



**PROJECT SEA DRAGON
STAGE 1 LEGUNE GROW-OUT FACILITY
DRAFT ENVIRONMENTAL IMPACT STATEMENT**

EXECUTIVE SUMMARY

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1 INTRODUCTION

1.1 PROJECT SEA DRAGON OVERVIEW

Project Sea Dragon is a large-scale, integrated, land-based prawn aquaculture project in northern Australia designed to produce high-quality, year-round reliable volumes for export markets for black tiger prawns (*Penaeus monodon*). Project Sea Dragon has the potential at final stage to produce >100,000 tonnes per annum of black tiger prawns, generating an export revenue of US \$1.6 B per annum.

It is a staged development of up to 10,000 hectares of production ponds, with the development of a series of facilities across northern Australia, including:

- The Grow-out Facility, Stage 1 of this Facility which is the subject of this Draft Environmental Impact Statement
- Quarantine, Founder Stock Facility and Back-up Breeding Centre – located at Exmouth (WA)
- Breeding Program (Core Breeding Centre and Broodstock Maturation Centre) - proposed to be located at Point Ceylon at Bynoe Harbour (NT)
- Hatchery Site – proposed to be located in the Darwin (NT) environs
- A Processing Plant – proposed to be located near Kununurra in Western Australia (WA), and
- Export Facilities – proposed to be located at either or both Wyndham and Darwin.

An overview of the integrated project is shown in Figure 1 and the location of key components in Figure 2.

The main operations will be at the Grow-out Facility located on Legune Station, an operating NT perpetual pastoral lease located approximately 106 km north-east of Kununurra on the western border of the Northern Territory, with an ultimate design for approximately 10,000 ha of production ponds over 27 farms.

Stage 1 of the Legune Grow-out Facility (the Project) comprises three grow-out Farms across 1,080 ha and associated supporting infrastructure, and is described in more detail in Section 3.

1.2 STAGE 1 LEGUNE GROW-OUT FACILITY DRAFT ENVIRONMENTAL IMPACT STATEMENT

Project Sea Dragon Pty Ltd submitted the Notice of Intent (NOI) for the Project to the Northern Territory Environment Protection Authority (NT EPA) on 15 July 2015 for consideration under the *Environmental Assessment Act* (EA Act). The Project was also referred to the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 20 July 2015.

On 31 August 2015, a delegate of the Commonwealth Minister for the Environment decided that the proposed action was a controlled action and, as such, required assessment and approval under the EPBC Act. The controlling provisions included the likely significant impact on:

- listed threatened species and communities (sections 18 & 18A)
- listed migratory species (sections 20 & 20A).

On 14 September 2015, the NT EPA decided that the Project required assessment under the EA Act at the level of an Environmental Impact Statement (EIS). The NT EPA decision was based on the following issues:

- Potential to impact threatened, marine and migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Territory Parks and Wildlife Conservation Act* (TPWC Act)
- Potential to impact values on the Legune coastal floodplain Site of Conservation Significance, which is host to migratory birdlife aggregations of international significance, and includes Turtle Point, a significant nesting beach for the flatback turtle (*Natator depressus*; listed as vulnerable under the EPBC Act)
- Potential impacts from the discharge of waste from the prawn farming activities into receiving waters considered to be of high environmental value



FIGURE 1 INTEGRATED PROJECT FRAMEWORK

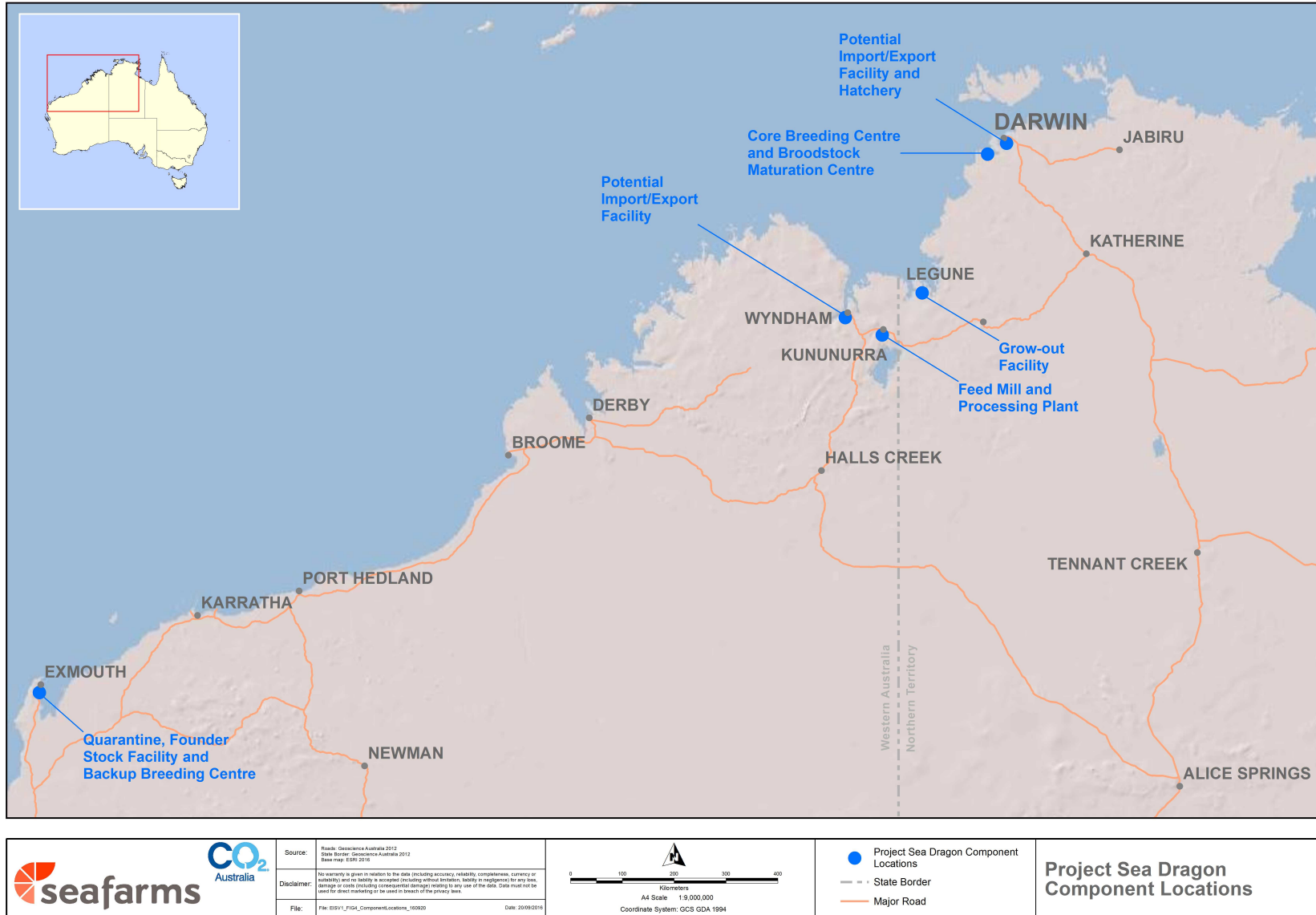


FIGURE 2 PROJECT COMPONENT LOCATIONS

- The management requirements for solid and liquid waste and the potential detrimental effects should there be inappropriate management practices
- Potential impacts on the local amenity and the environment e.g. from disturbance due to access to the area by unauthorised third-parties for recreational fishing, camping and hunting
- The implications of predation by birds on prawn stock held in ponds, both on the project feasibility and on bird aggregations
- The need for consideration of decommissioning of the site in the event of unplanned closure
- Potential economic, social and cultural impacts on the region and the Northern Territory, including the risks of the Project not realising its projected economic and social benefits

Project Sea Dragon Pty Ltd referred the Project to the Australian Government for consideration under the EPBC Act. On 31 August 2015, a delegate of the Commonwealth Minister for the Environment decided that the proposed action was a controlled action and, as such, required assessment and an approval decision under the EPBC Act. The controlling provisions included the likely significant impact on:

- listed threatened species and communities (sections 18 & 18A)
- listed migratory species (sections 20 & 20A).

The Project is being assessed under the assessment bilateral agreement between the Australian and Northern Territory Governments.

Terms of Reference for the Preparation of an Environmental Impact Statement to address the potential impacts identified by the Australian and Northern Territory Governments were issued in November 2015. This draft Environmental Impact Assessment addresses the requirements of those Terms of Reference.

1.3 LEGUNE STATION GROW OUT FACILITY - STAGE 1

The Project has been designed to accord with the Aquaculture Stewardship Council Shrimp Standard and the Environmental Code of Practice for Australian Prawn Farmers. It will also use husbandry practices that are well accepted by government and industry as outlined in the Australian Prawn Farmers' Manual.

The main operations for Project Sea Dragon will be at the Grow-out Facility located on Legune Station, located approximately 106 km north-east of Kununurra near the western border of the Northern Territory. At full production the Stage 1 Legune Grow-out Facility will produce nominally 14, 000 tonnes of prawns per annum and consists primarily of the Grow-out Centre, plus the supporting infrastructure as illustrated in Figure 3. The Project layout is shown in Figure 4.

There are a number of benefits to staging the development of the project including the learnings obtained from each incremental stage. By committing to Stage 1 (1,080 ha of ponds) Project Sea Dragon Pty Ltd will be in a position to monitor impacts and collect vital data to shape the design and implementation of subsequent stages of expansion.

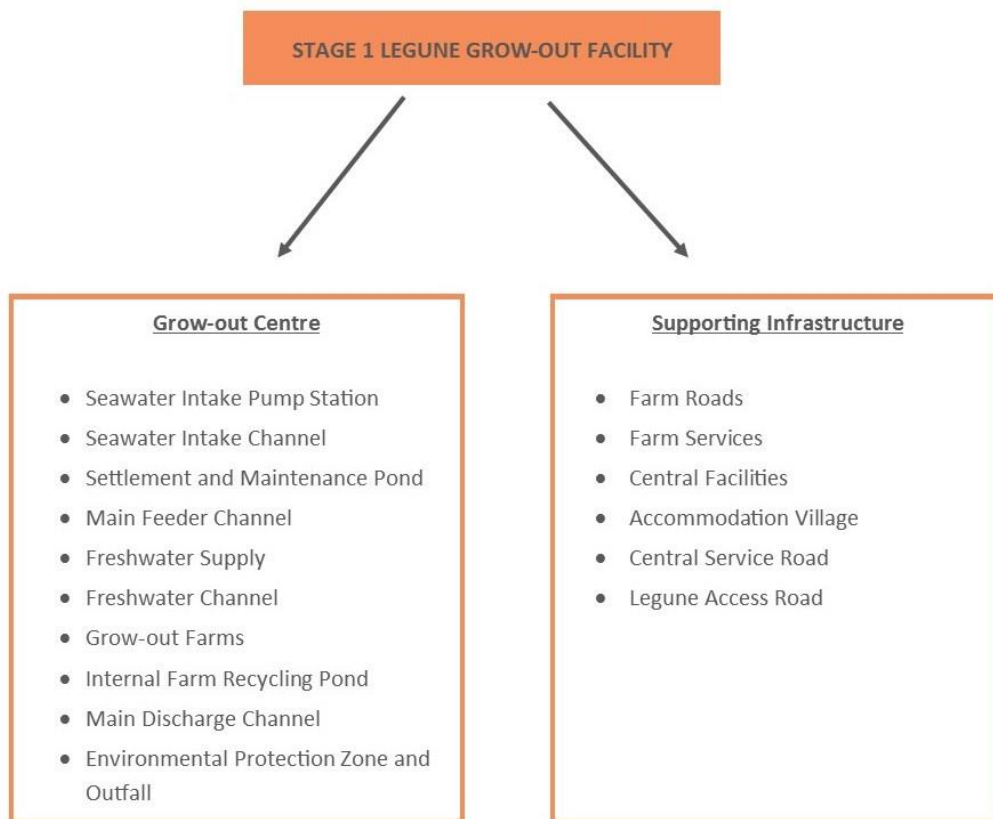


FIGURE 3 KEY COMPONENTS OF THE STAGE 1 LEGUME GROW-OUT FACILITY

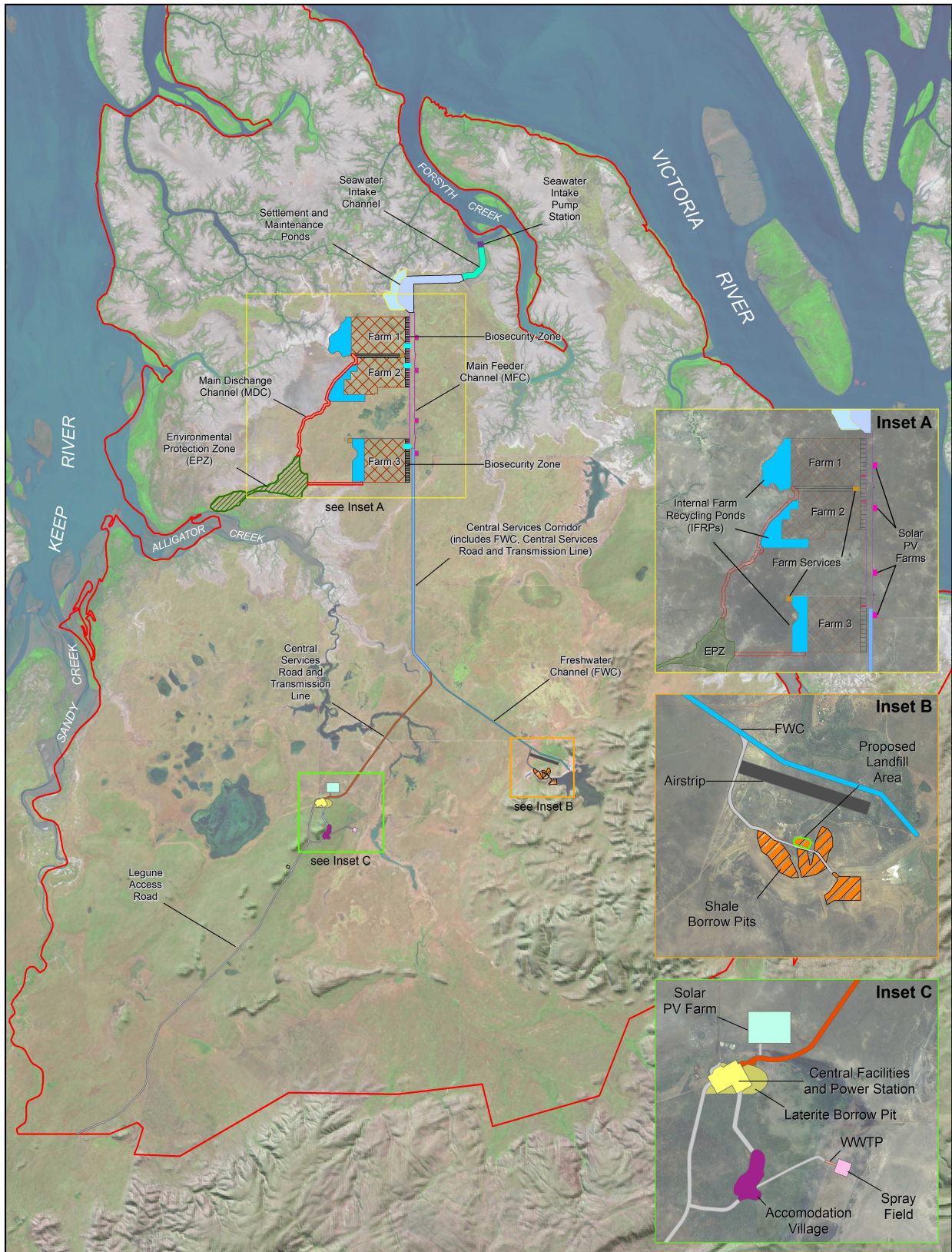
Specifically, Stage 1 involves:

- Three farms with a total productive area of 1,080 ha, each consisting of up to 40 ponds, of 10 ha each. These are each serviced by feeder and discharge channels, an internal gravity fed Internal Farm Recycling Pond (IFRP) for storage, settlement and return of water to the farm feeder channel (FFC) for re-use, and supporting infrastructure
- A common water intake, comprising pump station and intake channel at Forsyth Creek for seawater supply, rotating drum filters to screen the intake, a settlement pond, a Main Feeder Channel (MFC) and a freshwater channel (FWC) (freshwater will be sourced from the existing Forsyth Creek Dam).
- A Main Discharge Channel (MDC), feeding into an Environmental Protection Zone (EPZ) - a wide, shallow retention area designed to allow settlement of suspended solids and nutrient reduction through constructed wetlands and outfall to Alligator Creek
- Project supporting infrastructure, including:
 - Accommodation, offices and laboratory
 - Vehicle wash bays, workshops
 - Stores for fuel, oil and chemical storage, waste oil and chemical storage
 - A potable water treatment plant

- ▣ Wastewater Treatment Plant (WWTP) and Land Application Area (LAA), comprising one system for Central Facilities, and another larger system for the Central Village, plus small systems for the farm services areas
- ▣ A landfill for putrescible and non-putrescible waste, constructed in a depleted gravel pit
- ▣ Drainage and flood mitigation works, such as culvert and drainage channels
- ▣ A central diesel power station, consisting of multiple dual fuel generators with a capacity of 17.5MW, and distributed solar PV generation of approximately 17.5MW
- ▣ A 132KV transmission overhead line to transmit power to the farms and pump stations, distribution switchyards and step down transformers. Critical loads such as the pump stations will have self-contained standby diesel generating sets located adjacent to the Motor Load Centres.
- ▣ All weather, unsealed gravel-sheeted in-farm access roads to and from the ponds, and unsealed access tracks to connect farms with other facilities

The main Project area is the Grow-out Centre, which will be situated on the estuarine-deltaic plain of Legune Station (i.e. the floodplain, above 4.5-5 m AHD), utilising the largely grassed areas currently used for cattle operations. The Grow-out Centre will be constructed on these areas to provide flood immunity, storm surge and sea level rise immunity, and to avoid the coastal erosion plain (nominally below 4.5-5 m AHD) containing wetlands, potential acid-sulfate soils, and areas of environmental, heritage and cultural sensitivity.

