of top-soil to conserve the soil seed bank (where relevant and appropriate given the level of previous disturbance) • Stockpiling of deadwood and woody debris for later return to the rehabilitation area to provide fauna micro-habitat and increase the rate of faunal re-colonisation.	The objective of rehabilitating previously disturbed areas is to enhance the quality of existing habitat and potentially create new ones. Preservation of the soil seed bank will increase the chance of regenerating native species. Depending on its constituents, topsoil can serve a number of important functions including the supply of seed and other propagules, contribution of beneficial micro-organisms, supply of nutrients, and rapid development of groundcover. Preservation of the soil seed bank will increase the chance of regeneration of native species. Stockpiling material such as dead wood and woody debris has been used to provide shelter for small invertebrates and reptiles, erosion protection and nutrient return. Cleared timber has been used to establish shelter in the form of logs and log piles which ground-dwelling species shelter in or under (DITR, 2006).

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8.18 Comment 89 (NRETAS)

The predictions provided in the PER are limited to saying that the increased capacity of Ludmilla after its upgrade will “reduce the number of days that a process bypass (i.e. treatment discharge to Ludmilla Creek) occurs at year 2030”.

How this guideline could be met:

- *Discuss actual expected frequency and volume. How much will it be reduced (obviously this would also require what the current situation is).*
- *What will the nutrient loading be when these events occur?*
- *What effect will this have on the environment?*

A treatment capacity of up to 5×ADWF has been adopted for the development of the Ludmilla WWTP upgrade strategy, thus on average 97.8% of flow for the year is treated. This approach increases the volume of influent receiving treatment and also reduces the number of days that process bypass occurs, thereby reducing the risk that 90th percentile limits will be breached during exceptionally wet years whilst also reducing the impact on receiving environments (Hunter Water, 2009).

The Ludmilla Wastewater Treatment Plant hydraulic capacity has been increased to treat 5 x ADWF or a maximum of 87.5 ML/day. The plant is not expected to overflow into Ludmilla Creek until such times that the inflow reaches this volume. This is not expected to occur until severe wet weather events are experienced. As part of the discharge philosophy the plant will only discharge hydraulically treated and partially chemically treated effluent into Ludmilla Creek rather than raw sewage.

Historical flow data (2005 to 2009) was used to investigate the percentage of total flow treated with various treatment capacities (i.e., 3, 5, 7 & 9 × ADWF capacities). The number of days where flows in excess of treatment capacity were recorded was also determined. A design treatment capacity of 3×ADWF is able to treat >90% of flow for the year, 5×ADWF is able to treat on average 97.8% of flow for the year, 7×ADWF is able to treat on average 99.4% of flow for the year. The number of days where flow in excess of treatment capacity was recorded was 33 days at 3×ADWF capacity, 9 days at 5×ADWF capacity and 3 days at 7×ADWF capacity (Hunter Water, 2009).

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Table 8-3 Expected Nutrient Loading of the Discharge to Ludmilla Creek

Parameter	Units	Current Design Limits (90%ile)	Minimum Design Effluent Quality Targets (90%ile)
Dry Weather Flow	kL/day	11,000	34,500*
Wet Weather Flow	kL/day	30,000	87,500**
Temperature	°C	±5 °C ambient	±5 °C ambient
pH	-	>6	>6
Biochemical Oxygen Demand	mg/L	180	180
Total Suspended Solids (TSS)	mg/L	170	170
<i>E.coli</i>	cfu/100 mL	1×10^7	1×10^7
Total Nitrogen	mg/L	47	47
Free Ammonia	mg/L	33	33
Total Phosphorus	mg/L	15	15
*Including Larrakeyah Catchment		**Based on treating up to 5× (2030 ADWF), including Larrakeyah Catchment	

8.19 Comment 90 (NRETAS)

Although monitoring in Darwin Harbour for health and recreation issues has progressed since the Guidelines were issued, the PER does not discuss how this will integrate with PWC's proposed or current monitoring at East Point, nor does it discuss any of the results of the existing monitoring.

E. coli and *Enterococci* are currently monitored as part of the WDL license requirements and are reported to NRETAS and published on the NRETAS website (http://www.nretas.nt.gov.au/national-resource-management/water/dhac/water_sampling/eastpoint). Results published in 2011 met the discharge licence conditions.

