seafarms

PROJECT SEA DRAGON - CORE BREEDING CENTRE AND BROODSTOCK MATURATION CENTRE

NOTICE OF INTENT FOR AQUACULTURE OPERATIONS

FEBRUARY 2016

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ABBREVIATIONS AND ACRONYMS

AAPA	Aboriginal Areas Protection Authority
AHD	Australian Height Datum
ARI	average recurrence interval
ASS	Acid sulfate soils
BMC	Broodstock Maturation Centre
CBC	Core Breeding Centre
CE	Critically endangered
E	Endangered
EA Act	*Environmental Assessment Act*
EMP	Environmental Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
IPCC	Intergovernmental Panel on Climate Change
Mi	Migratory
MHWN	mean high water neap
MNES	matters of national environmental significance
NOAA	National Ocean Atmospheric Administration
NOI	Notice of Intent
NPV	Net Present Value
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
Paspaley	Paspaley Pearling Company
PASS	potential acid sulfate soils
PLs	post larvae
PSD	Project Sea Dragon Pty Ltd
ppt	parts per thousand
RAN	Royal Australian Navy's
Seafarms ASX: SFG	Seafarms Group Limited
TN	Total Nitrogen
TP	Total Phosphorous
TPWC Act	*Territory Parks and Wildlife Conservation Act 2006*
TSS	Total Suspended Solids
V	Vulnerable
WA	Western Australia
WW3	Wave Watch III

1 INTRODUCTION

Project Sea Dragon Pty Ltd (PSD), a wholly owned subsidiary of Seafarms Group Limited (Seafarms) (ASX: SFG), proposes to develop Project Sea Dragon, a large, fully integrated, prawn aquaculture project located in northern Australia. Project Sea Dragon will be delivered as an integrated production system, providing reliable, long-term, high quality and large scale production of Black Tiger prawns (*Penaeus monodon*). Project Sea Dragon focuses on sustainable land use and integrated design practices to maintain surrounding river and coastal environments and support adjacent agricultural land uses.

Project Sea Dragon is a large project with a long development timeline (approximately seven years) between first operations and full scale operations. It involves a number of facilities located across the Northern Territory (NT) and Western Australia (WA) including quarantine facilities at Exmouth, a breeding program within the Darwin Environs, a grow-out facility at Legune Station, a processing plant in Kununurra and exporting facilities at an established port such as Wyndham or Darwin.

This Notice of Intent (NOI) has been specifically prepared for the development of the Core Breeding Centre (CBC), Broodstock Maturation Centre (BMC) and associated infrastructure proposed to be developed at Point Ceylon in the NT (herein referred to as the CBC and BMC, or the project). Although Project Sea Dragon will be successively developed over a number of stages, this application relates to the full scale development of the CBC and BMC.

This NOI has been prepared based on consultation with the Northern Territory Environment Protection Authority (NT EPA) and review of the 'Draft Guideline for the Preparation of a Notice of Intent' and the 'Guide to writing a "Notice of Intent for Aquaculture" in the Northern Territory'. It includes:

- an overview of project particulars including details of the project proponent, key timeframes, locality, land use history and applicable regulations
- a detailed project description
- a description of development related to the project that is not the subject of this NOI
- a description of the existing environment including:
  - the natural environment
  - significant sites or features
  - cultural heritage environment
  - social and economic environment
- a description of the potential impacts arising from the proposed development
- an assessment of the susceptibility of the project to climate change
- an outline of the measures that will be taken to avoid and reduce impacts
- an overview of the likelihood of significant impacts on matters of national environmental significance protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- a conclusion on whether the proposal is likely to have a significant impact on the environment.

An NOI has been submitted separately for the Stage 1 Legune Grow-out Facility proposed to be located on Legune Station. PSD also intends to submit an independent NOI for the hatchery, proposed for a separate location, possibly in the Darwin environs, but separated geographically from the CBC and BMC.

2 PROJECT DETAILS

2.1 PROJECT PROPONENT

This application is made by Project Sea Dragon Pty Ltd, a wholly owned subsidiary of Seafarms. Project Sea Dragon Pty Ltd company details are outlined in Table 1. Details for the primary contact person for this application are provided in Table 2.

Seafarms is an Australian agri-food company which operates, builds and invests in sustainable aquaculture production platforms producing high-quality seafood. Seafarms is currently Australia's largest producer of farmed prawns – growing, processing and distributing the well-known Crystal Bay Prawns® premium brand. Seafarms has existing operations in Cardwell and Ingham, Queensland, and is a major supplier of prawns to Coles and Woolworths on the east coast of Australia. These farms are serviced by a hatchery near Flying Fish Point (Innisfail), Queensland. The company is one of Australia's largest prawn aquaculture enterprises.

TABLE 1 PROJECT SEA DRAGON PTY LTD DETAILS

Required Information	Details
ACN	604 936 192
Street Address	Level 11, 225 St Georges Terrace, Perth WA 6000 Australia
Postal Address	PO Box 7312 Cloisters Square, Perth WA 6850 Australia
Phone	+61 8 9321 4111
Fax	+61 8 9321 4411
Website	www.seafarms.com.au/project-sea-dragon

TABLE 2 PRIMARY CONTACT DETAILS

Required Information	Details
Name	Chris Mitchell
Title	Executive Director – Seafarms Group Limited
Postal Address	Unit 6 Ground Floor 31-47 Joseph St Blackburn North VIC 3130
Phone	03 9928 5111
Fax	03 9928 5199
Email	Chris.Mitchell@seafarms.com.au

2.2 TIMEFRAMES

Construction of the CBC and BMC is anticipated to commence in quarter 1 of 2017 with commissioning in quarter 4 of 2017.

2.3 LOCALITY, TENURE AND LAND OWNERSHIP

The CBC and BMC are proposed to be located on Portion 3192 at Point Ceylon, on the southern side of Bynoe Harbour (Figure 1). The project site is approximately 120 km by road from Darwin. Portion 3192 on which the project site is located is unregistered crown land owned by the NT Government.

The project will also require the construction of an access road into the site. There are currently two options for the access road into the site. The preferred option is a road that runs north-south from Fog Bay Road. This road will run along an existing road easement between several freehold lots (Portion 2621, 2622, 2608, 2594, 122, 121). The second option is road running east-west from Dundee Road. The road is required to pass through one freehold lot (Portion 2895).

The location of the site is shown in Figure 1 and is described in latitude and longitude in Table 3.

TABLE 3 LATITUDE AND LONGITUDE

	Latitude			Longitude		
Location	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
1	-12	43	0.577	130	34	44.468
2	-12	43	43.736	130	34	43.472
3	-12	44	26.231	130	34	9.941
4	-12	44	37.704	130	33	42.526
5	-12	46	30.855	130	33	4.24
6	-12	48	29.103	130	33	43.728
7	-12	44	38.424	130	33	3.555
8	-12	44	32.939	130	32	17.002
9	-12	43	29.864	130	31	35.187
10	-12	43	15.282	130	31	35.1
11	-12	43	2.382	130	32	16.331
12	-12	42	14.883	130	32	57.807
13	-12	41	49.237	130	32	51.638
14	-12	41	7.034	130	33	21.48
15	-12	41	13.891	130	33	32.73
16	-12	41	42.814	130	33	16.541
17	-12	42	9.117	130	33	38.896
18	-12	42	59.014	130	33	38.039
19	-12	42	57.515	130	34	38.001
20	-12	45	49.413	130	33	3.988
21	-12	45	49.794	130	31	58.7
22	-12	46	7.238	130	31	28.31
23	-12	46	31.413	130	31	28.455
24	-12	48	29.425	130	33	4.965

FIGURE 1 REGIONAL CONTEXT

2.4 LAND USE HISTORY

The CBC and BMC are proposed to be located on vacant unregistered crown land (Portion 3192). Historically the site has had low levels of activity, with current minimal use for recreational fishing and hunting. There are a number of tracks that allow access around Point Ceylon and an open sided shack is present that is occasionally used by local fishers and hunters. No other activities are known to occur on the site.

Around the 1990s, an experimental Barramundi farm was established at Point Ceylon. The proprietors of this development formed the existing single access track from Fog Bay Road and drilled some freshwater wells, two of which are still usable. This farm's concrete foundations, earth wall ponds and a dump site remain in the vicinity of the previously mentioned shack. In the first decade of this century, drilling exploration and sampling was undertaken over much of this lot. Test pitting, water testing and other exploratory works were undertaken circa 2002/3 by Suntay Aquaculture to support the production of their EIS for an aquaculture operation on this site.

Approval under the NT *Environmental Assessment Act* was obtained by Suntay Aquaculture in 2003 for the construction of a land based aquaculture facility on the site. The facility was never constructed and the lease has since lapsed.

2.5 REGULATION

The project will be subject to Commonwealth and Northern Territory jurisdiction. Approvals, permits and licenses under Commonwealth and Northern Territory legislation will be required as described below.

2.5.1 Commonwealth Legislative Requirements

Project Sea Dragon has been accorded 'Major Project Facilitation' through the Commonwealth Department of Infrastructure and Regional Development.

The CBC and BMC will be referred to the Commonwealth Government under the EPBC Act; however, as the project is not expected to have a significant impact on matters of national environmental significance (MNES), it is not anticipated to be a controlled action or require assessment under the EPBC Act. Other Commonwealth legislation which may apply to the CBC and BMC includes:

- *Aboriginal and Torres Strait Islander Heritage Act 1984*
- *Aboriginal Land Rights (Northern Territory) Act 1976*
- *Customs Act 1901*
- *Imported Food Control Act 1992*
- *Migration Act 1958*
- *Native Title Act 1993*
- *Quarantine Act 1908*
- *Export Control Act 1982.*

2.5.2 Northern Territory Legislative Requirements

Project Sea Dragon has been accorded 'Major Project Status' through the NT Department of the Chief Minister.

This NOI has been prepared for the NT EPA to assist in determining whether assessment under the NT *Environmental Assessment Act* (EA Act) is required for the CBC and BMC. Relevant Northern Territory government legislation which may also apply includes:

- *Bushfires Act*
- *Control of Roads Act*
- *Heritage Act*
- *Food Act*
- *Parks and Wildlife Conservation Act*
- *Public and Environmental Health Act*
- *Soil Conservation and Land Utilisation Act*
- *Waste Management and Pollution Control Act*
- *Weed Management Act*
- *Work Health and Safety Act.*

Northern Territory legislative consents and licenses which may be required to be obtained include:

- an aquaculture licence in accordance with the *Fisheries Act*, Fisheries Regulations and subordinate legislation.
- a sacred sites clearance from the Aboriginal Areas Protection Authority (AAPA) under the *Aboriginal Sacred Sites Act*
- a licence to take or use surface water pursuant to section 45 of the *Water Act*
- a waste discharge licence pursuant to section 74 of the *Water Act*
- an environmental protection licence under the *Waste Management and Pollution Control Act*
- a direct sale application pursuant to the *Crown Land Act*
- a permit to clear native vegetation on Crown Land under the *Planning Act*.

2.5.3 Local Government Legislative Requirements

The CBC and BMC are located within the Unincorporated Top End Region. The Unincorporated Top End Region contains those areas in the NT that are not part of an incorporated local government council area and therefore no local government consents or licenses are anticipated to be required for the development of the CBC and BMC.

3 PROJECT DESCRIPTION

3.1 OVERVIEW

The CBC will be used for the development, production and selection of high performing prawn stock. The top performing individual prawns produced at the CBC will be transferred to the BMC to produce commercial numbers of broodstock for use in the hatchery in the Darwin environs. Due to different development timeframes and geographical separation from the CBC and the BMC, the hatchery is subject to a separate NOI.

As depicted in Figure 2 the CBC and BMC are located on the same site but are physically separate for biosecurity reasons. The CBC and BMC are intended to be located in the approximate vicinity of the footprints indicated on Figure 2, but as detailed design progresses the locations of these facilities may move slightly to work in with local topography. There are also a number of common facilities on site that will support both the CBC and BMC. As outlined in Table 4 the total development footprint for the CBC, BMC and common facilities at full scale will be approximately 132 ha.

While this application is for the full scale development of the CBC, BMC and common facilities, infrastructure will be scaled up over time to support increased demand as described below:

- The CBC will be developed and expanded as the Specific Pathogen Free families become available. This will be in order to develop the necessary numbers to optimise breeding (i.e. 400 families).
- The BMC will be developed at a rate necessary to support the commercial hatchery operations and the ultimate demand for juveniles from the grow-out facility.
- Significant support infrastructure (known as headworks) will be developed initially to service the CBC and BMC. These headworks will have a capacity greater than that required by the Stage 1 of the project. As such it will not be necessary to duplicate these headworks with every expansion stage. For example, the seawater supply may only require the addition of another pump within the same pump house, using the original intake pipe.

Descriptions of the CBC, BMC and common facilities are provided below. Information is also provided regarding water supply, storage and discharge, workforce details, access and traffic, and bushfire management.

TABLE 4 CBC AND BMC COMPONENTS – DEVELOPMENT FOOTPRINT

Project Component		Footprint Area (ha) (inclusive of marine footprint)
Broodstock Maturation Centre		39.96
Core Breeding Centre		9.29
Common Facilities	Settlement Ponds	2.70
	Administration and accommodation compound	6.15
	Water storage	3.99
	Intake pipeline	5.53
	Seawater pipeline	11.18
	Discharge channel and/or pipe	13.31
	Biosecurity fence	2.22
	Roads	38.00
Total footprint		132.32

FIGURE 2 DEVELOPMENT FOOTPRINT

3.2 CORE BREEDING CENTRE

The CBC will be located to the east of Point Ceylon near Toss Point (Figure 2) and will be used for the genetic development, production and selection of high performing Specific Pathogen Free prawns. The prawns for the CBC will be sourced from the Quarantine and Founder Stock Facility in Exmouth, Western Australia[1]. At the CBC, families of prawns will be raised in separate tanks to avoid unmanaged cross-breeding and maintain genetic lineage. Once the prawns reach a certain size they will be tagged and combined without compromising genetics. The top individual performers within the top families will be used to supply the BMC and produce commercial broodstock. At full scale production, the CBC will have capacity for up to 400 families[2] of unrelated genetic signatures. The CBC will be fully biosecure and managed in accordance with the requirements of the PSD Biosecurity Manual.

The CBC will comprise between 12 and 16 large modules containing hatchery operations, tanks for rearing prawn stock and external covered grow-out raceways (vertical sided "ponds"). Figure 3 illustrates an indicative floor plan of one module and Figure 4 shows the 3D external view of one module. The majority of activities in the CBC will be contained within the buildings, tanks and enclosures of the module.

At full scale the CBC will cover an area of approximately 9 ha and include the following:

- culture facilities including local quarantine, nursery, on-growing, maturation, conditioning, spawning and hatchery facilities
- ponds and tanks for the storage, settlement and treatment of intake and discharge water
- infrastructure for the reticulation of treated seawater through the culture facilities including filters, pipes, valves and fittings pumps, pump house, electrics, monitoring and alarms, lined reservoirs, coverings (poly tunnels), filtration, water treatment (ozonation, activated carbon and UV) and temperature control
- infrastructure for the supply of low pressure air into tanks and aeration of raceways/ponds
- infrastructure for the storage, growing and/or supply of the various food types (algae, artemia, dry pellets and frozen fish) to prawns
- reticulation of power supplied from the common electrical substation
- back-up supply of freshwater for equipment cleaning, domestic and potable water requirements
- discharge channel and/or piping to transport water to the discharge point
- vehicle wash down point
- local laboratory, office and worker amenities probably in the form of transportable units ("dongas").

3.3 BROODSTOCK MATURATION CENTRE

The BMC will be used to mature the selected post larvae (PLs) and larger broodstock supplied from the CBC. The BMC will be located on high ground to the south of Point Ceylon as illustrated in Figure 2. The young broodstock entering the BMC from the CBC will be Specific Pathogen Free, in good health and brought up to a suitable size and condition for breeding. The BMC will be responsible for the production of commercial numbers of spawners

[1] The Quarantine and Founder Stock Centre will be a biosecure, segregated and controlled facility which allows production, breeding and disease screening to occur, enabling PSD to develop Specific Pathogen Free founder stock for transfer to the Core Breeding Centre.

[2] A family is a related group of animals with a traceable and controlled pedigree and degree of relatedness.

and their mates for the commercial hatchery, which is to be located within the Darwin environs. The BMC will be fully biosecure and managed in accordance with the requirements of the PSD Biosecurity Manual.

The BMC will comprise between 12 and 16 large modules. Figure 5 shows the indicative floor plan of one module and Figure 6 shows the 3D external view of one module. The majority of the activities undertaken at the BMC will be contained in buildings, tanks and enclosures within each module. At full scale the BMC will cover an area of approximately 40 ha and will consist of:

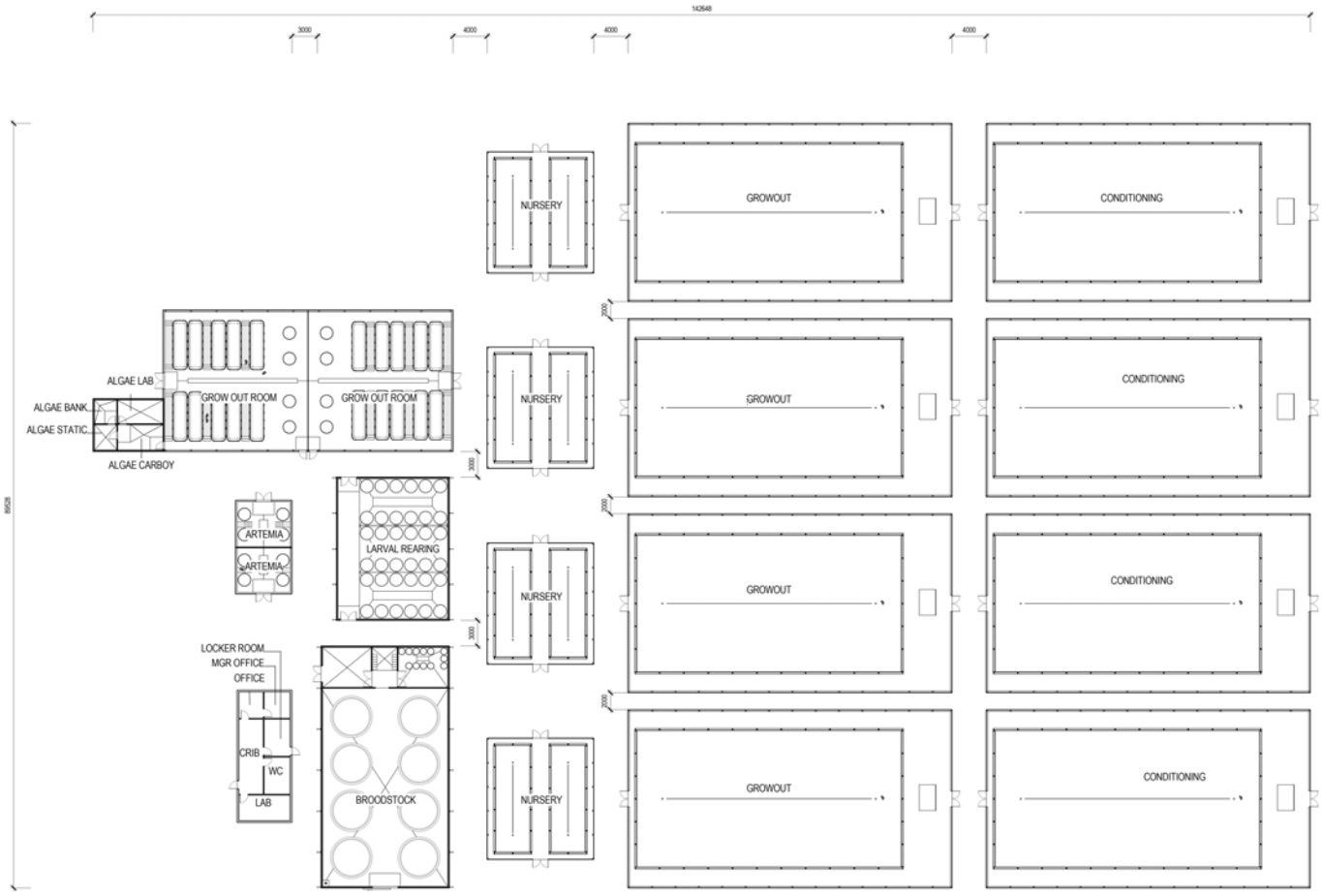
- culture facilities for the maturation, on-growing and conditioning of prawns which will be ponds and raceways typically covered by poly tunnel "houses"
- ponds and tanks for the storage, settlement and treatment of intake and discharge water
- infrastructure for the reticulation of treated seawater through the culture facilities including filters, pipes, valves and fittings pumps, pump house, electrics, monitoring and alarms, lined reservoirs, coverings (poly tunnels), filtration, disinfection treatment (ozonation, activated carbon and UV) and temperature control
- infrastructure for the supply of low pressure air into tanks and aeration of raceways/ponds
- infrastructure for the storage, growing and/or supply of the various food types (algae, artemia, dry pellets and frozen fish) to prawns
- reticulation of power supplied from the common electrical substation
- seawater supply/transfer pipeline to transport water from the intake point and/or settlement ponds
- back-up supply of freshwater for process requirements
- discharge channel and/or piping to transport water to the discharge point
- vehicle wash down point
- local laboratory, office and worker amenities probably in the form of transportable units ("dongas").

3.4 COMMON FACILITIES

Common facilities estimated to cover approximately 83 ha will be shared between the BMC and CBC. These facilities will include:

- biosecurity fence and checkpoint at the entrance of the site
- vehicle wash-downs at the entrance of the site
- water storage tanks and/or desalination plant for potable water supplies
- infrastructure for the supply, storage and discharge of seawater and fresh water (Sections 3.5, 3.6, 3.7)
- all weather access roads into the site and connecting the administration and accommodation buildings, the BMC and the CBC, see Section 3.9
- administration and accommodation compound including:
    - a reception, offices, warehouse and workshops
    - an electrical substation (5 megawatts) - electricity will be distributed to the CBC and BMC either via overhead or underground powerline
    - a manager's residence and accommodation for up to six people
    - onsite septic system for human ablutions waste
    - facilities for the collection, sorting and transfer of other solid wastes to the nearest approved waste station

FIGURE 3 CORE BREEDING CENTRE INDICATIVE FLOOR PLAN OF ONE MODULE



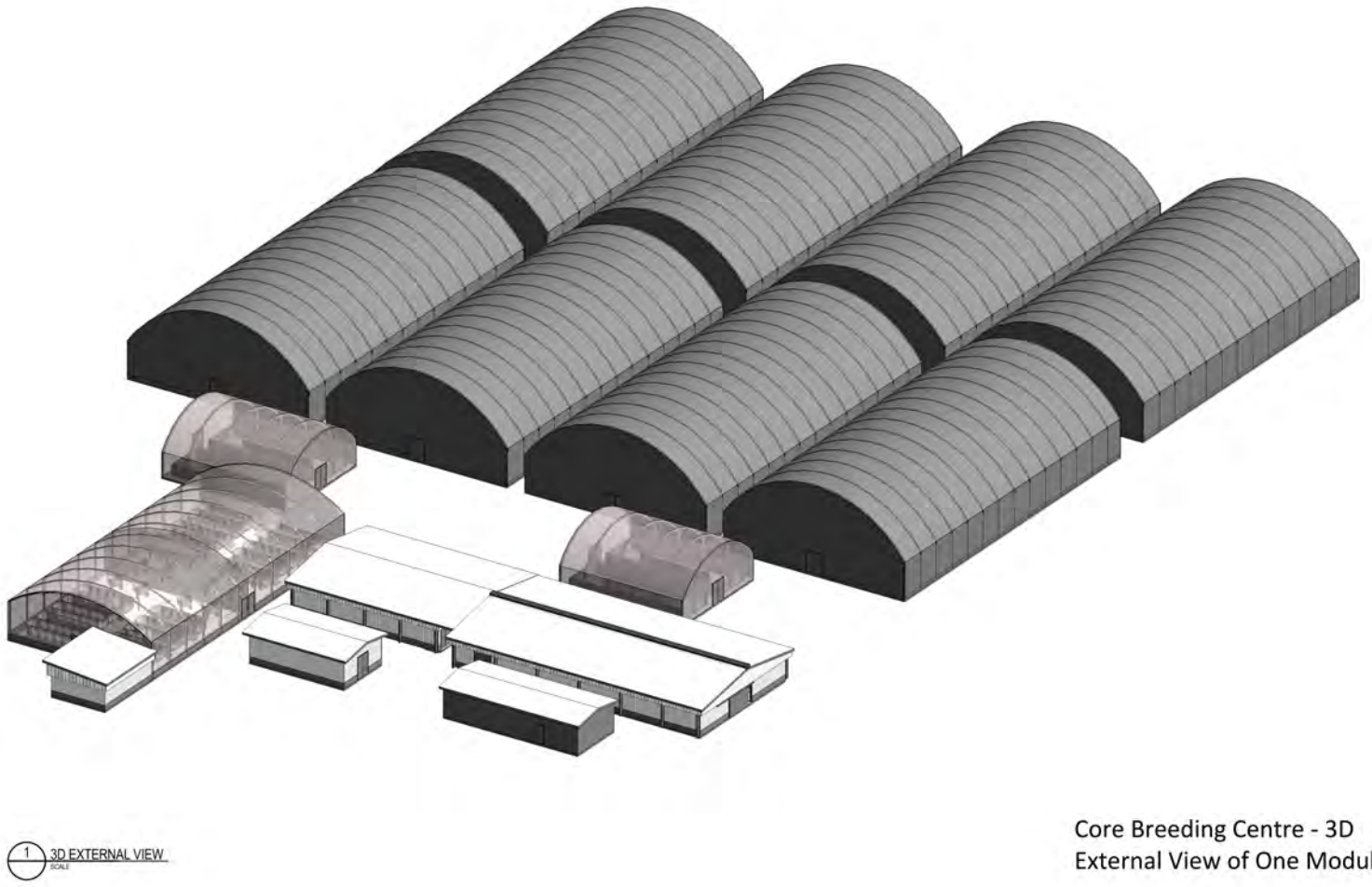
GROSS FLOOR AREA SCHEDULE			
NO.	BUILDING NAME	GROSS AREA	TOTAL GROSS AREA
4x	CONDITIONING	793.2 m2	3172.8 m2
4x	GROWOUT	793.2 m2	3172.8 m2
4x	NURSERY	177.8 m2	711.2 m2
1x	ARTEMIA	72 m2	72 m2
1x	ALGAE LAB & GROWOUT	614.24 m2	614.24m2
1x	OFFICE & AMENITIES	99.2 m2	99.2 m2
1x	LARVAL REARING	235.5 m2	235.5 m2
1x	BROODSTOCK	450.3 m2	450.3 m2
		TOTAL GFA	8423.94 m2

1 CBC LAYOUT
SCALE 1 : 250

Core Breeding Centre - Indicative Floor Plan of One Module

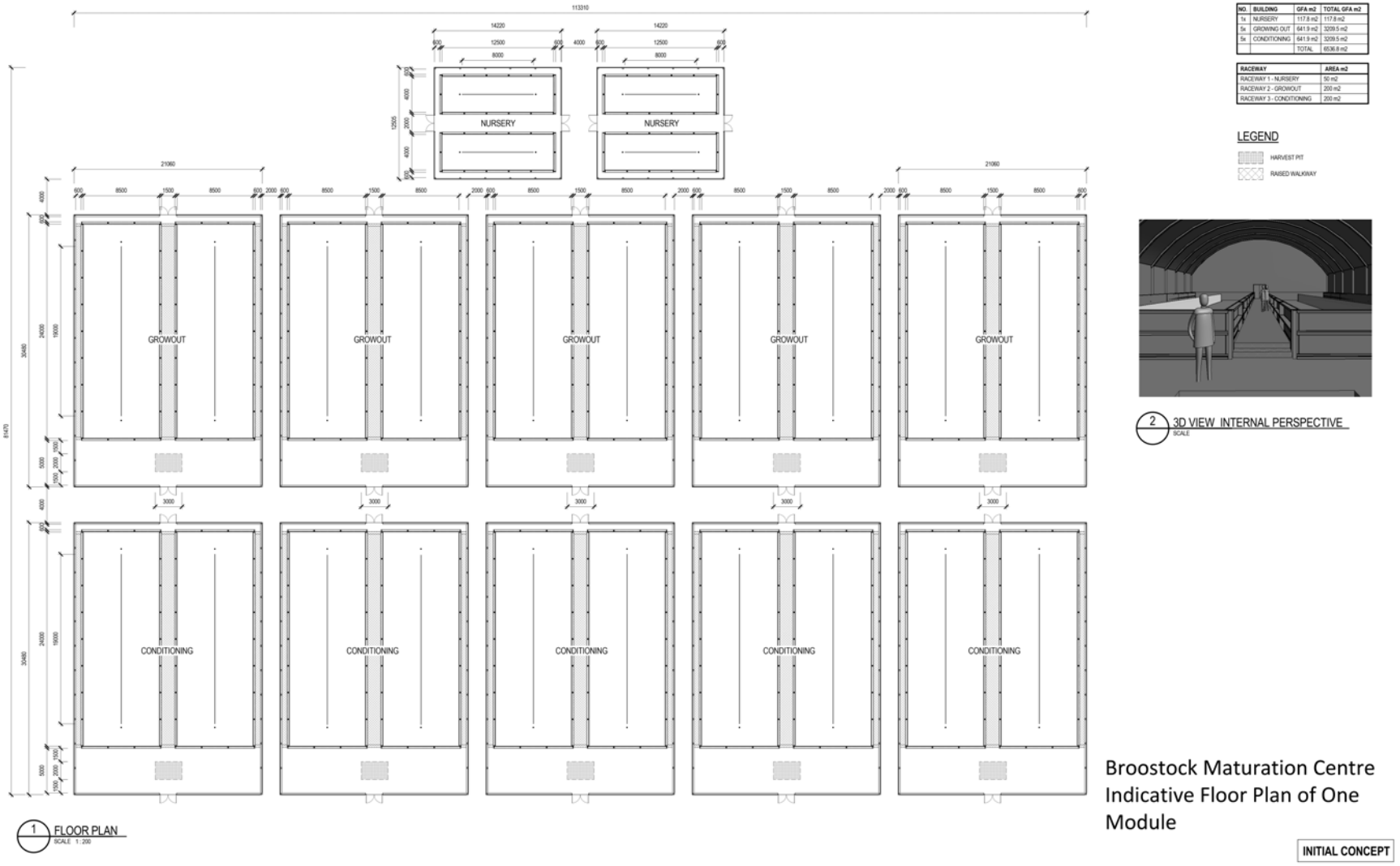
NOTE: PRE SITE PLACEMENT LAYOUT

FIGURE 4 CORE BREEDING CENTRE 3D EXTERNAL VIEW OF ONE MODULE



Core Breeding Centre - 3D
External View of One Module

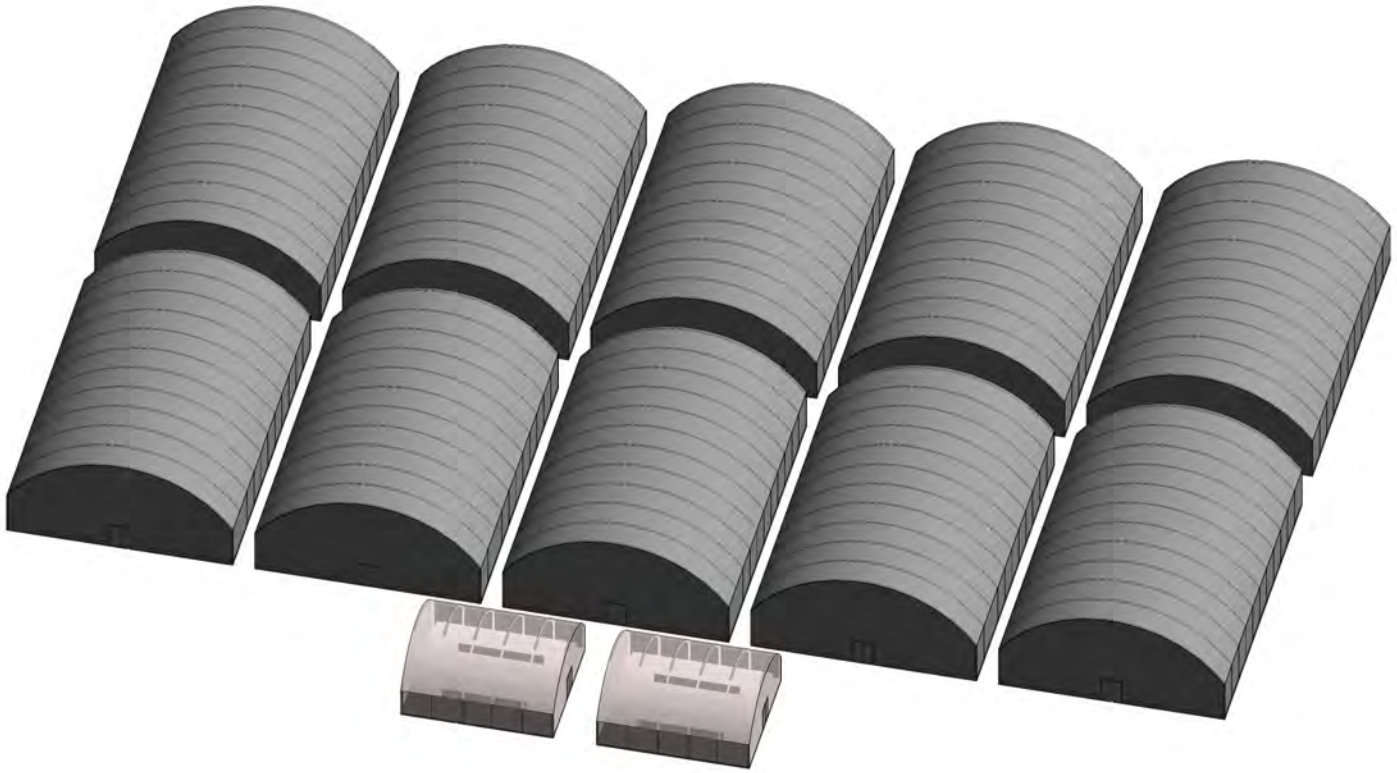
FIGURE 5 BROODSTOCK MATURATION CENTRE INDICATIVE FLOOR PLAN OF ONE MODULE



NO.	BUILDING	GFA m2	TOTAL GFA m2
1x	NURSERY	117.8 m2	117.8 m2
5x	GROWING OUT	641.9 m2	3209.5 m2
5x	CONDITIONING	641.9 m2	3209.5 m2
		TOTAL	6536.8 m2

RACEWAY	AREA m2
RACEWAY 1 - NURSERY	50 m2
RACEWAY 2 - GROWOUT	200 m2
RACEWAY 3 - CONDITIONING	200 m2

FIGURE 6 BROODSTOCK MATURATION CENTRE 3D EXTERNAL VIEW OF ONE MODULE



3.5 WATER SUPPLY

3.5.1 Seawater

The CBC and BMC will utilise both seawater and freshwater. Seawater will be piped in from a water intake pipeline extending out from Point Ceylon into Bynoe Harbour (Figure 2). The pipeline will extend approximately 2 km from Point Ceylon to approximately the 10 m chart datum to guarantee water intake at any tide. The onshore pumping station will have the capability to function 24 hours per day, 7 days per week, but the pumping operations will be biased to draw in seawater from mid-tide to high tide. The seawater quality treatment process will start with onshore settling ponds which will be sized to provide security of seawater storage for at least 5 days of normal site operations.

