



**Environmental
Protection
Authority**

Mardie Project

Mardie Minerals Pty Ltd

Report 1704

June 2021

This assessment report has been prepared by the Environmental Protection Authority (EPA) under s. 44 of the *Environmental Protection Act 1986* (WA) (EP Act). It describes the outcomes of the EPA's assessment of the Mardie Project proposal by Mardie Minerals Pty Ltd.

The Mardie Project was determined under the Commonwealth *Environment Protection and Biodiversity Act 1999* to be a controlled action and to be assessed by the EPA under an accredited process. This document is also the result of the EPA's accredited assessment process.

This assessment report is for the Western Australian and Commonwealth Ministers for Environment and sets out:

- what the EPA considers to be the key environmental factors identified in the course of the assessment
- the EPA's recommendations as to whether or not the proposal may be implemented and, if the EPA recommends that implementation be allowed, the conditions and procedures, if any, to which implementation should be subject
- other information, advice and recommendations as the Authority thinks fit.



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Summary

Proposal

The Mardie Project is a proposal to use seawater to produce raw salts as a feedstock for processing high purity salt, fertiliser grade sulphate of potash, and potentially other commercial by-products. The proponent is Mardie Minerals Pty Ltd (Mardie Minerals). The proposal is located 80 kilometres south-west of Karratha, in the Pilbara region of Western Australia.

The proposal is on the west Pilbara coast, which has been defined for the purpose of this assessment as the area from the bottom of the Exmouth Gulf to Karratha. The southern end of the development envelope intersects the Robe River Delta Mangrove Management Area. This area contains mangroves which were designated regionally significant in *EPA Advice: Protection of Tropical Arid Zone Mangroves along the Pilbara Coastline* (EPA 2001).

The proposal includes a seawater intake, concentrator and crystalliser ponds, processing plant, bitterns disposal to the marine environment, and a trestle jetty export facility.

Consultation

The EPA published the proponent's referral information for the proposal on its website for 7 days public comment. The EPA also published the proponent's environmental review document on its website for public review for 10 weeks. The EPA considered the comments received during these public consultation periods in its assessment.

Mitigation hierarchy

The mitigation hierarchy is a sequence of proposed actions to reduce adverse environmental impacts. The sequence commences with avoidance, then moves to minimisation/reduction/rehabilitation, and offsets are considered as the last step in the sequence.

The proponent has considered the mitigation hierarchy in the development and assessment of its proposal, and as a result has:

- designed the project footprint to avoid intertidal benthic habitat
- excised Mardie pool and a buffer area from the development envelope
- reduced the development envelope to the south of the proposal area to minimise impacts to the regionally significant mangroves in the Robe River Delta Mangrove Management Area.

Assessment of key environmental factors

The Environmental Protection Authority (EPA) has identified the key environmental factors (listed below) in the course of the assessment, and has assessed that the proposal was likely to result in the following:

Inland waters

- Decreased frequency of surface water inundation to 217 hectares (ha) of the intertidal zone, and increased frequency of inundation to 1,389 ha of the intertidal zone.
- Impacts to groundwater regimes and quality due to saline seepage from evaporation and crystalliser ponds.

Marine environmental quality

- Reduction in the level of protection from high to low, and subsequent loss of environmental quality, to 17.3 ha surrounding the bitterns disposal diffusers (Low Level of Ecological Protection – LEPA).
- Reduction in the level of protection from high to medium, and subsequent loss of environmental quality, to 56.8 ha outside of the proposed LEPA surrounding the bitterns disposal diffusers.
- Reduction in the level of protection from maximum to high, and potential loss of environmental quality to 9.3 ha surrounding the boat launching facility.
- Reduction in the level of protection from maximum to high, and potential loss of environmental quality to 7.9 ha surrounding the seawater intake.

Flora and vegetation

- Clearing of 2,319 ha of vegetation in good - to excellent condition.
- Clearing of 145 ha of the Horseflat Priority Ecological Community (PEC), and up to 20 ha through indirect impacts.
- Clearing of 854 ha of landward samphire communities.

Benthic communities and habitat (intertidal)

- Direct disturbance of 296 ha of coastal samphire.
- Direct disturbance of up to 880 ha algal mat.
- Direct disturbance of up to 13 ha of mangroves outside the Robe River Delta Mangrove Management Area.
- Direct disturbance of up to 4 ha of mangroves within the Robe River Delta mangrove Management Area.
- Indirect impacts as a result of decreased frequency of freshwater inundation to 50.3 ha of samphire.
- Indirect impacts as a result of decreased frequency of freshwater inundation to 13 ha of mangrove habitat outside of the Robe River Delta mangrove Management Area.
- Indirect impacts as a result of decreased frequency of freshwater inundation to 130 ha of mangroves within the Robe River Delta Mangrove Management Area.

Benthic communities and habitat (subtidal)

- Direct and irrecoverable impacts to 35 ha filter-feeder/macroalgae/seagrass benthic communities and habitat (BCH) and 44 ha coral/macroalgae BCH.
- Recoverable indirect impacts to 133 ha filter-feeder/macroalgae/seagrass BCH and 69 ha coral/macroalgae BCH.

Terrestrial fauna

- Clearing/disturbance of 11,142 ha fauna habitat, including Pilbara leaf-nosed bat foraging habitat, northern coastal free-tailed bat foraging habitat, potential Pilbara olive python habitat, northern quoll foraging habitat, and migratory bird habitat.

Marine fauna

- Impacts to intertidal and subtidal benthic communities and habitat as assessed in the relevant sections above.
- Disturbance of a 50 metre stretch of low-quality turtle nesting beach.
- Mortality as a result of vessel strike.
- Changes to behaviours and potential damage to hearing as a result of marine noise emissions.
- Changes to marine turtle nesting behaviours as a result of light spill.

Social surroundings

- Disturbance of Peter's creek, including changes to the hydrological regime of the creek
- Disturbance to registered and unregistered heritage sites, including shell middens.

Holistic impact assessment

The EPA has also considered connections and interactions between relevant environmental factors to inform a holistic view of impacts to the whole environment. The EPA formed the view that the holistic impacts would not alter the EPA's conclusions about consistency with the EPA's factor objectives.

Conclusion and Recommendations

The EPA has taken the following into account in its assessment of the proposal:

- environmental values likely to be significantly affected by the proposal
- residual impacts to those environmental values, separately and holistically, including cumulative impacts of the proposal
- the likely environmental outcomes which can be achieved with the imposition of conditions
- the consistency of the likely outcomes of the proposal with the EPA's objectives for the key environmental factors

- the EPA's confidence in the proponent's proposed mitigation measures
- whether other statutory decision-making processes can mitigate the potential impacts of the proposal on the environment
- the principles of the *Environmental Protection Act 1986*.

It is the EPA's view that reasonable conditions could be imposed on the proposal to prevent inconsistency with the EPA's objectives for the key environmental factors.

Given the above, the EPA has recommended that the proposal may be implemented subject to the conditions recommended in Appendix A.

Other advice

There is a requirement for aspects of the proposal to be regulated by other regulatory agencies. These are noted in section 7 (Other advice).

All future referrals for salt proposals will be required to assess potential regional and cumulative impacts associated with the proposal, with particular regard to intertidal benthic communities and habitats.

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1 Proposal

The Mardie Project is a proposal to use seawater to produce raw salts as a feedstock for processing high purity salt, fertiliser grade sulphate of potash, and potentially other commercial by-products. The proposal is located 80 kilometres (km) south-west of Karratha, in the Pilbara region of Western Australia (see Figure 1). The proposal includes access to the development envelope from Mardie Road via Pastoral Management Pty Ltd (PMPL) (Mardie Station) pastoral lease.

The proposal is on the west Pilbara coast, which has been defined for the purpose of this assessment as the area from the bottom of the Exmouth Gulf to Karratha. The southern end of the development envelope intersects the Robe River Delta Mangrove Management Area (see Figure 2). This area contains mangroves which were designated regionally significant in *EPA Advice: Protection of Tropical Arid Zone Mangroves along the Pilbara Coastline* (EPA 2001).

The proposal includes terrestrial, marine, and dredging development envelopes and a combined disturbance footprint of 11,283 hectares (ha). The development envelopes and disturbance footprints are shown in Figure 2 and are comprised of:

- 11,221 ha disturbance footprint within the 15,667 ha terrestrial development envelope
- 7 ha disturbance footprint within the 53 ha marine development envelope
- 55 ha disturbance footprint within the 304 ha dredge channel development envelope.

The proposal includes the development of seawater intakes, concentrator and crystalliser ponds, processing plants, bitterns disposal pipeline and outfall diffuser, trestle jetty export facility, dredge channel, causeway, administration buildings, drainage channels and seawalls, access/haul roads, desalination plant, borrow pits, freshwater supply bores and pipelines, and associated infrastructure (including but not limited to power supply, communications equipment, workshops, laydown areas, sewage treatment plant, landfill facility).

Salt, fertiliser grade sulphate of potash, and potentially other commercial by-products will be transported by truck from the stockpile areas to the barge-loading facility on the trestle jetty. Transshipment barges will travel offshore to dock with ocean-going vessels and transfer product from the barge into the bulk carrier vessels for overseas export.

The proponent expects production rates of 4 million tonnes per annum of salt, 100 kilotonnes per annum (ktpa) of sulphate of potash, and up to 300 ktpa of other salt products, sourced from a 150 giga-litre per annum (GL/a) seawater intake.

The proponent is Mardie Minerals Pty Ltd (Mardie Minerals). The proponent referred the proposal to the Environmental Protection Authority (EPA) on 17 April 2018. The referral information was published on the EPA website for 7 days public comment. On 13 June 2018, the EPA decided to assess the proposal at the level Public Environmental Review. The EPA published the Environmental Review Document

(ERD) (Preston Consulting 2020) on its website for public review for 10 weeks (from 29 June 2020 to 7 September 2020).

A Response to Submissions (RtS) was subsequently received in November 2020, with a final document endorsed by the EPA on 31 March 2021, providing further information and clarification to public comments received on the ERD (Preston Consulting 2021).

The proposal was determined under the *Environment Protection and Biodiversity Conservation Act 1999* to be a controlled action and to be assessed by the EPA under an accredited process.

The elements of the proposal which have been subject to the EPA's assessment are included in Table 1.

Table 1: Location and proposed extent of proposal elements

Proposal element	Location	Maximum extent or range
Physical elements		
Ponds and terrestrial infrastructure <ul style="list-style-type: none"> • concentrator ponds • crystalliser ponds • processing plants • access/haul roads • desalination facilities • causeway and stockyard • associated infrastructure (power supply, communications equipment, offices, workshops, accommodation village, borrow areas, laydown areas, sewage treatment plant, landfill facility). 	Figure 2	Disturbance footprint of no more than 11,221 ha within the 15,667 ha ponds and terrestrial infrastructure development envelope.
Marine infrastructure <ul style="list-style-type: none"> • seawater intake • bitterns disposal pipeline and outfall diffuser • trestle jetty export facility • berth pocket 	Figure 2	Disturbance footprint of no more than 7 ha within the 53 ha marine development envelopes.
Dredge channel	Figure 2	Disturbance of no more than 800,000 cubic metres within a 55 ha footprint within the 304 ha dredge development envelope.
Operational elements		
Desalination plant discharge	Discharge into ponds or bitterns stream only.	

Proposal element	Location	Maximum extent or range
Bitterns discharge	No more than 3.6 GL/a of bitterns with a specific gravity of no more than 1.25 via a diffuser, within the low ecological protection area.	
Pond seawater intake	No more than 150 GL/a from a screened intake with a maximum average intake flowrate at the screen of less than 0.15 metres per second.	
Greenhouse gas emissions		
Scope 1	45,760 tCO ₂ -e per year over the first 2 years from vegetation clearing.	
Scope 2	53,292 tCO ₂ -e per year from natural gas and diesel combustion.	
Timing elements		
Maximum project life	63 years	
Construction phase	3 years	
Operation phase	60 years	
Decommissioning phase	10 years	

Units and abbreviations

GL/a – gigalitres per annum

ha – hectare

km – kilometre

tCO₂-e – tonnes of carbon dioxide equivalent

Proposal amendments

The original proposal is set out in part A of the proponent's referral supporting information (Preston Consulting 2018) which is available on the EPA website.

The proponent requested changes to the proposal during the assessment. The changes were unlikely to significantly increase any impacts of the proposal. The EPA Chair's notice of 26 May 2020 consenting to the change is available on the EPA website.

The consolidated and updated elements of the proposal which has been subject to the EPA's assessment is included in Table 1.

Proposal alternatives

No alternative locations were considered for the proposal due to tenure constraints.

The proponent considered a number of alternative designs for the proposal, including a design with pond walls closer to the shore, which would result in greater impacts to benthic communities and habitat.

The proponent considered an alternative design which included shipping of product from an alternative port location, which reduced impacts to the marine environment, however this alternative was not considered to be feasible.



Figure 1: Regional location

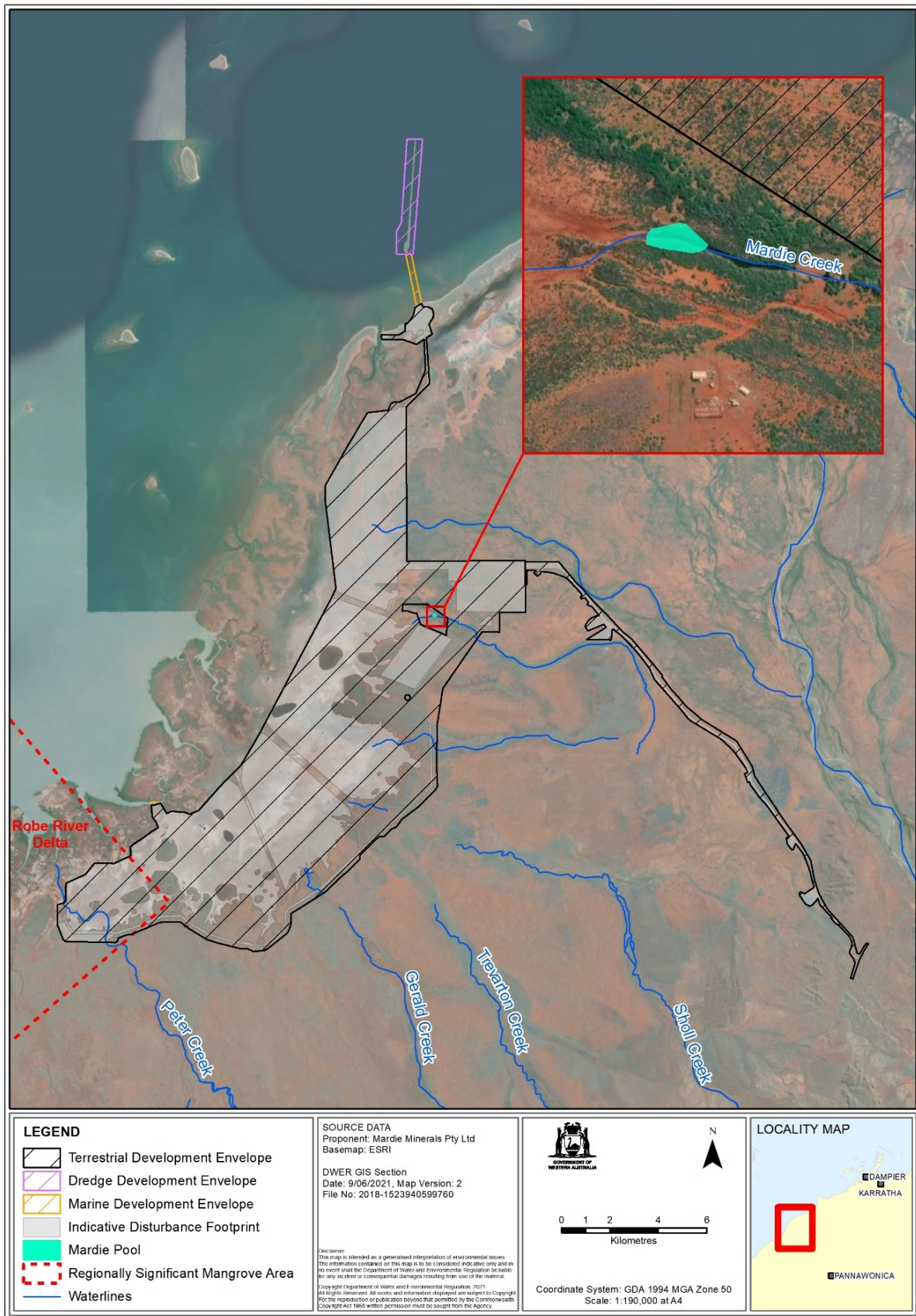


Figure 2: Development envelopes and indicative footprint

2 Assessment of key environmental factors

The EPA has determined that the key environmental factors for this assessment are inland waters, marine environmental quality, flora and vegetation, benthic communities and habitat (BCH), terrestrial fauna, marine fauna, and social surroundings.

For this assessment, the EPA has identified that intertidal BCH and subtidal BCH include different sensitive receptors and are impacted by different processes. The EPA has assessed intertidal BCH and subtidal BCH separately in this report to improve clarity and readability of the report.

2.1 Inland waters

2.1.1 Environmental objective

The EPA's environmental objective for inland waters is *to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected* (EPA 2018).

2.1.2 Investigations and surveys

The proponent conducted investigations to inform the assessment of surface water and groundwater impacts associated with the proposal, which are described in section 5.3.1 of the ERD (Preston Consulting 2020). The modelling of tidal inundation and surface water flood events, and the acid sulphate soil risk assessments carried out for the ERD are adequate to inform the EPA's assessment of the proposal.

Modelling of brine seepage and potential impacts to groundwater quality and regimes is provided in Appendix 10-1 of the ERD (Soilwater 2019). There are a number of uncertainties regarding the modelling of saline seepage impacts to groundwater regimes and quality, due to the limited number and locations of groundwater sampling points (AQ2 2020). These uncertainties are detailed in the draft groundwater monitoring and management plan (Preston Consulting 2021; Appendix 2) and in items 15, 16 and 17 of the RtS (Preston Consulting 2021).

Following the public review of the ERD, the proponent commissioned a desktop groundwater risk assessment of the groundwater investigations (AQ2 2020). This review determined that further studies are required to characterise the groundwater regime, relative to Mardie pool and coastal ecosystems. The requirement for further studies is addressed in the residual impact assessment section for groundwater below.

2.1.3 Proposal context – existing environment

Tidal inundation

Seawater floods the intertidal zone to the west of the terrestrial development envelopes intermittently, forming a shallow lake across the claypan. The extent of the flooded area varies with the height of the tidal event.

During high spring tides, the clay pan may be flooded for 4–6 hours every 12 hours. During neap tides, water is contained within the tidal creeks so that no flooding occurs and the flats may remain dry for up to 7–10 days (Preston Consulting 2020).

Storm surges, where sea levels rise as a result of strong onshore winds or low-pressure conditions, can occur during cyclone events. The combination of a high tide and cyclone event may result in tidal inundation extending several kilometres inland. On rare occasions, storm surges may reach Mardie pool.

Surface water

Rainfall is ephemeral and highly variable in the project area, with annual rainfalls between 9 mm and 886 mm (Preston Consulting 2020). Rainfall events are most common during the summer monsoons related to cyclonic activity or localised thunderstorms resulting in episodic flooding and inundation of the terrestrial development envelope.

During rainfall events surface water enters the terrestrial development envelope from upstream catchments via a number of channelised creeks (see Figure 2). This water then spreads out across the intertidal flats before draining away to the ocean through the tidal creeks. During very large rainfall events such as a 100-year average recurrence interval (ARI), inundation lasts for several hours, before discharging to the tidal creeks over one or two days, with some water remaining trapped in depressions on the flats to evaporate (Preston Consulting 2020).

Following a cyclone event, there may be particularly large flow events onto the intertidal mudflats from the upstream catchments. These flows generally occur sometime after the cyclone has abated, and therefore do not usually coincide with high tidal storm surges from the ocean.

Groundwater

The proposal area is underlain by a shelly calcarenite aquifer layer, which is covered by supratidal flats formed by deposition of terrestrial and marine sediments. The calcarenite layer outcrops into the mudflats in some areas (Preston Consulting 2020). The groundwater level was specified in the seepage modelling as around 8 metres below ground level (mbgl) but is now considered likely to be 1 mbgl (Preston Consulting 2021) (AQ2 2020).

Groundwater in the supratidal flats of the study area is hypersaline, while the underlying calcarenite aquifer is brackish to saline. All groundwater in the terrestrial development envelope has low levels of nutrients and metals (Preston Consulting 2020).

Based on regional water levels, groundwater flow appears to be generally towards and perpendicular to the coastline. Studies of similar systems suggest that density-coupled brine circulation processes may occur under coastal flats, causing upwelling of less saline groundwater beneath intertidal areas which may support intertidal benthic communities (Wood *et al.* 2002). Vertical distribution of salinity beneath the flats is undefined across the Mardie study area (Preston Consulting 2021), therefore it is unclear whether the groundwater regime at Mardie can be represented as a simple flow-through model or is subject to the more complex density coupled

circulation processes.

2.1.4 Potential impacts from the proposal

The proposal has the potential to significantly impact on inland waters from construction and operation through:

- construction of pond walls and the intertidal causeway impeding tidal flows across the intertidal area
- diversion of surface water around the ponds and through drainage channels onto the intertidal flats, and construction of the intertidal causeway changing surface water regimes in the intertidal zone, including diversion of Peter's creek in the southern area of the terrestrial development envelope
- diversion of surface water through drainage channels resulting in erosion and sediment loss, causing further changes to surface water regimes in the intertidal zone through channelisation of flows
- lateral seepage from evaporation ponds and breaches of pond walls impacting surface water quality
- brine, chemical and hydrocarbon spills impacting surface water quality
- seepage from on land dredge spoil disposal impacting surface water quality
- vertical seepage from evaporation ponds impacting groundwater quality causing groundwater mounding and altering groundwater regimes.

This proposal does not include any dewatering of groundwater.

2.1.5 Consultation

During the public review period, concern was raised in relation to the proponent's understanding of the hydrogeology of the study area, the potential for this to be more complex than currently described, and to significantly impact BCH in the intertidal zone and Mardie pool.

2.1.6 Avoidance measures

The proponent has designed the proposal to avoid impacts to inland waters by the exclusion of Mardie pool and the area around it from the terrestrial development envelope.

2.1.7 Minimisation (including regulation by other DMAs)

The proposal includes the following minimisation measures:

- Design of the intertidal rock causeway with culverts and floodways to maintain the tidal and surface water flows to the north of the project area
- Relocation of the rock causeway to the east of the original alignment to avoid direct impacts to tidal creek.
- Inclusion of two drainage corridors in the proposal design, and use of surface water spreading structures to minimise changes to surface water regimes in the intertidal zone.

- Monitoring of groundwater levels and quality down-gradient of the ponds, and implementation of groundwater seepage recovery if impacts to groundwater regimes or quality are detected.
- Monitoring of erosion at the outlets of surface water corridors after each significant flow event. If erosion occurs, then install additional erosion controls to minimise further erosion.
- Use of overflow structures to direct surface water from rainfall events greater than a 50-year ARI into the concentrator ponds.
- Use of leak detection devices and regular inspections on all pipelines to minimise the risk of brine spillages.
- Regular collection of soil samples and assessment for acid sulphate soils during construction to confirm the conclusions of the original assessment.

The EPA has determined on advice of the Department of Water and Environmental Regulation (DWER) that impacts to groundwater and surface water quality from the following aspects of the proposal can be adequately managed under Part V of the *Environmental Protection Act 1986* (EP Act) regulated through works approvals and licenses, Prescribed Premises Schedule 1, Part 1 Environmental Protection Regulation 1987:

- storage of products and spillages including brine, chemicals and hydrocarbons
- emissions and discharges from ancillary infrastructure including power supply, sewage facilities, landfills and chemical storage.

The EPA has determined on advice of Department of Mines, Industry Regulation and Safety (DMIRS) that the risk of lateral seepage and pond-wall breach is regulated by DMIRS under the *Mining Act 1978*, and that the geotechnical design of the pond wall will be reviewed and considered prior to approval of the mining proposal. DMIRS considers that this risk can be adequately managed¹.

Other aspects of the proposal which can be managed by DMIRS through the mining proposal (DMIRS 2020) required under the *Mining Act 1978* include sedimentation and erosion at pond walls and drainage channels, ongoing re-assessment of the potential for acid sulphate soils during construction, and mine closure and rehabilitation. There are provisions under the *Mining Act 1978* to condition leases i.e. Under section 82 A '*Condition to be included in certain mining leases*'.

2.1.8 Rehabilitation measures

At closure, all salts would be harvested from the ponds, which would then be opened to allow tidal flows to enter the ponds. If not requested to be retained by other stakeholders such as Pilbara Ports Authority (PPA), the intertidal causeway would be removed. Surface water drainage systems would be re-instated. Implementation of closure in areas not managed by the PPA would be regulated under the

¹ The DMIRS (2020) Statutory Guideline states that '*The mining proposal must provide information on the processes and methodologies undertaken to identify the environmental risk pathways and their potential environmental impacts, including a description of the risk assessment criteria and risk evaluation techniques*'.

requirements of the *Mining Act 1978*.

The proponent's documentation does not specify a life-of-mine or a closure date. The EPA has limited the life of this approval to 63 years, at which time the proponent would be required to either close and rehabilitate the development envelopes and all infrastructure or demonstrate that the proposal could continue without significantly impacting the environment.

2.1.9 Residual impact assessment

The EPA considers that the environmental values likely to be impacted by the proposal are tidal inundation regimes, surface water regimes, surface water quality, and groundwater quality and regimes. Key sensitive receptors that could be impacted by adverse changes to these values include Mardie pool, Intertidal BCH, and flora and vegetation.

Tidal inundation regimes

Changes to tidal regimes have the potential to impact BCH. No change to the infrequent inundation of Mardie pool by tidal flows is anticipated.

Modelling of changes to tidal inundation as a result of the proposal indicates that the extent of tidal inundation to intertidal BCH would remain the same in the presence of proposal infrastructure including the pond walls and rock causeway (with the exception of areas disturbed for the proposal) (RPS 2019). There would be no impediment to the occasional storm-surge tidal waters reaching Mardie pool as a result of the proposal.

During tidal events greater than 1.2 m, some areas of intertidal BCH would experience a greater depth of flooding as a result of tidal water building up against pond walls. The increased depth would be in the order of 10–20 cm near the walls during an extreme high tide event, and less than 5 cm in most areas of the intertidal zone. The increased depth of inundation would be present for 15–30 minutes at the height of the 4–6 hour inundation event (RPS 2019).

There is also potential for tidal inundation to drain away from pond walls more rapidly (over a shorter period of time) following a high tide event. Modelling demonstrates that for most of the modelled locations the duration of inundation remains similar during a high tide event (RPS 2019).

In the northern area of the proposal, there is potential for tidal inundation to be impeded by the proposed rock causeway. Modelling for the chosen design indicates that tidal inundation extent and depths were almost identical for the pre-development and proposal cases (RPS 2020a).

The EPA has assessed that, subject to the implementation of the causeway design described in the ERD (Preston Consulting 2020), changes to tidal inundation regimes as a result of the proposal are likely to be consistent with the EPA's factor objective to maintain hydrological regimes so that environmental values are protected.

Surface water regimes

Changes to surface water regimes have the potential to impact BCH, Flora and Vegetation, and the ecological and cultural values of Mardie pool.

Benthic Communities and Habitat (BCH)

The proposal includes diversion drains to direct surface water flows around the proposed evaporation ponds and through drainage channels onto the intertidal flats. Baffles and other surface water management structures would be used to distribute the flow across the intertidal zone, so that the pre-development flows would be maintained as far as possible. The proposal includes diversion of Peter's creek to the southern end of the ponds (see Figure 2).

Subject to implementation of surface water management, changes to the extent of flooding during a 100-year ARI would be minimal, with the majority of the intertidal zone flooded in both the pre-development and post-development scenarios. It is therefore unlikely that any area of the intertidal zone would be entirely deprived of freshwater flows during large flood events.

Modelling indicates that up to 217 ha of the intertidal zone would be subject to decreased frequency of flooding. This area would previously have flooded during the smaller 1-year ARI rainfall events (i.e, on average once a year), and now would only flood during an event greater than a 10-year ARI (i.e, on average once every 10 or more years).

Modelling also indicates that 1,389 ha of the intertidal zone would be subject to an increase in frequency of flooding. This area would usually remain dry during a 1-year ARI (i.e, this area would flood on average once in 10 or more years) and would now experience inundation in a 1-year ARI (i.e, flooding an average once per year) (see Figure 3).

The intertidal causeway has the potential to impact surface water flows to the north of the proposal area. This area includes a large basin which contains algal mat. Modelling (Preston Consulting 2021; Appendix 22) shows that the proposed causeway design would not result in any changes to the extent of flooding to the north of the causeway alignment. There would be a delay in the drainage of water out of the Northern basin through the causeway, with approximately 200 ha being subject to an increased duration of flooding up to 6 hours longer than the base case (RPS 2020a).

The EPA has assessed that the predicted changes to frequency and duration of surface water inundation have the potential to impact the health and extent of intertidal BCH. Impacts to areas of BCH subject to changes in frequency of inundation are considered in section 2.4 (BCH (intertidal)).

The EPA has assessed that, subject to implementation of the causeway design described in the proponent's ERD, the construction of the causeway is unlikely to result in significant changes to surface water flows.

The proposal could result in scouring and erosion at the areas where creeks have been diverted, and where drainage channels exit onto the intertidal flats. This could

result in channelisation of surface water flows to tidal creeks, reducing the extent of surface water flows to intertidal BCH. The EPA expects that the mining proposal² required under the *Mining Act 1978* would include details of monitoring and mitigation actions to ensure that pond walls and drainage structures do not result in erosion or scouring leading to changes in the extent of surface water flows. The EPA has assessed that erosion and scouring associated with the proposal is unlikely to have a material impact on surface water. The EPA notes that these impacts are subject to regulation by DMIRS under the *Mining Act 1978*.

Mardie pool

The catchment of Minor creek 1 which flows into Mardie pool would be reduced by the capture of rainfall by the eastern crystalliser pond. However, this reduction would be less than 5% of the volume of water expected to flow into Mardie pool during a rainfall event and is not expected to significantly impact the environmental or cultural values of the pool. There is potential for infrastructure associated with the proposal to further reduce the flow of surface water to Mardie pool in the event that drainage culverts and floodways for roads are not adequately designed.

The EPA has assessed that impacts to Mardie pool from changes to surface water flows are unlikely to be material and would meet the EPA's objectives, subject to monitoring of drainage structures to ensure that surface water diversion away from the pool is minimised.

Surface water quality

Impacts to surface water quality associated with the proposal have the potential to impact BCH, flora and vegetation, Mardie pool, and the marine environment.

Potential spills of brine, chemicals and hydrocarbons, and the risk of lateral seepage from evaporation ponds and pond-wall breaches, will be managed under other regulatory mechanisms as detailed in section 2.1.7.

Acid sulphate soil risk assessments carried out for the disturbance areas included both the proposed evaporation pond sites (Preston Consulting 2020; Appendix 10-4) and the intertidal causeway location (Preston Consulting 2020; Appendix 10-3 [Stantec 2017]). These assessments demonstrate that the presence of sulphides in the disturbance footprint and subsequent risk of acid production are unlikely.

Dredge spoil from the dredging of the channel extending out from the trestle jetty to allow for shipping activities would be transported from the dredge location to settling ponds located on coastal dunes. The dredge spoil would be consolidated via evaporation and used as construction material.

Marine sediment testing indicates that the dredge spoil would have significant acid buffering capacity, and that the only contaminants of potential concern, arsenic and nickel, are present in levels consistent with naturally elevated ambient background levels, which are low (Preston Consulting 2020; Appendix 5-1 [O2 Marine 2019]).

² In accordance with the DMIRS (2020) *Statutory Guideline for Mining Proposals* baseline environmental data, environmental risk assessment and environmental outcomes, performance criteria and monitoring is to be included within mining proposal and will be assessed by DMIRS.

However, spoil materials may contain sulphide minerals with the potential to produce harmful leachate.

Runoff from areas within which dredge spoil has been used for construction would be monitored for the life of the proposal to ensure that no contaminated water impacts the intertidal area or tidal creeks.

The EPA has assessed that impacts to surface water quality associated with the proposal are likely to be consistent with the EPA's objective for this factor. The EPA also notes that these impacts are subject to regulation by DWER through Part V EP Act; works approval and license, prescribed premises under Schedule 1, Environmental Protection Regulations 1987.

Groundwater quality and flows

Changes to groundwater quality and groundwater flows associated with the proposal have the potential to impact BCH, and the ecological and cultural values of Mardie pool, including riparian vegetation associated with the pool.

Saline seepage moving vertically from the evaporation and crystalliser ponds into groundwater may impact groundwater regimes and groundwater quality. There is a lack of certainty regarding the groundwater regime in the study area (see sections 2.1.2 and 2.1.3), and how groundwater may interact with sensitive receptors including intertidal BCH and Mardie pool.

Saline seepage may cause groundwater mounding and surface expression of saline groundwater, impacting intertidal BCH including algal mat, samphire and mangroves. The proponent has reviewed existing literature and aerial photography related to similar proposals, which suggests that this impact would be limited to an area extending 150 m from the pond walls (BCI 2021a).

There is potential that groundwater flow in the proposal area takes place through density-coupled brine circulation which causes the upwelling of less-saline groundwater which may support intertidal BCH (Preston Consulting 2021), and that saline seepage to groundwater could interrupt this system.

Groundwater flow from beneath the footprint of the crystalliser ponds has the potential to move towards Mardie creek (AQ2 2020). If high rates of seepage cause water mounding to occur, local groundwater flow directions in the area may change, with hypersaline water directed to Mardie creek upstream of Mardie pool (AQ2 2020). This could adversely impact water quality in Mardie pool and riparian vegetation associated with the pool.

The EPA has considered whether there are mitigation measures available to avoid or otherwise minimise impacts to groundwater (and subsequent impacts to Mardie pool, flora and vegetation and BCH).

The proponent has committed to management action that include implementation of saline seepage recovery in the event that saline seepage is identified as impacting groundwater quality or regimes. This would involve the use of bores and trenches within the current indicative footprint to retrieve saline seepage before it impacted any sensitive receptors, with recovered groundwater to be returned to the

evaporation ponds.

The EPA considers that the proposed mitigation of seepage recovery would be effective in preventing impacts to groundwater regimes and groundwater quality, provided that the proponent refines its understanding of the groundwater regime prior to any seepage occurring. This would require detailed hydrological investigations to characterise the calcarenite aquifer and the existing groundwater regime.

The EPA has assessed that, subject to the completion of hydrogeological investigations and development of detailed triggers, thresholds and mitigation actions, the residual impacts to groundwater from the proposal are likely to be consistent with its objective to maintain hydrological regimes and quality so that environmental values are maintained. This is subject to the EPA's recommended condition to ensure that additional investigations are carried out in an adequate manner to inform management actions.

Summary of likely residual impacts of proposal

The EPA has assessed the likely residual impacts of the proposal on inland waters to be:

1. unlikely to be significant changes to the depth and duration of tidal inundation in the project area, subject to the implementation of the causeway design described in the proponent's ERD
2. decreased frequency of surface water inundation to 217 ha of the intertidal zone, and increased frequency of inundation to 1,389 ha of the intertidal zone
3. unlikely to be material changes to surface water regimes as a result of erosion.
4. unlikely to be material changes to surface water flows to Mardie pool, subject to monitoring and management of drainage structures
5. unlikely to be material impacts to surface water quality from spills of brine, chemicals and hydrocarbons, lateral seepage from pond walls, pond wall breaches, and leachate from on shore dredge spoil disposal
6. potentially significant impacts to groundwater regimes and quality due to saline seepage from evaporation and crystalliser ponds.