The results of beach water quality monitoring for 2011 for the East Point Reserve site (the closest location to the EPO) showed two readings at the amber alert level ([http://www.health.nt.gov.au/library/scripts/objectifyMedia.aspx?file=pdf/60/61.pdf&siteID=1&str_title=Beach Water Quality 2011.pdf](http://www.health.nt.gov.au/library/scripts/objectifyMedia.aspx?file=pdf/60/61.pdf&siteID=1&str_title=Beach%20Water%20Quality%202011.pdf)). There was no beach closure at the East Point Reserve in 2011 resulting from bacterial levels.

Further, specialised testing of the foreshore water around Fannie Bay beaches in mid-June 2010 by NRETAS indicated that the *E. coli* responsible for elevated bacterial counts appeared not to have been related to the Larrakeyah and Ludmilla outfalls. While sewerage outfalls may increase bacteria loads to receiving waters, it is considered that during normal operation, bacteria present in discharge waters would be unlikely to survive in marine waters in sufficient quantity to impact on the water quality of beaches in the region (DHBWQ Task Force, 2011).

PWC will continue to monitor in accordance with the conditions of its WDL, including any amendments, and will continue to publicly report the results. This will include reporting of the results of the expanded monitoring program being undertaken as part of the ERM upgrade and EPO extension.

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Modelling undertaken by PWC as part of these responses (refer **Appendix B, Hydrodynamic and Water Quality Modelling**) shows that bacteria (*E. coli* and *Enterococci*) at above guideline levels under existing and proposed future scenarios are not predicted beyond the East Point area. The routine beach health monitoring program, which includes sites to the south (East Point Reserve, Vesteys Beach, Mindil Beach, Little Mindil and Cullen Bay Beach) and north (Nightcliffe Beach [2 sites] and Casuarina Beach) of the outfall is considered adequate to address this issue beyond the immediate area of monitoring around the outlet.

SECTION 9

Public Involvement and Consultation



9 Public Involvement and Consultation

9.1 Comment 24 (NRETAS)

It is stated that a Community Consultation and Communication Strategy was developed by PWC. This however is not provided in the PER and where it is discussed, it appears that the strategy is limited to events and actions prior to construction. Potential infrastructure and services that may be interrupted by construction has been discussed elsewhere in the PER.

How this guideline could be met:

- *Include the Community Consultation and Communication Strategy in the PER as an Appendix.*
- *Ensure that the Community Consultation and Communication Strategy include how stakeholders will be engaged throughout the process.*
- *Make particular note of how PWC will communicate specific issues (such as the East Point Bicycle Path).*
- *Include how the Community Consultation and Communication Strategy will be managed throughout the operation of the outfall*

The public involvement and consultation was discussed in Section 9 of the draft PER (PWC, 2011a), supported by the *East Point Outfall Extension and Rising Main Duplication Communication Strategy*, (PWC, 2011b), attached as **Appendix F, ERM Duplication Communication Strategy**.

The heading of phase 3 of the consultation program (Section 9.3 of the draft PER) has been corrected to '*Communication during the construction phase*' not '*Consultation during the public exhibition of the draft PER*'.

Phase 4, communication during the operational phase, was added to the consultation program. Under this phase ongoing consultation with the stakeholders will be addressed according to the WDL 150-01 (NRETAS, 2011a), where the Licensee must develop a communication plan about Licensed Action(s) which includes a strategy for communicating with members of the public who are likely to have a real interest in or be affected by the discharge. The plan must be submitted to the Executive Director by emailing environmentops.nretas@nt.gov.au by 1 July 2012.

The WDL 150-1 notes that the communication plan is to be developed by a suitably qualified person with demonstrated experience in communications consistent with the National Environment Protection (Assessment of Site Contamination Measure) 1999 Schedule B (8) Guideline on Community Consultation and Risk Communication. It further requires:

- The Licensee must keep a legible record of each complaint made to the Licensee or any employee or agent of the Licensee in relation to the Licensed Action(s). The record of a complaint must include details of the following:
 - the date and time of the complaint
 - the contact details of the complainant if known
 - the nature of the complaint and events giving rise to the complaint
 - prevailing weather conditions at the time of the incident

9 Public Involvement and Consultation

- the action taken in relation to the complaint
- any conclusions the Licensee made regarding the cause of the complaint
- any preventative measure put in place to prevent reoccurrence.
- During the term of this licence the Licensee will improve its complaint management system to enable the following details to be recorded:
 - where contact details of the complainant are incomplete, a note or flag to that effect
 - methods, other than telephone calls, by which complaints are received
 - details of follow-up contact with the complainant.
- If no action was taken by the Licensee in relation to the complaint, the reasons why no action was taken.