The pipeline has been designed to avoid the adjacent oyster leases in Bynoe Harbour. At full scale operations the expected maximum daily seawater intake volume for both the CBC and BMC is approximately 11,000 m^3.

The design, placement and anchoring of submersed and subterranean pipelines in moving water is a specialised area of civil engineering. That expertise will be provided by contractors engaged by PSD to ensure the longevity and reliability of this infrastructure.

The peak hydrodynamic loads on the pipe will be assessed from local flood, tidal and storm data to determine the optimal anchoring forces required to secure the pipe to that alignment. This anchoring is typically achieved by bolting together two half circles of pre-cast concrete clamped around the pipe at regular intervals to provide ballast to retain the pipe in position by gravity. Alternatively, seabed piling (or screw anchors) may be required on each side of the pipe if the seabed is too soft to restrain the lateral movement of the pipe and anchors under storm and maximum current conditions. Modelling of the local conditions and requirements will determine whether the pipe is placed on the seabed surface or requires partial or full subterranean burial.

Geotechnical investigations (core drilling or seabed probing) along the pipeline alignment will provide the local data to support this engineering design. This is a minimal disturbance activity usually undertaken from a work barge with a small portable drilling rig on-board.

The likely pipe material used for this application will be high density polyethylene (HDPE) because it is impact resistant and inert in seawater (i.e. no corrosion or problematic corrosion products present during its life cycle).

At full scale development of the CBC and BMC the intake piping is likely to comprise two 600mm pipes laid side by side, each with a 1.0m riser and fixed grille screen at the seaward end.

The simplest option for underwater pipe placement involves lowering each pipeline to the seabed onto the approved alignment. However, if any cover is required over the top of the pipe, for instance in the wave zone or beach, then guided horizontal drilling or pipe jacking will be employed, to bury the pipes. For this intake at Point Ceylon, the preferred option is to float the assembled pipe into position and sink it in a controlled manner.

The HDPE pipe lengths will be transported by road or seagoing barge to the construction site. The transport lengths are typically 21 to 24 metres if transported by road. Depending on the installation contractor's methodology, the pipeline sections will be either:

- Fusion welded onshore, plugged and floated onto the required alignment with the anchor weights already mounted, then progressively sunk by controlled flooding; or

- Placed from a work barge set up to progressively weld the lengths of pipe together and attach the anchor weights. The assembly will be then lowered as the barge is winched along the alignment.

Once the pipe is placed in or on the seabed, no further disturbance of the local environment is necessary. The routine replacement and/or cleaning of the intake screens of biofouling is the only maintenance activity requiring repeated access to the pipe's seaward termination point.

3.5.2 Freshwater

Existing fresh water supplies in the surrounding area are known to be limited. Some historic wells at Point Ceylon are used by local fishers for potable water when staying there. Two exploratory bores are registered on Portion 3192 so further evaluation may be undertaken to assess if local groundwater supply is viable. The preliminary designs for Stage 1 of the BMC and CBC show an estimated combined freshwater demand of 3 litres per second.

Further process optimisation as each stage progresses will occur, and as such it is unrealistic to scale this number up to provides a full scale demand estimate. At this early stage of design, the economics of the various options of freshwater sources and storage have not been determined. Fresh water for use in the operation of the BMC and CBC as well as potable supplies may be sourced through rainwater catchment and the operation of a desalination plant(s) onsite. It is unlikely that an on-stream or an off-stream catchment dam will be suitable or viable.

3.6 WATER STORAGE

Given the expected high loading of inorganic suspended solids in the intake water, all seawater will be allowed to settle in storage ponds for approximately 48 hours. Ponds will be constructed north of the BMC near Point Ceylon and will have the capacity to store untreated seawater sufficient for five days use (approximately 55,000 m^3 at full scale). Removable shade cloth coverings are proposed for the storage ponds to limit temperature increases. These storage ponds will be used in case of short term supply interruptions and variations in salinity levels in Bynoe Harbour following periods of heavy rainfall.

Following pumping and storage at a higher elevation closer to the BMC site, the water will be coarse filtered, disinfected (typically ozonation), fine and carbon filtered. Exposure to ultraviolet light as a final bacteriological elimination is likely to occur at the point of application. This level of treatment is designed to eliminate incoming bacteria and thus mitigate the risk of bacterial pathogens entering the system. The treated seawater will then be either pumped for use in the BMC or transferred across to the CBC via a pipeline as illustrated in Figure 2.

3.7 WATER DISCHARGE

3.7.1 Discharge Quantity

The discharge rate will be approximately proportional to the intake of seawater, with approximately 11,000 m^3 per day of wastewater being discharged from the project at full scale. The early Stage 1 discharge will be of the order of 2,200 m^3/day and the discharge will ramp up at approximately two to three years intervals in increments of around 20-25%, to the ultimate rate of 11,000 m^3/day at full scale.

3.7.2 Discharge Quality

The proposed facility at Point Ceylon will have operating conditions and discharge characteristics that are similar to the existing Seafarms Group prawn farming operations at Cardwell in North Queensland. As such, Seafarms propose to adopt the licence conditions set by the Queensland Department of Environment and Heritage Protection (Qld DEHP) for the Point Ceylon facility.

Table 5 presents the Qld DEHP discharge licence conditions for the Cardwell operations. The long term discharge license conditions of the Cardwell operations, and those proposed for the Point Ceylon facility, is in the order of 2 mg/L for Total Nitrogen and 0.4 mg/L for Total Phosphorus. However, the quality of the discharge is typically significantly better than the license conditions, as summarised in Table 6 below, which presents the results of the last 18 months of water quality sampling at two wastewater discharge points at the Seafarms Group Cardwell prawn farm.

TABLE 5 CARDWELL OPERATION DISCHARGE WATER QUALITY – LICENCE CONDITIONS

Parameter	Median	80th Percentile	Maximum
Total Nitrogen (mg/L)	2.0	2.5	5.0
Total Phosphorus (mg/L)	0.4	-	0.6

TABLE 6 CARDWELL OPERATION DISCHARGE WATER QUALITY – LICENCE CONDITIONS AND ACTUAL PERFORMANCE

Condition	Median	80th Percentile	Maximum
Total Nitrogen (mg/L)			
Licence Conditions	2.0	2.5	5.0
Actual Performance	*1.1*	*1.5*	*2.8*
Total Phosphorus (mg/L)			
Licence Conditions	0.4	-	0.6
Actual Performance	*0.08*	*0.11*	*0.27*

3.7.3 Discharge infrastructure, timing and location

Hydrodynamic numerical modelling of the dilution and dispersion of the discharge water was undertaken to inform the assessment of impacts upon the receiving environment, and to identify the optimum location and timing for water discharge. The modelling was conservatively based upon the assumption that discharge concentrations would be at the levels proposed for the licence conditions (i.e. median TN at 2.0 mg/L and median TP at 0.4 mg/L).

The results of the modelling indicated that the optimal location for the common discharge is on Wheatley Creek as shown in Figure 2. The numerical modelling also indicated that releasing the discharge during periods of higher water (for example when the water level rose above Mean High Water Neap tides) would further reduce the impact of the discharge on the surrounding water body. Releasing the discharge across a larger area (in the case of a weir discharge) could also increase initial mixing and minimise any impacts on the system. These findings have been incorporated into the design of the discharge infrastructure. Further discussion on hydrodynamic modelling of discharge water is presented in Section 5.1.7.

Water will be discharged from the CBC and BMC via a discharge channel, excavated into the terrain (the location of the channel is illustrated in Figure 2). The discharge rate will be approximately proportional to the intake of seawater (i.e. less than 11,000 m^3 per day). The volume and flow of the discharge water will be buffered by

settlement ponds along the channel alignment, which will retain the discharge water to settle and separate solids. The design of the discharge will include a flow control structure at the seaward end of the settling ponds. The water from the settling ponds will be released into a tidal pond which will be separated from Wheatley Creek via a broad crested weir. The weir will be designed with adequate scour protection to prevent undermining of the structure through high tidal flows. The pooling of the water within the tidal pond and mixing with the high waters will provide further initial dilution of the discharge water.

The discharge channel will be less than 1.0m deep, and nominally 1.0m wide. Actual width will be determined in the detailed design phase, and sized to provide for the range of discharge volumes that will occur from time to time, and to cater for all future stages of the project.

Channel width will be determined by the desired flow velocities to avoid scour of the channel bed and banks, according to soil type, channel slope and profile. The channel will be constructed using normal earthmoving equipment, most likely excavator and truck. Any unwanted excavated material will be utilised as bulk fill in other parts of the site.

Some revegetation of the open channel is possible, after a period of operation, and may be desirable for bank stability. An access track will be maintained alongside the channel, to allow for inspection and periodic maintenance, such as clearing of any accumulated sediments or blockage due to possible excess or unwanted revegetation.

Any areas of the channel likely to scour, such as at bends and changes of bed profile, will be protected by lining of the soils. Lining may consist of rip-rap (stone pitching), rock mattresses, shotcrete or proprietary products designed for such applications.

3.8 WORKFORCE

To support the development of 1,080 ha of ponds for the Stage 1 Legune Grow-out Facility a workforce of 27 will be required to be employed at the CBC and BMC, including managers, a geneticist, various technicians, administrators and aquaculture workers (see Section 5.4.4 for more details). At full scale production there is estimated to be a workforce of 45. The workforce is expected to come from a mixture of sources, including:

- directly employed staff, self-accommodated in the Dundee Downs areas and/or accommodated nearby
- local contractors, self-accommodated in the Dundee Downs areas and/or accommodated nearby
- local indigenous people
- fly-in/fly out (this option is likely to be the exception but for specialist expertise)
- temporary work skilled visa (sub-class 457) program.

3.9 ACCESS AND TRAFFIC

Access roads will be constructed between the common facilities, the BMC, CBC and seawater intake. The access roads will be unsealed, all weather roads. It will also be necessary to construct an access road into the site. There are currently two options for accessing the site, as depicted in Figure 1, however, only one road will be required to access the site. The preferred option is a road that runs north-south from Fog Bay Road. This road will run along an existing road easement between several lots (Portion 2621, 2622, 2608, 2594, 122, 121). The second option is road running east-west from Dundee Road. The road is required to pass through one lot (Portion 2895).

Light vehicle movements will be associated with the workforce to and from the site. Heavy vehicle movements to and from the site will be limited to the weekly transport of freight. Initially a medium rigid truck and later a semi-trailer will be used to deliver the broodstock weekly to the hatchery. Typically several chilled 1,200 litre bins filled with seawater will be strapped to the deck or inside a pantech trailer and a regulated oxygen supply added to each bin to maximize the survival of the PLs or prawns placed in them.

3.10 BUSHFIRE MANAGEMENT

As part of the Environment Management Plan (see Section 7.5), fire risk will be managed in accordance with the NT *Bushfire Act 2009* which establishes the legal framework and responsibilities for bushfire management. This includes management that mitigates risks to property and persons operating the proposed facility, as well as risks associated with bushfires initiated from the actions of persons or operation of the facility. Management will include vegetation clearing and ongoing hazard reduction activities to maintain a minimum of 4 m cleared firebreaks around shared boundaries, internal fence lines and other facility assets. Subject to more detailed site assessments, additional vegetation clearing may be required to maintain adequate separation distances between hazardous vegetation and Class 1-3 and 10a buildings, subject to calculation of Bushfire Attack Levels (BAL) in accordance with *Australian Standard (AS) 3959–2009 – Construction of buildings in bushfire-prone areas*. Bushfire risk will also be mitigated through construction of on-site fire-suppression infrastructure, as well as consultation and ongoing liaising with the nearby Dundee Volunteer Bushfire Brigade.

The project area contains suitable habitat for the eastern subspecies of Partridge Pigeon (*Geophaps smithii smithii*). While this species has not been recorded on the project site, it has been recorded from 8 km to the south-west, and the vegetation on the project site is dominated by the vegetation community that the subspecies is primarily known from. This species prefers to feed in recently burnt areas, and fire practices which result in a structurally patchy understorey at a small spatial scale are considered important, and are recommended to maintain habitat quality. As such, formulation of bushfire management practices will also take into account measures recommended to provide optimal habitat and resources for the Partridge Pigeon (eastern subspecies).

3.11 PROJECT DE-COMMISSIONING

Should the project be abandoned at some time in the future, a two staged approach to decommissioning is proposed. Stage 1 would involve the decommissioning of the site via a care and maintenance program so that the facilities could be offered to other users on a lease or sale basis. If this approach was not successful then a stage 2 removal, demolition and rehabilitation could be employed. These stages are further described below.

3.11.1 Stage 1 Decommissioning, Care and Maintenance

Stage 1 would involve de-stocking the tanks where live food and prawns were grown. Flushing and cleaning would then follow so that the facilities can dry-out and be maintained in a stable, idle condition until required again. This is an extended version of the standard Seafarms operating procedure used between batches of livestock.

3.11.2 Stage 2 Removal, Demolition and Rehabilitation

The majority of the facility is manufactured from long life-cycle products. Depending on the age and condition of the facilities at the time of this decision point, an economics based decision will be made between sale verses scrap value, or a mix of both options on a component by component basis. Structured removal and re-use would be a preferred option.

The remaining open spaces on the site would then be rehabilitated using native vegetation of local provenance, or depending on the conditions applicable at the time, the site could be adopted for another land use.

3.12 ALTERNATIVES

Seafarms has spent considerable time investigating suitable sites for the CBC and BMC across northern Australia. A total of 25 sites were short-listed and a formal multi-criteria analysis was applied to assess their suitability as potential locations. Attributes considered in the analysis included land tenure, land area, elevation, access to fresh water and seawater, access to mains power, logistics and workforce, existing infrastructure, surrounding land and marine uses. One of the more critical attributes for the CBC and the BMC is the access to, and availability of, seawater that maintains a relatively uniform salinity (i.e. has minimal interation with freshwater inflows). Site selection also considered avoidance of environmentally significant sites including protected areas, those with significant populations of threatened species, and/or sites of archaeological, heritage or Aboriginal significance.

Based on this analysis, the Point Ceylon site was ranked as the most optimal location for the CBC and BMC. The site was previously earmarked for the development of a land based aquaculture facility by Suntay Aquaculture Pty Ltd that was approved for development in 2003.

3.13 RELATED DEVELOPMENT

As depicted in Figure 7 the CBC and BMC are components of a larger project, Project Sea Dragon, which also comprises:

- the grow-out facility, and associated onsite and offsite infrastructure, located on Legune Station in the north-west NT
- a commercial hatchery proposed for a separate location in the Darwin environs.
- a processing plant located near Kununurra WA, or on Legune Station
- export facilities proposed to be located at either Wyndham in WA or Darwin in the NT
- a quarantine, founder stock facility and back-up breeding centre located at Exmouth in WA.

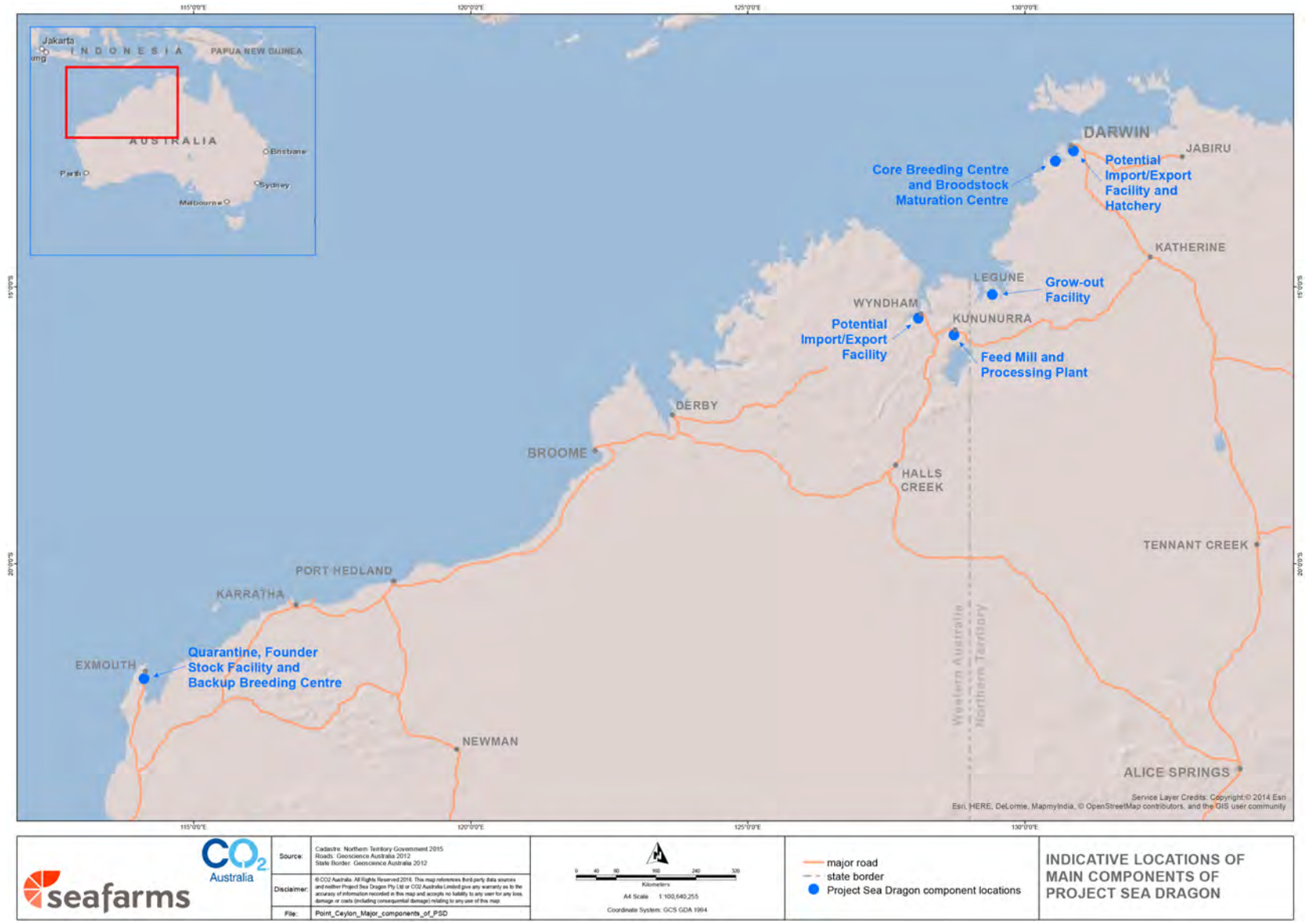
Approvals for the grow-out facility, commercial hatchery, processing plant, export facilities, quarantine, founder stock facility and back-up breeding centre will be sought separate to this NOI. This is due to:

- differing land tenures
- the different geographic location of and infrastructure required for each facility, and their distance from each other as illustrated in Figure 8.
- the current uncertainty surrounding the exact location of some of the facilities and infrastructure
- the risk of failing to secure tenure and/or acquire, sites for some of the facilities
- the different environmental impacts associated with each of the facilities and infrastructure, the need for tailored assessment and the fact that some facilities are in place
- the required timing for commissioning of some of the facilities is very different - assuming the Legune Grow-out Facility is ready to receive PL prawns by December 2018, the facilities at Bynoe Harbour need to be commissioned by September 2017, whereas the hatchery does not need to be commissioned until September 2018
- the different governmental jurisdictions for each of the project elements.

The Stage 1 Legune Grow-out Facility is being assessed under the bilateral agreement between the NT and Commonwealth Governments. In addition, a separate NOI for the commercial hatchery, proposed to be located within the Darwin environs, will be lodged with the NT EPA.

FIGURE 7 MAIN COMPONENTS OF PROJECT SEA DRAGON

FIGURE 8 PROPOSED LOCATIONS OF MAIN COMPONENTS OF PROJECT SEA DRAGON



4 EXISTING ENVIRONMENT

4.1 NATURAL ENVIRONMENT

4.1.1 Climate

The climate at Bynoe Harbour is considered to be tropical monsoon with a hot and dry season during the southern hemispheres winter months of June to August and a hot and humid wet season during the traditional summer months of December through February.

4.1.1.1 Temperature and Rainfall

The wet season is typified by high temperatures and humidity, and significant rainfall events, with most rain falling between November and April. The dry season, extending between May and September, is characterised by low humidity and temperatures, and very little rain. The closest long-term weather station to the project area is Dum In Mirrie Airstrip, located approximately 22 km to the north-west. Temperature and rainfall statistics from the Dum In Mirrie Airstrip are presented in Table 7 and Table 8 and shown on Figure 9.

TABLE 7 CLIMATE STATISTICS SUMMARY

Statistic	Annual Values	Years of Record
Mean maximum temperature (°C)	31.7	17
Highest maximum temperature (°C)	38.0	17
Lowest maximum temperature (°C)	21.4	17
Mean minimum temperature (°C)	23.2	17
Lowest minimum temperature (°C)	10.0	17
Highest minimum temperature (°C)	25.8	17
Mean rainfall (mm)	1,688.1	19
Highest rainfall (mm)	2,647.2	19

FIGURE 9 MONTHLY TEMPERATURE VARIATION

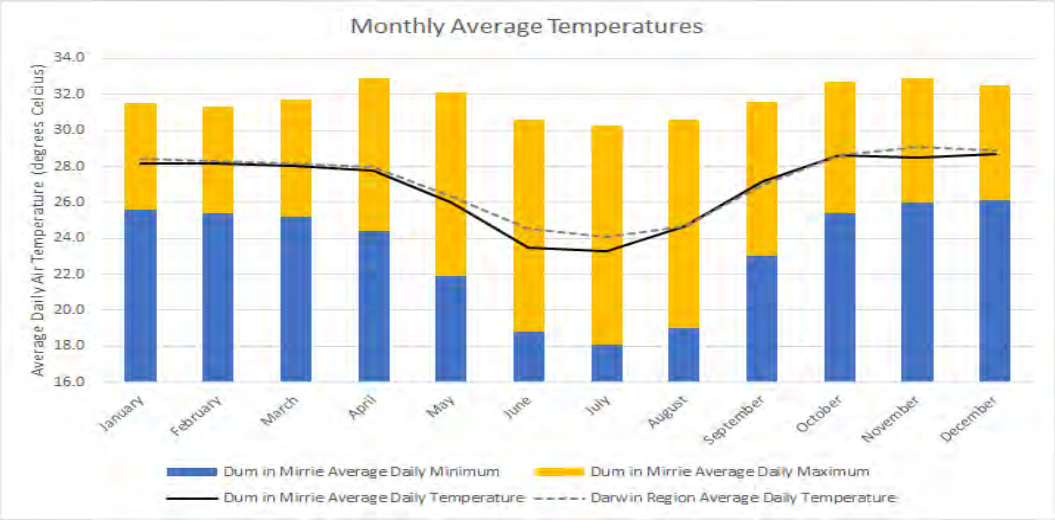


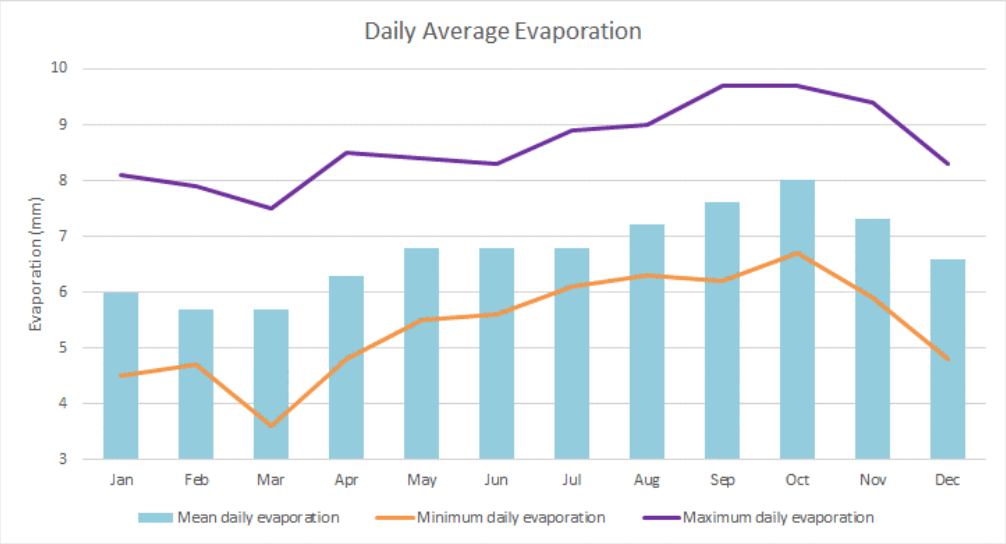
TABLE 8 MEAN RAINFALL (MM)

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
401.1	408.5	314.5	95.6	20.5	2.1	0.0	3.0	12.3	66.5	127.5	269.7

4.1.1.2 Evaporation

The high temperatures and high humidity lead to increased rates of evaporation in the region. Evaporation is measured by the BoM at the Darwin Airport on a daily basis. A summary of the daily average evaporation between 1977 and 2015 is provided below in Figure 10. As shown, the average daily evaporation builds through the dry season before peaking in October at, or prior to, the onset of the wet season before dropping through the wet season to March.

FIGURE 10 MONTHLY EVAPORATION VARIATION



4.1.1.3 Wind Conditions

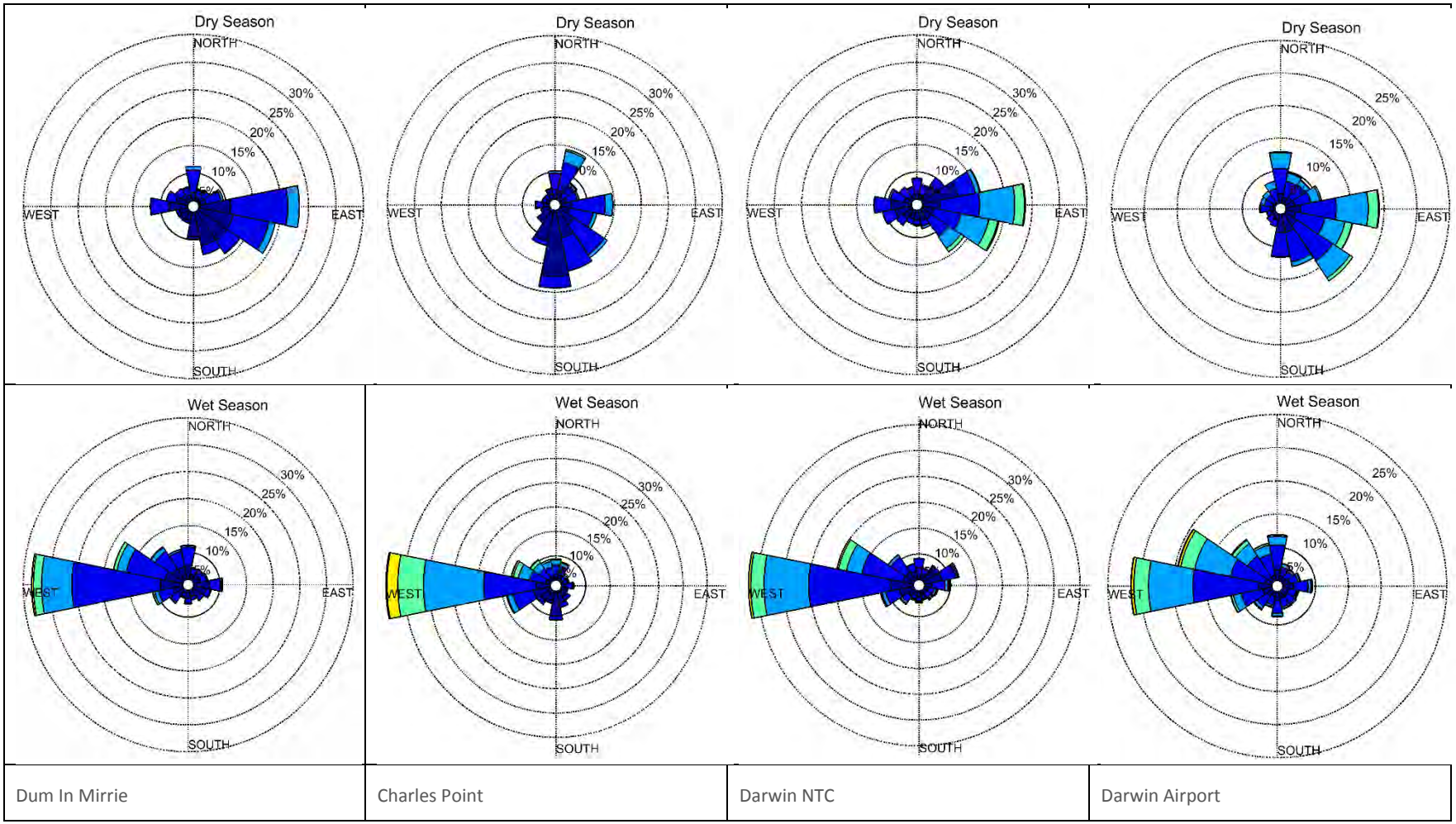
The monsoonal climate around Bynoe Harbour results in a reversal of the general wind patterns through the year. Wind roses for the wet season months of December through February, and the dry season months June through August are shown below in Figure 11 for a number of locations around Bynoe Harbour.