2.1.10 Consideration of conditions

The EPA has considered whether the proposal can be implemented to be consistent with the EP Act Principles and EPA factor objective.

The EPA has considered whether reasonable conditions could be imposed to prevent inconsistency with the EPA's factor objective. The EPA assessment findings are presented in Table 2.

Table 2: Summary of assessment, recommended conditions and DMA regulations for inland waters

Residual impact		Assessment finding	Recommended conditions and DMA regulation
1.	Changes to the depth and duration of tidal inundation in the project area.	Likely to be consistent with the EPA objective, subject to implementation of the causeway design described in the ERD.	Regulated by: <ul style="list-style-type: none"> condition 3: causeway design
2.	Decreased frequency of surface water inundation to 217 ha of the intertidal zone, and increased frequency of inundation to 1,389 ha of the intertidal zone.	Changes to surface water regimes, resulting in impacts to intertidal BCH as a sensitive receptor. Further addressed in section 2.4 (Intertidal benthic communities and habitats).	Regulated by: <ul style="list-style-type: none"> condition 3: causeway design condition 6: Prepare and implement a Benthic Communities and Habitat Monitoring and Management Plan (BCHMMP).
3.	Changes to surface water regimes as a result of erosion.	Unlikely to be material changes subject to visual monitoring of drainage structures following rainfall events to ensure that erosion has not occurred near drainage structures and pond walls.	Noted: <ul style="list-style-type: none"> DMIRS through a mining proposal (<i>Statutory Guidelines for Mining Proposals</i> (DMIRS 2020) required under the <i>Mining Act 1978</i>.
4.	Potential changes to surface water flows to Mardie pool.	Unlikely to be material impacts subject to the adequate design and monitoring of drainage structures upstream of the pool.	Regulated by: <ul style="list-style-type: none"> condition 3: Water quality in Mardie pool.
5.	Impacts to surface water quality from spills of brine, chemicals and hydrocarbons, lateral seepage from pond walls, pond wall breaches, and leachate from on shore dredge spoil disposal.	Unlikely to be a material impact.	Noted: <ul style="list-style-type: none"> DWER through Part V EP Act; works approval and license, prescribed premises under Schedule 1, Environmental Protection Regulations 1987. DMIRS through assessment and conditioning of the mining proposal required under the <i>Mining Act 1978</i>.

Residual impact		Assessment finding	Recommended conditions and DMA regulation
6.	Potentially significant impacts to groundwater regimes and quality due to saline seepage from evaporation and crystalliser ponds, potentially impacting intertidal BCH and Mardie Pool	Likely to be consistent with the EPA's objective subject to detailed hydrological investigations, monitoring, development of triggers and thresholds and implementation of mitigation actions including seepage recovery.	Regulated by: <ul style="list-style-type: none"> condition 3: groundwater monitoring and management plan.

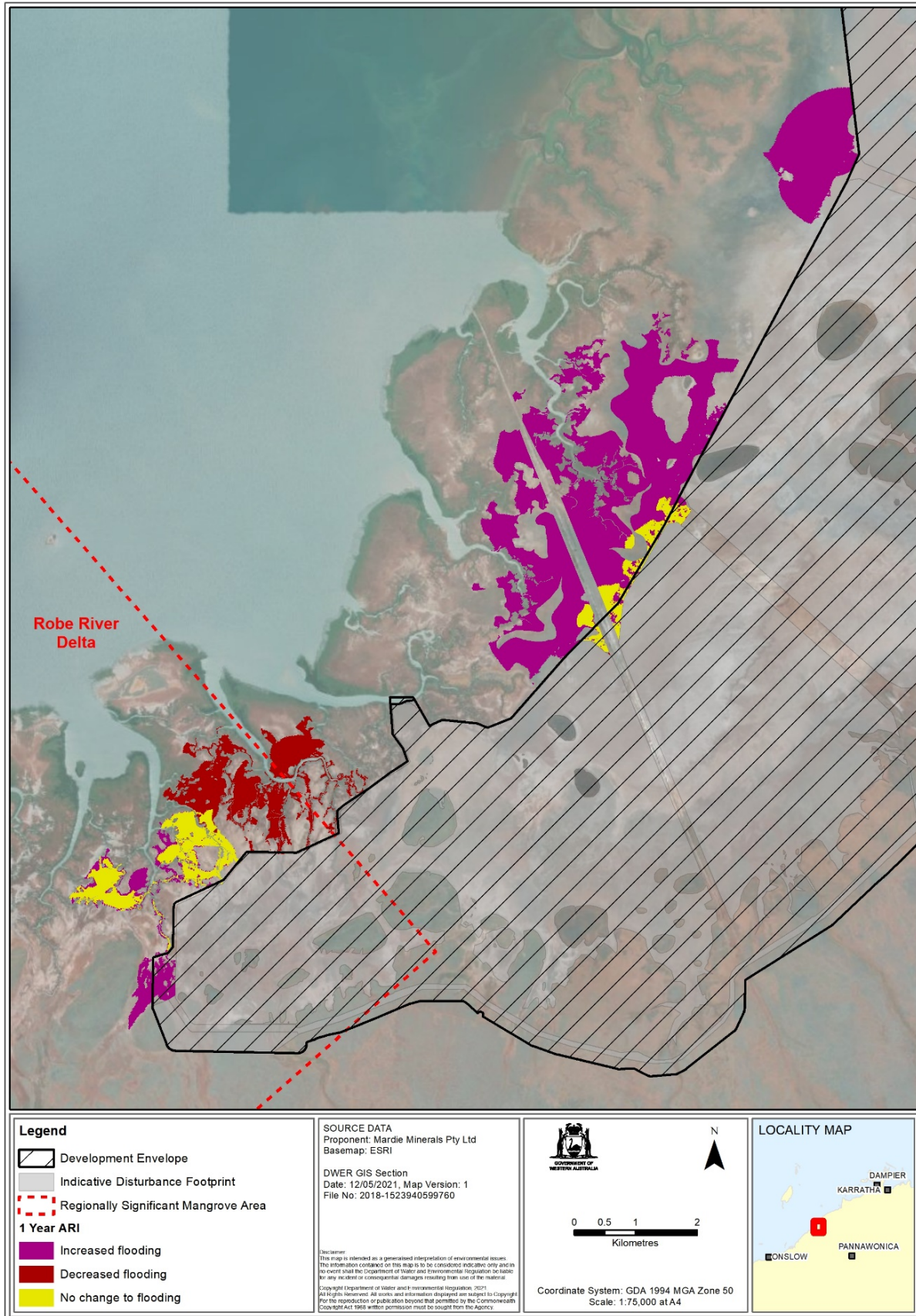


Figure 3: Changes to surface water extent during a 1-year ARI

2.2 Marine environmental quality

2.2.1 Environmental objective

The EPA's environmental objective for marine environmental quality is *to maintain the quality of water, sediment and biota so that environmental values are protected* (EPA 2016j).

2.2.2 Investigations and surveys

Details of the proponent's investigations to inform the assessment of impacts to marine environmental quality are described in section 6 of the ERD (Preston Consulting 2020).

The EPA determined that the investigations contained in the ERD and appendices were conducted in accordance with the EPA's *Technical Guidance – Protecting the quality of Western Australia's marine environment* (EPA 2016a) and *Technical Guidance – Environmental impact assessment of marine dredging proposals* (EPA 2016e) and were adequate to inform the EPA's assessment of this factor.

2.2.3 Proposal context – existing environment

The proposal area includes relatively pristine marine environment. The coastal and marine areas are not heavily utilised for any purpose. There is occasional recreational fishing and boating, however the coast is not readily accessible from the land for this purpose.

The dredge channel and bitterns disposal elements of the proposal are located in shallow waters approximately 2.2 km offshore. There are approximately nine offshore islands directly out from the proposal area which form part of a Class B nature reserve, however the closest of these islands is approximately 6 km west of the dredge channel development envelope.

Baseline data collected by the proponent indicates that the marine waters and sediments of the project area are pristine, and not currently impacted by anthropogenic impacts. (Preston Consulting 2020, O2 Marine 2020j). Inshore monitoring locations were noted to have greater turbidity than offshore monitoring locations due to frequent tidal movement, consistent with regional surveys (Preston Consulting 2020).

In the Pilbara, marine levels of ecological protection (LEPs) are established in the *Pilbara Coastal Water Quality Consultation Outcomes – Environmental Values and Environmental Quality Objectives Marine Series report No. 1* (DoE 2006). The nearshore marine waters extending approximately 2–3 km from the Mardie coastline have been assigned a 'maximum' level of ecological protection, and offshore waters have been assigned a 'high' level of ecological protection (see Figure 4).

2.2.4 Potential impacts of the proposal

The proposal has the potential to impact the quality of marine water, sediment and biota due to:

- discharge of up to 3.6 GL/a waste product (bitterns) from the evaporation ponds and desalination plant to the marine environment via a diffuser at the end of the trestle jetty approximately 2.2 km offshore
- sedimentation and increased turbidity associated with dredging up to 800,000 m³ of sediment within the dredge development envelope
- port operations including spillages and losses from windblown salt dust during ship loading and conveying of product to the transshipment anchorage points, hydrocarbon spills from vessels
- spillages of brine, chemicals and hydrocarbons to surface water entering the marine environment (assessed as a component of inland waters – see section 2.1)
- leachate from onshore spoil disposal entering the marine environment (assessed as a component of inland waters – see section 2.1)
- loss of nutrient input as a result of direct and indirect impacts to intertidal BCH (assessed as a component of intertidal BCH – see section 2.4).

2.2.5 Consultation

During public review of the proponent's ERD, submitters queried whether the modelling of bitterns discharge and dredge plumes was adequate, and raised concerns regarding the impacts of bitterns discharge.

2.2.6 Avoidance measures

The proponent has designed the proposal to avoid impacts to marine environmental quality by including on-shore disposal of dredge material to avoid additional impacts to marine environmental quality associated with dredge spoil disposal.

2.2.7 Minimisation measures (including regulation by other DMAs)

The proponent has prepared a Marine Environmental Quality Monitoring and Management Plan (MEQMMP) in accordance with *Technical Guidance - Protecting the quality of Western Australia's marine environment* (EPA 2016a) which details monitoring and management to ensure bitterns discharge criteria are met. Management and monitoring actions detailed in the MEQMMP include:

- limiting bitterns discharge rates to 3.6 GL/a
- limits to bitterns salinity concentrations
- dilution of bitterns prior to discharge
- water quality and sediment sampling and analysis
- contingency management including increased dilution, and modifications to diffuser design
- reporting commitments.

The EPA has determined on advice from DWER that impacts to the marine environment from the following aspects of the proposal can be adequately managed under works approvals and licenses required under Part V of the EP Act :

- storage of products and spillages including brine, chemicals and hydrocarbons
- emissions and discharges from ancillary infrastructure including power supply, sewage facilities, landfills and chemical storage
- management of bulk loading facilities to reduce spillages and loss of products to the marine environment.

2.2.8 Rehabilitation measures

In the event that PPA does not wish to retain the jetty and port structures, all infrastructure associated with jetty and port areas would be removed and all altered land stabilised to prevent any ongoing impacts to marine environmental quality.

As the port area is expected to be located on a lease under the *Port Authorities Act 1999*, a Mine Closure Plan for this area under the *Mining Act 1978* would not be required. DMIRS recommends that alternative measures be put in place to ensure closure of the port facility is adequately regulated.

The EPA has recommended condition 4-1 to ensure that marine infrastructure is appropriately decommissioned and removed offsite.

2.2.9 Residual impact assessment

The EPA considers the key environmental values likely to be impacted by the proposal are the quality of marine waters and marine sediments. Key sensitive receptors include subtidal BCH and marine fauna.

The EPA has assessed that the residual impacts associated with the proposal that have the potential to impact the above environmental values are bitterns disposal, increased sediments in the water column from dredging, port operations including spillages of product and hydrocarbons, and decommissioning of marine infrastructure.

Bitterns disposal

The proposal would require bitterns disposal from a diffuser located within the dredge channel at the end of the trestle jetty approximately 2.2 km offshore. Bitterns would be diluted with seawater prior to disposal, to a level that will ensure that the modelled outcomes (Baird 2020) are not exceeded. The modelling conducted was based on a diffuser consisting of 8 outfall ports spaced along a 200 m outfall.

The EPA uses an Environmental Quality Management Framework (EQMF) to assess and manage impacts to water and sediment in the WA marine environment. This involves the designation of different levels of ecological protection which are spatially defined areas which have established limits of acceptable change. There are four levels of ecological protection, maximum, high, moderate and low. The end of the trestle jetty and the diffuser are located in waters currently designated as high level of protection.

Whole of effluent testing was conducted on bitterns to determine the toxicity. The testing determined that toxicity of the bitterns was primarily related to changes in salinity which are expected to reach 325 pp (ERD Appendix 5-3).

Modelling carried out for the proposal indicated that the proposed discharge of bitterns would result in the criteria for High Level of Ecological Protection Area (HEPA) no longer being achieved in an area around the diffuser. The proponent has proposed that the areas around the diffuser be re-designated as Low Level of Ecological Protection Area (LEPA) and Moderate Level of Ecological Protection Area (MEPA). The proposed LEPA and MEPA are based on modelling of bitterns disposal and are shown in Figure 4.

Establishment of small areas of lower levels of protection within the areas designated as high or maximum by the *Department of Environment Marine Series MR1 Pilbara Coastal Water Quality Consultation Outcomes — Environmental Values And Environmental Quality Objectives* (DoE 2006) is not inconsistent with the guidance, which states that ‘*allowance has been provided in some Marine Conservation Reserve zones for approved activities that may require small areas of ecological protection less than maximum*’. The area of lower protection proposed is consistent with or smaller than those established in the vicinity of other port operations in the Pilbara.

The proposed LEPA would be less than 1.2 km long and 300 m wide at the widest point, covering an area of 17.3 ha (Preston Consulting 2021) and confined to the already disturbed dredge channel. While the entire dredge channel would be flushed several times a month by tidal movements, outside of these times bitterns would sink to the bottom of the channel, resulting in stratification, and potential anoxic conditions at the base of the channel (Preston Consulting 2020).

The proposed MEPA would extend up to 250 m from the dredge channel, covering an area of 56.8 ha. Water quality in this area would be managed and this area would be contained within the dredge channel where subtidal BCH is expected to be lost due to dredging activities. This is consistent with the *Technical Guidance – Protecting the quality of Western Australia’s marine environment* (EPA 2016a) which recommends a Moderate Level of Ecological Protection be applied in ports out to a radius of 250 m from ship turning basins and berths to accommodate potential impacts on environmental quality.

Given that the proposed LEPA and MEPA would be relatively small, and that bitterns disposal can be managed such that there would not be changes beyond these areas inconsistent with the established criteria for the existing levels of protection, the EPA has assessed that discharge of diluted bitterns through a diffuser within the dredge channel and considers the proposal can be implemented to consistent with the EPA’s objectives for marine environmental quality, subject to the implementation of management actions in the proponent’s MEQMMP, as described in section 2.2.7.

Dredge plume

Dredging has the potential to impact marine environmental quality through increased sedimentation of marine waters, and deposition of dredge sediments back to the sea floor.

Dredging will result in increased sedimentation within an area extending over approximately 970 ha during dredging and for a short time afterwards. It is expected that this sedimentation would settle out of the water column (Preston Consulting

2020). The receiving environment has a level of natural resilience to turbidity, given that the inshore areas are naturally turbid due to frequent tidal movements (O2 2020a).

The marine sediments in the dredge development envelope have been sampled and analysed (O2 2019), and are representative of natural environmental conditions. Temporary disturbance and suspension of these sediments is not considered likely to permanently impact the quality of marine waters or sediments. Impacts to subtidal BCH as a result of dredging are assessed in section 2.5 (BCH (subtidal)).

Due to the short-term nature of increased sedimentation and the inert nature of the sediments to be disturbed, impacts to marine environmental quality as a result of dredging are unlikely to be material.

Port operations including spillages of salt product during ship loading and conveying of product to the transshipment anchorage points, hydrocarbon spills from vessels

The proponent has designated two HEPA's within the 'maximum' ecological protection area designated by *Department of Environment Marine Series MR1 Pilbara Coastal Water Quality Consultation Outcomes — Environmental Values and Environmental Quality Objectives* (DoE 2006).

These areas are based on a 250m buffer around the proposed boat launching facility and the seawater intake in accordance with *Technical Guidance – Protecting the quality of Western Australia's marine environment* (EPA 2016a), and are 9.3 ha and 7.9 ha respectively (Figure 4). The HEPAs would be managed and monitored in accordance with the MEQMMP to ensure that only small changes to water quality occur. In order to meet criteria for a HEPA, changes to water and sediment quality in this area would not be so significant as to impact the health of marine biota in the area.

Establishment of small areas of lower levels of protection within the areas designated as high or maximum by the *Department of Environment Marine Series MR1 Pilbara Coastal Water Quality Consultation Outcomes — Environmental Values and Environmental Quality Objectives* (DoE 2006) is not inconsistent with the guidance, which states that '*allowance has been provided in some Marine Conservation Reserve zones for approved activities that may require small areas of ecological protection less than maximum.*' The area of lower protection proposed is consistent with or smaller than those established in the vicinity of other port operations in the Pilbara.

The existing maximum level of protection would be maintained in all areas outside of the designated HEPAs as shown in Figure 4.

The EPA has assessed that, given the relatively small areas (consistent with other port infrastructure in the Pilbara) proposed to be impacted, the high level of protection proposed to be maintained and the proposed management in the proponent's MEQMMP, impacts to marine quality associated with the boat launching facility and seawater intake are likely to be consistent with the EPA's objective for this factor, subject to implementation of the proponent's MEQMMP.

Spillages of product during boat loading and hydrocarbon spills from vessels can be managed under Part V of the EP Act.

The EPA has assessed that spillages associated with operation of the port for the Mardie Project are unlikely to be material, subject to regulation under Part V of the EP Act (Works approval and Operation license conditions).

Decommissioning of marine infrastructure including port and jetty

In the event that the PPA chooses not to retain infrastructure including the proposed jetty, boat launching facilities and other port facilities that is located on a lease under the *Port Authorities Act 1999*, closure requirements under the *Mining Act 1978* would not apply. DMIRS therefore recommends that alternative measures be put in place to ensure closure of the port facility is adequately regulated.

The proponent has committed to decommissioning the marine components of the proposal such that marine environmental quality would be preserved, including:

- removal of all marine infrastructure including the jetty, bitterns diffusers, wharf, seawater intakes, boat launching facility and navigation infrastructure to an offsite location
- abandonment of the dredge channel to gradually fill with sediment.

The EPA has assessed that the closure of the proposal would not result in material impacts to marine environmental quality subject to the implementation of the decommissioning activities as described in the proponent's ERD and above. The EPA has recommended a condition to ensure that marine infrastructure is appropriately decommissioned and removed offsite.

Summary of likely residual impacts of the proposal

The EPA has assessed the likely residual impacts of the proposal to be:

1. impacts to marine water quality from bitterns disposal, resulting in:
 - a. reduction in the level of protection from high to low, and subsequent loss of environmental quality, to 17.3 ha surrounding the bitterns disposal diffusers (LEPA)
 - b. reduction in the level of protection from high to medium, and subsequent loss of environmental quality, to 56.8 ha outside of the proposed LEPA surrounding the bitterns disposal diffusers
2. unlikely to be material impacts to marine environmental quality from temporary increased sedimentation associated with dredging
3. reduction in the level of protection from maximum to high, and potential loss of environmental quality to 9.3 ha surrounding the boat launching facility
4. reduction in the level of protection from maximum to high, and potential loss of environmental quality to 7.9 ha surrounding the seawater intake
5. unlikely to be material impacts to marine water associated with spillages of product during boat loading and in the event of hydrocarbon spills from vessels, subject to regulation under Part V of the EP Act

6. impacts to marine environmental quality from infrastructure remaining after closure of the proposal, subject to the implementation of decommissioning activities described in the proponent's ERD.

2.2.10 Consideration of conditions

The EPA has considered whether the proposal can be implemented consistent with the EP Act Principles and EPA factor objective.

The EPA has considered whether reasonable conditions could be imposed to prevent inconsistency with the EPA's factor objective.

The EPA assessment findings are presented in Table 3.

Table 3: Summary of assessment, recommended conditions and DMA regulations for marine environmental quality

Residual impact		Assessment finding	Recommended conditions and DMA regulation
1.	<p>Impacts to marine water quality from bitterns disposal, resulting in:</p> <p>a) Reduction in the level of protection from high to low, and subsequent loss of environmental quality, to 17.3 ha surrounding the bitterns disposal diffusers.</p> <p>b) Reduction in the level of protection from high to medium, and subsequent loss of environmental quality, to 56.8 ha outside of the proposed LEPA surrounding the bitterns disposal diffusers.</p>	<p>Impacts to marine water quality from bitterns disposal are likely to be consistent with the EPA's objective for this factor subject to management of bitterns in accordance with the proponent's MEQMMP.</p>	<p>Regulated by:</p> <ul style="list-style-type: none"> condition 4: implement the MEQMMP.
2.	<p>Impacts to marine environmental quality from temporary increased sedimentation associated with dredging.</p>	<p>Given that the increased sedimentation associated with dredging would be temporary, and sensitive receptors in the area are likely to be tolerant of turbid conditions, impacts to marine water and marine sediment quality as a result of dredging are unlikely to be material, subject to the</p>	<p>Regulated by:</p> <ul style="list-style-type: none"> condition 7: Implement the DMP.

Residual impact		Assessment finding	Recommended conditions and DMA regulation
		implementation of the proponent's Dredge Management Plan (DMP).	
3.	Reduction in the level of protection from maximum to high, and potential loss of environmental quality to 9.3 ha surrounding the boat launching facility.	Given the relatively small areas (consistent with other port infrastructure in the Pilbara) proposed to be impacted, the high level of protection proposed to be maintained and the proposed management in the proponent's MEQMMP, impacts to marine quality associated with the boat launching facility and seawater intake are likely to be consistent with the EPA's objective for this factor, subject to implementation of the proponent's MEQMMP.	Regulated by: <ul style="list-style-type: none"> condition 4: implement the MEQMMP.
4.	Reduction in the level of protection from maximum to high, and potential loss of environmental quality to 7.9 ha surrounding the seawater intake	As for no.3	Regulated by: <ul style="list-style-type: none"> condition 4: implement the MEQMMP.
5.	Impacts to marine water associated with spillages of product during boat loading and in the event of hydrocarbon spills from vessels	Impacts to marine water from spillages are unlikely to be material, subject to regulation under Part V of the EP Act (Works approval and Operation License conditions).	Noted: <ul style="list-style-type: none"> DWER through works approval and Operation Licence for ship loading required under Part V of the EP Act.
6.	Impacts to marine environmental quality from infrastructure remaining after closure of the proposal.	Unlikely to be material impacts to marine environmental quality from infrastructure remaining after closure of the proposal, subject to the implementation of decommissioning activities described in the proponent's ERD.	Regulated under: <ul style="list-style-type: none"> condition 4: decommissioning and removal offsite of all marine infrastructure that is not located on land managed under the <i>Mining Act 1978</i>, or retained by PPA.

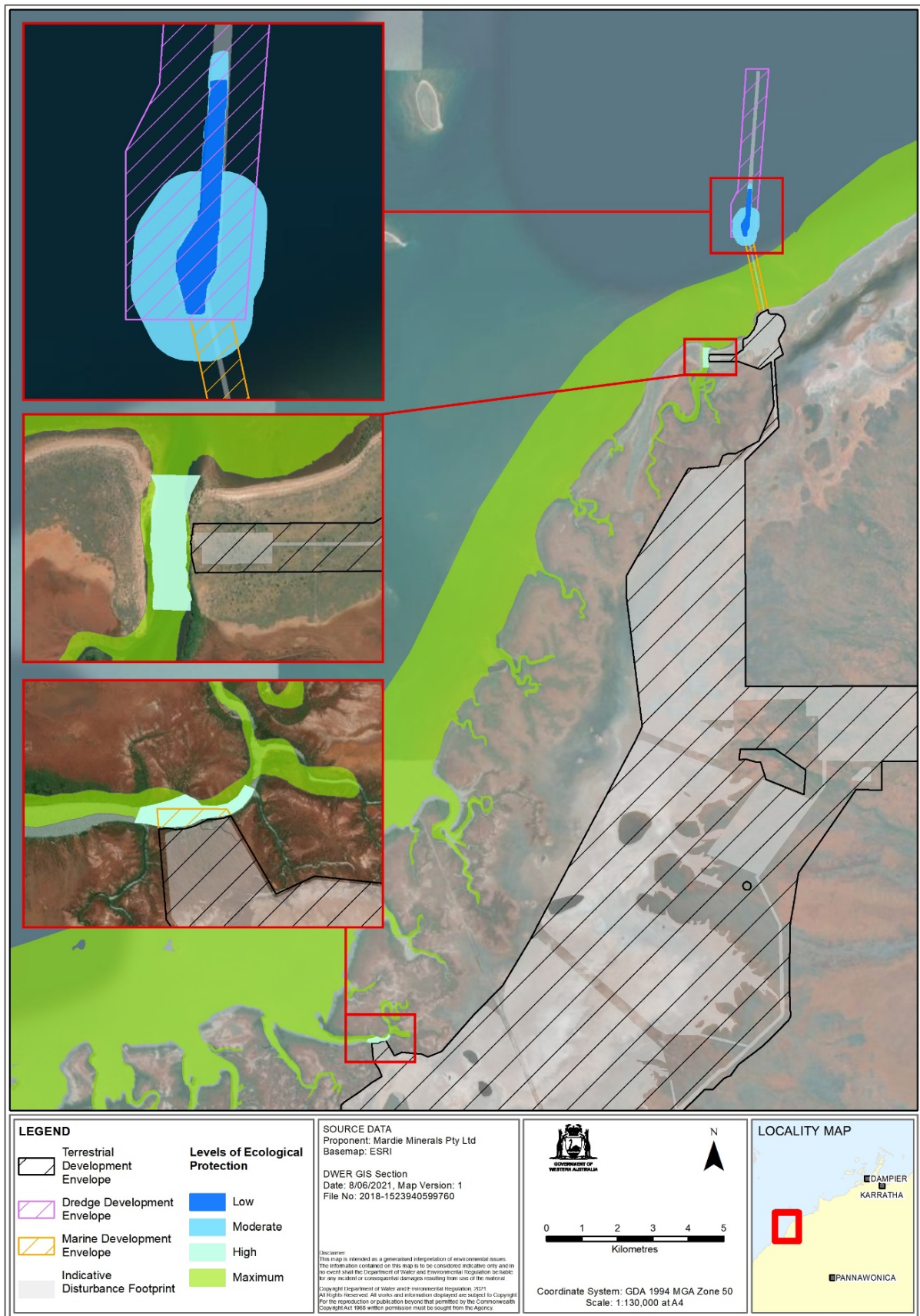


Figure 4: Marine levels of ecological protection

2.3 Flora and vegetation

2.3.1 Environmental objective

The EPA's environmental objective for flora and vegetation is to *protect flora and vegetation so that biological diversity and ecological integrity are maintained* (EPA 2016c).

2.3.2 Investigations and surveys

The proponent has commissioned the following surveys and investigations to inform the EPA's assessment of impacts to flora and vegetation:

- Detailed flora and vegetation surveys for the Mardie Project, Final Report (Phoenix 2020a)
- Independent expert review of *Tecticornia* information related to the proposal (Actis 2020).

The study area for the flora and vegetation assessment of the proposal included the entirety of the terrestrial development envelope and overlaps with the intertidal BCH study area. Extensive parts of the study area in the intertidal zone are devoid of vegetation.

The surveys for *Tecticornia* communities (Samphire) completed for the proposal were not fully consistent with the EPA's *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016d). This was in part due to the difficulty of accessing and surveying the terrain of the proposal area. The EPA determined that, while suitable for broad floristic definition, the surveys were not adequate to quantify *Tecticornia* communities at a direct impact scale.

To address the lack of specific targeted surveys for *Tecticornia* taxa and communities, and in response to consultation during the assessment of the proposal, the proponent commissioned an independent review of the available information on *Tecticornia* (Actis 2020).

The EPA has determined that, although surveys did not meet EPA (2016d) Guidance for this factor, the existing surveys, in conjunction with the expert independent review provided by Actis, provide adequate information to inform the EPA's assessment of impacts to flora and vegetation.

2.3.3 Proposal context – existing environment

The proposal is located predominantly within the Roebourne Interim Biogeographic Regionalisation of Australia (IBRA) subregion of the Pilbara bioregion.

Vegetation in the study area can be broadly categorised into mangroves, samphire shrublands, 'terrestrial' vegetation (grasslands, woodlands and shrublands), and riparian vegetation (Phoenix 2020a).

No flora species listed as threatened under the *Biodiversity Conservation Act 2016* (BC Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) or Threatened Ecological Communities (TEC) listed under the EPBC

Act or the BC Act are known to occur within the study area.

The Priority 3 Ecological Community (PEC) Horseflat Land System of the Roebourne Plains (the Horseflat PEC) falls within the terrestrial development envelope.

Sixteen vegetation types other than the Horseflat PEC were identified in the study area (excluding non-vegetated areas such as mudflat). Of these, 8 were considered locally significant.

Significant flora that were identified in the study area were Priority 1 *Minuria tridens*, Priority 4 *Goodenia nuda*, six taxa representing significant range extensions from previously known records, and one previously undescribed *Tecticornia* taxa. Four *Tecticornia* taxa could not be identified to species level and may be undescribed taxa and therefore are considered to be significant until further identification work can be carried out.

Except for the mud flats and tidal creeks, *Prosopis* spp. (commonly referred to as Mesquite) is widespread across the terrestrial development envelope. It is a weed of national significance and a declared pest under the *Biosecurity and Agriculture Management Act 2007*.

Samphire vegetation was not mapped to a community level for this proposal. The vegetation units on the landward side of the terrestrial development envelope are subject to different hydrological processes and topological conditions to those on the coastal side, resulting in distinctly different composition and coverage of species. For the purpose of this assessment, 'coastal samphire' and 'landward samphire' are used to distinguish between the two distinct areas of samphire.

2.3.4 Potential impacts of the proposal

The proposal has the potential to significantly impact flora and vegetation from:

- direct impacts to vegetation from clearing of 3,836 ha of vegetation
- changes to surface water regimes as a result of obstruction of drainage lines in the east of the proposal area
- impacts to riparian vegetation around Mardie pool as a result of saline seepage entering groundwater and migrating towards the pool
- increased risk of spreading Mesquite.

2.3.5 Consultation

During the public review period, concerns were raised about the adequacy of the surveys and identification of impacts to significant flora and vegetation, in particular *Tecticornia* taxa and *Tecticornia*-dominated vegetation (samphire).

2.3.6 Avoidance measures

The proponent has avoided direct impact to threatened and priority flora within the terrestrial development envelope, including *Minuria tridens* (listed as threatened under the EPBC Act and priority 1 by the Department of Biodiversity, Conservation and Attractions [DBCA]) by amending the development envelope to exclude the

recorded location of *M. tridens* from the development envelope.

2.3.7 Minimisation measures (including regulation by other DMAs)

The proponent has committed to the following measures to minimise impacts:

- pre-clearance surveys for Threatened and Priority flora, including *Tecticornia* taxa, and implementation of contingency actions if significant communities or taxa are identified, including avoidance of any potentially new specimen identified in surveys until it can be identified outside of the disturbance footprint (Draft BCHMMP, Preston Consulting 2021; Appendix 3)
- surveys to demonstrate that *Tecticornia*-dominated vegetation on the landward side of salt pans is contiguous beyond the project area, thereby reducing the percentage impact to this grouping and the likelihood that any individual, floristically defined vegetation units would be lost as a result of the proposal
- manage mesquite in accordance with the Mesquite Management Strategy developed by the Pilbara Mesquite Management Committee
- implement a mine closure plan to be regulated by the DMIRS under the *Mining Act 1978*.

2.3.8 Rehabilitation measures

The proponent has prepared a preliminary mine closure plan (BCI 2020) (Appendix 12 of the ERD). The EPA notes that the long life of the proposal means that the area may not be rehabilitated within the next 60 years or more. As such, the topsoil would no longer contain any viable native seedbank and rehabilitation works would require intensive measures including seeding, planting and weed management.

The mine closure plan would be regulated by the DMIRS under the *Mining Act 1978*.

2.3.9 Residual impact assessment

The following aspects of the proposal which are related to flora and vegetation have been assessed in other sections of this report:

- impacts to the extent of coastal samphire are addressed in section 2.4 (BCH (intertidal))
- impacts to the extent and diversity of mangroves are addressed in section 2.4 (BCH (intertidal))
- impacts to surface water and groundwater that could impact riparian vegetation associated with Mardie pool are addressed in section 2.1 (Inland waters).

The EPA considers that the key environmental values that could be impacted by the proposal are native vegetation, Horseflat PEC, significant flora species, *Tecticornia* taxa and diversity, landward samphire communities.

Native vegetation

Most of the disturbance footprint consists of unvegetated mudflats, algal mat and sandy beach. In accordance with the vegetation scale outlined in Trudgen 1988 and EPA *Technical Guidance – Flora and vegetation surveys for environmental impact*

assessment (EPA 2016d) the remaining disturbance footprint is vegetated. Of the 3,836 ha of vegetation to be cleared, 2,319 ha is in good to excellent condition, 1,230.5 ha is in poor condition, and 286.5ha is in degraded condition, as a result of pastoral activities and mesquite infestations.

Impacts to the Horseflat PEC (vegetation type PgvExCt) are addressed in the section below. Of the remaining seventeen vegetation types identified in the study area (see Figure 5), several have the potential to be locally significant due to providing habitat for significant or range-extended flora species. Each of these locally significant vegetation units were found to be consistent with vegetation types that extend outside of the development envelope. Impacts to these vegetation types are likely to meet the EPA's objectives for this factor.

The EPA has assessed that there is a significant residual impact associated with clearing of 2,319 ha of good to excellent condition vegetation in the proposal area. This impact is likely to be able to be counterbalanced in accordance with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014), and is likely to be consistent with the EPA's objective for Flora and Vegetation (see section 4)

The EPA has assessed that impacts to locally significant vegetation units are likely to be consistent with the EPA's objectives for this factor, subject to offsets.

Horseflat PEC

One vegetation type (PgvExCt) which intersects the terrestrial development envelope was identified as being consistent with Priority 3 Ecological Community (PEC) Horseflat Land System of the Roebourne Plains (Horseflat PEC) (see Figure 6). Surveys identified 287 ha of Horseflat PEC in the study area. The regional extent of this PEC is currently mapped at 49,432 ha.

The proposed direct impact to Horseflat PEC for the proposal is up to 145 ha. Implementation of the proposal may result in some minor indirect impacts. The proponent has committed to limiting indirect impacts to this vegetation type to 20 ha.

The EPA has assessed that direct and indirect impacts to 165 ha of the Horseflat PEC represents a significant residual impact. This impact is likely to be able to be counterbalanced consistent with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014) and is likely to be consistent with the EPA's objectives for Flora and vegetation.

Significant flora species

Excluding significant Tecticornia taxa, which are addressed in the section below, significant flora identified in the proposal area were:

- *M. tridens*, listed as Vulnerable under the EPBC Act and priority 1 under the BC Act. Records in the study area also represent an 800 km range extension from its previously known extent
- *G. nuda*, a priority 4 species
- Six species that represent range extensions of otherwise widespread species.