Section 3.1 and 3.2 below summarise the construction and operational phases of the development, described in more detail in Volume 1, Chapter 3 – Project Description, of the Draft EIS.



	Source: Legune Station: NT Land Information Services 2015 Project Master Plan: Australia 2016 LandSat: Geoscience Australia 2006	<p>A4 Scale: 1:250,000 Coordinate System: GDA 1994 MGA Zone 52</p>		Project Master Plan
	Disclaimer: No warranty is given in relation to the data (including accuracy, reliability, completeness, currency or suitability) and no liability is accepted (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.			
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FIGURE 4 STAGE 1 LEGUNE STATION PROJECT OVERVIEW

2 PROJECT PROPONENT

2.1 PROJECT PROPONENT

The project proponent is Project Sea Dragon Pty Ltd (PSD), a wholly owned subsidiary of Seafarms Group Limited (Seafarms). Seafarms is an ASX (ASX:SFG) listed company holding separate subsidiary companies each operating in emerging, non-conventional commodities areas - aquaculture, carbon and environmental offsets. The relevant companies are Seafarms Operations Limited, Seafarms Queensland Pty Ltd and CO2 Australia Limited.

2.2 ABOUT SEAFARMS

Seafarms is an Australian agri-food company which operates, builds and invests in sustainable aquaculture production platforms producing high-quality seafood. Seafarms is currently the largest Australian producer of farmed prawns – growing, processing and distributing the well-known Crystal Bay Prawns® premium brand. Seafarms has 148 ponds covering 160 hectares, across three locations throughout north Queensland and is a major supplier of prawns to Coles and Woolworths. The company is Australia’s largest prawn aquaculture enterprise.

Seafarms is committed to sustainability and is of the view that farmed seafood is the most sustainable way to provide seafood to the world, especially considering catch pressures on global wild fisheries. Crystal Bay Prawns are produced using environmentally sustainable culture processes, state of the art processing facilities and support services. Seafarms considers protection of the environment to be a core corporate responsibility.

3 LEGUME STAGE 1 GROW-OUT FACILITY PROJECT DESCRIPTION

3.1 CONSTRUCTION

Construction is proposed to begin in July 2017, however, this is dependent upon receiving all necessary Project approvals, including and especially those relating to Indigenous Sacred Sites. It will involve site establishment, earthworks and construction, and site commissioning. Additionally, the commencement and duration of construction will be heavily influenced by wet season constraints and the upgrading provision of road infrastructure by the WA and NT governments outside of the Project footprint.

3.1.1 Site establishment

Site establishment will involve preparing the site for earthworks to commence, involving laydown areas, access roads, and similar works. Two laydown areas will be developed, with one at the Central Facilities location, and the other at the Inlet Settlement Pond area. Construction of linear or distributed infrastructure (service corridor, roads, etc.) will be developed using the appropriate laydown and service areas above, with minor storage of raw materials along the route as required. Basic amenities, wash bays, wastewater treatment systems, potable water treatment plant, diesel power station, waste storage, spill management, fuel storage, chemical/oil and supply/equipment storage areas will also be developed at this time and unsealed access tracks will be upgraded where required to obtain access to all construction areas.

3.1.2 Construction

Following site establishment, construction of the Grow-out Centre and the supporting infrastructure will commence.

3.1.2.1 Grow-out Centre

- The farm areas will be control burned of pasture prior to commencement of earthworks, and trees removed and mulched
- Ponds, channels and berms will be constructed via a cut-to-fill operation to the designed levels
- The embankment walls for the ponds and the channels will be above-ground earthen structures. Farm walls will be ~2.0m above the natural ground level. Embankment walls for channels will be ~1.0- 5.0m above natural ground level
- Ponds and channels will not be lined with any other materials, as the surface soils (the black clay soils on the estuarine-deltaic plain) provide the impermeability needed to retain the water for operations
- Batter slopes will be designed to be suitable to obtain the required stability and re-vegetation of the batters will be encouraged by seeding with grasses to assist in achieving stability
- The tops of most berms will be sheeted with roadbase material and compacted for maintenance access, or where relevant will be incorporated into the site access roads (such as the central service road)
- Procedures will be followed to provide for appropriate management of PASS material that may be encountered, to avoid oxidation and acid production
- The seawater intake will utilise a piling rig to install the required steel tubular piles for the structure, with access to the site via an earthen access ramp from the floodplain out onto the coastal erosion plain to Forsyth Creek (reclaimed after use)

- The EPZ will be constructed on the estuarine-deltaic plain by placing minor bunds to direct flow where required
- A weir will be constructed at the outfall to Alligator Creek to guide the flow from the EPZ.

The major equipment utilised during the construction of these elements includes:

- Earthmoving equipment (Laser buckets, tractors, scrapers, trucks, excavators, compactor, graders, dozers, water carts)
- Cranes
- Trucks (delivery of materials, bitumen top-coat).

Once the earthworks have been completed, construction of the associated structures (inlet, outlet, filters, culverts, on- farm facilities, electrical and controls, trenching) will commence.

3.1.2.2 Supporting Infrastructure

In-farm access roads will be constructed on the trafficable bunds forming the ponds, channels and IFRPs.

Other works include the outlet to the existing dam on Forsyth Creek Dam, which will be modified to provide for seasonal control of outflows, by an additional valve and modified weir box on the downstream face of the wall.

Borrow pits on the site will be used for roadbase, and other construction materials.

Central Facilities, Farm Services and the Accommodation Village works will comprise vegetation clearing and bulk earthworks, followed by underground services, concrete foundations, building placement or erection, building fitout, electrical and controls and finishing civil works. Buildings will be prefabricated, transportable buildings that will come to site broken down in transportable sized units and then assembled on site.

A landfill will be established on the site at the location of the existing borrow pits near the Legune Station homestead. This, and the establishment of the Hazardous Waste Facility, and the Waste Transfer Facilities, will occur as soon as practicable during construction, to minimise issues with waste handling during construction.

3.2 OPERATIONS

Project Sea Dragon will grow black tiger prawns (*Penaeus monodon*) bred in an in-house captive breeding program. The prawns will be delivered from the commercial hatchery, proposed to be located in the Darwin environs, to Legune by truck, and stocked into the Grow-out Ponds located in the Grow-out Centre, comprised of the three farms and associated services.

The flow of water through the Grow-out Centre is illustrated in Figure 5, from the supply of water through the intake channels, recirculation within the system, to the subsequent discharge of water at the outfall into Alligator Creek. Ponds are fed by the Pond Feeder Channel, which takes seawater from Forsyth Creek (after settling), freshwater from Forsyth Dam, and recirculated water from the Internal Farm Recycling Pond (IFRP). The water is conditioned to achieve the correct pH balance and mix of pond biota (chiefly algal species) before being stocked with juvenile prawns.

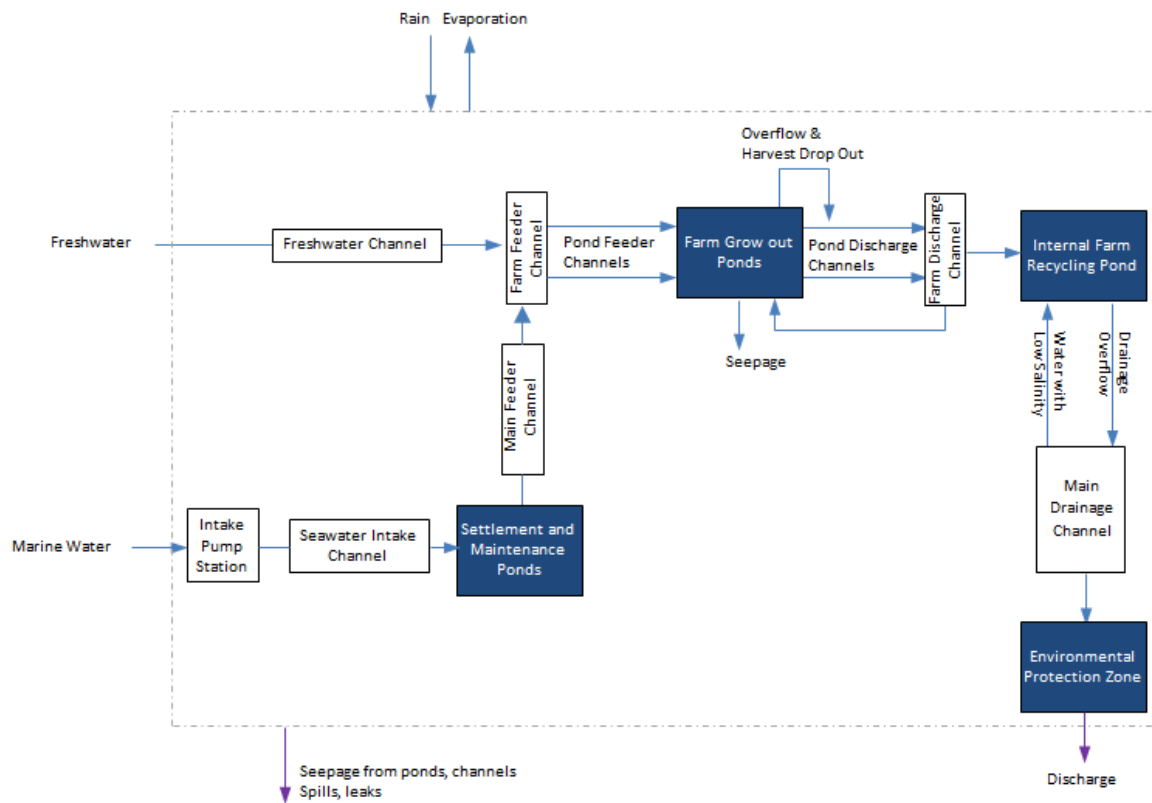


FIGURE 5 GROW-OUT CENTRE FLOW DIAGRAM

Water quality is controlled by:

- internal exchange (recirculation) of farm water via the IFRP to manage pond water nutrient levels and microalgae growth
- application of sea water and fresh water (from the Main Feeder Channel and the Freshwater Channel) to manage pond volumes and salinity levels
- drainage of water from the farms to the Main Discharge Channel to manage pond volumes and salinity levels
- aeration to manage levels of dissolved oxygen in the water.

Prawns are fed a formulated feed diet to optimise growth and animal health, supplied by feed trucks equipped with blowers. Several times per day a truck will drive around each pond perimeter and project the prawn feed up to 20 – 30 m in from the edge of the pond. The feed sinks to the pond bottom where it is eaten by the prawns. The amount of feed eaten by the prawns is monitored to minimise feed wastage, and the feeding regime is continually updated to reflect prawn feeding requirements and behaviour.

Harvest involves draining the pond via the outlet structure. The bottom of the pond is shaped and sloped to allow harvest drainage within a 12 hour period. Although water can recirculate within the farm, prawns are confined to the pond they are stocked in. Prawns are grown to marketable weight (typically 20+ grams) and harvested.

The water flow carries the prawns into the outlet structure where they are captured in a cage at the drainage point, lifted with a fish pump into a dewatering tower, and then deposited into ice slurry. The ice slurry both euthanizes and preserves the prawns for transport to the Processing Plant.

After harvest, the floor of the pond may be dried out as a fallow measure. This will allow the pond floor to be cleaned, the soil conditioned with application of lime, and drainage grades re-cut for the next crop. The centre mound of pond spoil, generated from silt, algal matter and prawn faeces, can also be removed from the pond to a remediation stockpile. This material, with its high levels of organic material, will be used to help revegetate pond banks once leached of salt.

Supporting infrastructure and services will include:

- Farm services, Central Facilities and Accommodation Village:
 - the functions to be carried out at the Central Facilities broadly include: harvest equipment storage and maintenance; harvest handling; vehicle washing and maintenance; slurry ice-making; equipment maintenance and warehousing; power generation and switchyard; energy storage and fuel dispensing; management, administration, fire, security, safety and paramedic; communication and systems controls; security and biosecurity control and laboratory
 - two Farm Services areas will be constructed to service Farms 1, 2, and 3. Each farm services area includes administration; accommodation and laboratory buildings (manager's house, short-term accommodation units, common mess and living areas for day and night shift staff, administration office and laboratory); a wash bay for vehicle washing between biosecurity zones; workshops for light farm vehicles and aerators; fuel, chemical, molasses and other material and waste stores; transport of post larvae tub storage; a wastewater treatment facility and spray field for discharge of treated water; potable water treatment and storage for human consumption and electrical substations
 - the permanent Accommodation Village will be located approximately 1 km south of the Central Facilities comprising: accommodation units; mess, wet mess and the recreation building; laundry units; central toilet facilities and BBQ areas.
- An integrated waste management system, comprising:
 - distributed waste receptacles and some sorting of waste at source
 - a Waste Transfer Facility, located at the Accommodation Village, and used to further sort waste prior to disposal at landfill or removal off-site (for recycling, reuse, or disposal)
 - an on-site landfill, for the disposal of general (non-recyclable) and putrescible waste.
- Wastewater management, including:
 - oil-water separator waste, and other liquid chemical waste which will be stored in the Hazardous Waste Facility before removal off-site, or removed directly from the sump or separator system off-site
 - effluent from farm services, Central Facilities, or Accommodation Village, which will be treated by on-site package treatment plants and irrigated into designated land application areas.

- Storage of chemicals and other hazardous materials in dedicated, spill proof (bundled, and depending on size roofed) stores. Minor quantities will be stored in accordance with AS 1940—Storage and handling of Flammable & Combustible Liquids.
- Airstrip - allowance has been made to extend the length of the existing unsealed runway to handle larger turbo-prop aircraft, in the event that flights to and from Kununurra and Darwin are justified.

4 APPROVALS, CONDITIONS AND AGREEMENTS

4.1 CURRENT AGREEMENTS

The proponent has current agreements in place with the owners of Legume Station to enable project feasibility investigations to be undertaken. The proponent is currently consulting and negotiating with the Traditional Owners regarding the development of an Indigenous Land Use Agreement (ILUA).

4.2 COMMONWEALTH LEGISLATION

Commonwealth legislation likely to be applicable to the Project is summarised in Table 1.

TABLE 1 COMMONWEALTH GOVERNMENT LEGISLATION

Legislation	Responsible Agency/Authority	Specific requirements/permit
<i>Aboriginal Land Rights (Northern Territory) Act 1976</i>	Prime Minister and Cabinet and Attorney-General's Department	Agreement from the claimants in areas subject to Land Claim 188
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Department of the Environment and Energy	Approval is required under sections 130(1) and 133 of the Act
<i>National Greenhouse and Energy Reporting Act 2007</i>	Clean Energy Regulator	If applicable, registration and reporting under the Act
<i>Native Title Act 1993</i>	The Attorney-General and Attorney-General's Department	Negotiation of an Indigenous Land Use Agreement

4.3 NORTHERN TERRITORY LEGISLATION

Northern Territory legislation likely to be applicable to the Project is summarised in Table 2.

TABLE 2 NORTHERN TERRITORY LEGISLATION

Legislation	Responsible Agency/Authority	Specific requirements/permit
<i>Bushfires Act 1980</i>	Department of Land Resource Management	Fire Management Plan
<i>Environmental Assessment Act</i>	NT Environment Protection Authority	Approval under the Act
<i>Fisheries Act</i>	Department of Primary Industries and Fisheries	Aquaculture Licence
<i>Heritage Act</i>	Heritage Branch of the NT Department of Lands, Planning and the Environment	Application to carry out work on a Heritage Place or Object
<i>Marine Act</i>	Department of Transport	Approval for the erection of structures below the high water mark or for attaching structures to the sea floor

Legislation	Responsible Agency/Authority	Specific requirements/permit
<i>Marine Pollution Act</i>	Depart of Lands, Planning & Environment	When operating a vessel at sea in NT waters, the proponent will comply with the requirements of the Act and associated regulations
<i>Northern Territory Aboriginal Sacred Sites Act</i>	Aboriginal Areas Protection Authority	Aboriginal Areas Protection Authority (authority certificate)
<i>Pastoral Land Act</i>	Pastoral Land Board	Non-pastoral use permit Vegetation clearing permit
<i>Public and Environmental Health Act</i>	Department of Health	Project will be required to comply with the Act and, if applicable, a waste water works design approval for disposal to land
<i>Soil Conservation and Land Utilisation Act 1969</i>	Department of Land Resource Management	Project will be required to comply with the Act. A sedimentation and erosion control plan will be prepared (see Volume 4, Chapter 3)
<i>Territory Parks and Wildlife Conservation Act</i>	Parks and Wildlife Commission NT	Permit to take or interfere with wildlife
<i>Waste Management and Pollution Control Act</i>	NT Environment Protection Authority	Environment protection approval Environment protection licence
Water Act	NT Environment Protection Authority Water Resources Division of the Department of Land Resource Management	Waste discharge licence Surface water extraction licences

4.4 NORTHERN TERRITORY POLICIES AND GUIDELINES

Several draft and current guidelines developed by the NT EPA and Department of Land Resource Management have been used to guide the design of assessment methodologies for the environmental and social assessments. Health guidelines pertaining to mosquito management, drinking water and accommodation were also consulted.