As can be seen from Figure 11, during the wet season winds are generally from the west through northwest, compared with dry season conditions where winds are predominantly from the east and southeast.

Further analysis of the wind climate indicates that during the wet season winds shift from westerly in the morning, to northwesterly in the afternoon. During the dry season conditions are more variable with conditions early in the dry season shifting from east and southeasterly in the morning, to east in the afternoon, and from east and southeasterly in the morning, to north and northwesterly in the afternoon during August.

Wind speeds are relatively low, with the wind speeds predominantly below 10m/s. Gust speeds, the highest 3 second duration wind recorded during a 30 minute observation, can however, exceed 28m/s (over 100km/h) during large storm events. Cyclonic winds and frequency of occurrence is discussed below in Section 4.1.1.4

FIGURE 11 WET AND DRY SEASON WIND CLIMATE (PERIOD OF RECORD)



Dum In Mirrie	Charles Point	Darwin NTC	Darwin Airport

4.1.1.4 Tropical Cyclones

Tropical cyclones occur on average once per year in the area of the Northern Territory west of the Gulf of Carpentaria (around 2 per year occur within the Gulf) (BoM, 2015). Cyclones which may affect the region will typically form in the Timor Sea to the west, or the Arafura Sea to the north during the months of November through to April. Cyclones forming in these areas typically travel in a southwest and west direction, travelling parallel with the general shape of the coastline.

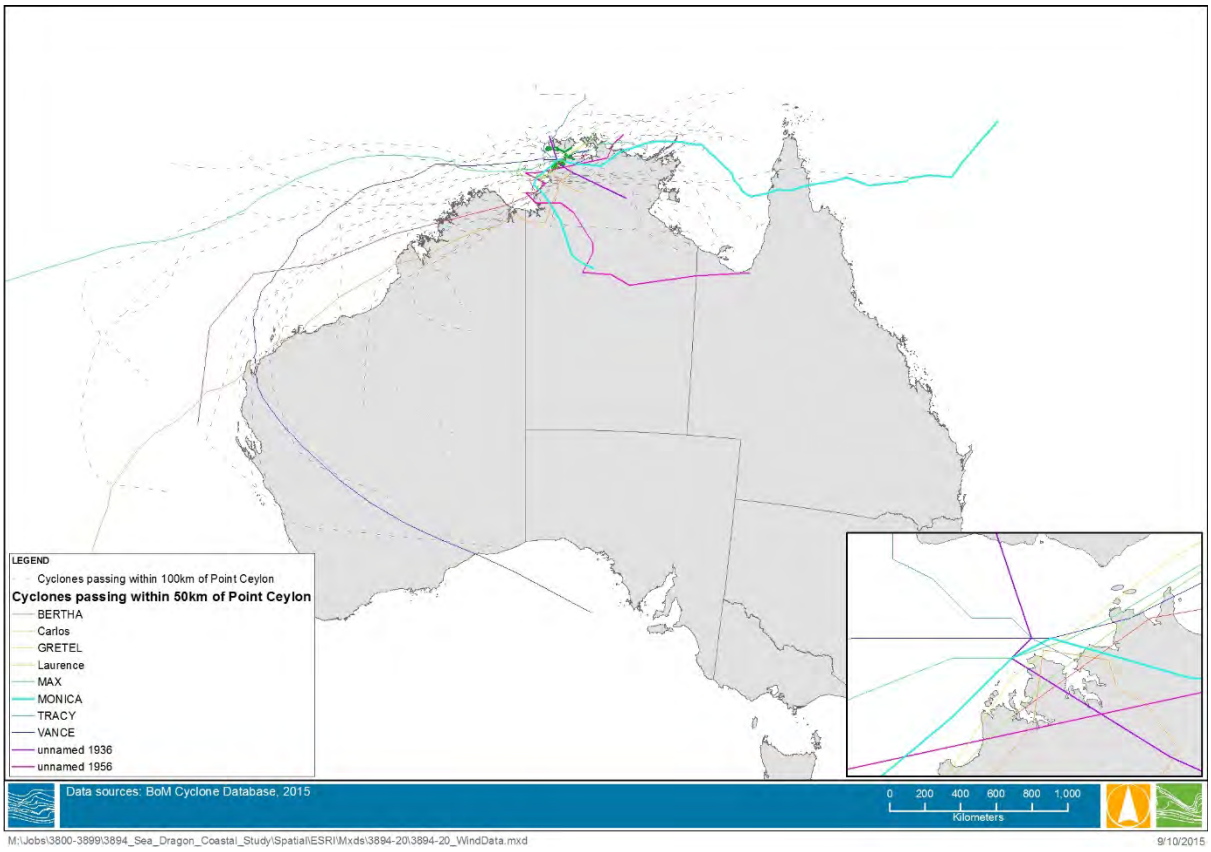
Statistics provided by the BoM indicate 104 cyclones were recorded in the Northern Territory and the Gulf of Carpentaria (including Queensland) in the period between 1960 and 2007. Of these, only 31 were considered "severe" – a category 3, 4 or 5; and only 4 events were a category 5 event. Detailed review of BoM data indicates that 35 cyclones have been recorded within a 100km radius of the proposed facility since 1906. 10 cyclones have passed within 50km of Point Ceylon (see Figure 12).

Statistics developed by the BoM indicate that a cyclone could be expected to occur within the area around Point Ceylon once every 2 – 3 years. However, wider climatic weather patterns have an impact on cyclone frequency, with more cyclones occurring during La Niña cycles when the frequency could be expected to be closer to 2 every 3 years (BoM, 2015).

The main structural features of the tropical cyclone are the eye, the eye wall, and the spiral rainbands. The four main components of a tropical cyclone that combine to make up the total cyclone hazard are described below:

- Extreme Winds – Maximum wind speeds are a function of central pressure, the radius to maximum winds, the forward speed of the cyclone and local topographic effects. Cyclonic winds circulate clockwise in the Southern Hemisphere however the wind fields are generally asymmetric such that the strongest winds are generally observed on the left-hand side of the direction of cyclone movement. During a coastal crossing at Bynoe Harbour, the cyclonic wind direction will be onshore north of the eye and offshore south of the eye.
- Extreme Waves – Tropical cyclones can generate very large ocean waves as a result of the transfer of energy from the wind to the ocean surface. The growth of ocean waves is a function of the fetch (the distance the wind acts over), wind speed, wind duration, the depth of water and the size of the cyclone. The area to the north of Bynoe Harbour is protected from very long fetch waves by Bathurst and Melville Island. Wave fetch and water depth increase to the northwest and west, although Indian Island and the outer islands of Dum In Mirrie and Grose Island will provide additional protection from cyclonic waves from the west and northwest. As a result, extreme wave conditions are likely to propagate into Bynoe Harbour from a relatively limited direction for short durations.
- Storm Surge – In the vicinity of the coastline, tropical cyclones can produce significant storm surges. Storm surges are meteorologically forced increases in coastal water levels caused by the combined action of extreme surface winds, which drive ocean currents towards the coastline, and the reduction in atmospheric pressure, which causes a local rise in sea level. The peak of a tropical cyclone storm surge generally only lasts for a few hours near the region of maximum wind speeds.
- Intense Rainfall – the rain bands of a tropical cyclone can expand up to 1000km in diameter with the heaviest rainfall usually located within the eye wall. Rainfall is not directly correlated to cyclone intensity, and recent low category cyclones have resulted in near record rainfalls within the Darwin region (BoM, 2015).

FIGURE 12 CYCLONE WITHIN 100KM OF DARWIN (1906 – 2015)



4.1.2 Geology and Geomorphology

The CBC and BMC are shown on the Bynoe geological sheet. The proposed facilities are underlain by the Welltree Metamorphics and the Finniss River Group. Together these units consists of a range of rock types including quartz, feldspar, biotite, gneiss, shales, siltstones and phylite. A local intrusion of Two Sisters Granite Unit consisting of granite, granodiorite and pegmatite occurs in the vicinity of the south-western corner of the project site. The bedrock is overlain by unconsolidated sands, and ferruginous, clayey, sandy, gravelly soils and laterites (Pietsch, 1986). The southern part of Bynoe Harbour, including Point Ceylon, is predominantly lateritic capping with some exposures of the underlying weathered granite and some fine-textured sedimentary rocks (Brocklehurst and Edmeades, 2003). Brocklehurst and Edmeades (2003) have summarised the soils of Bynoe Harbour catchment as highly weathered, low in plant nutrients with acid to neutral pH, and dominated by kaolinitic clays. Ironstone gravels are characteristic of soils associated with lateritic parent materials.

The morphology of Bynoe Harbour is the product of marine transgressions, fluvial erosion and deposition. Bynoe Harbour is classified as a drowned river valley estuary, also known as a ria shoreline. The present day estuary was formed as sea levels rose at the end of the last glacial period. During the last glacial period, which ended approximately 12,000 years ago, mean sea levels were approximately 120 metres lower than present day and the coastline was located off the edge of the continental shelf, approximately 450km to the northwest of Bynoe Harbour, at the edge of the present day Timor Trough. During this period, the Beagle Gulf and much of the Timor Sea were gently sloping coastal landforms, connecting Bynoe Harbour and Darwin to the Tiwi Islands. Bynoe Harbour drained northwest around Bathurst Island into the Timor Trough through a narrow valley (Harris *et al*. 2003).

Towards the end of the last glacial phase and into the Holocene, sea levels rose steadily to reach approximate present day levels around 7,000 years ago. The sea transgressed across the continental shelf and submerged Bynoe Harbour during this period. Deposits of terrigenous sediment dominate the seafloor across the region (Harris *et al.* 2003).

Under present conditions, sediments are delivered to Bynoe Harbour primarily during high rainfall and runoff events through the creeks. These sediments are then either carried in suspension out of the harbour by the strong tidal currents, or deposited in the mangrove forests along the shoreline. Sediment samples from the seafloor within Bynoe Harbour indicate a high proportion of sandy and gravel material. Conversely, Port Patterson, located west of Indian Island, has a higher proportion of fines.

The bed material at Point Ceylon consists of gravelly and lateritic soils, derived from Cretaceous sand- and clay-stone which has weathered to form a capping of ferricrete kandosols. The ferricrete and underlying Gneiss/Schist have been incised by river channels to form the creeks around Point Ceylon and Indian Island (Hill *et al.,* 2002). A large intertidal reef extends 450m from the northern end of Point Ceylon. The reef is formed of hard rock and is a combination of continuous material and loose boulders (Photo 1). The gently sloping intertidal shelf around the point is over 200m wide and is backed by a 60m margin consisting of a range of mangrove species (Photo 2). Landward of the mangroves a sandy beach is backed by a short wave cut cliff which is likely to have formed prior to the habitation by mangroves.

On the northwestern shore of Point Ceylon, the Geranium Channel separates the Point from Indian Island. The entrance to the Channel is located close to the head of Point Ceylon. A large intertidal bank can be observed on the eastern shore of Indian Island, extending well into Bynoe Harbour. The centreline of Geranium Channel migrates from the southern bank near Point Ceylon to the northern bank closer to Indian Island travelling westward.

PHOTO 1 LOOKING SOUTH TO POINT CEYLON ROCK REEF

PHOTO 2 LOOKING EAST FROM GERANIUM CHANNEL TO POINT CEYLON

4.1.3 Soils

Soils have been mapped for the area of the development (Portion 3192) (Hill *et al.*, 2002). The soils are considered to present mostly a low to moderate erosion risk. Figure 13 shows the mapped soil types of the area. Acid sulfate soils (ASS) and potential acid sulfate soils (PASS) have been mapped for the project area as illustrated on Figure 14. ASS and PASS are mapped within Point Ceylon and in the lower reaches of Wheatley Creek and the unnamed creek on the eastern side of the project site near the upper tidal level (Hill *et al.,* 2002) – see Figure 14. Specific mitigation and management measures will be taken to minimise disturbance to these soils.

4.1.4 Topography

The topography of the development area is generally undulating, rising from sea level to around 37 metres above sea level at the highest point along a peninsula which leads from the Finniss Road to Point Ceylon. There are no steep escarpments on the site. The proposed development areas for the CBC and BMC are between 5 and 25 m above sea level as illustrated in Figure 15.

4.1.5 Air Quality

Air quality for the area is very good, with no sources of industrial pollution for 40 km. During the dry season, smoke from bushfires will contribute particulate matter to the atmosphere. The impact of this smoke will depend on the distance the fire is from the site of the proposed infrastructure.

4.1.6 Noise

Ambient noise levels are very low, with only natural noise occurring within the region, except along roads and in residential areas.

FIGURE 13 SOILS

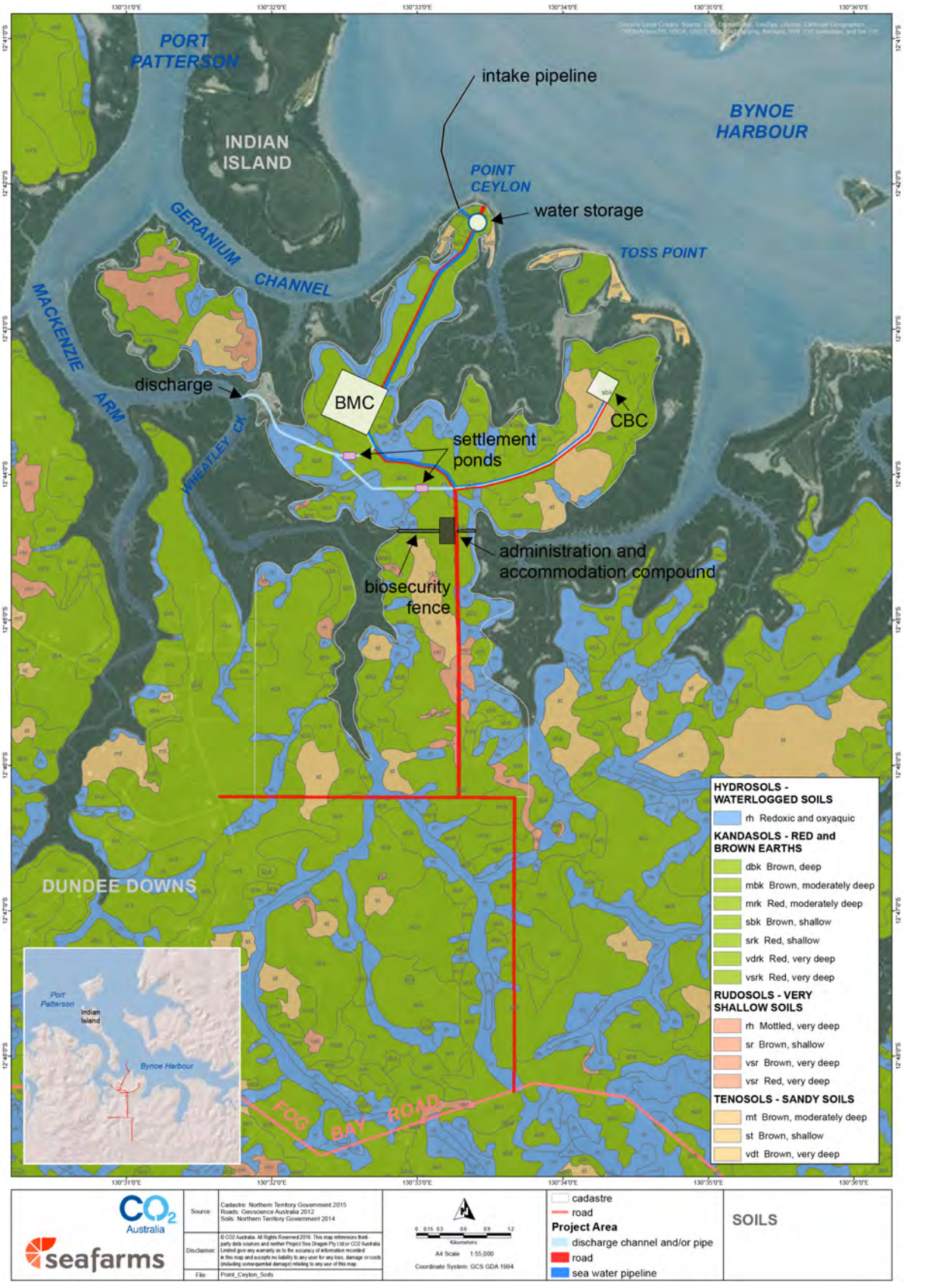


FIGURE 14 ACID SULFATE SOIL MAPPING

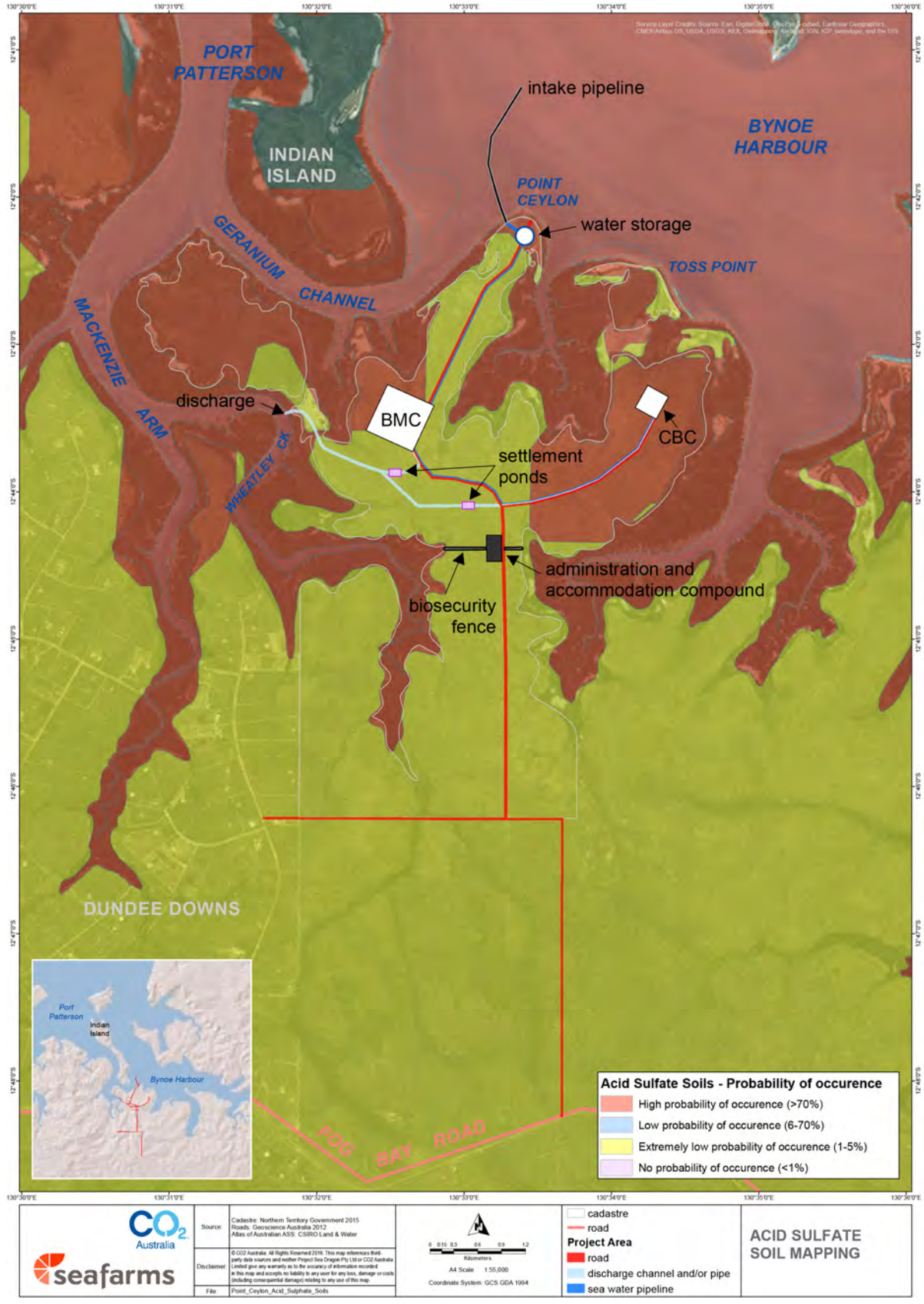
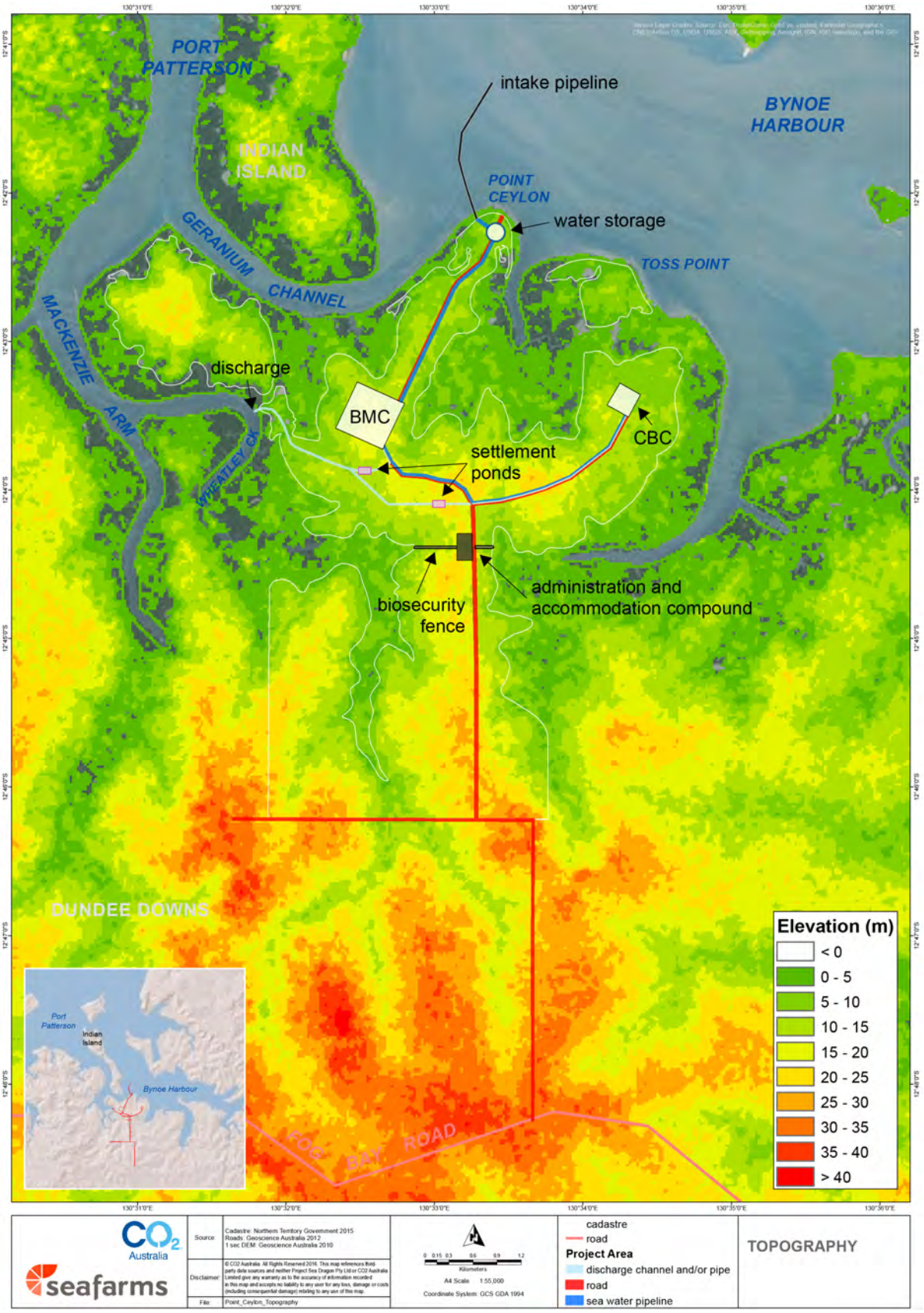


FIGURE 15 TOPOGRAPHY



4.1.7 Coastal Features

The project site is located on a peninsula on the southern shore of Bynoe Harbour. Bynoe Harbour is classified as a drowned river valley estuary, also known as a ria shoreline. The estuary is macro tidal, with a maximum tidal range of 7.6 m. The entrance to Bynoe Harbour is located at the northern end of Indian Island, although water also flows into Bynoe Harbour via Port Patterson and the Geranium Channel to the west of Indian Island (Figure 16). A number of small tidal creeks and bays are present along the shore of Bynoe Harbour.

Wheatley Creek (Photo 3 and Photo 4) flows on the western side of the peninsula, and an unnamed creek on the eastern side. Wheatley Creek feeds into Mackenzie Arm, which flows into the Geranium Channel. The unnamed creek on the eastern side flows into Vigilant Inlet, which feeds into Bynoe Harbour.

The proposed operation of the CBC and BMC includes the discharge of wastewater into Wheatley Creek. Wheatley Creek is approximately 9.5 km long from the confluence at Mackenzie Arm to the upstream end of the mangrove habitat. Both Wheatley Creek and the unnamed creek are fed by ephemeral streams. Stream flows are distinctly seasonal and concentrated during the wet season (NT Department of Infrastructure, Planning and Environment [DIPE] 2002).

FIGURE 16 SURFACE WATER FEATURES

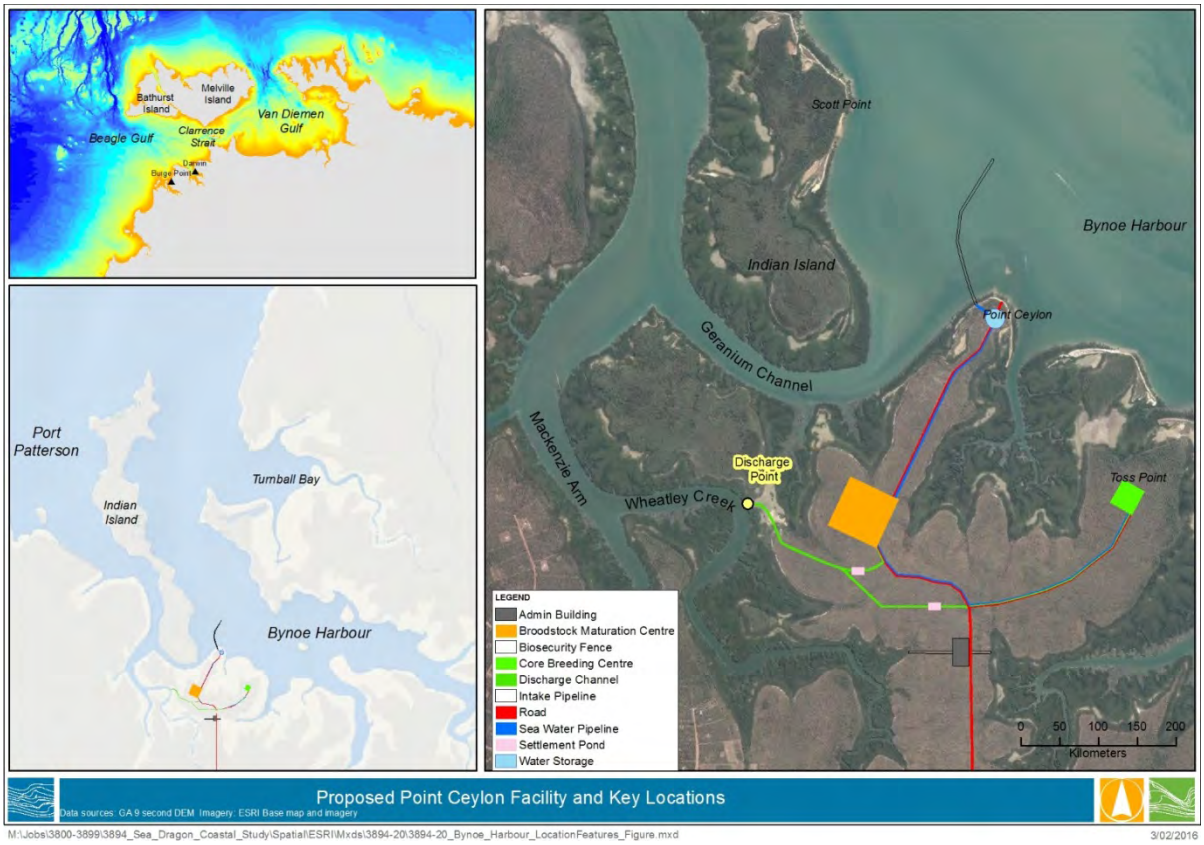


PHOTO 3 LOOKING NORTH ACROSS WHEATLEY CREEK TO INDIAN ISLAND

PHOTO 4 MUDDY BANK OF WHEATLEY CREEK

4.1.8 Coastal Processes

4.1.8.1 Tides

Bynoe Harbour is a macro-tidal environment with a maximum tidal range of 7.6m. Tidal information within Bynoe Harbour is provided by the Royal Australian Navy's (RAN) 'Australian National Tide Tables' at Burge Point, approximately 14km north of Point Ceylon. Tidal plane information for Burge Point is shown below in Table 9.

The tide at the site is semi-diurnal (i.e. two high and two low tides daily), with a slight diurnal inequity which results in one higher tide and one lower tide per day. The mean spring tide range is 5.2m, whilst the mean neap

tide range is 1.6m. The highest spring tides in the north of Australia occur in June and July. Lowest spring tides occur during October, November and December.