Each of the 6 range extension species are known to be widespread in the Pilbara region. Two of these species were located in areas which would not be directly or indirectly by the proposal. The other four were recorded at multiple locations within and outside the terrestrial development envelope and have habitats that extend outside of the terrestrial and marine development envelope. The EPA has assessed that impacts to flora species that represent range extensions are likely to be consistent with the EPA's objectives for this factor.

Surveys identified two individuals of *G. nuda* in the study area, in one location, outside of the terrestrial and marine development envelope and in an area unlikely to be directly or indirectly impacted by the proposal (see Figure 7).

M. tridens was previously known from only one specimen in Western Australia, with all other populations occurring in the Northern Territory. Approximately 75 individuals of *M. tridens* were located in 4 locations in the study area (Phoenix 2020a). Three of the locations are to the west of the terrestrial development envelope, in the intertidal zone. This area may be subject to changes to surface water and groundwater (see Figure 7). One location was to the east of the development envelope in an area unlikely to be subject to any direct or indirect impacts.

The vegetation type AcAjTE has been recognised as likely habitat for this species. The proponent has committed to pre-clearance targeted surveys for *M. tridens* in all areas of this vegetation type, and to avoid and minimise impacts to this species where practicable.

Given the location of the identified individuals outside of the terrestrial development envelope, the EPA has assessed that impacts to significant flora are unlikely to be material, subject to implementation of monitoring and management to identify and mitigate any indirect impacts to these species.

Tecticornia taxa and diversity

While targeted surveys were not conducted across the entirety of the study area, an independent expert review of the surveys undertaken concluded that adequate sites were surveyed to identify the majority of *Tecticornia* species in the survey area, and that there is no reason to believe that samphire species would be found exclusively in the impact area of the proposal (Actis 2020).

The proponent has committed to pre-clearance *Tecticornia* surveys, and avoidance of any potentially new specimen identified in surveys until it can be identified outside of the disturbance footprint (Draft BCHMMP, Preston Consulting 2021; Appendix 3).

One *Tecticornia* taxa identified during surveys was considered to represent an undescribed species and is therefore considered a significant species. Four other *Tecticornia* specimens could not be identified to species level and may also represent undescribed taxa. The locations in which these taxa were identified are shown in Figure 7.

The proponent has amended the proposal footprint to avoid the location of *Tecticornia* sp. Sterile 4 and one of the locations of *Tecticornia* sp. sterile 6. Each of the remaining taxa also occur in areas outside the terrestrial development envelope, and unlikely to be indirectly impacted by the proposal, based on current modeling.

The proponent will monitor for indirect impacts to potentially significant taxa and will mitigate impacts where required.

The EPA has assessed that there is a low risk of additional *Tecticornia* taxa being identified that are restricted to the proposal disturbance footprint, however there is a lack of scientific certainty associated with the existing flora and vegetation surveys. The EPA supports the proponent's commitment to pre-clearance surveys in areas of *Tecticornia* habitat (identified as vegetation types Tspp and TtSvTc), and implementation of avoidance and mitigation measures where significant taxa are identified, to address the uncertainty.

The EPA has assessed that impacts to *Tecticornia* taxa and diversity are likely to be consistent with the EPA's objectives for Flora and vegetation, subject to the implementation of pre-clearance surveys within *Tecticornia* habitat, the implementation of avoidance and mitigation strategies in the event that significant *Tecticornia* taxa are identified, and the monitoring of all identified significant taxa and mitigation of any indirect impacts that are identified.

Landward samphire vegetation

Samphire was not identified to community level for this proposal. The 'landward' and 'coastal' groupings of samphire were recognised as being distinct from each other, and therefore impacts to the extent of these groupings were assessed separately. Impacts to the extent of coastal samphire are considered under section 2.4 (BCH (intertidal)). The extent of landward and coastal samphire is shown in Figure 8.

The extent of landward samphire in the study area was mapped as 1,128 ha. Direct impacts to landward samphire would be up to 854 ha, representing 75.7% of its mapped extent.

Indirect impacts to the remaining landward samphire would be minimal. No landward samphire would be subject to a loss of surface water flows. Up to 41 ha may be subject to increased frequency of inundation, however as noted in section 2.4 samphire is expected to be tolerant of increased freshwater flows. No changes to tidal inundation of this vegetation are expected. There is potential for impacts associated with saline seepage intersecting groundwater as a result of the proposal, however as noted in section 2.1 (Inland waters), this impact can be managed subject to monitoring and implementation of mitigation actions.

Compared to the coastal samphire, the landward samphire communities have lower species diversity (average of six species per site) and were not identified as significant habitat for fauna or migratory birds during fauna surveys. No *Tecticornia* species were identified as being restricted to the landward samphire area, with most being found in the coastal samphire area, and/or widespread across the region. No significant fauna species were identified as being reliant on this vegetation for any part of its life cycle.

The landward communities are characterised by the absence of key species common to the coastal areas, and by the presence of some dryland species. Regional mapping and aerial photographs show similar areas of topography and vegetation extending to the north and south of the proposal area (Preston Consulting

2021; Appendix 21).

The EPA has determined that there is a low risk that any landward samphire community would be restricted to the impact footprint of the proposal. The EPA has assessed that the impact to the landward samphire is likely to be consistent with the EPA's objective for this factor, subject to implementation of the proponent's proposed pre-clearance surveys to demonstrate that these communities extend outside of the terrestrial development envelope.

Impacts to vegetation from the spread of weeds

The proposal area contains a number of known weed species. *Prosopis* spp. (commonly referred to as Mesquite) is widespread across the terrestrial development envelope, and there is a risk that the proposal could result in the spread of this weed into areas of good to excellent condition vegetation.

The proponent has committed to managing mesquite in consultation with the Pilbara Mesquite Management Committee.

The EPA has assessed that the risk of spread of weeds is likely to be consistent with the EPA's objectives for this factor. The EPA also notes that DMIRS can regulate weed hygiene practices through the mining proposal required under the *Mining Act 1978*.

Summary of likely residual impacts of the proposal

The EPA has assessed the likely residual impact of the proposal on flora and vegetation to be:

1. clearing of 2,319 ha of vegetation in good to excellent condition
2. unlikely to be significant impacts associated with clearing of locally significant vegetation units
3. clearing of 145 ha of the Horseflat PEC, and indirect impacts limited to 20 ha
4. direct and indirect impacts to the known locations of significant flora species and flora species that represent range extensions of previously known records
5. risk of impacts to the diversity of *Tecticornia* taxa
6. clearing of 854 ha of landward samphire communities
7. impacts associated with the spread of weeds, with particular regard to Mesquite.

2.3.10 Consideration of conditions

The EPA has considered whether the proposal can be implemented consistent with the EP Act Principles and the EPA factor objective.

The EPA has considered whether reasonable conditions could be imposed to prevent inconsistency with the EPA's factor objective.

The EPA assessment findings are presented in Table 4.

Table 4: Summary of assessment, recommended conditions and DMA regulation for flora and vegetation

Residual impact		Assessment finding	Recommended conditions and DMA regulation
1.	Clearing of 2,319 ha of vegetation in good to excellent condition	Significant residual impact, likely to be able to be counterbalanced. Likely to be consistent with the EPA's objectives for this factor.	Regulated by: <ul style="list-style-type: none"> condition 1: limit of extent condition 13: offsets.
2.	Impacts associated with clearing of locally significant vegetation units	Given the widespread nature of the species and vegetation types in the proposal area, impacts to locally significant vegetation types associated with the proposal are likely to be consistent with the EPA's objectives for this factor.	N/A
3.	Clearing of 145 ha of the Horseflat PEC, and potential indirect impacts up to 20 ha.	Significant residual impact, likely to be able to be counterbalanced. Likely to be consistent with the EPA's objectives for this factor.	Regulated by: <ul style="list-style-type: none"> condition 1: limit of extent – no more than 165 ha direct or indirect impacts condition 13: offsets.
4.	Direct and indirect impacts to the known locations of significant flora species and flora species that represent range extensions of previously known records.	Given the location of the identified species outside the development envelope, impacts to significant flora species are likely to be consistent with the EPA's objectives for this factor, subject to the proponent's proposed pre-clearance surveys, monitoring and management of indirect impacts.	Regulated by: <ul style="list-style-type: none"> condition 5: pre-clearance significant flora surveys condition 5: no indirect impacts associated with the proposal to the known locations of significant flora.
5.	Risk of impacts to the diversity of <i>Tecticornia</i> taxa	Likely to be consistent with the EPA's objectives for this factor, subject to the proponent's proposed pre-clearance surveys, monitoring and management of indirect impacts.	Regulated by: <ul style="list-style-type: none"> condition 5: pre-clearance significant flora surveys condition 5: no indirect impacts associated with the proposal to the known locations of significant flora condition 6: prepare and implement a BCHMMP.

6.	Clearing of 854 ha of landward samphire communities.	Likely to be consistent with the EPA's objectives for this factor, subject to the completion of pre-clearance surveys to demonstrate that the vegetation extends beyond the terrestrial and marine development envelope	Regulated by: <ul style="list-style-type: none"> condition 1: limit of extent condition 5: supplementary <i>Tecticornia</i> surveys condition 6: prepare and implement a BCHMMP.
7.	Risk of spread of weeds, with particular regard to Mesquite.	Likely to be consistent with the EPA's objective for this factor, subject to regulation by DMIRS under the <i>Mining Act 1978</i> .	Noted: <ul style="list-style-type: none"> DMIRS under the requirements of mining proposal as per DMIRS (2020) Statutory Guidelines enforced under the <i>Mining Act 1978</i>.

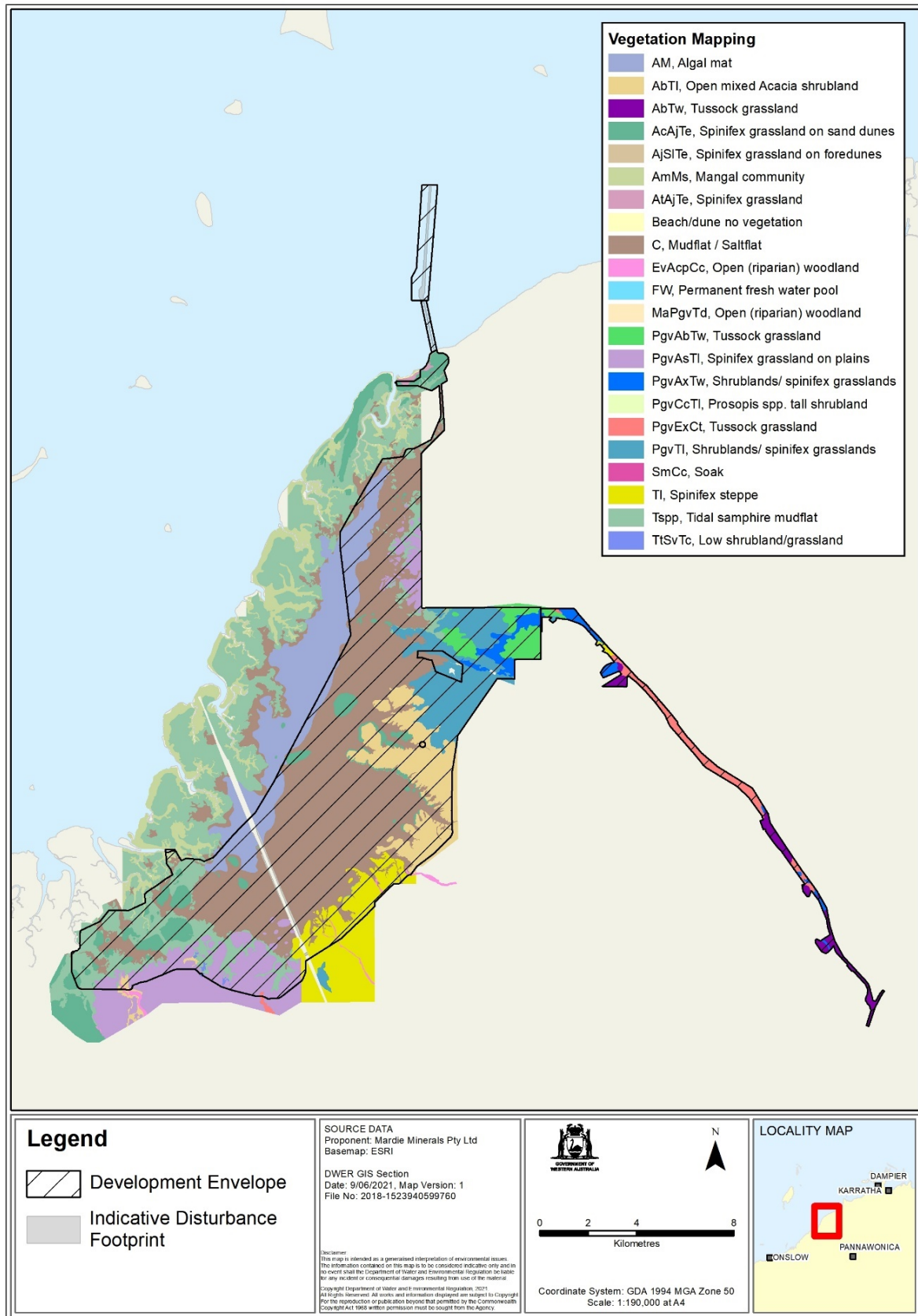
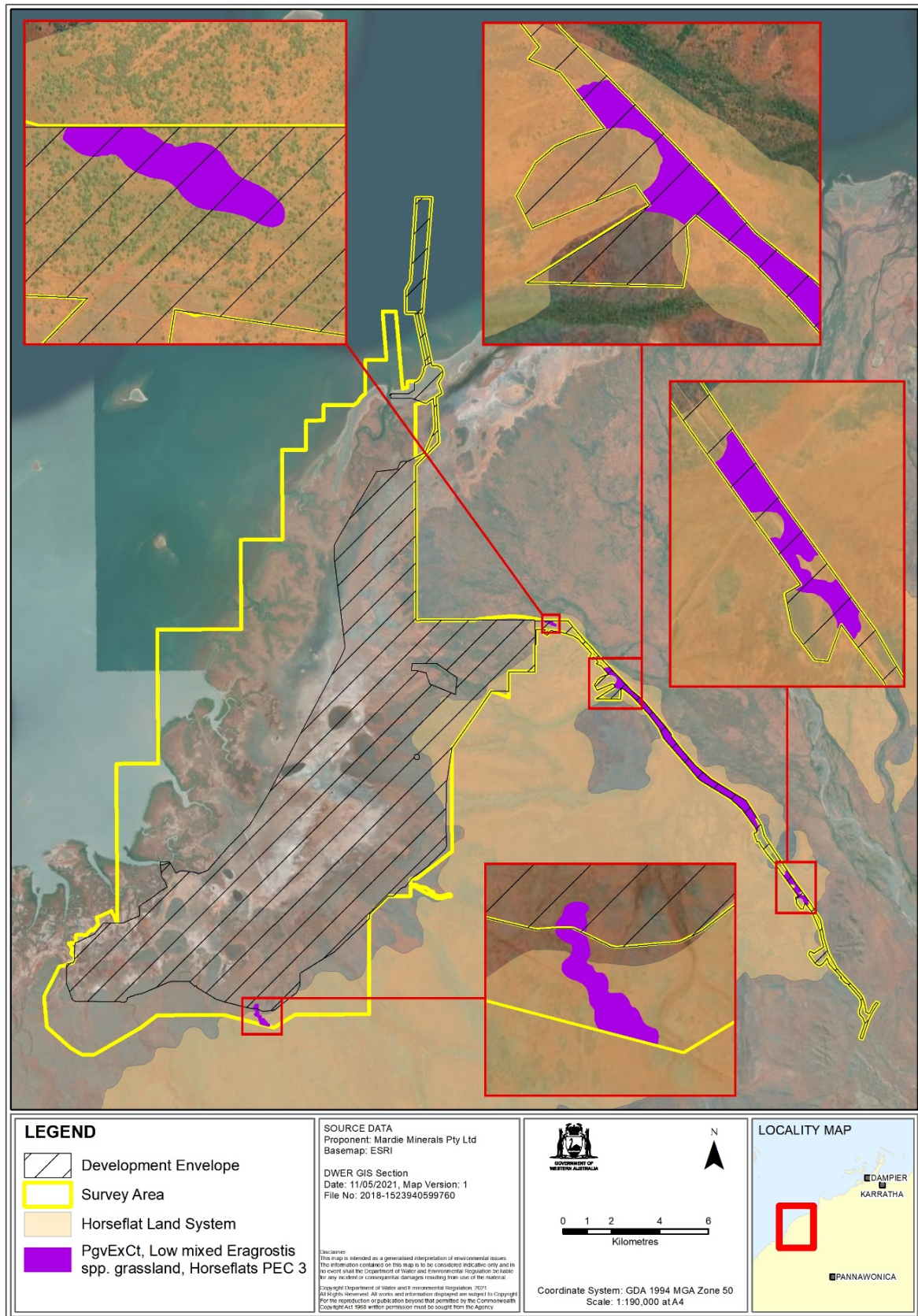


Figure 5: Flora and vegetation mapping



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Figure 6: Horseflat PEC land system and representative vegetation within the terrestrial development envelope

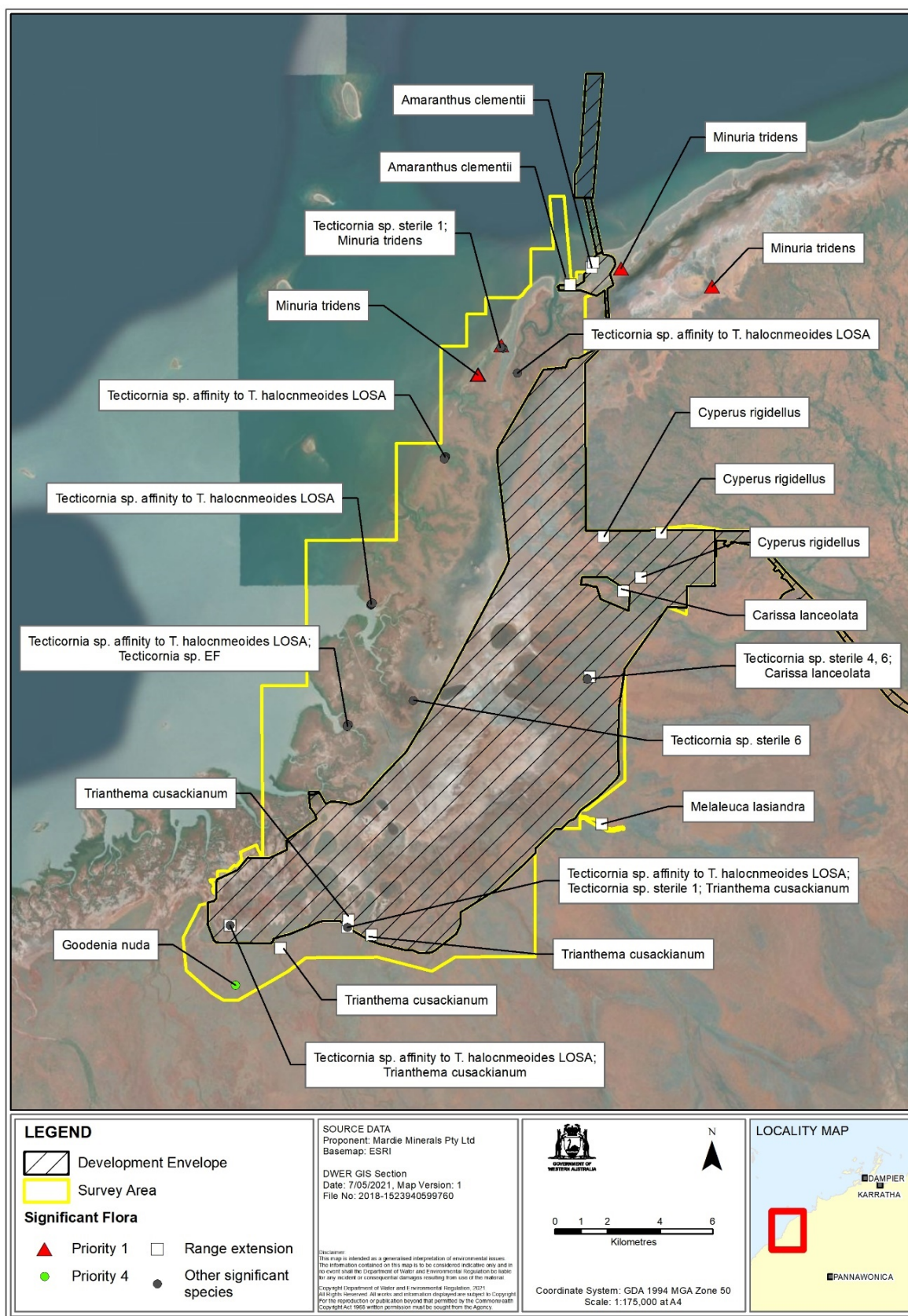
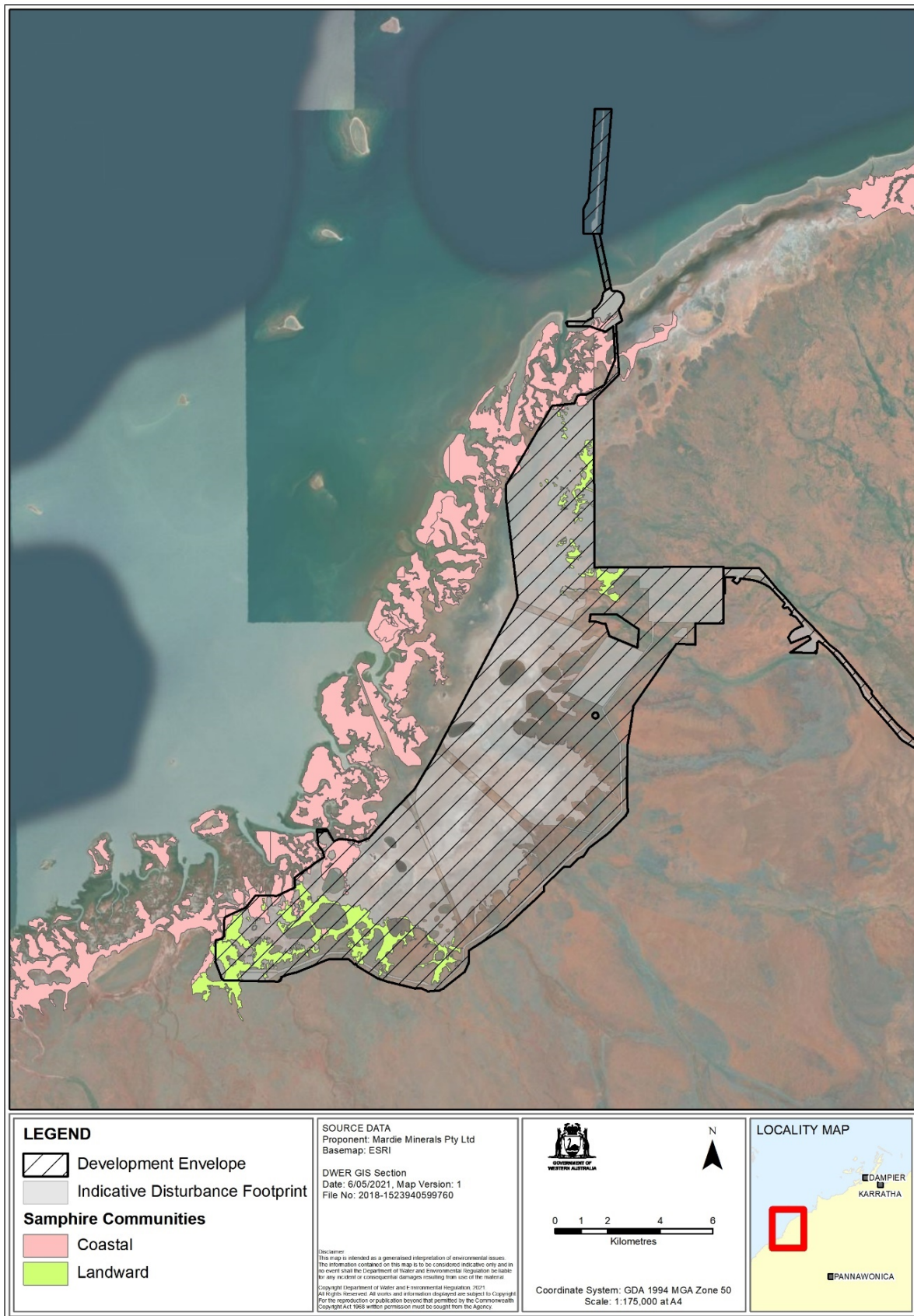


Figure 7: Significant flora identified in the terrestrial development envelope



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Figure 8: Landward and coastal samphire

2.4 Benthic communities and habitat (intertidal)

2.4.1 Environmental objective

The EPA's environmental objective for benthic communities and habitat (BCH) is to *protect benthic communities and habitats so that biological diversity and ecological integrity are maintained* (EPA 2016i).

2.4.2 Investigations and surveys

The proponent commissioned the following studies and surveys to inform the assessment of impacts to intertidal BCH associated with the proposal:

- detailed mapping of intertidal BCH (O2 Marine 2020a)
- modelling of potential changes to surface water flows and tidal inundation associated with the pond walls and other infrastructure, including the rock causeway (RPS 2019, 2020a, 2020b and 2021)
- seepage modelling assessment (Soilwater 2019) and desktop groundwater risk assessment (AQ2 2020)
- modelling and analysis of the impacts of the proposal under sea-level rise conditions (BCI 2021c).

As described in section 2.3 (Flora and vegetation), the proponent's *Tecticornia* surveys were not conducted in accordance with EPA Guidance. This is relevant in considering impacts to *Tecticornia* dominated vegetation (Samphire) in the intertidal area.

In response to concerns regarding the adequacy of the surveys, the proponent commissioned an independent review of available information relating to *Tecticornia* (Actis 2020).

The EPA considers that in this instance, based on the conclusions of the independent review, the proponent's assessment of intertidal Samphire as a single mosaic is appropriate to inform the assessment of impacts to intertidal BCH for this proposal.

The study area for intertidal BCH is defined by six Local Assessment Units (LAUs), which were determined in consultation with the Department of Water and Environmental Regulation (DWER) and consistent with *Technical Guidance – Protection of benthic communities and habitats* (EPA 2016b). The LAUs cover an area of 35,702 ha and include all areas of intertidal BCH with the potential to be directly or indirectly impacted by the proposal (see Figure 9).

The EPA has determined that the BCH mapping, surface water modelling and tidal inundation modelling carried out by the proponent are adequate to inform the EPA's assessment of the proposal. A number of uncertainties remain with regard to the quantification of potential impacts associated with saline seepage and groundwater.

2.4.3 Proposal context – existing environment

Intertidal habitats in the study area are relatively undisturbed (O2 Marine 2020a) with the exception of an existing gas pipeline that intersects the southern part of the terrestrial development envelope. Surveys identified the following intertidal BCH types in the study area (see Figure 9):

- algal mat
- foreshore mudflat/tidal creek
- mangroves
- rocky shores
- samphire
- mudflats
- sandy beach
- sand dune.

Of these, the proposal has the potential to significantly impact algal mat, mangrove, and samphire. The ERD describes the composition and distribution of intertidal BCH across the study area (Preston Consulting 2020).

The southern end of the terrestrial development envelope intersects the Robe River Delta Mangrove Management Area (RRDMMA) (see Figure 9). This area was identified in *EPA Guidance Statement No. 1 – Protection of tropical arid zone mangroves along the Pilbara coastline* (EPA 2001) as containing regionally significant mangrove habitat.

2.4.4 Potential impacts of the proposal

The proposal has the potential to significantly impact on intertidal BCH from:

- direct impacts to intertidal BCH from placement of infrastructure including evaporation and crystalliser ponds, including impacts within the RRDMMA
- changes to tidal inundation as a result of pond wall and causeway placement and design
- changes to overland freshwater flows during intermittent rainfall events as a result of pond wall and causeway placement and design, including impacts within the RRDMMA
- potential indirect impacts to intertidal BCH from the interaction of saline seepage with groundwater, including impacts within the RRDMMA
- placement of pond walls resulting in loss of capacity for intertidal BCH to migrate inland in response to sea-level rise scenarios.

2.4.5 Consultation

During the public review of the proposal, concerns were raised about the proponent's assessment of the ecological values of algal mat, loss of capacity for intertidal BCH to adapt to climate change, quantification of indirect impacts to intertidal BCH, with

particular regard to the proposed rock causeway, and impacts to intertidal BCH from saline seepage to groundwater.

2.4.6 Avoidance measures

The proponent has designed the proposal to avoid direct impacts to mangrove habitat in the RRDMMMA.

2.4.7 Minimisation measures (including regulation by other DMAs)

The proponent has committed to the following impact minimisation measures:

- Locate evaporation ponds as far inland as practicable to utilise areas of bare clay pans, reducing impacts to mangrove and coastal samphire habitat.
- Inclusion of two 300 m wide drainage corridors and surface water management structures to maintain the surface water regime in the intertidal zone.
- Inclusion of surface water management structures and diversions to maintain the volume of discharge from Peter's creek to the intertidal zone.
- Inclusion of culverts and floodways in the rock causeway to maintain flow regimes on both sides of the causeway.
- Monitoring of erosion at outlets of drainage corridors and installation of erosion protection as required.
- Monitoring of indirect impacts to intertidal BCH and implementation of management measures as required.
- Monitoring of groundwater levels and salinity west of ponds to verify any seepage to groundwater, and implementation of seepage recovery measures, including recovery bores and trenches, as required.
- Monitoring of intertidal BCH, and implementation of adaptive management actions, including alteration of drainage structures where practicable, if monitoring indicates adverse impacts.
- Monitoring of samphire health and distribution, and implementation of adaptive management actions where possible.
- Monitoring of mangrove health and extent, and implementation of mitigation measures where impacts are identified, including re-distribution of surface water flows associated with Peter's creek. Drainage structures to achieve this outcome would be incorporated into the footprint.

The EPA has determined on advice from DMIRS that the risk of lateral seepage and pond-wall breach can be regulated by DMIRS under the *Mining Act 1978*, and that the geotechnical design of the pond wall will be reviewed and considered prior to approval of the mining proposal. DMIRS considers that this risk can be adequately managed.

The EPA has assessed that the draft Mine Closure Plan provided by the proponent contains appropriate outcomes and closure objectives to adequately manage closure of the proposal. The EPA notes that aspects of this proposal that are regulated by DMIRS include mine closure and rehabilitation.

2.4.8 Rehabilitation measures

The proponent has not provided a defined life of proposal as the project has an infinite life span. The EPA has recommended a condition to limit the life of this approval to 63 years, at which time the proponent would be required to either close and rehabilitate the proposal or demonstrate that the proposal could continue without significantly impacting the environment.

Following closure of the proposal, all salts would be harvested from the evaporation and concentrator ponds, the walls would be flattened OR opened up to allow tidal flows to enter the pond, and ponds rehabilitated to an acceptable landform.

A preliminary mine closure plan has been prepared to detail and regulate the above commitments (BCI 2020). The MCP would be finalised through consultation with DMIRS as required under the *Mining Act 1978*.

2.4.9 Residual impact assessment

The EPA considered that the key environmental values likely to be significantly impacted by the proposal are algal mat, coastal samphire and mangroves, including mangrove habitat in the RRDMMA. Values associated with intertidal BCH include:

- primary productivity
- ecosystem maintenance
- nutrient cycling
- habitat values including foraging habitat for migratory birds (samphire), breeding and nursery habitat for significant marine species (mangroves), and intermittent foraging habitat for marine species (algal mat).

The proponent commissioned a review of the significance and ecological values of intertidal BCH in the region (O2 Marine 2020b). During consultation, the EPA received conflicting advice regarding the ecological role of algal mat in the project area. In the absence of agreement on this issue, the EPA has determined to assess the impacts to algal mat based on the assumption that algal mat has high values in supporting the marine and intertidal ecosystems of the project area.

Impacts to the biodiversity of intertidal BCH

The EPA considers that there is low risk of any novel or rare *Tecticornia* species being restricted to the proposal area as detailed in section 2.3 (Flora and vegetation).

Consistent with other mangrove habitat on the Pilbara coastline, 3 mangrove species were recorded across the surveys area. These species are known to be widespread along the Pilbara coastline (Preston Consulting 2020). The EPA considers that the proposal would not result in impacts to the diversity of mangrove taxa in the region.

The EPA has assessed that impacts to the diversity of intertidal BCH are unlikely to be material and that this aspect of the proposal is likely to be consistent with the EPA's objectives for this factor.

Direct impacts to the extent of intertidal BCH

Direct Impacts to intertidal BCH would be:

- coastal samphire – 296 ha representing 7.2% of the extent within the study area
- algal mat – 880 ha representing 25% of the extent within the study area
- mangroves outside of the RRDMMMA – 13 ha representing less than 0.5% of the extent within the study area
- mangroves inside the RRDMMMA – 4 ha representing less than 0.5% of the extent within the study area.

Coastal samphire

The EPA has assessed that the loss of 296 ha of coastal samphire habitat would represent a significant residual impact due to the associated loss of habitat value for migratory birds. Given the large areas of continuous samphire that would remain in the proposal area to ensure the maintenance of ecosystem and habitat values, the EPA has determined that impacts to coastal samphire from the proposal can be made consistent with the EPA's objective to *protect benthic communities and habitats so that biological diversity and ecological integrity are maintained*, and that the significant residual impact associated with this disturbance could be counterbalanced in accordance with the WA Offsets Guidelines (Government of Western Australia 2014).

Algal mat

Algal mat in the area have not been recorded as providing foraging habitat for significant species such as migratory birds, and no known species are considered to be solely reliant on algal mat as a habitat or food source (Stantec 2018).

The West Pilbara coastline (from the bottom of the Exmouth gulf to Karratha) is currently mostly undeveloped and large areas of algal mat would remain along the coast. Although the regional extent of algal mat on the West Pilbara coast has not been extensively surveyed, estimates provided by DWER from aerial images indicate that the direct cumulative regional losses from this proposal and existing proposals would be less than 14% of the regional extent, with up to 86% of regional extent remaining.

Up to 75% of the local extent of algal mat mapped in the study area would not be disturbed for this proposal. The EPA has assessed that nutrient cycling and other ecosystem maintenance functions of algal mat would be supported by the remaining local and regional extent of algal mat and mangrove communities, given the current extent of algal mat in the region.

Protection of tropical arid zone mangroves along the Pilbara coast - Guidance Statement No.1 (EPA 2001) (Guidance Statement No.1), states that '*algal mat associated with undisturbed mangroves in the region should not be significantly impacted.*' The EPA has determined that direct impacts to algal mat would represent a significant residual impact due to the loss of ecosystem maintenance functions associated with the loss.

Due to the extent of algal mat that would remain to maintain ecosystem functions, and the absence of biota which are solely reliant on this habitat, the EPA has determined and considers that the significant residual impact associated with the proposed disturbance of algal mat from the proposal can be implemented to be consistent with the EPA's objective to *protect benthic communities and habitats so that biological diversity and ecological integrity are maintained*, it is likely to be able to be counterbalanced in accordance with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014).

Given the current lack of knowledge in regard to algal mat on the Pilbara coast, the significant residual impacts to algal mat could be counterbalanced through research aimed at improving knowledge of the values, interactions and subsequent management of intertidal BCH in the region.

The EPA considers that any expansion of the proposal, or future proposals on the west Pilbara coast, would require careful consideration of the cumulative impacts to algal mat in the region, and has provided other advice in section 7 (Other advice).

