PART D ENVIRONMENTAL MANAGEMENT

This page has been left blank intentionally.

9.0 Environmental Management and Monitoring

9.1 Safeguards and Mitigation Measures

TEA has committed to a high level of mitigation measures to protect against long-term damage to the environment and the trigger of MNES. The outcomes of the impact assessment have been used to provide the basis for identifying the type of mitigation considered necessary to avoid or manage potential impacts.

A key aspect of environmental management is to have a clear understanding of the roles and responsibilities assigned to the team that will implement the Project. This is described in Section 9.2. A framework for a Construction and Operations Management Plan is provided in Section 9.3, and the basis for management plans related to particular environmental issues identified in previous sections are provided in Section 9.4.

9.2 Environmental Responsibilities

Environmental management and compliance will be the responsibility of all personnel and a contractual obligation for all contractors involved with the Project. The proposed organisation and responsibilities for personnel overseeing environmental management during construction are detailed in Table 38. The positions identified are generic and may be held individually or may be amalgamated or the responsibilities shared under a modified arrangement.

The overall responsibility for environmental compliance lies with the Proponent, TEA. TEA will maintain on-site supervision of the construction contractor and the environmental performance of potential contractors will be reviewed as part of construction tender evaluation. The construction contractor(s) and individuals will also be responsible and accountable through their conditions of employment or contract. The training of all personnel involved in the construction will ensure that each individual is made aware of their environmental responsibility.

Table 38 Roles and responsibilities for construction and operations

Role	Responsibilities
Executive Management	- Licence holders. Therefore hold overall responsibility for project and environmental management
Project Director	- Responsible for overall implementation - Reports directly to Executive Management
Project Manager	- Directly responsible for the management of the project, including all environmental aspects - Reports directly to Project Director
Construction Manager	- Directly responsible for the overseeing and fulfilling of commitments contained in Construction Environmental Management Plan (CEMP) - Assesses compliance with the CEMP through regular inspection - Reports to the Project Manager and Project Director regarding the project's environmental performance and due diligence
Environment and Safety Manager	- Oversees CEMP implementation - Monitors the activities of construction contractors and assesses compliance with the CEMP - Coordinates environmental supervision of key activities - Coordinates the monitoring and audit program - Represents the Project on environmental matters with stakeholders - Reports to the Project Manager and Project Director
Construction Contractors	- Responsible for ensuring that works comply with the contractual agreements, meet regulatory requirements and that all environmental objectives contained in the contracts are attained - Will be required to have a designated and appropriately experienced/qualified environmental officer

9.3 Construction and Operational Environmental Management

The Construction Contractors will be required to prepare a Construction Environmental Management Plan (CEMP) in line with the issue specific management plans discussed below. The contractor(s) will comply with all conditions and procedures as outlined in the following management plans. The CEMP will contain:

- Project overview
- Statutory requirements and environmental legislation
- Environmental aspects and impacts
- Environmental Risk Assessment
- Environmental objectives
- Environmental responsibilities
- Training requirements
- Reporting
- Auditing
- Environmental Management Protocols

An operational environmental management plan (OEMP) will be prepared for operations and will include similar sections for ongoing management and adaptive management based on scientific investigations and monitoring to be implemented to comply with EPA approval conditions.

9.4 Mitigation Measures

The purpose of the management plans is to ensure that a suitable structure is in place that provides for impacts to be avoided, minimised, rectified, reduced or offset. These management plans are designed to incorporate all mitigation actions to reduce the risk of impact on MNES. They are a comprehensive set of detailed plans that will be implemented to mitigate direct and indirect impacts on MNES and include:

- Sedimentation and erosion management (Section 9.4.1)
- Water quality (Section 9.4.2)
- Vegetation management (Section 9.4.3)
- Fauna management (Section 9.4.4)
- Noise and vibration management (Section 9.4.5)
- Emission management (Section 9.4.6)
- Waste and hazardous materials (Section 9.4.7).

The likely effectiveness of the environmental management sub-plans, the impact each management plan will address and the residual magnitude of each impact is identified in the residual risk assessment in Section 6.0. The management sub - plans address environmental objectives, management actions, monitoring, timing, responsibilities, corrective actions, adaptive management and reporting for each environmental factor. Monitoring is a combination of several different approaches including:

- triggers that initiate targeted monitoring and adaptive and contingency management responses to manage impacts within limits of acceptable loss
- informative programs designed to measure environmental responses to dredging and provide contextual information on effects of sedimentation and turbidity on sensitive receptors
- indicators are environmental parameters that are measured to describe current state of environment being monitored
- reactive indicators are those parameters that are triggers in reactive monitoring programs to implement targeted monitoring or initiate management responses
- informative indicators are those that are used to support general management responses particularly in reactive monitoring programs.

9.4.1 Sedimentation and Erosion Management

During construction activities, personnel will be required to minimise the effects of their activities on sedimentation and erosion. General principles for the minimisation and management of impacts on sedimentation and erosion are listed in Table 39.

Table 39 Sedimentation and Erosion Management Sub-plan

Soil - Erosion and Sedimentation	Description	Responsibility
Objectives and Targets	- To avoid or minimise and control, soil erosion and sedimentation during construction and operation activities thereby controlling and minimising discharge of sediment into King Sound . - Avoid impacts on MNES from sedimentation and erosion.	
Management Actions	**Management Actions for Construction** - Ensure disturbance of soil and vegetation is minimised during construction works. - Ensure existing trees/mangroves retained. - Install erosion and sediment control measures around the perimeter of work site(s) and on slopes subject to run off, including silt booms, or other sediment control measures, as appropriate/practical. - Ensure stockpiles are located within sediment control zone (i.e. upslope of sediment barrier or control fence), or install sediment fencing around the base of stockpiles. - Ensure shake-down grids, or similar are installed at vehicle exit points, where there is a risk of transferring significant amounts of sediment onto public bitumen roads. - Direct drains around lots or batters or to suitable erosion protected drop structures where necessary. - Keep flow velocities within natural variation in table drains and unlined channels for terrestrial works. - In the event of a significant rain event (i.e. storm) postpone erosion and sediment work or install additional control measures down slope of construction activities.	Construction Manager
	- Be vigilant about disturbance of soil, vegetation and drainage lines, and report erosion and sedimentation issues to the Site Supervisor. - Be aware of erosion and sedimentation control structures, and report maintenance issues to the Construction Manager.	All Personnel
Performance Indicators	- Sedimentation is monitored to record increase in habitat for mangrove vegetation as modelled. - Areas of erosion will also be monitored to see if they are progressing as modelled. - Minimal erosion resulting from works.	Construction Manager
Monitoring	- Monitor scouring and sedimentation to compare with modelled values. - Monitor extent of mangroves in control and impact areas to determine if sedimentation is increasing/replacing areas of mangrove habitat. - Baseline and annual shorebird surveys will be undertaken to monitor changes in species numbers and diversity using the intertidal areas. - Turbidity will be monitored weekly during construction and monthly during the first five years of operations to ensure that turbidity maximums are not exceeded. Long term biannual monitoring will be undertaken thereafter. - Annual survey of intertidal area available to shorebirds for first five years to determine whether there are significant changes to size of habitat. - Monitor populations and diversity of marine fauna during baseline, construction and operations.	Construction Manager

Soil - Erosion and Sedimentation	Description	Responsibility
Reporting	- Incidents are to be reported and records retained (Incident, Accident and Near Miss Report). An incident would include accidental loss or damage to mangrove or intertidal habitats, increases in turbidity, changes in populations of MNES species.	Construction Manager
Corrective Actions	- If mangrove areas are not regenerating at new baseline areas within five years then plans will be implemented to plant mangroves in appropriate areas. - If reduction on number and diversity of shorebirds visiting/using intertidal habitats is reduced then seek advice on improving habitat/removing threats. - Investigate incidents and implement preventative actions as required.	Construction Manager
Timing	- Ongoing during project activities.	
Key Standards	- National Water Quality Management Strategy: Guidelines for Fresh and Marine Water Quality (ANZECC 2000). - *Soil and Land Conservation Act* 1945.	

9.4.2 Water Quality

Water quality incorporates physical, chemical and biological aspects of an aquatic ecosystem (Commonwealth of Australia, 2002). For the purpose of this EIS, water quality refers to the ocean water and surface water at Doctor's Creek. The water quality issues include:

- increase in organic matter from decomposition of mangroves
- turbidity
- reduced sediment load
- reduced flushing impacts on upper reaches of the creek.

Doctor's Creek water quality is directly related to King Sound water quality, tidal movements, and seasons. Water quality varies greatly due to factors such as an influx of fresh water from the Fitzroy River. Storms and wind-driven waves contribute significantly to entrainment of sediment. According to Wolanski and Spagnol (2003) the upper reaches of the sound are turbid with fine suspended sediment concentration reaching $3kgm^{-3}$.

TEA proposes to provide detailed water quality targets upon completion of the baseline water quality surveys. Furthermore, water quality management actions are listed in Table 40.

Table 40 Water Quality Management Sub-Plan

Ground and surface water management	Description	Responsibility
Objectives and Targets	- To avoid, or minimise and control, contamination caused by the discharge of pollutants into waterways, established drainage systems and groundwater. - To minimise the generation of extensive, prolonged turbidity plumes and sedimentation during construction and operation activities. - To manage water quality and sedimentation effects to limit undue effects on benthic habitats and MNES habitats as a result of construction and operation.	