TABLE 9 ASTRONOMICAL TIDAL PLANES

	HAT	MHWS	MHWN	MLWN	MLWS	LAT
Burge point	3.6	2.6	0.8	-0.8	-2.6	-4.0

4.1.8.2 Currents

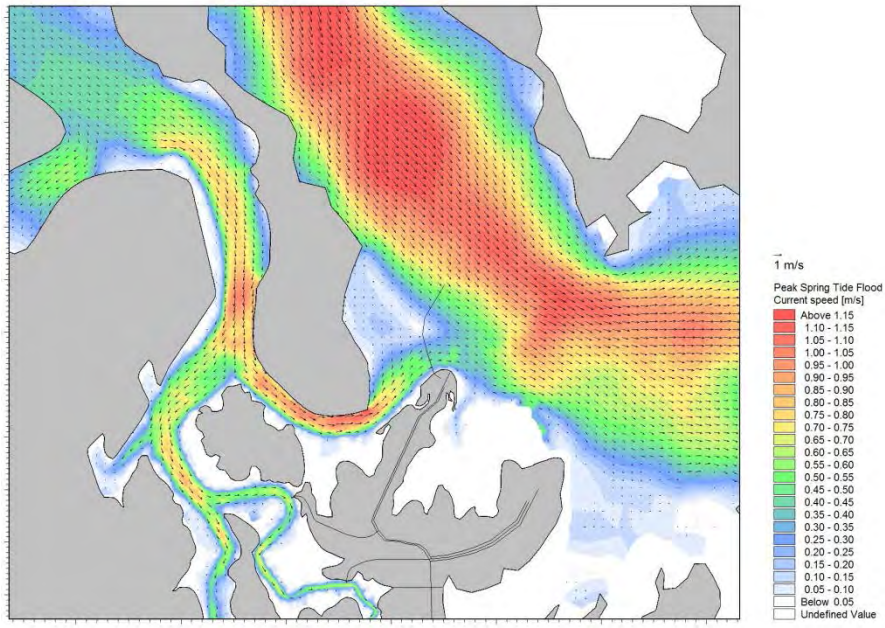
Currents around the site are driven primarily by the large astronomical tidal range. The RAN provides tidal stream information, with the bathymetry chart AUS 29 (RAN 2014) indicating tidal currents at the northern end of Bynoe Harbour (adjacent to Burge Point) peak at approximately 0.9m/s during the flood spring tide, and 0.4m/s during the flood neap tide.

Maximum current speeds around Point Ceylon are shown below in Figure 17. Peak tides do not occur simultaneously at Point Ceylon (near the proposed intake location) and in Wheatley Creek (near the proposed discharge locations), as shown in the timeseries of current speeds in Figure 18. Currents are derived using the calibrated hydrodynamic model of the site. See Section 5.1.6 and Section 5.1.7 for more details on the hydrodynamic modelling.

These figures show the following main features of the currents in the Point Ceylon area:

- The current speeds around the proposed intake point peak at approximately 0.7m/s during spring tides and at around 0.2-0.25m/s during the neap tide. There is little difference in current speeds at the intake point during the ebb and flood tides as the intake point is within the main body of the channel. Greater difference between the ebb and flood tidal currents can observed in the shallower water west of Point Ceylon on both tides.
- Peak currents in Wheatley Creek at proposed discharge location are of similar magnitude to the intake location, with the peak spring flood and ebb tidal currents in the order of 0.7m/s. Neap tidal currents are lower on both the flood and ebb tides at around 0.2m/s. As shown in Figure 18, currents within Wheatley Creek change between flood and ebb tides much faster than in the larger Bynoe Harbour water body during both the spring and neap tides. During the spring tides water level pulses through the channel, with two peaks on the flood tide.
- While the flood tide flows into Bynoe Harbour and Port Patterson simultaneously, the deeper channel and larger upstream volume of Bynoe Harbour results in the flood tide travelling from Port Patterson to Bynoe Harbour through Geranium Channel as Bynoe Harbour fills on the flood tide (Figure 17).
- During the ebb tide, water drains from Wheatley Creek and Mackenzie Arm through the northern section of Geranium Channel into Port Patterson. The flow within the eastern section of Geranium Channel to the south of Indian Island also flows into Port Patterson for the main portion of the tide as the larger volume of Bynoe Harbour drains (Figure 17).
- Ebb current speeds drop at the mouth of Geranium Channel within Port Patterson and low tidal currents could be expected here (Figure 17).

FIGURE 17 MAXIMUM SPRING TIDAL CURRENT SPEEDS, FLOOD AND EBB TIDES



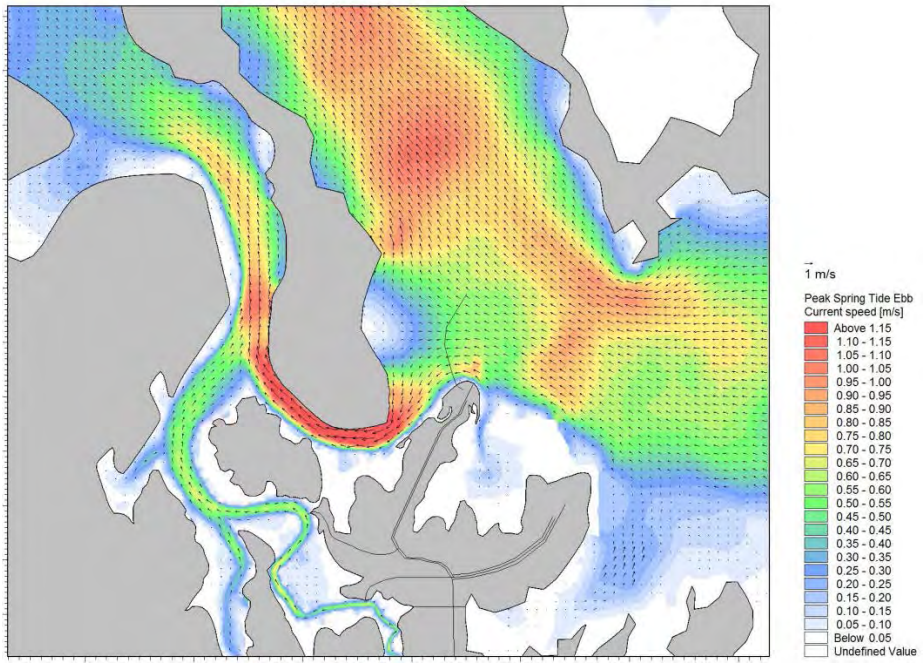
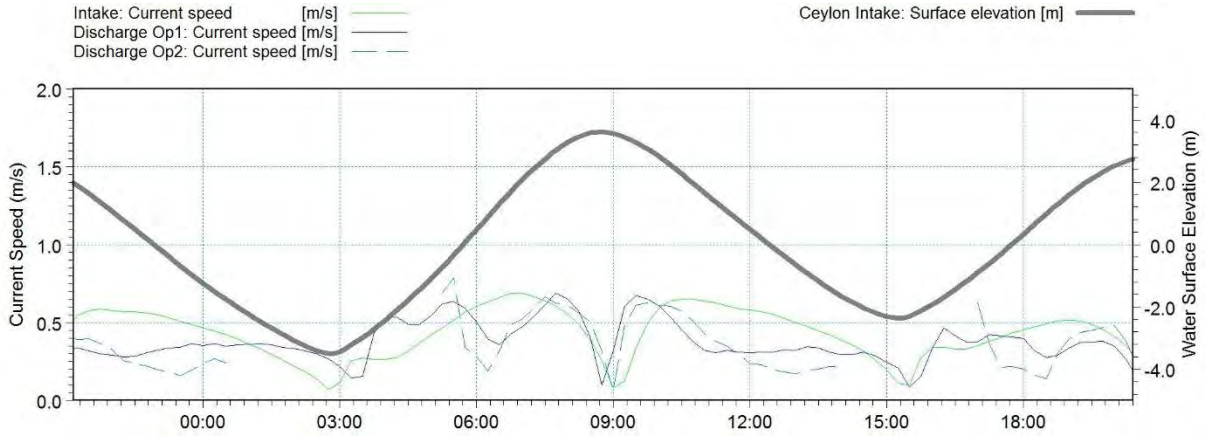


FIGURE 18 TIMESERIES OF CURRENT SPEEDS

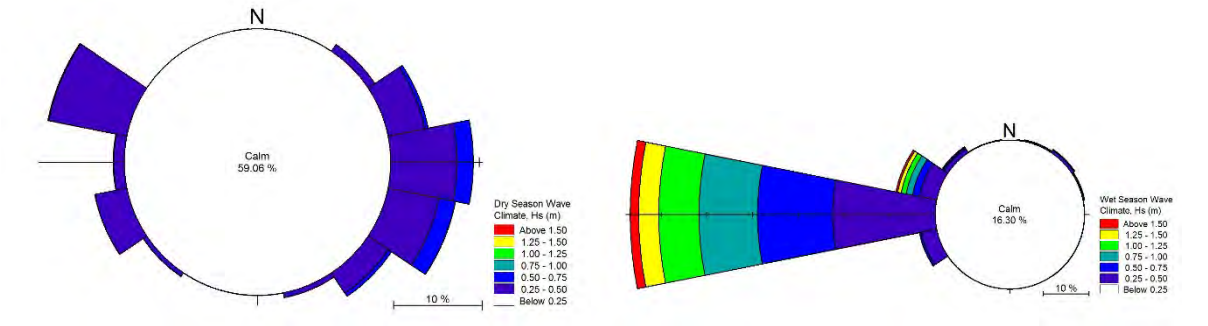


4.1.8.3 Wave Conditions

Offshore wave conditions have been extracted from the National Ocean Atmospheric Administration (NOAA) Wave Watch III (WW3) model to provide an understanding of the offshore wave climate which may impact Bynoe Harbour and the proposed facility. NOAA provides a global model reanalysis hindcast of 3 hourly data for the period 1979 through to 2010. The following features of the wave climate at Bynoe Harbour can be observed in Figure 19:

- The offshore wave conditions mimic the seasonal reversal of the dominant wind direction.
- Dry season conditions are very calm, with a large proportion of the record indicating wave heights less than 0.25m.
- Wet season conditions are more energetic, with close to 50% of the period having wave heights greater than 0.5m. Waves are predominantly from the west, with a small proportion of waves from the west-northwest.

FIGURE 19 BEAGLE GULF WAVE CONDITIONS, DRY SEASON (LEFT) AND WET SEASON (RIGHT)



The wave conditions at Point Ceylon during non-storm conditions are expected to be low, in line with the offshore wave conditions. The fetch to Point Ceylon is relatively limited, with the exception of winds blowing from the north and east. Winds from the north and east are uncommon, and are limited to generally less than 10m/s. Waves generated across deep water at these wind speeds could be expected to peak in the order of 0.4 – 0.5m and a period of around 3-4 seconds.

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4.1.8.4 Bathymetry

A digital elevation model (DEM) of Bynoe Harbour including the channels around Point Ceylon is shown in Figure 20. Data was sourced from the Royal Australian Navy AUS Chart 29 throughout the main waterway. Where chart data was inadequate, additional bathymetric data was collected during site assessments in August and September 2015. The general known shapes and depths of channels have been used to create a continuous bathymetric surface where no data exists.

The main features of the bathymetry are summarised as follows:

Bynoe Harbour

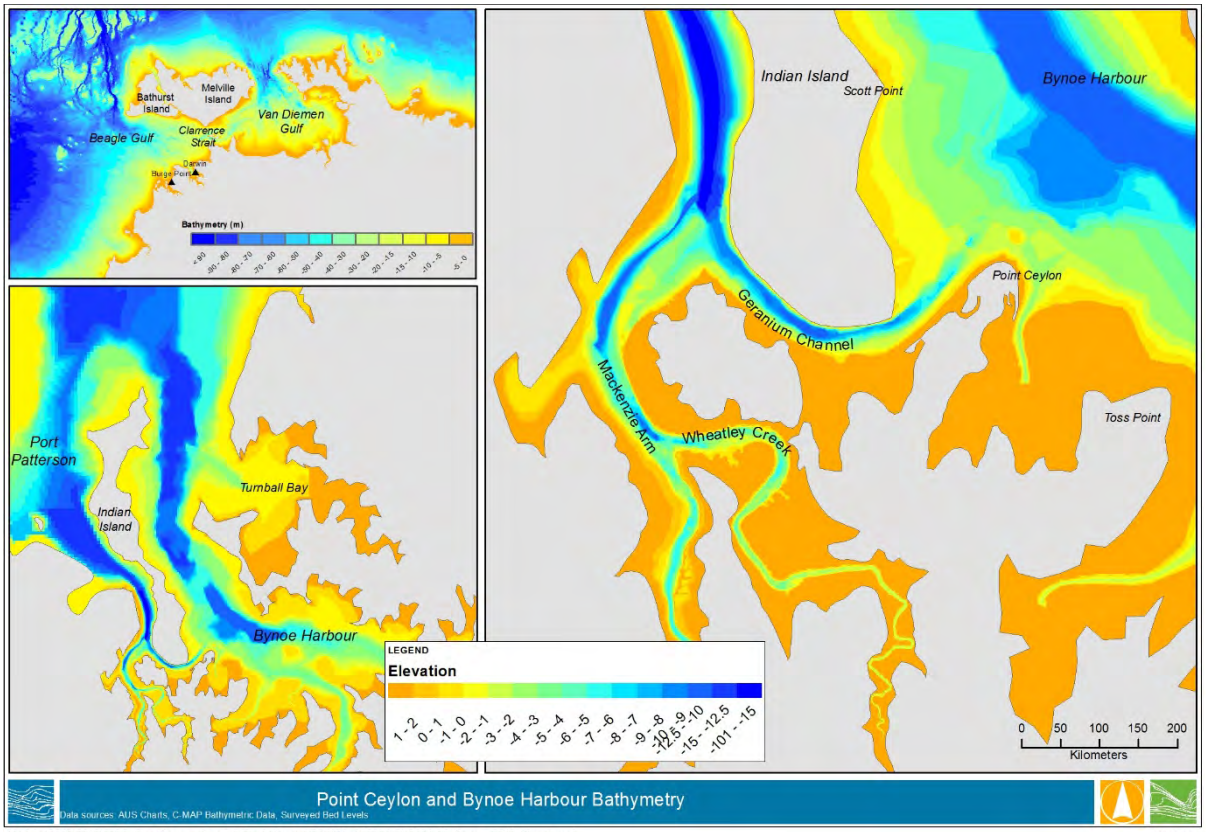
- Bynoe Harbour varies in width between 6km at the northern end of Indian Island to 3.5km at Point Ceylon. The bed level within Bynoe Harbour ranges from below -20 m AHD at the entry, increasing to around -15m AHD eastward of Point Ceylon.
- The shores along the harbour vary between intertidal mangrove backed shorelines, rocky headlands and sand spits with sandy berm beaches.
- The shoreline of Bynoe Harbour is considered relatively stable, with only small and isolated pockets of erosion or deposition (UniQuest, 2010)
- Indian Island separates Bynoe Harbour from Port Patterson to the west. The island is low lying and there is potential for exchange of water across the island during high storm surges.
- The distance from the entry of the Harbour at the northern end of Indian Island to the eastern extent of the main tidal channels is over 40 km.
- Large sand bars are exposed at low tides west of Point Ceylon, particularly in the area between Knife Island and Patience point at the confluence of Milne Inlet and the Harbour.

Point Ceylon and channels

- Point Ceylon is located on the southern shore of Bynoe Harbour between the entrance to the Geranium Channel and Mawson Inlet.
- The area offshore of Point Ceylon is shallow and a large rock reef is present.
- Geranium Channel provides flow connection between Bynoe Harbour and Port Patterson around the southern end of Indian Island. The Channel at the south of the island maintains a consistent width of approximately 350-400 m. Limited bathymetry data indicates the main channel is closer to the steep northern bank, whilst the southern bank has a wide tidally exposed flat which slopes gently north to the main channel. The minimum depth of the channel is around 8m at mean water and the channel remains wet during low tide.
- West of Indian Island, Geranium Channel continues northward into Port Patterson. The channel is wider here with a minimum span of 600m. The minimum bed level within the channel is around -16 m AHD. Wide mangrove and saltpans are present on either side of the channel on Indian Island and the land to the west.

- The Mackenzie Arm joins Geranium Channel to the southwest of Indian Island. A large sand spit is exposed during low waters to the south of the channel connection. The sand spit extends close to 1.5 km and indicates the main tidal flow is directed along the western bank of the channel.
- The depth of main channel within the Mackenzie Arm is around -10m AHD through to the connection to Wheatley Creek (depths were not recorded in Mackenzie Arm beyond this point). The Mackenzie Arm catchment is quite small and is comprised of predominantly large rural residential properties with some small scale agriculture.
- Depths within Wheatley Creek vary from -7 m AHD at the connection to Mackenzie Arm to - 5.0 m AHD at the discharge point. Limited bathymetric data collection indicates there are a number of deeper pools within the channel, particularly at the channel bends, and shallower sections in the channel where the minimum bed level is greater than -3.0 m AHD. It is probable that sections of Wheatley Creek dry out during low tide and pools form along the waterway.

FIGURE 20 BYNOE HARBOUR AND POINT CEYLON DEM



4.1.9 Water Quality

4.1.9.1 Literature Review

To characterise the ambient water quality of the receiving environment, a literature review was undertaken (Water Technology Pty Ltd, 2016). Previous water quality assessments of Bynoe Harbour and Port Patterson (EcOz Environmental Services 2003a and Enesar 2006) were assessed, as well as water quality information available from the Paspaley Pearling Company (Paspaley), and the NT Department of Land and Resource Management.

Existing reports indicate that available ambient water quality data in the area is limited, therefore, data collected from comparable estuarine areas of the Darwin Harbour region (Fortune, 2015) was also reviewed.

Salinity

Salinity within Bynoe Harbour and around Point Ceylon is primarily influenced by offshore salinity levels during the dry season, and catchment runoff during the wet season, with potential for salinity levels to increase upstream of the system at the end of the dry. Based on information provided by Paspaley (pers.comm), salinity near the intake pipe ranges between 28 and 37 parts per thousand (ppt). Following larger flood events the salinity can drop to around 20 ppt and has been measured as low as 12 ppt. Data collected by Seafarms in December 2015, within the vicinity of the proposed site, indicates very little vertical stratification within the waterbody. Salinity levels were recorded between 34.2 and 35.5 ppt across a full ebb-flood tidal cycle. Data collected from sites within Darwin Harbour (West Arm and Woods Inlet) is considered comparable to the environments of Geranium Channel and Wheatley Creek. The range of salinity levels from these sites, as discussed by Fortune (2015), is approximately 33 to 38 ppt.

Turbidity

Turbidity within Bynoe Harbour is seasonal, with runoff from the catchment contributing to high turbidity levels during the wet season. Based on data collected by Paspaley, visibility through the water column following a large flow event has been recorded using a Secchi[3] disk as low as 0.3m (Enesar, 2006). During the dry season, turbidity reduces and a maximum Secchi depth of 8m has been recorded. Turbidity is also influenced by the tide. High tidal currents act to keep suspended sediment entrained within the water body, and moderate to high turbidity levels are common throughout the year. This is particularly so during spring tides, as more of the (muddier) intertidal flats are inundated, and higher current speeds occur and draw sediments from these intertidal banks into the waterway (Water Technology, 2016). Turbidity data from Woods Inlet and the West Arm of Darwin Harbour ranges from 2 to 6 Nephelometric Turbidity Units (NTUs)[4].

Nutrients

The literature review revealed no historical ambient Total Nitrogen (TN), Total Phosphorus (TP) or chlorophyll *a* data for the area is available. Data from Woods Inlet and the West Arm is in the range of:

- TN – 120-200 µg/L
- TP – 5-10 µg/L
- Chlorophyll *a* – 0.38-1.63 µg/L

Freshwater Inflows

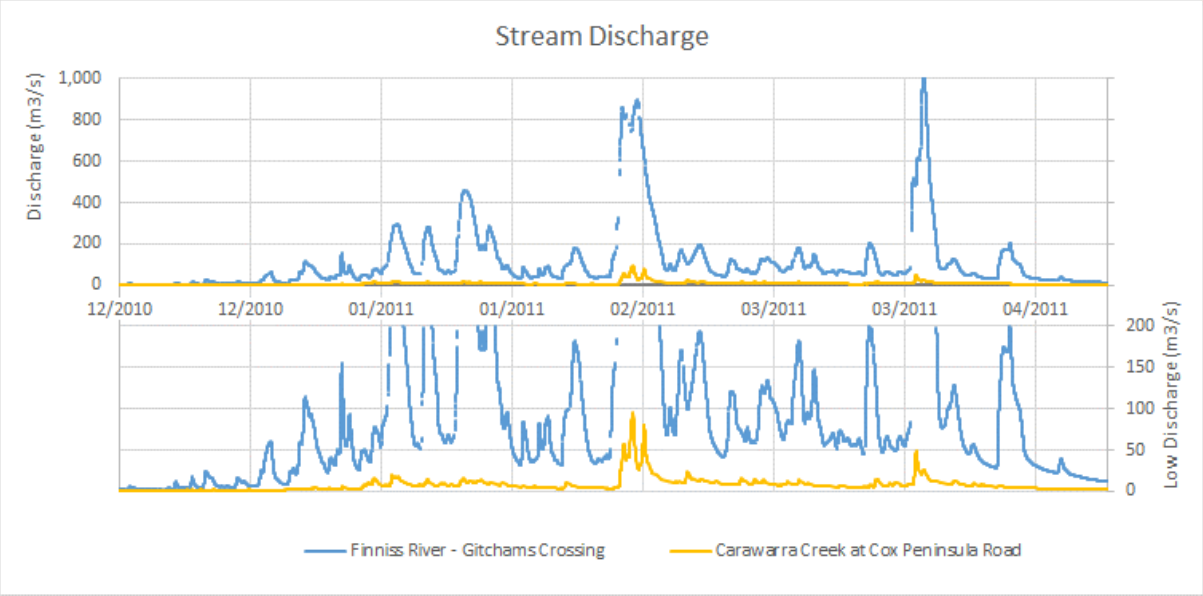
The catchments around Bynoe Harbour are ungauged and relatively small in size. The Wheatley Creek catchment is approximately 33km^2. The total catchment for Bynoe Harbour is approximately 1,000km^2 (UniQuest, 2010), including Turnball Bay. Gauged streamflow data is available for Corrawarra Creek, to the north of Bynoe Harbour (catchment size 191km^2), and the Finniss River to the south (catchment size 2,800km^2) (UniQuest, 2010). These waterways have significantly different catchment areas; however, flow data follows similar peaks as shown below

[3] The Secchi disk is a plain white, circular disk 30 cm in diameter used to measure water transparency. The disc is mounted on a pole or line, and lowered slowly down in the water. The depth at which the disk is no longer visible is taken as a measure of the transparency of the water. This measure is known as the Secchi depth and is related to water turbidity.

[4] Nephelometric Turbidity Units measures the passage of light through turbid water.

in Figure 21. These flow patterns are expected to be replicated within the Bynoe Harbour and Wheatley Creek catchments, albeit on a smaller scale.

FIGURE 21 GAUGED FLOW DATA, CORRAWARRA CREEK AND FINNISS RIVER (NT DATA WAREHOUSE, 2015)



Limited water quality data is available for the freshwater inflows; however, a single set of samples was taken at a number of the Bynoe Harbour tributaries in May 2005. The results of these samples are summarised in Table 10. This data has been extracted from the NT Water Data Portal, maintained by the Department of Land Resource Management.

TABLE 10 BYNOE HARBOUR TRIBUTARY WATER QUALITY DATA

Variable	Sites	Maximum	Average	Minimum
Temperature (degrees C)	7	29.4	27.6	22.9
Depth (m)	8	0.5	0.5	0.1
Total Nitrogen (mg/L)	5	0.2	0.18	0.15
Dissolved Oxygen (% sat)	7	63%	55%	30%
Total Phosphorus (mg/L)	8	0.02	0.01	0.01

4.1.9.2 Water Quality Sampling Program

In November 2015 PSD commenced a sampling program to establish existing water quality conditions within the receiving environment and its associated waterways. Monthly samples are being taken at the locations illustrated in Figure 22. A range of physiochemical parameters are being measured including hydrocarbons, BTEX, heavy metals, organochlorine pesticides and nutrients. The results of sampling to date for TN, TP, Chlorophyll *a* and turbidity are presented in Table 11. Based on this data, water quality levels (with the exception of one potential outlier TN value in Mackenzie Arm) at all sites are relatively consistent with the information obtained through the literature review presented above.

The 80th percentile values of these data sets (the metric typically used to quantify ambient water quality levels) are as follows for the key water quality parameters of concern to this project:

- Turbidity 8 NTU
- TN 0.2 mg/L
- TP 0.02 mg/L
- Chlorophyll *a* 2 µg/L

For the purposes of the numerical modelling, and the impact assessment presented in Section 5.1.7, these values were adopted as 'background' concentrations.

FIGURE 22 WATER QUALITY SAMPLING SITES

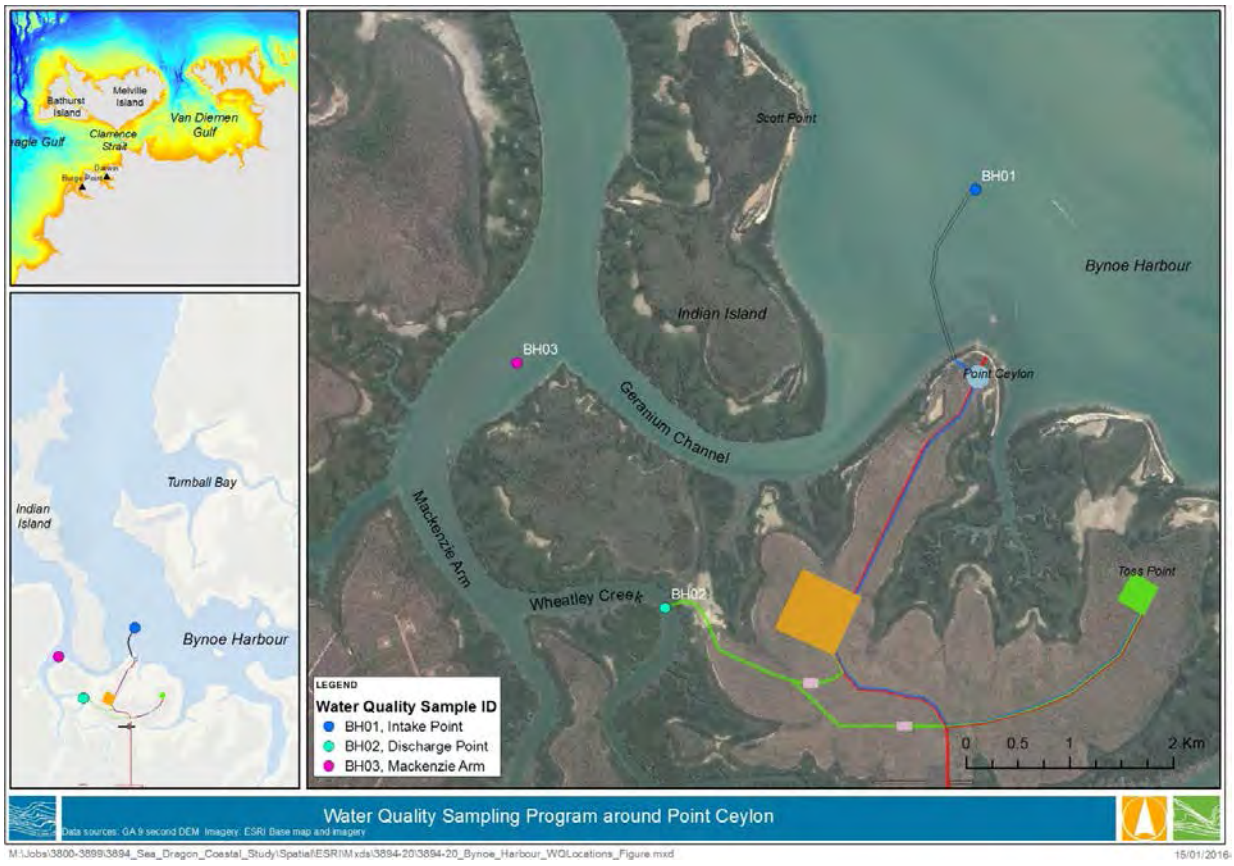


TABLE 11 BASELINE WATER QUALITY RESULTS

Parameter	November 2015			December 2015		
	BH01	BH02	BH03	BH01	BH02	BH03
Total Nitrogen (mg/L)	0.15	0.14	0.41	0.10	0.20	0.20
Total Phosphorus (mg/L)	0.02	0.02	0.02	0.03	0.02	0.02
Chlorophyll a (µg/L)	<1	<1	<1	1.6	2.9	2.1
Turbidity (NTU)	1.7	10	4.5	3.0	7.6	5.1

4.1.10 Groundwater

The Finniss Sub-Region, in which the project area is located, has limited groundwater potential (DIPE 2002). NT Department of Land Resource Management records indicate that there is an existing bore on the project site. The bore, RN23176, is estimated to pump 2.0 L per second to 5.0 L per second (Department of Land Resource Management, 2014).

Local consultation has identified two active (and at least two collapsed wells) still used for potable water by fishers staying at Point Ceylon. This water was previously assessed by Suntay Aquaculture in around 2003, as being of potable quality.

4.1.11 Threatened Flora and Vegetation

A flora survey of the project area was undertaken in 2003 by EcOz Environmental Services. No threatened flora species and/or ecological communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Territory Parks and Wildlife Conservation Act 2006* (TPWC Act) were recorded during these surveys. Although not recorded on the proposed development site, an NT NRM Report generated for the surrounding project area indicates that Armstrong's Cycad (*Cycas armstrongii*) and Arrowleaf Monochoria (*Monochoria hastata*) have been recorded in area. Both species are listed as vulnerable under the TPWC Act (Table 12) and have the potential to occur within the project footprint.

EcOz Environmental Services (2003b) also verified the vegetation communities in the project area that had been previously mapped and described in the Lower Finniss Land Resources Study (Hill *et al.,* 2002). The vegetation communities in the project area and surrounds are shown in Figure 23 and are listed in Table 13. The project area is dominated by mid to tall open *Eucalypt* spp. woodland with a mid-storey of *Livistona humilis* over *Eriachne* spp., *Sorghum* spp., and *Heteropogon triticeus*. This vegetation type represents over 80% of vegetation within the project footprint.

No threatened ecological communities listed under the EPBC Act are known to occur within or surrounding the proposed project area.

TABLE 12 THREATENED FLORA

Common Name	Scientific Name	EPBC Act Status	TPWC Act Status	Likelihood of Occurrence
Armstrong's cycad	*Cycas armstrongii*	-	Vulnerable	Likely – species occurs in Darwin region and west to Finniss River in the same Darwin stringybark and Darwin woollybutt woodland that occurs on this site.
Arrowleaf Monochoria	*Monochoria hastata*	-	Vulnerable	Possible – recorded 16 km to the south of the project area*.