Mangroves

Given the regional and local extent of mangrove habitat, and the relatively low proportion to be cleared within each LAU (ERD), the clearing of 13 ha of mangroves outside of the RRDMMMA is likely to be consistent with the EPA's objectives for this factor. Clearing of mangroves in the Pilbara represents a significant residual impact, which can be counterbalanced in accordance with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014).

Clearing of mangroves within the Mangrove Management Areas established under Guidance Statement 1 is a relevant consideration for this assessment. The clearing of 4 ha of mangroves within the RRDMMMA is inconsistent with the requirements and considerations of Guidance Statement No. 1. Mangroves within the RRDMMMA are identified within the guidance as regionally significant mangroves. The objective for regionally significant mangrove habitat stated in the guidance is that '*no development should take place that would adversely affect the mangrove habitat*'.

The proponent has provided the following additional information regarding the proposed direct impacts within the RRDMMMA in relation to Guidance Statement No.1 (Preston Consulting 2021a):

- The proponent has demonstrated minimisation and avoidance of mangroves in the RRDMMMA, including re-design of the pond layout during the course of the EIA process through a change to proposal under S43A of the EPA Act approved on 26 May 2020.
- The proponent attempted to balance the requirement for a large evaporation area to operate a viable solar salt project, with the environmental values across the proposal area, including algal mat and samphire. The avoidance of other environmental values resulted in a small impact to mangroves within the RRDMMMA being required.
- In redesigning the pond layout the proponent has avoided all areas of closed canopy mangroves, with all impacts to mangroves within the RRDMMMA being to

the lower-biomass sparse canopy mangroves. The mangroves to be impacted are at the fringes of tidal creeks extending away from the intertidal zone.

- The proposed disturbance represents less than 0.5% of the total mangrove extent within LAU 6. This disturbance is likely to have a negligible impact on the local and broader mangrove habitat within the RRDMMA.

Having given consideration to the above information, and to the objectives of Guidance Statement No. 1, the EPA considers that the clearing of 4 ha of mangrove habitat within the RRDMMA may not be fully consistent with the objective of Guidance Statement No. 1. It is noted that the proposal would also include clearing of other BCH and vegetation in the RRDMMA, and that this clearing is not inconsistent with guidance, subject to the below discussion regarding disturbance of hydrological processes.

Having given due consideration to the objectives of Guidance Statement No. 1, the EPA considers that the proposed level of clearing within the RRDMMA could be implemented without impacting the ecological functions of mangroves in the RRDMMA. The EPA notes that this small level of clearing, representing less than 0.5% of the mangroves in the relevant LAU would not be inconsistent with the EPA's objectives for this factor, based on the consideration of hydrological processes below.

Changes to tidal inundation

Modelling of changes to tidal inundation as a result of the development indicates that the extent of tidal inundation to intertidal BCH would remain the same in the presence of proposal infrastructure including the pond walls and rock causeway. Some areas of intertidal BCH would experience a greater depth of flooding, and there is potential for tidal inundation to drain away from pond walls more rapidly following a high tide event. In the northern area of the proposal, there is potential for tidal inundation to drain more slowly through the causeway (Preston Consulting 2020).

The increased depth and decreased or increased duration of inundation would be present for only a few hours in each high tide (RPS 2019). The EPA has determined that these small changes are unlikely to impact the distribution or health of intertidal BCH. The EPA has assessed that impacts to intertidal BCH from changes to tidal inundation as a result of the proposal are unlikely to be material and are therefore likely to be consistent with the EPA's objective for this factor.

Changes to surface water flows

Modelling conducted for the assessment (BCI 2021d) concludes that the potential changes to surface water regime in areas of intertidal BCH would be:

- Increased frequency of freshwater flooding to 633 ha of algal mat, 424 ha of coastal samphire and 40.4 ha of mangroves, including 18.7 ha within the RRDMMA. These areas would be flooded during a 1 year ARI event, where prior to development they would only flood during a less frequent (higher intensity) event.
- Loss of freshwater flows during a 1 year ARI event to 50.3 ha of coastal samphire, and 143 ha of mangroves, including 130 ha within the RRDMMA, due

to the diversion of Peter's creek around the southern end of the indicative footprint.

Increased inundation

In areas subject to increased freshwater flows, the additional periods of inundation would be relatively short in duration, and normal salinity balances would be restored during the next high tide event (Preston Consulting 2021). The EPA considers that mangrove and samphire species in this area are likely to be tolerant to additional freshwater flows, as other areas of similar vegetation in the study area are subject to freshwater flows during one-year ARI events (Preston Consulting 2020). It is also likely that Algal mat would be resilient to increased frequency of freshwater flows, given that desiccated algal mat have been observed to rehydrate and commence primary production in the presence of rainfall (Williams 2014).

There is a low risk that the increased flushing of these areas would change the salinity regime such that the distribution of intertidal BCH would be impacted. The EPA has assessed that impacts to intertidal BCH associated with increased inundation are unlikely to be material and is likely to be consistent with the EPA's objectives for this factor, subject to the implementation of monitoring and adaptive management actions.

Reduced inundation

Areas of intertidal BCH (mangrove and samphire) which are predicted to be deprived of freshwater flows during a one-year ARI event would still be expected to receive flows during less frequent events (i.e, 10-year ARI or greater). The residual impact to these areas would be a reduction in the frequency of inundation, rather than a complete loss of freshwater flows. No area of algal mat would be subject to a reduced frequency of inundation as a result of this proposal.

Samphire

The proponent's modelling indicates that 50.3 ha of coastal samphire would be subject to reduced frequency of freshwater inundation (BCI 2021). These communities may be adversely impacted as some *Tecticornia* species are likely to rely on freshwater pulses in order to germinate (Preston Consulting 2020d). It is unclear to what extent samphire would be impacted. In the worst-case scenario that all samphire subject to reduced frequency of inundation is lost, the cumulative direct and indirect impacts to samphire would be 8.4% of the extent mapped in the study area.

The loss of coastal samphire would represent a significant residual impact, with regard to values relating to habitat for migratory bird species, and ecosystem maintenance. This impact could be counterbalanced in accordance with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014). Monitoring would be required to ensure that losses of Samphire are recorded and offset appropriately.

The EPA has assessed that the likely cumulative impacts to coastal samphire from direct impacts and reduced frequency of inundation would likely be consistent with the EPA's objectives for BCH subject to the implementation of monitoring and

adaptive management actions.

Mangrove

The proponent's modelling indicates that up to 143 ha of mangroves has the potential to experience reduced frequency of freshwater flows (BCI 2021d), including up to 130 ha within the RRDMMA.

The proponent has concluded that arid zone mangrove species are not likely to be reliant on frequent freshwater inflows (Preston Consulting 2021), as there are areas of similar mangrove in the study area that are not inundated during a one-year ARI event (Preston Consulting 2021). This conclusion is supported by a study conducted for the Yannarie Solar Salt project (Biota, 2005), which stated that the value of freshwater inputs to mangrove habitat in the Exmouth Gulf was negligible, and earlier studies indicating that the importance of freshwater input to mangroves decreases with increasing aridity (Gordon 1988).

The EPA has determined that a risk remains that the predicted reduction in frequency of freshwater flows to mangroves could adversely impact the health or extent of mangroves in the study area. Guidance Statement No. 1 states '*freshwater inflows and quality should be maintained in undisturbed mangrove areas*'. Adame *et al* (2021) notes that altered hydrology resulting in hypersalinity is a threat to arid-region mangroves.

In the event that a worst-case scenario occurs, in which decreased frequency of inundation results in the loss of mangroves in the affected areas, the cumulative direct and indirect impacts to mangrove habitat associated with the proposal would be 4.4% of the extent mapped in the study area.

Any loss to mangrove habitat is considered to be a significant residual impact. The EPA has assessed that in this instance, the impact could be counterbalanced in accordance with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014).

The EPA has assessed that, subject to the implementation of monitoring and mitigation measures to minimise impacts to mangrove habitat, cumulative impacts to mangrove habitat from direct disturbance and decreased frequency of freshwater inundation would likely be consistent with the EPA's objectives for this factor.

The areas subject to decreased frequency of inundation include 130 ha of mangrove habitat within the RRDMMA. In a worst-case scenario, this could increase the cumulative impact to mangroves within LAU 6 (which corresponds to the northern end of the RRDMMA) to 8.8%. Decreased inundation in this area would be caused by the diversion of Peter's creek around the indicative footprint.

Guidance Statement No. 1 includes an objective for the RRDMMA of '*no development that would adversely affect... the maintenance of ecological processes which sustain the mangrove habitats*.' Guidance 1 further states that '*The EPA will give these mangrove formations the highest degree of protection*'. Therefore, the risk associated with decreased frequency of inundation of mangroves within the RRDMMA is not fully consistent with the requirements of Guidance Statement No. 1.

The EPA has given due consideration to the objectives of Guidance Statement No. 1, and considers that at this time the proponent has not demonstrated that the proposed disturbance inside the RRDMMA, including diversion of Peter's Creek, would not significantly impact the maintenance of ecological processes that sustain mangrove habitats. However, the EPA has determined that the proposal could be implemented subject to minor amendments to maintain these processes. The EPA has recommended a condition to ensure that the final design of any disturbance in this area is designed to avoid any changes to ecological processes that maintain mangrove communities.

Impacts to groundwater quality

The potential for impacts to groundwater quality and regimes is addressed in section 2.1 (Inland waters). There is a lack of scientific certainty regarding potential impacts to groundwater quality and groundwater regimes associated with saline seepage from evaporation ponds. However, the EPA has concluded that the proponent's proposed mitigation measures, including monitoring and seepage recovery where required, are likely to be effective in preventing significant impacts to groundwater and to sensitive receptors including intertidal BCH.

As concluded in section 2.1, the EPA has assessed that impacts to BCH from saline seepage to groundwater is likely to be consistent with the EPA's objectives for this factor, subject to the implementation of monitoring and mitigation measures.

Capacity to adapt to climate change

Little is known about the precise salinity and hydrological requirements of intertidal BCH. Sea-level rise as a result of climate change is expected to result in the inland migration of intertidal BCH ahead of rising sea-levels (EPA 2008). In a non-development scenario, the BCH would migrate inland until a rise in land at the high-water shoreline prevents further movement, at which time the BCH would be lost. There is potential that the pond walls would prevent this inland migration, resulting in loss of BCH earlier than expected in a non-development scenario.

The proponent has provided an analysis (BCI 2021d) which indicates that while mangroves and samphire might be expected to move inland, algal mat is likely to be lost under both the pre-development and post development scenario due to increased flushing of the shallow basins in which they are generally found. It is also noted that inland migration of algal mat would be subject to future sediment dynamics creating new depressions further inland.

Modelling conducted for the assessment has been provided to characterise the potential impacts of the proposal under a 0.9m relative sea level rise (BCI 2021d). In tidal events in which tide levels approach and partially inundate the pond walls, it is expected that the walls would result in a short-lived increase in tidal depth relative to the non-development scenario. Tidal waters are also expected to discharge back to the ocean more quickly than in a non-development scenario, because they would be discharging back over a shorter distance than in the pre-development case due to the location of the walls. These effects would be magnified by sea level rise because the frequency of inundation events reaching the walls would be increased (BCI 2021d).

Due to the greater depth and faster discharge of tidal inundation, sea-level rise scenarios are likely to result in increased flushing of the intertidal zone, potentially resulting in changes to salinity levels in the intertidal zone. It is noted that these changes could also occur to a lesser extent in a non-development scenario due to the increased depth and frequency of tidal inundation associated with sea-level rise.

While there is no clear evidence that intertidal BCH would move inland in the study area (BCI 2021d), there is some likelihood that mangroves and samphires might. The proposal would therefore result in a reduction in the capacity of some intertidal BCH to adapt to climate change. This could result in loss of these areas of BCH up to 20 years earlier than would occur in a non-development scenario (Preston Consulting 2020). The Mardie Project combined terrestrial, marine and dredge channel development envelopes are approximately 27 km long, impacting approximately 7.9% of the west Pilbara coast, from the bottom of the Exmouth Gulf to Karratha.

The loss of capacity to adapt to climate change for samphires and mangrove habitat represents a significant residual impact to intertidal BCH. The EPA has assessed that residual impact could be counterbalanced in accordance with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014), through research aimed at improving management of intertidal BCH in the region in the event of sea-level rise (see section 4).

Given that there is a strong possibility that loss of this BCH would occur in a non-development scenario, and that a relatively small percentage of the regional coastline would be impacted, the EPA has assessed that this impact is likely to be consistent with the EPA's objective for BCH, subject to offsets.

Summary of likely residual impacts of the proposal

The EPA has assessed the likely residual impact of the proposal on intertidal BCH to be:

1. direct disturbance to Intertidal BCH comprised of:
 - a. direct disturbance of 296 ha of coastal samphire
 - b. direct disturbance of up to 880 ha algal mat
 - c. direct disturbance of up to 13 ha of mangroves outside the RRDMMA
2. direct disturbance of up to 4 ha of mangroves within the RRDMMA
3. unlikely to be material impacts to BCH associated with changes to tidal inundation
4. unlikely to be material impacts to BCH as a result of increased frequency of freshwater inundation
5. indirect impacts as a result of decreased frequency of freshwater inundation to:
 - a. 50.3 ha of samphire
 - b. 13 ha of mangrove habitat outside of the RRDMMA
6. indirect impacts as a result of decreased frequency of freshwater inundation to 130 ha of mangrove habitat within the RRDMMA

7. indirect impacts to intertidal BCH from saline seepage to groundwater
8. loss of capacity for intertidal BCH to adapt to climate change along 7.9% of the west Pilbara coast.

2.4.10 Consideration of conditions

The EPA has considered whether the proposal can be implemented consistent with the EP Act principles and the EPA factor objective.

The EPA has considered whether reasonable conditions could be imposed to prevent inconsistency with the EPA's factor objective.

The EPA assessment findings are presented in Table 5.

Table 5: Summary of assessment, recommended conditions and DMA regulation for benthic communities and habitat (intertidal)

Residual impact		Assessment finding	Recommended conditions and DMA regulation
1.	Direct disturbance to intertidal BCH comprised of: a) direct disturbance of 296 ha of coastal samphire b) direct disturbance of up to 880 ha algal mat c) direct disturbance of up to 13 ha of mangroves outside the RRDMMMA.	Given the high values of intertidal BCH for habitat and ecosystem maintenance, impacts to intertidal BCH represent a significant residual impact. The EPA has assessed that due to the extent of intertidal BCH remaining in the study area and the wider region, the proposed direct impacts of the proposal can be made consistent with the EPA's objectives. The significant residual impact could be counterbalanced in accordance with the <i>WA Environmental Offsets Guidelines</i> .	Regulated by: <ul style="list-style-type: none"> condition 1: proposal limit and extent condition 14: offsets.
2.	Direct disturbance of up to 4 ha of mangroves within the RRDMMMA.	May not be fully consistent with the requirements of Guidance Statement No.1. Proposal can be implemented subject to minor changes to ensure the	Regulated by: <ul style="list-style-type: none"> condition 2 - development that may impact mangroves or hydrological processes supporting mangroves within the RRDMMMA is subject to consideration of the

		maintenance of hydrological processes supporting mangroves in the RRDMMMA.	maintenance of ecological processes supporting mangroves.
3.	Impacts to BCH associated with changes to tidal inundation.	Unlikely to be material.	N/A
4.	Impacts to BCH as a result of increased frequency of freshwater inundation.	Impacts not likely to be material, subject to monitoring and adaptive management.	Regulated by: <ul style="list-style-type: none"> condition 6: prepare and implement a BCHMMP.
5.	Indirect impacts as a result of decreased frequency of freshwater inundation to: <ul style="list-style-type: none"> a) 50.3 ha of samphire b) 13 ha of mangrove habitat outside of the RRDMMMA. 	Significant residual impact, likely to be able to be counterbalanced. Likely to be consistent with EPA objectives subject to the implementation of monitoring and mitigation actions and offsets.	Regulated by: <ul style="list-style-type: none"> condition 6: prepare and implement a BCHMMP. condition 14: offsets.
6.	Indirect impacts to 130 ha of mangrove habitat within the RRDMMMA as a result of decreased frequency of freshwater inundation	May not be fully consistent with the requirements of Guidance Statement No.1 Proposal can be implemented subject to minor changes to ensure the maintenance of hydrological processes supporting mangroves in the RRDMMMA.	Regulated by: <ul style="list-style-type: none"> condition 2: development that may impact mangroves or hydrological processes supporting mangroves within the RRDMMMA is subject to consideration of the maintenance of ecological processes supporting mangroves.
7.	Indirect impacts to intertidal BCH from saline seepage to groundwater.	Significant residual impact, but likely to be able to be counterbalanced.	Regulated by: <ul style="list-style-type: none"> condition 3: prepare and implement a GWMMMP condition 6: prepare and implement a BCHMMP. condition 14: offsets.
8.	Loss of capacity for intertidal BCH to adapt to climate change along 7.9% of the west Pilbara coast.	Significant residual impact, but likely to be able to be counterbalanced.	Regulated by: <ul style="list-style-type: none"> condition 14: offsets.

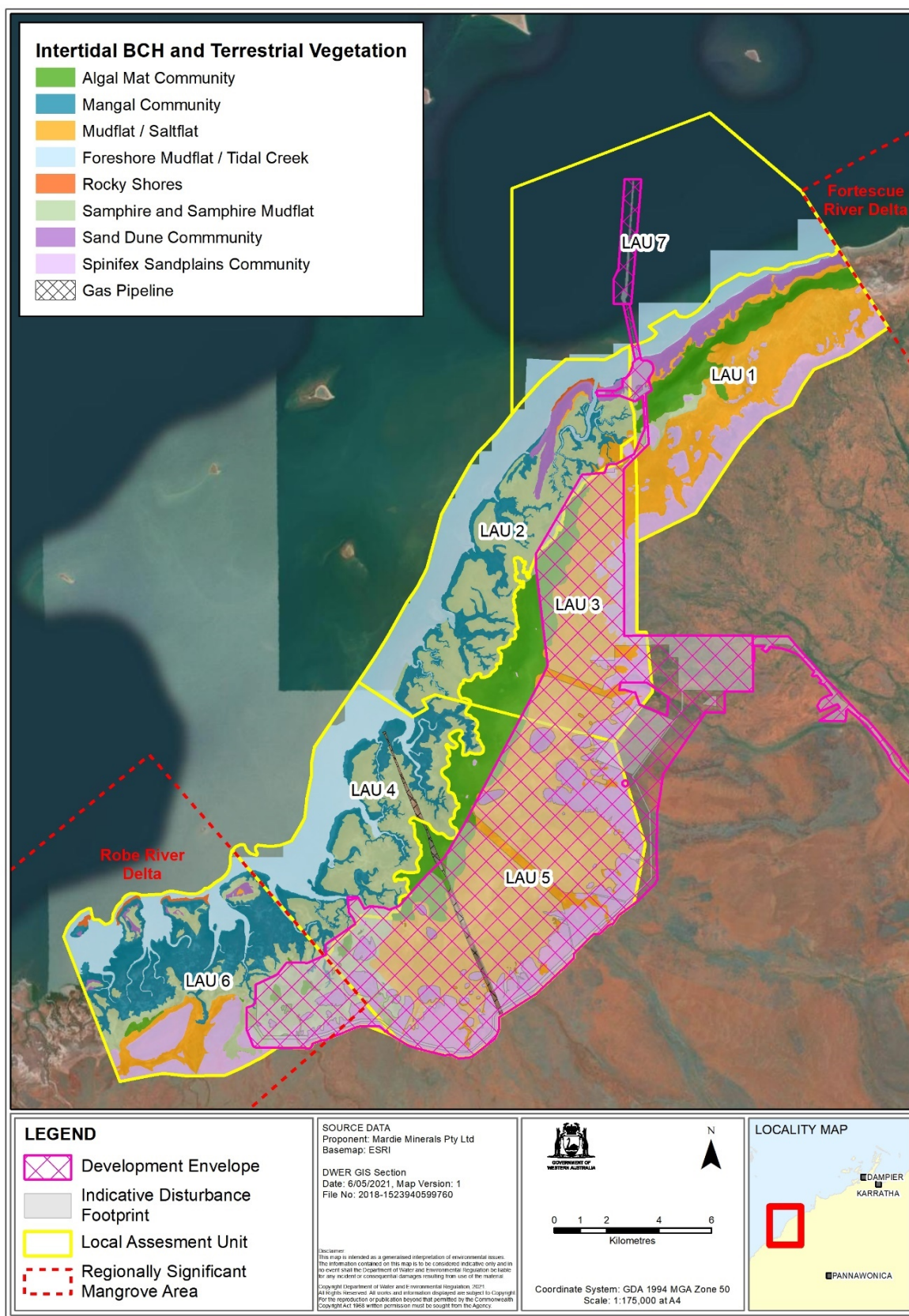


Figure 9: Local Assessment Units (LAUs), intertidal benthic communities and habitat mapping, and Robe River Delta Mangrove Management area boundary

2.5 Benthic communities and habitat (subtidal)

2.5.1 Environmental objective

The EPA's environmental objective for BCH is to *protect benthic communities and habitats so that biological diversity and ecological integrity are maintained* (EPA 2016i).

2.5.2 Investigations and surveys

The proponent commissioned the following surveys and investigations to inform the assessment of impacts to subtidal BCH associated with this proposal:

- mapping of subtidal BCH (O2 Marine 2020c)
- cumulative loss assessment (O2 Marine 2020d)
- modelling of the likely extent of impacts associated with Bitterns disposal (Baird 2020a) and dredge plume sedimentation (Baird 2020b)
- whole effluent toxicity testing (O2 Marine 2020e).

The study area for subtidal BCH is defined by Local Assessment Unit 7 (see Figure 10), which was determined in consultation with the DWER and consistent with *Technical Guidance – Protection of benthic communities and habitats* (EPA 2016b).

The EPA has determined that the proponent's surveys and modelling as described above are adequate to inform the EPA's assessment of the proposal for this factor.

2.5.3 Proposal context – existing environment

Subtidal BCH mapped in LAU 7 are shown in Figure 10. The study area is a shallow, naturally turbid environment characterised by bare sand/silt with patchy distributions of filter feeder/macroalgae/seagrass and coral/macroalgae habitat.

Coral species in study area are present in low to moderate densities, with the majority of corals in the vicinity being associated with the nearby islands outside of the study area. Coral communities mapped in the study area were generally of low diversity and abundance, representing less than 2% of the mapped BCH in the study area (O2 Marine 2020c).

No subtidal BCH in the study area is considered to be locally or regionally significant. The study area is unlikely to represent important foraging habitat for significant species (Preston Consulting 2020). Dugongs were not observed in the study area despite over 700 hours of observation (Preston Consulting 2020), and Marine Turtles were primarily observed around the off-shore islands (Pendoley Environmental 2019).

Within the study area, a total of 445 ha of filter feeder/macroalgae/seagrass BCH was mapped, and 189 ha of coral/macroalgae BCH was mapped, with the remainder of the study area comprised of bioturbated or bare sand (6,940 ha).

2.5.4 Potential impacts of the proposal

The proposal has the potential to significantly impact on subtidal BCH from:

- discharge of up to 3.6 GL/a waste product (bitterns) from the evaporation ponds and desalination plant to the marine environment via a 200 m 8 port diffuser at the end of the trestle jetty approximately 5 km offshore
- direct disturbance, sedimentation and increased turbidity associated with dredging up to 800,000 m³ of sediment to construct the trestle jetty export facility
- introduction of marine pests (refer to section 2.7 – Marine fauna).

2.5.5 Consultation

During public review of the proponent's ERD, submitters queried whether the modelling of bitterns discharge and dredge plumes were adequate, and raised concerns regarding the impacts of bitterns discharge.

One submitter noted that impacts to corals could be largely avoided by relocating the dredge channel a further 500 m offshore, however this was not considered feasible by the proponent, as it could increase the impact to high quality corals associated with offshore islands.

2.5.6 Avoidance measures

The proponent has avoided impacts to subtidal BCH by locating the bitterns dispersal ports within the area that would be disturbed by dredging activities, ensuring that additional subtidal BCH is not impacted by bitterns disposal outside of the required disturbance area, thereby avoiding cumulative impacts to subtidal BCH.

2.5.7 Minimisation measures (including regulation by other DMAs)

The proponent has committed to the following:

- implementing a DMP to minimise the area of subtidal BCH subject permanent impacts from smothering and sedimentation
- implementing a MEQMMP to ensure that impacts to biota, including subtidal BCH, are limited to within established areas of low ecological protection
- minimising the risk of introducing Marine Pests in accordance with the *Biosecurity and Agriculture Management Act 2007* (BAM Act.)

2.5.8 Rehabilitation measures

In the event that PPA does not wish to retain the jetty and port structures, all infrastructure associated with jetty and port areas would be removed and the dredge channel left to fill with sediment over time. See section 2.2 (Marine environmental quality).

The EPA has recommended condition 4-1 to ensure that marine infrastructure associated with the proposal is decommissioned and removed offsite.

2.5.9 Residual impact assessment

The EPA considers that the key environmental values associated with subtidal BCH for this proposal are coral, macroalgae, seagrass and filter feeders, and their associated values of primary production, and foraging habitat for marine fauna.

Bitterns disposal

The disposal of bitterns is addressed in section 2.2 (Marine environmental quality). In this instance, the area that would be significantly impacted by bitterns dispersal such that some biota would be impacted would be confined within the dredge channel where subtidal BCH would be removed. BCH would therefore not be cumulatively impacted by bitterns disposal in addition to dredging. The EPA has assessed that discharge of diluted bitterns through a diffuser within a previously disturbed dredge channel is consistent with the EPA's objectives for this factor, subject to the implementation of management actions in the proponent's MEQMMP.

Dredging

The direct disturbance to subtidal BCH associated with dredging would be confined to a 55 ha dredge channel.

In accordance with *Technical Guidance – Environmental Impact assessment of marine dredging proposals* (EPA 2016e), the proponent has calculated the likely dredge plume extent, including the Zone of High Influence (ZoHI) and Zone of Moderate Influence (ZoMI) associated with the proposal (see Figure 11).

Within the ZoHI, it is expected that sedimentation would occur such that impacts to subtidal BCH would be irreversible, and BCH is expected to be lost. For this proposal, the ZoHI would cover an area of 128 ha.

Within the ZoMI, impacts to benthic organisms are predicted to be recoverable within a period of five years. The recovered BCH may be altered from that present prior to development. For this proposal, the worst-case ZoMI would cover an area of 797 ha, however this area includes large areas of bare or bioturbated sand.

Table 6 quantifies the direct, irreversible and reversible impacts to subtidal BCH associated with dredging of the proposal represented in Figure 11.

Table 6: Direct and indirect impacts to BCH (subtidal)

BCH category	Extent in study area	Direct Impacts	ZoHI (irrecoverable indirect impacts)	ZoMI (recoverable indirect impacts)	Cumulative impacts Irreversible/including reversible impacts	Percent of known extent impacted
Bioturbated/bare sand	6940	36 ha	68 ha	595 ha	104 / 699 ha	1.4% / 10.1%
Filter feeder/macroalgae/seagrass	445	9 ha	26 ha	133 ha	35 / 168 ha	7.9% / 37.8%
Coral/macroalgae	189	10 ha	34 ha	69 ha	44 / 113 ha	23.3% / 59.8%
Total	7,574 ha	55 ha	128 ha	797 ha		

The coral/macroalgae BCH that would be permanently impacted would be 23.3% of the mapped extent within the study area. This coral is generally of low abundance, diversity and density, with 163 ha of the 189 ha mapped being low density (less than 25% cover) (O2 Marine 2020a). The low quality of this BCH is likely to be related to the highly turbid nature of the study area. There is extensive high quality coral/macroalgae BCH associated with the offshore islands outside the study area (Preston Consulting 2020).

Given the sparse and low quality nature of the subtidal BCH in the study area, the EPA has assessed that the predicted impacts to subtidal BCH associated with dredging for the proposal would likely be consistent with the EPA's objective for this factor, subject to the implementation of the proponent's DMP to ensure that dredging impacts remain within the predicted extent.

Introduction of Marine Pests

Introduction of marine pests is addressed in section 2.7 (Marine fauna). The EPA has assessed that the residual impacts of marine pests within the marine environment (if managed as proposed) are likely to be consistent with EPA's objective for this factor. The EPA has recommended a condition to ensure that marine pest impacts are managed as described in the proponent's ERD.

Summary of likely residual impacts of the proposal

The EPA has assessed the likely residual impact of the proposal on subtidal BCH to be:

1. disposal of up to 3.6 GL/a of bitterns within the previously disturbed 55 ha dredge channel
2. dredging of up to 800,000 m³ sediments, resulting in:
 - a. direct and irrecoverable impacts to 35 ha filter-feeder/macroalgae/seagrass BCH and 44 ha coral/macroalgae BCH
 - b. recoverable indirect impacts to 133 ha filter-feeder/macroalgae/seagrass BCH and 69 ha coral/macroalgae BCH
3. risk of introduction of marine pests.

2.5.10 Consideration of conditions

The EPA has considered whether the proposal can be implemented consistent with the EP Act principles and the EPA factor objective.

The EPA has considered whether reasonable conditions could be imposed to prevent inconsistency with the EPA's factor objective.

The EPA assessment findings are presented in Table 7.

Table 7: Summary of assessment, recommended conditions and DMA regulation for benthic communities and habitat (subtidal)

Residual impact		Assessment finding	Recommended conditions and DMA regulation
1.	Disposal of up to 3.6 GL/a of bitterns in within the previously disturbed dredge channel.	See section 2.2 – Marine environmental quality. Impacts likely to be consistent with the EPA's objective for this factor, subject to the implementation of monitoring and management actions to restrict impacts to the predicted extent.	Regulated by: <ul style="list-style-type: none">condition 4: implement a MEQMMP.
2.	Dredging of up to 800,000 m ³ sediments, resulting in: <ul style="list-style-type: none">direct and irrecoverable impacts to 35 ha filter-feeder/macroalgae/seagrass BCH and 44 ha coral/macroalgae BCHrecoverable indirect impacts to 133 ha filter-feeder/macroalgae/seagrass BCH and 69 ha coral/macroalgae BCH.	Impacts likely to be consistent with the EPA's objective for this factor, subject to the implementation of monitoring and management actions to restrict impacts to the predicted extent.	Regulated by: <ul style="list-style-type: none">condition 7: implement a DMP.
3.	Risk of introduction of marine pests.	Likely to be consistent with the EPA's objective for this factor, subject to compliance with other regulatory requirements.	Regulated by: <ul style="list-style-type: none">condition 7: prepare and implement marine pest management procedures See section 2.7 (Marine fauna).

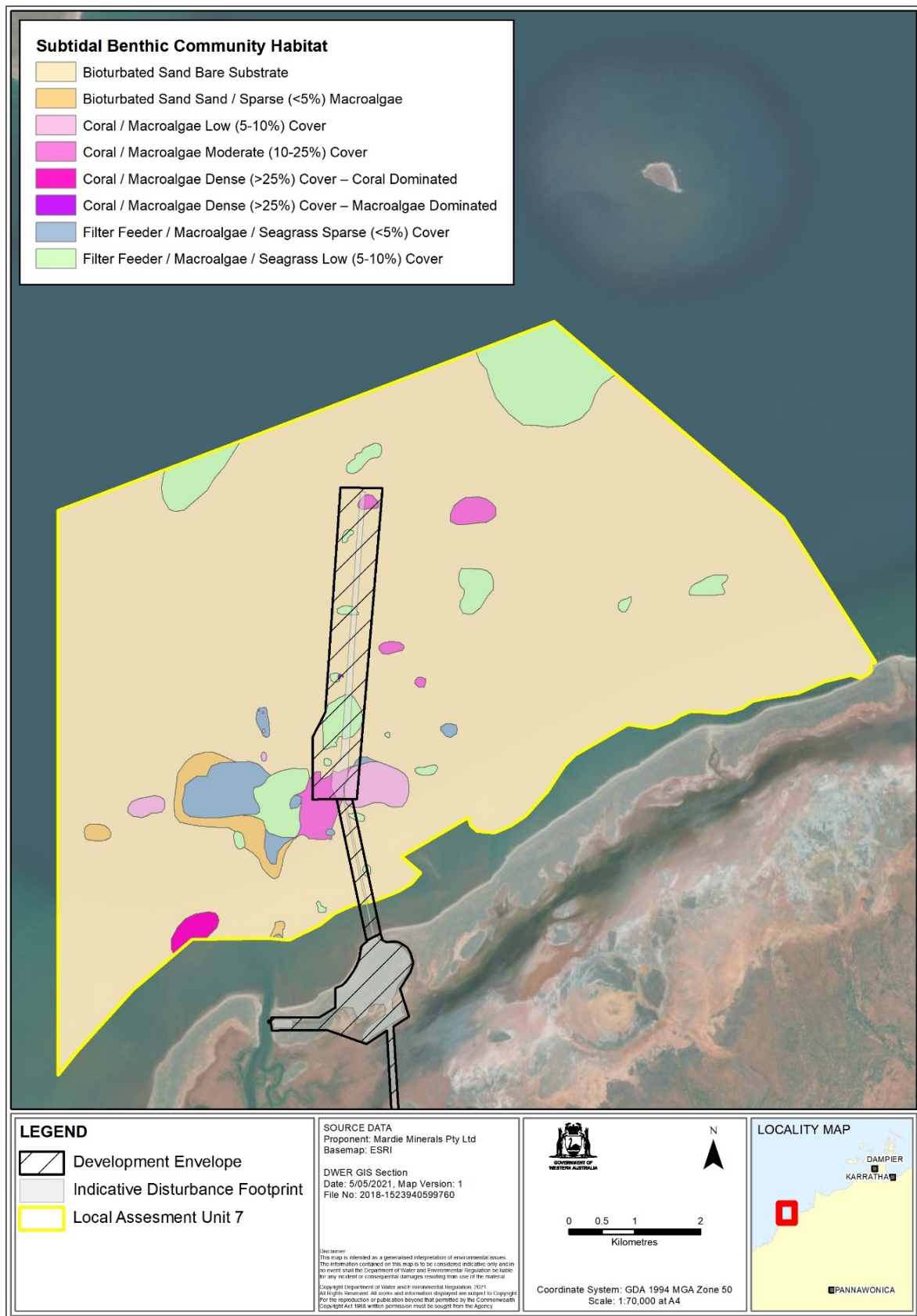
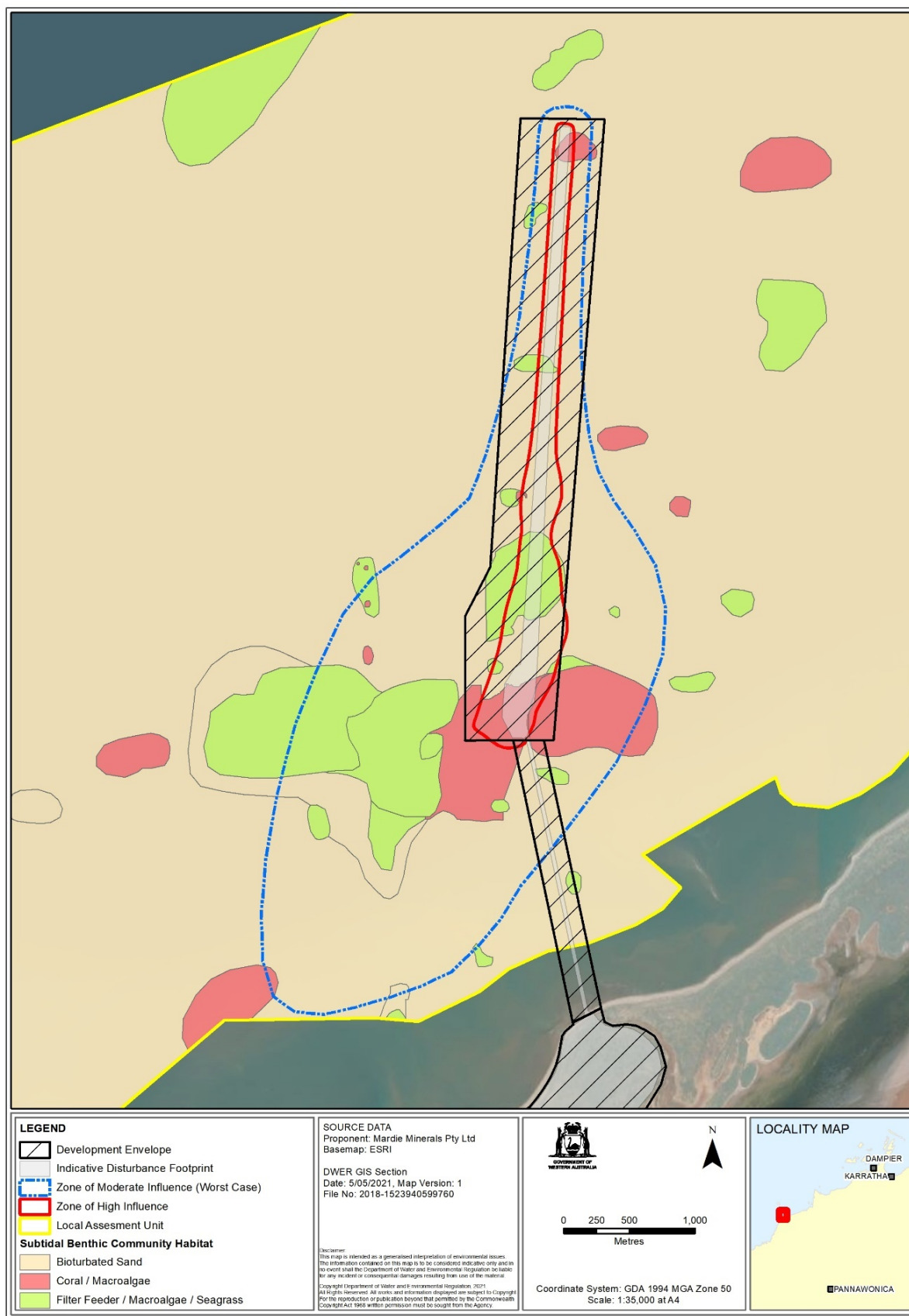


Figure 10: Subtidal benthic communities and habitat mapping



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Figure 11: Extent of dredging impacts relative to subtidal benthic communities and habitats

2.6 Terrestrial fauna

2.6.1 Environmental objective

The EPA's environmental objective for terrestrial fauna is *to protect terrestrial fauna so that biological diversity and ecological integrity are maintained* (EPA 2016f).