5 PROJECT ALTERNATIVES

Alternatives for various aspects of the project, including not proceeding with the project; siting the Project in a location other than Legune Station; and different design elements were considered during the Project planning and design phase.

5.1 NOT PROCEEDING WITH THE PROJECT

The Project has the potential to provide significant short and long term economic and social benefits to the Northern Territory. Not proceeding with the Project would result in a loss of prawn production valued at an average of \$195 million per year; capital expenditure during the construction of the Project of approximately \$411 million; recurrent operating expenditure of approximately \$125 million at full production; business opportunities, particularly for local suppliers, to supply goods and services to the Project; 444 Full Time Equivalent (FTE) construction jobs and 334 FTE operations jobs; and, tax and royalty payments over the life of the Project to the Commonwealth and NT governments of nominally \$50 million over the period to of 2032.

The recent mining downturn, and the completion of construction phases and closure of key regional projects had a significant impact on the economy of the region. The project provides a significant opportunity to offset this, creating approximately 444 Full Time Equivalent (FTE) construction jobs and 334 FTE operations jobs, and business opportunities, particularly for local suppliers, to supply goods and services to the Project. Not proceeding with the Project would also result in the loss of this opportunity.

5.2 PROJECT LOCATION

Considerable time and money was spent in studying suitable sites for the Project Sea Dragon Grow-out Facility across northern Australia. To determine the optimal location for the Project, a formal multi-criteria analysis was applied across the northern Australian coast using site suitability criteria based on initial investigations by CSIRO, and further developed by the proponent.

Biophysical, environmental, economic, commercial and socio-political attributes were used to define the criteria used in the analysis. Site selection considered, inter alia, land tenure, land area, topography, temperature, rainfall, evaporation, biosecurity risk, land use, availability of fresh-water and marine water, assimilative capacity of the receiving environment, feasible logistics and workforce, location away from industrial processes and contamination and relative proximity to a port. In terms of avoidance of environmental and cultural values it specifically considered avoidance of sites with significant populations of threatened species, sites of archaeological, heritage or Aboriginal significance, Ramsar wetlands, breeding colonies, known critical habitat, mangroves, intertidal zones, acid sulfate soils, significant vegetation clearance and Great Barrier Reef and inshore reefs.

Sites were ranked according to this multi-criteria analysis and as a result Legune Station is the preferred site.

5.3 PROJECT DESIGN

Protecting biological diversity, and maintaining essential ecological processes, has been a core focus of the engineering and operational design of the Project. For example, design has focused on: minimising the extent of the Project footprint; minimising earthworks movement; avoiding dredging; avoidance of Acid Sulfate Soils and Potential Acid Sulfate Soils; stormwater, erosion and sedimentation control; avoidance of the use of toxicants and antibiotics; hydrocarbon management; dust management; noise minimisation; traffic

management; maximisation of water re-use/recirculation; use of settlement ponds, channels and environmental protection zones to treat effluent; use of outfall controls and optimisation of timing of discharge; breeding efficiency (i.e. the genetic improvements from the domestication program mean that prawns grow faster and require less feed over time); best practice for feed formulation (minimising marine ingredients - fish meal, fish oil); and incorporation of renewable energy component into the power generation demand.

Specifically, a number of locations and/or configurations for specific project elements were considered, including:

- Intake location: Locations along Alligator Creek, Victoria River and Forsyth Creek were considered for the seawater intake - a location along Forsyth Creek was selected as the optimal location due to its closer proximity to the grow-out farms (and hence minimised extent of earthworks required) and because of access to water that is less sediment laden and therefore requires a smaller footprint for settlement ponds than the other locations considered
- Seawater and freshwater channels: Options investigated for seawater delivery from the seawater intake to the settlement pond, and freshwater delivery from Forsyth Creek Dam to the grow-out farms were an open channel or pipeline - open channels were selected due to the smaller size of footprint and costs to construct and maintain
- Design of the grow-out farms, including:
 - the individual pond size: small and large sized ponds were considered - project economics dictated the selection of larger sized ponds
 - the number of ponds within each Grow-out Farm: Grow-out Farms with 36 to 40 ponds were selected over less, or more than, this number due to superior and production efficiencies
 - the configuration of ponds within each grow-out farm: the selected configuration maximises earthworks and energy efficiencies.
- Freshwater Sources: a number of options were studied at a concept engineering level, which improved confidence that the existing Forsyth Creek Dam has sufficient capacity for the Project
- Outfall location considered:
 - Separate outfall locations for each of the grow-out farms versus a single outfall location - a single location was selected to limit to ensure environmental impacts could be properly monitored and managed to a single location only, to improve future capability to apply adaptive management principles
 - Siting the outfall on a tributary of the Keep River versus Victoria River or Forsyth Creek - once it was determined that Forsyth Creek was the preferred intake location, a tributary of the Keep River was the preferred outfall location as this minimises the potential for re-uptake and recirculation of the discharge water in accordance with industry practice to maximise biosecurity protocols. Sites at Bob's Creek and Alligator Creek were considered, with Alligator Creek being the preferred location due to a superior assimilative capacity, and less potential for impacts to the intertidal flats
- Outfall channel design and configuration: once Alligator Creek was selected as the optimal location, two different EPZ channel designs were considered that intercepted Alligator Creek at two different points,

with the ultimate location chosen due to minimisation of terrestrial and marine impacts relative to the other discharge location considered

- ▀ Central Facilities and Accommodation Village: a number of locations were considered for the central facilities and accommodation village, including:
 - ▀ close to the grow-out farms, on the estuarine-deltaic plain - rejected due to requirement for significant extra earthworks to raise the area for flood immunity, and considered more likely to be prone to biting insects due to increased proximity to the marine environment relative to other locations considered
 - ▀ rebuilding the area currently occupied by the Legume Station homestead - rejected due to insufficient sufficient flat land, proximity to registered sacred sites and it is not central to other project elements
 - ▀ off the estuarine-deltaic plain on the higher ground adjacent to the Legume Access Road - selected as the preferred option due to proximity to other project elements, immunity from flooding and considered less likely to be impacted by biting insects by virtue of its elevated position
- ▀ Transport: considered barging and road transportation - barging rejected due to costs of constructing hardened facilities in a highly mobile coastal environment and navigation risks associated the highly dynamic nature of the channels and currents, potential impacts on banks, and large tidal variation around Legume Station
- ▀ Central Services Road: three alignments were studied - two options were rejected after consultation with the Traditional Owners
- ▀ Energy Sources and Power Generation Options: a number of energy sources were investigated for the Project including renewable energy sources (i.e. solar, wind, geothermal and tidal) and fossil fuels (i.e. diesel, trucked liquefied natural gas, trucked compressed natural gas and piped gas). A hybrid power generation plant was the option ultimately selected.

5.4 OPERATIONS

Numerical modelling was used to quantify the impact of effluent discharged into Alligator Creek on the creek and the wider coastal environment. For the assessment two alternative effluent discharge scenarios were considered; a constant discharge rate, and an ebb tide discharge regime. Discharging effluent only under ebb tide conditions was selected as it maximises assimilation and dilution, and minimises potential impacts on the receiving environment.

6 WATER BALANCE

A water balance based on long-term integrations of the Gold Sim model was undertaken for the Project to understand and describe the:

- the optimal engineering for the project based on water
- water requirements for the project based on a wide range of scenarios
- investigate a wide range of operating assumptions and constraints
- dynamics between operational decisions, environmental variations and water balances.

Maintaining salinity within the biological tolerances of the prawns (at 10 to 45 g/L) is necessary for the successful operation of the Project.

Water salinity within farms will vary through the year in response to the inflow of estuarine water, incident rainfall and evaporation, farm operations involving the recirculation of water between the farm grow-out ponds and IFRP, operational discharge of more saline or excess water volumes, and inflow of fresh water from the storage.

This will require the management, and reduction of, in-farm salinity to acceptable levels using freshwater from the Forsyth Creek Dam, conveyed to the farms via the Freshwater Channel. Operational flexibility will be required to maintain levels of salinity to within acceptable ranges and hence water balances within the Project will be dynamic and are unlikely to be at steady state.

While the system can be operated across a wide range of conditions and tolerances, and, as mentioned above, will vary depending upon environmental and operational variables, in order to enable a water balance assessment for the purposes of this EIS, the water balance assessment presented a steady-state case with a water exchange of 1.4% of maximum dry season total system volume, which represents an average of 575ML/day of inflow of seawater from Forsyth Creek, and 410 ML/day of discharge into Alligator Creek.

An assessment of the reliability of the storage at the Forsyth Creek Dam was also undertaken, finding that the reliability of storage is adequate to support the assumptions made in the overall project water balance.

7 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

An assessment of how the Project complies with, and contributes to, the core objectives and guiding principles of ESD as defined in the National Strategy for Ecologically Sustainable Development was undertaken.

The assessment confirmed that, through the implementation of sustainable aquaculture practices, the Project satisfies the core objectives and principles of ecologically sustainable development. The development of the Project offers the potential to contribute to global food security for a growing population, whilst relieving the pressure on world fisheries by providing sustainable protein alternatives, and by investing in alternative feed sources that break the reliance on fish meal and fish oil.

It is considered that the Project provides a unique opportunity for economic growth, whilst optimising use of natural resources and the wellbeing of individuals and communities. Importantly, although the project has been nominally been accorded a 30 year lifetime, there is no intrinsic reason why the activities cannot continue for decades. Thus the project offers unique intergenerational opportunities for jobs and continued social economic development, carrying the prospect of a positive intergenerational legacy.

Australia is well placed both scientifically, politically and geographically to develop a comparative advantage in aquaculture. In particular, the geography of Northern Australia is well suited to aquaculture and Australia has some of the world's leading aquaculture research institutions in CSIRO and James Cook University. There is strong potential to develop a centre of excellence in aquaculture research in the NT based around the facilities that will be developed through Project Sea Dragon. The Project is the potential realisation of this comparative advantage.

8 RISK ASSESSMENT

A number of key potential risks were identified in the Terms of Reference for the Project. Each of the identified risks, and further risks that were identified through the risk assessment process, have been addressed in the risk assessment for the Project, and management measures are outlined in the Project Environmental Management Plan.

8.1 METHOD

The risk assessment consistent with AS/NZS ISO 31000:2009 ‘Risk Management – Principles and Guidelines’ was undertaken, and provided a framework for identifying components of the Project with the potential for greater environmental risk.

Risks were first identified and then analysed by assigning a level of consequence and a level of likelihood. Once the level of consequence and the level of likelihood had been assigned to each identified risk, the overall risk level was evaluated, and a ranking of risk was arrived at for each identified risk. In all, a total of 100 risks were identified (51 for construction and 49 for operations). Possible risk classifications were:

- Very Low
- Low
- Medium
- High
- Extreme

The initial risk rating considered the consequence and likelihood of the event occurring without any control measures in place.

Control measures were then developed to further reduce the risk. The risk was then reassessed (i.e. assigning a level of consequence and a level of likelihood to arrive at a ranking) based on the implementation of these control measures. This second rating is known as the residual risk rating and was used as the final risk rating.

The comparison of Initial and Residual Risk ratings are given in Table 3 and Table 4.

TABLE 3 INITIAL AND RESIDUAL RISK RATINGS FOR CONSTRUCTION PHASE

Construction	Initial Risk	Residual Risk
Extreme	0	0
High	5	0
Medium	29	16
Low	15	23
Very Low	2	12

TABLE 4 INITIAL AND RESIDUAL RISK RATINGS FOR OPERATIONAL PHASE

Operation	Initial Risk	Residual Risk
Extreme	0	0
High	6	0
Medium	32	19
Low	6	13
Very Low	5	17

There were no risks identified and assessed during construction or operations that had an extreme risk rating. Five construction related risks, and six operational risks, were initially rated as high. These risks were associated with:

- Risks to general ecological values and threatened and migratory species as a result of the introduction and/or spread of weeds and pest animals during construction and operations
- Risks to cultural heritage sites during construction works
- Risks to marine and estuarine water quality as a result of the discharge into Alligator Creek
- Risks to human health and safety as a result of vehicle incidents and meteorological events (i.e. cyclones and bushfires).

Through the application of controls measures however, these risks were able to be reduced. As such there are no residual risks with a high risk rating.

Low to medium risks are considered able to be successfully managed through inclusion of the identified control measures into the EMP procedures and management plans.

Ongoing monitoring and management will be undertaken to test the effectiveness of the nominated controls, audit their implementation and identify other measures or different approaches that may be required to achieve and maintain acceptable risk levels. Measures to do so are outlined in the Project EMP.

9 ENVIRONMENTAL VALUES

9.1 PROXIMITY TO SIGNIFICANT SITES AND FEATURES

Legune Station is bordered by the Keep River to the west, and Victoria River to the east, with the Project footprint situated within the Legune Coastal Floodplain Site of Conservation Significance.

The Legune Wetlands are also situated on Legune Station, and are recognised as a Nationally Important Wetland. The proposed services corridor and one of the proposed roads intersect the Legune Wetlands. Other significant natural features include seasonal / intermittent freshwater lakes and ponds, and swamps, floodplain lakes and ponded pastures; and the northern territory coastline.

Other nearby sites or features that will not be impacted by the Project, but that were considered include:

- The Keep River National Park, located 80 km southwest of the Project, with an extension proposed that would extend it to be approximately 17 km south of the nearest Project element
- The Spirit Hills Wilderness Conservation Area, which falls within the Keep River National Park extension
- The Joseph Bonaparte Gulf Marine Reserve, around 25km seawards from Turtle Point
- World Heritage Properties (nearest 250km south west) and National Heritage Places (nearest 130km west)
- No public or private reserves are located within or near the Project area, and the area is not designated as a conservation zone under a planning scheme
- The project area is not mapped as a storm surge zone.(what are we trying to say here ?)

9.2 GEOLOGY, GEOMORPHOLOGY AND SOILS

9.2.1 Existing Environment

Legune Station is located at the junction of two geological basins – the Bonaparte Basin in the north and west of Legune (where most of the Project is located), and the Fitzmaurice Basin in the south east. The surface geology of Legune Station is comprised primarily of the Cockatoo, Langfield and Kulshill Groups, with the Legune Formation present as the Legune Range, in the southeast of Legune Station, associated with Forsyth Dam.

In terms of soils and landforms, the Project footprint traverses four plain ‘tiers’, as it moves from north to south across Legune Station. The plains extend from the delta between the mouths of the Keep and Victoria Rivers to the foot of the Legune ranges and Spirit Hills, with the land systems and soils characterised as below:

- The Coastal plain, an area of tidal flats and low closed mangrove forest / samphire forbland vegetation, between sea level up to 4.5-5 m AHD. Soils are hydrosols - poorly drained silty clays and muds. Only the intake structure, intake channel, and part of the discharge structure are located on this plain
- The Estuarine Deltaic Plain, located between 4.5-5 m and 10 m AHD, with scattered residuals up to 30 m, comprised of poorly drained clay soils (Vertosols - self mulching cracking clays) with sandstone residuals, and grassland, open woodland and wetland/swamp areas. This area contains freshwater and tidal estuarine systems, typically saline shallow groundwater (~2-3m depth) and some deeper productive bores. The bulk of the Project infrastructure is located on this plain.

- The Coastal Erosional Plain is characterised as lateritic plains and rises, situated between 10 and 50 m AHD, with residuals rising to 100 m. Soils are Tenosols - Deep red and yellow sands and sandstone residuals, with Sclerophyll woodland, and minor wetland areas around playas. Only the Central Facilities, Accommodation Village and Legume Access Road are located in this land system. Minimal surface water systems are in proximity, although some productive or potentially productive bores are located in the vicinity.
- The Legume Access road traverses a fourth plain system, known as the Flood-out Plain. This plain is located below the Ranges and inland from the Coastal Erosional Plain, representing washout and deposition from local river systems. It is comprised of Hydrosols - Yellow podzolics and yellow earths (sandy clay loam, sandy loam).