Ground and surface water management	Description	Responsibility
Management Actions	**Management actions to prevent water, sedimentation and contamination** - Establish baseline existing conditions to detect unacceptable levels of change associated with operations. Baseline surveys will be conducted prior to construction. - Confirm areas and delineate zones of impact. - Ensure stockpiles of bulk materials are located well clear of any waterway or drainage systems. - Ensure equipment and vehicles are serviceable and are free of debris and contaminated soil prior to being transported to work sites. - Train operators in implementation of safe work practices to minimise risks and impacts of spillage of fuels, chemicals and other contaminants. - Construct bunds around fuel and chemical storage areas according to Australian Standards 1940. - Minor storages are to be constructed to retain all spills and prevent impacts on soil and stormwater. - Maximum quantity 100L petrol and 250L oils and lubricants permitted as minor storage within 1m of a residence or any other building; and maximum quantity 2500L permitted as minor storage on a construction site (See AS 1940 for detailed information relating to minor and major storages). - 110 % bunding and spill trays to be used for spill containment. **Management actions to address contamination** - Record and report all petroleum, oil and lubricants (POL) spills. - Ensure personnel have access to spill kits that contain an absorbent clearly marked oily waste disposal drum and a shovel. - In the event of a POL spill less than 20L on soil, remove the soil and dispose of in oily waste disposal drum. If on a hard surface such as road or concrete, use absorbent and dispose in the drum. - In the event of a POL spill of between 20 and 80L, soak up as much as possible using absorbent, and turn/aerate the soil to allow natural processes (i.e. aeration and microbial systems) to breakdown the organic compounds (i.e. hydrocarbons). Remove contaminated soil if the spill occurs in the vicinity of drainage lines and waterways. If on a hard surface such as road or concrete, use absorbent and dispose in the oily waste disposal drum. - In the event of a POL spill greater than 80L, all contaminated soil is to be removed prior to return of the tide to avoid contaminating the water with POL, and dispose of in a clearly marked oily waste disposal drum. - Undertake validation sampling of soil if the spill is greater than 80L to confirm all contaminated soil has been removed. - All contaminated soil and absorbent in the oily waste disposal drum should be disposed of at an approved designated oily waste disposal site. **Dangerous goods record keeping** - Retain MSDS information on site. - Chemicals to be applied according to MSDS and label. - Maintain a Hazardous Substances Register detailing the location and quantities of hazardous substances including their storage, use and disposal. - Keep waste tracking/disposal records for dangerous goods in Daily Site Diary.	Construction Manager
	- Be vigilant for waste management and spill issues and report to the Construction Manager. - Wash down and inspect equipment and vehicles for POL leaks, etc. prior to being transported into project area. - Implement safe work practices in handling and use of fuel, chemicals and other potential contaminants.	All Personnel

Ground and surface water management	Description	Responsibility
Performance Indicators	- No pollution or contamination of waterways or groundwater. - Hazardous materials stored correctly and in designated areas. - No pooling of water on site. Turbidity maintained as per trigger levels in - Table 41.	Construction Manager
Monitoring	Monitoring of turbidity levels as per - Table 41. - Regular inspection of bunds, where present, to check integrity and to detect leak and spills. - Regular inspection of stormwater drains for any sediment capture (Weekly Inspection Checklist).	Construction Manager
Reporting	- Incidents are to be reported and records maintained (Incident, Accident and Near Miss Report). - Keep waste tracking/disposal records for all dangerous goods in Daily Site Diary.	Construction Manager
Corrective Actions	- Investigate incidents and implement any preventative actions. - Ensure water is remediated or appropriately disposed of, as required.	Construction Manager
Timing	- Ongoing during project activities.	
Key Standards	- AS 1940 (2004) The storage and handling of flammable and combustible liquids. - AS 1216 (1995) Class labels for dangerous goods. - AS 3780 (2008) The storage and handling of corrosive substances. - National Water Quality Management Strategy: Guidelines for Groundwater Protection (ANZECC 1995). - National Water Quality Management Strategy: Guidelines for Fresh and Marine Water Quality (ANZECC 2000). - *Dangerous Goods (Transport) Act* 1998. - *Dangerous Goods Safety Act* 2004. - *Dangerous Goods Safety (Explosives) Regulations* 2007. - *Dangerous Goods Safety (General) Regulations* 2007. - *Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations* 2007. - *Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations* 2007. - *Rights in Water and Irrigation Act* 1914. - *Country Areas Water Supply Act* 1947.	

Table 41 Management trigger criteria for Zone of Effect for water quality

Management response level	Turbidity levels within zone of effect	
	Low trigger levels	High trigger levels
Conformance	Median < LTL each day in three consecutive days	Median< HTL on any six of seven consecutive days
Level 1 exceedance ("Watching")	Median >10% and <50% higher than LTL for 3 days	Median >10% and <30% higher than HTL for any six of seven consecutive days
Level 2 exceedance ("Responding")	Median >50% higher than LTL for 3 days	Median >30% higher than HTL for any five of seven days
Level 3 exceedance ("Adapting")	Median >100% higher than LTL for 3 days	Median >50% higher than HTL for any five of seven days
Level 4 exceedance ("Correcting")	Median >200% higher than LTL for 3 days	Median >100% higher than HTL for any five of seven days

Management Response Protocol

Conforming

- continue operations and monitoring as usual

Level 1

- report to EPA routinely
- photograph if necessary
- assess activities adjacent to affected area
- use tidal and current flow data to predict sediment deposition areas
- compare with modelling
- continue regular monitoring.

Level 2

- report to EPA within 24 hours
- reduce activities
- adopt additional actions to limit sediment liberation
- continue continuous monitoring and supplement with additional spatial coverage.

Level 3 and Level 4

- notify EPA directly
- collect aerial photography
- limit activities to non-sediment producing
- cease activities temporarily until sedimentation dissipates to below HTL
- continue continuous monitoring and further supplement with additional spatial coverage.
- only recommence dredging in affected area once levels return.

9.4.3 Vegetation Management

During construction activities, personnel will be required to minimise the effects of their activities on vegetation. Infrastructure has generally been located in areas devoid of mangroves on the peninsula and the transmission line is expected to be constructed in the road reserve, minimising the need for clearing native vegetation. At this stage of the project it is planned that vegetation disturbance will be restricted to the corridor previously impacted by installation of other utilities in the road reserve.

Disturbance to mangroves will not occur from machinery movements or clearing, but mangroves death is expected to occur from changes in hydrology. Colonisation of mangroves is expected to occur as a result of sedimentation and changes to hydrology. Monitoring of mangroves is addressed in the Sedimentation and Erosion management plan.

General principles for the minimisation and management of impact on vegetation and flora are listed in Table 42.

Table 42 Vegetation Management Sub-Plan

Vegetation management	Description	Responsibility
Objectives and Targets	- To avoid or minimise impacts including damage to terrestrial native vegetation and fauna habitat as a consequence of construction activities. - Manage impacts to mangroves to encourage regeneration in suitable new areas of the low basin. - To prevent the introduction of new weeds species into the project area. - To prevent the spread of existing weeds from the project area to new locations.	
Management Actions	**Management Actions for Construction Works - Transmission** - Clearing of native vegetation for the power transmission line is not expected as existing road reserves will be used. The following management measures should still be considered: • vegetation clearing will be minimised so that only areas that are considered absolutely necessary for safe construction and operation are cleared • areas to be cleared will be delineated on project drawings and pegged/flagged in the field by the contractor to define the extent of authorised clearing • no unauthorised clearing will be undertaken • boundaries of areas to be cleared or disturbed will be identified by GPS coordinates and maps of boundaries and provided to equipment operators • mangrove studies will be conducted in accordance with EPA conditions • clearing beyond approved limits will be reported using the Environmental Incident/Non-conformance Report • clearing will require written approval from the Environment Manager prior to disturbance • all employees/contractors will be inducted on the importance of vegetation and habitat, minimising vegetation clearing and disturbance, and “no access” areas. - All tracked or ground breaking vehicles and machinery will be washed down prior to mobilisation to site and certified as weed and soil free. - Lay Down areas will be located away from sensitive habitat areas. - Ensure no new informal tracks arise and all vehicle traffic is limited to the approved roads, defined and dust managed access tracks. - Appropriate dust suppression methods will be implemented where necessary to minimise dust lift-off. - Display visual Weed ID sheets on site to ensure native flora is not mistaken for weeds. - Obey speed limits to minimise dust generation. - Mangrove areas will not be actively cleared. **Management Actions for Post-Construction Works** - All rubbish, material heaps or other debris will be removed. **Management Actions for Operations** - Undertake weed and soil hygiene measures - Keep vehicles to designated tracks - Pruning of tall vegetation under powerlines will be undertaken as per existing practices and low vegetation will be allowed to regenerate as per existing practices.	Construction Manager and post construction – Operations Manager
	- All personnel will read visual Weed Identification sheets to ensure weeds are able to be distinguished from native flora.	All Personnel
Performance Indicators	- No damage to native vegetation outside the road reserve. - No new infestation of weed species as a result of works. - Mangrove colonisation in the low and high basins.	Construction Manager

Vegetation management	Description	Responsibility
Monitoring	- Weekly monitoring to monitor any direct disturbance to native vegetation during construction (Weekly Inspection Checklist). - Weed Seed inspection certificates for all tracked or ground-breaking machinery arriving on site for first time. - Annual monitoring of mangrove colonisation against predictive modelling.	Construction Manager
Reporting	- Incidents are to be reported and records retained (Incident, Accident and Near Miss Report). - Records of weed introduction and control maintained.	Construction Manager
Corrective Actions	- Investigate incidents and implement future preventative actions as required. - Implement weed control measures for new infestations. - If disturbance occurs outside the road corridor then the disturbed area will be rehabilitated in time for the next wet season - If mangroves are not approaching predicted levels within ten years then actions to assist with re-colonisation will be implemented	Construction Manager and Operations Manager
Timing	- During construction and operations.	
Key Legislation and guidance	- EPBC Act guidelines. - *Wildlife Conservation* Act. - *Conservation and Land Management Act 1984.* - *Conservation and Land Management Regulations 2002.* - *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.* - *Agriculture and Related Resources Protection Act 1976.*	

9.4.4 Fauna Management

Since vegetation is the main habitat for terrestrial MNES, the management practices presented in vegetation management (Section 15.4.3) will be applicable for fauna management. However, additional management measures in reference to aquatic and terrestrial fauna and their habitats are listed in Table 43.

Hassell (2002) recommends completing any work that may affect the mid-portions of the east branch (low basin) of Doctor's Creek in early May to mid-August as the use of the area by migratory shorebirds will be at its lowest.

Slow turning turbines will be installed between the high and low basins. Sluice gates between the basins and King Sound will allow for the movement of marine fauna. The sluices will open for 10 of every 24 hours allowing marine fauna movement and preventing confinement. Marine fauna do not have to pass through turbines to move in and out of the basins and the turbines are only installed between the basins, not at the sluice gates.