*NT Department of Land Resource Management 2015

TABLE 13 VEGETATION COMMUNITIES

Vegetation Community Code*	Vegetation Community Description	Area Within Footprint (ha)
A1	Mid high open woodland to tall open woodland of *Eucalyptus tetrodonta*, *Eucalyptus miniata* and *Erythrophleum chlorostachys*, mid of *Livistona humilis* over *Eriachne* spp., *Sorghum* spp., and *Heteropogon triticeus*.	100.23
A2	Mid high open woodland to tall open woodland of *Corymbia polycarpa* and *Erythrophleum chlorostachys*, mid of *Livistona humilis* over *Eriachne* spp.	0.82
A3	Mid high open woodland of *Erythrophleum chlorostachys* and *Corymbia polysciada*, mid of *Livistona humilis* over *Eriachne* spp., *Sorghum* spp., and *Themeda triandra*	0.88
B1	Low open woodland to mid high open woodland of *Lophostemon lactifluus*, mid of *Lophostemon lactifluus* and *Livistona humilis* over *Eriachne burkittii*, *Eriachne* spp., and *Themeda triandra*	2.65
C1	Mid high open woodland of *Xanthostemon paradoxus* and *Erythrophleum chlorostachys*, mid of *Livistona humilis* and *Acacia* spp. over *Eriachne* spp. and *Sorghum* spp.	4.28
D1	Low open woodland to tall open woodland of *Melaleuca viridiflora*, mid of *Melaleuca viridiflora* over *Eriachne* spp. and *Sorghum* spp.	6.81
E1	Monsoon vine thicket	6.63
J1	Tall open woodland and forest of mixed riparian species	0.94
P1	Grassland of *Sorghum* spp. and *Eriachne burkittii*	1.51
	Mangroves	0.66
	Saltflats	1.23
Total area		126.64

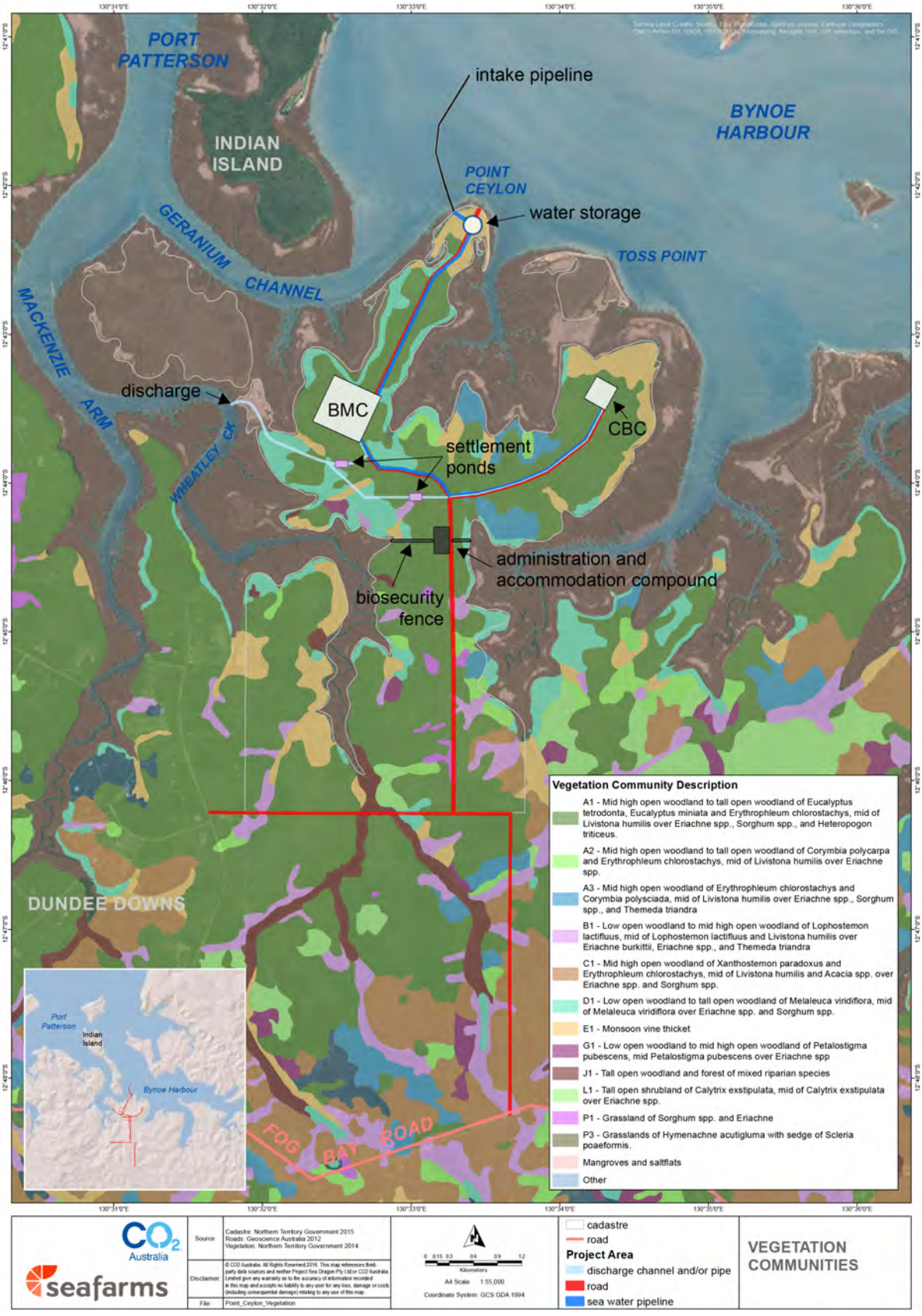
*Hill *et al.,* 2002

4.1.12 Weeds

Weeds are abundant in parts of the project area which have been disturbed by previous activity (EcOz Environmental Services 2003b). The most prevalent infestations occur at Point Ceylon and along existing access tracks. Eight weed species were recorded by EcOz Environmental Services (2003b) including:

- gamba grass (*Andropogan gayanus*)
- cobbler's peg (*Bidens pilosa*)
- wild passionfruit (*Passiflora foetida*)
- hyptis (*Hyptis suaveolens*)
- annual mission grass (*Pennisetum pedicellatum*)
- sicklepod (*Sida obtusifolia*)
- grader grass (*Themeda quadrivalvis*)
- mission grass (*Pennisetum polystachion*).

FIGURE 23 VEGETATION COMMUNITIES



4.1.13 Threatened Fauna

Fauna surveys of the terrestrial project area were undertaken during 2002 and 2003 by GHD. No threatened fauna species listed under the EPBC Act and/or TPWC Act were recorded during these field surveys. Nevertheless, additional desktop assessments of the following sources were undertaken to further assess the likelihood of threatened fauna species utilising the project site:

- Commonwealth EPBC Act Protected Matters Search Tool
- NT NRM Infonet
- NR Maps
- Fauna Atlas Data from the NT Department of Land Resource Management
- National Conservation Values Atlas from the Commonwealth Department of the Environment
- Previous fauna surveys undertaken in the project area and surrounds, including:
    - Suntay Aquaculture Centre Terrestrial Fauna Survey (GHD 2003)
    - Ichthys Nearshore Environmental Monitoring Program
        - Routine Turtle and Dugong Monitoring Program Report – Dredging Report 3 (Cardno 2013)
        - Turtle and dugong monitoring post-dredging report (Cardno, 2015a)
        - Seagrass monitoring post-dredging report (Cardno 2015b)
    - A survey of intertidal seagrass from Van Dieman Gulf to Castlereagh Bay, Northern Territory, and from Gove to Horn Island, Queensland (Roelofs *et al.*, 2005)
    - Mangrove Survey of Bynoe Harbour Northern Territory (Brocklehurst & Edmeades, 2003)
    - Darwin and Ashmore Reef Tour Report 12 - 22 October 2010 (Peregrine Bird Tours 2010).

Based on assessment of these sources Table 14 lists 26 threatened species listed under the TPWC Act that may occur around, or relate to the Bynoe Harbour area. Table 14 also provides an assessment of the likelihood of occurrence of each threatened species. The likelihood of a species occurring on the project area was assessed based on a GIS analysis of threatened species records within the project area, surrounds and the wider Bynoe Harbour and Lower Finniss region. Likelihood of a species occurring on the project area was categorised into one of the following four categories:

- Known - the species has been observed or recorded on the project site.
- Likely - the project site contains potential habitat for the species and there are records of species from similar habitats in Bynoe Harbour and/or the Lower Finniss Region.
- Possible - the project site contains potential habitat for the species however there are no records within the Bynoe Harbour and/or Lower Finniss Region.
- Unlikely - the species has not been recorded in the Bynoe Harbour and/or Lower Finniss Region and the project site does not contain potential habitat for the species.

Threatened and migratory fauna species that are listed only under the EPBC Act that have the potential to occur on, or relate to project area and surrounds are discussed further in Section 8.

4.1.14 Pest Species

GHD (2003) recorded wild pigs (*Sus scrofa*) and Asian house gecko (*Hemidactylus frenatus*) in the study area.

TABLE 14 THREATENED FAUNA SPECIES LISTED UNDER THE TPWC ACT

Scientific Name	Common Name	EPBC Act Status^	TPWC Act Status	Source					Likelihood of Occurrence
				EPBC PMST	NR Maps	NT NRM Report	Fauna Atlas#	Other	
Insects									
Ogyris iphis doddi	Dodd's Azure Butterfly	E	E	-	-	•	-	-	Possible - potential habitat exists in project area and surrounds.
Fish									
Glyphis garricki	Northern River Shark, New Guinea River Shark	E	E	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Pristis clavata	Dwarf Sawfish, Queensland Sawfish	V	V	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Pristis pristis	Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish	V	V	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Pristis zijsron	Green Sawfish, Dindagubba, Narrowsnout Sawfish	V	V	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Terrestrial Reptiles									
Acanthophis hawkei	Plains Death Adder	V	V	•	-	-	-	-	Unlikely – no suitable habitat for the species (i.e. cracking black soils) exists on the project area and there are no records of the species within the Lower Finniss Region.
Varanus panoptes	Yellow-spotted Monitor	-	V	-	•	•	•	-	Likely – the species has been recorded 3 km to the south-west of the project area (Figure 24).
Marine Reptiles									
Caretta caretta	Loggerhead Turtle	E, Mi	V	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.

Scientific Name	Common Name	EPBC Act Status^	TPWC Act Status	Source					Likelihood of Occurrence
				EPBC PMST	NR Maps	NT NRM Report	Fauna Atlas#	Other	
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	E, Mi	CE	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Eretmochelys imbricata	Hawksbill Turtle	V, Mi	V	•	•	-	•	•[1]	Likely – the species is known to occur in Bynoe Harbour (Figure 24).
Lepidochelys olivacea	Olive Ridley Turtle, Pacific Ridley Turtle	E, Mi	V	•	-	-	-	-	Likely – the species is known to occur in Bynoe Harbour.
Birds									
Calidris canutus	Red Knot	Mi	V	-	•	•	-	-	Likely – the species is known to occur in Bynoe Harbour.
Calidris tenuirostris	Great Knot	Mi	V	•	•	•	-	-	Likely – the species is known to occur in Bynoe Harbour.
Charadrius leschenaultii	Greater Sand Plover	Mi	V	•	•	•	•	-	Likely – the species has been recorded 4 km to the east of the project area (Figure 24).
Charadrius mongolus	Lesser Sand Plover	Mi	V	•	•	•	-	-	Likely – the species is known to occur in Bynoe Harbour.
Erythrotriorchis radiatus	Red Goshawk	V	V	•	-	•	-	-	Possible - potential habitat exists in the project area.
Erythrura gouldiae	Gouldian Finch	E	V	•	-	-	-	-	Possible – potential habitat exists in the project area.
Geophaps smithii smithii	Partridge Pigeon	V	V	•	•	•	•	-	Likely – potential habitat exists in the project area and surrounds and the species has been recorded in similar habitat within the Lower Finniss Region. The nearest record is 8 km to the south-east of the project area (Figure 24).
Limosa lapponica	Bar-tailed Godwit	Mi	V	-	•	•	•	-	Likely - the species is known to occur in Bynoe Harbour (Figure 24).
Numenius madagascariensis	Eastern Curlew	CE; Mi	V	-	•	•	•	•[2]	Likely - the species is known to occur in Bynoe Harbour. The nearest record of the species is 5 km to the north-east of the project area (Figure 24).

Scientific Name	Common Name	EPBC Act Status^	TPWC Act Status	Source					Likelihood of Occurrence
				EPBC PMST	NR Maps	NT NRM Report	Fauna Atlas#	Other	
*Rostratula australis**	Australian Painted Snipe	E, Mi	V	•	-	-	-	-	Unlikely - no suitable habitat for the species (i.e. shallow freshwater wetlands) exists on the project area and there are no records of the species within the Lower Finniss Region.
Tyto novaehollandiae kimberli	Masked Owl	V	V	•	•	•	-	-	Possible - potential habitat exists in project area and surrounds however there are no records within the Lower Finniss Region. The nearest record is 20 km to the south of the project area (DLRM 2015).
Terrestrial Mammals									
Conilurus penicillatus	Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma	V	E	•	-	-	-	-	Possible - potential habitat exists in project area and surrounds however there are no records within the Lower Finniss Region.
Dasyurus hallucatus	Northern Quoll	E	CE	•	•	•	-	-	Likely – potential habitat exists in project area and surrounds and the species has been recorded in similar habitat within the Lower Finniss Region.
Mesembriomys gouldii gouldii	Black-footed Tree-rat (Kimberley and mainland NT), Djintamoonga	E	V	•	-	-	-	-	Possible – potential habitat (i.e. tall forest of Darwin Woolybutt and Darwin Stringybark) exists in project area and surrounds. The nearest record is in Litchfield National Park, approximately 50 km to the south-west of the project area.
Phascogale pirata	Northern Brush-tailed Phascogale	V	E	•	-	-	-	-	Possible - potential habitat (i.e. tall forest of Darwin Woolybutt and Darwin Stringybark) exists in project area and surrounds. The nearest record is in Litchfield National Park, approximately 50 km to the south-west of the project area.

^ CE – critically endangered; E – endangered; V – vulnerable; Mi – Migratory.

• Recorded.

- Not recorded.

Based on records within a 5 km radius surrounding the site.

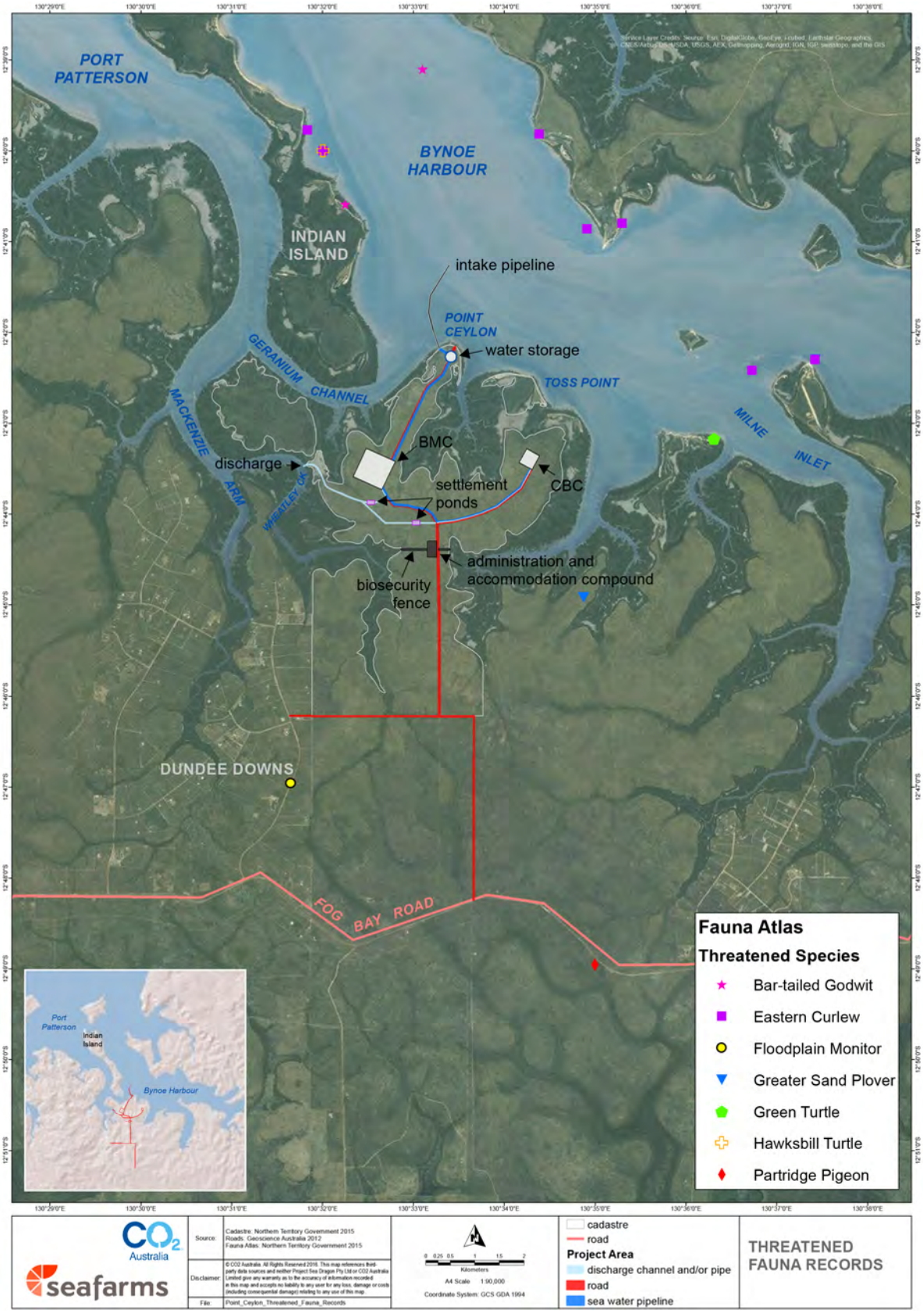
* As a marine species this species is listed as *Rostratula benghalensis* (*sensu lato*). Under the TPWC Act this species is listed as *Rostratula benghalensis australis.*

^ Recorded as *Ardea modesta.*

1 Routine Turtle and Dugong Monitoring Program Report – Dredging Report 3 Ichthys Nearshore Environmental Monitoring Program. http://www.inpex.com.au/media/1910/turtle-and-dugong-monitoring-report-3.pdf

2 Darwin and Ashmore Reef Tour Report 12 - 22 October 2010. http://www.peregrinebirdtours.com/a/Tour-Reports/Darwin-and-Ashmore-Reef

FIGURE 24 THREATENED FAUNA RECORDS



4.2 SIGNIFICANT SITES OR FEATURES

4.2.1 National Parks

There are no National Parks within the proposed project area or surrounds. The nearest National Park is Litchfield National Park, located approximately 50 km to the south-east of the project area.

4.2.2 Conservation Reserves

Indian Island Conservation Area is located 2 km to the north-east of the project area (Figure 25). This was the first protected area to be declared in the Northern Territory in 1889, and is of high conservation value because of its relatively undisturbed state. The beaches also provide important breeding habitats for turtles. The development of the project will not impact the Indian Island Conservation Area.

4.2.3 Marine Parks or Reserves

There are no Commonwealth or Northern Territory marine parks or reserves located in the vicinity of the project area. The nearest Commonwealth Marine Area is located over 50 km to the north-west of the proposed project.

4.2.4 World Heritage Properties and National Heritage Places

There are no World Heritage Properties or National Heritage Places located in the vicinity of the project area. The nearest World Heritage Property and National Heritage Place is Kakadu National Park which is located over 150 km to the east of the proposed project area.

4.2.5 Public or Private Reserves

There are no public or private reserves in the vicinity of the project area.

4.2.6 Conservation Zones under a Planning Scheme

The project area falls within the Unincorporated Top End Region. This is not part of an incorporated local government council area and therefore has no planning scheme under which conservation zones are designated.

4.2.7 Significant Natural Land Features

The closest significant natural land feature is the Finniss River coastal floodplain, approximately 15 km to the south of the project (Figure 25). The project is not expected to have an impact on the Finniss River coastal floodplain.

4.2.8 Proximity to the Northern Territory Coastline

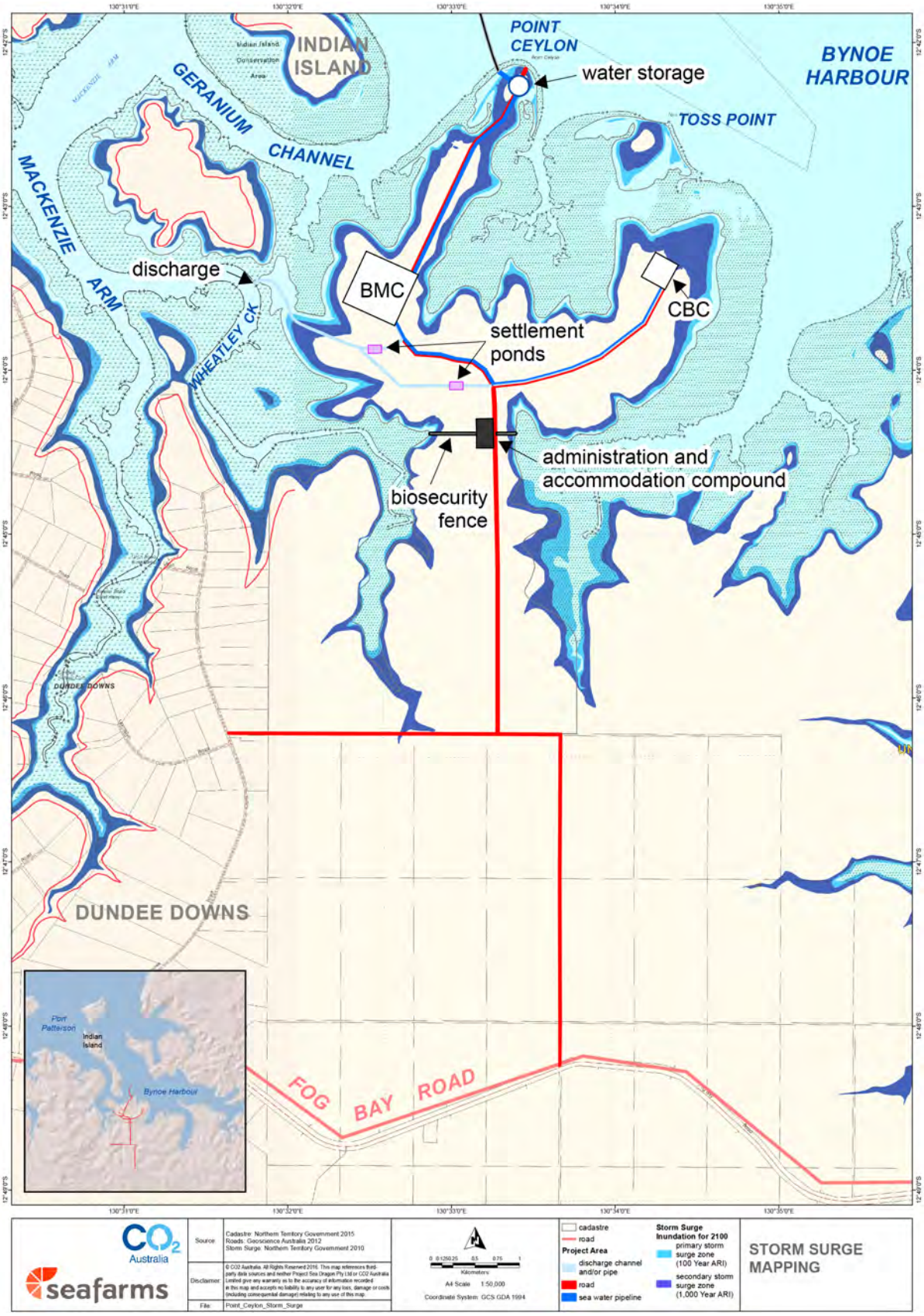
The nature of the proposed project requires close proximity to the coastal environment. The intake and outfall to the surrounding marine waters will be located so as to be viable during all tidal conditions.

4.2.9 Relation to Storm Surge Zones

Storm surge inundation mapping based on projected 2100 sea levels has been developed for an area that encompasses the project area. The mapping shows the storm surge hazard risk due to the combined effects of astronomical tide, storm surge and wave height. The primary storm surge zone indicates the extent of inundation for a storm tide event of a 100 year average recurrence interval (ARI), while the secondary storm surge zone indicates the further extent of inundation for a storm tide event of a 1,000 year ARI. The mapping indicates that low lying areas around the perimeter of Portion 3192 would be subject to both primary and secondary storm surge however the CBC, BMC and administration and accommodation compound have all been located out of the primary and secondary storm surge zones (Figure 26).

FIGURE 25 SIGNIFICANT SITES

FIGURE 26 STORM SURGE MAPPING



4.3 CULTURAL HERITAGE ENVIRONMENT

The cultural heritage environment of an area includes the following:

- Aboriginal sacred sites
- Aboriginal archaeological sites and artefacts
- Macassan archaeological sites and artefacts
- Non-indigenous heritage sites or artefacts.

4.3.1 Aboriginal Heritage

An application for an Authority Certificate has been submitted to the Aboriginal Areas Protection Authority (AAPA) for the project area. Work will not commence until the Authority Certificate has been issued.

An archaeological survey of the project area was undertaken by Begnaze Pty Ltd in 2002. Only one site was identified during the surveys, a shell scatter of approximately 40 *Telescopium telescopium* shells on a chenier ridge that runs south on the eastern side of Ceylon Point. The site, known as Point Ceylon 1, is considered to be of low archaeological significance (Begnaze Pty Ltd 2002). The site is located approximately 500 m from the proposed water storage area and would not be impacted by the project (Figure 27).

4.3.2 Macassan archaeological sites and artefacts

There are no known recorded instances of Macassan archaeological sites or artifacts in, or in proximity to, the project area.

4.3.3 Non-indigenous Heritage

Non-indigenous heritage relates to the places or objects associated with the European settlement of the area. No non-indigenous heritage sites are listed on the Commonwealth Heritage Database or on the NT Heritage Register as occurring on the project area.

4.4 SOCIAL AND ECONOMIC ENVIRONMENT

The project is located within the Dundee Region. The Dundee Region is located in the Finniss-Mary Area, which is a constituent of the Top End Region; the largest unincorporated area in the Northern Territory. This area is not governed by Local Government under the *Local Government Act* (2008), and municipal services are provided by the Northern Territory Government (Creative Territory, 2016).

The Dundee Region is home to around 800 residents and a large number of weekenders. The population is estimated to grow to around 1,200 each weekend. It is also a popular destination for tourists, with the population swelling to more than 2,000 people on public holidays and long weekends.

The Dundee Region is characterised by:

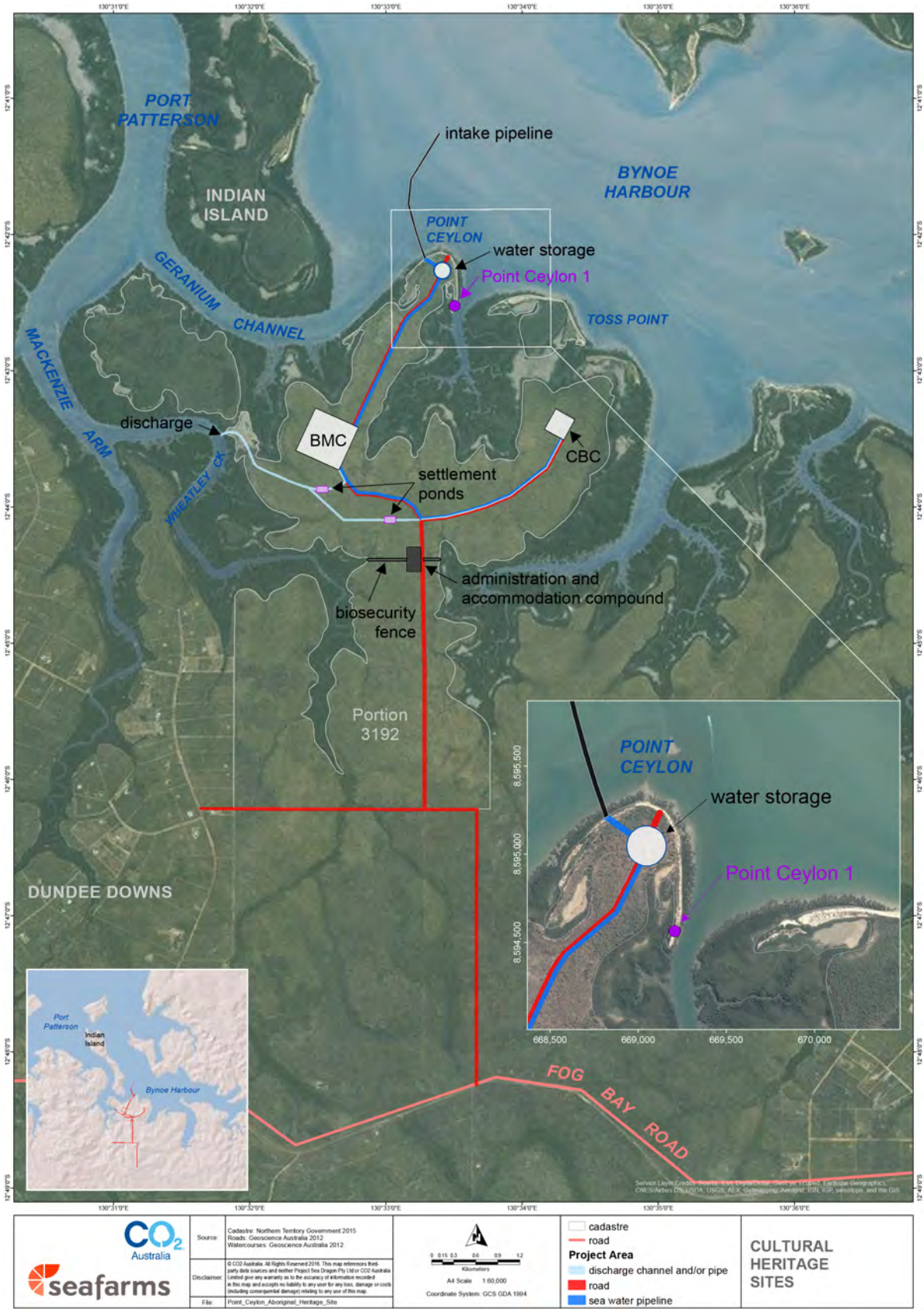
- high population growth (56.6%) in the last six years
- low cultural diversity with low proportions of Language Other than English at home (7.9%) or individuals that were born overseas (14.4%)
- low income levels ($604 is the median weekly household income) and high unemployment levels (25.5%)
- large retired community and an ageing population profile, with a median age of 48 years old.

The main attraction of Dundee is fishing, with an abundance of land and sea-based fishing and crabbing opportunities available to residents and visitors. In the Bynoe area, access to fishing is via numerous boat ramps and land-based fishing areas on creeks, rivers and the beach. At Dundee Beach itself, there is a boat ramp located at The Lodge of Dundee. A large number of people also fish from the beach, creeks and rivers from Patterson Point in the north to the Finniss River mouth in the south.

Access to the Finniss River mouth has been severely limited in recent months with the closure of the area by the owners of Finniss River Station due to poaching and illegal activities. While the Dundee Progress Association and the Amateur Fishermen's Association of the Northern Territory are separately working on access arrangements, this closure has placed more pressure on fishing areas in the Bynoe area (Creative Territory, 2016).

The Top End Region also includes the statistical areas of Alyangula, Darwin Waterfront, East Arm, Finniss-Mary, Nhulunbuy and Yulara. The total population of this Unincorporated Top End Region at June 2011 was 9,500 people (Australian Bureau of Statistics [ABS] 2011). The dominant industries in the Top End Region are tourism and agriculture. The unemployment rate in the broader Finniss statistical area is approximately 8% (ABS, 2011) which is higher than the unemployment rate across the whole of the Northern Territory (3.4%).

FIGURE 27 CULTURAL HERITAGE SITES



5 POTENTIAL IMPACTS

5.1 NATURAL ENVIRONMENT

5.1.1 Climate

The proposal will not impact upon local or regional climatic conditions.

5.1.2 Geology, Geomorphology and Soils

Other than localised impacts, confined to within the footprint of the infrastructure, the project will not impact upon geology, geomorphology or soils.

5.1.3 Topography

Other than localised impacts, confined to within the footprint of the infrastructure, the project will not impact upon topography.

5.1.4 Air Quality

There are no expected impacts on air quality of the operation of the facility. Construction of the facility could result in some minor, localised impacts in the form of dust generation during excavation, however, this is not expected to extend to areas outside of the project site.

5.1.5 Noise and Vibration

There are no expected impacts from noise or vibration during the operation of the facility. Construction of the facility could result in some minor, localised impacts from earth moving machinery and construction machinery/tools. These will be confined to business hours and are expected to be short lived in duration.

5.1.6 Coastal Features and Processes

5.1.6.1 Numerical modelling

A variety of numerical models including hydrodynamic, wave and sediment transport models have been developed to enable the simulation of the influence of tides, waves and sediment transport, and extreme events on the physical processes of the project area. The numerical models have also been utilised to quantify potential impacts as precisely as possible, and to enable cumulative impacts to be investigated.