The Ranges are located as the backdrop to the above systems, with only the Forsyth Dam, some borrow pits and scattered residuals being included in this land system. Soils are Lithosols, shallow sandy soils and rock outcrop on sedimentary rocks. Some productive groundwater bores, and surface freshwater systems are located in proximity to the works.

9.2.1.1 Acid Sulfate Soils

The Northern Territory Acid Sulfate Soils Risk 1:2M spatial mapping identifies most of the site within the medium risk area for Acid Sulfate Soils (ASS). Areas within the mapped high risk areas include the inlet, sediment pond and maintenance pond in the north, and the Main Discharge Channel (MDC) from farms 1 and 2, the Internal Farm Recirculation Pond (IFRP) in Farm 2 and the Environmental Protection Zone (EPZ).

The airstrip, dam and borrow pit, and the road south of the central facilities and the associated borrow pit are mapped as no risk, though the central facilities area itself is in the medium hazard area.

Sampling has shown that widespread and shallow actual Acid Sulfate Soils (ASS), being ASS that have oxidised and are producing acidic leachate, are not present at the site, in the areas investigated. Results do confirm the presence of Potential Acid Sulfate Soils (PASS - could potentially oxidise) at a number of locations at or below 2.5 - 3m depth below ground level, which is generally above 4.5-5 m AHD in the majority of the development footprint. In relation to reduced levels (relevant to Australian Height Datum, AHD) this equates to:

- ~1.3m AHD at the location of the intake channel and settlement/maintenance ponds, and the edges of the farms (soil site was northwest of Farm 1), where excavation is anticipated to end more than 2 metres above the PASS in this location, at ~3.7m AHD
- ~2.4m AHD along the MFC, with excavation expected to extend to no lower than 4.7m AHD, which is 2.3 m above the PASS in this location
- PASS material was encountered at 1.7 - 2.7m AHD within the farm areas, and an implied level from the MFC and a site northwest of farm 1 at 1.3 - 2.4m AHD. Excavation is expected to extend to no lower than 4.2m AHD, thus will be at least 1.5 m above any PASS material

Generally, this indicates that where PASS is likely to be present across the site, it is below the level of proposed excavation at ~1.3 m AHD along the Coastal Plain / Estuarine-Deltaic plain boundary, and up to ~2.7 m AHD within the Estuarine-Deltaic plain. Specifically, the farm discharge channels (PDC and FDC), where the deepest excavations will occur, have been hydraulically designed by width, slope and depth (and hence farm shape) to avoid PASS.

Regardless, results also indicate that where PASS was found, it naturally has sufficient Acid Neutralising Capacity to result in no Net Acidity (i.e. no chance for PASS to produce acid leachate or runoff), based on groundwater records and soil sampling results.

9.2.1.2 Soil Salinity and Sodicity

Sampling and site observations on Legume Station indicate that the soils in the region of the proposed farm infrastructure and much of the Estuarine-deltaic and Coastal Plains, are saline-sodic, evidenced by elevated salinity and Exchangeable Sodium Percentage (ESP), although this is patchy and does not show any clear patterns, other than stronger associations closer to the Coastal Plain. Sampling also indicates that some soils are potentially dispersive, though this is not widespread, and is also relatively patchy.

The saline and sodic nature of soils in this area are a direct result of marine influence on these plains, which are subject to alternating drying out and large freshwater pulses onto, over, and through soils each wet season. Salinity profiles indicate generally increasing salinity with depth associated with a shallow, saline groundwater table, and relatively rapid leaching of salts through the profile.

More generally, site soils appear naturally habituated to the salt/fresh cycle, without apparent breakdown. In particular, site investigations found no evidence of current dispersion or breakdown of sodic soils, even in areas that have previously been excessively worked such as turkey nest dams, embankments, roadways and channels.

9.2.1.3 Contaminated Land

Potentially contaminating past activities on the site include an operating landfill near the Legume homestead, cattle yards and one known cattle dip, all are located outside the Project footprint. Waste infrastructure on the site is limited to the existing landfill, off-site removal of other wastes, and the potential for unexpected findings of residual waste materials during construction, as a result of the long history of pastoral operations on the site. A site contamination assessment did not identify any residual contamination within the Project footprint.

9.2.2 Environmental Values

The key environmental values are:

- The ability of undisturbed land systems to be self-supporting, sustainable and stable soil-vegetation systems
- The ability of the soils and landforms to provide a stable landform and infrastructure, both during construction and post-construction
- The in-situ topsoils as a resource for land stabilisation and rehabilitation
- Ability of the land to continue to support pastoral uses during operation of the Project
- Post-Project beneficial landuses, notably pastoral uses

9.2.3 Potential Risks and Impacts

Based on the above, the key potential risks can be summarised as:

- Direct disturbance of soils and landscapes through earthworks and traffic
- Soil erosion from vegetation clearing and batter / channel works, and bare or imperfectly stabilised surfaces
- Disturbance and oxidation of acid sulfate soils

- Soil contamination from leaks and spills
- Soil structural decline from working and exposure of sodic sub-soils
- Salinization and sodification of soils subject to saline Project waters (ponds, farm channels)
- Revegetation problems with poor rainfall infiltration and soil structure for plant root growth
- Instability, settlement / consolidation, and poor trafficability from weak soils or unsuitable embankment, berm and supporting materials
- Deterioration of in-situ concrete structures and footings from aggressive soils
- Sterilisation of potential economic mineral resources.

9.2.4 Mitigation and Management Measures

Management strategies and commitments to mitigate the potential impacts have been identified and are documented in the Project Environmental Management Plan (EMP). It includes the following environmental management strategies that have direct reference to Geology, Geomorphology and Soils:

- Soil, Erosion and Sediment Control
- Acid Sulfate Soil Management Procedure
- Hazardous Materials Management
- Spill Management

Monitoring of soil investigations and erosion and sediment control measures will be conducted before and during construction.

Mitigation and monitoring during the operational phase, for land systems and soils, will involve essentially monitoring and maintaining existing structures from erosion, instability / cracking, and avoidance of soil contamination or structural decline.

A detailed site Decommissioning and Rehabilitation Plan will be prepared following Project approval, and adapted based on findings during the operation of Stage 1.

Operations will also include a trial of rehabilitation methods for pond and channel infrastructure to provide a proven rehabilitation method that is cost effective and practical, and achieves the rehabilitation aims.

9.3 MARINE AND ESTUARINE WATER

9.3.1 Coastal Geomorphology

The Project site is located in the lower part of Joseph Bonaparte Gulf, a relatively shallow marine area with a coastline dominated by sand banks, extensive mudflats, mangrove systems, tidal creeks and the estuaries of the Victoria River and Keep River systems. In the Joseph Bonaparte Gulf generally:

- Estuaries are well-mixed, macro-tidal (tides > 4m), with little or no vertical water column stratification
- There are extensive shifting unvegetated intertidal flats dominated by relatively fine sediment material
- The waterways typically experience high levels of bed and bank erosion and reformation due to strong tidal and wind generated currents

- Water is extremely and chronically turbid due to the large tides (~8 m) and periodic flow of sediment-laden water from the Victoria and Keep Rivers.
- While nutrient concentrations can be relatively high, the concentration of chlorophyll a (an indicator of phytoplankton biomass) and the phytoplankton count are relatively low.
- In the wet season, freshwater lenses may develop above the saline estuarine water, and variations between tidal cycles may be greatest, as there will be the greatest potential for interaction between fresh and tidal waters.
- Estuaries are typically lined with mangroves and extensive areas of hypersaline saltmarsh and salt flats. These flats tend to trap terrigenous sediment

The Project is closely associated with the marine environment surrounding the site, with the inlet taking water from Forsyth Creek, treating it and using it in the farms, and discharging (again treated) water through the EPZ to Alligator Creek. As such, a detailed assessment of the marine environment was undertaken as part of the Environmental Impact Study for the Project.

In general, Forsyth Creek has a meandering channel form, comprising a single main channel with smaller tidal creeks joining along its length. At the proposed intake location on Forsyth Creek, this changes to split into a series of channels forming a more braided morphology along this 3 km section. Upstream of the divided channels, the creek reverts to a single flow path, however the channel centreline follows a more meandering form than the downstream channel indicating lower current speeds are present.

The intake is to be located on the outside bend of the southern channel, which is significantly deeper than the central or northern channels and conveys the majority of the flood and ebb tide flows. Bank scour in this region has been estimated at around 15 m per year and has been taken into account in the open engineering design of the water intake structure.

Alligator Creek is comprised of a series of sub-channels separated by braid bars, essentially low tide flats, which are flooded at high tide, and are highly dynamic with significant changes occurring over relatively short timeframes. The banks are typically sloping over much of the tidal range, transitioning abruptly to a near vertical bank at the channel margins.

9.3.2 Water Quantity and Quality

In terms of hydrology, the volume of water extracted from Forsyth Creek and subsequently discharged to Alligator Creek represents a small percentage of the tidal prism. The extraction or discharge of water will be unlikely to impact water levels or current speed within the waterways.

The temperature of the discharge water may be elevated above the natural levels in Alligator Creek due to solar warming during retention in the EPZ. As the volume of water compared to the tidal prism is minimal and as this discharge will be rapidly mixed into receiving waters, no adverse consequence of this temperature differential are expected.

Estuarine and marine environments in this location were generally highly turbid, with high concentrations of total phosphorus and oxides of nitrogen. Forsyth Creek and Alligator Creek in particular have extremely high levels of turbidity and suspended solids at all times. In addition, turbidity increased with depth in the wet season in Forsyth Creek.

In the dry season, currents driven by stronger offshore winds suspend the sediment, increasing turbidity and limiting primary production even further.

The high phosphorous but low total nitrogen load is consistent with a system which has low existing inputs of nitrogen and considerable particulate phosphorus sources, likely to be bound to the sediment and as such, related to the high rates of sediment re-mobilisation occurring in the system due to the high tidal energy which dominates mixing and transport processes.

Sampling at different depths indicated that water quality was well mixed throughout the water column, with little variation between surface and deep water at any of the sites. Salinity was relatively stable at most sites, but was lower in the wet and late wet season at sites in Forsyth Creek, as would be expected.

The ambient concentration of potential toxicants was generally low, although there were some elevated levels of some total metals (dissolved metals were below the laboratory limit of reporting). However, the results indicated that Forsyth Creek can supply source waters to the operation without concern for metals or metalloids in the waters to be used in the farming process. Given that none of these substances will be present in the proposed discharge, it is also considered that Alligator Creek can receive wastewater flows with no associated environmental impact concerning metals and metalloids.

Sediments were dominated by silt / clay with sand, with nutrient levels consistent with other sites in the Keep River estuary, and metals and metalloids, and pesticides being generally low or below the laboratory limits of reporting. Hydrocarbons in the C15-C36 fraction were detected at most sites in June 2015; however, concentrations were mostly below laboratory limits of reporting in March 2016. While the C15 to C36 fractions can include diesel, fuel oils and lubricating oils, they are also found in natural vegetation. Given the highly dynamic nature of these environments, and that none were not detectable in March 2016, the source of hydrocarbons in this survey were most likely natural.

9.3.3 Forsyth Creek Intake

The key potential impacts in this area would relate to construction phase works, however the construction methods used will avoid machinery contact with marine muds and clays, and given the short duration and small area of disturbance, overall impacts will be minimal. The intake bell-mouth at the inlet to the pump will be fitted with a 100 mm aperture mesh grille, to exclude all but small debris and aquatic fauna. This will be regularly cleaned of marine fouling by raising the pump assembly up and onto the jetty platform, so that personnel access can be afforded safely and the fouling wastes collected without any need for floating plant.

The intake pumps will terminate in the water at a level between Mean Low Water Neap and Mean Low Water Spring, and will only operate between mid to high tide daily. The operation of intake itself will have a negligible impact upon the local coastal morphological and sediment transport processes.

9.3.4 EPZ and Alligator Creek Discharge

The primary function of the EPZ is to regulate the flow of discharge water by reducing the velocity of flow and holding the release water so that discharge can be timed to occur at a constant rate during ebb tides. The majority of the discharge will flow through a channel in the centre of the EPZ, but the EPZ is sized for 'overflow' from this channel, to enable it to hold the peak discharge and water from storm events, up to the 50 year ARI event. It is expected that this 'overflow' and the margins of the channel itself will be colonised by local samphire and/or mangrove species, which will assist in nutrient uptake.

Effluent from the farms will be discharged into the main drainage channel (MDC) before passing through the EPZ to the bank of Alligator Creek. Scour protection on the downstream side of the Alligator Creek weir will be provided by a rock blanket. An outflow weir (100 m wide and set back 30 m from the existing bank) will enable control of discharges.

Observable impacts on water quality from the proposed wastewater discharge from the project are limited to the local waterway of Alligator Creek. Optimisation of the discharge flow regime has shown that timing discharges to the ebb tides can effectively mitigate measurable impacts into these waters. There are unlikely to be any unacceptable changes to nutrient, chlorophyll a or suspended sediment concentrations within Alligator Creek and there will be no detectable changes in the Keep River, the Victoria River or the oceanic waters beyond.

Suspended sediments and turbidity are likely to be either the same, or even lower, than receiving waters. As such, no impacts in relation to sediment and turbidity as a result of the operation of the Project, are anticipated.

9.3.5 Environmental Values

The key values to be protected are:

- Marine and estuarine ecosystems
- Recreation and aesthetics, in relation to water quality and fisheries resources in areas adjacent to the site for public use
- Human consumers (primarily for fish species, crabs and other fauna)
- Cultural and spiritual values of marine and estuarine waters, including ecosystems and biota

9.3.6 Potential Risks and Impacts

The key potential risks can be summarised as:

- Changes to estuarine water quality due to planned or unplanned discharges into Alligator Creek
- Runoff of sediment laden water during construction, from erosion and sediment loss from exposed surfaces
- Leaching of oxidising acid sulfate soils into freshwaters (unlikely to be large enough volumes even at worst to significantly affect estuarine and marine tidal areas)
- Leaks and spills into fresh, estuarine and marine waters.

9.3.7 Mitigation and Management Measures

Avoidance, and then minimisation of, environmental impacts has been a key consideration of the design process. The use of settling ponds and recirculation within the farms, and the passage of the discharge through the Environmental Protection Zone are design elements at the facility-wide level that minimise potential for impacts to coastal processes and environmental values.

Design elements to minimise impacts on the coastal plain and coastal processes include rock blanketing to minimise erosion of the outfall at Alligator Creek, and use of single piles, rather than sheet piling for the intake jetty at Forsyth creek, and operationally, timing the discharge to maximise the mixing (and hence dispersal) in the receiving environment to minimise potential water quality impacts.

Management strategies and commitments to mitigate the potential impacts during construction and operation have been identified and are documented in the Project EMP. It includes the following environmental management strategies that have direct reference to marine and estuarine water:

- development of site specific erosion and sediment control plans for the site

- construction supervision and monitoring
- noting that the facilities have been engineered to avoid intersection of acid sulfate soils, implementation of, and adherence to, an Acid Sulfate Soil Management Procedure, should it be required
- dedicated fuel, oil, chemical and waste storage facilities will be utilised on the site
- monitoring for bank erosion and scour rates around infrastructure on the coastal plain
- maintenance of the rock blanket at the base of the discharge weir on Alligator Creek
- implementation of a Water Quality Monitoring Program
- Hazardous Materials Management
- Spill Management

9.4 FRESHWATER

Freshwater on Legume Station largely comprises freshwater creeks, Osmands Lake, ephemeral wetlands, spring-fed waterholes and man-made dams. Forsyth Creek and Alligator Creek catchments are the two major waterway catchments of the site. The floodplain hydrological conditions of both the Forsyth Creek and Alligator Creek catchments have been substantially modified over time as part of the pastoral operations to promote the growth of pasture. Alligator Creek is bunded at several locations, and both Forsyth and Alligator Creeks are bunded such that there is no longer any connectivity between the freshwater and estuarine reaches in the dry season. Since 2006, rainfall from the Forsyth Creek headwaters has been captured by Forsyth Creek Dam. The dam has altered the natural hydrology of the system, capturing wet season rainfall that would normally reach Forsyth Creek, and modifying dry season conditions through an annual release of water within both Forsyth and Alligator Creek catchments.

In the wet season, much of the lower plains (estuarine-deltaic plain and lower) are inundated, and as such the freshwater water bodies of the area are characteristically ephemeral, filling in the wet season and drying out in the dry season. While there are extensive floodplains in the wet season, in the dry season, surface water is confined to the bunded areas of Alligator Creek, small channels, billabongs and swamps. With the exception of the bunded areas of Alligator Creek, these water bodies gradually evaporate, becoming stagnant and commonly drying out. Storms in the early wet season result in turbid 'flushes' from surface run-off from the catchment, from stagnant pools in the riverbed, and from previously dried up water bodies. These flushes are further characterised by high concentrations of decayed organic matter, high bacterial pollution and low oxygen content, often resulting in a rapid deterioration of water quality and fish kills.