Peak current velocities are estimated to occur for 75% of the sluice gate opening time after which velocities will progressively reduce to 0 m/s prior to the sluice gates closing. The turbines will be installed to allow a minimum of one metres of water above the exit tube to prevent cavitation. The turbine speed is 60rpm with a blade diameter of 5.5m with a tip speed of 18m/s. Wicket gates installed in front of the turbines control and direct the flow of water so it contacts the blades at the correct speed and angle. The wicket gates will prevent large fauna from entering the blade area of the turbine and small fish are expected to be able to pass through the turbines without damage. The wicket gates are closed when the turbines are not working.

Table 43 Fauna Management Sub-Plan

Fauna management	Description	Responsibility
Objectives and Targets	- To avoid or minimise impacts including disturbance and/or damage to fauna or the surrounding environment as a consequence of construction and operation activities. - To prevent the introduction of new feral animal species into the project area. - To prevent increases in the population of existing invasive fauna species due to construction and operation activities. - To minimise damage to marine fauna as a result of barrage and turbine construction and operation.	

Fauna management	Description	Responsibility
Management Actions	**Management Actions for Construction Works** - Plant and equipment is to arrive on site free of debris, vegetative matter and contaminated soil and waste. - Ensure areas required during construction for lay down are located away from any sensitive habitat areas. - Ensure a buffer area between construction works and habitat patches is maintained to ensure minimal disturbance and includes appropriate barrier (eg bunting). - The turbine installation area will require a large excavation which will have ramps for vehicle access. If terrestrial fauna does enter this area it will easily be able to escape. - Ensure all vehicles, equipment and materials being transported to the project area have undergone a complete quarantine inspection and are free of invasive fauna species. - Check no fauna remains in excavation prior to allowing water to re-enter the area to flood the turbine area. - Prevent vehicles from accessing the mudflats other than on designated tracks.	Construction Manager
	Management Actions for Operations - The following measures would be implemented to manage vehicles with respect to fauna: • Speed limits would be maintained on all roads and access tracks • Special speed restrictions would apply in specially designated areas during periods of dusk and dawn • Adopt passive driving techniques and avoid driving at night to avoid disturbing wildlife • Dust suppression measures such as road watering and progressive rehabilitation of disturbed areas would be used • Fauna observations and/or contact/near misses with fauna in the project area would be recorded to allow periodic impact assessment of vehicle movement on fauna. - Report all fauna injuries and disturbances to the Operations Manager. - If predation on MNES increases then control predators. - Maintain general housekeeping to ensure natural fauna behaviours are not affected including covering waste bins to prevent fauna access. - Fire arms will be prohibited on site except for protection of workers from crocodiles. - Interaction with native fauna is prohibited. - No fauna (including snakes) is to be deliberately harmed. - Be aware of the location of any sensitive habitat areas. - Prepare an education program to be implemented for all site personnel, including training and inductions on conservation-significant fauna relevant to the project. - The following measures would be implemented to manage introduced fauna/pests: • domestic fauna would be prohibited within the project area and any construction sites • feeding of feral (and native) animals would be prohibited • all waste, particularly food waste would be isolated and removed from work areas • trap and eradication programs would be implemented if feral animals are detected.	All Personnel

Fauna management	Description	Responsibility
Performance Indicators	- No harm or injury to native fauna. - MNES still utilise habitat. - No new infestation of pest fauna species as a result of works. - Migratory birds continue to visit the area.	Construction Manager
Monitoring	- Baseline survey and biannual monitoring of shorebirds visiting the area to be undertaken prior to construction and during operations - Baseline survey and monitoring of mangrove habitat - Marine fauna monitoring to confirm that habitat is still used by MNES species - Weekly monitoring of site during construction to ensure there have been no injuries or fatalities to wildlife, and to ensure only minimal disturbance to terrestrial fauna and habitat as a result of works (Weekly Inspection Checklist). - Vehicle Inspection checklists.	Construction Manager
Reporting	- Incidents are to be reported and records retained (Incident, Accident and Near Miss Report). - Reportable incidents in relation to fauna management include: • disturbance of habitat outside the Disturbance Zone • domestic fauna being brought onto site • injury/death of any fauna • trapping of any fauna • non-native fauna increasing on site resulting in control measures being required • fire arms on site. - Records of invasive fauna species introduction and removal maintained. - Reporting on monitoring of shorebirds, marine fauna and mangroves.	Construction Manager
Corrective Actions	- Investigate incidents and implement preventative actions as required. - If fauna are found on site and are at risk of impact, contact the Site Environment Manager or suitably qualified personnel. - Investigate and mitigate if monitoring of fauna indicates changes in fauna behaviour or increases in predation that may be detrimental to the species	Construction Manager
Timing	- During construction and operations.	
Key Legislation and Guidance	- EPBC Act and guidelines - WC Act. - *Conservation and Land Management Act 1984.* - *Conservation and Land Management Regulations 2002.* - *Environmental Protection (Clearing of Native Vegetation) Regulations 2004.* - *Agriculture and Related Resources Protection Act 1976.*	

9.4.5 Noise and Vibration Management

Noise would be generated for 18 months, from machinery operating during construction. Once construction is complete the power station will have low ambient noise levels as the underwater turbines will be rotated by the tidal movements. The Project is situated 14 km from the nearest residential area of Derby.

The turbines and sluice gates are not expected to create atmospheric noise or vibration during operation. All operating and moving equipment will be below the water surface therefore there should be minimal impact. The potential for noise and vibration during the construction of the Project will be managed by the management actions listed in Table 44.

Table 44 Noise and Vibration Management Sub-Plan

Noise and vibration	Description	Responsibility
Objectives and Targets	- To control, minimise or avoid impacts caused by noise and vibration during construction works. - To protect the amenity of Derby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards. - To protect MNES from noise sufficient to change behaviours or to cause physical damage.	
Management Actions	TEA would ensure that noise and vibration from the project complies with the requirements of the Noise Regulations through implementation of the following management actions: - Carry out all construction work out in accordance with Section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites. - Ensure works are undertaken on site only during approved hours of work, and not on Sundays or Statutory holidays, unless without appropriate authorisation. - Check all plant, equipment and machinery is manufactured to Australian Standard, is operated and maintained in accordance with acceptable industry standards and is fitted with effective noise suppression devices (generally exhaust mufflers) as applicable. - Investigate noise and vibration complaints. - Ensure lower vibration generating items including excavation equipment are used where possible. - Be sensitive to climatic conditions such as temperature inversions or unusual wind directions, which may exacerbate construction noise for short periods. - Consider additional sound proofing for compressors and other static noise generation sources as appropriate. - Inform all personnel (including contractors) through site inductions of their responsibilities and the importance of managing noise levels during the construction phase.	Construction Manager
	- Use two-way radios for site signalling and communication, or other form of communication (e.g. mobile phones) as required. - Ensure engine driven machinery is switched off when not in use. - Report noise and vibration issues to the Construction Manager. - Minimise noise during peak shorebird migration season.	All Personnel
Performance Indicators	- Minimal internal and/or external complaints concerning noise or vibration. - Shorebird and marine fauna populations remain unchanged in comparison with control groups.	Construction Manager
Monitoring	- Review noise and vibration complaints as required. - As appropriate, undertake noise monitoring in response to complaints (Weekly Inspection Checklist). - Undertake baseline and ongoing monitoring of shorebird and marine fauna populations to establish changes in behaviours.	Construction Manager
Reporting	- Complaints are to be reported and records maintained (Incident, Accident and Near Miss Report). - Reporting on monitoring of shorebirds and marine fauna.	Construction Manager

Noise and vibration	Description	Responsibility
Corrective Actions	- Assess all noise or vibration complaints on a case-by-case basis. - Fit noise suppression devices or change compaction machinery to a lower capacity, where possible. - Plan high vibration activities so that works are undertaken in the shortest time reasonably possible. - Change timing of noise-producing activities. - Investigate changes in management practices if behaviour or population changes are noted in shorebird and marine fauna monitoring.	Construction Manager
Timing	- Ongoing during project activities.	
Key Standards	- AS 2436 (1981) Guide to Noise Control on Construction and Demolition Sites. - *Environmental Protection (Noise) Regulations* 1997.	

9.4.6 Emission Management

Emissions management includes the management of dust, waste, air quality, hazardous materials and artificial lighting. General principles for the minimisation and management of dust, waste, air quality, hazardous materials and artificial lighting emissions are listed in Table 45.

Table 45 Emission Management Sub-plan

Emission	Description	Responsibility
Objectives and Targets	- To control, minimise or avoid impacts caused by dust during construction works. - To minimise emissions to levels as low as practicable on an ongoing basis. - To ensure that pollutants emitted are as low as reasonably practicable, and comply with all statutory requirements and acceptable standards.	
Management Actions	**Dust Management** - Adhere to all speed limits, particularly on unsealed roads. - Minimise the use of vehicles by providing buses for transport of personnel to site, where practicable. - Avoid new informal tracks and limit vehicle traffic to the approved roads, as well as defined and dust managed access tracks. - Ensure all material deliveries such as insulation, foam, etc, are transported to/from the site with loads appropriately secured or dampened down. - Maintain general housekeeping practices to avoid the accumulation of dust generating waste materials within construction area. - Waste products that may generate fine dust particles will be contained/covered/relocated to prevent wind lift-off. - Obtain approval from Construction Manager prior to operating equipment on site to allow pre-mobilisation assessment against relevant Industry Codes of Practice, regulations and licence conditions for dust emissions of abrasive blasting equipment. - Complete encapsulation of site for blasting and spray painting. - Particular pre-start mention to be made for blasting and painting personnel of the particular consequences of damage to the environment from these activities. - Undertake regular housekeeping of the area. - Obtain permits and clearances prior to commencing work. - Operators to check equipment, leads/hoses prior to use. - Blasting to be undertaken in designated areas only. - Risk assessment to be performed for each location where abrasive blasting and spray painting is to be performed.	Construction Manager