2.6.2 Investigations and surveys

Details of the terrestrial fauna surveys undertaken for the proposal are provided within Appendix, 9.1 of the proponents Environmental Review Document (Preston Consulting 2020):

- Phoenix Environmental Sciences (Phoenix 2020b) Level 2 targeted terrestrial fauna survey for the Mardie project. Final report. Prepared for the BCI Minerals Ltd.

The level 2 fauna report includes surveys (2017 and 2019) covered in the terrestrial fauna study area (TFSA) (29,141.3 ha) (see Figure 12) and the migratory shorebird study area (MSSA) (64,201.1 ha) (see Figure 13). The development envelopes (marine and terrestrial) intersect these study areas (see Figure 12). The MSSA has been determined to be a contiguous 'shorebird area' as per EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed Migratory shorebird species (DotEE, 2017). The surveys/assessments (excluding shortrange endemic [SRE] invertebrates) carried out for the ERD and RtS are adequate to inform the EPA's assessment of the proposal.

Phoenix (2020b) reported that site specific searches for SRE invertebrates were undertaken at the terrestrial fauna sites and additional sites on the mudflats near *Triodia* hummocks, saltflat, rocks and rock crevices. The *Aneme mellosa* (mygalomorph trap-door spider) was recorded within the samphire shrubs at the base of a mudflat Island (Phoenix 2020b). The survey effort for SRE's invertebrates did not meet the requirements of *Technical Guidance – Sampling of short range endemic invertebrate fauna* (EPA 2016g). This is further addressed in section 2.6.2.

Eleven fauna habitat types were recorded within the terrestrial and marine development envelopes including mudflat or saltflat, tidal samphire mudflat, spinifex grassland, shrubland over spinifex grassland, tussock grassland, mangrove habitat, open woodland (riparian), low shrubland, beach and dune and tidal channels and ocean (see Figure 12) (Phoenix 2020b).

A total of 33 conservation significant vertebrate species were recorded within the survey area, including 25 birds (including the Curlew sandpiper (*Calidris ferruginea*) and Eastern curlew (*Numenius madagascariensis*)), 4 mammals and 4 reptiles, 3 of which were marine turtles³. Four significant terrestrial fauna species were recorded within the terrestrial development envelope during the survey including two bat species Pilbara leaf-nosed bat (*Rhinonicteris aurantia* Pilbara) Vulnerable under both the EPBC Act and the BC Act and northern coastal free-tailed bat (*Ozimops cobourgiensis*) is listed by Department of Biodiversity Conservation and Attractions

³ Refer to section 2.7 (marine fauna).

(DBCA) as a Priority 1 (Phoenix 2020b).

The northern quoll (*Dasyurus hallucatus*) and the Pilbara olive python (*Liasis olivaceus barroni*), which are threatened fauna species listed as Endangered and Vulnerable and respectively under the EPBC Act, were not recorded during the fauna survey but their foraging habitats were present within the terrestrial development envelope Phoenix (2020b).

The western pebble-mound mouse (*Pseudomys chapmani*) (Priority 4) BC Act and lined-soil crevice skink (*Notoscincus butleri*) (Priority 4) BC Act was recorded outside the terrestrial development envelope.

A targeted (audio recording) night parrot (*Pezoporus occidentalis*) survey was completed within the TFSA from December 2017 to March 2018 and did not detect any calls during the assessment (Phoenix 2020b). One (unconfirmed) historic record of the night parrot occurs at Robe River approximately 30 km south of the TFSA. The survey also assessed the habitat at the Robe River site and compared it to the habitats of the TFSA. The size and maturity of the spinifex hummock was more evident than the habitat present within the TFSA and there is also no prominent water source like the Robe River which intersects the TFSA (including the terrestrial development envelope) (Phoenix 2020b).

2.6.3 Proposal context - existing environment

There are no conservation reserves within the marine, terrestrial and dredge channel development envelopes. The closest conservation reserve is the Passage Island Archipelago, associated with the Great Sandy Island Nature Reserve (Class B) (Preston Consulting 2020). This reserve is made up of a number of offshore islands.

The dominant terrestrial fauna habitat⁴ within the terrestrial development envelope is mudflat or saltflat⁵ (71%) and large portions of terrestrial habitats are heavily impacted by a Mesquite infestation. Preston Consulting (2020) reports that this fauna assemblage is largely devoid of vegetation and supports very few fauna species and is not considered to be an important habitat of significant species. Therefore, considered to be of low value habitat.

The following fauna habitats mapped within the terrestrial and marine development envelopes are considered to be significant due to occurrence of significant fauna species, species with restricted distribution, threatening processes or habitat type important to life cycle of significant species:

- Tidal samphire mudflats (1,371.4 ha): adjacent to the coast, between tidal mangrove creek channels are often inundated by the tides.
- Mangrove habitat (26.3 ha): is mostly present within the southern section of the proposal area.

⁴ It is noted that vegetation units described within section 2.3 (flora and vegetation) differs to fauna habitats/assemblages presented below because mapping of fauna habitats does not align with mapping of vegetation types.

⁵ Note that fauna habitat type 'mudflat or saltflat' is a different assemblage to 'tidal samphire mudflat'. Refer to Table 51 in ERD (Preston Consulting 2020).

- Shrubland over spinifex grassland (3,160 ha): is within the eastern margin of the proposal area and within a transition zone adjacent to creeklines. This habitat is structurally more complex than the surrounding spinifex grasslands. The tidal creek channels act as conduits for the tidal waters that inundate the samphire mudflats and mudflats / saltflats during spring tides.
- Creeklines and open woodland: there are a number of creeklines which, traverse the eastern side of the proposal area before dispensing water into the mudflats / saltflats, which support open woodland (riparian) habitats (15.9 ha).
- Mardie pool is a freshwater pool which is outside (but adjacent to) the terrestrial development envelope (Preston Consulting 2020).

For (marine) migratory birds, the following fauna assemblages are considered to be significant habitats within the MSSA (and terrestrial and marine development envelopes):

- 1) Tidal samphire mudflats – the most widespread and longest inundated (and therefore available for feeding) within the MSSA. The portions of this habitat type that occur closer to the coast have the highest density of vegetation (estimated on average more than 50% cover). The vegetation density generally decreases further from the coast, generally averaging 20–50% cover mid-way between the coast and the western boundary of the terrestrial and marine development envelope, and less than 10% cover within the terrestrial and marine development envelopes. Tidal samphire mudflats are further discussed in section 2.3 (Flora and vegetation) and section 2.4 (BCH (intertidal)).
- 2) Ocean mudflats and sandbars – during low tides mudflats and sandbars are exposed. On extreme low tides foraging was recorded > 2 km offshore (Phoenix, 2020b).
- 3) Mangrove community on river channels – for roosting/loafing and extend along the coastline. Mangroves are further discussed in section 2.3 (Flora and vegetation).

2.6.4 Potential impacts of the proposal

The proposal has the potential to significantly impact on terrestrial fauna from:

- direct disturbance of 11,142 ha to fauna habitat, including critical samphire, mangrove, open riparian woodland, spinifex grasslands and *Triodia* grasslands habitat
- clearing/disturbance to 6 ha of potential Pilbara olive python habitat
- clearing/disturbance to 64.5 ha of potential northern quoll foraging habitat
- clearing/disturbance to 2,562 ha to Pilbara leaf-nosed bat foraging habitat (*Triodia* grasslands foraging habitat)
- direct impact up to 1,132 ha to northern coastal free-tailed bat foraging habitat (including 17 ha of disturbance of mangrove community habitat and 1,115 ha of tidal samphire shrubland habitat)
- direct impact to 1,210 ha of migratory bird habitat and potential indirect impacts to migratory bird habitat comprised of:

- up to 1,115 ha of disturbance tidal samphire mudflats habitat
- up to 17 ha of mangrove communities
- up to 6 ha of disturbance open woodland (riparian) habitat
- up to 72 ha of tidal channel and ocean habitat
- direct impact to SRE invertebrates and habitats
- increased distribution risk of Mesquite (weeds)
- direct impacts on terrestrial fauna from the generation of noise, artificial light spill during construction and operational activities and potential vehicle strike and entrapment in crystallisation/evaporative ponds
- increased risk of feral animal predation
- habitat degradation through uncontrolled access
- indirect impacts associated with hydrological changes and the risk of spreading mesquite (refer to sections 2.1 Inland waters and 2.3 Flora and vegetation).

The effects of climate change (i.e. sea level rise) was discussed during the assessment process. Sea level rise may result in a gradual inland migration of coastal habitats and the increasingly frequent submergence of the (existing) tidal samphire mudflat habitat which may impact the availability of habitat for migratory birds (Preston Consulting 2020). Refer to section 2.4 (BCH (intertidal)) for further information and discussion.

2.6.5 Consultation

The 10-week public review on the proposal raised concerns about the methodology and the EPBC Act Policy Statement 3.21 for the migratory bird surveys, the SRE survey effort completed as part of the terrestrial fauna assessment (Phoenix 2020b) and impact to SRE and the residual impacts to SRE invertebrates and MNES.

With regard to MNES issues raised were Pilbara olive python habitat, Pilbara leaf-nosed bat habitat, and northern quoll habitat have not been adequately quantified and the consideration of *WA Environmental Offsets Policy* (2014) principles associated with the proposed residual impacts (see section 4).

2.6.6 Avoidance measures

The proponent has designed the proposal to avoid key fauna habitat where possible by configuring the terrestrial and marine development envelope and the disturbance footprint within it to:

- relocated the ponds further east, to avoid all of the higher value coastal tidal samphire mudflats habitat within the MSSA
- avoided direct impacts to Mardie pool by excising it from the terrestrial development envelope.

2.6.7 Minimisation measures (including regulation by other DMAs)

The proponent has prepared a Long-term migratory shorebird monitoring program

for the Mardie Project (*Phoenix Environmental Sciences (2020c. Final V1)*).

Migratory shorebirds would be monitored using a remote, networked camera array across the terrestrial and marine development envelopes and control sites (MSSA). The annual survey will take place in the summer season (December to February) and will cover the following scope of work:

- determine and track the species richness, density (birds per ha), and population size of migratory shorebirds using the ponds and in proximity to the trestle jetty (impact areas) and in representative habitats in control areas over time
- determine and track shorebird activity/use type in the ponds (e.g. feeding or roosting/loafing) (impact areas)
- record any threats to shorebirds in impact and control areas (e.g. feral or native predators, human influences) (Phoenix 2020c).

The results of the long-term migratory shorebird monitoring program will be reviewed bi-annually by a suitable migratory bird researcher/consultant. This review will also consider the program efficacy, and recommend changes if suitable (Phoenix 2020c).

The proponent has committed to:

- Additional surveys to determine the potential risk, mitigation and management measures for SRE invertebrates, which includes:
 - Completion of additional surveys for SRE fauna habitat prior to ground disturbance. If habitat is confirmed, the proponent will preserve a minimum of 50% of any mudflat islands that are confirmed as SRE habitat.
 - Preparation and implementation of a SRE Mitigation Plan that verifies how the management measures will be implemented.
- Implement a register for fauna entrapment in concentrator and crystalliser ponds and install egress points where required to minimise the risk of entrapment will be undertaken.

The EPA has determined in consultation with DMIRS that industry standard fauna management actions including management of vehicle strike, feral animals, and fauna entrapment can be managed through the mine plan required under the *Mining Act 1978*.

The EPA has determined in consultation with DWER that the management of light-spill impacts to terrestrial fauna including bats, such as targeting external lighting, use of shields and directional lighting, the use of red or low pressure sodium lights can be regulated via the required works approvals and operation licence conditions under Part V of the EP Act.

2.5.8 Rehabilitation measures

The proponent has prepared a preliminary mine closure plan (BCI 2020) (Appendix 18 of the RtS, Preston Consulting 2021). Key rehabilitation measures that relate to terrestrial fauna are summarised below:

- salts will be harvested from each pond prior to closure

- concentrator pond walls will be flattened or opened up to allow tidal flows to enter the ponds
- all infrastructure will be removed if not retained by Mardie Station or PPA
- all disturbance areas to be ripped and seeded
- all crystalliser ponds will be rehabilitated to an acceptable landform.

2.6.9 Residual impact assessment

The key terrestrial fauna environmental values likely to be impacted by the proposal are conservation significant vertebrate and invertebrate fauna species which were identified as utilising the terrestrial development envelope. The significant fauna identified were:

- Pilbara leaf-nosed bat (*Rhinonictis aurantia Pilbara*) VU (EPBC Act; BC Act)
- northern coastal free-tailed bat (*Ozimops cobourgianus*) (BC Act Priority 1)
- Pilbara olive python (*Liasis olivaceus barroni*) VU (EPBC Act; BC Act) while not recorded in the surveys there is habitat associated with Mardie pool which is outside the terrestrial development envelope
- northern quoll (*Dasyurus hallucatus*) EN (EPBC Act; BC Act) foraging habitat is present within the terrestrial development envelope and there is no recorded denning or shelter habitat within in terrestrial development envelope (Preston Consulting 2021)
- significant Migratory birds and other shorebirds, comprised of:
 - bar-tailed godwit (*Limosa lapponica*) Mig. (EPBC Act; BC Act)
 - caspian tern (*Hydroprogne caspia*) Mig. (EPBC Act; BC Act)
 - crested tern (*Sterna bergii*) Mig. (EPBC Act; BC Act)
 - common tern (*Sterna hirundo*) Mig. (EPBC Act; BC Act)
 - red-necked stint (*Calidris ruficollis*) Mig. (EPBC Act; BC Act)
 - pacific golden plover (*Pluvialis fulva*) Mig. (EPBC Act; BC Act)
 - curlew sandpiper (*Calidris ferruginea*) CR/Mig. (EPBC Act); VU/Mig. (BC Act)
 - eastern curlew (*Numenius madagascariensis*) CR/Mig. (EPBC Act); VU/Mig. (BC Act)
 - oriental plover (*Charadrius veredus*) Mig. (EPBC Act; BC Act)
 - oriental pratincole (*Glareola maldivarum*) Mig. (EPBC Act; BC Act)
 - osprey (*Pandion cristatus* (haliaetus) Mig. (EPBC Act; BC Act)
 - great knot (*Calidris tenuirostris*) CR/Mig (EPBC Act; VU/Mig (BC Act)
 - greater sand plover (*Charadrius leschenaultia*) VU/Mig. (EPBC Act); Mig. (BC Act)
 - lesser sand plover (*Charadrius mongolus*) EN/Mig. (EPBC Act)
 - common greenshank (*Tringa nebularia*) Mig. (EPBC Act; BC Act)
 - common sandpiper (*Actitis hypoleucos*)

- red knot (*Calidris canutus*) EN/Mig. (EPBC Act); Mig.(BC Act)
- ruddy turnstone (*Arenaria interpres*) Mig. (EPBC Act; BC Act)
- sanderling (*Calidris alba*) Mig. (EPBC Act; BC Act)
- grey-tailed tattler (*Tringa brevipes*) Mig. (EPBC Act; BC Act); P4 (DBCA)
- grey plover (*Pluvialis squatarola*) Mig. (EPBC Act; BC Act)
- gull-billed tern (*Gelochelidon nilotica*) Mig. (EPBC Act; BC Act)
- terek sandpiper (*Xenus cinereus*) Mig. (EPBC Act; BC Act)
- white-winged black tern (*Chlidonias leucopterus*) Mig. (EPBC Act; BC Act)
- white-shafted little tern, Little tern (*Sternula albifrons*) Mig. (EPBC Act; BC Act)
- whimbrel (*Numenius phaeopus*) Mig. (EPBC Act; BC Act)
- SRE invertebrates.

The EPA has assessed the likely impacts of the proposal to the above values includes clearing of terrestrial fauna habitat, disturbance to SRE invertebrate habitats, indirect impacts to significant fauna habitat, and indirect impacts to fauna such as noise emissions, artificial light spill, and increased risk of vehicle strike.

Clearing of terrestrial fauna habitat

Pilbara leaf-nosed bat (Pilbara)

Clearing and disturbance of up to 2,562 ha to Pilbara leaf-nosed bat (Pilbara) foraging habitat (triodia grassland⁶) which is 9.5% of the mapped extent of this habitat type within the TFSA. The direct impact will occur at the western-most extent of the mapped triodia grassland habitats. It is noted that some of this habitat type is degraded due to mesquite infestation or grazing.

Roost sites are unlikely to be present as there are no caves within the terrestrial development envelope. Mardie pool is likely to be regularly used as a water source or foraging habitat. This area has been excised from the terrestrial development envelope (Preston Consulting 2021).

Open Woodland (Riparian) fauna habitat (adjacent to Mardie pool) has high value as foraging habitat. Within the terrestrial development envelope, only 5.4 ha of this habitat type is proposed to be disturbed representing 7.3% of the mapped extent within the TFSA (Preston Consulting 2020).

The EPA has assessed there to be a significant residual impact to the listed Pilbara leaf-nosed bat (Pilbara) from clearing of any foraging habitat which is in good to excellent condition. Given that the direct impact to potential habitat in the proposal is a small percentage of the known extent for this species, the EPA considers that this impact is likely to be consistent with the EPA's objective for this factor, and could be counter-balanced to be consistent with the *WA Environmental Offsets Guidelines*

⁶ shrubland over spinifex grassland

(Government of Western Australia 2014) (see section 4).

Northern coastal free-tailed bat

The proposal includes clearing and disturbance of up to 1,132 ha of northern coastal free-tailed bat foraging habitat. This species was recorded across the mangrove habitat and tidal samphire shrublands, and also 'inland' east of the mudflat playa, suggesting fairly wide-ranging foraging activity. It is likely that this species mainly utilises mangrove habitat for roosting and foraging. Disturbance to habitat for this species would include:

- tidal samphire mudflat – 1,115 ha of this habitat type is proposed to be disturbed, this equates to 21.4% of the extent within the TFSA and 9% of the regional extent
- mangrove habitat – 17 ha of this habitat type is proposed to be disturbed. This equates to 1% of the extent within the TFSA and <1% of the regional extent (Preston Environmental 2020 and 2021).

From a regional perspective the habitat types to be removed is less than 10% of the mapped extent.

The EPA has assessed there to be a significant residual impact from clearing of habitat to the listed northern coastal free-tailed bat. Given that the direct impact to potential habitat in the proposal is a small percentage of the known extent for this species, the EPA considers that this impact is likely to be consistent with the EPA's objective for this factor and could be counter-balanced to be consistent with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014) (see Section 4).

Pilbara olive python

The proposal includes clearing and disturbance of up to 6 ha of potential Pilbara olive python habitat. While no individuals were recorded within the terrestrial and marine development envelopes during the surveys, approximately 15.9 ha of the open riparian woodland (foraging habitat) surveyed (73.5ha) is located in the terrestrial and marine development envelopes. Less than 5.4 ha is expected to be disturbed (7.3% of TFSA). The proposal does not impact on freshwater pools including Mardie pool (Preston Consulting 2020).

The EPA has assessed there to be a significant residual impact to the Pilbara olive python from habitat removal. However, due to the remaining habitat proposed not to be disturbance within the terrestrial and marine development envelopes and within the TFSA, the impact is likely to be consistent with the EPA's objectives for terrestrial fauna.

The EPA considers that the significant residual impacts to Pilbara olive python habitat could be counter-balanced consistent with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014) (see Section 4).

Northern quoll

The proposal includes clearing of up to 64.5 ha of northern quoll foraging habitat for the widening of the existing Mardie Station access road associated with the

proposal. The disturbance represents only a small incremental decrease in foraging habitat, alongside an already disturbed road alignment.

Northern quoll denning/ shelter habitat is located within 1 km (outside) of the terrestrial development envelope associated with spinifex grassland on rocky hills. There is no recorded denning or shelter habitat within the terrestrial development envelope (Preston Consulting 2021).

Associated with the denning habitat (outside the terrestrial development envelope) is 923.6 ha foraging habitat, which includes the terrestrial development envelope. The disturbance of this foraging area within the terrestrial development envelope is 6.98% of the total foraging habitat associated with the denning habitat. The remaining northern quoll foraging habitat of 859.1 ha is not under threat of disturbance from other known proposals (Preston Consulting 2020).

The EPA considers that impact to habitat for this conservation significant species is a significant residual impact. Given that the direct impact to potential foraging habitat in the proposal is a small percentage of the known local extent for this species, the EPA considers that the proposal is likely to be consistent with the EPA's objective for this factor and could be counter-balanced to be consistent with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014) (see section 4).

Migratory birds

Clearing of up to 1,204 ha of migratory bird habitat, which includes:

- Up to 1,115 ha tidal samphire mudflats habitat. 1,115 ha of this habitat type equates to 21.4% of the extent within the TFSA and 9% of the regional extent. It is noted that of this, 296 ha represents the high-value coastal samphire described in section 2.4 (BCH (intertidal)).
- Up to 17 ha of mangrove communities. 17 ha of this habitat type equating to 1% of the extent within the TFSA and <1% of the regional extent.
- Up to 72 ha of tidal channel and ocean habitat. 72 ha of this habitat type equates to 2.6% of the extent within the TFSA and <1% of the regional extent (Preston Consulting 2021).

There is a low proportion of migratory birds recorded within the terrestrial development envelope in comparison with the remainder of the MSSA. The percentage of significant habitat within the disturbance footprint is low compared to the available habitat within the TFSA and MSSA (Preston Consulting 2021).

The proponent has prepared a Long-term migratory shorebird monitoring program for the Mardie Project (*Phoenix Environmental Sciences (2020c) Final V1*) which includes mitigation and management responses to be implemented if declining utilisation is attributable to the project (including artificial light spill) (Preston Consulting 2021).

The EPA has determined that feral animals and artificial light spill can be regulated by DMIRS through the mine plan required under the *Mining Act 1978* and by DWER via the required Works approvals and Operation licenses under Part V of the EP Act.

Given that, from a regional perspective each habitat type to be cleared is less than 10% of the mapped extent, the EPA has assessed that impacts to migratory birds from clearing of tidal samphire habitat would not be inconsistent with the EPA's objective for this factor, subject to the implementation of the proposed monitoring program. However, the EPA has assessed that all impacts to habitat for listed Migratory/Marine bird species represent a significant residual impact. This significant residual impact is likely to be able to be counterbalanced consistent with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014) definition of significant residual impact regarding rare and endangered animals (see Section 4).

Disturbance to SRE invertebrate habitats

A large portion of the terrestrial development envelopes have a low SRE habitat prospectively, however, there are several vegetated mudflat islands (average size of approximately 40 ha) within the mudflats which potentially containing moderate SRE habitat prospectively (see Figure 14) (Preston Consulting 2021).

While SREs were a consideration in all terrestrial fauna foraging it is noted that there is limited information about SREs within the moderate prospective areas (see Figure 14). These areas are associated with creek lines and isolated remnants of vegetation (typically associated with vegetation unit AcAjTe, Spinifex (*Triodia* spp.) steppe). Based on existing survey information the direct and indirect impact to SRE invertebrates and habitats cannot be determined.

Additional SRE surveys have been commissioned by the proponent to verify the SRE potential within the moderate prospectively SRE habitat areas and mitigation measures are proposed to ensure that SREs' will not be significantly impacted (Preston Consulting 2021). The outcomes of the additional surveys are not available as part of this EPA assessment.

Due to the lack of survey to determine the composition of the SRE fauna assemblage, there remains a residual risk of direct and indirect impacts to conservation significant SRE species. The EPA has assessed that this uncertainty can be addressed such that the EPA's objectives for this factor can be met, subject to the implementation of the proponent's proposed pre-clearance surveys and mitigation measures in the event that SRE habitat is identified.

Indirect impacts to significant fauna habitats

The indirect influence of the overland freshwater changes to significant fauna habitats are estimated to be:

- Tidal samphire mudflat – 492.7 ha of this habitat type will experience altered fresh water inflows, with 438.3 ha being wetter and 50.5 ha being drier than current conditions. An additional 3.9 ha will be flooded during a 100 year ARI rainfall event. This equates to 9.5% of the extent within the TFSA.
- Mangrove community – 183.4 ha of this habitat type will experience altered fresh water inflows, with 40.4 ha being wetter and 143 ha being drier than current conditions. This equates to 5.9% of the extent within the TFSA.

- Open woodland (riparian) – 14.1 ha of this habitat type will experience altered fresh water inflows, with 6.8 ha being drier than current conditions and 7.3 ha will be flooded during a 100 year ARI rainfall event. This equates to 19.2% of the extent within the TFSA (Preston Consulting 2021).

It is noted that mapping of terrestrial fauna habitats, with particular regard to tidal samphire mudflats, may not be consistent with mapping of similar vegetation types for the flora and vegetation or intertidal BCH assessments.

The EPA assessment on the indirect influence of overland freshwater changes have been addressed in section 2.1 (Inland waters), section 2.4 (BCH (intertidal)) and section 2.3 (Flora and vegetation). The EPA has assessed and considers that indirect impacts to each of the assessed habitats are likely to be consistent with the EPA's objectives for this factor, subject to monitoring and management required in conditions described in those sections.

Indirect impacts to fauna including noise emissions, artificial light emission and increase in fauna strike

There are potential impacts on terrestrial fauna from the generation of noise, artificial light spill from construction and operational activities and possible vehicle strike.

There will be an increase the risk of the death or injury of individuals due to vehicle strike due with traffic movement on the proposed access road. The proponent has advised that the secondary road into the proposal area will not be used as a haul road as product will be leaving via the port. The workforce vehicle movements will be relatively low, as personnel will be accommodated on site (i.e. will not drive in on a daily basis) and a significant workforce is not required for the proposal during operation (Preston Consulting 2020).

The EPA has assessed that impacts to fauna associated with vehicle strike, feral animal control and pond entrapment are unlikely to be material subject to regulation by DMIRS via assessment of mining proposal (DMP 2012 and DMIRS 2020) and associated MCP (DMIRS 2020a) required under the *Mining Act 1978*.

While terrestrial noise modelling assessment were not included within the ERD (Preston Consulting 2020) and Response to Public Submission (Preston Consulting 2021) the proponent has advised that the construction of the proposal will result in relatively low levels of noise as most of the works will be conducted in narrow strips on soft mudflats (for the pond walls) and the utilisation of low noise equipment will be used (where available to suitable). Minimal night works are expected during pond construction given the difficult terrain (Preston Consulting 2020).

The operation of the proposal is expected to emit low noise and light emissions as it relies on solar evaporation for the majority of the process.

The EPA considers that the noise emission from the proposal are unlikely to have a material impact on terrestrial fauna and is not expected to affect the ecological integrity of the species within the terrestrial development envelope or to be inconsistent with the EPA's objective to protect terrestrial fauna subject to requirement for the proponent to comply with the Environmental Protection (Noise)

Regulations 1997 (EP Noise Regulations).

Artificial light emissions from the processing plant and associated infrastructure may potentially alter behaviours of terrestrial fauna. The proponent has advised that the Port will export low volumes of product and will not require significant lighting, apart from navigational aids (Preston Consulting 2020).

The EPA considers that terrestrial artificial light spill from the proposal is unlikely to have a material impact on terrestrial fauna and is not expected to affect the ecological integrity of the species or to be inconsistent with the EPA's objective subject to the implementation of an Illumination Plan to protect terrestrial fauna.

Summary of likely residual impacts of proposal

The EPA has assessed the likely residual impact of the proposal on terrestrial fauna habitats to be:

1. clearing/disturbance to 2,562 ha to Pilbara leaf-nosed bat foraging habitat (Triodia grasslands foraging habitat)
2. direct impact up to 1,132 ha to northern coastal free-tailed bat foraging habitat (including 17 ha of disturbance of mangrove habitat and 1,115 ha of tidal samphire shrubland habitat)
3. clearing/disturbance to 6 ha of potential Pilbara olive python habitat
4. clearing/disturbance to 64.5 ha of potential northern quoll foraging habitat
5. direct impact to 1,204 ha of migratory bird habitat and potential indirect impacts to migratory bird habitat, comprised of:
 - a) up to 1,115 ha of disturbance tidal samphire mudflats habitat
 - b) up to 17 ha of mangrove communities
 - c) up to 72 ha of tidal channel and ocean habitat
6. indirect impacts to significant fauna habitat, including Tidal samphire mudflats, Mangal communities and open woodland (riparian)
7. impacts to SRE invertebrates and habitats
8. indirect impacts to terrestrial fauna, including noise emissions, artificial light emissions, increased fauna strike increased feral animals and pond entrapment.

2.6.10 Consideration of conditions

The EPA has considered whether the proposal can be implemented consistent with the EP Act Principles and the EPA factor objective.

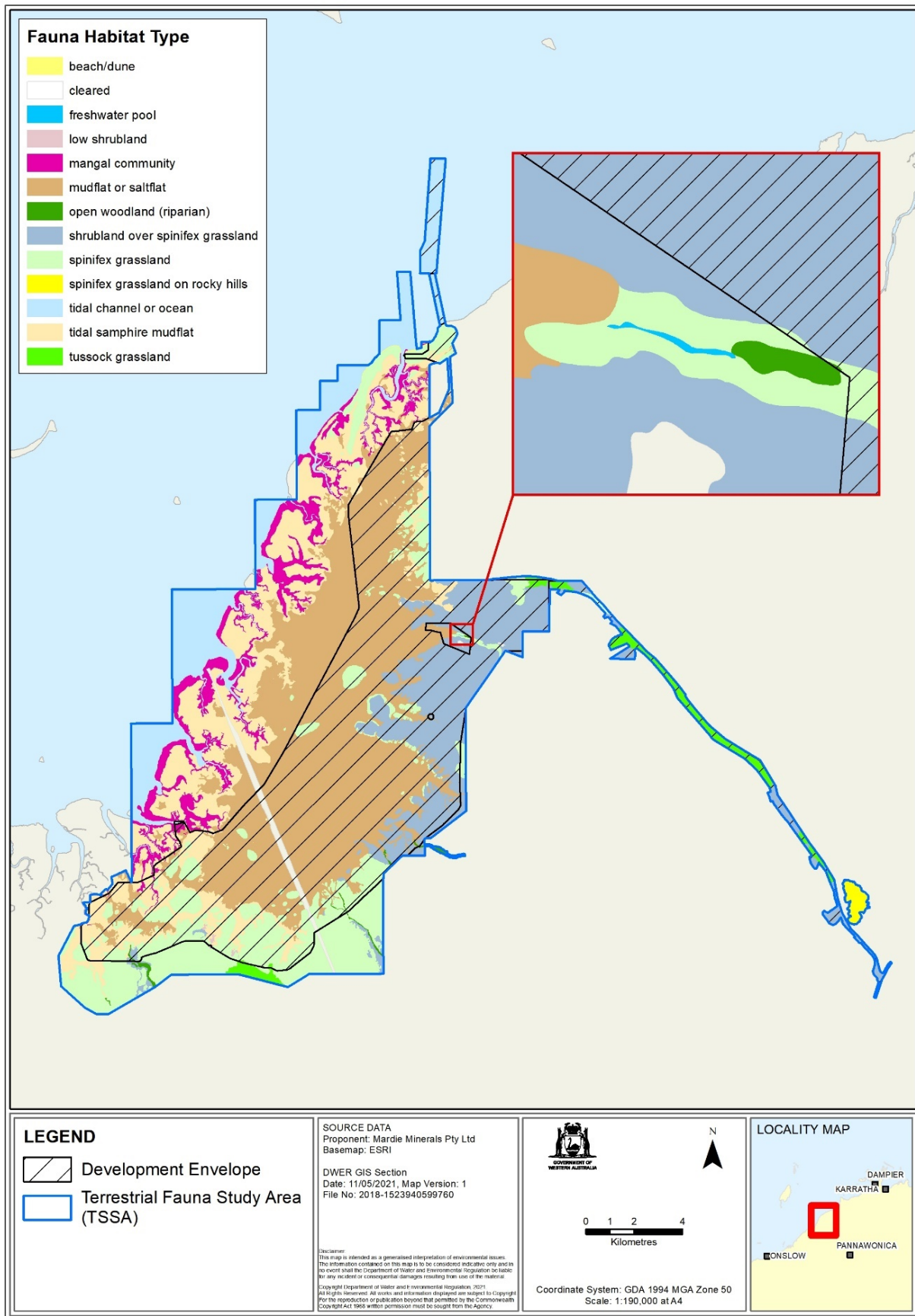
The EPA has considered whether reasonable conditions could be imposed to prevent inconsistency with the EPA's factor objective.

The EPA assessment findings are presented in Table 8.