9.2 Comment 80 (NRETAS)

Compliance activities or public educational programs to ensure a high level of compliance with Trade Waste entering the Ludmilla sewerage network has not been discussed to any significant extent.

What incentives or disincentives are used to divert wastes from entering the sewerage system and into land based waste receptacles has not been discussed to any significant extent. It is stated that the “Water Supply and Sewerage Services Act 2002 (NT) regulates the provision of sewerage and water services in the Northern Territory. The NT Power and Water Corporation must be contacted before any trade waste or noxious waste is disposed to sewer”.

How this guideline could be met:

- *If PWC does not manage Trade Waste issues, discuss how it operates within the context of the Water Supply and Sewerage Services Act 2002.*
- *Again, more information on Trade Wastes should be provided, what activities (e.g. compliance activities or public educational programs) are undertaken by PWC to ensure trade waste does not enter the sewerage system and then enter the marine environment as effluent.*

PWC is licenced by the Utilities Commission under the *Water Supply and Sewerage Act 2000*, to convey, accept and treat domestic waste water. It is an offence under the Act to discharge, without approval from PWC, any substance that is not domestic sewerage into and asset controlled or operated by PWC.

PWC has developed a Trade Waste Management System that provides a framework for administering, accepting and regulating the disposal of Trade Waste. PWC may give written approval, by a Permit or Agreement, to discharge Trade Waste to sewer if it is satisfied that:

- The discharge will not harm the sewerage services infrastructure, treatment processes, the environment or the health and safety of PWC’s personnel, or the public at large.

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- Accepting the discharge will not adversely affect opportunities for the reasonable re-use of bio-solids or treated effluent from treatment processes.
- Sewerage services infrastructure and treatment processes have sufficient capacity to collect, convey and treat the Trade Waste.
- Environmental licence and regulatory compliance requirements are not comprised.

As there is a requirement to manage industrial and commercial waste streams, an occupier of land may discharge Trade Waste if an Agreement exists between PWC and the Occupier. See **Section 8.12, Comment 79 (NRETAS)** for a detailed description of how PWC manages Trade Waste issues.

PWC apply Trade Waste charges according to the quality of the Trade Waste effluent, and the higher the concentration of contaminant, the higher is the Customer charged (See **Section 8.12, Comment 79 (NRETAS)**). The charge will decrease if the quality of the Trade Waste is improved or the volume is decreased (lower risk rating). This is an incentive for the customer to introduce cleaner production principles to improve the quality of Trade Waste discharge.

9.3 Comment 91 (NRETAS)

A mixing zone for the existing outfall has not been substantiated. No communication plan was provided informing the public of the existing outfall or risks to human health of additional effluent.

The PER guidelines relates to the proposed EPO and not the existing PER. As described under **Section 9.1, Comment 24 (NRETAS)** of this Supplement, the Waste Discharge Licence 150-01 requires communication of any potential risks to human health from discharge.

9.4 Comment 93 (DPI)

There are no strategic lands issues with this proposal.

Noted.

9.5 Comment 94 (George Roussos)

The page <http://www.nt.gov.au/nreta/environcomment> does not exist

Noted, correct web address is <http://www.nretas.nt.gov.au/environment-protection/assessment/register>

9.6 Comment 95 (CDU)

The page <http://www.nt.gov.au/nreta/environcomment> does not exist

Noted, correct web address is <http://www.nretas.nt.gov.au/environment-protection/assessment/register>

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9.7 Comment 96 (DLP Road Network Division)

Road Network Division wishes to advise that there are no major Transport concerns with this Draft PER. It does not seem to have direct corridor access implications for NTG roads.

Noted.

SECTION 10

References



10 References

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¹ This work is not an aid to identification but gives brief descriptions of the families and genera of plants. The classification scheme used has recently been adopted at the Northern Territory Herbarium.

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