A water quality sampling program was implemented between June 2015 and March 2016 to establish the baseline water quality across the site and to allow for future assessment of Project construction and operation on freshwater water quality. The results of the baseline sampling program showed water quality in the creeks on Legume Station was relatively poor and characterised by low dissolved oxygen (i.e. lower than the Australian Water Quality Guidelines), high turbidity and high nutrients in the dry and pre-wet seasons. In Forsyth Creek Dam water quality was poorest in the pre-wet season, with low dissolved oxygen and higher nutrients at this time. Water quality in the ephemeral wetlands was poor to moderate, and characterised by low dissolved oxygen and high turbidity, particularly in the remaining water in the dry season.

Potential direct impacts from the Project include intersecting drainage lines and causing changes to flooding, flowpaths, flow velocities and volumes, and providing barriers to fish movement. These will generally be minor drainage lines, other than a crossing of Alligator Creek. However, all affected areas will be constructed with

culverts and floodways to mitigate any changes, and, with these in place, no changes are expected to lead to any significant changes to floodplain hydrology. By contrast to the modifications that have already been implemented the risk of impacts to floodplain hydrology are negligible

The Project will also require that the Forsyth Creek Dam water be used solely to support farming operation. As such, the releases from Forsyth Dam that have occurred in the dry season will no longer occur, leading to a return to natural dry season conditions.

In regard to floodplain hydrology, modelling shows:

- Development of the Project will have no impact on typical dry season conditions as it is not altering any dry season flow paths or inundated areas.
- The inclusion of culverts, and appropriately placed channel works are shown to significantly mitigate the risk of that the Project leads to upstream water blockages during the wet season, thereby generally increasing flood depth and flood extent
- Flow conveyance and drainage infrastructure will be required to ensure the connectivity of storm runoff from upstream to the estuarine discharge areas of the Forsyth Creek and Alligator Creek.
- The effect of ceasing water flow from the annual release of Forsyth Creek Dam is a decrease in the extent of surface water of only approximately 4 to 8 weeks.
- The extent of inundation arising from an uncontrolled release of water due to over-topping of the facility during an extreme weather event is considered insignificant when compared to the natural flooding that would occur naturally as a result of such extreme rainfall.

In regard to freshwater quality, given the existing poor water quality on Legume Station and the implementation of the mitigation measures outlined below, it is concluded that construction and operation of the Project will not further degrade the freshwater water quality within the Project Area and its surrounds.

9.4.1 Environmental Values

The key values to be protected are:

- Freshwater aquatic and floodplain ecosystems
- Water supplies for future pastoral uses (general water uses, stock drinking water)
- Recreation and aesthetics, in relation to water quality
- Cultural and spiritual values of fresh waters and floodplains, including ecosystems and biota
- Suitable freshwater supply to support the Project, primarily related to the Forsyth Dam supply

9.4.2 Potential Risks and Impacts

The key potential risks can be summarised as:

- Runoff of sediment laden water during construction, from erosion and sediment loss from exposed surfaces
- Leaks and spills into fresh waters
- Direct impacts from the Project intersecting natural drainage lines and causing changes to flooding, flowpaths, flow velocities and volumes, and introducing additional barriers to fish movement. These will

generally be minor drainage lines, other than a crossing of Alligator Creek (though all affected areas will be subject to culverts and floodways to mitigate any changes)

- Potential loss of ephemeral wetlands. Impacts would be associated with removal of temporary habitats for aquatic biota, although this occurs naturally during the dry season when these systems dry up
- Lack of releases from Forsyth Dam, leading to a reversion to natural dry season conditions in some catchments

9.4.3 Mitigation and Management Measures

Mitigation and monitoring measures to minimise the risk of the Project to floodplain hydrology and freshwater quality include:

- adoption of a design that avoids intersection with freshwater bodies and major drainage lines to the greatest extent practical
- the use of suitable culvert crossings to maintain flow paths and avoid changes to flood patterns on the site
- the development and implementation of an Environmental Management Plan during both construction and operation of the Project, including an Erosion and Sediment Control Plan
- storing and disposing of chemicals according to manufacturer's instructions and state and commonwealth regulatory requirements
- maintaining a Hazardous Materials Register
- storing and handling fuel in accordance with AS1940
- development and implementation of a Water Quality Monitoring Program.

9.5 GROUNDWATER

9.5.1 Hydrogeology

Legume Station is primarily located in the Bonaparte Gulf Basin groundwater aquifer, with the south eastern section of the property in the Victoria River Basin aquifer. Groundwater generally flows from the ranges towards the coast in sandstone, fractured rock and sand / colluvial deposits, with a corresponding but opposite flow of saline water from coasts back inland, each balanced by the relative hydraulic head. Local recharge zones exist around low hills and rises on the plains, which become saline near the foot of these hills, after passing through saline deposits, or forcing saltier water-tables to the surface.

Some deep aquifers are located across the site, with recharge from these sandstone and shale hills and rises, and subcrops, particularly on the Coastal Erosional Plain areas. A shallow saline water table is located at ~3m depth in the dry season, and up to ground level in the wet season across the Estuarine-Deltaic and Coastal Plains, fed by tidal waters and surface rainfall.

Almost the entire Project area (with the exception of minor service corridor areas) is located in an area mapped as containing saline groundwater.

9.5.2 Groundwater Dependent Ecosystems

Soils on the coastal erosional plains are sandy and permeable, receiving large amounts of freshwater recharge during the annual wet season. The resulting high head of pressure keeps groundwater in the vicinity of these elevated landforms fresh, with freshwater fronts in similar systems in the Keep River plain area found up to one

kilometre from the edge of these outcropping sandstone plains. However, these systems can (and generally do) abut the relatively impermeable black soils on the estuarine-deltaic plains. This higher groundwater head can force more saline waters to express at the foot of these hills, as the saline water table is elevated or fresh waters pass through more saline deposits.

As such, species regularly found in lower positions on the fringe of the coastal erosional plain (where it meets the estuarine-deltaic plain and where groundwater is known to move laterally towards the estuarine-deltaic plain) may have a facultative dependence on groundwater (i.e. they make use of, but do not rely upon, groundwater). Other areas where facultative dependence on groundwater may occur include perennial springs on the margins of the ranges and flood out plain, and fringing forest/woodland communities along creeks and downstream of Forsyth Dam. Given that the project will have very minor impacts upon groundwater, no impacts that will affect the ability of these communities to use groundwater are expected.

A number of springs are also known to occur at the foot of the Legune ranges (for example, Alligator Springs, located in the upper Alligator Creek catchment), where recharge from fractured rock aquifers discharges into creeks. One such spring was observed outside Legune Station, approximately five kilometres south west of Linden's bore, where it waters a sometimes lush fringing open forest community.

9.5.3 Environmental Values

The key environmental values for groundwater are:

- the ability of groundwater resources as a water supply for pastoral operations, in the locations, depths and at the quality currently found at the site
- the ability of ecosystems potentially dependent on groundwater to continue to be functionally and ecologically sustainable

9.5.4 Potential Risks and Impacts

Potential impacts to groundwater are expected to be minimal, but could include:

- Impacts to productive aquifers due to lowering of groundwater, where excavation in borrow pits or other excavations extends below groundwater levels
- Direct contamination of groundwaters, from general spills and leaks, and leakage of saline and nutrient rich waters from farm dams and other infrastructure
- Contamination of groundwater from wastewater irrigation areas
- Changes to hydrology, affecting recharge zones and therefore groundwater recharge
- Interactions with the shallow saline water table on the estuarine-deltaic and coastal plains, with impacts possible to Project infrastructure, and to shallow groundwater (refer contamination above)
- Impacts to productive aquifers due to lowering of groundwater

9.5.5 Mitigation and Management Measures

The key control measures will include:

- Implementing a spill controls system, including dedicated fuel, oil, chemical and hazardous waste storage facilities, and spill response training
- Manage excavation depths and flood impacts to avoid lowering groundwater, and changing flow into and out of important recharge and discharge zones

- Confirm the absence of acid sulfate soils prior to deep (≥ 2 m deep) excavation occurring on the site, and then if present implement the Acid Sulfate Soil Management Plan
- Ensure that stormwater diversions and flood management does not change the flow into, and out of, recharge and discharge zones.
- Avoidance of the existing pastoral operations bores and borefield areas. This is because pastoral operations will be required to continue, as a part of the non-pastoral use permit approvals for the Project. Instead of drawing from these existing bores for potable water for human consumption, the project will draw from the freshwater channel and Forsyth Creek Dam, and treat that water to potable water standards.
- Implementing a robust monitoring program to provide early warning of potential issues, particularly shallow groundwater in the vicinity of the farms, and excessive nutrient loss from on-site wastewater irrigation areas
- Implement procedures for rapid response to identified leaks and other issues identified by the monitoring program.
- Hazardous Materials Management

9.6 TERRESTRIAL FLORA

9.6.1 Threatened Species and Ecological Communities

A search of the Commonwealth Protected Matters database did not predict the presence of any threatened ecological communities, and nor were any identified during field surveys. The Commonwealth Protected Matters database predicted one species (Craven's native hibiscus, *Hibiscus cravenii*), listed as vulnerable under the EPBC Act. The online NT Maps database found three flora species of conservation significance (including Craven's native hibiscus). In total, the following species were predicted to occur on the site, all of which are listed as vulnerable:

- Craven's native hibiscus (Commonwealth and NT)
- *Platysace saxatilis* (NT)
- *Zeuxine oblonga* (NT)

All three are considered unlikely to be on the Project site, due to their highly restricted and localised ranges and rarity, the lack of suitable habitat, and the fact that no individuals were found during field investigations.

Two species listed as 'near threatened' under the TWPC Act were recorded in Legume Station during the surveys:

- Fine-leafed Kimberley fan palm (*Livistona lorophylla*)
- *Turraea pubescens*.

Both of these are near threatened due to the threat from inappropriate fire regimes, which may interfere with recruitment and kill adults if fires occur too often (more than every 5 years for *Livistona lorophylla*).

Livistona lorophylla was found to occur in the Legume Ranges and low ranges near the Marralam community. *Turraea pubescens* was recorded from a small residual on the estuarine-deltaic plain outside of the Project footprint where it was an uncommon element of the vine thicket community. Neither species will be directly

affected by Project works. Any risk of impacts to these species would therefore arise from an increased frequency of fires on the property.

A further four species listed as 'data deficient' under the TWPC Act were recorded in Legune Station during the surveys:

- *Eleocharis acutangula* - a sedge recorded from Legune Station in Melaleuca low woodland on the flood-out plain, in the vicinity of the proposed Legune Access road
- *Ptilotus capitatus* - a woody herb recorded within Legune Station from Darwin stringybark/Darwin woollybutt woodland on the coastal erosional plain
- *Spermacoce gibba* - a herb found within Legune Station in Darwin stringybark/Darwin woollybutt open forest on the coastal erosional plain
- *Triodia triticoides* - a 'spinifex' hummock grass recorded from the ranges open woodland vegetation community on sandstone of the Legune formation, where it was moderately common

Species listed as data deficient are those whose conservation status cannot be accurately categorised from available information. All of the above species, other than *Triodia triticoides*, were located in habitats that will be impacted by clearing for the Legune Access road (within Legune Station). These species are relatively widespread in other Australian states, and *E. acutangula* is considered likely to be more widespread within the NT than current records indicate. None of these three data deficient species were widespread within Legune Station, all of them being represented by a few records each. Given all were recorded from habitats that are well represented within Legune Station and within the bioregion and NT generally, impacts on these species from clearing for the Project are expected to be minor.

9.6.2 Other species of note or Indigenous cultural significance

One species identified in past surveys of the region was identified on the site as being rare, of conservation significance, or otherwise noteworthy - *Brachychiton tuberculatus*. This is a relatively common species on the coastal erosional plain within Legune Station, however, it has a restricted distribution primarily clustered on the lower Ord River valley.

Two other species of note were recorded on the site:

- Giant spear grass (*Heteropogon triticeus*) – a least concern species which is at its most westerly distribution in Legune Station, was recorded from ranges open woodland.
- *Acacia praelongata*, an NT endemic (also least concern), was recorded from two small populations on low residuals on the coastal erosional plain, approximately two kilometres north-west of Linden's bore. The distribution of this species is centred on Darwin and the Litchfield National Park with one previous record from the Victoria-Bonaparte bioregion.

As advised by the Northern Land Council, plant species identified as being used by the Jaminjung, Ngaliwurru and Nungali people are considered to constitute flora species of Indigenous cultural significance. A total of 98 flora species of cultural significance to Indigenous people in the region were recorded within Legune Station. Of these:

- 65 species are associated with food, including flora species closely associated with fauna utilised for food, and plants that indicate the changing of seasons or seasonal availability of resources

- 47 species have material cultural significance (e.g., as a source of glue/resin, fibre, soap, insect repellent etc)
- 42 species are utilised for weapons or have a technological use, including musical instruments, pipes, fish poison, shields, spears etc.
- 21 are utilised as source of medicine.

9.6.3 Local Vegetation Communities

Clearing of less than 5% of the extent of a vegetation community at the local scale is considered to have a minor to negligible impact on that community overall. Only three of the 16 vegetation communities mapped within the Project footprint will require clearing of more than 5 % of the extent at the local scale (i.e. within Legume Station), they are: Wild plum low open woodland (9%), Northern rice grass (*Xerochloa imberbis*) grassland (8%) and Canegrass (*Ophiuros exaltatus*) grassland (6%).

Wild plum low open woodland is primarily located on the estuarine-deltaic plain in one large patch dominated by one species, wild plum, and is unique within the Project area, and may be a rarely occurring community. However it is not protected, and does not contain threatened species or their habitats, or any species that are otherwise noteworthy. Other wild plum areas exist on the site, though lacking the large mature trees.

The clearing of 2,930 ha of northern rice grass and canegrass grasslands for the Project will have a minor impact on vegetation community diversity at the local level, as large areas of this community will still be retained (92% of rice grass and 94% of canegrass grasslands in the Project area, assuring they will still be well represented at the local scale).

9.6.4 Vegetation Loss at the Bioregional and NT scale

Two vegetation units are impacted by the Project where clearing will comprise >1% of the total unit/class area in the bioregion, namely:

- a. *Xerochloa* (ricegrass) grassland (unit 104) – clearing will remove 2,920 ha, which equates to 4% of its bioregional extent and 3% of its NT-wide extent, and
- b. Mixed closed-grassland/sedgeland (seasonal floodplain) (unit 54) – clearing will remove 186 ha, which equates to 4% of its bioregional occurrence and 0.02% of its NT-wide extent.

For the purpose of assessing impact for the Project, clearing impacts of one percent or less at a bioregional and NT-wide scale have been assessed as negligible.

As such, the impact of the proposed clearing of northern rice grass grassland at a bioregional and NT-wide scale will be minor, since ~96% of the total extent at the bioregional level and ~97% at the NT level will remain, ensuring it continues to maintain its representation at these scales. Similarly, the retention of 96% of the bioregional extent and over 99% of the NT-wide extent of mixed closed-grassland/sedgeland indicates that clearing impacts on this vegetation unit will be minor at the bioregional scale and negligible at the NT-wide scale.

9.6.5 Weeds

One Class A declared weed was detected in Legume Station – gamba grass (*Andropogon gayanus*). Two individuals of this species were found in one location, in a fenced enclosure for a pump at the Linden's bore yards. It is not accessible to stock and it does not appear to be spreading. One Class A weed, chinee apple (*Ziziphus mauritiana*) has been recorded in Legume Station previously. However, no plants of this species were recorded during the field survey.

The following plants designated as Class B weeds under the Northern Territory *Weeds Management Act 2001* were observed during the vegetation and flora surveys:

- Neem (*Azadirachta indica*)
- Caltrope
- Flannel weed (*Sida cordifolia*)
- Olive hymenachne
- Hyptis
- Parkinsonia
- Sicklepod
- Spinyhead sida

Caltropis procera is also common but it is only declared in Northern Territory where it occurs south of 16°30' S (Legune is 15°23' S).

In the Northern Territory, all Class A and B weeds are also Class C weeds. No additional Class C weeds were observed.

The majority of these weeds are spread primarily by grazing animals. The proliferation of these weeds is then encouraged by the preferential grazing of palatable species, which reduces competition for the non-palatable weed and allows it to proliferate. The two exceptions are neem, whose seeds are spread by birds and bats, and olive hymenachne, which is spread by water and animals.

Of those weeds found in Legune Station, the species of most concern from an ecological viewpoint (in terms of damage being done currently) are parkinsonia and hyptis. Parkinsonia is prevalent in patches on the estuarine-deltaic plain within the grassland mosaic, and unless actively managed in future it could continue to spread, with the potential to significantly change the structure of the grasslands. Hyptis is a particular issue in sclerophyll woodland, where it is generally found in the more accessible areas near dams, stock yards, and roads. Here, it often dominates the ground layer, partially or completely replacing native grasses and herbaceous species. Hyptis has no grazing value and so as grazing continues and palatable species are suppressed, hyptis increases.

9.6.6 Environmental values

Given that threatened ecological communities and protected plants have not been found, and are unlikely to be present, the key environmental values in relation to terrestrial flora are therefore:

- Vegetation community diversity, at a local, bioregional or NT-wide scale
- Flora species diversity, primarily at a local scale
- Habitat for flora and fauna
- Land / soil stability (potentially degraded after clearing).