5.1.6.2 Coastal features

The intake pipe within Bynoe Harbour will be placed on the seabed. There is potential that the pipe could interrupt sediment transport within the intertidal zone and lead to a change in the configuration of the intertidal flats as material accumulates on either side of the pipe and a net loss of material occurs away from the pipe.

The discharge outlet in Wheatley Creek is likely to also involve some removal and disturbance of vegetation, and there may be some visual disturbance owing to the construction of the intake pipe in an area with low level of development, however, minimal impact is expected upon coastal values in the area.

5.1.6.3 Bathymetric Conditions

Placement of the intake pipe on the bed will result in minor and localised changes to the bathymetry in deeper water, due to scour and deposition. More significant changes could be observed in the intertidal region where sediments are more mobile.

Discharged flow has the potential to cause scour of the bed and or bank within Wheatley Creek. Discharging flow across a weir structure will reduce the likelihood of scour on adjacent banks, as flows will be low compared with tidal currents. Some scour could occur adjacent to the overflow weir during high flow conditions.

5.1.6.4 Oceanographic Conditions

The macro tidal environment within Bynoe Harbour and Wheatley Creek means that the potential changes to the tidal water levels and currents by the intake or discharge are low. The tidal prism (the volume of water which is exchanged during a tide) at Bynoe Harbour (from north of Geranium Channel) is in the order of 3 x 10^9 m^3 during a spring tide and over 9 x 10^7 m^3 during a neap tide. During a single tide, the intake pipe will remove 5,500 m^3 of water from Bynoe Harbour (over approximately 12 hours). This represents 0.0002% of the tidal prism during a spring tide and 0.006% during a neap tide, and is thus unlikely to have any impact on tidal water levels or currents.

The spring tidal prism within Wheatley Creek is 5 x 10^6 m^3 compared with 1 x 10^6 m^3 during a neap tide. The discharge of 5,500 m^3 during a tidal cycle is an addition of 0.1% and 0.55% of the creek tidal prism for spring and neap tides respectively. Again, this is considered unlikely to have any impact on tidal waters or currents.

High tidal currents will also necessitate the anchoring of the intake pipe to the bed to prevent damage through movement. Modelling of the local conditions and requirements will determine whether the pipe is placed on the seabed surface, or requires partial or full subterranean burial.

5.1.6.5 Sediment Transport and Coastal Processes

As noted above, the intake pipe may cause localised changes to the bathymetry around it. Within the intertidal zone where small waves may be impacted by the pipe some changes to the coastline could occur. However, these are expected to be minor as the mangrove buffer along the coast presently prevents wave action from impacting the shoreline.

5.1.7 Water Quality

The potential impacts of the proposed discharge into Wheatley Creek were assessed via the formulation, application and interpretation of a calibrated, far field, two-dimensional hydrodynamic and advection dispersion modelling tool built using the MIKE 21 Flexible Mesh hydrodynamic model. The data used, the methods and key findings are summarised below. The full report, entitled “Point Ceylon Coastal Environment and Hydrodynamic Assessment” (Water Technology, 2016), is available upon request.

The numerical modelling was used to simulate the transport, dilution and dispersion of the proposed discharge within Wheatley Creek and its adjoining waterways. The proposed discharge was modelled as a conservative tracer, which allowed the dilution and dispersion of the effluent to be understood.

The numerical modelling was considered conservative for the following reasons:

- Biological and physical processes such as the deposition of particulate material, or the take up of bioavailable nutrients by vegetation or absorption by sediments and algal mats (microphytobenthos) growing on the sediments of the significant intertidal areas in and around Bynoe Harbour was not included in the modelling;
- Three dimensional turbulent dispersion associated with, for example, depth varying flow around river bends was not been included in the modelling; and
- Constant discharge of waste water into Wheatley Creek was assumed. However, as discussed in Section 3.7, since the modelling was completed, Seafarms have incorporated a weir structure into their

discharge infrastructure design. Provision of the weir will restrict discharge to periods of higher water within Wheatley Creek, which will have beneficial outcomes on the dilution and dispersion of the discharge waters.

- As discussed in Section 3.7, modelling was based upon discharge concentrations being at the levels proposed for the licence conditions (i.e. median TN at 2.0 mg/L and median TP at 0.4 mg/L), however, the concentrations in the discharge water are typically significantly better than the licence conditions.

5.1.7.1 Water Quality Objectives

In order to assess the impacts of the discharge upon the receiving environment, the findings of the modelling exercise were assessed against the performance objectives set out in the Water Quality Objectives for the Darwin Harbour Region (DNRETAS, 2010). The justification for using the Darwin Harbour Region Water Quality Objectives is set out below.

In accordance with Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, 2000), there is an accepted hierarchy of documentation to refer to for performance objectives. This hierarchy is that where there are no locally specific guidelines (which would require comprehensive local water quality data collection, typically spanning at least a one to two year period), that management decisions should default to relevant State based guidelines, and in their absence, to National guidelines.

There are no locally specific water quality guidelines for Bynoe Harbour, and there is currently insufficient data available to enable them to be developed (see Section 4.1.9). Nor are there any whole of Northern Territory guidelines.

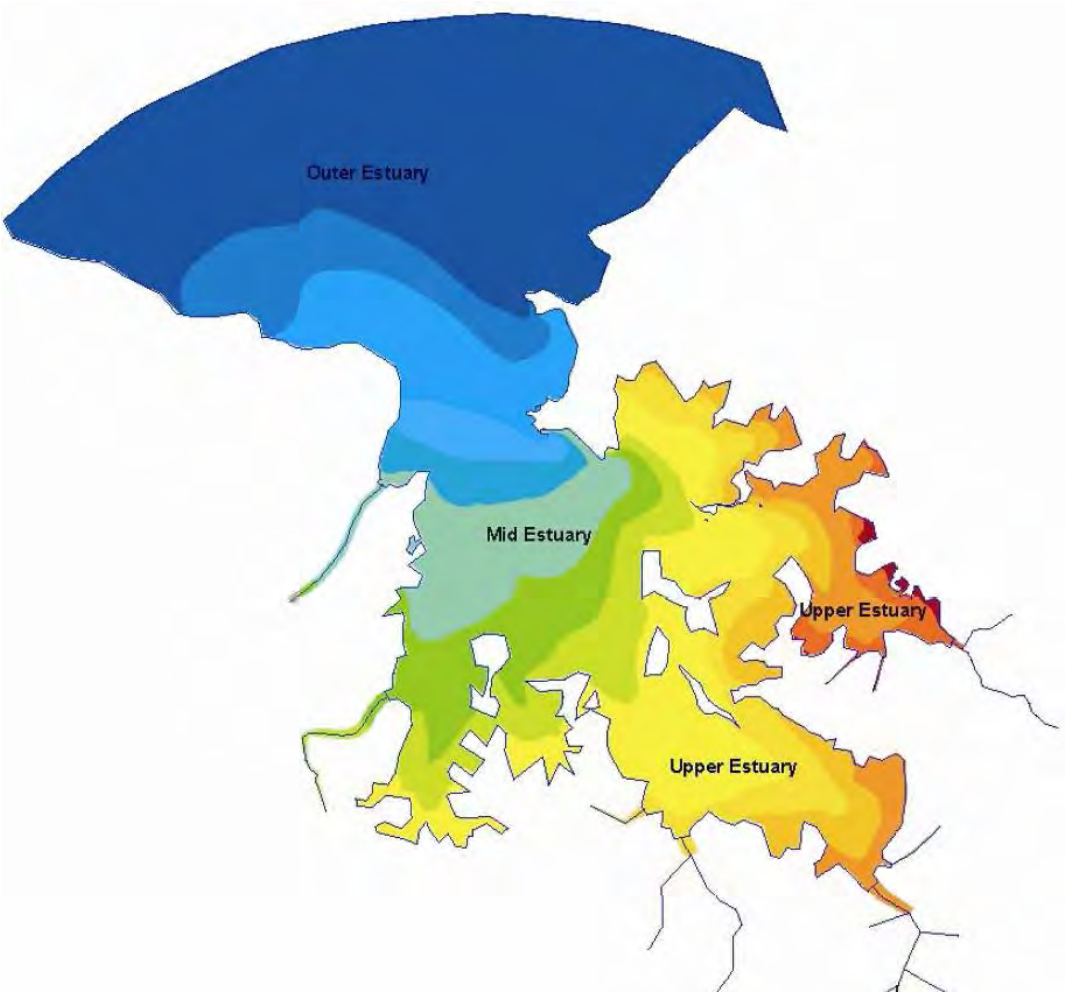
As mentioned above, in the absence of Local or Northern Territory Guidelines, there is a potential need to defer to the National (ANZECC, 2000) Guidelines, which, as they need to cater for all possible circumstances, are accepted as being conservative. However, an acceptable alternative to simply adopting the broader ANZECC guidelines, which has been undertaken by many proponents, is to draw upon other studies undertaken in comparable climatic regions, and to use these studies to derive relevant *interim* water quality objectives, which can then be used until such time as sufficient data are available for robust *locally specific* water quality objectives to be derived.

The Water Quality Objectives for the Darwin Harbour Region (DNRETAS 2010) provides specific objectives for 'mid' and 'upper' estuaries. The guideline values for these estuarine categorisations that are relevant to this project are presented in Table 15. Figure 28 shows the estuarine classifications used for Darwin Harbour.

TABLE 15 WATER QUALITY GUIDELINES FOR DARWIN HARBOUR

Parameter	Mid estuary	Upper estuary
Total Nitrogen (mg/L)	<0.27	<0.3
Total Phosphorus (mg/L)	<0.02	<0.03
Chlorophyll a (µg/L)	<2	<4

FIGURE 28 ESTUARY ZONATIONS USED IN DARWIN HARBOUR (AFTER DNRETAS, 2010)



Much of the data which underpins the establishment of the water quality guideline values for Darwin Harbour has been collected from relatively un-impacted catchments of the Harbour, similar to Bynoe Harbour, as is required when defining water quality objectives. Given the similar nature and close proximity of Darwin Harbour to the current study area, we propose the interim water quality guidelines listed in Table 16 for this study, based upon the guidelines for Darwin Harbour.

TABLE 16 PROPOSED INTERIM WATER QUALITY GUIDELINES

Parameter	Mackenzie Arm and Geranium Channel (Mid estuary)	Wheatley Creek (Upper estuary)
Total Nitrogen (mg/L)	<0.27	<0.3
Total Phosphorus (mg/L)	<0.02	<0.03
Chlorophyll a (µg/L)	<2	<4

Seafarms are currently undertaking water quality sampling around the site on a monthly basis (as described above in Section 4.1.9.2) in order to enable the development of locally specific water quality objectives. At the time of writing, three rounds of sampling had been undertaken – typically one to two years of data are required to comprehensively describe the existing water quality conditions such that locally specific water quality objectives can be developed.

5.1.7.2 Model results

The proposed discharge (see Section 3.7.2) was modelled as a conservative tracer, which allowed the dilution and dispersion of the effluent to be understood. Concentrations of the model tracer were extracted from the area around Point Ceylon at those locations shown in Figure 29. Models were run to simulate both dry season, and wet season conditions.

FIGURE 29 LOCATION OF MODEL TRACER STATISTICS

The modelling for the dry season indicated a median value of total nutrient concentration in the receiving waters of the order of 0.26 mg/L for TN and 0.033 mg/L TP at Point 1, and 0.205 mg/L TN and 0.022 mg/L TP at Point 2, with negligible changes at all other model tracer statistical locations (Figure 29). These concentrations are compliant with the proposed Interim Water Quality Guidelines objective (Table 16) for total nitrogen, and marginally exceed the total phosphorus objective. Studies of nutrients within Darwin Harbour indicate nitrogen is more likely to be the limiting nutrient in the estuarine environments (Burford *et al.,* 2008)[5].

[5] A limiting nutrient is one essential for plant growth — but is available in smaller quantities than needed for free-floating algae (i.e., phytoplankton) to increase their abundance. Once the limiting nutrient in a waterbody is exhausted, the population of algae stops expanding.

For the wet season, the modelling showed that the worst case in regard to water quality impacts will almost certainly be the dry season. As such, no further description of the wet season results is required.

As noted above, modelling results are conservative and do not consider biological assimilation of dissolved nutrients, the settling of particulate components in the discharge within the waters of Wheatley Creek and Geranium Channel, nor the controlled timing of the discharge across a tidal weir. When these additional processes are taken into consideration, the proposed discharge of wastewater into the receiving environment of the Bynoe Harbour region can be expected to have low impacts on local or regional water quality levels and associated environmental values.

It should also be noted that, the results presented above are those for the modelling of the facility at ultimate capacity. The predicted impacts of the Stage 1 discharge are far smaller, with median TN increases at Point 1 of the order of 0.01 mg/L and median TN increases of the order of 0.0025mg/L. This means that, based on the results of the modelling, the facility will be operating within the nominated interim Water Quality Objectives whilst the development of locally specific Water Quality Objectives take place.

5.1.8 Groundwater

At this stage it is not proposed to use groundwater, and there are no anticipated impacts of the construction and operation of the facilities on groundwater. However, some historic wells at Point Ceylon are used by local fishers for potable water whilst staying there, so if other avenues for sourcing freshwater supplies (such as through rainwater capture, or desalination) prove unviable, further evaluation may be undertaken to assess if local groundwater quality and quantity are such that it is a viable freshwater supply option.

5.1.9 Threatened Flora and Vegetation

5.1.9.1 Vegetation Clearance

Construction of the CBC, BMC and associated facilities will result in the clearing of up to 126.64 ha of vegetation. This allows for buffers. As mentioned in Section 3.1 the CBC and BMC are intended to be located in the approximate vicinity of the footprints indicated on Figure 2, but as detailed design progresses, the locations of these facilities may move slightly to work in with local topography. Should these facilities move slightly, it is considered that the area of vegetation clearing required would not comprise a significantly greater area of disturbance, unless required under governmental policy (for example, compliance with fire break regulations etc. – see Section 3.10). There are also a number of common facilities on site that will support both the CBC and BMC. As outlined in Table 4 the total development footprint for the CBC, BMC and common facilities at full scale will be approximately 132 ha, of which 126.64 ha is vegetated. The total anticipated clearing required constitutes 0.28% of the vegetation within a 10 km radius of the project, and 0.12% of the vegetation within the entire Lower Finniss Region. This is not considered to constitute a significant impact. Furthermore, it is expected that as the project footprint is further refined, the footprint will be reduced, lessening the direct impacts on vegetation.

The majority of the vegetation within the project footprint (around 80%) is mapped as open woodland of *Eucalyptus tetrodonta*, *Eucalyptus miniata* and *Erythrophleum chlorostachys.* This community (Vegetation Community Code A1) is widespread across the region, and the area within the project footprint constitutes 0.86% of the extent of the vegetation community that occurs within a 10 km radius of the project, and 0.3% within the entire Lower Finniss region. The clearing of this vegetation is not considered to constitute a significant impact to this vegetation community (A1). Furthermore, as mentioned above, it is expected that as the project footprint is further refined, the footprint will be reduced, lessening the direct impacts on this vegetation community.

5.1.9.2 Taking of Threatened Flora

Two threatened flora species, the Armstrong's Cycad (*Cycas armstrongii*) and Arrowleaf Monochoria (*Monochoria hastata*), have been identified as having the potential to occur in the project area and surrounds. Pre-clearance field surveys to assess the presence of these species, or suitable habitat for them, will be undertaken by a suitably qualified ecologist prior to any clearing activities or earthworks taking place.

5.1.10 Weeds

The greatest risk of weeds being introduced and spread will occur during the construction of the project. Vegetation clearing, soil disturbance and vehicle movements are considered likely to create opportunities for weeds and an increased potential for weed incursion into adjacent native vegetation.

5.1.11 Threatened Fauna

Desktop assessments revealed that 26 threatened fauna species listed under the TPWC Act may occur or have suitable habitat within the project site and surrounds. Of these, all but one, the Yellow-spotted Monitor (*Varanus panoptes*), are also listed as threatened or migratory species under the EPBC Act.

The likelihood of occurrence was assessed on a 4-tier scale as follows:

- Known - the species has been observed or recorded in the project footprint.
- Likely - the project area contains potential habitat for the species and there are records of species from similar habitats in Bynoe Harbour and/or the Lower Finniss Region.
- Possible - the project area contains potential habitat for the species however there are no records within the Bynoe Harbour and/or Lower Finniss Region.
- Unlikely - the species has not been recorded in the Bynoe Harbour and/or Lower Finniss Region and the project area does not contain potential habitat for the species.

Two of the 26 species, the Plains Death Adder (*Acanthophis hawkei*) and the Australian Painted Snipe (*Rostratula australis*) are considered unlikely to occur due to lack of suitable habitat on the project site and surrounds. The remaining 24 species are known, or considered likely or possible to occur in and around the project site. They are:

- One insect – Dodd's Azure Butterfly (*Ogyris iphis doddi*)
- One terrestrial reptile – the Yellow-spotted Monitor (*Varanus panoptes*)
- Four species of mammal
- Ten species of bird – six that are considered shorebirds (i.e. using resources predominantly found in the intertidal environment) and four terrestrial birds (i.e. using resources predominantly found within the terrestrial environment)
- Four fish species – comprised of one shark species (the Northern River Shark *Glyphis garricki*) and three species of sawfish (*Pristis* spp.)
- Four species of marine turtle.

A Marine Fauna Assessment was commissioned to assess the likelihood of impacts to marine species, and to recommend measures to mitigate potential impacts to marine species. The report, entitled "Project Sea Dragon CBC & BMC Marine Fauna Assessment" (GHD, 2016), is available upon request.

Results of the fauna impact assessment are summarised below.

5.1.11.1 Insects

Dodd's Azure Butterfly (*Ogyris iphis doddi*) is apparently restricted to the Top End of the Northern Territory. It is known only from Darwin and Melville Island. It is not clear if the apparent rarity of this subspecies is due to insufficient survey effort, or that the subspecies is in decline. On the whole, adults of this subspecies are rarely collected because they are relatively cryptic and difficult to sample due to their extreme localization and arboreal specialization on mistletoe food plants, which frequently grow in the canopy of eucalypts (Braby and Woinarski, 2006).

The general ecology of this species is well known for the nominate subspecies *O. i. iphis* from Queensland. The larvae shelter during the day in hollows or cracks in the haustorium of mistletoe where attendant ants have established a nest, and pupate in similar situations. The adults fly rapidly among the tree tops, but are rarely observed. Little has been recorded for the NT subspecies but Dodd (1935) indicated that the larvae were feeding on mistletoe and that they were attended by ants (Braby and Woinarski, 2006).

There is no evidence that any external factors have caused a decline in numbers or distribution of Dodd's Azure Butterfly. However, clearing of its preferred eucalypt forest habitat and increased fire regime potentially leading to declines in mistletoes in habitats on which *Ogyris iphis doddi* and related species depend, may be threatening processes (Braby and Woinarski, 2006).

The project will require the clearing of a maximum of 126.64 ha of vegetation, which equates to 0.28% of vegetation within a 10 km radius of the project. The vegetation type to be cleared is widespread in the area (Section 5.1.9.1) and given the relatively low level of clearing required, it is considered unlikely that removal of vegetation to facilitate the project would constitute a potential significant impact to Dodd's Azure Butterfly, should it occur in the area. The project will not lead to any increases in fire regime.

5.1.11.2 Terrestrial Reptiles

The Yellow-spotted Monitor (*Varanus panoptes*) is considered likely to occur on the site. This species has been recorded 3 km to the south-west of the project area. *Varanus panoptes* is widespread in the NT. The most important conservation issue it faces is its propensity to eat cane toads and to die from the ingested toxins (Ward *et al.,* 2012).

The project will not contribute to the spread of cane toads or increase the density of them. Cane toads may have the potential to enter the settlement ponds. Measures to prevent their entry into ponds will be developed if necessary.

As mentioned above, the clearing equates to 0.28% of the vegetation within a 10 km radius of the project and the vegetation type is widespread in the area (Section 5.1.9.1). This species occupies a wide range of habitats and should not be affected by the loss of habitat due to this vegetation clearing.

5.1.11.3 Terrestrial Mammals

Four terrestrial mammals have the potential to occur across the project site. They are the:

- Brush-tailed Rabbit-rat (*Conilurus penicillatus*)
- Northern Quoll (*Dasyurus hallucatus*)
- Black-footed Tree-rat (*Mesembriomys gouldii gouldii*)
- Northern Brush-tailed Phascogale (*Phascogale pirata*).

None of these species have been recorded from the site or surrounds. The Brush-tailed Rabbit-rat has not been recorded within the Lower Finniss Region. The Black-footed Tree-rat and the Northern Brush-tailed Phascogale have both been recorded from Litchfield National Park, approximately 50 km to the south-west of the project area. Northern Quoll have been recorded from similar habitat to that on the project site, within the Lower Finniss Region.

The Brush-tailed Rabbit-rat prefers eucalypt tall open forest. Its range and population size in the NT has declined by well over 50 per cent since European settlement, with considerable localized declines within the last ten years No one factor has been found to have caused the decline of brush-tailed rabbit-rats, but it is considered probable that the decline is not due to land-use factors, but rather to either disease or exotic predators. It is believed that the most likely causal factor is predation by feral cats. But it is considered possible that broad-scale habitat change may have contributed to the apparent decline. Changed fire regimes, weeds and grazing by livestock and feral animals may have changed the availability of preferred or vital food resources (Woinarski and Hill, 2012a).

The Northern Quoll occurs across much of northern Australia, and has declined across much of this range. In the NT, it is restricted to the Top End. The Northern Quoll is a generalist predator, and occur in a wide range of habitats, but the most suitable habitats appear to be rocky areas. It was common in many eucalypt open forests but has been declining in the NT for at least several decades, possibly because of impacts from feral cats, disease or changed fire regimes. However, more recently, the spread of cane toads has become a more pressing threat than cats, disease or fire. Quolls are particularly vulnerable to the poison of cane toads, and are killed when they attempt to kill or consume the toads (Woinarski and Hill, 2012b).

The Black-footed Tree-rat is found in the top end of the Northern Territory and may have remained relatively abundant (or become more abundant) in the Darwin rural area, perhaps because of fire regimes. Threatening processes are considered to be habitat modifications in the form of loss of tree hollows and shrubby understory due to altered fire regimes. Forest fragmentation and predation by feral cats are also considered to be threats (Hill, 2012).

There are relatively few records of the Northern Brush-tailed Phascogale in the NT and no empirical data available to evaluate threatening processes. Cane toads are considered to be a threatening process, as they are for other dasyurid species, such as the northern quoll. However, declines in the phascogale population were apparent prior to the arrival of cane toads, and exotic predators (cats) or disease may be a factor. Other processes potentially involved in the decline of phascogales in the NT include vegetation change due to altered fire regimes, and/or pastoralism. This species may be severely disadvantaged by extensive clearing of eucalypt forests, especially those with hollow-bearing trees.

Other than land clearing, the project is not considered likely to contribute to any of the threatening processes listed above for the terrestrial mammals that could potentially occur on the project site. The project will not contribute to the spread of cane toads or increase the density of them. Nor will it change fire regimes or increase the spread of weeds or grazing by livestock. The clearing required to facilitate the project equates to 0.28% of the vegetation within a 10 km radius of the project. The habitat within the areas to be cleared are widespread throughout the region (see Section 5.1.9). As such habitat loss due to this vegetation clearing is not considered to constitute a potential significant impact for any of the conservation significant terrestrial mammal species that have the potential to occur on the site. Furthermore, it is expected that as the project footprint is further refined, the footprint will be reduced, lessening the direct impacts on vegetation.

5.1.11.4 Avifauna

Terrestrial birds

Four species of shorebirds listed as threatened under the under the TPWC Act are known to occur around Bynoe Harbour. They are:

- Red Goshawk (*Erythrotriorchis radiatus*)
- Gouldian Finch (*Erythrura gouldiae*)
- Partridge Pigeon (*Geophaps smithii smithii*)
- Masked Owl (*Tyto novaehollandiae kimberli*).

The Red Goshawk, Gouldian Finch and Masked Owl have been assessed as having the potential to occur, based upon suitable habitat for them occurring within the project area. However, none of these species have been recorded from the site or surrounds. The Partridge Pigeon has been assessed as being likely to occur on site, based upon suitable habitat existing in the project site and surrounds, as well as a record of this species from 8 km south-west of the project area (Figure 24).

The Red Goshawk occurs in tropical and warm-temperate coastal and sub-coastal woodlands and forests. In the Northern Territory, the preferred habitat is tall open forest and woodland, or tall fringing woodlands along rivers in grasslands, shrub-lands, and low open woodlands (Aumann and Baker-Gabb 1991). The species has a large home range, of up to 200km^2 (Garnett and Crowley 2000). Widespread clearance for agriculture, particularly of lowland and riverine forests is thought to have caused the historical decline in north-eastern NSW and Queensland (Garnett and Crowley 2000).

The Gouldian Finch was once common and widespread across northern Australia, but is now absent from large areas of its former range, primarily persisting in small, fragmented populations (Dostine, 1998). The Gouldian Finch inhabits open woodlands that are dominated by *Eucalyptus* trees and support a ground cover of *Sorghum* spp. and other grasses. The main threats to the species are thought to be grazing pressure, establishment of pastoral, agricultural and mining operations, and fire (Dostine, 1998; O'Malley, 2006). Grazing intensity has been found to be the process most strongly correlated with historical declines of granivorous (seed eating) birds on the savannas of northern Australia (Franklin *et al*., 2005).

The distribution of the Masked Owl (northern) is very poorly known. It has been recorded from riparian forest, rainforest, open forest, *Melaleuca* swamps and the edges of mangroves, as well as along the margins of sugar cane fields. The subspecies has a low population density, which is suspected to be declining due to broad scale changes to the environment as a result of altered fire regimes, grazing by livestock and other feral animals, and invasion of exotic plants, particularly introduced pasture grasses.

The eastern subspecies of the Partridge Pigeon occurs only in sub-coastal areas of the northern Northern Territory and is known from the Tiwi Islands, near the McKinley River, the Daly River, Finniss River and west of Katherine (Garnett and Crowley 2000). The Partridge Pigeon (eastern) is known to occur in the Litchfield National Park, approximately 50 km to the south-east of the project area, and there are four records of the species from within 25 km of the project area - the closest being from 8 km south-west of the project area (NT NRM Infonet search, 2015).

The Partridge Pigeon (eastern) lives primarily in open forest and woodland dominated by Darwin Stringybark *Eucalyptus tetrodonta* and Darwin Woollybutt *E. miniata* that has a structurally diverse understorey (Braithwaite 1985; Garnett and Crowley 2000; Higgins and Davies 1996). The project area is dominated by mid high open

woodland to tall open woodland of *Eucalyptus tetrodonta, Eucalyptus miniata* and *Erythrophleum chlorostachys*, with a mid-story of *Livistona humilis* over *Eriachne* spp., *Sorghum* spp., and *Heteropogon triticeus*, so suitable habitat for this species is present.

The key threats to this species are considered to be changes in structure and floristic composition of open forest and woodland habitat caused through vegetation clearing, overgrazing and particularly the change from patchy fires over time to a late dry season fire regime.

Other than the clearing of vegetation for the building footprints, the project is not considered likely to contribute to any of the threatening processes listed above for the terrestrial mammals that could potentially occur on the project site. The project will not contribute to changed fire regimes or increase the spread of weeds or grazing by livestock. Under the *Bushfire Act 2009* (NT) there are certain responsibilities for bushfire management to mitigate risks to property and personnel that need be adhered to. Formulation of bushfire management practices for the facility will take account of the responsibilities under the Act, as well as fire management guidelines recommended to maintain and/or enhance ecological values of the vegetation communities on site (see Section 3.10).

The clearing required to facilitate the project equates to 0.28% of the vegetation within a 10 km radius of the project. The habitats within the areas to be cleared are not considered to be unique, or to represent critical habitat for any species, as the vegetation communities on the project site are widespread throughout the region (see Section 5.1.9). As such, habitat loss due to this vegetation clearing is not considered to constitute a significant impact for any of the conservation significant avian species that have the potential to occur on the site. Furthermore, it is expected that as the project footprint is further refined, the footprint will be reduced, lessening the direct impacts on vegetation, and potential habitat for these species.

Shorebirds

Six species of shorebirds listed as threatened under the under the TPWC Act are known to occur around Bynoe Harbour. They are:

- Red Knot (*Calidris canutus*)
- Great Knot (*Calidris tenuirostris*)
- Greater Sand Plover (*Charadrius leschenaultii*)
- Lesser Sand Plover (*Charadrius mongolus*)
- Bar-tailed Godwit (*Limosa lapponica*)
- Eastern Curlew (*Numenius madagascariensis*).

Bynoe Harbour is not listed as a site of significance for any of these species on the Australian Department of Environment Species Profile and Threats Database database, but the broader Darwin area is listed as being important for both Greater and Lesser Sand Plovers.

The project activities associated with construction and operation are considered unlikely to represent a significant impact to any of the threatened shorebirds likely to utilise the area around the project site. Construction impacts will be short lived and confined to a relatively small area. Operational impacts in the form of nutrient discharge is unlikely to have any negative impacts upon shorebirds given that;

1. The area to be affected by the discharge is unlikely to constitute critical habitat for any shorebird species.

2. The findings of the numerical modelling water quality assessment revealed that it is considered unlikely that the proposed discharge will have significant water quality, or water quality related ecological impacts to Wheatley Creek, Geranium Channel or any other waterways in the Bynoe Harbour area.
3. Nutrient enrichment may in fact confer a positive benefit upon shorebirds, by increasing the biomass of the benthic invertebrates they feed upon.

5.1.11.5 Fish and marine reptiles

The Northern River Shark (*Glyphis garricki*) and three species of sawfish (*Pristis clavata, P. pristis,* and *P. zijsron*), have not been recorded from Bynoe Harbour, but it is considered possible that they may occur there. The Conservation Values Atlas (DoE, 2015) does not map the project area as a biologically important area for these species. The closest areas mapped as being biologically important are located 730 km south west of the project area in Camden Sound. However, these species utilise estuarine habitats, such as that present at Bynoe Harbour and Wheatley Creek, at varying stages of their lifecycles.

Key threatening processes to these species include commercial and recreational fishing activities. The proposed action will not increase these activities.

The Hawksbill (*Eretmochelys imbricata*) and Olive Ridley (*Lepidochelys olivacea*) turtles are known to occur in Bynoe Harbour. Further, the project area is mapped as a biologically important (interesting habitat) area for Olive Ridley Turtles (DoE, 2015).

The Leatherback (*Dermochelys coriacea*) and Loggerhead (*Caretta caretta*) turtles have not been recorded within 20 km of the project area (DLRM 2015). There are no known nesting beaches in the proposed project area, but these species are known to occur in NT waters, so it is possible that they could use the waters surrounding the project. The Conservation Values Atlas (DoE, 2015) which maps biologically important areas (e.g. foraging, mating, nesting and interesting) for listed species does not map the project area as a biologically important area for either of these species (DoE, 2015).

Nesting beaches are absent from the project footprint and immediate surrounds as the intertidal and foreshore areas are characterised by mangrove forests and soft sediments. The closest nesting beaches to the project footprint are located approximately 15 km away at the northern end of Indian Island.

Potential impacts to fish and marine turtles from construction and operation of the proposed project are considered to be:

- Construction impacts - Vessel strike, noise and vibration, lighting, reduction in water quality and introduction or spread of marine pests
- Operational impacts - Physical entrapment, lighting and reduction in water quality

Vessel strike and physical entrapment

There is potential for vessels involved in the construction activities to strike or entangle marine fauna including cetaceans, fish and marine reptiles. The main collision risk associated with the activities is construction vessels colliding with slow moving/surface basking marine turtles.