Emission	Description	Responsibility
Performance Indicators	- Visually acceptable levels of airborne dust. - Visually acceptable deposition of dust on flat surfaces and foliage around the work site. - Minimal internal and/or external complaints concerning dust.	
Monitoring	- Monitor dust generation daily by visual assessment (Daily Inspection Checklist). - Review complaints as required (Weekly Inspection Checklist).	
Reporting	- Complaints are to be reported and records maintained (Incident, Accident and Near Miss Report).	
Corrective Actions	- Assess all dust complaints on a case-by-case basis and implement preventative actions as required. - Ensure water carts or equivalent measures are available for use, and request as required.	
Timing	- Ongoing during project activities.	
Key Standards	- EPA Final Guidance No. 18 Prevention of Air Quality Impacts from Land Development Sites. - Land Development Sites and Impacts on Air Quality (1996) Guidelines. - AS/NZS 3580.1.1:2007: Methods for sampling and analysis of ambient air - Guide to siting air monitoring equipment. - AS 2985-2009: Workplace atmospheres - Method for sampling and gravimetric determination of respirable dust. - AS 3640-2009: Workplace atmospheres - Method for sampling and gravimetric determination of inhalable dust. - AS 2724.5-1987: Ambient air - Particulate matter - Determination of impinged matter expressed as directional dirtiness, background dirtiness and/or area dirtiness (directional dust gauge method). - National Environment Protection Council (NEPC) 1998 National Environment Protection Measure (NEPM) for Ambient Air Quality, 26 June 1998 and variation 23 May 2003. - Environmental Protection (Abrasive Blasting) Regulations 1998.(W.A.). - A.S./N.Z. 4114.1 – 2003 –Painting. - Spray painting Code of Practice June 2000 (W.A.). - Abrasive Blasting Code of Practice June 2000 (W.A.). - *Dangerous Goods Safety Act* 2004 (WA) and associated Regulations.	

9.4.7 Waste and Hazardous Materials

A project specific plan for reducing waste will be developed prior to commencement of construction. The plan will identify known and potential waste streams and will consider how identified waste streams can be managed in accordance with the principles listed above. It will take into consideration waste handling facilities available on site, including recycling programs and disposal requirements. Waste management actions are listed in Table 46.

Table 46 Waste and Hazardous Materials Management Sub-Plan

Waste	Description	Responsibility
Objectives and Targets	- To ensure that land uses and activities that may emit or cause pollution are managed to maintain: • physical and biological environment and the natural processes that support life; and • the health, welfare and amenity of people and land uses. - To control disposal of general waste, including hazardous and controlled waste, generated by construction activities. - To identify opportunities to reuse, recycle or salvage waste generated by construction activities.	

Waste	Description	Responsibility
Management Actions	**Waste and Hazardous Materials Management** - Waste disposal would be managed on site in accordance with the Environmental Protection Regulations 1987 which governs the general control of pollution and, more specifically, the Environmental Protection (Controlled Waste) Regulations 2004 which outline obligations relating to the transportation and disposal of 'controlled' (generally hazardous) wastes. - Record all disposed waste in the Daily Site Diary. - Ensure all hazardous and controlled wastes on the construction sites are identified according to required labelling, and handled according to the MSDS. - Keep records of hazardous waste on site including documentation for controlled waste transport and disposal in compliance with the Environmental Protection (Controlled Waste) Regulations 2004. - All hazardous waste materials will be documented and tracked, segregated from other waste streams and stored in suitable containers. - Chemical wastes shall be stored in accordance with the requirements of the MSDS and Statutory Authority and disposed of in accordance with regulatory body's requirements and following the client's site procedure. - Notify appropriate personnel of all hazardous material proposed for use prior to transport to site. - All hazardous waste materials will be documented and tracked, segregated from other waste streams and stored in suitable containers. - Hazardous waste will be contained via encapsulation (Non-combustible sheeting/shrouding for insulation application). - Promptly remove full waste skips / bins from site to approved disposal areas. - Keep the construction site free from waste materials by directing regular clean ups. - Isolate, control, treat and/or dispose of contaminated water in accordance with statutory requirements (seek advice from the Environment Manager, should this be required). - Ensure any portable toilets are serviced regularly. - Ensure waste water is disposed of in accordance with site water management requirements and licences. - Ensure construction waste material and general waste (food scraps, cans, paper, etc.) are placed in separate covered waste skips / bins. - Inspect waste storage and disposal facilities to ensure they are functioning sufficiently and dealing adequately with the quantities of waste. - Disposal /refuse bins shall be correctly labelled for ease of disposal allocation. - Paint will be stored in appropriately bundled areas to prevent spills occurring. - Residual paint will be drained into hazardous sealable drums, the empty paint containers will be stored in hazardous waste skips and both wastes will be disposed of in accordance with relevant permits. - Engage a licensed Waste Contractor to collect hazardous and controlled waste materials [identified in Schedule 1 of the Environmental Protection (Controlled Waste) Regulations 2004] as required. - Paint requirements will be mixed in quantities sufficient for the	Construction Manager

Waste	Description	Responsibility
	work in hand. - Waste material from clean-up to be bagged in the same manner. - Waste rock wool material to be treated as hazardous in accordance with local authority regulations. - - The majority of hydrocarbon storage would be in the form of diesel fuel (distillate). Small quantities of lubricating oils would also be stored on site. Limited quantities of chemicals or other hazardous materials and their associated wastes will be stored on site for use during operation of the Proposal. An indicative list includes, but is not limited to: • fuels including distillate and liquefied petroleum gas • oil and greases • paints and degreasers • solvents • waste chemicals, hydrocarbons and other hazardous materials. - Tank, pipe and bunding design and construction would comply with all relevant regulations under the *Dangerous Goods Act 2004* in order to prevent and/or manage any spills. - Ensure that waste materials are reused and recycled where it is practicable. - Ensure that where practical, recyclable materials are separated from general waste. - Identify instances where material reuse is applicable. - Promote continuous improvement initiatives and incorporate the 4R principles (reduce, reuse, recycle and recover) in induction procedures and on site meetings.	
	Waste and Hazardous Materials Management - Participate in regular clean ups to avoid waste accumulation. - Be vigilant for waste management issues and report to Construction Manager if required. - Ensure that appropriate waste disposal receptacles are used at all times, and that all waste is secured. - Promote continuous improvement initiatives and incorporate the 4R principles (reduce, reuse, recycle and recover) in induction procedures and on site meetings.	All Personnel
Performance Indicators	- Waste disposed of at designated and approved facilities. - Discussion of opportunities with the relevant local council. - If in agreement, implement recycling and minimise amount of waste produced. - No hydrocarbon spills into environment.	Construction Manager
Monitoring	- Daily monitoring of site to ensure regular clean-ups are being undertaken (Daily Inspection Checklist). - Weekly monitoring of site to ensure waste is being disposed of correctly (Weekly Inspection Checklist). - Weekly monitoring to ensure no hydrocarbon leaks or spills (Weekly inspection checklist).	Construction Manager

Waste	Description	Responsibility
Reporting	- Monitoring records maintained. - Records of approximate amount and type of waste disposed of to landfill to be maintained in QHSE Daily Site Diary. - Keep records of hazardous waste and non-hazardous materials and their segregation on siteAn inventory of all waste material shall be provided that details: • description of waste • quantity • storage location/s • collection details • disposal methods. - Records of meetings and discussion.	Construction Manager
Corrective Actions	- Investigate incidents and implement preventative actions as required. - Remove and dispose of any waste that has been disposed of inappropriately. - Clean up spills appropriately and within 24 hours of notification.	Construction Manager
Timing	- Ongoing during site activities.	
Key Standards	- Dangerous Goods Safety Act 2004 (WA) and associated Regulations. - Dangerous Goods Safety (Storage and Handling of Non–explosives) Regulations 2007. - Australian Standard 1940 – 2004 (Storage and Handling of Flammable and Combustible Liquids). - Storage and handling of dangerous goods Code of Practice (DMP 2010). - Best Practice Waste Reduction Guidelines for the Construction and Demolition Industry, Waste Wise Construction Program (Environment Australia, 2000). - Guide to the Use of Recycled Concrete and Masonry Materials, HB155-2002 (Standards Australia, 2002). - Hazardous Substances – General: Labelling of Chemicals, NT WorkSafe Bulletin Bulletin No. 08.01.04 (WorkSafe, 2008). - *Health Act* 1911. - *Occupational Health and Safety Act* 1984.	

9.5 Monitoring, Auditing and Reporting

9.5.1 Monitoring

During construction, activities will regularly be inspected and reporting will be undertaken, to manage compliance with the CEMP and other environmental requirements. TEA will have a representative on site to supervise civil works and the containment of disturbance to designated areas, in order to minimise or avoid impacts to MNES. Monitoring is outlined in the mitigation sub-plans outlined above in Section 15.4.

Baseline studies and investigations will be undertaken of:

- Shorebird populations and diversity
- Mangrove coverage and regeneration
- Marine fauna species diversity and populations, particularly the northern river shark and sawfish species.

Shore birds will be monitored twice per annum for the first five years then annually during operations.

Mangrove coverage will be monitored annually for the first five years then every two years thereafter.

Marine fauna species will be monitored twice per annum for the first five years then once per annum during operations.

These investigations and monitoring events will be modified and adapted as new information is received thereby maintaining the monitoring methods and timing with seasons and results of field studies required under the EPA approval conditions.

9.5.2 Auditing

It is proposed that annual audits are undertaken during construction and operation of the Project to evaluate compliance with the management actions as set out in the CEMP. The first audit of the CEMP will be undertaken within three months of commencement of construction, to enable non-conformances to be identified early in the construction phase so that corrective action can be undertaken if necessary.

9.5.3 Reporting

During each phase of the Project, an appropriate and auditable record system will be maintained. Environmental reporting will be conducted in accordance with licence conditions. Environmental records will include:

- daily and weekly checklists
- non-conformance reports
- remedial actions taken following incident reports
- inspection reports
- training and induction attendance
- consultation records and meeting notes
- audit reports
- monitoring results.

Environmental incidents and identified instances of non-compliance will be recorded and reported by way of a Non-conformance Report.

9.5.4 Non-Compliance and Corrective Actions

The purpose of the CEMP is to identify and manage environmental risks and impacts. This will be achieved through the elements described above. If unforeseen events or system failures occur, the CEMP will provide for prompt identification, review and response, in order to minimise impacts and prevent reoccurrence. Formal reporting and corrective action will include the use of non-conformance reports and corrective action requests.