9.6.7 Potential Risks and Impacts

Impacts to vegetation from this project are expected to be primarily restricted to those experienced from clearing. Impacts on flora habitat and flora species diversity of least concern species are expected to be negligible. The key potential impacts are:

- Reductions in vegetation community and flora species diversity, at a local, bioregional or NT-wide scale, through additional or unintentional clearing or damage to flora outside clearing limits
- Loss of habitat for flora and fauna
- Land degradation from acid sulfate soils, upslope land clearing or runoff leading to vegetation die-back
- Decreased volume of surface water released from the dam in the late dry season which may affect floodplain vegetation communities
- Impacts to groundwater dependent flora and communities (though this is considered unlikely without changes to groundwater hydrology, also considered unlikely)
- Removal of woody or deep rooted vegetation resulting in the rising of the water table, and surface soil salinity (although again impacts from this source are considered unlikely)
- Dust deposition on vegetation and communities (considered minor given existing dust impacts at the site)
- Risks to near threatened species under NT legislation (Fine-leafed Kimberley fan palm (*Livistona lorophylla*) and *Turraea pubescens*) from changes to fire regimes that do not take into account the needs of these species
- Impacts to data deficient species, for which due to this factor the local and bioregional impacts are not well defined
- Introduced flora and weeds from vehicles, machinery, personnel, resulting in a negative change to community diversity
- Weeds, introduced and pest species (flora and fauna) may cause changes in natural systems diversity and community structure. Introduced flora may potentially out compete species and communities, and introduced fauna may outcompete and over predate on native fauna (particularly threatened or near threatened)

9.6.8 Mitigation and Management Measures

The key identified risks from the Project will be mitigated by adopting the following control measures:

- Undertaking pre-construction surveys for the data deficient species *Ptilotus capitatus*, *Spermacoce gibba* and *Eleocharis acutangula*
- Obtaining suitable vegetation clearing approvals prior to clearing being conducted
- Pre-construction weed surveys and development of a Weed Management Plan based on these surveys
- Preparing and implementing:
 - A site specific Vegetation Management Plan, including Vegetation Clearing Plans
 - Site specific Erosion and Sediment Control and Acid Sulfate Soil Management Plans

- ▢ The Weed Management Plan, incorporating weed washdown procedures and weed hygiene to minimise weed introduction and spread
- ▢ Vegetation clearing monitoring during clearing works, and ongoing weed surveillance
- ▢ The Bushfire Management Plan to be prepared for the site will take into account recommended fire regimes for the near threatened species, *Turraea pubescens* and *Livistona lorophylla*.

9.7 TERRESTRIAL FAUNA AND AVIFAUNA

9.7.1 Legume Coastal Floodplain Site of Conservation Significance

The Legume coastal floodplain has been identified by the Northern Territory Government as a site of conservation significance because it supports internationally and nationally significant numbers of some waterbird species and exceeds internationally significant thresholds for some shorebird species. This was confirmed based on dry and wet season surveys for the Project.

An extensive terrestrial fauna and avifauna field survey program was implemented over a 12 month period between May 2015 and May 2016. The survey program involved more than 130 survey person days and was implemented by a team of eight highly experienced biologists. The surveys focussed on waterbirds and shorebirds of both estuarine and freshwater habitats, and on the identification of records and habitat for listed threatened and migratory species under the EPBC Act and the TPWC Act. Understanding how waterbird usage changes over time, in response to changes in freshwater resources, was a particular focus of the survey effort.

The results of the assessment concluded that the construction and operation of the Project, when undertaken in accordance with the mitigation measures outlined in the EIS, will not result in a significant impact to nationally important aggregations of waterbirds, or other listed threatened and migratory species under the EPBC Act and TPWC Act.

9.7.2 Waterbirds and shorebirds

The surveys identified a variety of habitats across of the site of importance to waterbirds. Osmans Lake and the lower parts of Alligator Creek were found to support the highest values for waterbirds during the dry season and transition periods. In the wet season, consistent with much of northern Australia, wetland habitat was widespread and the coastal plain supported a range of wetland types, water depths and vegetation characteristics. The estuarine wetlands (Alligator Creek, Bob's Creek and Forsyth Creek) were found to not support a high species richness or abundance of waterbirds and there were no significant or notable congregations of birds (at roost) at these locations. Turtle Point was found to support nationally important habitat for migratory shorebirds, and in comparison to the other estuarine sites on Legume Station, provides important habitat for a variety of migratory shorebird species.

Freshwater wetland species considered to be present in significant numbers were magpie goose, plumed whistling-duck, radjah shelduck, green pygmy-goose, wandering whistling-duck, pied heron, marsh sandpiper, red-necked stint, sharp-tailed sandpiper, curlew sandpiper, little curlew, black-tailed godwit and common greenshank. Estuarine wetland species considered to be present in significant numbers at Turtle Point only were the greater sand plover, lesser sand plover, black-tailed godwit, bar-tailed godwit, whimbrel, eastern curlew, terek sandpiper, grey-tailed tattler, ruddy turnstone, red-necked stint and curlew sandpiper. Importantly, the survey results showed that the lowest density of waterbirds, and lowest waterbird species richness, was generally associated with the northern-most survey transects, where the majority of clearing is proposed to occur for the construction of the farms.

9.7.3 Non-waterbird species

The surveys identified 10 threatened species listed under the EPBC Act and/or the TPWC Act that are known to occur on the site (bare-rumped sheath-tailed bat, lesser sand plover, greater sand plover, bar-tailed godwit, eastern curlew, great knot, red knot, curlew sandpiper, Gouldian finch and grey falcon), one that is likely to occur (Australian painted snipe), six that may possibly occur (northern quoll, Mertens' water monitor, Mitchell's water monitor, yellow-spotted monitor, red goshawk and water mouse), three that are unlikely to occur (pale field-rat, vrd blacksoil ctenotus and masked owl (nth)) and six that are highly unlikely to occur (partridge pigeon, purple-crowned fairy-wren (western), brush-tailed rabbit-rat, plains death adder, northern crested shrike-tit and night parrot). Field surveys also identified 40 listed migratory species under the EPBC Act that are known to occur on site and one that is considered likely to occur.

9.7.4 Pest and Introduced Species

Grazing of the wetlands and floodplains of Legune Station by cattle has also been undertaken for many decades. Of the other species, the fauna survey program provided evidence of five pest animals:

- cane toad (*Rhinella marina*) - this represents arguably the greatest potential threat, however it appears to be well established, at least in parts of the site. Anecdotal observations indicate that toads are of lower abundance (and in parts, absent) in the woodlands within the southern part of the site
- feral pig (*Sus scrofa*) - uncommon to rare on the site
- feral cat (*Felis catus*) - present but apparently not prevalent
- feral dog (*Canis familiaris*) - present but apparently not prevalent
- house mouse (*Mus musculus*) - may be uncommon on the site, although an ongoing baiting program is in place at the homestead complex for mouse control.

In addition, three native species considered to be pests are present on the Project site - agile wallaby (*Macropus agilis*), red-tailed black-cockatoo (*Calyptorhynchus banksii macrorhynchus*), and sulphur-crested cockatoo (*Cacatua galerita*).

Pest animal species are not expected to gain a significant benefit from either the construction or operational phase of the development.

9.7.5 Environmental Values

The key environmental values relate to those of the existing ecosystems, primarily terrestrial ecosystems, namely:

- Vegetation community diversity, at a local, bioregional or NT-wide scale
- Flora and fauna species diversity, particularly threatened or near threatened species.
- Important wetland habitat, particularly associated with the Alligator Creek wetlands and Osman's Lake wetlands (though the latter will not be affected by the Project)
- Nationally and internationally significant, listed threatened and near threatened, and listed migratory species.

9.7.6 Potential Risks and Impacts

The potential impacts of the Project in regard to impacts to nationally important aggregations of waterbirds, and listed threatened and migratory species were identified, these were:

- vegetation clearance leading to habitat loss or mortality
- changes in floodplain hydrology leading to changes in wetland fauna habitat characteristics
- changes in receiving environment water quality, due to increases in nutrient content and total suspended solids, leading to changes in estuarine shorebird habitat
- disturbance associated with noise and visual stimulation
- disturbance due to bird predation management strategies
- degradation of habitat value or mortality due to introduced species
- weed spread may also result in reduction in the quality of residual grazing land, and consequent economic consequence to current, and potential future grazing potential on the site

9.7.7 Mitigation and Management Measures

The design of the project has taken into account and avoided areas of key habitat for threatened and migratory species. Inclusion of culvert and channel works will minimise changes to wet season wetland habitats to as low as is practicable.

The key identified risks from the Project will be mitigated by the following:

- Vegetation management plan
- Fauna Management Plan
- experimental trials to ascertain the effectiveness and potential impacts to avifauna as a result of bird predation management strategies
- management of pest animals and weed species.

9.8 ESTUARINE AND MARINE ECOLOGY

There are extensive areas of mangroves and saltmarsh/saltflats in the surrounding estuaries, which provide habitat for a variety of both avian and aquatic species, including species that are commercially and recreationally important, species that are of conservation significance, and species of cultural significance.

In the wet season, water from the catchment is flushed into the estuarine receiving environment from high flows created by heavy rainfall. This catchment run-off transports freshwater, sediment loads and detritus that have built up during the dry season. Within the freshwater and sediments, nutrients are transported and deposited further downstream. Despite nutrient availability, high turbidity limits primary production.

In the dry season, currents driven by stronger offshore winds suspend the sediment, increasing turbidity and limiting primary production even further.

Desktop investigations and field sampling found that:

- There are no seagrass or large macroalgal beds in the surrounding estuaries, likely due to the chronic turbidity and extreme tidal range.
- Coral has not been recorded in the vicinity and primary productivity of phytoplankton is limited, both due to the high turbidity.

- Benthic macroinvertebrate communities have relatively low abundance and diversity, and are dominated by polychaetes and crustaceans, with few filter feeders. These communities are limited by high turbidity, high sediment mobility, and long exposure periods.
- *Avicennia marina* var. *eucalyptifolia* was the dominant mangrove species at most survey sites and was present at all sites, and mangrove communities were found to be in good health, indicating unimpacted communities.
- Several commercial and recreational fisheries operate in the region, targeting prawns, mud crabs, barramundi, threadfin salmon and a variety of other estuarine and pelagic species. Seafood from the Territory is marketed as being from a pristine environment, and from heavily regulated fisheries.
- There are 15 aquatic species listed as threatened under the EPBC Act and/or the TPWC Act in the region. Of these, nine - northern river shark, spear-tooth shark, dwarf sawfish, green sawfish, freshwater sawfish, green turtle, hawksbill turtle, olive ridley turtle and flatback turtle were considered to have high or moderate likelihood of occurring in the estuarine environment surrounding the Project.
- The desktop assessment identified 18 aquatic species listed as migratory under the EPBC Act within the region. Of these, eight - green turtle, hawksbill turtle, olive ridley turtle, flatback turtle, estuarine crocodile, dugong, Australian snubfin dolphin and Australian humpback dolphin were considered to have high or moderate likelihood of occurring in the estuarine environment surrounding the Project.

The key risks to these species are related to entrainment or impingement in the intake structure, water quality changes due to site discharges, particularly the main controlled releases from the EPZ, escape of prawns and prawn diseases into wild stocks, noise and light impacts, and boat impacts. However, the results of the impact assessment found that these risks are unlikely to cause a significant impact to any threatened or migratory species.

9.8.1 Environmental Values

In relation to estuarine, marine and freshwater aquatic ecosystems, the primary environmental value is the protection of these aquatic ecosystems. This includes protection and maintenance of:

- community and species diversity
- threatened and near threatened species, and
- aquatic habitat.

9.8.2 Potential Risks and Impacts

The potential impacts to estuarine and marine ecologies have been identified as:

- Direct disturbance of habitat for aquatic flora and fauna from vegetation clearing and earthworks
- Changes to floodplain hydrology as a result of changes to the terrain and blocking of flood waters (although these will be engineered away), and the cessation of dry season flows from Forsyth Creek
- The creation of waterway barriers in freshwater waterways
- Entrainment or impingement of aquatic fauna at the seawater intake pump station on Forsyth Creek.
- Changes in water quality resulting from:
 - vegetation clearing and earthworks

- ▣ discharge of waste water from the grow-out facility
- ▣ Spills of hydrocarbons or other contaminants, including oxygen reducing substances (such as cement) and treated or untreated effluent wastewater directly to waterways
- ▣ Proliferation of pest plants, more so to freshwaters
- ▣ Escape of prawn stock and/or diseases and pathogens from the grow-out facility.
- ▣ Disturbance, including physical presence, noise and/or impacts to food chain for estuarine crocodiles
- ▣ Increased risk of boat strike, and interruption of movement, for turtles and other large slow moving surface marine creatures, although boat movements are expected to be minimal, particularly for fast moving vessels – limited primarily to environmental monitoring work
- ▣ Increase in plastic litter and debris resulting in ingestion and entanglement.
- ▣ Loss of access to fishing grounds and/or loss of species of significance to Indigenous communities
- ▣ Increased site access, increasing habitat disturbance and direct take of aquatic fauna (primarily fish).

9.8.3 Mitigation and Management Measures

Key mitigating elements are:

- ▣ the location of most of the structures above the tidal limits
- ▣ short term construction impacts in highly localised locations in estuarine environments (primarily the intake structure, and to some extent the outlet structure to Alligator Creek)
- ▣ water quality modelling indicates minimal negative changes to receiving environments from planned discharges, and spills, leaks and loss of waste and litter from the site can be controlled through routine management measures
- ▣ intake structures will be designed to control entrainment and impingement by reducing intake velocities in critical channel zones, but will require monitoring and ongoing management to ensure the system is effective in reducing impacts.
- ▣ the risk of prawns escaping the facility into wild stocks is low, with the biosecurity plan in place, including the spread of disease, although this needs to be actively managed.
- ▣ noise impacts will be temporary (limited to the construction period) and result most likely in temporary movement of species from very small locales (primarily the intake structure), and turtle nesting or other sensitive sites are too far away to be affected by lighting impacts.
- ▣ management of boat movement will be required to manage marine fauna impacts, though these are also expected to be low, due to the low vessel traffic and presence of large marine species in the vicinity of the project.

9.9 FRESHWATER ECOLOGY

9.9.1 Freshwater Ecosystems

The freshwater aquatic habitats of Legume Station include freshwater creeks, Osmans Lake, ephemeral wetlands, spring-fed waterholes and man-made dams. Forsyth Creek and Alligator Creek catchments are the two major waterway catchments of the site, and both have been substantially modified over time as part of the

pastoral operations. This appears to have resulted in the aquatic habitat of these systems being generally of low to moderate condition.

Osmans Lake is the largest natural wetland feature on Legume Station, with the riparian vegetation highly disturbed due to grazing. However, the Project will not result in any direct or indirect impacts on Osmans Lake given it is outside of any impacted catchments. The aquatic habitat value of ephemeral wetlands was found to be of low value, limited in structure to aquatic plants and detritus. Waterholes and springs provide some refuge areas for fauna in an otherwise seasonally dry environment. Aquatic habitat within Forsyth Creek Dam was minimal and limited to aquatic plants, detritus and rock faces, with some trailing root vegetation depending on water levels.

Water quality in the creeks on Legume Station was relatively poor and characterised by low dissolved oxygen, high turbidity and high nutrients in the dry and pre-wet seasons. Cattle on the property contribute to poorer water quality through the input of excess nutrients and disturbing the in-stream bed sediments. Sediments were predominantly fine, and the concentration of most metals and metalloids were low. The abundance and diversity of freshwater macroinvertebrate communities across sampled sites were relatively low, and typical of disturbed ephemeral waterbodies with relatively fine sediment. There is little structure, such as in-stream or riparian vegetation, to provide varied habitat for macroinvertebrates.

All aquatic flora species recorded on the site are commonly occurring aquatic plants, many of which are typical of disturbed ecosystems (e.g. cumbungi and azolla). No listed threatened species or declared pest aquatic plants species were recorded during field surveys, nor are any expected to occur.

The fish communities in the water bodies on Legume Station are likely to have been impacted both by the installation of roads, bunds and artificial dams that impede fish passage and by clearing and cattle grazing. The removal of trailing roots, overhanging vegetation, shading of the waterways and the lack of large woody debris has reduced habitat availability. Despite these conditions, there are considered likely to be diverse fish communities in the water bodies on the station, and water bodies such as Alligator Creek, Forsyth Creek Dam and Osmans Lake are likely to provide refugial habitat in the dry season for a variety of species. No threatened fish species were recorded during field surveys. All species recorded are relatively common in northern Australia and appeared to be healthy, with no lesions, abrasions or parasites.

To date, there have been no records of any freshwater turtle species on Legume Station; however, surveys in the area are likely to be minimal. No freshwater turtles were caught or observed on Legume Station during the field surveys for the Project. While turtles, and in particular the northern long necked turtle, are likely to occur on site, water bodies on Legume Station are unlikely to provide substantial significant habitat. In-stream habitat (i.e. woody debris and trailing tree roots) is limited and would provide little protection from predators (i.e. crocodiles) and potential breeding areas are likely to be disturbed by cattle.