Table 8: Summary of assessment, recommended conditions and DMA regulation for terrestrial fauna

Residual impact		Assessment finding	Recommended conditions and DMA regulation
1.	Clearing and disturbance of up to 2,562 ha to Pilbara leaf-nosed bat (Pilbara) foraging habitat	Clearing of habitat for significant fauna represents a significant residual impact, however this is likely to be able to be counter-balanced in accordance with the <i>WA Environmental Offsets Guidelines</i> . The impact is likely to be consistent with the EPA's objective for this factor.	Regulated by: <ul style="list-style-type: none"> condition 1: extent of authorisation condition 13: offset
2.	Clearing up to 1,132 ha to northern coastal free-tailed bat foraging habitat	Clearing of habitat for significant fauna represents a significant residual impact, however this is likely to be able to be counter-balanced in accordance with the <i>WA Environmental Offsets Guidelines</i> . The impact is likely to be consistent with the EPA's objective for this factor.	Regulated by: <ul style="list-style-type: none"> condition 1: extent of authorisation condition 13: offset
3.	Clearing/ disturbance of up to 6 ha Pilbara olive python habitat (open woodland (riparian) and freshwater pool habitat).	Clearing of habitat for significant fauna represents a significant residual impact, however this is likely to be able to be counter-balanced in accordance with the <i>WA Environmental Offsets Guidelines</i> . The impact is likely to be consistent with the EPA's objective for this factor.	Regulated by: <ul style="list-style-type: none"> condition 1: extent of authorisation condition 3: inland waters condition 13: offset.
4.	Clearing and disturbance of up to 64.5 ha of northern quoll foraging habitat.	Clearing of habitat for significant fauna represents a significant residual impact, however this is likely to be able to be counter-balanced in accordance with the <i>WA Environmental Offsets Guidelines</i> . The impact is likely to be consistent with the EPA's objective for this factor.	Regulated by: <ul style="list-style-type: none"> condition 1: extent of authorisation condition 13: offset.
5.	Clearing/disturbance of to 1,204 ha of migratory bird habitat a) up to 1,115 ha of disturbance tidal	EPA has assessed that impacts to migratory birds from clearing of tidal samphire habitat would not be inconsistent with the EPA's objective for this factor,	Regulated by: <ul style="list-style-type: none"> condition 1: extent of authorisation

	<p>samphire mudflats habitat</p> <p>b) up to 17 ha of mangrove communities</p> <p>c) up to 72 ha of tidal channel and ocean habitat.</p>	<p>subject to the implementation of the proposed monitoring program. However, the EPA has assessed that all impacts to habitat for listed Migratory/Marine bird species represents a significant residual impact. This significant residual impact is likely to be able to be counterbalanced in accordance with the <i>WA Environmental Offsets Guidelines</i>.</p>	<ul style="list-style-type: none"> condition 8: migratory bird monitoring condition 13: offset.
6.	<p>Indirect impacts to significant fauna habitat, including tidal samphire mudflat, mangrove habitat and open woodland (riparian).</p>	<p>Addressed in section 2.1(Inland waters), section 2.4 (BCH (intertidal)) and section 2.3 (Flora and vegetation).</p> <p>Likely to be consistent with the EPA's objectives for this factor, subject to the proponent's proposed monitoring and management.</p>	<p>Regulated by:</p> <ul style="list-style-type: none"> condition 3: GWMMP condition 5: flora and vegetation condition 6: prepare and implement a BCHMMP.
7.	<p>Impacts to SRE invertebrates and habitats</p>	<p>Likely to be consistent with the with EPA objective for this factor, subject to the implementation of the proponent's proposed pre-clearance surveys and mitigation measures in the event that SRE habitat is identified.</p>	<p>Regulated by:</p> <ul style="list-style-type: none"> condition 8: SRE pre-clearance surveys, mitigation, avoidance and minimisation.
8.	<p>Indirect impacts to terrestrial fauna associated with terrestrial noise, light spill and vehicle strike, feral animals, pond entrapment</p>	<p>The risk vehicle strikes on significant fauna is considered to be low risk.</p> <p>Not likely to be a material impact and likely to be consistent with EPA objective provided that the management and mitigation measures within the Illumination management plan, are implemented, and subject to regulation by DWER and DMIRS.</p>	<p>Regulated by:</p> <ul style="list-style-type: none"> condition 9: Illumination Plan <p>Noted:</p> <ul style="list-style-type: none"> DWER via Operation Licence under Part V of the EP Act DMIRS as part of mining proposal approval required under <i>Mining Act 1978</i>.

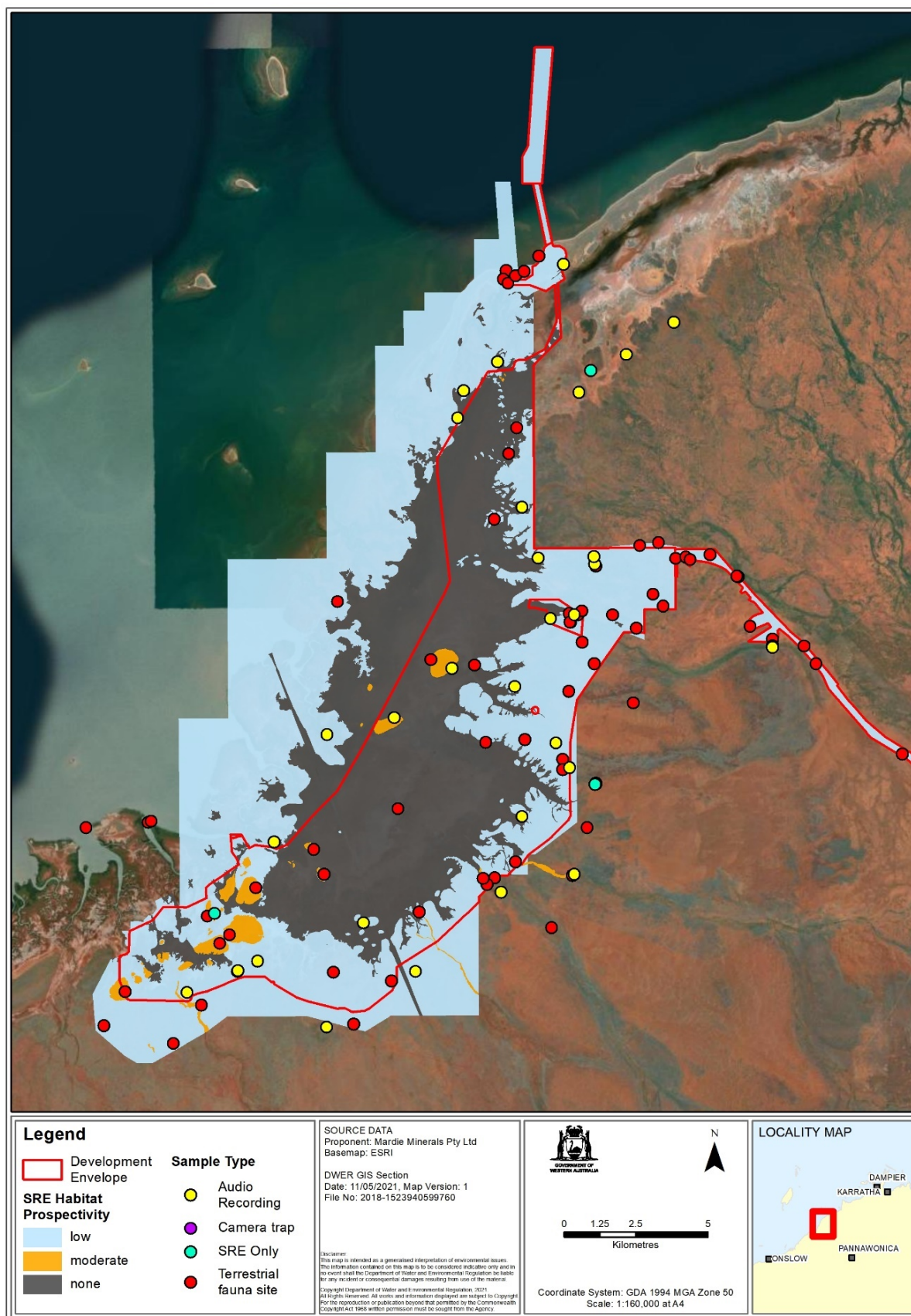


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Figure 12: Terrestrial fauna study area and habitat mapping



Figure 13: Migratory shorebird study area



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Figure 14: Short range endemic invertebrate sample sites and habitat mapping

2.7 Marine fauna

2.7.1 Environmental objective

The EPA's environmental objective for marine fauna *is to protect marine fauna so that biological diversity and ecological integrity are maintained* (EPA 2016k).

2.7.2 Investigations and surveys

A marine fauna review completed for the proposal is in Appendix 7 of the proponent's ERD (Preston Consulting 2020). It consists of a comprehensive desktop review including database searches and literature review on coastal development projects in the Pilbara and relevant scientific journal articles on marine fauna in the Pilbara region and globally (02 Marine 2020f). Incidental observation of marine fauna recorded during field surveys undertaken by 02 Marine and Stantec for other scope of works within the Marine area were included within the review. The proponent did not undertake any additional marine fauna studies within the proposal area to inform the desktop assessment, with the exception of specific marine turtle studies.

A 2018/2019 marine turtle (flatback, green and hawksbill turtles) monitoring survey was undertaken for the proposal (Preston Consulting 2020 Appendix 7) (see Figure 15). The surveys were conducted on suitable sections of sandy coastline in the vicinity of the terrestrial, marine and dredge channel development envelopes and nearby offshore islands. Data captured during the survey included nesting habitat assessment – track census, nesting habitat assessment – incubation success, artificial light monitoring and hatchling orientation. The survey was timed to coincide with the peak nesting period for flatback and green turtles and covered a full inter-nesting period. Subsequently, as hawksbill turtle nesting is more seasonally diffuse than green and flatback nesting it has been recommended that an additional survey be completed in October targeting hawksbills turtle utilisation on the mainland beach (Pendoley Environmental 2020). Turtles were also sighted along the coastline within the MSSA (Preston Consulting 2021).

An underwater noise assessment was completed for the marine environment to predict underwater noise levels associated with dredging and piling activities (within and adjacent to the marine and dredge channel development envelope) for the construction and operational activities of the port facility and assess the potential impacts on relevant marine fauna (Talis 2019).

The EPA has determined that the studies and surveys conducted in relation to marine fauna are adequate to inform the EPA's assessment for this factor.

Threatened marine species listed under the EPBC Act, the BC Act and the International Union for Conservation of Nature (IUCN) Red List of Threatened Species which were recorded within the vicinity of the terrestrial, marine and dredge channel development envelopes include:

- dugong (*Dugong dugon*) Marine, Migratory EPBC Act, Specially Protected BC Act, Vulnerable IUCN
- Australia humpback dolphin (*Sousa sahulensis*) Marine, Migratory EPBC Act, Priority 4 BC Act, Near threatened IUCN

- humpback whale (*Megaptera novaeangliae*) Marine, Migratory, Vulnerable EPBC Act, conservation dependent BC Act, Least Concern IUCN
- green sawfish (*Pristis zijsron*) - Vulnerable EPBC Act, Vulnerable BC Act, Critically Endangered IUCN
- loggerhead turtle (*Caretta caretta*) - Endangered, Migratory, Marine EPBC Act, Endangered BC Act, Vulnerable IUCN
- green turtle (*Chelonia mydas*) - Vulnerable, Migratory, Marine EPBC Act, Vulnerable BC Act, Endangered IUCN
- flatback turtle (*Natator depressus*) - Vulnerable, Migratory, Marine EPBC Act, Vulnerable BC Act
- hawksbill turtle (*Eretmochelys imbricate*) - Vulnerable, Migratory, Marine EPBC Act, Vulnerable BC Act, Critically Endangered IUCN
- short-nosed seasnake (*Aipysurus apraefrontalis*) Critically Endangered EPBC Act and BC Act, Critically Endangered, IUCN
- reef manta ray (*Manta alfredi*) Marine, Migratory EPBC Act, Marine, Migratory BC Act, Vulnerable IUCN.

Flatback turtle and a hawksbill turtle were recorded adjacent to the terrestrial and marine development envelope (Preston Consulting 2020). The survey identified that the offshore islands (particularly Long and Sholl Islands) provide suitable and viable habitat for turtle nesting i.e. rookeries (Pendoley 2019).

The humpback whales predominantly occur further offshore, however some have been observed by O2 Marine in 2018 within 5 km of the dredge channel and marine development envelope. It is advised that other species such as the Brydes whales, Minke whales have been sighted further offshore and that these whales only transit through oceanic waters well offshore from the shallow waters of the LAUs (Preston Consulting 2020). The presence and the likelihood of these species intersecting the dredge channel and marine development envelope is therefore considered to be low.

No dugongs (*Dugong dugon*) have been observed in the waters around Mardie during the surveys (based on O2 Marine [2020f] desktop review) but have the potential to occur in the region. This is likely influenced by the lower value of the subtidal BCH in the area as suitable feeding or foraging habitat for dugong (O2 Marine 2020f).

The Australia humpback dolphin was not been recorded within the dredge channel and marine development envelope during surveys (based on O2 Marine [2020f] desktop review of surveys). Dolphins (species unknown) have been sighted near Sholl Island (Preston Consulting 2020).

The short-nosed seasnake (*Aipysurus apraefrontalis*) is typically found in reef flats or shallow waters along the outer reef edge in water depths to 10 m. While the mapped subtidal BCH types within the Marine area is suitable habitat for the short-nosed sea snake it is unlikely to occur in proximity to the dredge channel and marine development envelopes. The nearest suitable habitat is located more than 5 km away from the dredge channel and marine development envelope (Preston

Consulting 2020).

Manta rays have been recorded from south-western Australia around the tropical north and south to the southern coast of New South Wales. While there is a moderate likelihood that the species occurs within the Mardie area the species has not been recorded in the region (based on O2 Marine [2020f] from desktop review). The proponent notes that potential habitat does occur near the dredge channel and marine development envelope (O2 Marine 2020f).

2.7.3 Proposal context – existing environment

Critical marine fauna habitat types in the terrestrial, dredge channel and marine development envelopes which support the significant species listed above include sub-tidal, intertidal (BCH), open and nearshore waters, tidal creeks and sandy beaches.

There are several offshore islands, Long Island and Sholl Island, within 10 to 15 km of the Mardie Creek entrance and in close proximity to the dredge channel and marine development envelope. All inshore islands of the West Pilbara coast are listed as Class C Nature Reserves and are important foraging and/or breeding habitats for migratory seabirds and turtles and supports large areas of macroalgal beds and coral communities (Preston Consulting 2020).

The marine and dredge channel development envelope intersects the sub-tidal. Intertidal, foreshore (sandy beach). The trestle jetty is approximately 2.2 km long with the bitterns outfall/diffuser also located at the end of the trestle jetty.

2.7.4 Potential impacts of the proposal

The proposal has the potential to significantly impact marine fauna are addressed in previous sections of this report:

- disturbance of sub-tidal and intertidal marine fauna habitat (refer to section 2.4 (BCH (intertidal)) and section 2.5 (BCH (subtidal))
- loss of marine environmental quality (increase in salinity) (within the low environmental protection area) from bitterns dispersal (refer to section 2.2 Marine environmental quality).

The proposal has the potential to impact on marine fauna from:

- injury and/or mortality as a result of vessel strike from dredging and transhipper barge
- entrapment of threatened marine fauna including marine turtles, mammals, sawfish, short-nosed sea snake in seawater intakes
- marine noise emissions (during construction and operation), particularly during pile driving activities
- damage to hearing and organs and/or behavioural changes on of marine species from piling noise
- behavioural impacts due to noise from construction and dredging
- increase predation due to aggregation capacity of marine infrastructure

- introduction of marine pests
- artificial light spill from facility including plant and port.

2.7.5 Consultation

The 10-week public review on the proposal raised concerns about the impact on commercial fisheries, marine fauna management including the mitigation of impacts, alterations to turtle and hatchling behavior as a result of light spill.

2.7.6 Avoidance measures

The proponent has designed the proposal to avoid key fauna habitat where possible by configuring the terrestrial, marine and dredge channel development envelope and the disturbance footprint within it to:

- relocated the ponds east, to avoid the majority of mangrove and tidal creek habitats including the RRDMMA
- impacts associated with significant dredging activities and ocean-going vessel movements close to shore have been avoided by the use of a transshipment loading method
- impacts associated with the use of a cutter-suction dredge have been avoided by utilising a simpler barge-mounted long-reach excavator method.

2.7.7 Minimisation measures (including regulation by other DMAs)

It is noted that marina fauna management is incorporated into several management plans and the proposal has committed to the following:

- vessels will not be permitted to venture or operate outside of port operational waters unless conducting monitoring or rescue operations
- implementation of an approved DMP (*02 Marine, 2020h Rev 1 Report R190043*)
- minimise potential noise impacts to marine fauna for the duration of the marine pile-driving operations by implementing marine noise controls which are provided within the draft Underwater Noise Management Procedure (UWNMP)
- IMP control measures. Port activities fall under the jurisdiction of PPA in consultation with Department of Primary Industries and Regional Development (DPIRD)
- minimise the risk of fatal vessel strikes to marine fauna through training of vessel operators and implementing of control measures
- reporting of sightings of large marine fauna (i.e. mammals, turtles, sawfish) to all Mardie Minerals vessels in order to minimise vessel strike incidents
- implement the MEQMMP
- seawater intakes to be fitted with intake screens designed to prevent marine fauna from being drawn into the intake, and designed such that intake speeds are limited to a maximum of 0.15 m/s
- develop and implement an 'illumination plan' for coastal and marine infrastructure

- pre-construction survey to confirm hawksbill utilisation of the mainland beach area
- light management monitoring including hatchling orientation and light emissions on the offshore islands during construction and for the first three years of operations
- key environmental windows for marine fauna (breeding seasons) are considered when planning construction activities.

2.7.8 Rehabilitation measures

The proponent has committed to decommissioning the marine components of the proposal, including:

- removal of all marine infrastructure including the jetty, bitterns diffusers, wharf, seawater intakes, boat launching facility and navigation infrastructure to an offsite location.
- the dredge channel will be left to gradually fill with sediment if not required by PPA.

2.7.9 Residual impact assessment

The EPA considered that the key marine fauna values likely to be significantly impacted by the proposal are marine fauna habitat, with particular regard to habitat for green sawfish, short-nosed sea snake, and marine turtles, and threatened marine species listed under the EPBC Act, the BC Act and the International Union for Conservation of Nature (IUCN) Red List of Threatened Species as listed below.

In considering the likely residual impact to marine fauna associated with the proposal, the EPA has considered:

- DotEE⁷ (2017) National Strategy for Mitigating Vessel Strike of Marine Mega-fauna.
- DotEE (2020) Light Pollution Guidelines: National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds.
- EPA (2010) Environmental Assessment Guideline No. 5 – Environmental Assessment Guideline for Protecting Marine Turtles from Light Impacts.
- Underwater Noise Management Procedures (Mardie Salt 2021).

Clearing, degradation or modification of marine fauna habitat

General habitat

The proposal would require the clearing (disturbance) of sub-tidal marine fauna habitat (see Table 5). Of the sub-tidal BCH to be disturbed, 36 ha is bare bioturbated/bare sand, 9 ha Filter Feeder / Macroalgae / Seagrass and 10 ha Coral / Macroalgae (Preston Consulting 2020) (see Table 6).

Seagrasses are known commonly foraged marine fauna particularly turtles and

⁷ Now known as Department of Agriculture, Water and the Environment (DAWE) (Commonwealth)

dugongs. Within and adjacent to the marine and dredge channel development envelope seagrasses have limited distribution and low cover. The proponent has indicated that based on the BCH surveys undertaken there is low quality foraging habitat available (Preston Consulting 2020). Whilst seagrasses were identified in the shallow nearshore waters within the sub-tidal portion of the Study Area, they were generally in areas dominated by filter feeder and macroalgal BCH. These marine habitats are located outside the marine and dredge channel development envelope and are well represented along the Pilbara coast (Preston Consulting 2020).

Most of the disturbance to the subtidal zone will be via dredging where high points along the channel (dredge channel development footprint) will be excavated to allow for safe passage of the shallow-draft transshipment vessels.

The intertidal BCH to be impacted does not constitute locally or regionally significant habitat for any significant marine fauna species (Preston Consulting 2020).

Impacts to intertidal and subtidal BCH are addressed in sections 2.4 and 2.5 respectively. The EPA has assessed that impacts to these habitats are likely to be consistent with the EPA's objectives for this factor, subject to the implementation of monitoring and management actions to minimise indirect impacts to BCH.

Green sawfish habitat

Green sawfish are expected to be present in the creeks and rivers of the Mardie coastline. It is noted that sawfish are most likely to be found at the mouths of tidal creeks and are highly unlikely to be found within the upstream reaches of tidal creeks (Preston Consulting 2021).

The proposal includes minor works disturbance of 9 ha within two of the 15 tidal creeks in the LAUs (see Figure 4). Acoustic studies have indicated that sawfish do not travel more than 700 m upstream from the mouth of the river. The proposal includes minor disturbance more than 700 m upstream, therefore it is unlikely that any sawfish will be present at the seawater intake or small boat launching facility due to their location (Preston Consulting 2020 and 2021).

The EPA has assessed there to be an unlikely significant residual risk to the green sawfish from the proposed habitat to be removed due to the remaining potential habitat available within the other 13 tidal creeks within the LAU and that there is a low risk that the species would be present within the disturbance area.

The EPA considers that the proposal is unlikely to have a material impact on the habitat associated with the green sawfish and is likely to be consistent with the EPA's objective to protect marine fauna.

Short-nosed sea snake habitat

There is a moderate likelihood that the species may occur near the marine and dredge channel development envelope in the vicinity of the offshore Islands. Impacts to coral and other subtidal habitats were assessed in section 2.5 (BCH (Subtidal)), and the EPA has determined that the likely impacts from the proposal would meet the EPA's objectives for this factor.

The EPA has assessed there to be an unlikely significant residual risk to the Short-nosed sea snake with habitat removal due to a lack of viable habitat within the marine and dredge channel development envelope. Preston Consulting (2020) reports that corals are significantly sparse (i.e. 86.7% of coral in LAU 7 is < 25% coverage) and that this BCH type is well represented outside of the LAUs.

The EPA considers that the proposal is unlikely to have a material impact on the habitat associated with the short-nosed sea snake and is not expected to affect the ecological integrity of the species within the development envelope and is likely to be consistent with the EPA's objective to protect marine fauna.

Turtle habitat

A small area of marine turtle nesting beach lies within the terrestrial development envelope, within a section of the mainland beach known as 'Mardie creek east'. Previous surveys have identified no evidence of nesting attempts on the mainland coast west of Mardie creek and very minor nesting effort by flatback turtles and a single hawksbill turtle, along the 15 km stretch of coastline to the east of the creek. These results indicated that the mainland beach (Mardie creek east) are not currently a regionally important rookery potentially due to mainland beaches (sand) being significantly warmer than the offshore islands. This has impacted the success rate of any marine turtle nests on these beaches (Preston Consulting 2020).

There are several offshore islands within 15 km of the Mardie creek entrance, of which Long Island and Sholl Island recorded marine turtle nest activity. In vicinity of the terrestrial, marine and dredge channel development envelope turtles nested successfully on the offshore islands 34–42 % of flatback and 36–50 % of hawksbill nesting attempts on the islands resulted in a nest. None of the three flatback nesting attempts on the mainland (Mardie creek east) resulted in a nest (Pendoley Environmental 2019). This is likely due to the nesting habitat characteristics between the island and mainland. The main species recorded on the offshore islands were flatback turtles, with relatively less nesting effort seen for hawksbill and green turtles at the same locations (Preston Consulting 2020).

Pendoley Environmental (2019) states that the coast adjacent to the terrestrial development envelope is characterised by very low turtle nesting activity relative to other mainland sites within the Pilbara area, which is likely due to nesting habitat geomorphology.

A high level of nesting activity was recorded on Long and Sholl Islands by flatback (24 tracks), hawksbill (12 tracks) and green (15 tracks) turtles. By comparison, nesting activity detected on the mainland beach (Mardie creek east) was low, including flatback (3 tracks) and hawksbill (2 tracks) turtle activities.

The marine turtle field survey was designed to focus effort during the peak nesting period for flatback and green turtles. Hawksbill turtle nesting is more seasonally diffuse than green and flatback nesting, however a spring (October) peak in nesting is recognised in the Pilbara. While the turtle monitoring survey (Pendoley Environmental 2019) confirmed that Hawksbill nesting was occurring regionally during the December survey and the mainland habitat featured less activity compared to the offshore islands. To validate the low utilisation rates and low-quality

turtle nesting of the hawksbill turtle on the mainland beach (Mardie creek east), the proponent has committed to a pre-construction survey to be completed in October.

Direct disturbance of 50 m stretch of low-quality turtle nesting mainland beach will occur within the terrestrial development envelope for the construction and operation of a jetty/conveyor and small boat launch facility. No vegetation or modification to habitat on or within close proximity to offshore islands is proposed.

Seagrasses and macroalgae BCH (within creeks and inlets) provide important feeding habitats for turtles. BCH surveys of the proposal support findings that the marine and dredge channel development envelopes are comprised of relatively poor quality (i.e. low cover and dynamic) vegetated habitats for foraging (Preston Consulting 2020). While nearshore islands and tidal creeks represent the most important feeding areas for turtles, the clearing of BCH will represent a loss of potential foraging habitat within the marine and dredge channel development envelopes.

No subtidal BCH in the study area is considered to be locally or regionally significant. The study area is unlikely to represent important foraging habitat for significant species. Dredging and this associated sedimentation is predicted to result in a loss of vegetated subtidal BCH within LAU7 (Preston Consulting 2020). Refer to section 2.5 (BCH (subtidal)).

The EPA has assessed there to be an unlikely significant residual impact from the clearing (disturbance) of low-quality turtle nesting habitat as there is suitable and viable marine turtle nest habitat offshore (particularly Long and Sholl Islands) within 15 km of the entrance to Mardie creek.

The EPA considers that the proposal is unlikely to significantly impact marine turtle habitat and is not expected to affect the ecological integrity of the species habitat within the terrestrial, marine and dredge channel development envelope and is likely consistent with EPA objective for this factor. This is subject to the outcomes of a pre-construction survey to confirm the low utilisation of hawksbill turtle on the mainland beach area and to confirm the low-quality habitat status.

The potential impacts of vessel strike, noise and artificial light spill are discussed in following sections.

Increased predation

The proposal will create salinity ponds within the terrestrial development envelope adjacent to the MSSA which may result in an increase shorebirds population numbers in the southern salinity pond area due to the creation of a modified habitat and presence of infrastructure for roosting. This may result in increased predation to turtle rookeries in the vicinity of the terrestrial and marine development envelope. The pond areas are located more than 10 km from the closest island nesting beach, and 4 km from the low-quality turtle nesting habitat on the mainland beach. Due to the distance and the presence of available high-quality foraging habitat within the MSSA, the possible increase in shorebird numbers and impacts upon turtle nesting beaches is expected to be negligible (Preston Consulting 2020).

The EPA has assessed there to unlikely to be a significant residual risk of increased

predation on marine fauna.

The EPA considers that increased predation associated with the proposal is unlikely to significantly impact marine fauna within the terrestrial, marine and dredge channel development envelopes and is likely to be consistent with the EPA's objective to protect marine fauna.

Vessel strike

Dredging during construction would be undertaken in a slow and progressive manner. The ERD (Preston Consulting 2020) and revised DMP (*Mardie Mineral Pty Ltd, 2020 Rev 1 Report No. R190043*) specifies that operations will be undertaken at 'a safe speed' within a 8–12 knots speed limit and low vessel movements are estimated to be between 2–4 transshipment barge movements per day.

The revised DMP (*Mardie Mineral Pty Ltd, 2020h Rev 1 Report No. R190043*) identifies management targets and management measures to reduce the risk and strike including vessel speed, a Marine Fauna Observer (MFO) on board at all times and the cease of dredge operations if marine fauna within a certain distance from operations and managing vessel speed so no injury or death of marine fauna as a result of vessel strike. During operation, vessel operators will log and report locations (sighting) of large marine fauna for them to be tracked (if visible) and avoided (O2 Marine 2020b). In a managed environment, environmental risk of vessel strike is considered to be low.

With the incorporation of management measures the EPA has assessed that there is unlikely to be a residual risk to marine fauna from the proposal.

The EPA considers that potential impacts associated with vessel strike as a result of the proposal are likely to be consistent with the EPA's objective for this factor, subject to the implementation of the proponent's proposed monitoring and mitigation measures.

Entrapment in seawater intakes

The proposal will have two seawater intakes with the primary seawater intake located approximately 2.2 km upstream of the creek mouth. The seawater intake will be located within a screened enclosure (minimum 162 m² of screen within the water column when the seawater intake is operational). The intake velocity of seawater (at the screen) will be maintained below 0.15 m/s at all times and should only be extracted at Mean Sea Level (MSL) or higher to ensure the screens are adequately covered (Preston Consulting 2020). The primary seawater intake will abstract up to 150 GL/a.

The offshore seawater intake (used for dilution of the bitterns) will also be screened enclosure (albeit a much smaller size) and operated as a less than 0.15 m/s around the perimeter of the screen. A total of 3.6 GL/a of bitterns with specific gravity of no more than 1.25 will be diffused into the marine environment within the boundary of the dredge channel and berth pocket (refer to section 2.2 Marine environmental quality for further discussion).

Based on published information, designing intake screening infrastructure operating

at or below 0.15 m/s adequately address impingement/entrapment impacts to marine fauna (US Environmental Protection Agency [2011] and Department of Sustainability and Environment [2008]). The EPA has assessed that, based on the structural and operations specifications of the seawater intakes residual impacts of marine fauna entrapment are likely to be consistent with the EPA's objective for this factor.

Introduced Marine Pests

No marine pest listed as species of concern on the National Introduced Marine Pests Coordination Group have been recorded in the Mardie region. The nearest introduced species known, is *Didemnum perlucidum* that has been recorded at Barrow Island, approximately 50km to the north-west of the project site at Mardie (02 Marine 2020i).

The proposal will utilise vessels during construction and operation that will be transported to the marine and dredge channel development envelope area from other ports within Australia and overseas which have the potential to transport marine pests which may impact sub-tidal BCH. Based on the vessel type to be used in construction and operation a marine pest risk assessment was completed by the proponent which identified a low risk for bulk carriers and crew transfer vessels, medium risk for transshipment vessel, barges, tugs and long-reach excavator and a high risk for jack-up barge and dredging barge (02 Marine 2020i).

The proponent has indicated that while the origin of equipment is to be confirmed, it is likely that it will be sourced from China and south-east Asian ports, which share similar environmental conditions with Pilbara marine waters (Preston Consulting 2020). Twenty-seven species were identified as having a potential risk of becoming a marine pest if introduced to the marine water at the marine and dredge channel development envelope including the green mussel (*Perna viridis*) or black striped mussel (*Mytilopsis sallei*). Dredging of the transshipping channel will remove existing substrate and generating deeper areas which may create a niche environment not previously available (02 Marine 2020a). These disturbed areas have the potential to be colonised by opportunistic marine pests which can out-compete native species and potentially cause habitat degradation. Marine pests are typically introduced and translocated within the marine environment by ballast water discharged by commercial shipping, bio-fouling on hulls and inside internal seawater pipes of vessels.

The introduction of marine pests has the potential to cause significant and widespread impacts to natural marine communities and to commercial fisheries within the Mardie Area.

The EPA has assessed the project management risk (proposed treatment and management measures) to reduce the risk of the introduction of marine pests as prescribed by 02 Marine (2020i), which include:

- implementation of the DPIRD 'vessel check' biofouling risk assessment which is a requirement for vessels entering Ports by PPA
- under the Commonwealth *Biosecurity Act 2015* all vessels are required to use the Marine Arrives Report System (MARS) which include ballast water management requirements

- sourcing construction equipment from low/risk domestic locations
- regular maintenance of operation vessel (O2 Marine 2020i).

The proposal was identified as being of 'low risk' of introducing marine pests within and adjacent to the marine and dredge channel development envelope. The EPA notes the application of industry controls through DPIRD and PPA.

The EPA has assessed that the residual impacts of marine pests within the marine environment from this proposal are likely to be consistent with EPA objective to maintain ecological integrity to protect marine fauna, subject to the implementation of the proposed management measures.

Noise emissions

Potential impacts of marine noise emissions from piling, dredging and other anthropogenic sound sources can effect/influence fauna from permanent hearing loss (PTS), temporary hearing loss (TTS) through to behavioral disturbance and prey detection and navigation. Vulnerability to PTS and TTS depends not only on the frequency range of an animal's hearing, but also on how sensitive its hearing is within that range (Preston Consulting 2020).

The proposal will produce marine noise emissions, predominantly during the construction phase during dredging and pile driving activities for jetty and wharf construction. Due to the use of a long-reach excavator a small amount of noise is expected to occur during dredging relative to conventional cutter-suction dredging methods (Talis 2019). A Sound Pressure Level (SPL) source level used for modelling of dredging activities was 167 dB re 1 μ Pa which is considered to be a conservative approach for dredging activities Talis (2019). A Sound Exposure Level (SEL) of 205 dB re 1 μ Pa².s @ 1m was also used as part of the model for a single strike for piling activities. The species considered to be at most risk from underwater noise related impacts were:

- dugongs
- turtles (loggerhead turtle, green turtle, flatback turtle)
- humpback whales
- Australian humpback dolphins
- green sawfish.

Marine noise emission modelling was undertaken for dredging and piling activities (Talis 2019). The results for dredging and barging, indicate that these activities are not expected to result in any behavioral disturbance of turtles and green sawfish.

The zone of behavioral disturbance is expected to be 1,500 m from the dredger and barge for humpback whales and dugongs (low frequency cetaceans) and 200 m from the dredger and barge for Australian humpback dolphins (mid frequency cetaceans).

Modelling results (noise emissions) associated with piling activities report that water levels associated with tides have a significant effect on the received noise levels. At low tide, the received levels are predicted to be below TTS threshold for all the

assessed fauna while at mean and high tides the TSS thresholds are exceeded at the following ranges:

Table 9: Impacts of noise from dredging, barging and piling activities on whales, dugong and dolphins from the proposal (Adapted from Talis, 2019)

Marine fauna	Piling activities	
	Possible TTS (Distances less than)	Possible behavioural response (Distances less than)
Humpback whales and dugong	500 m at high tide 300 m at mean tide Low tide – only at pile	High and mean tides: 10 km Low tide – only at pile.
Australian humpback dolphins	100 m at high and mean tide Low tide – only at pile	High and mean tides: 4 - 5 km Low tide – only at pile.
Marine turtles and green sawfish	100 m at high and mean tide Low tide – only at pile	High and mean tides: 500 m Low tide – only at pile.

The associated piling activities will be a short-term intermittent activity (between the hours of sunrise to sunset) associated with construction. The operational noise emissions from dredging are not expected to exceed TTS threshold levels for any assessed marine fauna. However, there may be potential behavioural disturbance for Australian humpback dolphin (200 m) and humpback whales and dugongs (1,500 m).

The EPA has assessed that the residual risk of marine noise to marine fauna is likely to be consistent with the EPA's objective for this factor, subject to the implementation of the proposed mitigation and management plans within the DMP and UWNMP, which includes soft start procedures for both observation and exclusion zones and will reduce the potential impact risk. The EPA has recommended conditions to ensure that these plans are implemented.

Artificial Light spill (pollution)

Preston Consulting (2020) reported that existing baseline artificial light results found the overhead skies within the terrestrial development envelope area are typically very dark and representative of pristine, natural dark skies unaffected by artificial light. The only light source visible from all mainland and offshore light monitoring sites was the Sino Iron facilities located over 30 km away on the easterly horizon. The hatchling orientation results indicate marine turtle hatchlings successfully oriented seaward, regardless of the orientation of the beach (e.g. Sholl Island north and south) or the visibility of the glow from the Sino Iron facilities (Pendoley Environmental 2019).