9.5.5 Competence, Training and Awareness

All personnel involved with the construction and operation of the Project will be required to complete environmental induction prior to commencing work. The objective of the induction will be to provide project personnel with the necessary information to allow them to recognise and effectively manage the environmental interactions of the Project.

The environmental induction program will involve the discussion of a variety of issues including:

- relevant legislation and legislative requirements
- roles and responsibilities
- specific environmental issues for the project, including:
    - erosion and sediment control
    - protection of water quality
    - vegetation and habitat management
    - weed and pathogen control
    - interaction with fauna
    - noise and vibration
    - emissions management
    - waste management
    - heritage
    - emergency response
- project documentation (including the CEMP, alignment sheets, technical drawings and other associated documents)
- incident reporting.

An environmental induction register will be maintained to ensure that all personnel are made aware of requirements prior to commencement.

This page has been left blank intentionally.

10.0 Project Justification

10.1 Project Rationale

The Project would improve power supply in the local and regional area of Derby, in the Kimberley. The cost of power would reduce to approximately 10-15 cents per kWh less than present alternative suppliers and existing mining companies, as well as the RAAF Curtin Air Base and the Curtin Detention Centre, have agreed to purchase the power at these rates. It is likely that the increased availability of cheaper power would promote further growth and development in the region, which, in-turn would provide more employment opportunities and growth within the region.

Horizon Power purchases its energy from Energy Developments Limited (EDL) at a price in excess of 50 cents per KWh, which it onsells to the general public at the uniform tariff in WA of 22.62 c/KWh. Horizon Power actively discourages industrial development as each extra KWh sold increases their loss. Large contestable customers (users requiring > 0.5 MW) and government departments have to pay the full cost of generation.

The Project would have a net environmental benefit, by reducing greenhouse gas emissions associated with the generation of energy, the expansion of mangroves in the high basin and potential improvements in primary productivity of Doctor's Creek.

The lifespan of the project is expected to be 120 years. This is an appropriate time scale for other industries to commence production in the area and make use of the cheap power for a long period of time.

The reduction in greenhouse gas emissions associated with generating energy for the local community from a renewable resource would assist Australia in meeting its Kyoto Protocol targets in 2020.

10.2 Ecological Sustainability

DSEWPaC identifies ecologically sustainable development as *"development which aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations'* (DSEWPaC, 2010). Furthermore, the EPBC Act also identifies the need for the consideration of decision-making processes in environmental impact, namely that *"decision making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations"* and the promotion of ESD in projects is one of the objects of the EPBC Act (section 3(b)).

Australia's *National Strategy for Ecologically Sustainable Development (1992)* defines ESD as:

> "development that improves the total quality of life, both now, and in the future,. In a way that maintains the ecological processes on which life depends"

The principles of ESD as outlined in Section 3A of the EPBC Act are as follows:

a) Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations (the 'integration principle').

b) If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (the 'precautionary principle').

c) The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations (the 'intergenerational principle').

d) The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making (the 'biodiversity principle').

e) Improved valuation, pricing and incentive mechanisms should be promoted (the 'valuation principle').

10.2.1 Integration of Decision Making Processes

Integrated decision-making processes need to include economic, environmental, social and equitable considerations in the short and long term. This EIS has provided an assessment of the Project in terms of these considerations, which need to be considered during the approval process.

An assessment of the short, medium and long term impacts of the Project, taking into account the principles of ESD is described in this EIS. The environmental mitigation, management and monitoring requirements for the construction and operation of the Project are provided in Section 9.0 of this EIS.

The project approval process prescribed under the Commonwealth and WA State legislative frameworks ensure that decision making and monitoring of the Project would be undertaken in an integrated manner, having regard to relevant issues associated with the Project within its context. Additionally, transparency throughout the decision making process for the design, impact assessment and development of management measures has been carried out through consultation with regulatory authorities and community groups during the preparation of the EIS. This has allowed comment and discussion regarding potential environmental impacts and concerns and proposed environmental management procedures.

10.2.2 Precautionary Principal

The Project is consistent with the precautionary principle as conservative assumptions have been employed to take into account worst case scenario impacts. Lack of full scientific certainty has not been used as a reason for postponing measures to prevent environmental degradation. As discussed in Section 9.1, safeguards and mitigation measures have been identified and proposed to avoid, mitigate or manage potential risks of environmental damage. Environmental investigations have provided a sound understanding of the environmental characteristics of the study area and as part of the EPA conditions for approval, a large number of additional studies would be undertaken with a particular focus on mangrove colonisation and the relationship with the biotic and abiotic environment. This would improve the understanding of dynamic intertidal ecosystems. It is unlikely that the project would cause irreversible damage to the environment.

10.2.3 Intergenerational Equity

The Project is consistent with the principle of inter-generational equity as it would provide ongoing benefits for the current and future generations by producing cheap, renewable energy while maintaining the health and productivity of the environment. The availability of cheaper power would have a significant impact on the social and economic well-being of local and regional communities.

With a projected life-span of 120 years for the Project, both current and future generations may benefit from cheap power, an increase in industry opportunities and an improvement in the quality of life in the local and regional area of Derby. This inter-generational time scale would allow for other industries to commence production in the area and make use of the cheap power for a long period of time

In addition, the Project is in itself an innovation which would allow future studies to be conducted for cost-benefit analyses of other tidal power projects in suitable areas of Australia.

The reduction in greenhouse gases and mitigating effect on climate change is an essential contribution towards ensuring an improved quality of life for future generations.

10.2.4 Conservation of Biological Diversity

This principle requires the maintenance and conservation of a full and diverse range of plant and animal species. An assessment of the effect of the Project on biological diversity and ecological integrity is provided in Sections 10 and 11.

Consideration of the impacts of the proposed Project on flora and fauna has been undertaken as part of development of the project through design modifications and environmental investigations. The flora and fauna assessment undertaken as part of the EIS concluded that the Project would not significantly impact upon threatened species or ecological communities or listed migratory species.

The ecological assessment found that there is limited potential for the proposed works to have a significant impact on threatened ecological communities, important fauna habitats or movement corridors or potentially present threatened flora or fauna species or populations, together with listed migratory species. Biological diversity and ecological integrity on areas surrounding the Project would be maintained.

10.2.5 Improved Valuation, Pricing and Incentive Mechanisms

The *Intergovernmental Agreement on the Environment* requires improved valuation, pricing and incentive mechanisms to be included in policy making and program implementation. In the context of environmental assessment and management, this would translate to environmental factors being considered in the valuation of assets and services.

The principle of internalising environmental costs into decision making requires consideration of all environmental resources that may be affected by a project, including air, water, land and living things. Placing a reliable monetary value on the residual environmental and social effects of a project presents a number of challenges. Given the different values placed on various components of the environment and the subjectiveness of such a process, it is difficult to assign a monetary value against the environmental costs and benefits associated with the Project that would be objectively accepted by a broad cross section of society.

Given this, the approach adopted for the Project has been an evaluation of the management of environmental impacts through appropriate safeguards and the inclusion of the cost of implementing identified safeguards and environmental management measures in the total cost of the Project.

In addition, the value placed on the environment is evident in the development of project design features and also in the extent of environmental management measures proposed.

10.3 Measures to Minimise Impacts on MNES

There are three groups of MNES using the Doctor's Creek area and transmission line area. These groups are terrestrial fauna, migratory shorebirds and marine fauna. While the marine fauna and migratory birds use Doctor's Creek as Foraging habitat there is no evidence to suggest that the habitat in Doctor's Creek is particularly significant for any species of MNES. Regardless, TEA will still undertake avoidance and mitigation measures to make sure the impact on these species is as low as possible.

Measures to avoid impacts to MNES include:

- Excavation of mudflats to be undertaken when the tide is out so dredging equipment and the impacts on marine fauna due the addition of large amounts of sediment into the water column are avoided
- The banks of Doctor's Creek will largely remain unmodified to maintain the natural shape of the tidal inlet
- A bunded area will be created on the point for the construction of the sluice gates and turbine housing. This will isolate construction activity from marine fauna particularly in terms of exposure to noise and electric currents
- The tidal fluctuations and periodic filling of the basins will be maintained to avoid removing the habitat from use by marine fauna
- The road to the power station will be constructed along the levee between the high and low basin on the high ground between the basins to avoid building another structure within the marine MNES habitat.
- Designing the transmission line to be constructed in a previously disturbed area to avoid impacts to terrestrial fauna
- Electromagnetic (EMF) cables will not be introduced to the marine environment avoiding impact to marine fauna from EMF.

Measures to minimise impacts to MNES include:

- Restricting excavation in the mudflats to the low basin to minimise disturbance to foraging habitat for shorebirds
- The loss of intertidal habitat in the high basin due to the tide not dropping below half full would be compensated by to maintenance of lower water levels in the low basin increasing the area of intertidal habitat for shorebirds.
- Wicket gates will be used to control water onto the turbines, preventing larger fauna from coming into contact with turbines.
- Sluice gates will be open for several hours twice per day to allow movement of the tides and to allow ingress and egress of fauna into the tidal creek system
- Maintenance of existing pools in the low basin to prevent fauna becoming stranded
- Maintenance of water levels to the same high water level in the high water basin, minimising impacts to mangroves in this basin
- Maintenance of current tidal pattern to maintain access to habitat as per current level

- Presence of gate/sluice pillars to provide areas of calmer water to assist fauna to swim against the tidal currents
- Minimise the external noise level by improving the acoustic isolation of the powerhouse and turbine, controlling vibrations of the ventilation system, improving hydrodynamic design of hydraulic structures and by using non-reflecting and sound absorbing materials such as fibreglass mat, false ceiling and heavy mass trap doors
- Minimising lighting to that required to meet safety levels
- Monitoring of shorebirds, mangroves and marine species will be undertaken to determine any changes to populations and to increase our knowledge of how alterations to habitat affect these species and communities.

10.4 Justification for Undertaking the Proposal in the Manner Proposed

Undertaking the Project in the manner proposed in this EIS is justified when considering its potential biophysical, social and economic impacts.