Freshwater and estuarine crocodiles are known to occur on Legume Station, they are considered common and locally abundant, and have been recorded throughout the Victoria and Keep River catchments, and are unlikely to be significantly impacted by the Project.

Finally, no threatened aquatic flora species, ecological communities or aquatic fauna species, listed under the EPBC Act or TPWC Act, are present within the Project Area and therefore will not be impacted by the Project.

9.9.2 Environmental Values

In relation to freshwater aquatic ecosystems, the primary environmental value is the protection of these aquatic ecosystems both for freshwater aquatic species and waterbirds that also use these habitats. This includes protection and maintenance of:

- community and species diversity
- threatened and near threatened species, and
- aquatic habitat.

9.9.3 Potential Risks and Impacts

The potential impacts to freshwater ecology have been identified as:

- Direct disturbance of habitat for aquatic flora and fauna from vegetation clearing and earthworks
- Changes to floodplain hydrology as a result of changes to the terrain and blocking of flood waters (although these will be engineered away), and the cessation of dry season flows from Forsyth Creek Dam
- The creation of waterway barriers in freshwater waterways
- Changes in water quality resulting from:
 - vegetation clearing and earthworks
 - discharge of waste water from the grow-out facility
 - Spills of hydrocarbons or other contaminants, including oxygen reducing substances (such as cement) and treated or untreated effluent wastewater directly to waterways
- Proliferation of pest plants

9.9.4 Mitigation and Management Measures

The potential environmental impacts of the Project on freshwater aquatic habitats, aquatic species and communities will be mitigated and managed in accordance with the Project's Environmental Management Plan. Specific measures include:

- Erosion and Sediment Control Management Plan
- the avoidance of freshwater water bodies and major drainage lines to the greatest extent practical
- obtaining and complying with a Wastewater Discharge Licence
- storing and disposing of chemicals according to manufacturer's instructions and state and commonwealth regulatory requirements
- maintaining a Hazardous Materials Register
- Storing and handling fuel in accordance with AS1940
- Waste Management

9.10 WASTE MANAGEMENT

9.10.1 Existing Site Waste

Past activities on the site include an operating landfill near the Legume homestead, cattle yards and one known cattle dip, all located outside of the Project footprint. Waste infrastructure on the site is limited to the existing landfill, off-site removal of other wastes, and there may be potential for unexpected findings of residual waste materials during construction of the project, as a result of the long history of pastoral operations on the site.

9.10.2 Waste Characterisation

The project will produce a number of different solid and liquid wastes during both construction and operations. The key waste types and the potential quantities have been identified and a management strategy to deal with them has been devised.

9.10.3 Waste Management Strategy

Waste Minimisation

The overarching strategy to be implemented on the site is one of minimisation, in the following order of preference (with those listed first preferred over each of the following practices): avoid, reduce, reuse, recycle, recover, dispose. The following sections describe how this strategy will be implemented.

Waste Infrastructure

A site wide integrated waste management system will be developed on the site, with the key elements to be initiated as soon as practicable during construction. Until all elements are installed and operational, construction waste will be dealt with by nominated waste storage locations on-site, prior to removal off-site to licensed landfills or recycling / reprocessing facilities.

The overall waste strategy involves the following key infrastructure:

- Transfer of general, recyclable and other non-listed and non-hazardous wastes to a Waste Transfer Facility at the Accommodation Village, or temporary storage at farm services and Central Facilities prior to transfer to this Waste Transfer Facility
- Transfer of listed and hazardous wastes to a Hazardous Waste Facility located at the Central Facilities, before removal off-site by licenced transporters to licenced facilities for reuse, recycling, recovery or disposal
- Drainage of washwaters and rainfall from putrescible bin storage areas into the wastewater treatment plants, via appropriate trash rack screens and sumps in the floor of these areas
- Disposal of general and inert waste at an on-site landfill.

Solid Waste Management

Solids wastes will be managed as part of the waste infrastructure described above, and management will include the identification of waste types, quantification of waste tonnage and volumes, and both on and off-site measures for recycling, recovery or disposal.

Wastewater Management

Wastewater on the site will comprise:

- Non-sewage wastewater:
 - Waste oils and oil/fuel contaminated water from oil-water separators, from refuelling areas, workshops and vehicle wash down
 - Waste liquid chemicals or water/chemical mixes, from laboratories, workshops and vehicle wash down
- Sewage wastewater: from the Accommodation Village, Central Facilities and farm services.

Sewage wastewater will be treated in package wastewater treatment plants on-site, and irrigated in designed land irrigation areas. Non-sewage wastewater will be either treated in the on-site wastewater treatment plants, or removed to the hazardous waste facility for later removal from the site.

9.10.4 Environmental Values

The environmental values in relation to waste are:

- The quality of air, land and water environments
- The quality and aesthetic value of the environment, including social and culturally significant sites and landscapes.

9.10.5 Potential Risks and Impacts

The potential impacts of inappropriate waste management can range from nuisance impacts from noise, odour and dust, through to land and water contamination, attraction and breeding of pests, and human health impacts due to landfill gas asphyxiation or explosion.

Inappropriate handling and storage of waste can result in a range of impacts, including:

- Release of dust and odour, causing nuisance impacts to nearby sensitive receptors, primarily the construction camp and work areas
- Breeding of vermin, with impacts to the natural environment, and nuisance impacts to site workers (flies, rats)
- Contamination of groundwater from inappropriately stored or disposed waste, particularly putrescible and/or chemical (oil, fuel, other chemicals) waste.

9.10.6 Mitigation and Management Measures

The following controls and mitigation measures for Waste will be implemented:

- Adoption of the waste hierarchy, prioritising avoidance, reduction, reuse, recycling and recovery, in order, over disposal, with an overall aim of waste minimisation
- Provision of solid and liquid waste management systems and infrastructure
- Spill management, and emergency preparedness and response procedures
- Monitoring and review

9.11 AIR QUALITY

9.11.1 General Project Emissions

Air quality in the Project Area is strongly influenced by the predominating wet and dry seasons. The dry season is characterised by moderate temperatures, low humidity and dry conditions, with strong winds from the east and south-east. Conversely, the wet season is characterised by high temperatures and humidity, with predominant winds coming from the north and north-west. Tropical cyclones, thunderstorms and monsoon rains are common during the wet season.

Based on the available air quality data for a representative site near Darwin (the closest such site), in general air quality can be said to be excellent in the wet season and poor during the dry season. The Northern Territory Ambient Air Quality Monitoring Report produced by the NT EPA states that the primary air pollutant in the

Darwin region are particulates generated by bushfires and fuel reduction burns. It is expected that this would also be the case in Project Area due to the large areas of vegetation surrounding the site.

Other existing sources of air pollutants which may potentially affect the air quality of the Project Area include:

- sea-salt as an aerosol from the surrounding coastal environment
- dust from land clearing activities.

The primary emissions generated during the construction of the Project will be dust, through mechanical disturbance from vehicles and equipment, and wind erosion of exposed, disturbed soil surfaces.

Emissions from the operation of the Project will result primarily from the operation of the power station located at the central facilities. The power station will consist of 12 CAT3516C diesel generators, operating concurrently. The capacity of thermal engines is expected to be 17.5 megawatts (MW).

9.11.2 Sewage Treatment Plant Odour

Odorous emissions could also occur from sewage treatment plants, though generally only when the plants are not operating efficiently. No odour impacts are expected as the Recommended Separation Distances for Industrial Residual Air Emissions will be applied, unless more detailed analysis shows a lower distance can be managed without impacts.

9.11.3 Environmental Values

As the Project Area is remote, the only potentially sensitive receptors in relation to air quality are the Legune Station homestead and the proposed accommodation village. The Legune Station homestead is located over 15 km from the grow-out centre. The accommodation village which will be constructed as part of the Project will be located approximately 18 km from the grow-out centre.

9.11.4 Potential Risks and Impacts

The only potential impacts on air quality are from dust emissions, most notably PM₁₀, during construction, emissions from the power station during the operation of the Project. Odour emissions may arise from the pond waste stockpiles during operation and from poorly operated or sited sewage treatment plants.

As Legune Station is remote, the only potentially sensitive receptors to these emissions are the Legune Station homestead and the proposed accommodation village. Given the distance between the Project and the Legune Station Homestead and the proposed accommodation village there will be no impact on air quality or odour at either of these potentially sensitive receptors.

9.11.5 Mitigation and Management Measures

Standard dust management and mitigation measures will be implemented during the construction of the Project to minimise dust emissions. Offset distances recommended for sewage treatment plants will be applied, unless more detailed analysis shows a lower distance can be managed without impacts.

9.12 CLIMATE AND CLIMATE CHANGE

9.12.1 Climate

The climate at Legune Station is tropical monsoonal with a hot and dry season occurring from June to August, and a hot and humid wet season occurring from late December through March. Transitional conditions occur between these two periods and vary in length. The hottest months are November and December as the wet season begins. Average monthly maximum temperatures in this period are 38°C and 37°C degrees respectively. The high temperatures in the region lead to high rates of evaporation. Average daily evaporation increases

through the dry season before peaking in October, prior to the onset of the wet season and then reducing through the wet season to March.

The average annual rainfall is close to 1,200 mm at Legune with over 90% occurring in the period from November through to April. Higher average monthly rainfall totals can be observed at Legune compared to the wider area. Port Keats shows similar annual rainfall totals to Legune Station, however, stations across the region which are less affected by coastal storms record an average annual rainfall of less than 950 mm. Wind patterns at Legune Station during the dry season are offshore from the east and south-east direction. In contrast, predominant wet season winds come from the north and north-west direction.

A tropical cyclone season between November and April overlaps with the wet season. Tropical cyclones occur on average once per year in the area of the Northern Territory west of the Gulf of Carpentaria. A detailed review of BoM data indicates that 44 cyclones have been recorded within a 200 km radius of the Project Area since 1906. 15 of these cyclones passed within 50 km of Legune Station.

9.12.2 Climate Change Assessment

The assessment of climate change impacts to the Project involved:

- The calculation of GHG emissions for the Project based on the methodology outlined in the National Greenhouse Accounts Factors
- a desktop review of relevant literature on potential climate change impacts to the Project
- the development of numerical models including hydrodynamic, wave and transport models to enable the simulation of the tides, waves, and extreme events on physical processes.

9.12.3 Potential Risks and Impacts

GHG emissions

The Project's estimated average annual GHG emissions (72,075 t CO₂-e) equate to approximately 0.01% and 0.58% of total 2014 emissions for Australia and the Northern Territory, respectively. The annual emissions exceed the 25 kt threshold listed in the Commonwealth *National Greenhouse and Energy Reporting Act 2007* (NGER) Act.

Climate Change Assessment

The key threats to the Project from climate change are sea level rise and increases in tropical cyclone intensity and frequency. These climate change impacts are likely to result in:

- shoreline recession
- increase in storm tide elevations
- higher maximum wind speeds generating larger waves and associated wave set-up on the coastline
- higher maximum wind speeds and lower central pressures generating larger storm surges.

The Project components at risk from climate change impacts include the intake and discharge infrastructure and the land based facilities situated on the estuarine-deltaic plain (i.e. the farms and channels).

9.12.4 Mitigation and Management Measures

GHG emissions

GHG emissions have been minimised through project design, which includes use of photovoltaic energy along more traditional energy sources. The Project will comply with the requirements of the NGER Act, including all record keeping and reporting obligations.

Climate Change Assessment

The potential risks to the Project from climate change will be mitigated through the design of the facility, including the shifting of the intake structure with the movement of the channel, set back of discharge weir 30 m from the bank, installation of the rock blanket to convey effluent to Alligator Creek and scour protection of the farm bunds and infrastructure near to the banks. Monitoring and continual assessment of bank and channel changes, and the effectiveness of the mitigation measures, will be undertaken to respond and adapt to the changing conditions into the future.

9.13 NOISE AND VIBRATION

Noise levels at the Legune Station homestead were found to be typical of a rural environment with negligible levels of transport noise, but higher background noise levels recorded during the day and evening periods. The noise levels at the proposed grow-out farms were representative of an extremely quiet area with little or no artificial sources of noise, but higher background noise levels during the evening period attributed to insect noise.

Areas close to station access tracks currently experience higher levels of noise due to vehicle traffic than at the proposed grow-out farms.

9.13.1 Environmental Values

As the Project Area is remote, the only potentially sensitive receptors in relation to air quality are the Legune Station homestead and the proposed accommodation village. The Legune Station homestead is located over 15 km from the grow-out centre. The accommodation village which will be constructed as part of the Project will be located approximately 18 km from the grow-out centre.

9.13.2 Potential Risks and Impacts

Based on the results of the modelling, noise levels at the Legune Station homestead will be well below the noise criteria during both the construction and operational phases of the Project.

Construction noise criteria will be exceeded at the accommodation village during the construction of the accommodation camp itself and nearby infrastructure (i.e. roads and the central facilities area). As the majority of the inhabitants of the accommodation village will be part of the construction workforce, any noise impacts will be expected by those affected and will occur during working hours. Noise levels at the accommodation village during operations will be well below the operational noise criteria.

No blasting activities or large scale piling operations or similar will be conducted for Project construction (or operation). Piling operations for the intake structure will be isolated from human sensitive receptors, and will be of short duration, anticipated to have minimal to no impacts due to its location (and the location of sensitive environmental receptors such as turtle breeding colonies).

As such, there will be no vibration impacts.

9.13.3 Mitigation and Management Measures

While there are no anticipated impacts on any potentially sensitive receptors, the following measures will be implemented to manage and mitigate noise generated during the construction and operation of the Project:

- All equipment will be selected to minimise noise emissions.
- Equipment will be fitted with appropriate silencers and be in good working order.
- All engine covers will be kept closed while equipment is operating.
- The height at which material is dropped into or out of trucks will be minimised as far as possible.
- Vehicles should be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes will be minimised, where practicable.
- Machines found to produce excessive noise compared to industry best practice will be removed from the site or stood down until repairs or modifications can be made.
- To reduce the annoyance associated with reversing alarms, broadband reversing alarms (audible movement alarms) will be used for site equipment.

10 SOCIAL, ECONOMIC AND CULTURAL ASSESSMENTS

10.1 SOCIO-ECONOMIC

The project area is remote with the nearest population centre being the town of Kununurra in Western Australia, approximately 106 km to the south-west. The closest population centre to the project in the Northern Territory is Timber Creek, approximately 135 km to the south-east.

The town of Kununurra is located in the Shire of Wyndham – East Kimberly and is the major commercial centre for the region. The town was created in the early 1960s to service the development of the Ord River Irrigation Scheme and has experienced steady population growth since its establishment.

The Shire of Wyndham – East Kimberly has an estimated permanent population of approximately 8,500 people (Australian Bureau of Statistics 2012). The majority of the population is based in the towns of Kununurra and Wyndham with the remaining inhabitants scattered through several Aboriginal communities, pastoral stations and mining camps. The population of the shire can increase by over 25% with the arrival of tourists during the dry season.

Aboriginal people comprise of about 35% of the total population of the area (Australian Bureau of Statistics 2011). The traditional owners of the project area have been identified and consultation is underway to ensure the traditional uses and activities of the area are taken into consideration.

Dominant industries in the region are agriculture including pastoral industries and irrigated agricultural operations, mining, tourism and fishing. The labour force participation rate in the region is 67%, which similar to Australia as a whole (65%) (Australian Bureau of Statistics, 2011). Unemployment however is much higher within the Aboriginal population (8%) than non-Aboriginal people (4%).

The Project (Stage 1 Legune) will create significant local employment with over 300 staff and contractors employed at Legune and additional workforce required in the vicinity of Kununurra. The project includes a wide variety of employment categories with the potential to provide meaningful and significant job opportunities for Indigenous people as well as the broader community. The intention is to maximise local and Indigenous employment within the Project.

10.1.1 Social and Community values

Social and Community values relevant to the Project include:

- Indigenous employment and business opportunities within the region
- Local employment and business opportunities within the region
- Recreational fishing and tourism and
- Community safety.

10.1.2 Potential Risks and Impacts

10.1.3 Impacts

During construction, potential negative social impacts may arise, including:

- Negative community relations, due to insufficient communication and community involvement on the progress of the Project

- Failure to meet Indigenous and general local community employment and business expectations
- Restriction of community access to fishing, camping and other recreational and tourism activities
- Damage to locally significant areas, particularly in relation to fishing areas, and other areas that have been commonly accessed or can be seen by the public
- Inadequate attention to community safety, particularly in relation to product transport on public roads.