Vessels will be required during construction, however, the application of management control measures as nominated in Section 7.1.6.2, will reduce the likelihood of vessel interactions, such as collisions or entanglement, to as low as reasonably practicable. The risks due to vessel movements are therefore not considered significant. While the potential exists for interference with marine fauna from vessel movements during the activity, impacts will be localised and relatively short lived, being confined to the duration of the activity.

During operation there is potential for marine fauna to become entrapped in the water intake mechanism. A simple intake screen mesh is proposed for all seawater intake points. The intake screen mesh will minimise this risk to as low as reasonably practicable.

Noise and vibration

In-water noise and vibration will be generated by marine construction activities. The construction vessel(s) will generate through-hull noise associated with engine and propulsion systems, and propellar tip vortex cavitation noise. The vessel(s) are expected to produce similar noise emissions to other marine vessels that frequent Bynoe Harbour (e.g. recreational vessels, etc.), and will be continuous rather than pulsed with noise levels not expected to exceed the thresholds identified for marine fauna, therefore reducing the likelihood of permanent physiological impacts.

The most likely impacts from the noise emitted during construction are behavioural impacts (e.g. swimming away from the area) to marine fauna, with the most sensitive species being cetaceans. Any behavioural impact caused by the vessel noise is likely to be localised and temporary, with marine species expected to resume normal behavioural patterns in the waters surrounding the project area in a short time-frame. This is supported by the findings of the Ichthys nearshore environmental monitoring program (Brooks and Pollock, 2015), which found relatively small changes in coastal dolphin abundance and distribution during construction. Construction activities for that project included pile driving, which generate in-water noise and vibration on a much larger scale than expected under this project.

Lighting

Construction and operational lighting has the potential to affect fauna by altering use of visual cues for orientation, navigation or other purposes. This can result in behavioural responses which can alter foraging and breeding activity in marine turtle and fish. Turtles are the most sensitive to lighting, however given that turtles do not nest within the project area or adjacent habitats (the nearest nesting beach is located 15 km from the project area), it is unlikely the artificial light will interfere with the breeding success and population longevity of these fauna.

Management controls have been nominated in Section 7.1.6.2 to further reduce the impacts on marine fauna to environmentally acceptable levels. The environmental risks are considered to be as low as reasonably practicable as the lighting will be short lived during construction, and managed to the requirements for vessel and occupational safety regulations. Operational lighting will be minimal and directed away from the marine environment.

Reduction in water quality

During construction, minor sediment disturbance will occur and will temporarily influence the water quality at the seabed adjacent the footprint. This disturbance will be localised, short term and temporary in nature. The species that may be influenced by these are highly mobile and are expected to move away from disturbance areas such that they are not detrimentally affected. They are also expected to return to the area following cessation of disturbances; this is supported by evidence collected under the Ichthys nearshore environmental monitoring program (Cardno 2015a, b) for a large scale dredging and pile driving program in the Darwin region. Monitoring results found no indication that dredging activities affected turtle distribution or population sizes (Cardno 2015a).

The results of the numerical modelling (Section 5.1.7) investigating the impacts of the operational discharge on the marine environment revealed that, outside of the initial mixing zone (which will be defined as part of the

application for the Waste Discharge Licence), the interim water quality objectives that have been defined for the project are unlikely to be exceeded. As such it is not predicted that the operational discharge will detrimentally affect water quality such that habitat, feeding resources or health of fish or turtle species would be affected.

If marine megafauna do transit the discharge point during discharging activities, the most likely impacts would be behavioural impacts (e.g. swimming away from the area). Any behavioural impact caused by a reduction in water quality is likely to be localised and temporary, with marine species expected to resume normal behavioural patterns in the waters surrounding the project area in a short time-frame. Given the spatial disconnect between the discharge locale and the areas known to be utilised by marine megafauna, impacts from discharge are expected to be minimal.

Other water quality related operational risks such as the unplanned accidental release of cleaning chemicals are considered a very low risk and will be controlled via operational procedures and environmental management plans required to detect and respond to any unplanned accidental releases to ameliorate impact to the environment.

Management controls for unplanned construction inputs from land-based erosion (including during extreme weather events) have been nominated in Section 7.1.6.2.

Introduction or spread of marine pests

Invasive pest species can be successfully introduced into the activity areas by construction vessels. There is considered to be a very low risk of this occurring as locally based construction companies are likely to be utilised for construction activities requiring the use of vessels. In addition, Seafarms will stipulate that the construction contractor will not use vessels that have been used in areas with marine fouling.

Management controls have been nominated in Section 7.1.6.2 to reduce the risk of introducing a marine pest to as low as reasonably practicable.

5.2 SIGNIFICANT SITES OR FEATURES

There are no anticipated impacts to significant sites or features. The important nesting beaches of the Indian Island Conservation Reserve, which is located two km to the north-east of the project area, will not be impacted by the construction or operation of the project.

5.3 CULTURAL HERITAGE ENVIRONMENT

There are no anticipated impacts to cultural heritage.

5.4 SOCIAL AND ECONOMIC ENVIRONMENT

5.4.1 Community Consultation

Community consultation has been undertaken within the Dundee area which includes Dundee Beach, Dundee Forest, Dundee Downs and Bynoe Haven. The consultation process identified a number of key stakeholders including residents and landowners, local clubs and associations, local retail businesses and community groups.

A total of 67 individuals were reached during the consultation period which included the distribution of information brochures, attendance at two community events and informal communication with local residents. Of those consulted 55 were permanent residents, 11 were weekenders and one was a visitor (Member for Daly, Gary Higgins).

Table 17 presents the key issues identified during the consultation process and Seafarms corresponding responses. Those consulted during this process were overwhelmingly supportive of the project so long as the main concerns were addressed, particularly that fishing and crabbing activities will not be impacted.

Based on this analysis, the development of the project will not result in any significant negative social impacts. Conversely, development of the project has the potential to result in positive social impacts, particularly through the generation of economic benefits and employment opportunities, as described in Sections 5.4.3 and 5.4.4 below.

5.4.2 Paspaley Consultation

The intake pipe alignment has been designed to avoid the adjacent Paspaley oyster leases in Bynoe Harbour. Seafarms have discussed the implications of such proximity with Paspaley. Paspaley have been encouraging of the proposed development and see potential for future shared use of infrastructure. Paspaley have also shared local water quality data with Seafarms and allowed Seafarms to anchor water quality loggers to their infrastructure. Seafarms will continue to liaise with Paspaley as the project progresses.

TABLE 17 COMMUNITY CONSULTATION – KEY ISSUES AND RESPONSES

Issue and number of people who raised issue (out of 67)		Seafarms response
Fishing Concern was raised about the potential for the project to have a negative impact on fishing and crabbing activities in the area.	50	• The proposal will not impact upon fishing and crabbing access at all. Only the land area itself will have limits on access. • As described in Section 5.1.7, the daily water discharge rate at full scale will be 11,000 m^3/day. This is equivalent to approximately 0.1% of the tidal volume flushed through Wheatley Creek during a spring tide and around 0.55% of the volume during a neap tide. In other words, at most, the additional water volume being discharged into Wheatley Creek will be around half of one percent of the volume that currently passes through the creek. • There will be no discharge of any elements that do not occur naturally in the local environment. • As described in Section 5.1.7 levels of total nitrogen and total phosphorous will not exceed the Water Quality Guidelines for the Darwin Harbour Region in the receiving environment. • No anti-biotic, anti-parasitic or anti-fouling agents will be discharged into the environment. • All cleaning products used in the tanks (i.e. chlorines) are biodegradable and all water will be held in the settlement ponds until the products have fully broken down. • Both the BMC and CBC facilities will be fully biosecure and will be managed in accordance with the Project Sea Dragon Biosecurity Manual. The biosecurity strategy for Project Sea Dragon is premised upon developing a domesticated and selectively bred population of animals that has been screened for a suite of known pathogens, satisfying the 'Specific Pathogen Free' condition. Unscreened animals will not be used within the production system. • In the event of a disease outbreak within the production system, any diseased prawns identified will be euthanized and disposed of either through incineration or ensiling (dissolving in organic acids). • To prevent the accidental escape of prawns from the CBC and BMC into the surrounding environment, filters will be placed over all outlets to the settlement ponds prior to release. The channels/pipelines which lead to the discharge point also present a harsh environment in which any escaped prawns are unlikely to survive.
Work opportunities Strong interest in future work opportunities, particularly from the 'weekenders' who live in Darwin during the week and see the opportunity to move permanently to the region as well as young local residents who have limited opportunity for local work at present.	18 people	• To support the development of 1,080 ha of ponds for the Stage 1 Legune Grow-out Facility a workforce of 27 will be required to be employed at the CBC and BMC, including managers, a geneticist, various technicians, administrators and aquaculture workers. • At full scale production there is estimated to be a workforce of 45 at the CBC and BMC. • Seafarms would welcome applications from appropriately qualified local workers. • The workforce is expected to come from a mixture of sources, including:

Issue and number of people who raised issue (out of 67)		Seafarms response
		• directly employed staff, self-accommodated in the Dundee Downs areas and/or accommodated nearby; and drive-in/drive-out from Darwin environs • local contractors, self-accommodated in the Dundee Downs areas and/or accommodated nearby; and drive-in/drive-out from Darwin environs • local indigenous people • fly-in/fly out (this option is likely to be the exception but for specialist expertise) • temporary work skilled visa (sub-class 457) program for selected specialist expertise.
Discharge water quality 13 of the residents enquired about the quality of wastewater discharge	13 people	• No significant impact on discharge water quality - see response to "fishing" above and results presented in Section 5.1.7 for details.
Boat water access 11 people were concerned about whether the intake or discharge pipes would impede boat access.	11 people	• The project will not impact upon boat water access at all. Only the land area itself will have limits on access.
Road placement The siting of the access road is of interest to residents in the immediate facility	10 people	• Two road options are under consideration – a new access road from Dundee Road or along an existing road easement from Fog Bay Road. • As this stage the preference is to develop along the existing easement from Fog Bay Road, which would also provide access to properties located along the easement. • Further discussions will be undertaken with landowners before a final decision is made.
Fire management Fire management was canvassed by residents involved with the Dundee Volunteer Bushfire Brigade.	5 people	• As described in Section 3.10, fire risk will be managed in accordance with the *Bushfire Act 2009*. • Management will include vegetation clearing to maintain firebreaks around shared boundaries, internal fence lines and other facility assets. • Bushfire risk will also be mitigated through construction of on-site fire-suppression infrastructure, as well as consultation and ongoing liaising with the nearby Dundee Volunteer Bushfire Brigade.
Access to site Three residents identified themselves as currently accessing the site on a regular basis. One resident has a fisherman's shack located at Point Ceylon and two others also said they used this shack and the surrounding land on a regular basis. A number of other residents said they fished and hunted from the land area.	3 people	• For the security of infrastructure assets on site, and for biosecurity purposes, access to the land area will be restricted to personnel working on site and will not be open to the public. • A biosecurity fence will be erected at the entrance to the site as shown in Figure 2.

5.4.3 Economic Benefit

The aquaculture industry has been identified as a key opportunity for northern Australia, and Project Sea Dragon has been awarded Major Project Status by the Australian, Western Australian and Northern Territory governments because it has the potential to generate significant economic and employment opportunities for the Northern Territory and East Kimberley. At full scale, Project Sea Dragon is expected to create an export industry worth an estimated US $1.7 billion. In addition the project also represents a contribution to the diversification of northern Australia's economy, which is frequently subject to the cyclical fluctuations of commodity markets.

As a general rule the CBC and BMC, as components of Project Sea Dragon, ought not be considered separately from the broader project. However, it is possible to illustrate economic value associated with the development at Portion 3192 by constructing an artificial 'no development' case based on an the assumption that Project Sea Dragon could proceed with procurement of broodstock from the wild as opposed to the development of a domesticated population; noting that the development at Portion 3192 is required for the development and maintenance of the domesticated population. The consequence of obtaining broodstock from the wild is that no breeding program takes place and the benefits of genetic selection are lost. The value of this loss can be calculated by assuming a productivity benefit of selective breeding as anticipated over the course of the project period. In this case a range of productivity gains due to selective breeding have been assumed based on expert opinion from CSIRO scientists and other international science experts. These are shown below in Table 18.

TABLE 18 PRODUCTIVITY BENEFIT OF SELECTIVE BREEDING

	Assumed percentage improvement in growth rate as a result of selective breeding		Resultant average weekly growth at year 7 (grams per week)
	Prior to year 7	After year 7	
Wild caught	0	0	1.2
Breeding A	5	2	1.61
Breeding B	10	2	2.03
Breeding C	15	2	2.78

The economic benefits of the investment in breeding can now be expressed in terms of Net Present Value (NPV) to the entire project. For this illustration we have simply assumed the difference based on the full scale sized project comprising 10,000 ha of grow-out ponds. Given the staged nature of the project the 'actual' NPV would be less than illustrated. Included in this example is the sensitivity of NPV to a range of risk discount rates from those typically associated with a mining project that employs standard technologies to riskier 'greenfield' projects.

TABLE 19 CALCULATION OF NPV ASSOCIATED WITH THE CBC AND BMC

	NPV at 20% discount rate (AU$m)	NPV at 15% discount rate (AU$m)	NPV at 10% discount rate (AU$m)
Wild caught	-405	40	1,550
Breeding A	569	1,557	3,512
Breeding B	1,318	2,945	5,879
Breeding C	2,355	4,382	8,331

One additional observation is that a selective breeding program has an additional economic benefit; namely a reduction in volatility of earnings. This arises as a consequence of domestication and breeding through:

- a narrower distribution of harvest sizes (i.e. less variability in growth rate), and
- the ability to screen for disease and potentially introduce disease tolerance/resistance.

All things being equal an earnings stream with lower volatility is worth more than an equivalent average earnings stream with higher volatility. In valuation such riskiness is expressed through the discount rate with a lower discount rate being used for lower volatility earnings. Thus this effect is captured horizontally in the table.

In this example, the cash-flow benefit of the breeding program conducted at the proposed facility to the project as a whole is illustrated by the cells within each column.

This example does not take into account the feasibility of obtaining wild caught animals (that is, availability). The wild populations may be insufficient to support the capture requirements; in any case it may be not possible to obtain permits for such a requirement.

Another conclusion could be drawn through this analysis, namely that the project would not proceed without these facilities. This is for two reasons:

- the demand for wild broodstock is potentially so large that it would deplete the wild population and thus not be acceptable
- the economic case for the project would be impaired to the extent that it would not be investable.

It could be argued therefore that the potential of a $1.7 billion industry is contingent upon the proponent being able to secure the site for this purpose.

5.4.4 Workforce

An assessment of potential direct jobs was undertaken by the company for the pre-feasibility assessment and Table 20 provides guidance for potential direct jobs that would be created on-site. As part of the company's full Bankable Feasibility Study these estimates will be revised. These estimates are for facilities that would support 1,080 ha of grow-out ponds at Legune (i.e the Stage 1 Legune Grow-out Facility).

TABLE 20 CBC AND BMC EMPLOYMENT ROLES

Unit	Functional Area	Position title	Skill level	Minimum Education Achieved	Experience (Years)	FTE positions Stage 1
BMC	Management	BMC Manager	High	BSc	7	1
	Management	Assistant Manager	High	BSc	5	0
	Technical	Technicians - Health, Water Mgt, Grow out	Skilled	TAFE	3	2
	Technical	Junior Technicians	Skilled	TAFE	0	2
	Management	Warehouse and Facility Supervisor	Semi-skilled	Experience (and tickets)	3	1
	Labour	General Labour	Unskilled	Y10	0	1
	E&T	Electro Mechanical Technician	Skilled	TAFE	5	3
	E&T	Electro Mechanical Assistants	Skilled	TAFE	0	2
	Management	Administrator	Skilled	Experience	2	1
CBC	Management	CBC Manager	High	BSc	7	1
	Breeding	Technicians - Health, Water Mgt, Grow out	Skilled	TAFE	3	2
	Breeding	Technicians - Tagging and Measurement	Skilled	TAFE	3	1
	Breeding	Junior Technicians	Skilled	Y12	0	2
	Warehouse	Warehouse and Facility Supervisor	Semi-skilled	Experience	3	1
	Breeding	Hygiene and Sanitation Workers	Semi-skilled	Y12	0	2
	Breeding	General Labour	Unskilled	Y10	0	2
	E&T	Electro Mechanical Technicians	Skilled	TAFE	5	1
	E&T	Electro Mechanical Assistants	Skilled	Y12	0	0
	Management	Administrator	Skilled	Experience	2	1
	Management	Geneticist	Specialist	PhD	7	1

6 SUSCEPTABILITY TO CLIMATE CHANGE

6.1 POTENTIAL CLIMATE CHANGE EFFECTS OF RELEVANCE

Increased concentrations of greenhouse gases in the earth's atmosphere are projected to cause a warming of the atmosphere and oceans, which in turn are projected to drive a range of other changes to the earth's climate and the climate variability. A risk assessment was undertaken to:

- identify the relevant threats to the coastal environment associated with climate change
- determine the aspects of the proposed development that could potentially be exposed to those threats
- assess the overall risk of the exposure.

The potential climate change effects that could impact the physical processes operating on the coastal environment of the project area are:

- sea level rise
- tropical cyclone intensity and frequency.

6.1.1 Sea Level Rise

Global average sea level rose by approximately 0.17 m during the 20th Century. The average global rate of sea level rise between 1950 and 2000 was 1.8 ± 0.3 mm/year. The tidal gauge in Darwin Harbour to the east of Bynoe Harbour is one of the National Tide Centre's array of sixteen high accuracy sea level measurement stations. The net relative sea level trend since installation in June 1992 is 7.6 mm/year at Darwin (Bureau of Meterology 2015). The Intergovernmental Panel on Climate Change (IPCC) is the authoritative source on projections of future sea-level rise due to climate change. Table 21 displays the IPCC sea level rise projections relative to late 20th century mean sea levels for the A1F1 high emission scenario. The main impacts associated with the projected increase in mean sea level at Bynoe Harbour are considered to be:

- shoreline recession
- increase in storm tide elevations.

TABLE 21 IPCC 2014 PROJECTED SEA LEVEL RISE

Scenario	2030	2070	2100
IPCC	0.18m	0.42m	0.82m

6.1.2 Tropical Cyclone Intensity and Frequency

There is considerable debate regarding the projected impact of climate change on tropical cyclones. The Engineers Australia 'Guidelines for Responding to the Effects of Climate Change in Coastal and Ocean Engineering' suggests that whilst there is "*no evidence that (globally) tropical cyclones are getting stronger, or are becoming more frequent or producing greater rainfall*", there is the opportunity that peak winds during a tropical cyclone may increase by 11% by the year 2100, and that rainfall associated with a tropical cyclone may increase by 20% by 2100 (Engineers Australia 2012).

The spatial and seasonal distribution of cyclone occurrence is expected to remain approximately similar to present whilst the frequency of tropical cyclone formation may actually decline under climate change.

The main potential impacts associated with increases in tropical cyclone intensity are considered the following:

- higher maximum wind speeds generating larger waves and associated wave set-up on the coastline
- higher maximum wind speeds and lower central pressures generating large storm surges.

The predicted storm tides for a number of return periods and horizons at Bynoe Harbour are summarised relative to existing conditions in Table 22. Table 22 shows increases in predicted storm tide elevations at Bynoe Harbour of 0.8 m through to 1.5 m by 2100. This increase is comprised of 0.8 m of mean sea level rise and an additional meteorologically induced component of 0.1 m for the 1 in 100 year Average Recurrence Interval (ARI) event and 0.7 m for the 1:500 ARI year event.

TABLE 22 PREDICTED STORM TIDE LEVELS (M AHD)

Return Period (Average Recurrence Interval, ARI)					
	50	100	500	1,000	10,000
Bynoe Harbour					
2010	3.5	3.7	4.2	4.7	6.3
2050	3.8	4.1	5.0	5.6	7.4
2100	4.3	4.6	5.7	6.2	7.9

6.2 POTENTIAL CLIMATE CHANGE IMPACTS

The main components of the CBC and BMC, and the coastal environment, that are considered to be exposed to the impacts of sea level rise and tropical cyclone intensity and frequency are the:

- intake and discharge infrastructure
- land based facilities
- water quality and circulation.

6.2.1 Intake and Discharge Infrastructure

The intake and discharge infrastructure are vulnerable to potential changes to the shoreline through increased inundation, or coastal erosion due to increases in mean sea level, storm tides and wave action. Higher wave energy could result in deeper water during storm events which may impact the bed more than present conditions.

The consequences of changes to the shoreline are likely to be minimal at the intake pipe location as the pipe will be secured by piles to the bed. Changes to the shoreline at the discharge point could result in more significant consequences, and could include redesign and relocation costs and inconvenience.

Increased wave energy on the bed could lead to increase scour and movement of the intake pipeline, potentially causing damage to the pipe and loss of production.

6.2.2 Land Based Facilities

Facilities associated with the project adjacent to, or near, the existing shoreline could potentially be exposed to threats associated with shoreline recession. As a result of the climate change assessment, the BMC, CBC and administration and accommodation facilities have been located on high ground away from the existing shoreline.

Some minor areas of the development are, however, necessarily located at an elevation of between 3.5-4.0 m AHD and could potentially be subjected to inundation during an extreme storm tide by 2100. This is particularly true for the discharge point and the connecting discharge channel. These areas could potentially be inundated to

depths of 0.5 – 1.0 m in an extreme storm tide event by 2100. The consequences of this inundation include costs associated with damage to infrastructure and repair works along with potential interruption of production and associated loss of production costs.

Areas of the facility located adjacent to the existing shoreline could potentially be impinged upon by shoreline recession hazards by 2100. The consequences of exposure to this risk include potential exposure to more significant inundation by storm tides, and foundation instability risking building integrity.

6.2.3 Water Quality and Circulation

The discharge point is located on a low lying portion of land which separates Geranium Channel and Wheatley Creek. Elevation of this area has not been determined; however, there is potential that as mean sea levels rise, this area could be inundated more frequently and the Wheatley and Geranium Channels connected on a more regular or permanent basis. Connection of the waterways could lead to a change in the dispersion of material from the outlet and higher concentrations could occur within Bynoe Harbour.

The consequences of this are that the dispersion and dilution characteristics of the discharge water may be altered.

6.3 MITIGATION OF POTENTIAL IMPACTS

The impact assessment revealed a possible risk posed by climate change to intake and discharge infrastructure. However, this can easily be accommodated by designing intake and discharge facilities setback from the present day coastline to allow for any changes as a result of increased inundation to 2100. Design of the intake pipe and bedding will also consider the potential for increased wave conditions into the future.

The impact on areas of the development that could potentially be subjected to storm tide inundation under extreme 2100 storm tide conditions can be mitigated by raising critical infrastructure and floor levels in these areas and/or landscaping using bunds or elevated roadways to prevent storm tides penetrating into these areas.

In terms of potential changes to the mixing and dispersion of the discharge, in the event that sea levels rise as predicted, numerical modelling taking into account the change in the frequency of connectivity between the Geranium Channel and Wheatley Creek could be undertaken. Outcomes of the modelling could be used to derive engineering solutions, such as:

- moving the discharge to a more optimal location
- timing the discharge to minimise dispersion during times of connectivity between the Geranium Channel and Wheatley Creek
- elevating the land in the area around the discharge point to minimise connection of the two channels to extreme water level events only.

7 MEASURES TO AVOID OR REDUCE IMPACTS

PSD is committed to avoiding impacts on matters of significance to the greatest extent practical. For unavoidable impacts, mitigation measures will be implemented to reduce the extent of the impact. Measures to avoid, reduce or mitigate impacts in relation to each of the potential impacts presented in this NOI are presented below. These measures include mitigating impacts through site selection, engineering and operational design, undertaking social and Indigenous engagement and implementing environmental management measures. An Environmental Management Plan (EMP) is being prepared to guide the management during both construction and operation of the project.

An overview of the framework for the EMP is presented in Section 7.5 and Appendix A - Environmental Management Plan Framework. During construction, the contractor will be responsible for the implementation of construction environmental management plans, which will also need to take into account any conditions under which the project may be approved. During operation, Seafarms will be responsible for the implementation of the operational environmental management plans, which also will take into account any conditions of project approval. The mitigation and management measures discussed below will be described in more detail in the EMP.

7.1 NATURAL ENVIRONMENT

7.1.1 Air Quality

There may be localised impacts to air quality in the form of dust movement during construction. Sources of dust are likely to come from construction activities and unsealed roads around the site. Dust suppression techniques to protect vegetation, worker health and amenities will be implemented and may include the periodic application of water and/or proprietary products in dry conditions to suppress dust.

7.1.2 Noise and Vibration

There are no expected impacts from noise or vibration during the operation of the facility.

Construction of the facility could result in some minor, localised impacts from earth moving machinery and construction machinery/tools. To ensure these activities do not disturb neighbours, they will be confined to business hours. There is also the potential for impact on marine megafauna from marine noise and vibration during construction activities. Management measures to minimise these impacts are discussed in Section 7.1.6.2.

7.1.3 Coastal Features and Processes

7.1.3.1 Coastal features

The following actions will be implemented to ensure there is minimal impact of the project on the coastal values around Point Ceylon:

- Implement measures to minimise disturbance to ASS and PASS
- Ensure adequate scour protection is provided in the design of the intake pipe bedding and during construction
- Minimise the visual impact of the intake pipe as much as is practicable across the intertidal bank
- A broad crested weir will provide a tidal pond for flow control of the discharge at the seaward end of the settling ponds

- The weir will be designed with adequate scour protection to prevent undermining of the structure through high tidal flows
- The pooling of the water within the tidal pond and mixing with the high waters will provide further initial dilution of the discharge water

- Design of the discharge infrastructure will seek to minimise the loss of vegetation and visual intrusion of the discharge into Wheatley Creek.

7.1.3.2 Bathymetry

The following actions are considered to alleviate the impact of the project on the bathymetry around Point Ceylon:

- Ensure adequate scour protection is provided in the design of the intake pipe bedding and during construction.
- A broad crested weir will provide a tidal pond for flow control of the discharge at the seaward end of the settling ponds.
    - The weir will be designed with adequate scour protection to prevent undermining of the structure through high tidal flows.

7.1.3.3 Oceanographic Conditions

Removal of seawater through the intake pipe within Bynoe Harbour is unlikely to result in any changes to the hydrodynamic conditions. Design of adequate anchoring of the intake pipe will be undertaken to ensure the pipeline is stable.

Addition of discharge water into Wheatley Creek could result in some isolated changes to the hydrodynamics around the discharge point, more likely during the neap tide when current speeds are lower. However, this is considered unlikely to have any significant impact on tidal waters or currents.

7.1.4 Water Quality

The numerical modelling was considered conservative and did not consider biological assimilation of dissolved nutrients, the settling of particulate components in the discharge within the waters of Wheatley Creek and Geranium Channel, nor the controlled timing of the discharge across a tidal weir. Nonetheless, even without considering these factors, the results showed that the impact of the discharge on the receiving waters of the Mackenzie Arm and Wheatley Creek will be low, and constrained to the area around the discharge point.

The numerical modelling assumed a constant rate of discharge. However, interrogation of the modelling indicated that, if required, releasing the discharge during periods of higher water (for example when the water level rose above Mean High Water Neap tides) would further reduce the impact of the discharge on the surrounding water body. Releasing the discharge across a larger area (in the case of a weir discharge) could also increase initial mixing and minimise any impacts on the system.

As a result of these findings, Seafarms have committed to providing a weir to optimise the timing of the discharge with the tidal variation and to increase initial mixing.

The preliminary design of the discharge will include a flow control structure at the seaward end of the settling ponds. The water from the settling ponds will be released into a tidal pond which is separated from Wheatley Creek via a broad crested weir. The weir will be designed with adequate scour protection to prevent undermining

of the structure through high tidal flows. The pooling of the water within the tidal pond and mixing with the high waters will provide further initial dilution of the discharge water.

7.1.5 Threatened Flora and Vegetation

7.1.5.1 Vegetation Clearance

Construction of the CBC, BMC and associated facilities will result in the clearing of up to 126.64 ha of vegetation. This allows for buffers. The majority of the vegetation within the project footprint (around 75%) is mapped as open woodland of *Eucalyptus tetrodonta*, *Eucalyptus miniata* and *Erythrophleum chlorostachys.* This community (Vegetation Community Code A1) is widespread across the region and the area within the project footprint constitutes 1.14% of the extent of the vegetation community that occurs within a 10 km radius of the project and 0.40% within the entire Lower Finniss region.

Detailed engineering design will allow for the project footprint to be further refined and the direct impacts upon vegetation to be reduced. There will be clear delineation of the disturbance areas on the ground prior to any clearing activities (e.g. flagging tape and posts), and restriction of clearing to within these areas.

Two threatened flora species, the Armstrong's Cycad (*Cycas armstrongii*) and Arrowleaf Monochoria (*Monochoria hastata*), have been identified as having the potential to occur in the project area and surrounds. Flora and vegetation surveys of the project area will be undertaken by a suitably qualified botanist prior to any clearing or earthmoving activities taking place. Should any individuals of these species be identified within the project footprint, the footprint would be modified to avoid them if at all practicable. If this were not possible, the possibility for translocation of individuals and the provision of offsets for the unavoidable impacts would be investigated.

Any temporary works areas and trenches dug for underground infrastructure (e.g. water pipes, electricity etc) will be rehabilitated.

A vegetation management plan will be developed to set out procedures for protection of vegetation during construction and operation of the facilities.

7.1.5.2 Weed Invasion

The greatest risk of weeds being introduced and spread will occur during the construction of the project. Vegetation clearing, soil disturbance and vehicle movements are considered likely to create opportunities for weeds and an increased potential for weed incursion into adjacent native vegetation.

To avoid weeds being introduced and spread as part of construction and operation of the facilities, a weed management plan will be developed as part of the construction section of the Environmental Management Plan, which will outline weed mitigation measures for the project.

7.1.6 Threatened Fauna

7.1.6.1 Terrestrial fauna and Avifauna

Pre-clearance fauna and habitat surveys of the project area will be undertaken by a suitably qualified ecologist prior to any clearing or earthmoving activities taking place. Should any important habitat for threatened species be identified within the project footprint, the footprint would be modified to avoid them if at all practicable. If conservation significant fauna are identified within the project footprint, mitigation measures, including relocation of the fauna if appropriate, will be developed in consultation with DLRM.

Formulation of bushfire management practices (as required under the *Bushfire Act 2009*) will also take into account measures recommended to provide optimal habitat and resources for the threatened fauna, in particular, the Partridge Pigeon (eastern subspecies).

A Fauna Management Plan will be developed to provide for the protection of fauna during construction and operation of the facility.

7.1.6.2 Marine

Numerical modelling has shown that during operation, the impact of the discharge on the receiving waters of the Mackenzie Arm and Wheatley Creek will be low, and constrained to the area around the discharge point. The mitigation measures specified above for coastal features and processes (Section 7.1.3) and Water Quality (Section 7.1.4) are also relevant to megafauna. In addition, the following actions will be considered to alleviate the potential impact of the project on megafauna and their habitat in Bynoe Harbour:

- Intake pipes will be screened to avoid entrapment or entrainment
- If practicable, the installation of intake pipeline on seabed and in-water operational maintenance works will be timed to be undertaken outside of peak breeding or migration periods
- Use of vessel based marine megafauna observers
- Implementation of vessel speed limits in the construction zone and implementation of megafauna observation zone (150 m) and megafauna exclusion zone (50 m)
- Lights during construction and operation to be directional, achieving no spill to the marine environment (particularly in the direction of the turtle nesting beach at Indian Island)
- Lighting to be limited to only that which is essential
- Lighting to be installed low in the vertical plane and using the lowest intensity practicable
- Automated controls (e.g. timers and motion detectors) to be used as appropriate to minimise lighting
- Consider designing ground-level path lighting for use where practicable
- Construction vessels used to be certified as free of marine fouling.