The Project involves the harvesting of tidal energy to provide a clean power supply. This means that there are particular aspects of the proposal that cannot be altered. This is particularly true for the engineering design of the project, which has been designed to maximise power generation and minimise environmental impacts. No dredging would be required except for maintenance dredging (in approximately 20 years) and the tidal movements in the high basin would remain similar to current tidal movements with the operation of sluice gates.

An assessment of alternatives was completed and focussed on alternative locations to tidal energy projects. These were based on criteria that were established based on the prerequisites of a tidal power project. Three alternative locations were identified, none of which was evaluated as being able to host a double-basin scheme as environmentally acceptable as the Project (van Walsum, 2004) and capable of producing consistent power.

Survey evidence suggests that Doctor's Creek comprises foraging habitat not of particular regional significance to the northern river shark or to sawfish (Thorburn 2014). In addition avoidance, minimisation and mitigation actions will reduce impact to the level where it is unlikely that there would be a significant impact of the Project on MNES. Habitat of the Northern River Shark and sawfish species will be altered, but given the constantly changing system and extreme tidal movements it is considered that these species will find the changes due to the project acceptable and will continue to use the area for foraging. Entrapment in the creek system may occur for a short time when sluice gates are closed, however sluice gates are open twice per day for 10 out of 24 hours to allow water and fauna movement and foraging in the high basin will be abundant. Water flow into turbines is directed by wicket gates, and studies have shown that large marine species are unable to move through the turbines.

There is likely to be a short term significant impact on mangroves, however, mangroves are a dynamic ecosystem of Doctor's Creek, and are constantly changing (SKM 2011). The mangroves in themselves are not a unique ecosystem to Doctor's Creek being well represented in the Kimberley area. Modelling indicates that tidal movements are likely to increase the total area of mangroves within Doctor's Creek in the medium to long term. This would have positive implications for migratory shorebirds using the tidal flats and mangroves for foraging.

Changes in sedimentation, erosion, and tidal exchange are unlikely to have a significant negative impact on migratory shorebirds. There is evidence that indirect impacts such as reduction in turbidity and improvements in water quality would result in an increase in primary productivity as a result of reduced suspended sediments and increased light filtration.

The location of the transmission line has been sited where it causes minimal environmental impact within the existing Main Roads reserve. Clearing is not expected and as a result, terrestrial MNES are not expected to be disturbed. Avoidance, minimisation and management measures will be implemented to keep any impact to a minimum.

Expected impacts on MNES include:

- short term disturbance from construction activities
- reduced marine access to the upstream area of the low basin (eastern branch of Doctor's Creek)
- reduced intertidal habitat for shorebirds in the high basin
- increased intertidal habitat for shorebirds in the low basin

- relocation of mangrove habitat in the low basin due to the drop in the high water level
- increase in water velocities through the gates potentially making ingress and egress more difficult for marine fauna
- change to tidal creek morphology with areas of scouring and sedimentation
- changes to water quality with potential decrease in turbidity where water is still for longer in the basins behind the gates and increased turbidity from scour in the area of the gates
- possible increased food availability in the basins due to high benthic productivity in less turbid water
- decreased tidal exchange from altered tidal inundation caused by a delay in the reduction of the tidal height
- changed patterns of water flow where tides flow from the ocean into the high basin and then from the high to the low basin and then to King Sound
- changed dynamics of the tidal creek (resulting from the introduction of the barrages), potentially causing long term changes to the habitat and potentially the flora and fauna utilising the habitat.

10.5 Offsets

The Derby Tidal Power Station is likely to have impacts on foraging habitats of MNES, in particular on tidal regimes, mangrove habitat distribution and changes to depths and tidal penetration of the tidal creek. This type of habitat cannot be purchased for an offset and as the majority of the coastline of King Sound is in pristine condition there are no areas suitable for rehabilitation.

Offsets can comprise a mixture of direct offsets and other compensatory measures. In this case, where the ecosystem is poorly understood and a measureable conservation gain would be scientifically difficult to demonstrate, other compensatory measures are more suitable as an offset if an offset is required. These offsets will be centred on studies of MNES species and their habitats and the resilience of the species in response to changes in their habitat. These studies would be undertaken by an accredited local research institute (such as Murdoch University), or by suitably qualified practitioners, completed with full scientific process culminating in a research paper or report. The Department of Fisheries has also been consulted and will be a stakeholder in the design of suitable research and education programs.

These other compensatory measures include research and investigations to:

1. As noted in the Draft Recovery Plan for *Glyphis* and *Pristids*, there have been no population studies of these species from this area or elsewhere in Australia. The project could contribute to such a study with the collection of genetic material taken during monitoring events of the area. A full population study would be beyond the scope of this project and require extensive resources in areas outside the project area
2. Evaluate turbidity changes, sedimentation and erosion impacts on water quality caused by placing tidal barrages and the response of marine fauna and migratory species to the introduction of barrages and sluice gates including their use of the modified habitat
3. Evaluate the dynamics of mangroves system, the response of different species to change and need for intervention to establish mangrove habitat colonisation and the implementation of a permanent long-term monitoring program to establish management trigger levels for both mangrove health and sedimentation and erosion.

This page has been left blank intentionally.

11.0 Conclusion

It is unlikely that the Derby Tidal Power Project would cause irreversible impacts on Matters of National Environmental Significance. There would be long term changes to the distribution of mangroves and changes to water levels in Doctor's Creek, but these would not be significantly different to naturally occurring variations. The intertidal creek systems in the Kimberley are dynamic ecosystems that exist in volatile environments where conditions change rapidly with weather and offshore conditions.

All residual environmental risks potentially affecting MNES were classified after avoidance, minimisation and mitigation as either Low or Very Low. The only aspect of the Project that has a Medium risk of impacts on marine MNES is associated with the sluice gates. The sluice gates, once operational (opening and closing over 12 hour periods), would change the amplitude of tidal movement and water levels within the basins and restrict fauna ingress and egress for up to six hours at a time. These impacts are an integral component of the Project, but will be undertaken alongside management and monitoring practices to minimise environmental impacts on MNES that may be present.

Impacts to roosting sites of migratory birds and shorebirds are considered unlikely as no roosting sites were located during the surveys (Hassell, 1997) and it is likely that shorebirds roost in open areas of the supra-tidal flats. Foraging areas on the mud flats would remain virtually unchanged as reductions of area in the high basin would be compensated by gains in the low basin. In addition, while there would be a loss of exposure of the creek floor in the high basin, this may be offset by an increase in the time of exposure of the creek bottom in the low basin and a potential increase in foraging habitat due to sediment build-up adjacent to barrages and from bank slumping (Hassell, 2002).

Construction activities are unlikely to impact directly on shorebirds (Hassell 2002) or marine fauna as the construction area will be isolated from the tidal system. Once constructed, the operation of the power station will be a regular and systematic opening and closing of the sluice gates resulting in a new tidal equilibrium in Doctor's Creek.

Potential direct impacts of the Project on water quality have been identified as an increase in turbidity due to scouring and a decrease in turbidity due to calmer waters higher in the basins, neither of which will significantly change the habitat within Doctor's Creek. Indirect beneficial impacts of an improvement in water quality remain less clear. The increase in organic matter from decomposition of mangroves may improve food availability for migratory shorebirds. Reduced sediment load may also allow more sunlight to filter through the water column, improving primary production and providing more food for migratory shorebirds. Short term increases in turbidity during construction would result in increased sediment load, reduced light penetration and primary productivity would also be reduced. Impacts of reduced flushing of the upper reaches of the creek are uncertain. None of these potential impacts would be irreversible and if the tidal power station was removed after installation, the creek is likely to return to equilibrium similar to that which currently exists.

The Project is consistent with the principles of ecologically sustainable development in that:

- The decision making processes behind the Project have integrated environmental, social and economic considerations.
- The methodology in undertaking this EIS and the environmental management measures and safeguards identified, embody the precautionary principle.
- The Project provides for intergenerational equity by providing ongoing benefits for the social and economic well-being of local and regional communities by producing non-polluting, renewable energy for generations while maintaining the health and productivity of the environment.
- With the proposed mitigation measures in place, the Project would not significantly impact on the biological diversity or ecological integrity of the project area or its surrounds.
- The Project provides for internalising environmental costs into decision making by considering the environmental resources that may be affected by the Project and including the implementation of identified safeguards and environmental management measures in the total cost of the Project.

This EIS has considered the potential beneficial and adverse impacts of the Project, with a full consideration of the principles of ESD. With the implementation of the mitigation measures identified in this EIS, it is unlikely that significant impacts would affect MNES or have an impact on the recovery of MNES within the vicinity of the project area and its surrounding environment.

This page has been left blank intentionally.

12.0 Information Sources

12.1 Information Sources

A summary of information sources is provided below. Table 47 includes studies undertaken specifically for the Project, or those that are directly related to the Project.

Table 47 Summary of information sources used for and directly related to the Derby Tidal Power project

Study	Year completed	Reliability	Uncertainties
Sediment and erosion modelling	2011, updated and modelling time extended in 2014	Completed by a team of marine specialists	Inputs for sediment and erosion model were uncertain so worst case values were used. Power demand modelling was also not undertaken for the reduced number of turbines that will be initially installed for the project.
Water quality of King Sound	1997 and 1998	Published scientific paper	Large variations in water quality and sediment load of King Sound.
Assessment of changes in mangroves in Doctor's Creek	2011	Based on change analysis between 1997 and 2010 using ESRI ArcGIS software	Magnitude of expansion and recession of mangroves not fully understood due to different analysis processes used between 1997 and 2010.
Engineering design report	2012	Completed by a reputable company	None
Geotechnical studies	2002	Completed by geotech specialists	None
Terrestrial fauna and avifauna at Derby Tidal	1997	Completed by zoologists	The survey is an incomplete inventory as migratory birds will only utilise the area at particular times of the year. To overcome information gaps a follow-up survey was completed in 2002.
Assessment of impacts on migratory shorebirds	2002	Completed by an avifauna specialist	Extent of impact on migratory shorebirds.
Flora and vegetation survey of the transmission line alignment and point torment peninsula	1997	Completed by botanists	None
Mangrove and samphire vegetation	1997	Completed by a team of ecologists	None
Supplementary information on the occurrence of Pristis (Sawfish) and Glyphis (River Shark) species in Doctor's Creek WA	2014	Completed by Dr Dean Thorburn; a specialist in these species	Did not involve a new field survey, but collated data from all previous studies in the area.