10.1.4 Mitigation and Management Measures

Mitigation and management measures to ameliorate potential social impacts are as follows:

- Obtain AAPA Clearance Certificates.
- Develop ILUA with Traditional Owners.
- Develop and implement Heritage Management Plan and Cultural Heritage Management policy.
- Establish Traditional Owner Land Access Protocols as per ILUA.
- Establish Indigenous Employment, Training and Business Policy and Programs.
- Engage Indigenous rangers to monitor and manage impacts of increased public or PSD employees on Legume Station fishing, camping and cultural areas.
- Integrate Indigenous business and employment targets into ILUA and NT Government Priority Project agreements.
- Establish and implement a Local Employment Policy and targets.
- Integrate local business and employment targets into NT and Australian Government Priority Project agreements.
- Establish Project Sea Dragon Local Community Reference Group (PSDLCRG) for annual review of Project Sea Dragon social impacts and progress against targets and management actions.
- Develop Community Grievance Policy.
- Establish and implement a private property Recreational Fishery Access Policy, balancing public access with cultural, heritage, environmental, biosecurity, safety and other farm management concerns.
- Open and use Industry Capability Network.
- Provide local industry briefings for potential suppliers and contractors.
- Develop local expenditure targets and work with suppliers and service providers to ensure local products and services can be provided cost-effectively.
- Establish, implement and monitor a Driver Safety and Fatigue Management Policy for employees and contractors.
- Establish and implement OHS policies as required under law.
- Comply with Australian Securities and Investment Commission requirements.

10.2 HISTORIC AND CULTURAL HERITAGE

No non-Indigenous heritage sites are listed on the Commonwealth Heritage Database or on the NT Heritage Register as occurring on Legune. However, a number of sacred sites protected under the Aboriginal Sacred Sites Act (NT) have been registered and recorded on Legune. The NT archaeological database also lists ten Aboriginal archaeological sites and artefacts on Legune, though these were identified as a result of two surveys only in the south-west corner of the property. Large areas of Legune have not been subjected to archaeological survey and as such the NT archaeological database may not record all Aboriginal sites and artefacts present in the area.

Some of the project infrastructure including roads, quarries and accommodation village will be situated on the Cockatoo land system, which has a very high likelihood of archaeological sites. These are most likely to be located on sandstone outcrops and may include rock art and artefact scatters.

However, the majority of the project footprint is located on the Legune and Carpentaria land systems, comprised of tidal mudflats and seasonally inundated coastal floodplains with poorly drained clayey soils. These land systems are considered unlikely to host Aboriginal archaeological sites, although shell middens and mounds are possible around the margins of these areas.

The area of proposed works on Legune Station has also had Native Title Determination, and the Project is seeking to discuss and negotiate an Indigenous Land Use Agreement (ILUA) with Traditional Owners, gain their support for the Project and establish and maintain a sustainable legacy benefit to them. Discussions with the broader Indigenous community are planned and such discussions will encompass opportunities the Project may bring. The Project has also submitted applications to the Aboriginal Areas Protection Authority and will seek further advice and will consult with custodians to determine any further constraints that may apply to the proposed project areas. The applications for clearance cover all proposed ground disturbing works, including those incorporated in the environmental baseline work and any temporary works needed in the Feasibility Study.

More broadly, the site selection for the Project has taken into consideration potential impacts to these sites, and the majority of the Project has been located on land which has low archaeological potential and impacts on known heritage sites will be avoided and/or minimised where possible. Additionally, consultation will continue to be undertaken with the Traditional Aboriginal Owners to ensure any impacts to cultural heritage from the development of the project are avoided and/or minimised.

10.2.1 Cultural values

The Cultural heritage values requiring protection as part of the Project works include:

- Indigenous objects, sites or places of cultural heritage value, including important songlines
- Non-Indigenous historically important sites and objects that may be discovered during site investigations or construction
- Land access by local Indigenous people for fishing, hunting and for cultural reasons.

10.2.2 Potential Risks and Impacts

The potential impacts to cultural heritage values mainly occur due to the removal and/or damage of cultural items or sites, associated with ground disturbing activities conducted during the construction phase. This may occur to known objects or sites, or to chance finds discovered during construction works.

Construction (and operation) also has the potential to limit important site access by Traditional Owner / local Indigenous persons, particularly for fishing and hunting activities, or accessing culturally important sites. The

degree of impact in this regard (as well as mitigation) will depend on ongoing discussions and negotiations with local Indigenous people.

10.2.3 Mitigation and Management Measures

Mitigation and monitoring of identified risks will be directly addressed in the Indigenous Land Use Agreement (ILUA) and through the conditions applying to the proposed works established by the AAPA following consultation with the Aboriginal custodians (Gadjerrong Native Title holders).

Any places identified, in either the Indigenous Land Use Agreement (ILUA) and/or Authority Certificates, to be at risk from the Project shall be included in the Heritage Management Plan with clear and prescriptive mitigation and management measures for protecting the values of those places.

The Heritage Management Plan will be the product of the consultative approach that has been adopted from the onset that involves working closely with the peak bodies to address Native Title holders concerns for the protection of cultural heritage places that are integral to maintaining traditional attachments with their country.

The Heritage Management Plan will include:

- procedures to avoid significant cultural heritage sites
- methods for protecting identified cultural heritage sites during construction, operation and decommissioning work on the Project
- measures to enable the Proponent, or contractor to the Proponent, to meet its duty of care to protect all identified places or objects of the cultural and heritage significance
- procedures to be followed in the event of the discovery of any surface or sub-surface archaeological objects, including skeletal material,
- details of applications and Authority Certificate conditions issued by the Aboriginal Areas Authority with respect to identified sacred sites.

10.3 HUMAN HEALTH AND SAFETY

10.3.1 Potential Risks and Impacts

The potential risks to human health and safety during construction and operation of the Project can be broadly categorised as:

- Meteorological conditions and natural disasters including cyclones and severe storm events, storm surge and flooding, heat and sun exposure and bushfires.
- Biological hazards including, crocodiles, other potentially dangerous wildlife and biting insects.
- Operational hazards including working on or near water and working with boats and helicopters.
- Hazardous materials including the exposure of personnel to hazardous materials.
- Access issues including increased traffic movements and unauthorised access.

Measures to manage and mitigate these risks will be detailed in the Health and Safety Plan which will be developed for the Project.

10.3.2 Mitigation and Management Measures

The proponent commits to the preparation and implementation of a Health and Safety Plan to mitigate the risk of the Project on human health and safety. The Health and Safety Plan will include the mitigation and monitoring measures referred to in this chapter. It will also include detailed emergency plans and response procedures in the event of an emergency or accident. Responsibilities and liabilities in the event of an emergency or accident will be identified in the Health and Safety Plan.

10.4 TRAFFIC AND TRANSPORT

The Project is located approximately 100 km north of Kununurra. Road access is via a single route made up of the Legune Access Road, Cave Springs Road and Moonamang Road. From Moonamang Road, heavy vehicles and trucks heading to the Processing Plant for the Project and/or the Victoria Highway will bypass Kununurra via Stock Route Road, Research Station Road and Ivanhoe Road. Light vehicle traffic heading to Kununurra and/or Victoria Highway will use the Weaber Plain Road.

10.4.1 Potential Risks and Impacts

Traffic generation estimates have been made for the construction and operational phases of the Project. The forecast total generation of 30 vehicles per day and 42 vehicles per day during construction and operation, respectively, will not have a significant impact on the road network.

10.4.2 Mitigation and Management Measures

As no impacts are expected no specific mitigation and management measures are proposed.

However, the upgrading of part of Moonamang Road, the Cave Springs Road by the WA and NT governments and the Legune Access Road as part of the Project will ensure that the entire route from Legune Station to Kununurra is of an appropriate standard and capacity to accommodate the needs of the Project.

Consultation will be undertaken with the Shire of Wyndham - East Kimberley in regards to any required road or intersection upgrades on local roads (i.e. Stock Route Road, Research Station Road and Ivanhoe Road) on the route to the processing plant in Kununurra.

10.5 AMENITY

The focus of the amenity assessment was on visual amenity and the potential impacts of increased access.

The visibility of these Project components was considered and assessed from potentially sensitive viewpoints which included key vantage points, publically accessible areas and/or areas of significance.

10.5.1 Potential Risks and Impacts

Visual

Given the remote location of the Project on private property, the only potentially sensitive viewpoints from which the Project may be visible will be the estuarine environment and the residual outcrops and ranges to the south of Legune Station. The Project will not have a significant impact on the visual amenity of the area from these viewpoints given:

- Views of the Project from the estuarine environment will be limited to the intake and outfall structures. These views will be limited to parts of Forsyth and Alligator Creeks that are within the immediate vicinity of the structures. Mangroves along the banks of Forsyth and Alligator Creeks will help screen the intake and outfall structures and reduce the level of visual impact.

- The grow-out farms and intake and outfall structures will not be visible from the ranges and residual outcrops in the south of Legune Station given the intervening distance and the low profile of the bund walls.
- The accommodation village and central facilities will not be visible from the ranges and residual outcrops as the buildings will be lowset and screened by the surrounding bushland.

Access

The amenity of the area may be impacted by increased the numbers of recreational visitors to the area resulting from the upgrade of part of Moonamang Road, the Cave Springs Road and the Legune Access Road.

10.5.2 Mitigation and Management Measures

To mitigate the potential impact of increased visitor numbers to Legune Station, access to the Project Area will only be permitted to authorised personnel. As the only road into the Project Area, a gate will be installed at the entrance to Legune Access Road to prevent unauthorised access and potential third party interference with the Project. All access to Legune Station will be subject to private property and biosecurity management requirements due to the importance of quarantine requirements. As there are limited impacts to visual amenity resulting from the Project, no other specific mitigation measures are proposed.

11 CUMULATIVE IMPACT ASSESSMENT

The Cumulative Impact Assessment considered the potential for cumulative impacts arising from the Project in the context of a number of existing, and potential, external developments in the region.

Due to fundamental land system differences – that is, that the coastal floodplain required to facilitate the Project differs significantly from the landforms that underlie the external projects considered– the potential for cumulative environmental impacts to any given species, community, habitat or soil type are considered relatively limited.

Hydrodynamic modelling of potential cumulative water quality impacts showed that the cumulative impacts of Ord Stage 2 and 3 and Project Sea Dragon on water quality within the Keep River and Alligator Creek will be negligible.

The potential cumulative impacts on waterbirds was considered. The Legune coastal floodplain supports internationally and nationally significant numbers of some waterbird species. The Project will result in the some loss of ephemeral (wet season) wetlands that occur on *Xerochloa* (ricegrass) grassland and mixed closed-grassland/sedgeland. However, as these vegetation communities do not occur on any of the external development sites discussed in the cumulative impact assessment there is not considered to be any potential for cumulative impact to the specific ephemeral wetlands found on Legune.

The potential for cumulative impacts to the critically endangered Bare-rumped Sheath-tail Bat found on the Project site and considered to be potentially present on the Knox Creek Plain development site will be managed through the EPBC conditions applied to the Knox development, and through mitigation and management measures applied to the Project site that are outlined in this EIS and the Project EMP. Furthermore, the area within the Project footprint is considered to be an area of comparatively lower habitat value, and constitutes a minor proportion of the total potential habitat for this species (<1%), hence impact is considered minimal.

Groundwater modelling for the Weaber and Knox Creek Plains developments indicates that cumulative impacts will arise from clearing and farming these areas. However, as no groundwater impacts are expected as a result of the Project, there is no potential for the Project to contribute to any cumulative impact.

Cumulative economic and social impacts are expected to be positive, while Aboriginal heritage and cultural considerations will be managed under the guidance of Traditional Owners and relevant Native Title and Aboriginal heritage legislation (for both the NT and WA). This will be undertaken to ensure any cumulative impact is within limits acceptable to the Gajirrabung peoples, and is a primary focus of the activity of Seafarms in developing the Stage 1 Legune Grow-out Facility project.

12 ENVIRONMENTAL MANAGEMENT

12.1 ENVIRONMENTAL MANAGEMENT SYSTEM

An Environmental Management System (EMS) Manual has been prepared for the Project. The EMS is the key document outlining the Environmental Management System for Project Sea Dragon overall. It documents the overarching policies and procedures for the management of impacts on the environmental values for the project, commits to complying with applicable environmental legislation, regulations and other requirements, along with continual improvement in environmental performance.

The EMS considers all elements of Project Sea Dragon and will primarily be implemented on a site basis. As such, it outlines controls, documents and procedures that are common across all sites, rather than being specific to the Legume Stage 1 Grow-out Facility. Under the EMS, site based procedures are required relevant to each site and phase (or combinations of these). The EMS manual outlines the strategic environmental management procedures, registers and forms for the project as a whole.

The EMS has been prepared with reference to:

- AS/NZS ISO 14001:2004 Environmental Management Systems - requirements with guidance for use
- AS/NZS ISO 14004:2004 Environmental Management Systems - general guidelines on principles, systems and support techniques
- AS/NZS ISO 9001:2015 Quality Management Systems.

The EMS is modelled on the AS/NZS ISO 14001 Plan-Do-Check-Act (PDCA) continual improvement model, as outlined in Figure 6, and designed for simple implementation, review and update.

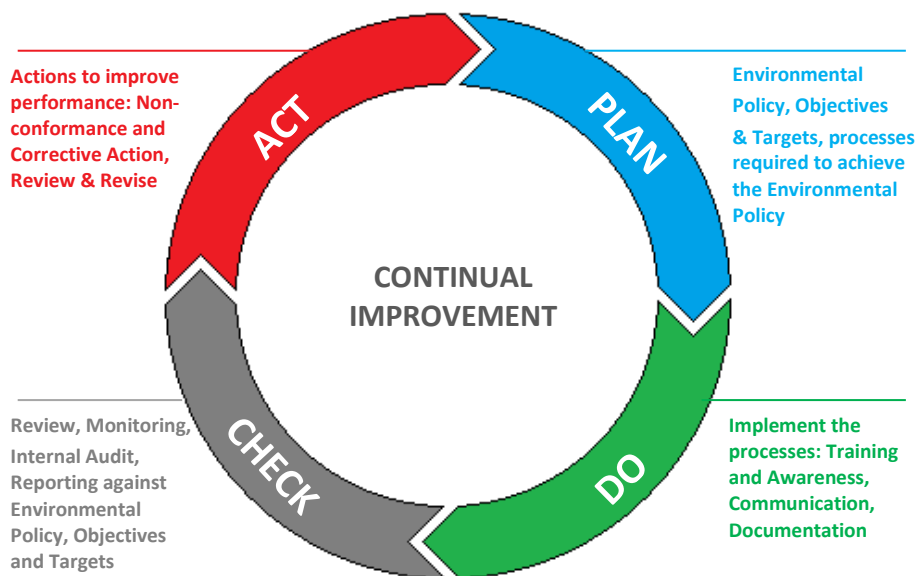


FIGURE 6 EMS CONTINUAL IMPROVEMENT MODEL

A site specific Environmental Management Plan (EMP) has been prepared for the Legume Stage 1 Grow-out Facility using the processes set out in the EMS.

12.2 ENVIRONMENTAL MANAGEMENT PLAN

This Draft Environmental Management Plan (EMP) is the site specific EMP document for construction and operation of the Project Sea Dragon Stage 1 Legume Grow-out Facility, and exists under the Project Sea Dragon Environmental Management System.

On approval of the Project, the Draft EMP will be updated to reflect approval requirements and to be a standalone document (apart from the EIS), and implemented on the Project site along with the overarching EMS. As described above the EMS Manual documents the overarching policies and procedures for the management of impacts on the environmental values for the whole of the PSD project, provides project wide commitments and details continual improvement measures. The EMP builds on these procedures by detailing the specific targets to meet the PSD project wide objectives relevant to the Project, during the construction and operational phases.

Environmental management strategies outlined in the EMP have been prepared based on the environmental risks identified in the Volume 1, Chapter 9 - Risk Assessment, and potential impacts, mitigation measures and monitoring identified Volume 2 - Environmental Assessment. These environmental management strategies consolidate and summarise the commitments made as part of the EIS, and will be used to develop site specific management procedures after approval of the Project.

13 CONCLUSION

Project Sea Dragon Pty Ltd intends to establish Stage 1 of the Grow-out Facility for Project Sea Dragon at Legume Station, near the western border of the Northern Territory.

The project will realise significant economic and social benefits on a regional, territory and national scale. The Project is projected to provide for prawn production valued at an average of \$195 million per year; capital expenditure during the construction of the Project of approximately \$411 million; and recurrent operating expenditure of approximately \$125 million at full production.

Moreover, the Project will generate nominal tax revenues to Australian governments totalling \$50 M over 15 years to 2032.

The facility itself, along with the proposed construction and operational phases of the project have been designed with minimisation of environmental impacts and ecologically sustainable principles as a central tenet. Studies undertaken for the EIS conclude that the development and operation of the Project will not impose any significant negative impacts on the regions natural, social or economic environment.

The recent mining downturn, and the completion of construction phases and closure of key regional projects had a significant impact on the economy of the region. The project provides a significant opportunity to offset this, creating approximately 444 Full Time Equivalent (FTE) construction jobs and 334 FTE operations jobs, and business opportunities, particularly for local suppliers, to supply goods and services to the Project.

Australia is well placed both scientifically, politically and geographically to develop a comparative advantage in aquaculture. The geography of Northern Australia is well suited to aquaculture and Australia has some of the world's leading aquaculture research institutions in CSIRO and James Cook University. The Project is the potential realisation of this comparative advantage.

As such, the Project provides a unique opportunity for economic growth, without sacrificing natural resources and the wellbeing of individuals and communities, offering the potential to contribute to global food security for a growing population, whilst relieving the pressure on world fisheries by providing sustainable protein alternatives.