There is a risk that light from the proposal will be visible to hatchlings on the offshore islands located between 10 to 15 km away (i.e. Angle, Middle, Long, Round, Sholl, and Mardi Islands) as there is a direct line of sight to the proposal across the ocean (Preston Consulting 2021). The potential impacts can include:

- influence or alter the passage of emerging turtle hatchlings from the beach to the sea
- hatchlings leaving the nesting beaches on the offshore islands could potentially be attracted to light from the onshore facilities and jetty
- significant artificial light spill (pollution) can influence and alter nocturnal behaviours, particularly the selection of nesting sites
- deter mature turtles from emerging from the water to nest
- the effect of light spill on marine turtles is heavily influenced by wavelength (colour), intensity, glow, direction and elevation (Preston Consulting 2020).

The proponent has informed that hatchlings departing from nesting beaches on the offshore islands will typically be carried on prevailing tides and currents into deeper offshore waters and not inshore to the mainland where the jetty is located. This is due to the following:

- Waters flow both east-west and northeast-southwest at 1–1.5 knots (AUS742 navigation chart; 0.5–0.8 m.s⁻¹), in the waters between the marine and dredge channel development envelope and the coastal island chain.
- That strong flow rates are expected in the channels between the islands. Therefore, it is unlikely that hatchlings would be able to correct against current displacement over the 10 – 12 km distance from their nesting beach to reach the source of artificial light at the jetty, particularly when current speeds may exceed hatchling swimming speeds (i.e. >0.4 m.s⁻¹) (Pendoley Environmental 2020).

Pendoley Environmental (2020) advised that due to the higher sand temperature within the mainland beach area the low success rate of turtle nests, this area is not considered to be a significant rookery area (Preston Consulting 2020). Due to the extremely low density of nesting by Flatback and Hawksbill turtles along this stretch of the mainland coast, the risk of exposure to light on the mainland is considered to be low (Preston Consulting 2021).

The proponent has identified that marine turtles may be attracted to light spill on the water beneath the trestle jetty and has committed to:

- Development and implementation of an Illumination Plan which will include design, construction, mitigation and management measures as per EPA (2010) and DotEE⁸ (2020) guidelines.
- Completion of a turtle nesting monitoring program (offshore Island and mainland beach) when construction commences and for three years when the proposal is operational. The outcomes of this program may amend the proposed management measures to ensure that potential significant impact of light spill on nesting and hatching viability on the beaches on Long Island and Sholl Island can be reduced.

The proponent has assessed that the impact of artificial light emissions from the vessels (dredge, support vessels) based on the potential light spill and glow reaching significant turtle habitats and/or nesting beaches and rookeries is expected to be

⁸ Now known as Department of Agriculture, Water and the Environment (DAWE)

negligible (Preston Consulting 2020).

The EPA is unable to assess the residual risk of artificial light spill due to the absence of detailed monitoring information.

The EPA has considered whether there are mitigation measures available to avoid where practicable, or otherwise minimise the impact of light spill. Consistent with the principle of intergenerational equity, the EPA has also considered whether there are mitigation measures available to ensure that the ecological integrity of suitable and viable marine turtle nesting habitat can be maintained for future generations.

The EPA expects that the results obtained from the proposed monitoring program (and associated mitigation and management strategies to reduce the impacts of light spill within the Illumination Plan) will enable the impacts of lighting to be managed to ensure that the ecological integrity of the turtle nesting areas and hatchling survival rates are not compromised by artificial light spill.

The EPA has determined that impacts to marine turtles as a result of light spill from the proposal are likely to be consistent with the EPA's objectives for Marine fauna, subject to the implementation of proposed monitoring, mitigation and management strategies.

Summary of likely residual impacts of proposal

The EPA has assessed the likely residual impact of the proposal on marine fauna habitats to be:

1. clearing (disturbance) of sub-tidal and intertidal marine fauna habitat in addition to gas pipeline disturbance habitat (this environmental value and impact is further discussed in section 2.4 (BCH (Intertidal)), and 2.5 (BCH (Subtidal))
2. unlikely to be material impacts to 9 ha of tidal creek habitat for green sawfish
3. unlikely to be material impacts to 10 ha of habitat for short nosed sea snake
4. clearing (disturbance) of 50 m wide low-quality turtle nesting beach
5. unlikely to be significant risk of increased predation on marine fauna
6. risk of marine fauna mortality as a result of vessel strike
7. risk of fauna entrapment in seawater intakes
8. risk of introduction of introduced marine pests
9. marine noise emissions impacting behaviours and potential impacts to hearing for significant marine species
10. artificial light spill emissions impacting nesting behaviours for turtles.

2.7.10 Consideration of conditions

The EPA has considered whether the proposal can be implemented consistent with the EP Act principles and EPA factor objective.

The EPA has considered whether reasonable conditions could be imposed to prevent inconsistency with the EPA's factor objective.

The EPA assessment findings are presented in Table 10.

Table 10: Summary of assessment, recommended conditions and DMA regulation for marine fauna

Residual impact		Assessment finding	Recommended conditions and DMA regulation
1.	Disturbance of sub-tidal and intertidal marine fauna habitat (this environmental value and impact is further discussed in sections 2.4 and 2.5 (BCH).	Likely to be consistent with EPA objective, subject to monitoring and mitigation described in the proponent's ERD.	Regulated by: <ul style="list-style-type: none"> condition 6: prepare and implement a BCHMMP condition 7: Implement the Dredge Management Plan (DMP).
2.	Impacts to 9 ha of habitat for green sawfish.	Impacts unlikely to be material.	N/A
3.	Impacts to 10 ha of habitat for short-nosed sea snake.	Impacts unlikely to be material.	N/A
4.	Disturbance of 50 m width of a low-quality turtle nesting beach.	The impact is likely to be consistent with EPA objective, subject to the outcomes of a pre-construction survey to confirm the low utilisation of hawksbill turtle on the mainland beach area and to confirm the low-quality habitat status.	Regulated by: <ul style="list-style-type: none"> condition 10: minimise clearing of turtle nesting habitat condition 10: minimise direct impact condition 10: pre-construction marine turtle survey.
5.	Risk of increased predation on marine fauna	Impacts unlikely to be material.	N/A
6.	Risk of marine fauna mortality as a result of vessel strike	Impacts associated are likely to be consistent the EPA's objective for this factor, subject to implementation of the proposed monitoring and mitigation measures as described in the DMP.	Regulated by: <ul style="list-style-type: none"> condition 7: Implement the DMP.
7.	Risk of fauna entrapment in seawater intakes	Impacts unlikely to be material.	N/A
8.	Risk of introduction of introduced marine pests	Likely to be consistent with the EPA's objective for this factor, subject to the implementation of the	Regulated by: <ul style="list-style-type: none"> condition 7: prepare and implement marine pest management procedures.

		proponent's proposed management measures.	
9.	Noise impacts on marine fauna	Significant Impact likely to be able to be counter-balanced with an outcome based management approach of the implementation of the UWNMP.	Regulated by: <ul style="list-style-type: none"> condition 10: Implement the UWNMP.
10.	Impacts from light spill on marine turtle nesting behaviour.	The EPA has determined that impacts to marine turtles as a result of light spill from the proposal are likely to be consistent with the EPA's objective for marine fauna, subject to the implementation of proposed monitoring, mitigation and management strategies.	Regulated by: <ul style="list-style-type: none"> condition 9: Implement the Illumination Plan condition 10: Prepare and implement the Turtle monitoring program.



Figure 15: Marine turtle survey sites

2.8 Social surroundings

2.8.1 Environmental objective

The EPA's environmental objective for social surroundings is *to protect social surroundings from significant harm* (EPA 2016h).

2.8.2 Investigations and surveys

Two Aboriginal heritage (ethnographic and archaeological sites and other heritage places) surveys have been completed by Horizon Heritage Management (Horizon Heritage) in 2017 and 2018. The surveys defined the heritage values associated with the proposal and within areas where the terrestrial development envelope had been modified.

Horizon Heritage (2018) was also engaged by the Yaburara Mardudhunera (YM) People to undertake a work program clearance of the proposal with representatives of the YM People native title holders. The works included archival research, a field investigation and reporting. This assessment identified areas of high heritage significance and identified a number of areas to be demarcated, as well as 30 'cultural salvage points' that would require salvage of material prior to the implementation of the proposal.

The potential impacts on commercial fishing and aquaculture operation resulting from the proposal was completed by Fishwell Consulting (2020). The assessment included the identification and aquaculture activities and commercial fishing sector which operate within and adjacent to the proposal area and the scale of the fishing effort present.

2.8.3 Existing environment

The proposal is located approximately 80 km south west of Karratha adjacent to the coast, there are 15 tidal creeks of varying size that can be identified along the 26 km coastline west of the proposal, which are a common occurrence within the region. The site is remote and consists of rural pastoral activities. There are no known or established recreational and community uses within or adjacent to the marine and terrestrial development envelope.

Aboriginal Heritage

The YM People and Kuruma Mardudhunera (KM) People are the Traditional Owners associated with the land that underlies the proposal. In 2012, a Land Access Deed between BCI (parent company of Mardie Minerals) and the YM people was formalised (Preston Consulting 2020).

The ERD identified the Department of Planning Lands and Heritage (DPLH) Aboriginal Inquiry System Database Aboriginal Heritage Sites within or adjacent to the terrestrial, marine and dredge channel development envelope. The registered sites (as reported in 2020) include:

- DPLH 6322 Mardie creek Burial located near Mardie pool. The terrestrial development envelope avoids Mardie pool.

- DPLH 10351 Wiruwandi Plain extends from Wearawandie Well in the south to Mardie Wool Shed in the north and west of the Mardie-North West Coastal Highway Road. The terrestrial development envelope does not overlap the Plain.
- DPLH 11409 Mardie Station A⁹ is estimated to be located on the nearby Yarraloola Station. The terrestrial development envelope does not overlap the site.
- DPLH 11410 Mardie Station B⁹ it is estimated to be located away from the proposal and there is no overlap with the terrestrial development envelope (Preston Consulting 2020).

Other heritage sites include:

- DPLH 17429 Nyungarrarra (Peter's creek): the terrestrial development envelope is expected to overlap the western extent of this site.
- DPLH 17833 Tap Site 2: the terrestrial development overlaps with the site.
- DPLH 22932 Hadson 2: the site will not be disturbed by construction activities but will be flooded.
- DPLH 22933 Hadson Midden 1: the site will not be disturbed by construction activities but will be flooded.
- DPLH 26578 Wirawandi pool (Mardie pool): the site is not located within the terrestrial development envelope.

Since the submission of the ERD (Preston Consulting, 2020) the DPLH Aboriginal Heritage Site database has been updated (DPLH, 2021) (see Figure 16). DPLH 17429 Nyungarrarra (Peter's creek) is now a registered site and DPLH 11409 Mardie Station A and DPLH 11410 Mardie Station B location has been adjusted and is no longer within close proximity to the terrestrial development envelope.

The work program clearance (Horizon Heritage 2018) identified seven areas to be demarcated (exclusion) (including Island 5), and 30 'cultural salvage points' that would require salvage of material prior to the implementation of the proposal (Preston Consulting 2020) (see Figure 17).

Country has been used for traditional uses (bush tucker or medicine) including the area within the terrestrial and marine development envelope. Historically the YM People used coastal areas for recreation activities such as fishing, camping and hunting associated with the mangroves. More recently access to these areas is limited due to the inaccessible terrain and changing lifestyle of the YM and KM People. Spinifex grassland, shrubland and woodland areas are also important areas traditionally a food source and medicine purposes (Preston Consulting 2020). The availability of year-round fresh water made Mardie pool a vital asset and resource to Aboriginal people (Traditional Owners).

⁹ Horizon Heritage (2018) reports that these sites have been incorrectly mapped and that they do not exist despite an extensive search of the area of the registered sites. BCI consulted with DPLH and advised that even if the sites are not reliably recorded a Section 18 application would need to be completed for any impact to the site (BCI 2020).

European heritage

The WA databases (inHerit) database specifically describes the Mardie Station homestead and woolshed complex as a listed European Heritage site. It is reported that all of the features of the Mardie Station European Heritage site will not be disturbed with the homestead and woolshed complex located outside of the terrestrial development envelopes (Preston Consulting 2020).

There are no reported maritime heritage sites within the marine and dredge channel development envelope. The closest is Macey's Wreck (located approximately 4 km west of the proposal) (Preston Consulting 2020).

Commercial fisheries (economic)

Commercial fisheries are present within the Mardie region. There are four commercial fisheries working in the Mardie area between 2010-2011 and 2018-2019 (Fishwell Consulting 2020) which include:

Onslow Prawn Managed Fishery (OPMF)

The Onslow Prawn Managed Fishery (OPMF) operating along the western part of the North-West Shelf. The OPMF is divided into three fishing areas. The marine and dredge channel development envelopes intersect the OPMF Fortescue Nursery Area, where the fishing seasons typically operate between March and November (O2 Marine, 2020c). There is potential impact from the proposal due to proposed disturbance intersecting the Fortescue Size Managed Fishery Ground (SMFG) (Fishwell Consulting 2020). However, there is little to no OPMF effort in the vicinity of the proposal, therefore any impact of the Proposal on the current OPMF is likely to be minimal (Preston Consulting 2021).

The Mackerel Managed Fishery (MMF)

Spanish and Grey Mackerel are both widely distributed species, and the proposal is very unlikely to affect either stock. Given the lack of fishing effort reported in the vicinity of the Proposal, it is unlikely that it will impact the MMF (Preston Consulting 2021).

The Marine Aquarium Fish Managed Fishery (MAFMF)

MAFMF operates in all WA waters, but is most active south of Broome with most effort around the Capes region, Exmouth, Geraldton and Perth. The fishery is primarily dive based with collection allowed using landlines, nets and hand operated tools only. Within the review reporting period there has been limited fishing effort reported in the vicinity of the marine and dredge channel development envelopes (within the Mardie area), it is unlikely that it will impact the MAFMF (Preston Consulting 2021).

The Specimen Shell Managed Fishery (SSMF)

Within the review reporting period there was limited fishing effort reported in the vicinity of the proposal, the impact risk of the proposal on the SSMF is likely to be minimal.

2.8.4 Potential impacts of the proposal

The EPA identified the following proposal elements could impact on its social objective for social surroundings:

- disturbance (including the diversion which will change the hydrological regime) of Peter's creek (DPLH 17429)
- disturbance of part DPLH 17833 Tap Site 2 other heritage site
- disturbance via flooding of DPLH 22932 Hadson 2 and DPLH 22933 Hanson Midden 1 other heritage sites (including Shell Midden 3)
- disturbance of land used for traditional purposes (17 ha mangrove community and up to 2,401 ha disturbance of Spinifex grassland, shrubland and woodland areas)
- reduced recreational use of marine and coastal water within the marine and dredge channel development envelope area
- visual amenity of Mardie homestead residents and visitors
- indirect influence of fishing opportunity on commercial fishery operations.

2.8.5 Consultation

During the referral and assessment process consultation with the City of Karratha, Pastoral Management Pty Ltd (PMPL) (Mardie Station), King Bay Sporting Fishing Club, Nickol Bay Sporting Fishing Club and the traditional owners YM People and KM People was undertaken. The main matters raised include Mardie Road Access, access agreement terms, disturbance to Aboriginal heritage site, impact bush medicine plants and bush tucker.

2.8.6 Avoidance measures

The proponent has avoided:

- two Registered Aboriginal Heritage Sites
- two Demarcated Aboriginal Heritage Areas
- the Mardie homestead and woolshed complex
- Mardie pool
- 'Island 5' – a Demarcated Aboriginal Heritage Area.

2.8.7 Minimisation measures (including regulation by other DMAs)

The proposal has committed to:

- obtain Access Agreement with PMPL
- implement industry best-practice management measures for Aboriginal Heritage
- apply for and comply with section 18 approvals obtained under the *Aboriginal Heritage Act 1978* (AH Act) for any Aboriginal Heritage sites (or Other Heritage Places that are likely to be sites) that are to be disturbed

- ensure Aboriginal ‘cultural salvage areas’ are appropriately salvaged prior to disturbance
- minimise clearing and access restrictions within areas used for traditional purposes
- maintain and improve Traditional Owners’ access to land for traditional uses
- develop and implement a Cultural Heritage Management Plan in consultation with the YM and KM People (Horizon Heritage 2018).

2.8.8 Rehabilitation measures

The proponent has prepared a MCP (Appendix 18 of the RtS, Preston Consulting 2021) and will examine inundated demarcation sites and remediate to the satisfaction of the YM and KM People.

2.8.8 Residual impact assessment

The EPA considered that the key social values likely to be significantly impacted by the proposal are Aboriginal Heritage sites and amenity.

The EPA has assessed the likely residual impact of the proposal on these social values to be related to Aboriginal heritage, European heritage, visual amenity, noise and dust emissions and commercial fisheries:

Aboriginal heritage

Aboriginal sites

Part of DPLH 17429 Nyungarrarra (Peter’s creek) will be disturbed and a section 18 application will need to be applied for to disturb this site under the AH Act.

DPLH 17833 Tap Site 2 will be impacted from the proposal. Prior to ground disturbing activities the salvage and relocation artefacts to a demarcated island structure adjacent to Peter’s creek will be undertaken.

Disturbance via flooding of DPLH 22932 Hadson 2 and DPLH 22933 Hanson Midden 1 other heritage sites (including Shell Midden 3) will also occur through the implementation of the proposal. The proponent has undertaken a work program clearance, which included an agreed methodology between YM, Horizon Heritage and the proponent (Horizon Heritage 2018). The YM People have cleared the terrestrial and marine development envelopes for development, subject to the cultural management conditions agreed to with BCI Minerals Limited in the field. These management measures (i.e. presence of cultural monitors, salvage and relocation of cultural material is Island 5) are presented within the *Horizon Heritage, (2018) Work Program Clearance for the Yaburara & Marthudunera People and BCI Minerals Limited for the proposed Mardie Salt Project, south of Cape Preston, WA.*

The EPA has assessed that there is a material impact to social surroundings (Aboriginal heritage sites) associated with implementation of the project. The Horizon Heritage, (2018) Work Program Clearance reports that the YM people have cleared the terrestrial and marine development envelopes for development subject to the cultural management conditions. With the implementation of the agreed

management measures, the proposal is not likely to be inconsistent with the EPA's objective for this factor.

Associated approvals such as section 18 under the AH Act and associated Heritage Management Plans for the proposal (i.e. disturbance to Peter's creek) will be sought by the proponent.

Land use for Traditional Purposes

Access to Mangroves is limited due to the inaccessible terrain. With changing lifestyle of the YM and KM People, the use of Spinifex grassland, shrubland and woodland areas for traditional purposes may also be reduced. Preston Consulting (2020) advises that while the cumulative loss of land use associated with mangroves is not qualifiable it is likely to be less than 1% of the total extent. The vegetation associations (spinifex grassland, shrubland or woodland) within the terrestrial and marine development envelope will have >80% of their pre-European extent remaining.

Based on the above, clearing of up to 17 ha mangrove community and up to 2,401 ha disturbance of Spinifex grassland, shrubland and woodland areas, is not expected to have a significant impact of the land use for traditional purposes within the terrestrial and marine development envelope and would be consistent with the EPA's objectives for social surroundings.

European heritage

Mardie Station will not be disturbed as the homestead and woolshed complex is located outside of the terrestrial development envelopes (Preston Consulting 2020). The EPA concludes that there is no expected material impact from the implementation of the proposal on European heritage and impacts to European heritage are likely to be consistent with the EPA's objectives for this factor.

Visual amenity

Due to the remote location of the proposal, and adjacent mud flats access to the terrestrial development envelope rarely occurs. There has been no frequent usage (camping or fishing) within or adjacent to the terrestrial and marine development envelope. There is no public access through Mardie station (CITIC Pacific and Pastoral Management Pty Ltd- holder of the Mardie Station Pastoral lease) as entrance to the station consists of locked gates. The proponent has liaised with City of Karratha and various fishing clubs who confirmed that there are no notable recreational or community uses of the marine and coastal; waters proximity to the proposal (Preston Consulting 2020).

Mardie homestead is located 700 m from the ponds within the terrestrial development envelope. While there are no direct impacts to Mardie homestead the SoP plant maybe visible from the homestead. The proponent has advised that access agreements with the homestead will address amenity issues.

Based on the above information, the EPA concludes that there is no expected visual amenity impact from the implementation of the proposal to the Mardie homestead if the access agreement is confirmed. The EPA has assessed that the proposal is

likely to be consistent with the objective for this factor.

Noise and dust

The ERD discusses that the proposal will result in low noise emission during construction as most of the works will be conducted in narrow strips on soft mudflats (for the pond walls) and minimal night work will be undertaken sure to site terrain. During operation as solar evaporation is the main process noise emission will be low. (Preston Consulting 2020). No terrestrial noise modelling was not completed as part of the ERD. However, there is a requirement for the proponent to comply with the EP Noise Regulations.

The influence of dust emission was not highlighted within the ERD. The proponent discusses that water or dust suppressant will be applied to disturbed areas and product transfer / storage areas as required to minimise dust generation (Preston Consulting 2020). While it is noted that the proposal is located within a remote location, the Mardie homestead is located 700 m from the ponds within the terrestrial development envelope. The EPA recommends that the site risk assessment for activities generating uncontaminated dust within the Department of Environment and Conservation (DEC) (2011) guideline for managing dust is consulted. This will determine whether dust mitigation measures are required to reduce impact to Mardie homestead (nearest sensitive receptor).

Artificial light spill and marine noise are discussed in section 2.7 (Marine fauna).

Commercial Fisheries (economic)

Based on the Fishwell (2020) report there is limited usage of marine waters within the marine and dredge channel development envelope area by the four identified commercial fisheries (OPMF, MMF, MAFMF and SSMP). Therefore, the EPA considers that there is unlikely to be a significant impact from the construction and operation of the proposal upon the current commercial fisheries industry operations near the marine and dredge channel development envelope area. The EPA has assessed that the project is likely to be consistent with the EPA's objective for this factor.

Summary of likely residual impacts of proposal

The EPA has assessed the likely residual impact of the proposal on social surroundings to be:

1. disturbance (including the diversion which will change the hydrological regime) of Peter's creek (DPLH 17429)
2. disturbance of part DPLH 17833 Tap Site 2 other heritage site
3. disturbance via flooding of DPLH 22932 Hadson 2 and DPLH 22933 Hanson Midden 1 other heritage sites (including Shell Midden 3)
4. unlikely to be significant impacts to land use for traditional purposes
5. unlikely to be material impacts to visual amenity
6. unlikely to be material impacts associated with noise and dust, subject to compliance with EP Noise regulations and Part V of the EP Act

7. unlikely to be significant impact to commercial fisheries.

2.8.10 Consideration of conditions

The EPA has considered whether the proposal can be managed consistent with the EP Act Principles and the EPA factor objective.

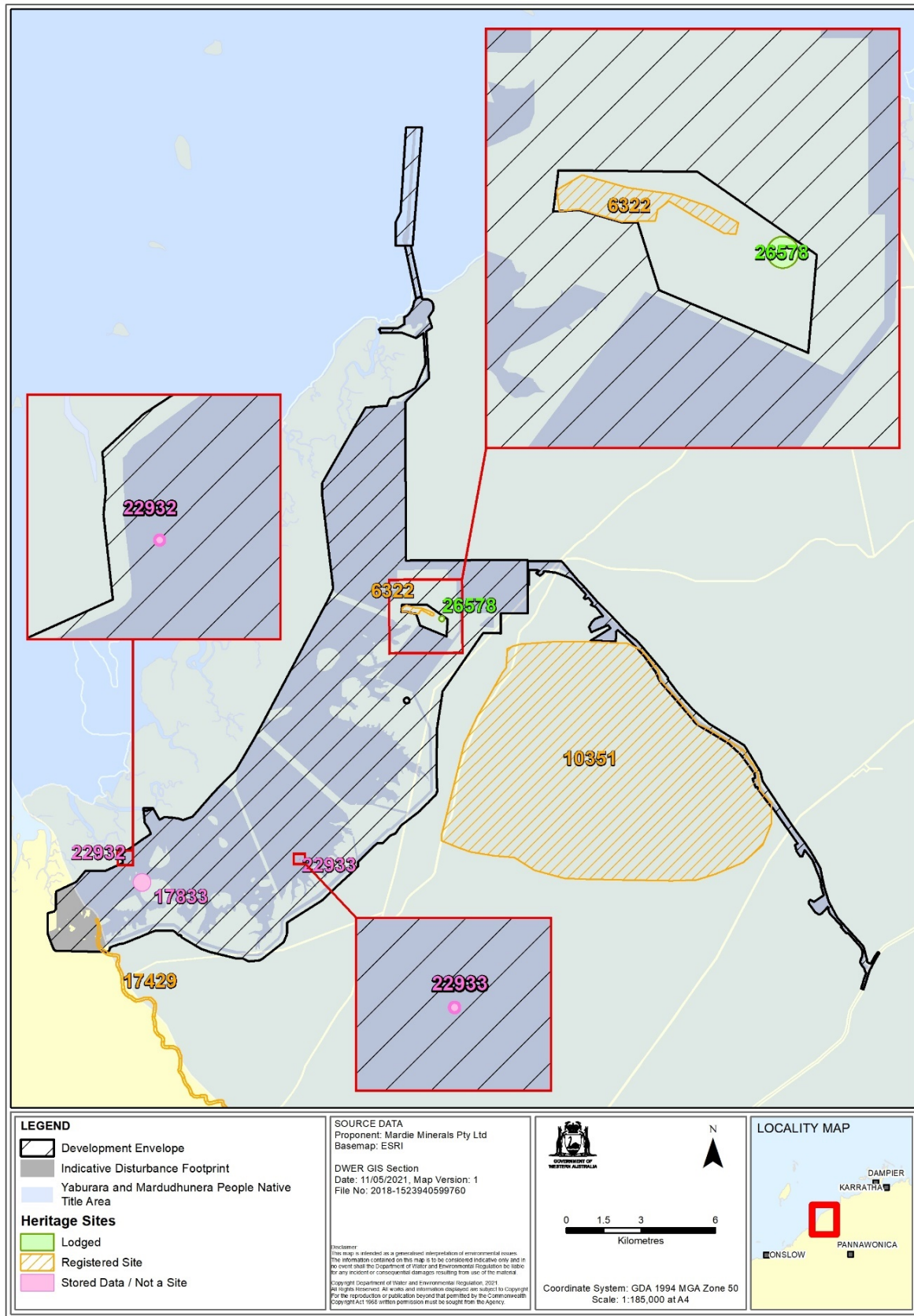
The EPA has considered whether reasonable conditions could be imposed to prevent inconsistency with the EPA's factor objective.

The EPA assessment findings are presented in Table 11.

Table 11: Summary of assessment, recommended conditions and DMA regulation for social surroundings

Residual impact		Assessment finding	Recommended conditions and DMA regulation
1. 2. 3.	Disturbance to 17429 Nyungarrarra (Peter's creek) and DPLH 17833 Tap Site 2, and flooding of DPLH 22932 Hadson 2 and DPLH 22933 Hanson Midden 1 other heritage sites (including Shell Midden 3).	Potential material impact to Aboriginal heritage sites and cultural values. Can be managed through implementation of the agreed requirements/specifications reported within the <i>Horizon Heritage Management 2018. Work Program Clearance for the Yaburara and Marthudunera People and BCI Minerals Limited for the proposed Mardie Salt Project, south of Cape Preston.</i> The EPA considered that the proposal is likely to be consistent with the objective for this factor subject to conditions.	Regulated by: <ul style="list-style-type: none"> condition 11: avoid and minimise impacts condition 11: heritage management plan.
4.	Disturbance of Land used for traditional purposes (17 ha mangrove community and up to 2,401 ha disturbance of Spinifex grassland, shrubland and woodland areas	The EPA considers that the proposal is unlikely to have a material impact on land used for traditional purposes or to be inconsistent with the EPA's objective to protect social surroundings.	Regulated by: <ul style="list-style-type: none"> condition 1: extent of authorisation.
5.	Influenced visual amenity of Mardie homestead.	Not likely to be a material impact.	<ul style="list-style-type: none"> N/A
6.	Noise and dust emissions	Not likely to be a material impact there is a requirement for the proponent to comply with the EP Noise Regulations and dust risk assessment of dust emission to the nearest sensitive receptor.	Noted: <ul style="list-style-type: none"> The DWER via licence conditions under Part V of the EP Act.

7.	Impact to commercial fisheries	Not likely to a material impact or inconsistent with or be inconsistent with the EPA factor objective.	N/A
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Figure 16: Registered heritage sites

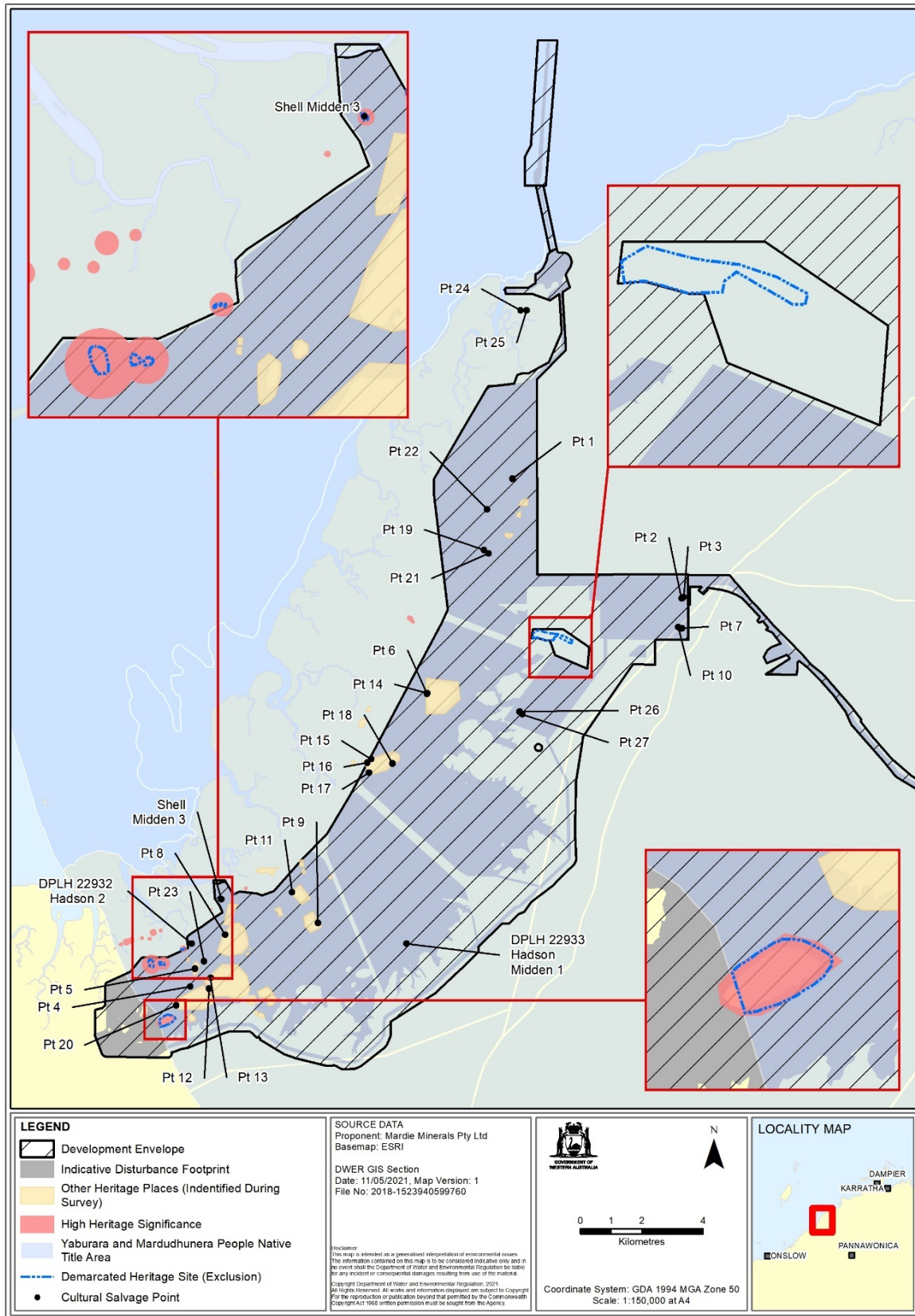


Figure 17: Demarcated heritage sites

3 Holistic assessment

The EPA assessed the impacts of the proposal against the objectives of the key environmental factors individually. The EPA also recognises the links between flora and vegetation, terrestrial fauna, inland waters, marine environmental quality, BCH, marine fauna and, social surroundings (see Figure 18) and have therefore also considered the connections and interactions between parts of the environment to inform a holistic view of impacts to the whole environment.

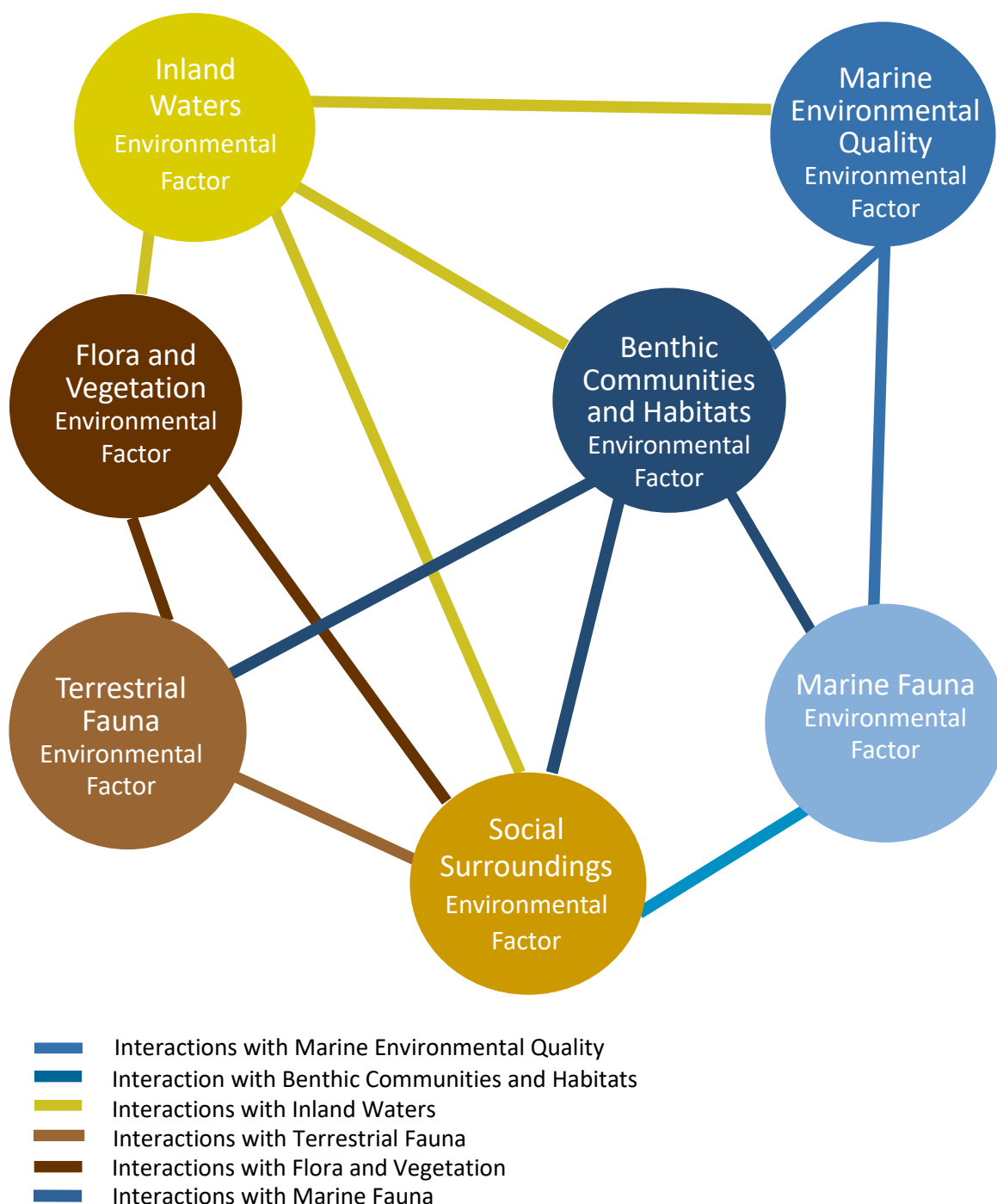


Figure 18: Intrinsic interactions between the key environmental factors

Understanding the environmental processes and interactions was critical to assessing the significance of potential impacts from the proposal on the environmental values.