This page has been left blank intentionally.

13.0 Reference List and Bibliography

AECOM, 2009, Environmental Assessment Registration Document – Fundy Tidal Energy Demonstration Project Volume I: Environmental Assessment", Fundy Ocean Research Centre for Energy (Minas Basin Pulp and Power Co. Ltd.), prepared by AECOM Canada Ltd, Project Number 107405, June 2009.

Allo, JC 2013. Marine Current Energy in Indonesia: a new way of producing energy, the conference preceedings of the Indian Ocean and Pacific Conference, Bali, Indonesia, 16 June

Bamford Consulting Ecologists, 2005. Gorgon Development on Barrow Island Technical Report, Avifauna. Prepared for Chevron Texaco Australia Pty Ltd.

Beard, JS 1979 *Kimberley, 1:1 000,000 vegetation series : explanatory notes to sheet 1, the* vegetation *of the Kimberley area,* Nedlands, WA, University of Western Australia Press ISBN 0-85564-091-X

Birdlife International 2007 *Species factsheet:* Glareola maldivarum*,* viewed 11 April 2013, http://www.birdlife.org

Birds in Backyards 2012a, *White-bellied Sea-Eagle – Basic Information*, viewed 26 March 2013, http://www.birdsinbackyards.net/species/Haliaeetus-leucogaster

Birds in Backyards 2012b, *Rainbow Bee-eater – Basic Information,* viewed 4 October 2012 at http://www.birdsinbackyards.net/species/Merops-ornatus

Broome Bird Observatory 1997, *Shorebird monitoring of the Doctor's Creek system November 1997*, prepared for Derby Tidal Power Ltd.

Campagno, L., M. Dando, and S. Fowler. 2005. *Princeton Field Guides: Sharks of the World.* Princeton University Press: Princeton, New Jersey. Pg. 33.

Cardno 2014, Proposed Derby Tidal Power Station – Hydrodynamic and Sediment Transport Modelling, Unpublished report for Tidal Energy Australia, Perth Western Australia, Revised March 2014.

Centre for Marine and Coastal Studies Ltd (CMCSL) 2012, East Anglia One Offshore Wind Farm: Electromagnetic Field Environmental Appraisal, assessment of EMF effects on sub tidal marine ecology, report published as part of environmental assessment for Vattenfall and Scottish Power.

Coffey Partners International Pty Ltd 1997, *Derby Hydro Power Pty Ltd Geotechnical Studies,* Report P1036/1-AM prepared for Halpern Glick Maunsell.

Coffey 2002, *Derby Tidal Project – Geotechnical Investigation of Sand Bar*. Report P2041/3-AD prepared for Tidal Energy Australia.

Commonwealth of Australia 2002, *Water Quality Targets: A Handbook,* Version 1.0 June 2002, Environment Australia, Canberra, ACT.

Daborn, GR 1987, Potential Impacts of Hydro and Tidal Power Developments on the Ecology of Bays and Estuaries, in SK Majumdar (eds) *Environmental Consequences of Energy Production: Problems and Prospects,* Chapter 23, Pennsylvania Academy of Science 1987.

Dadswell, MJ, Rulifson, RA and Daborn, GR 1986, *Potential Impact of Large-Scale Tidal Power Developments in the Upper Bay of Fundy on Fisheries Resources of the Northwest Atlantic,* Fisheries vol. 11 no. 4.

Davies JK, 1988, A review of information relating to fish passage through turbines: implications to tidal power schemes, Journal of Fish Biology vol. 33 (Supplement A), pp. 111-126, the Fisheries Society of the British Isles.

Department of Environment 2013. *National Conservation Values Atlas*. Viewed 12 October 2013. http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf.

Department of Environment and Conservation 1999, *Environmental Weed Strategy for Western Australia,* Government of Western Australia, Perth.

Department of Environment and Conservation 2001, Dugong Research in Shark Bay, viewed 19 June 2013, http://www.dec.wa.gov.au/news/archives-calm/dugong-research-in-shark-bay.html

Department of Environment Sport and Territories 1995, *Greenhouse 21C. A Plan of Action for a Sustainable Future*, Department of the Environment, Sport and Territories, Australia.

Department of Sustainability, Environment, Water, Population and Communities 2012. *Marine Bioregional Plan for the North-west Marine Region*. Viewed 12 October 2013. http://www.environment.gov.au/coasts/marineplans/north-west/index.html.

Department of Sustainability, Environment, Water, Population and Communities 2013, *Australia's Bioregions*, viewed 10 April 2013, http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html.

Department of Sustainability, Environment, Water, Population and Communities 2013a *Species Profile and Threats Database*. Viewed 12 October 2013. http://www.environment.gov.au/biodiversity/threatened/index.html.

Department of Trade and Industry 1993, *Fish and Shrimp Passage Through Turbines,* Renewable Energy Enquiries Bureau, Oxfordshire, UK.

Department of Transport 2013, *Tide Predictions of Derby,* viewed 30 May 2013, http://www.transport.wa.gov.au/imarine/19102.asp.

Department of Water 2008, *Derby Water Reserves: Drinking Water Source Protection Plan,* Report 98, Government of Western Australia, Perth, WA.

Diamond Island Pty Ltd 1997, *Kimberley Prawn Farm, Derby WA Consultative Environmental Review,* prepared for Kimberley Prawn Company, November 1997.

Dooling RJ,. Fay, RP., Popper, AN. 2000. Conparative Hearing: Birds and Reptiles. Springer-Verslag.

Dooling, RJ., and Popper, AN. 2007. The effects of highway noise on birds. Environmental BioAcoustics LLC for the California Department of Transportation, Division of Environmental Analysis.

Duffield, ARJ 2003, Transmission Line Deed of Agreement, Letter, Main Roads Western Australia.

Dyer, KR Christie, MC Wright, EW 2000, *The Classification of Intertidal Mudflats,* Continental Shelf Research vol. 20 pp. 1039-1060.

Edwards, J 2002, *Bulletin 1071 Derby Tidal Power Proposal,* Letter of Appeal, Minister for the Environment, Perth, Australia.

Ellison, JC 1998, *Impacts of sediment burial on mangroves,* Marine Pollution Bulletin vol. 37 pp. 420–426.

Environmental Protection Authority 1999, *Derby Tidal Power Project* Bulletin 942, viewed on 19 June 2013 http://www.epa.wa.gov.au.

Environmental Protection Authority 2000, *Derby Tidal Power Project* Bulletin 984, viewed on 19 June 2013 http://www.epa.wa.gov.au.

Environmental Protection Authority 2002, *Derby Tidal Power Project* Bulletin 1071, viewed on 19 June 2013 http://www.epa.wa.gov.au.

Finn, P.G., Driscoll, P.V. and Catterill, C.P. 2002. *Eastern curlew numbers at high-tide roost versus low-tide feeding grounds: a comparison at three spatial scales*. Royal Australasian Ornithologists Union, Emu, 2002 (102).

Fletcher, WJ and Head F (eds) 2006, *State of the Fisheries Report 2005/06,* Department of Fisheries, Western Australia.

FRC Environmental 2012, *Gold Coast International Marine Precinct EIS: Aquatic Ecology*, viewed 10 April 2013, http://www.gcintmarineprecinct.com.au/eis.php.

FRC Environmental 2012, *Gold Coast International Marine Precinct EIS: Aquatic Ecology*, viewed 10 April 2013 http://www.gcintmarineprecinct.com.au/eis.php.

Furuwaka, K, Wolanski, E and Mueller, H, *Currents and Sediment Transport in Mangrove Forests*, Estuarine, Coastal and Shelf Science vol. 44 pp. 301-310.

GHD 2012, *TEA Investments (No.1) Preliminary Design Report*. May 2012, prepared for Tidal Energy Australia

Graham, G 2001, Dampierland: Fitzroy Trough subregion. In: CALM 2002, *Bioregional Summary of the 2002 Biodiversity Audit for Western Australia*, Department of Conservation and Land Management, Perth.

Halpern Glick Maunsell 1998, *Derby Tidal Power Project, Doctor's Creek, Kimberley*. Consultative Environmental Review, for Derby Hydro Power Pty Ltd, 1998.

Halpern Glick Maunsell 1999, *Further Assessment of Issues Relating to Sedimentation and Acid Sulphate Soils at Doctor's Creek*, for Derby Hydro Power Pty Ltd, February, 1999.

Halpern Glick Maunsell 2003, *Preliminary Sedimentation Assessment of the Proposed Tidal Power Station at Doctor's Creek, Derby*, prepared for Tidal Energy Australia.

Halvorsen, MB, Carlson, TJ and Copping, AE. 2011, Effects of Tidal Turbine Noise on fish Hearing and Tissues, Environmental Effects of Marine and Hydrokinetic Energy, prepared for the US Department of Energy, Pacific NorthWest National Laboratory, Sequim, Washington 98382.

Hanley, JR no date, *Quantitative Assessment of Mangrove Invertebrate Fauna*. Marine Ecology Unit, Muserum and Art Gallery of Northern Territory.

Hassell, C. 1997, *Shorebird Monitoring of the Doctor's Creek System.* Prepared for Halpern Glick and Maunsell.

Hassell, C. 2002, *Report on the Impact of the Proposed Kimberley Tidal Power Project on Migratory Shorebirds*. Prepared for Halpern Glick Maunsell Pty Ltd.

Hill B.M. and Ward S.J., 201,. National Recovery Plan for the Northern Quoll *Dasyurus hallucatus.* Department of Natural Resources, Environment, The Arts and Sport, Darwin.

Hughes, G.R. and Oxley-Oxland, R. 1971, A survey of Dugong (Dugong dugon) in and around Antonio Enes, Northern Mozambique. Biological Conservation. 3:299-301

Hussey, BMJ Keighery, GJ Dodd, J Lloyd, SG Cousens, RD 2007, *Western Weeds 2nd edition*, The Plant Protection Society of Western Australia, Victoria Park, Western Australia.

Hutchings, P and Saenger, P 1987, *Ecology of Mangroves*. University of Queensland Press.

Johnstone, RE 1990, *Mangroves and Mangrove Birds of Western Australia,* records of WA Museum, Supplement 32 Western Australian Museum, Perth.