7.2 SIGNIFICANT SITES OR FEATURES

The only significant site or feature with the potential to be impacted by the proposed project is the Indian Island Conservation Area, which is located 2 km to the north-east of the project area (Figure 25). The provision of management measures for water quality detailed in Section 7.1.3 and 7.1.4 will ensure that there are no impacts to the Indian Island Conservation Area.

7.3 CULTURAL HERITAGE ENVIRONMENT

There are no anticipated impacts to non-indigenous and/or Aboriginal heritage places or objects. The one known Aboriginal heritage site, Point Ceylon 1, will be clearly marked on site plans and on the ground to prevent it being disturbed during vegetation clearance activities. All staff and/or contractors will be made aware of the site's locality.

An AAPA certificate for the project area will be obtained prior to the commencement of construction. All conditions of the AAPA certificate will be complied with.

In the event that an archaeological site is located, all works will cease in that area and the relevant authorities notified. No further work will be undertaken until approval is granted from the relevant authority.

7.4 SOCIAL AND ECONOMIC ENVIRONMENT

There are no anticipated negative impacts to the social and economic environment. The key issues raised during the community consultation process have been addressed in Section 5.4.1 of this NOI. PSD is committed to ongoing consultation with the community and key stakeholders throughout the development of the project, particularly with regard to access and the development of access roads.

7.5 ENVIRONMENTAL MANAGEMENT PLAN

To ensure that the appropriate environmental management practices are implemented, Seafarms is committed to developing an Environmental Management Plan for the construction and operational stages of the project. The EMP will clearly describe the management activities, mitigation and control measures that will be adopted to minimise environmental impacts and enhance the benefits of the project. It will include those management activities, mitigation and control measures detailed in this Notice of Intent as well as those arising from the final detailed design and construction and operational requirements.

Environmental matters for which management activities, mitigation and control measures will developed and include (but are not limited to):

- waste water discharge
- community consultation
- cultural heritage
- air quality
- flora and vegetation
- bushfire management
- human health and safety
- sewage and waste
- terrestrial and marine fauna
- invasive species management
- biting insect management
- traffic and transport
- erosion and sedimentation.

A draft framework for the EMP is provided in Appendix A – Environmental Management Plan Framework, and is based on the NT EPA's Guideline for the Preparation of an Environmental Management Plan (NT EPA 2015). The draft EMP framework will be updated and finalised by Seafarms to reflect the final detailed design and construction, and operational, requirements and will be submitted with future approvals and/or applications required for the project.

8 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Table 23 summarises the Matters of National Environmental Significance (MNES) that may occur in, or may relate to, the project area and surrounds. These values are derived from a search of the EPBC Act protected matters search tool with a buffer of 20 km applied to the project area. A referral will be submitted to the Australian Government to obtain a decision on whether the project will need formal assessment and approval under EPBC Act.

TABLE 23 MNES THAT MAY OCCUR OR MAY RELATE TO THE CBC AND BMC

Matter of National Environmental Significance	
World Heritage properties	no
National Heritage places	no
Wetlands of International Importance	no
Great Barrier Reef Marine Park	no
Commonwealth Marine Area	no
Listed threatened ecological communities	no
Listed threatened species	26 threatened species – see Table 24
Listed migratory species	37 migratory species – see Table 24

In addition, to the EPBC Act protected matters search tool, the following search tools, databases and information sources were also searched for records of threatened and migratory species listed under the EPBC Act:

- Commonwealth EPBC Act Protected Matters Search Tool
- NT NRM Infonet
- NR Maps
- Fauna Atlas Data from the NT Department of Land Resource Management
- National Conservation Values Atlas from the Commonwealth Department of the Environment
- Previous fauna surveys undertaken in the project area and surrounds, including:
  - Suntay Aquaculture Centre Terrestrial Fauna Survey (GHD 2003)
  - Ichthys Nearshore Environmental Monitoring Program
    - Routine Turtle and Dugong Monitoring Program Report – Dredging Report 3 (Cardno 2013)
    - Turtle and dugong monitoring post-dredging report (Cardno, 2015a)
    - Seagrass monitoring post-dredging report (Cardno 2015b)
  - A survey of intertidal seagrass from Van Dieman Gulf to Castlereagh Bay, Northern Territory, and from Gove to Horn Island, Queensland (Roelofs *et al.*, 2005)
  - Mangrove Survey of Bynoe Harbour Northern Territory (Brocklehurst & Edmeades, 2003)
  - Darwin and Ashmore Reef Tour Report 12 - 22 October 2010 (Peregrine Bird Tours 2010).

It should be recognised that the EPBC Act protected matters search tool predicts which species protected under the auspices of the EPBC Act may occur or relate to a site based on bioclimatic modelling. As such, the species returned from the EPBC protected matters search tool searches have not necessarily been recorded from the

site, and may not be likely to occur on the site. Table 24 provides an assessment of the likelihood of occurrence of the threatened and migratory species listed under the EPBC Act predicted to occur on, or relate to, the project area and/or surrounds. The likelihood of a species occurring on the project area has been assessed using the methodology described in Section 4.1.13.

It should be noted that some species listed EPBC Act are also listed under the TPWC Act. These species have been assessed in section 5.1.11 but have been included in Table 24 for completeness.

TABLE 24 THREATENED AND MIGRATORY SPECIES LISTED UNDER THE EPBC ACT

Scientific Name	Common Name	EPBC Act Status	TPWC Act Status	Database Searches				Other	Likelihood of Occurrence
				EPBC PMST	NR Maps NT	NT NRM Report	Fauna Atlas#		
Fish									
Carcharodon carcharias	Great White Shark	V, Mi	-	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Glyphis garricki	Northern River Shark, New Guinea River Shark	E	E	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Manta birostris	Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray	Mi	-	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Pristis clavata	Dwarf Sawfish, Queensland Sawfish	V	V	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Pristis pristis	Largetooth Sawfish, Freshwater Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish	V	V	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Pristis zijsron	Green Sawfish, Dindagubba, Narrowsnout Sawfish	V	V	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Rhincodon typus	Whale Shark	V, Mi	-	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Terrestrial Reptiles									

Scientific Name	Common Name	EPBC Act Status	TPWC Act Status	Database Searches				Other	Likelihood of Occurrence
				EPBC PMST	NR Maps NT	NT NRM Report	Fauna Atlas#		
Acanthophis hawkei	Plains Death Adder	V	V	•	-	-	-	-	Unlikely – no suitable habitat for the species (i.e. cracking black soils) exists on the project area and there are no records of the species within the Lower Finniss Region.
Marine Reptiles									
Caretta caretta	Loggerhead Turtle	E, Mi	V	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Chelonia mydas	Green Turtle	V, Mi	-	•	•	•	•	-	Likely – the species is known to occur in Bynoe Harbour.
Crocodylus porosus	Salt-water Crocodile, Estuarine Crocodile	Mi	-	•	-	-	•	-	Likely – the species is known to occur in Bynoe Harbour.
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	E, Mi	CE	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Eretmochelys imbricata	Hawksbill Turtle	V, Mi	V	•	•	-	•	•[2]	Likely – the species is known to occur in Bynoe Harbour.
Lepidochelys olivacea	Olive Ridley Turtle, Pacific Ridley Turtle	E, Mi	V	•	-	-	-	-	Likely – the species is known to occur in Bynoe Harbour.
Natator depressus	Flatback Turtle	V, Mi	-	•	-	•	-	•[2]	Likely – the species is known to occur in Bynoe Harbour.
Birds									
Actitis hypoleucos	Common Sandpiper	Mi	-	•	-	-	•	-	Likely – the species is known to occur in Bynoe Harbour.
Apus pacificus	Forked-tailed Swift	Mi	-	•	-	-	•	-	Likely – records of the species exist with 5 km of the project area.

Scientific Name	Common Name	EPBC Act Status	TPWC Act Status	Database Searches				Other	Likelihood of Occurrence
				EPBC PMST	NR Maps NT	NT NRM Report	Fauna Atlas#		
Ardea alba	Great Egret, White Egret	Mi	-	•	-	-	•	•[3]	Likely – the species is known to occur in Bynoe Harbour.
Ardea ibis	Cattle Egret	Mi	-	•	-	-	-	-	Likely – potential habitat exists in the project area and there a number of records of the species to the south of the project area.
Arenaria interpres	Ruddy Turnstone	Mi	-	•	-	-	•	-	Likely – the species is known to occur in Bynoe Harbour.
Calidris alba	Sanderling	Mi	-	•	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Calidris canutus	Red Knot	Mi	V	-	•	•	-	-	Likely – the species is known to occur in Bynoe Harbour.
Calidris tenuirostris	Great Knot	Mi	V	•	•	•	-	-	Likely – the species is known to occur in Bynoe Harbour.
Charadrius leschenaultii	Greater Sand Plover	Mi	V	•	•	•	•	-	Likely – the species has been recorded 4 km to the east of the project area.
Charadrius mongolus	Lesser Sand Plover	Mi	V	•	•	•	-	-	Likely – the species is known to occur in Bynoe Harbour.
Charadrius veredus	Oriental Plover, Oriental Dotterel	Mi	-	•	-	-	-	-	Likely – potential habitat exists in the project area and the species has been recorded in similar habitat within the Lower Finniss Region.
Erythrotriorchis radiatus	Red Goshawk	V	V	•	-	•	-	-	Possible - potential habitat exists in the project area.
Erythrura gouldiae	Gouldian Finch	E	V	•	-	-	-	-	Possible – potential habitat exists in the project area.

Scientific Name	Common Name	EPBC Act Status	TPWC Act Status	Database Searches				Other	Likelihood of Occurrence
				EPBC PMST	NR Maps NT	NT NRM Report	Fauna Atlas#		
Gelochelidon nilotica	Gull-billed Tern	Mi	-	-	-	-	•	-	Likely - recorded 4 km to the east of the project area.
Geophaps smithii smithii	Partridge Pigeon	V	V	•	•	•	•	-	Likely – potential habitat exists in the project area and surrounds and the species has been recorded in similar habitat within the Lower Finniss Region. The nearest record is 8 km to the south-east of the project area.
Glareola maldivarum	Oriental Pratincole	Mi	-	•	-	-	-	-	Likely – potential habitat exists in the project area and surrounds. The species has been recorded in similar habitat within the Lower Finniss Region.
Hirundo rustica	Barn Swallow	Mi	-	•	-			-	Possible - potential habitat exists in the project area, however, there are no records of the species within the Lower Finniss Region.
Hydroprogne caspia	Caspian Tern	Mi	-	-	-	-	•	-	Likely - the species is known to occur in Bynoe Harbour.
Limosa lapponica	Bar-tailed Godwit	Mi	V	-	•	•	•	-	Likely - the species is known to occur in Bynoe Harbour.
Limosa limosa	Black-tailed Godwit	Mi	-	•	•	-	-	-	Likely – potential habitat exists in the project area. The species has been recorded in similar habitat within the Lower Finniss Region.

Scientific Name	Common Name	EPBC Act Status	TPWC Act Status	Database Searches				Other	Likelihood of Occurrence
				EPBC PMST	NR Maps NT	NT NRM Report	Fauna Atlas#		
Merops ornatus	Rainbow Bee-eater	Mi	-	•	•	-	•	•[1]	Known – the species has been recorded in project area (GHD 2003).
Numenius madagascariensis	Eastern Curlew	CE; Mi	V	-	•	•	•	•[3]	Likely - the species is known to occur in Bynoe Harbour. The nearest record of the species is 5 km to the north-east of the project area.
Numenius phaeopus	Whimbrel	Mi	-	•	-	-	•	•[1]	Known – the species has been recorded in project area (GHD 2003).
Pandion cristatus	Eastern Osprey	Mi	-	•	-	-	•	-	Likely - potential habitat exists in the project area and the species is known to occur in Bynoe Harbour.
Pluvialis squatarola	Grey Plover	Mi	-	•	-	-	•	-	Likely – the species is known to occur in Bynoe Harbour.
Rhipidura rufifrons	Rufous Fantail	Mi	-	•	-	-	-	-	Possible - potential habitat exists in the project area, however, there are no records of the species within the Lower Finniss Region.
*Rostratula australis**	Australian Painted Snipe	E, Mi	V	•	-	-	-	-	Unlikely - no suitable habitat for the species (i.e. shallow freshwater wetlands) exists on the project area and there are no records of the species within the Lower Finniss Region.
Sterna hirundo	Common Tern	Mi	-	-	-	-	•	-	Likely – the species is known to occur in Bynoe Harbour.

Scientific Name	Common Name	EPBC Act Status	TPWC Act Status	Database Searches				Other	Likelihood of Occurrence
				EPBC PMST	NR Maps NT	NT NRM Report	Fauna Atlas#		
Sternula albifrons	Little Tern	Mi	-	•	-	-	•	-	Likely – the species is known to occur in Bynoe Harbour.
Tringa brevipes	Grey-tailed Tattler	Mi	-	-	-	-	•	-	Likely - potential habitat exists in the project area and there are records of the species within 5 km of the project area.
Tringa nebularia	Common Greenshank	Mi	-	-	-	-	•	-	Likely – the species is known to occur in Bynoe Harbour.
Tyto novaehollandiae kimberli	Masked Owl	V	V	•	•	•	-	-	Possible - potential habitat exists in project area and surrounds however there are no records within the Lower Finniss Region. The nearest record is 20 km to the south of the project area (DLRM 2015).
Terrestrial Mammals									
Conilurus penicillatus	Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma	V	E	•	-	-	-	-	Possible - potential habitat exists in project area and surrounds however there are no records within the Lower Finniss Region.
Dasyurus hallucatus	Northern Quoll	E	CE	•	•	•	-	-	Likely – potential habitat exists in project area and surrounds and the species has been recorded in similar habitat within the Lower Finniss Region.

Scientific Name	Common Name	EPBC Act Status	TPWC Act Status	Database Searches				Other	Likelihood of Occurrence
				EPBC PMST	NR Maps NT	NT NRM Report	Fauna Atlas#		
Mesembriomys gouldii gouldii	Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga	E	V	•	-	-	-	-	Possible – potential habitat (i.e. tall forest of Darwin Woolybutt and Darwin Stringybark) exists in project area and surrounds. The nearest record is in Litchfield National Park, approximately 50 km to the south-west of the project area.
Phascogale pirata	Northern Brush-tailed Phascogale	V	E	•	-	-	-	-	Possible - potential habitat (i.e. tall forest of Darwin Woolybutt and Darwin Stringybark) exists in project area and surrounds. The nearest record is in Litchfield National Park, approximately 50 km to the south-west of the project area.
Saccolaimus saccolaimus nudicluniatus	Bare-rumped Sheathtail Bat	CE	-	•	-	-	-	-	Possible - potential habitat exists in project area and surrounds. No nearby records.
Xeromys myoides	Water Mouse, False Water Rat, Yirrkoo	V	-	•	-	-	-	-	Possible - potential habitat exists in project area and surrounds. No nearby records.
Marine Mammals									
Balaenoptera edeni	Bryde's Whale	Mi	-	•	-	-	-	-	Unlikely
Balaenoptera musculus	Blue Whale	E, Mi	-	•	-	-	-	-	Unlikely
Dugong dugon	Dugong	Mi	-	•	-	-	-	•[2]	Likely - known to occur in Bynoe Harbour.
Megaptera novaeangliae	Humpback Whale	V e, Mi	-	•	-	-	-	-	Unlikely - rarely migrates as far as the NT.

Scientific Name	Common Name	EPBC Act Status	TPWC Act Status	Database Searches				Other	Likelihood of Occurrence
				EPBC PMST	NR Maps NT	NT NRM Report	Fauna Atlas#		
Orcaella brevirostris	Irrawaddy Dolphin	Mi	-	●	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Orcinus orca	Killer Whale, Orca	Mi	-	●	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour. The species has been recorded in Fog Bay, approximately 65 km from the project site (Faggion and La Canna 2015).
Sousa chinensis	Indo-Pacific Humpback Dolphin	Mi	-	●	●	-	●	●[3]	Likely – the species is known to occur in Bynoe Harbour.
Stenella attenuata	Spotted Dolphin, Pantropical Spotted Dolphin	Mi	-	●	-	-	-	-	Possible - potential habitat exists in Bynoe Harbour.
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	Mi	-	●	-	-	●	-	Possible - potential habitat exists in Bynoe Harbour.

Based on records within a 5 km radius surrounding the site.

* As a marine species this species is listed as *Rostratula benghalensis* (*sensu lato*). Under the Territory Parks and Wildlife Conservation Act 2006 this species is listed as *Rostratula benghalensis australis*

^ Recorded as *Ardea modesta*

1 GHD (2003) Suntay Aquaculture Centre Terrestrial Fauna Survey

2 Routine Turtle and Dugong Monitoring Program Report – Dredging Report 3 Ichthys Nearshore Environmental Monitoring Program. http://www.inpex.com.au/media/1910/turtle-and-dugong-monitoring-report-3.pdf

3 Darwin and Ashmore Reef Tour Report 12 - 22 October 2010. http://www.peregrinebirdtours.com/a/Tour-Reports/Darwin-and-Ashmore-Reef

9 CONCLUSION ON THE LIKELIHOOD OF SIGNIFICANT IMPACTS

As detailed in Section 5, the construction and operation of the proposed facility may cause localised impacts to water quality, marine species and their habitat and resources, and terrestrial species. However, with the implementation of the control, management and mitigation measures listed in Section 7, none of these potential impacts are considered likely to be *significant* in nature, as described below.

9.1 WATER QUALITY

Available water quality information, together with data collected to date in association with this project, and reference material sourced from comparable estuarine locations in the adjacent Darwin Harbour, have been used to quantify existing water quality levels in those waterways which will receive, and then assimilate effluent from the facility.

These data, together with relevant more detailed investigations in Darwin Harbour, have then been used to define Interim Water Quality Objectives for the region of potential influence.

Detailed and conservative numerical modelling has shown that the full capacity (11,000 m^3/day) discharge from the facility, at a conservative licence condition of 2 mg/L TN and 0.4 mg/L TP (noting that the effluent quality is expected to be better than these levels) will cause localised and at worst case modest increases in nutrient levels in these areas.

When the additional effect of initial mixing and timed discharge through provision of a weir, biological assimilation and particulate matter deposition is taken into account, it is considered unlikely that the proposed discharge will have significant water quality, or water quality related ecological impacts to Wheatley Creek, Geranium Channel or any other waterways in the Bynoe Harbour area.

Ongoing monitoring of water quality parameters around the site will be used to further quantify the likely impact of the discharge on the system and the existing water quality levels in the region, and ultimately to define local Water Quality Objectives. Initial operating conditions will discharge levels far less than those modelled for, hence will almost certainly be well within the defined Interim Water Quality Objectives. This means that, based on the results of the modelling, the facility will be operating within the nominated interim Water Quality Objectives whilst the development of locally specific Water Quality Objectives take place.

9.2 MARINE ECOLOGY

Marine megafauna of conservation significance listed under the TPWC Act (2006) that are considered likely or possible to occur include:

- Four species of marine turtles
- Four species of fish

These species are all transient or migratory animals that will not be confined to one area. The marine habitat to be affected by the project is restricted to footprint of seabed over which the intake or outlet pipelines will be

placed. The ability of marine megafauna to transit through the project area is not likely to be affected by a change in the seabed habitat in these locations.

Potential impacts to marine megafauna as a result of the project include:

- Vessel strike during construction
- Entrainment of species in intake pipes during operation
- Localised short-term noise and vibration disturbance during construction
- Light spill from facilities or construction vessels affecting migration or navigation
- Reduction in water quality from construction activities, operational effluent discharge, unplanned release of wastes or other pollutants or erosion and runoff
- Introduction or spread of marine pests

Management measures have been identified of relevance to controlling risks for this project; these measures will be prescribed within construction and operational Environmental Management Plan for the project. Detailed design for discharge will be such that discharge will be managed and meet the interim Water Quality Objectives that have been defined. As mentioned above in Section 9.1, it is considered unlikely that the proposed discharge will have significant water quality, or water quality related ecological impacts to Wheatley Creek, Geranium Channel or any other waterways in the Bynoe Harbour area.

The potential to significantly impact upon species with distributions or habitat requirements that overlap with the project footprint was assessed in accordance with EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013). Based on the assessment provided in Section 5.1.11 and adopting the impact control measures described in Section 7.1.6.2, the proposed action is not considered likely to result in a significant impact to marine megafauna as:

- No direct impact to marine megafauna is anticipated, such that no reduction in population size is considered likely to occur
- The project will not reduce the area of occupancy or fragment the habitat of any significant species. Surveys have not mapped important habitat for megafauna within the project area or immediately adjacent. Species of relevance are transient or migratory animals that are not confined to one area and suitable habitat is well represented in the surrounding region. Impacts to habitat or water quality which could affect habitat will be controlled
- No critical habitat, preferred feeding grounds or breeding sites are known to be present in close proximity to the project footprint
- Risk of introduction or spread of invasive pests or diseases is low, but regardless will be controlled
- Management and mitigation strategies that are known to be effective will be adhered to during both construction and operation such that any potential impacts to the marine environment will be localised and short-term.

9.3 TERRESTRIAL ECOLOGY

Sixteen species of conservation significant terrestrial fauna listed under the TPWC Act (2006) are known, or considered likely or possible to occur in and around the project site. They are:

- One insect
- One terrestrial reptile

- Ten species of bird – six that are considered shorebirds (i.e. using resources predominantly found in the intertidal environment) and four terrestrial birds (i.e. using resources predominantly found within the terrestrial environment).
- Four species of mammal.

Management measures have been identified of relevance to controlling risks for this project; these measures will be prescribed within the construction and operational Environmental Management Plan for the project.

The potential to significantly impact upon species with distributions or habitat requirements that overlap with the project footprint was assessed in accordance with EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013). Based on the assessment provided in Section 5.1.11 and adopting the impact control measures described in Section 7.1.6, the proposed action is not considered likely to result in a significant impact to any terrestrial fauna as:

- No direct impact to terrestrial fauna is anticipated, such that no reduction in population size is considered likely to occur
- The project will not reduce the area of occupancy or fragment the habitat of any significant species. There are no mapped areas of critical or important habitat for any of the species that may occur within the project area or immediately adjacent. Suitable habitat for these species is well represented in the surrounding region
- There is a low risk (which will nonetheless be controlled) of introduction or spread of invasive pests or diseases
- Management and mitigation strategies that are known to be effective will be adhered to during both construction and operation such that any potential impacts to the terrestrial environment will be localised and short-term.

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APPENDIX A - ENVIRONMENTAL MANAGEMENT PLAN FRAMEWORK

seafarms

SEAFARMS GROUP LIMITED - CORE BREEDING CENTRE AND BROODSTOCK MATURATION CENTRE

DRAFT ENVIRONMENTAL MANAGEMENT PLAN FRAMEWORK

FEBURARY 2016

CONTENTS

1 INTRODUCTION

1.1 PURPOSE

Seafarms Group Limited (Seafarms) are proposing to develop a Core Breeding Centre (CBC) and Broodstock Maturation Centre (BMC) and associated infrastructure (herein referred to as the CBC and BMC, or the project) at Point Ceylon in the Northern Territory. As part of the project, Seafarms are committed to the development of an Environmental Management Plan (EMP). The EMP will guide environmental management on the site through the various stages of the project including during construction and operations. It will clearly describe the key policies, commitments and environmental management strategies that will be adopted to manage activities, minimise environmental impacts and enhance the benefits of the project.

This document outlines a framework for the Environmental Management Plan (EMP) and has been developed with reference to the Northern Territory Environment Protection Authority (NT EPA) Guideline for the Preparation of an Environmental Management Plan (NT EPA 2015). The EMP framework will be updated and finalised by Seafarms to reflect the detailed design and construction and operational requirements of the facility and will be submitted with future approvals and/or applications for the project.

1.2 OBJECTIVES

The objectives of the EMP are to provide a practical working framework for environmental management of the project. The EMP will:

- set objectives and benchmark performance measures to address risk
- outline management of the process and activities to ensure that adverse environmental impacts are avoided or minimised during all phases of the Project
- establish monitoring protocols as a means of evaluating the success of the management practices and mitigation measures
- provide for review of management strategies at regular and appropriate intervals to determine success areas and areas requiring additional attention.

2 PROJECT OVERVIEW

The EMP will contain a brief overview of the project including:

- proponent details, including name of the proponent and contact details
- project description; including:
  - figures showing the location and layout of all infrastructure
  - a description of the key physical components of the key physical components of the project including infrastructure and major equipment items
  - description of all key activities covered by the EMP
  - the timing and staging of key activities, including anticipated commencement and completion dates
- key contacts, including the primary contact responsible for the EMP and emergency contacts.

3 EXISTING ENVIRONMENT

The EMP will build upon the information covered in the NOI and will contain a brief overview of the existing environment where the project will occur, including:

- information on land tenure and zoning for the site
- a description of land use and ownership for the site and surrounding areas
- the location of the project and its proximity to landmark features, sites of cultural/social significance, regional community centres, sensitive environments
- a description of the general characteristics of the proposed site and surrounding area; including topography, climate, geology, geomorphology, soils, vegetation, fauna, groundwater and surface drainage
- information on existing environmental conditions (e.g. water quality, air quality)
- a description of natural processes of relevance to the existing environment (e.g. bushfires, cyclones)
- information on threatened species or ecosystems potentially impacted by the project
- a description of the social and economic environment.

4 LEGISLATIVE REQUIREMENTS

The EMP will contain information on the regulatory framework governing the project. A register of legislation, approvals, licenses and permits relevant to the project will be compiled. This register will be

the primary source for Seafarms managers and staff in relation to the relevant legal, regulatory and other associated requirements in relation to environmental management and performance.

5 ENVIRONMENTAL MANAGEMENT FRAMEWORK

5.1 STRUCTURE AND RESPONSIBILITY

The EMP will outline the organisational structure of the company and identify those positions within it responsible for implementation of the EMP.

5.2 TRAINING AND AWARENESS

Effective implementation of the EMP requires all staff and contractors to receive appropriate training in order to have an awareness of their roles and responsibilities.

The EMP will contain outline the processes for environmental training, including:

- identifying training needs
- development of appropriate training programs
- maintaining training records.

Records of the training provided to staff and contractors will be maintained for the project. Training will include, but not be limited to, Environmental Awareness Inductions, formal presentations, Toolbox meetings, Job Safety Environment Analysis (JSEA's) and Execution Plans.

5.3 COMMUNICATION AND REPORTING

Communication and reporting protocols will be developed in the EMP to facilitate:

- internal communication to employees and contractors regarding the requirements of the EMP, identified environmental impacts, objectives and targets and other relevant environmental issues
- communication and liaison with external stakeholders regarding:
  - environmental policy and the EMP
  - activities that may have an impact on the surrounding communities
  - management of environment-related complaints and comments.

5.4 EMERGENCY RESPONSE

The EMP will contain procedures to be followed in the event of an environmental incident or emergency. Procedures will include:

- the names and contact details for emergency personnel that will be available 24 hours a day, seven days a week
- response personnel responsibilities
- location of on-site hazardous materials information and spill containment materials
- steps to follow in response to incidents, including contingency management measures to minimise environmental impact and notifying relevant authorities and the community.

5.5 MONITORING

Environmental performance will be monitored and reported against performance indicators specified in the EMP and in the environmental approval conditions. The methodology for measuring, reviewing and reporting on environmental performance indicators to track progress towards environmental objectives and targets will be outlined in the procedures for the specific environmental matter.

5.6 CORRECTIVE ACTIONS AND CONTINGENCIES

The EMP will contain corrective actions that would be implemented in the event that there is a non-conformance with a management measure, or if monitoring indicates that a performance criteria is not being achieved.

5.7 REPORTING

The EMP will include a description of the project's reporting requirements and timing. This includes:

- internal environmental reporting requirements
- periodic (e.g. annual compliance reports) or event-based (e.g. incident reports) required by approvals or licences
- monitoring reports required by licences or approvals.

5.8 REVIEW AND AUDITING

Environmental audits will be conducted on a regular basis to evaluate and record whether the EMP is being complied with. The EMP will describe the program and procedures for auditing the EMP's implementation and effectiveness. The audit program will cover internal and/or external audit requirement, including the scope of the audit, timing, frequency, methodology and reporting requirements.

When an audit identifies the need for corrective action, the EMP will be reviewed and updated as required.

6 ENVIRONMENTAL MANAGEMENT AND MITIGATION

6.1 ENVIRONMENTAL RISK ASSESSMENT

The EMP will be informed by the identification, analysis and mitigation of environmental risks through a project risk assessment. Through the risk assessment process, the EMP will:

- identify and discuss the full range of risks presented by the project
- quantify and rank risks so that the reasons for the proposed management actions are clear
- acknowledge levels of uncertainty about estimates of risks and the effectiveness of the management actions put in place.

A formal risk assessment is yet to be undertaken for the project, however, risks that have been identified through the preparation of the Notice of Intent for the project include:

- reduction in water quality as a result of waste water discharge from the project
- clearing of vegetation and loss of habitat for threatened flora and fauna species
- introduction and spread of weeds and introduced species
- social and economic impacts on the local community

Management measures to mitigate these risks along with those risks identified through the formal risk assessment process will be included in the EMP.

6.2 CONCEPTUAL SITE MODEL

The EMP will include a conceptual site model (CSM) that represents the nature, fate and transport of discharges and wastes from the project and allows an assessment of potential exposure of the environment to contaminants.

The CSM will support the environmental risk assessment and will be prepared with reference to the NT EPA's Guidelines on Conceptual Site Models (NT EPA 2013).

6.3 ENVIRONMENTAL MANAGEMENT STRATEGIES

The EMP will state all environmental management activities, mitigation and control measures that will be used to mitigate risks identified in the risk assessment and prevent or minimise environmental impacts. It will include management activities, mitigation and control measures detailed in the Section 7 of the Notice of Intent as well as those arising from final detailed design and construction and operational requirements.

Table 1 presents the information that will provided for each environmental matter. Environmental matters for which management activities, mitigation and control measures are to be developed include (but are not limited to):

- waste water discharge
- community consultation
- cultural heritage
- air quality
- flora and vegetation
- bushfire management
- human health and safety
- sewage and waste
- terrestrial and marine fauna
- invasive species management
- biting insect management
- traffic and transport
- acid sulfate soils and potential acid sulfate soils
- erosion and sedimentation.

TABLE 1 INFORMATION REQUIREMENTS FOR EACH ENVIRONMENTAL MATTER

Environmental Matter	
Objective	The overall objective(s) for the particular environmental aspect or impact.
Performance Criteria	The targets and performance indicators to measure achievement of the environmental objective. The performance criteria will be specific, well defined and measurable. They may be standards or requirements specified in legislation, codes or practice, national or Northern Territory guidelines, or may be determined in consultation with regulatory agencies.
Management Measures	The management measures or actions that will be used to achieve the environmental objective and performance criteria and a description of how and when they will be implemented. Where appropriate control plans and maps will be provided to demonstrate environmental management measures
Responsibility	The person/role responsible for the implementation of the management measures.
Monitoring	The methodology that will be used to measure and monitor the environmental performance indicators to track progress towards environmental objectives.
Reporting	The reporting requirements including internal environmental reporting requirements and any reporting requirements required by approvals or licences.
Contingency	Mechanisms that will be implemented in the event that there is a non-conformance with a management measure, or monitoring indicates that a performance criteria is not being achieved. This allows for an adaptive approach to managing impacts. Adaptive management is a systematic process for continually improving management practices in response to monitoring and evaluation of the effectiveness of current management practices. An adaptive approach may be necessary where there is a lack of scientific knowledge about the environment potentially impacted and/or uncertainty about the effectiveness of proposed management measures.

7 REFERENCES

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