Kimberley Coast website 2013, http://kimberleycoast.com.au/kimberley-mangroves/ accessed October 14 2013.

Kwan, D 2002, *A Review of Dolphins, Dugongs and Turtles (Loggerhead, Green, Hawksbill and Flatback) at Doctor's Creek, King Sound: potential impacts of the Kimberley Tidal Power Project*, prepared for Halpern Glick Maunsell Pty Ltd.

Lanyon, J Limpus, CJ and Marsh, H 1989, Dugongs and turtles: Grazers in Seagrass systems, In AWD Larkum, AJ McComb and SA Shepard (eds) *Biology of Seagrasses: A treatise on the biology of seagrasses with special reference to the Australia Region'* pp. 610-634, Elsevier, Amsterdam

Larson, HK 2002, *Comments on the Kimberley Tidal Power Project with regard to the listed elasmobranch fishes.* Prepared for Halpern Glick Maunsell Pty Ltd.

Lewis, JG 1963, *The Tidal Power Resources of the Kimberley,* Journal of the Institution of Engineers, Sydney.

Luck, M 2008, *Encyclopaedia of Tourism and Recreation in Marine Environments,* CABI, Oxfordshire, UK.

Marsh H 1999, Reproduction in Sirenians. pp. 243–256, in JE Reynolds and SA Rommel (eds) *Biology of Marine Mammals,* Smithsonian Institution Press, Washington DC.

Marsh H Heinsohn GE and Marsh LM 1984, *Breeding Cycle, life history and population dynamics of the dugong Dugong dugon (Sirenia: Dugongidae),* Australian Journal of Zoology vol. 32 pp. 767-788.

Marsh H Penrose H and Eros C 2003, A Future for the Dugong, pp. 383-399. In: N Gales, M Hindell and R Kirkwood (eds) *Marine Mammals: Fisheries, Tourism & Management Issues*, CSIRO Publishing, Victoria.

Marsh, H and Lefebvre, LW 1994, *Sirenian Status and Conservation efforts.* Aquatic Mammals. **20:**767-788.

Masini, RJ Sim, CB and Simpson, CJ 2009, *Protecting the Kimberley*: *A Synthesis of Scientific Knowledge to Support Conservation Management in the Kimberley Region of Western Australia*, Department of Environment and Conservation, Western Australia.

McCauley R.D. Fewtrell J. Duncan A.J. Jenner C. Jenner M.N. Penrose J.D. Prince R.I.T. Adhitya A. Murdoch J. and McCabe K. 2000. Marine Seismic Surveys - a Study of Environmental Implications. APPEA Journal pp. 692-708

Mersey Barrage Company 1992, *Tidal Power From the River Mersey*, A Feasibility Study, Stage III Report.

Morcombe M 2003, *Field Guide to Australian Birds*, Steve Parsh Publishing, Australia.

Morgan, D Gill, H White, W Thorburn, D no date, "*Comments on the Kimberley Tidal Power Project with regard to Environment Australia listed elasmobranch fishes" Helen K. Larson External Review,* Prepared for Halpern Glick Maunsell Pty Ltd.

Morgan DL Whitty JM Phillips NM 2009, Endangered Sawfishes and River Sharks in the West Kimberley, Centre for Fish and Fisheries Research Murdoch University, Report to Woodside Energy Ltd.

Nagelkerken, I Blaber, SJM Bouillon, S Green, P Haywood, M Kirton, LG Meynecke, J-O Pawlik, J Penrose, HM Sasekumar, A and Somerfield, PJ 2008, *The Habitat Function of Mangroves for Terrestrial and Marine Fauna: A Review.* Mangrove Ecology vol. 89 pp. 155-185.

Ogden, E.L.J. 2002*. Summary report on the bird friendly building program: effect of light reduction collision of migratory birds*. A special report for the Fatal Light Awareness Program, Toronto, Ontario, Canada.

Paling, EI 1997, *Mangrove Assemblages in Doctor's Creek, Derby, Their Regional Significance and the Potential Impacts of a Tidal Power Station,* Environmental Science Report MAFRA 97/10, Murdoch University, Western Australia, prepared for Derby Hydro Power Pty Ltd.

Paling, E Humphries, G McCardle, I and Thomson, G 2001, *The Effects of Iron Ore Dust on Mangroves in Western Australia: Lack of Evidence for Stomatal Damage*, Wetlands Ecology and Management vol. 9 pp. 363-370.

Paling, E Kobryn, HT and Humphreys 2008*, Assessing the extent of mangrove change caused by cyclone Vance in the eastern Exmouth Gulf, north western Australia*, Estuarine, Coastal and Shelf Science vol. 77 (2008) pp.603-613.

Pogonoski JJ and Pollard D 2003, Glyphis garricki, in IUCN 2009, *IUCN Red List of Threatened Species* Version 2009, www.jucnredlist.org [16/12/2009].

Poot, H., Ens, B.J., de Vries, H., Donners, M.A.H., Wernand, M.R. and Marquenie, J. (2008). *Green light for nocturnally migrating birds*. Ecology and Society 13 (2): 47.

Radford, PJ 1994, *Pre- and Post-Barrage Scenarios of the Relative Productivity of Benthic and Pelagic Subsystems of the Bristol Channel and Severn Estuary*, Biological Journal of the Linnean Society, vol. 51 no. 1 and 2.

Ramos H, 2000, Guidelines for Design of Small Hydropower Plants, published through Western Regional Energy Agency and Setwork, Department of Economic Development, Belfast, North Ireland.

Retiere, C 1994, *Tidal Power and the Awuatic Environment of La Rance*, Biological Journal of the Linnean Society, vol. 51 no. 1 and 2.

Rich, C., and T. Longcore. (2006). *Ecological Consequences of Artificial Night Lighting*. Washington DC, Island Press.

Robertson, AI and Alongi, DM 1992, *Tropical Mangrove Ecosystems*, Coastan and Estuarine Studies 41 American Geophysical Union, Washington DC.

Robson, B 2008, *Response of the Lower Ord River and Estuary to Changes in Flow and Sediment and Nutrient Loads,* CSIRO, Australia.

Rogers, D 1999, *Roost choice in the waders of Roebuck Bay: is avoiding heat stress their main consideration?,* Stilt vol. 35 no. 65.

Rogers, D. I., Piersma, T., and Hassell, C. J. 2006. *Roost availability may constrain shorebird distribution: Exploring the energetic costs or roosting and disturbance around a tropical bay*. Biological Conservation 133: 225-235.

Seminiuk, V Kenneally, KF and Wilson, PG 1978, *Mangroves of Western Australia*, Western Australia Naturalist Club, Perth.

Seminiuk, V 1980, *Mangrove Zonation Along an Eroding Coastline in King Sound*, North-Western Australia, Journal of Ecology vol. 68 pp. 789-812.

Schodde, R and Tidemann, SC 1990, *The Complete Book of Australian Birds,* Readers Digest, Sydney.

Sinclair Knight Merz 2011, *Derby Tidal Power: Assessment of Mangrove Changes in Doctor's Creek Between 1997 and 2010*, prepared for Tidal Energy Australia.

Southall B.L. Bowles A.E. Ellison W.T. Finneran J.J. Gentry R.L. Greene Jr. C.R. Kastak D. Ketten D.R. Miller J.H. Nachtigall P.E. Richardson W.J. Thomas J.A. and Tyack P.L. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals. 33. 411-521.

Stevens, JD Pillans, RD Salini, J 2005, *Conservation assessment of Glyphis sp. A (speartooth shark), Glyphis sp. C (northern river shark), Pristis microdon (freshwater sawfish) and Pristis zijsron (green sawfish),* prepared for the Department of Environment and Heritage, June 2005, CSIRO.

Thorburn, DC, 2014, Supplementary information on the occurrence of Pristis (Sawfish) and Glyphis (River Shark) species in Doctor's Creek, Western Australia.

Thorburn, DC Morgan, DL Rowland, AJ and Gill, HS 2004 *The Northern River Shark (Glyphis sp. C) in Western Australia*, Murdoch University report to the Natural Heritage Trust, Government of Australia.

Tyack P. 2008. Large scale changes in the marine acoustical environment and its implications for marine mammals. Journal of Mammalogy 89:549–558

Van Walsum, E 2003a, *Barriers Against Tidal Power: Part 1,* International Water Power & Dam Construction vol. 55 no. 9

Van Walsum, E 2003b, *Barriers to Tidal Power: Part 2. Environmental Effects,* International Water Power & Dam Construction vol. 55 no. 10.

Van Walsum, E 2004, *Barriers to Tidal Power: Part 3. Multi-Basin Plants,* International Water Power & Dam Construction vol. 56 no. 5.

Wartzok D. and Ketten D.R. 1999. *Marine mammal sensory systems.* In: Reynolds J.E. and Rommel S.A. (eds). Biology of Marine Mammals. pp. 117-175. Washington D.C. Smithsonian Institution Press.

WAWA 1992, *Derby Groundwater Management Plan*, prepared for the Water Authority of Western Australia, December 1992.

Weilgart L.S. 2007. *A brief review of known effects of noise on marine mammals*. Int. J. Comp. Psych. 20 (2-3):159-168.

Whiting, S 2002, An independent assessment of "A Review of Dolphins, Dugongs and Sea Turtles conducted by Dr Donna Kwan", prepared for Halpern Glick Maunsell.

Wiese, F.K., Montevecchi, W.A., Davoren, G.K., Huettmann, F., Diamond, A.W. and Linke, J. (2001). *Seabirds at risk around offshore oil platforms in the North-west Atlantic*.

Wolanski, E and Spagnol, S 2003, *Dynamics of the Turbidity Maximum in King Sound, Tropical Western Australia*. Estuarine, Coastal and Shelf Science, vol. 56 no. 5-6 pp. 877-890.

Wood, P 1993, *Tidal Power Generation – Demonstration Project,* results of research carried out as MERIWA Project No. E209, Minerals & Energy Research Institute of Western Australia.

WRC 1998, *Letter from the Water and Rivers Commission to the EPA on the workshop on the Derby Tidal Power Station and the Kimberley Prawn Farm,* from Tony Laws, 17 June 1998.

This page has been left blank intentionally.