The proposal has been designed to avoid direct impact to all threatened and priority flora within the terrestrial development envelope, including *Minuria tridens* (listed as threatened under the EPBC Act and priority 1 by the DBCA).

There is a high level of connectivity between the environmental factors inlands waters and intertidal BCH. The proponent has incorporated design elements to reduce the environmental impact to BCH as a result of changes to inland waters. The proponent's modelling and assessment adequately considered the connectivity of these factors and the impacts to surface water are adequately described in the ERD (Preston Consulting 2020).

The EPA has considered the cumulative impacts of the proposal on each of the sensitive receptors identified. There is a particular risk that intertidal BCH could be subject to cumulative impacts from direct disturbance, changes to surface water and groundwater associated with the proposal. The EPA has determined that the risk of impacts additional to the proposed direct disturbance can be managed to meet the EPA's objectives, subject to the implementation of the recommended conditions.

The monitoring of intertidal BCH, and samphire health and distribution and implementation of adaptive management actions would ensure that the processes of primary productivity, ecosystem maintenance, and nutrient cycling, as well as habitat values including foraging habitat for migratory birds (samphire), breeding and nursery habitat for significant marine species (mangroves), and intermittent foraging habitat for marine species (algal mat) can be maintained to ensure consistency with the EPA's environmental factor objectives.

Marine fauna and associated habitats are also dependent on environmental factors marine environmental quality and BCH, which can influence the ecosystem processes. While bitterns are to be diluted with seawater prior to disposal, reduced water quality is expected in the LEPA and MEPA, which are within 250 m of the bitterns diffuser (Preston Consulting 2020). The impacts associated with bitterns disposal are not considered to be significant beyond the LEPA and are unlikely to adversely impact the ecological integrity of marine fauna, subject to the implementation of management measures to minimise the area which would be subject to lower water quality.

The offshore island (i.e. Sholl and Long Islands) which are key viable marine turtle nesting (rookeries) area are outside both the (worse case) ZoMI and zone of influence (Preston Consulting 2020), and are not expected to be directly or indirectly impacted by the proposal. Key important habitats (tidal samphire mudflats, ocean mudflats and sandbars and mangal communities) for migratory birds identified in the MSSA are widely distributed locally and regionally.

As part of the proposals construction and operation there are potential impacts such as vehicle/vessel strike, artificial light spill, noise emissions and introduction of pest species (both marine and terrestrial) which can directly and indirectly impact and influence marine and terrestrial fauna and their environs. Through the

implementation of the proposed management measures and environmental management plans, and associated (additional) approvals under the *Mining Act 1978*, and Part V of the EP Act potential impacts can be minimised to ensure the proposal would not be inconsistent with the EPA's factor objectives.

The EPA also considered the connection between the key environmental factor social surroundings, flora and vegetation and inland waters. The EPA noted the significance and cultural attachment to Mardie pool and DPLH17429 Nyungarrarra (Peter's creek). The EPA advises the importance of the implementation of the Horizon Heritage (2018) work program clearance in close association with the YM People to preserve the cultural significant artifacts to a Demarcated Aboriginal Heritage Area. On-going consultation with the YM People and KM throughout the life of the proposal will assist with relationship with Country for future generations.

In assessing the proposal, the EPA has afforded the highest degree of protection to the geographical areas of high conservation values, with particular regard to the RRDMMA, Mardie Pool, and areas of intertidal BCH. The EPA has recommended conditions to ensure that impacts to these areas do not undermine broad ecosystem or environmental processes.

The EPA notes that the proponent has not proposed a life of mine or end date for the proposal. However, in considering the entirety of the proposal, the EPA considers that a number of factors may be increased with the passing of time, including the impacts of the proposal in conjunction with climate change. The EPA has recommended condition 1 (extent of authorisation) limiting the authorisation of the proposal to 63 years. At this time, the proposal may be decommissioned, or re-assessed for a further approval.

The EPA considers that a 10 yearly environmental performance report should also be required from the proponent, given the interconnected environmental values in the area likely to be affected by the proposal, and the 63 year life of the proposal. This environmental performance reporting will provide the proponent and the Minister with renewed and current information about the performance of the proposal with respect to environmental values over the life on the project.

Summary of holistic assessment

When the separate environmental factors of the proposal were considered together in a holistic assessment, the EPA formed the view that, the interactions between impacts from the proposal would not lead to any additional inconsistency with the EPA's factor objectives.

4 Offsets

Environmental offsets are actions that provide environmental benefits which counterbalance the significant residual impacts of a proposal. The EPA may apply environmental offsets where it determines that the residual impacts of a proposal are significant, after avoidance, minimisation and rehabilitation have been pursued.

Consistent with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014) the EPA has considered whether offsets can counterbalance and are appropriate for the proposal's residual impacts which are likely to be significant.

In the case of this proposal, offsetting of significant residual impacts through the provision of funds to the Pilbara Environmental Offset fund (PEOF) would be appropriate for any residual impacts to terrestrial flora, vegetation, and fauna values that the EPA has determined could be counterbalanced.

Significant residual impacts to intertidal and marine values cannot be offset through the PEOF at this time. In its current form, the PEOF is designed specifically to deliver terrestrial and land-based outcomes, and is therefore not sufficiently relevant to intertidal and marine to meet the requirements of the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014).

Significant residual impacts to terrestrial flora, vegetation and fauna values

The EPA considers that the clearing of native vegetation and impacts on other associated environmental values in the Pilbara Interim Biogeographic Regionalisation for Australia (IBRA) bioregion is significant where the cumulative impact may reach critical levels if not managed. The proposal is located within the Roebourne IBRA subregion of which only 3.45% is currently reserved for conservation.

In applying the residual impact significance model (Government of Western Australia 2014), the EPA considers that the proposal would have a significant residual impact to terrestrial flora, vegetation and fauna from:

- Clearing of up to 2,319 ha of good to excellent condition native vegetation, including landward samphire, foraging habitat for the Pilbara leaf-nosed bat, Northern coastal free-tailed bat, and northern quoll, and dispersal habitat for the Pilbara olive python, and foraging habitat for migratory birds.
- Clearing up to 145 ha and indirect impacts to up to 20 ha of Priority 3 PEC - Horseflat Land System of the Roebourne Plains.
- Clearing of up to 6 ha critical Pilbara olive python habitat (riparian and freshwater pool habitat).

In its advice on the cumulative impacts in the Pilbara (EPA 2014), the EPA considered that without intervention, in the increasing cumulative impacts of development and land use in the Pilbara region will significantly impact on biodiversity and environmental values.

Consistent with other decisions within the Pilbara region, the EPA recommends that

the following offset rates (calculated on the 2020 calendar year) should apply in the form of a contribution to a Pilbara strategic conservation initiative for landscape-scale actions to protect biodiversity in the Pilbara:

- \$826 AUD (excluding GST) per hectare of good to excellent condition native vegetation, including foraging habitat for the Pilbara leaf-nosed bat, northern coastal free-tailed bat, and northern quoll, and dispersal habitat for the Pilbara olive python, and EPBC Act listed Migratory/marine bird habitat.
- \$1,653 AUD (excluding GST) per hectare of direct impacts and indirect impacts leading to complete loss of Priority 3 PEC – Horseflat Land System of the Roebourne Plains.
- \$1,653 AUD (excluding GST) per hectare of critical Pilbara olive python habitat (riparian and freshwater pool habitat).

The EPA recommends that condition 13 is imposed on the proponent to provide an offset for terrestrial impacts in the form of a contribution to the PEOF to counterbalance the significant residual impacts of the proposal.

Significant residual impacts to intertidal and marine values

The EPA considers that residual impacts to intertidal BCH associated with this proposal are significant because there is potential for ecosystem maintenance and function to be impacted in the event of cumulative impacts to significant portions of the regional coastline, including support for nationally and internationally significant populations of migratory shorebirds, green sawfish and sea turtles.

In this instance, due to the low habitat values, sparse nature of subtidal BCH in the likely areas of impact, and the presence of higher quality subtidal habitat around the nearby offshore islands that would not be impacted, the EPA considered there is not a significant residual impact associated with disturbance of subtidal BCH for this proposal.

Determination of significant residual impact

In applying the residual impact significance model (Government of Western Australia 2014), the EPA considers that the proposal would have a significant residual impact to intertidal and marine values from:

- disturbance of up to 296 ha coastal samphire
- disturbance of up to 880 ha algal mat
- disturbance of up to 13 ha mangrove habitat outside the RRDMMA.

The proposal also has the potential to impact intertidal and marine values through:

- potential direct disturbance to up to 4 ha mangrove habitat within the RRDMMA, subject to the requirements of recommended condition 2
- potential indirect impacts to intertidal BCH as a result of decreased frequency of freshwater inundation and saline seepage to groundwater, resulting in a loss of health or diversity of intertidal BCH.

Determination of quantification of offsets

The EPA is of the view that the quantification of offsets for intertidal and marine values should be linked to the cost associated with achieving outcomes that would aid in the protection of the relevant habitat values in the west Pilbara coast region. While the values of algal mat in the project area are not fully known, the EPA determined to assess impacts to this habitat based on the assumption that it has high value.

In this instance, the proponent proposed an offset strategy including research programs that would improve efforts to protect intertidal BCH and its associated values in the region. The proponent was not able to identify any rehabilitation or on-ground programs that would offset the values to be impacted by the proposal. The proposed research programs are discussed below.

The EPA has considered the proponent's offset strategy and has proposed research outcomes that the EPA believes are relevant and commensurate to the scale of the impact associated with direct disturbance of coastal samphire, algal mat and mangroves outside of the RRDMMMA. These outcomes would meet the objective of guiding the protection and management of the ecological values of intertidal BCH including habitat values for migratory birds and ecological maintenance of habitat for significant marine fauna. The outcomes to be achieved in order to offset direct impacts to intertidal BCH are:

- Completion of mapping of algal mat and samphire extent on the West Pilbara coast (defined as the area from the bottom of the Exmouth gulf to Karratha), in order to provide an understanding of the regional extent and distribution of algal mat and complement existing mangrove mapping.
- Completion of studies to provide guidance to the EPA, future proponents, and decision-making authorities on the potential impacts of sea-level rise on intertidal BCH on the West Pilbara Coast, and the significance of salt projects in preventing the adaptation of intertidal BCH to sea-level rise.
- Completion of studies to provide guidance to the EPA, future proponents and decision-making authorities in regard to the ecological roles and values of algal mat.

The EPA has obtained advice from the Western Australian Marine Science Institute (WAMSI) regarding the cost of achieving the above outcomes to guide the quantification of offsets for intertidal BCH. In considering the likely cost of achieving the required outcomes, and the amount of intertidal BCH to be directly impacted by the proposal, the EPA has concluded that, in this instance, the quantification of offsets for impacts associated with direct disturbance of intertidal BCH for this proposal would be:

- \$2102 per hectare of Algal mat, Coastal samphire or Mangrove lost as a result of direct disturbance or project-attributable indirect impacts.

The EPA considers that where indirect impacts are identified that are attributable to the proposal, these should also be offset at the above mentioned rate.

Where an area of habitat contains two values that are to be offset, the higher offset amount would apply. Offsets would not be applied twice for the same area of land. In

this case, areas of mangrove and samphire which are offset for intertidal values would not also be subject to offset for good to excellent native vegetation, however the higher of the two rates would apply.

Consideration of the proposed offset methodology

There is currently no Pilbara strategic conservation initiative that is undertaking actions that would be relevant to marine and intertidal values. Therefore, offsets for this factor would need to include specific actions to improve or increase values that are the same as or similar to the values being offset, in accordance with the principles of the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014).

The proponent has prepared an offset strategy to counterbalance the significant residual impacts described above. For marine and intertidal significant residual impacts the strategy includes research programs that would improve efforts to strategically protect intertidal BCH and its associated values in the region in the future.

In considering the principles of the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014), the EPA has a preference for offsets which include actions that directly improve the level of protection, extent or condition of the value to be offset. While research is usually included as only a small part of a balanced offset strategy, in this instance, research is likely to comprise the entirety of the offset proposed.

Research projects applied as offsets under Part IV of the EP Act must be reasonably related to the impacts. Research projects can add significant value to the outcomes of on-ground strategic protection and the understanding of the environmental values being impacted. The research projects will need to be in addition to the required monitoring and management plans that are to be implemented as part of the project approval. The outcomes of the research projects should work in relationship to these monitoring and management plans to achieve the objectives above.

For this proposal, the EPA is of the view that research offsets for impacts to algal mat, coastal samphire and mangroves are appropriate due to the high degree of uncertainty regarding impacts to these values, and the lack of available options for direct offsets to be undertaken.

The EPA is of the view that the research projects will provide new science to develop better mitigation measures for impacts to mangroves and algal mat from future salt farms and provide valuable scientific knowledge to inform regional and strategic protection of these values. The research must be designed to result in positive conservation outcomes, address priority knowledge gaps and provide critical information to improve environmental assessment of future projects. Outcomes of research projects must be publicly available. and provided to the relevant agencies.

In proposing outcomes and considering whether research offsets are in accordance with *WA Environmental Offsets Guidelines* (Government of Western Australia 2014), the EPA has considered the following principles:

1. **Environmental offsets will only be considered after avoidance and mitigation options have been pursued.** The proponent has detailed avoidance and mitigation in their ERD and RtS. The EPA has further considered in conditions, especially condition 2. The EPA considers that this principle has been met.
2. **Environmental offsets are not appropriate for all projects.** The EPA has determined that in this instance offsets are appropriate due to the nature and magnitude of the likely significant residual impacts, therefore this principle has been met.
3. **Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted.** The EPA has determined that, given the need to improve the knowledge base regarding intertidal BCH and their management, research-based offsets would be relevant and cost-effective counterbalance for impacts to these factors. This principle will be met.
4. **Environmental offsets will be based on sound environmental information and knowledge.** Given the need to improve the knowledge base regarding the values and management of intertidal BCH, with particular regard to the values of algal mat, this principle may not be met. However, the provision of research-based offsets may provide a basis for future offsets to be considered.
5. **Environmental offsets will be applied within a framework of adaptive management.** The proponent will be required under condition 14 to provide adaptive management measure to ensure that risks and unintended consequences are managed, therefore this principle will be met.
6. **Environmental offsets will be focused on longer term strategic outcomes.** The proposed research outcomes would, when met inform the long-term strategic protection of intertidal benthic communities and habitats along the West Pilbara Coast, therefore this principle will be met.

The EPA recommends that condition 14 is imposed on the proponent to provide an offset for impacts to intertidal and marine values in the form of contributions to relevant research programs that meet the objectives proposed by the EPA to counterbalance the significant residual impacts of the proposal, and to ensure that the proposed offset is in accordance with the Principles of the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014).

5 Matters of national environmental significance

The Commonwealth Minister for the Environment has determined that the proposal (EPBC 2018/8236) is a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as it is likely to have a significant impact on one or more Matters of National Environmental Significance (MNES) (DoE, 2013). It was determined that the proposed action is likely to have a significant impact on the following matters protected by the EPBC Act:

- listed threatened species and communities (sections 18 and 18A)
- listed migratory species (sections 20 and 20A)
- commonwealth marine area (sections 23 and 24A).

The EPA has undertaken an accredited assessment of the controlled action, on behalf of the Commonwealth (Department of Agriculture Water and the Environment [DAWE]). However, the EPA's assessment does not include the controlling provision: Commonwealth Marine Environment (sections 23 & 24A) as the EPA can only consider matters that will have an environmental impact within the State. The proponent was required to include sufficient information in the ERD to enable the Commonwealth Department of Agriculture, Water and the Environment (DAWE) to assess the impacts of the proposal on this particular controlling provision. Nevertheless, the discussion below on marine fauna is relevant to the DAWE's consideration of impacts on the Commonwealth Marine Environment.

During the assessment process DAWE has provided comment at the draft ESD stage, draft ERD stage, during the public review period, the draft RtS stage and on the assessment strategy including conditions.

This assessment report is provided to the Commonwealth Minister for the Environment who will decide whether or not to approve the proposal under the EPBC Act. This is separate from any Western Australian approval that may be required.

Commonwealth policy and guidance

The EPA had regard to the following relevant Commonwealth guidelines, policies and plans during its assessment:

- Commonwealth of Australia 2012. Commonwealth EPBC Act Environmental Offsets Policy.
- Commonwealth of Australia 2015. Wildlife Conservation Plan for Migratory Shorebirds, Department of the Environment, Canberra, ACT.
- Department of the Environment 2015. Conservation Advice *Calidris ferruginea* curlew sandpiper. Canberra: Department of the Environment
- Department of the Environment (015. EPBC Act Policy Statement 3.21 - Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (Department of the Environment, 2015).

- Department of the Environment 2015. Conservation Advice *Numenius ferruginea* eastern curlew, Department of the Environment, Canberra, ACT.
- Department of the Environment 2015. Threat abatement plan for predation by feral cats, Commonwealth of Australia, Canberra, ACT.
- Department of the Environment 2015. EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species, Department of the Environment, Canberra, ACT.
- Department of the Environment 2016. EPBC Act Referral guideline for the endangered Northern quoll (*Dasyurus hallucatus*), Department of the Environment, Canberra, ACT.
- Department of the Environment and Energy 2017. National Strategy for Mitigating Vessel Strike of Marine Mega-fauna.
- Department of the Environment and Energy 2020. Light Pollution Guidelines: National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds,
- DEWHA 2008a. Approved Conservation Advice for *Liasis olivaceus barroni* (Olive Python – Pilbara subspecies), Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.
- DEWHA 2008b. Threat abatement plan for predation by the European red fox, Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.
- DEWHA 2009. Significant impact guidelines for 36 migratory shorebird species, Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.
- Hill, B.M. & S.J. Ward 2010, National recovery plan for the Northern quoll (*Dasyurus hallucatus*), Department of Natural Resources, Environment, The Arts and Sport, Darwin, NT.
- Threatened Species Scientific Committee 2005, Commonwealth Listing Advice on Northern quoll (*Dasyurus hallucatus*).
- Threatened Species Scientific Committee 2005, Commonwealth Conservation Advice on Northern quoll (*Dasyurus hallucatus*).
- Threatened Species Scientific Committee 2016, Conservation Advice *Calidris canutus* red knot, Department of the Environment, Canberra, ACT.

EPA assessment

Impacts to the environment relating to MNES are also covered under the key environmental factors of Inland Waters, Marine Environmental Quality, Flora and Vegetation, Benthic Communities and Habitat (BCH), Terrestrial Fauna, Marine Fauna, and Social Surroundings of this report.

The ERD (Preston Consulting 2020) identified the MNES and the predicted environmental impacts, assessment against significant impact criteria for listed threatened species and ecological communities, listed migratory species and mitigation measures.

Listed threatened species and communities (Sections 18 & 18A)

The following threatened fauna species are listed under the EPBC Act as occurring within or in the vicinity of the terrestrial, marine and dredge channel development envelope (Preston Consulting 2020 and 2021).

Minuria tridens

Five new populations of *Minuria tridens* that total 75 individuals were found within the TFSA. The proponent has avoided impact to all threatened and priority flora within the terrestrial development envelope, including *M. tridens* by amending the terrestrial development envelope to exclude the recorded location of *M. tridens*.

From information presented within the RtS there will be no disturbance to any known individuals (Preston Consulting, 2021). Further preclearance surveys for priority species including *M. tridens* will be undertaken. Indirect impacts to *M. tridens* due to changes in hydrology will be monitored and managed through management procedures.

The EPA considers that the proposal is unlikely to have a material impact on *M. tridens* and is not expected to affect the ecological integrity of the species within the terrestrial development envelope or to be inconsistent with the EPA's objective to protect flora and vegetation.

Pilbara leaf-nosed bat

Clearing and disturbance of up to 2,562 ha to Pilbara leaf-nosed bat (PLNB) foraging habitat (triodia grassland) which is 9.5% of the mapped TFSA. The direct impact will occur at the western-most extent of the mapped triodia grassland habitats (i.e. there will be no fragmentation of habitat). Roost sites are unlikely to be present as there are no caves within the terrestrial development envelope. No diurnal roosts were identified within the TFSA and the foraging habitat recorded within the development envelopes would not be considered 'critical to the survival' of this species (Preston Consulting 2020).

Open Woodland (Riparian) fauna habitat (adjacent to Mardie pool, outside the terrestrial development envelope) is high foraging value. The percentage of the open riparian woodland surveyed (15.9 ha of 74 ha) is within the development envelope, only 5.4 ha is proposed to be disturbed (7.3% of mapped extent) (Preston Consulting, 2020). The main foraging area of Mardie Pool will not be cleared.

The operation of the proposal will result in low noise and light emissions as it relies on solar evaporation for the majority of the process. Construction will be undertaken during daylight hours to reduce noise impacts to PLNB. While terrestrial noise modeling has not been completed for the proposal, the facility will need to operate in accordance with the EP Act noise regulations.

Vehicle strike impacts are considered to be low since operations will require minimal night work. Artificial lighting impacts will be managed under Part V of the EP Act.

A total of 8 ha of foraging habitat is predicted to be indirectly impacted due to changes in surface and groundwater hydrology, increase of weed invasion, and

possible brine seepage and spills. A spill or leak of brine from the ponds or pipelines could result in impacts to the health of the surrounding fauna habitat associated with Pilbara leaf-nosed bat. DWER has advised that management procedures and contingency measures for spills (including brine) can be adequately managed under works approvals and licenses required under Part V of the EP Act. Therefore, the operation risk of potential spills and leaks is considered to be low.

The EPA has assessed there to be a significant residual risk to Pilbara leaf-nosed bat (Pilbara). While the direct impact to potential habitat in the proposal is a small percentage of the known extent for this species, the EPA considers the potential impact to habitat of the proposal to this conservation significant species is a significant residual impact. This is consistent with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014) definition of significant residual impact regarding vulnerable animals. It is noted that offsets would only be applied to vegetation in good to excellent condition, given that parts of the development envelope are impacted by mesquite infestations.

Pilbara olive python

The proposal will involve clearing/disturbance of up to 6 ha potential Pilbara olive python habitat. While no individuals were recorded within the terrestrial and marine development envelope during the surveys, approximately 15.9 ha of the open riparian woodland (foraging habitat) surveyed (73.5ha) is located in the development envelope. Less than 5.4 ha is expected to be disturbed (7.3% of mapped extent). Mardie pool occurs adjacent to the terrestrial development envelope and could be used as a water source by the species (Preston Consulting 2021).

A total of 8 ha of foraging habitat is predicted to be indirectly impacted due to changes in surface and groundwater hydrology, increase of weed invasion, and possible brine seepage and spills. A spill or leak of brine from the ponds or pipelines could result in impacts to the health of the surrounding fauna habitat. The crystalliser ponds adjacent to Mardie pool will be lined to prevent seepage.

Mesquite is present within the terrestrial development envelope and within the riparian areas of Mardie pool. The proponent has committed to manage mesquite in consultation with the Pilbara Mesquite Management Committee.

Deliberate killing and vehicle strike due to mistaken identification will be minimised through limited roads intersecting with Pilbara Olive Python habitat and operations will require minimal night work.

The EPA has assessed there to be an unlikely significant residual risk to the Pilbara olive python from habitat removal due to the remaining habitat proposed not to be disturbed within the terrestrial and marine development envelope and within the TFSA.

The EPA considers that the proposal is unlikely to have a material impact on the habitat associated with the Pilbara olive python and is not expected to affect the ecological integrity of the species within the terrestrial and marine development envelope or to be inconsistent with the EPA's objective to protect marine fauna.

Northern quoll

Clearing and disturbance of up to 64.5 ha of northern quoll foraging habitat for the widening of the existing Mardie Station access road associated with the proposal. The disturbance represents only a small incremental decrease in foraging habitat, alongside an already disturbed road alignment. Vehicle strike will be managed using speed limits along the access road.

Northern quoll denning/ shelter habitat is located within 1 km of the terrestrial development envelope associated with spinifex grassland on rocky hills, with a total of 120.9 ha occurring within the Terrestrial Fauna Area (TFSA). There is no recorded denning or shelter habitat within in terrestrial development envelope (Preston Consulting 2021).

Associated with the denning habitat (outside the terrestrial development envelope) is 923.6 ha foraging habitat, which includes the terrestrial development envelope. The disturbance of this foraging area within the terrestrial development envelope is 6.98% of the total foraging habitat associated with the denning habitat. The remaining northern quoll foraging habitat of 859.1 ha is not under threat of disturbance from other proposals (Preston Consulting 2020).

The EPA has assessed there to be a significant residual risk to the listed northern quoll. While the direct impact to potential habitat in the proposal is a small percentage of the known extent for this species, the EPA considers the potential impact to habitat of the proposal to this conservation significant species is a significant residual impact. This is consistent with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014) definition of significant residual impact regarding rare and endangered animals.

Listed migratory species (sections 20 and 20A)

Migratory birds

A total of 34 species listed as migratory bird under the EPBC Act have been recorded or are considered likely to occur in the vicinity of the proposal based on an assessment of habitat requirements. Twenty-six migratory bird species were recorded within the MSSA (Preston Consulting, 2020) of which include 3 species listed as Critically Endangered and 3 Endangered:

- bar-tailed godwit (*Limosa lapponica*) Mig. (EPBC Act; BC Act)
- black-tailed godwit (*Limosa limosa*) Mig. (EPBC Act; BC Act)
- caspian tern (*Hydroprogne caspia*) Mig. (EPBC Act; BC Act)
- crested tern (*Sterna bergii*) Mig. (EPBC Act; BC Act)
- common tern (*Sterna hirundo*) Mig. (EPBC Act; BC Act)
- red-necked stint (*Calidris ruficollis*) Mig. (EPBC Act; BC Act)
- pacific golden plover (*Pluvialis fulva*) Mig. (EPBC Act; BC Act)
- curlew sandpiper (*Calidris ferruginea*) CR/Mig. (EPBC Act); VU/Mig.(BC Act)

- eastern curlew (*Numenius madagascariensis*) CR/Mig. (EPBC Act); VU/Mig. (BC Act)
- oriental plover (*Charadrius veredus*) Mig. (EPBC Act; BC Act)
- oriental pratincole (*Glareola maldivarum*) Mig. (EPBC Act; BC Act)
- osprey (*Pandion cristatus* (haliaetus) Mig. (EPBC Act; BC Act)
- great knot (*Calidris tenuirostris*) CR/Mig (EPBC Act; VU/Mig (BC Act)
- greater sand plover (*Charadrius leschenaultia*) VU/Mig. (EPBC Act); Mig. (BC Act)
- lesser sand plover *Charadrius mongolus* EN/Mig. (EPBC Act)
- common greenshank (*Tringa nebularia*) Mig. (EPBC Act; BC Act)
- common sandpiper (*Actitis hypoleucos*)
- red knot (*Calidris canutus*) EN/Mig. (EPBC Act); Mig. (BC Act)
- ruddy turnstone (*Arenaria interpres*) Mig. (EPBC Act; BC Act)
- sanderling (*Calidris alba*) Mig. (EPBC Act; BC Act)
- grey-tailed tattler (*Tringa brevipes*) Mig. (EPBC Act; BC Act); P4 (DBCA)
- grey plover (*Pluvialis squatarola*) Mig. (EPBC Act; BC Act)
- gull-billed tern (*Gelochelidon nilotica*) Mig. (EPBC Act; BC Act)
- terek sandpiper (*Xenus cinereus*) Mig. (EPBC Act; BC Act)
- white-winged black tern (*Chlidonias leucopterus*) Mig. (EPBC Act; BC Act)
- white-shafted Little tern, Little tern (*Sternula albifrons*) Mig. (EPBC Act; BC Act)
- whimbrel (*Numenius phaeopus*) Mig. (EPBC Act; BC Act).

The ESD (Preston Consulting 2020 Figure 129) indicated that threatened migratory birds recorded within the terrestrial and marine development envelope include the eastern curlew, red knot; and the species in close proximity to the terrestrial and marine development envelope include the curlew sandpiper, great knot, lesser sand plover and greater sand plover.

The terrestrial and marine development envelope contains portions of the significant migratory shorebird habitats identified and mapped by Phoenix (2020) within the TFSA. These habitats are also present outside the terrestrial and marine development envelope within the MSSA:

- Tidal samphire mudflats
- Tidal channel and ocean
- Mangal communities.

The red knot, curlew Sandpiper, great knot and eastern curlew, greater sand plover and lesser sand plover all have wide distributions and do not breed in Australia. The proposal will impact only a small proportion of their habitat within the MSSA, which in turn represents only a portion of the area of occupancy of these species. This

disturbance equates to less than 5% of any habitat of value within the MSSA as the proposal has been designed to minimise clearing within these areas (Preston Consulting 2020).

Clearing/disturbance to habitat

The EPA notes from a regional perspective each habitat type to be cleared is less than 10% of the mapped extent, the EPA has assessed there to be a significant residual risk to the listed Migratory/Marine bird species due to the impact on tidal samphire mudflats habitat and Mangal communities. This is consistent with the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014) definition of significant residual impact regarding rare and endangered animals.

Human disturbance to migratory shorebird habitat will be minimised through limiting the access to habitats. Fauna egress mechanism will be installed in all the trenches and evaporation ponds to avoid fauna entrapment.

The proponent has prepared a long-term migratory shorebird monitoring program for the Mardie Project (Phoenix Environmental Sciences (2020) Final V1) which includes mitigation and management responses if declining utilisation is attributable to the project (Preston Consulting 2021).

Noise emission and artificial light spill

The operation of the Proposal is expected to emit low noise and light emissions as it relies on solar evaporation for the majority of the process.

The EPA notes that there is a requirement for the proponent to comply with the EP Act Noise Regulations.

The EPA considers that the noise emission from the proposal is unlikely to have a material impact on terrestrial fauna and is not expected to affect the ecological integrity of the species within the development envelope or to be inconsistent with the EPA's objective to protect terrestrial fauna.

Artificial light emissions from the processing plant and associated infrastructure may potentially alter behaviour of terrestrial fauna. The proponent has advised that the Port will export low volumes of product and will not require significant lighting, apart from navigational aids (Preston Consulting 2020).

The EPA considers that terrestrial artificial light spill from the proposal is unlikely to have a material impact on terrestrial fauna and is not expected to affect the ecological integrity of the species through the implementation of an Illumination Plan or to be inconsistent with the EPA's objective to protect terrestrial fauna.

Australian humpback dolphin and humpback whales

Dolphins were not been recorded within the marine and dredge channel development envelope during opportunistic surveys (desk top review of surveys), although were sighted on the outside edge of Sholl Island (Preston Consulting 2020).

The humpback whales predominantly occur further offshore, however some have been observed by O2 Marine in 2018 within 5 km of the dredge channel and marine development envelope. It is advised that other species such as the Brydes Whales, Minke Whales have been sighted further offshore and that these whales only transit through oceanic waters well offshore from the shallow waters of the LAUs (Preston Consulting 2020). The presence of the species and the likelihood of the species intersecting the marine and dredge channel development envelope is considered to be low risk.

Vessel strike

The likelihood of a vessel strike during dredging, piling, operations, and construction from proposed vessel movements is considered a low risk as the humpback whales typically prefers deeper water than that within the proposed dredging area and the Australian humpback dolphin has not been recorded within this area. The proponent has predicted that there will be slow speed (of the transshipment barge and relatively low vessel movements (2–4 barge movements per day). In a managed environment, environmental risk of vessel strike is considered to be low with the implementation of the Dredge Management Plan (DMP) required by the EPA's recommended conditions. The EPA notes that to determine the vessel 'safe speed', due regard should be given to the DotEE (2017) guideline as part of the implementation of the revised DMP (Mardie Mineral Pty Ltd 2020 Rev 1 Report No. R190043).

With the incorporation of management measures the EPA has assessed that there is unlikely to be a residual risk to humpback whales and Australian humpback dolphin from the proposal.

The EPA considers that impacts associated with vessel strike as a result of the proposal are likely to meet the EPA's objective for this factor, subject to the implementation of the proponent's proposed vessel speed limits of <12 knots, monitoring and mitigation measures.

Marine noise emissions

A Marine Noise Assessment indicated that humpback whales, dugongs, and Australian humpback dolphins could be impacted by noise from dredging and piling activities (Talis 2019).

The EPA has assessed there to be a potential significant residual risk of marine noise to marine fauna and if not managed will likely be inconsistent with its objective. The residual impact is likely to be able to be counter-balanced with an outcome-based management approach. The implementation of the proposed mitigation and management plans required under the recommended conditions (DMP and UWNMP which includes soft start procedures for both observation and exclusion zones) will reduce the potential impact risk and therefore not expected to affect the ecological integrity of marine species within and adjacent to the marine and dredge channel development envelope.

Bitterns disposal and spills

Bitterns disposal will occur within the LEPA and MEPA, which will reduce the water

quality within the areas but unlikely to affect marine mammals traversing the LEPA/MEPA.

Refuelling of vessels is proposed to occur at the Mardie port (trestle jelly), and therefore there is a risk of hydrocarbon spill from vessels during construction. Refuelling of vessels will occur while the vessels are moored at the boat ramp (Preston Consulting, 2020).

An Oil Spill Response Plan is to be developed and implemented in consultation with PPA.

Marine turtles

Habitat disturbance

A small part of potential marine turtle nesting beach lies within the terrestrial development envelope, a narrow section of the mainland beach known as 'Mardie creek east'. Previous surveys have identified no evidence of nesting attempts on the mainland coast west of Mardie creek and very minor nesting effort by Flatback turtles and a single Hawksbill turtle, along the 15 km stretch of coastline to the east of the creek. BCH surveys within the LAUs indicate that the marine and dredging channel development envelope comprised of relatively poor quality (i.e. low cover and dynamic) vegetated habitats for foraging compared to areas where turtles typically congregate. Therefore, the terrestrial and marine development envelopes are unlikely to represent critical habitat for marine turtles (Preston Consulting 2020).

These results indicated that the mainland beaches are not currently a regionally important rookery potentially due to mainland beaches (sand) being significantly warmer than the offshore islands, impacting the success rate of any marine turtle nests on these beaches (Preston Consulting 2020).

There are several offshore islands within 15km of the Mardie creek entrance, of which Long Island and Sholl Island recorded marine turtle nest activity. Pendoley Environmental (2019) states that the coast adjacent to the terrestrial development envelope is characterised by very low turtle nesting activity relative to other mainland sites within the Pilbara area, which is likely due to nesting habitat geomorphology.

The marine turtle field survey was designed to focus effort during the peak nesting period for flatback and green turtles. Hawksbill turtle nesting is more seasonally diffuse than green and flatback nesting, however a spring (October) peak in nesting is recognised in the Pilbara. While the turtle monitoring survey (Pendoley Environmental 2019) confirmed that hawksbill nesting was occurring regionally during the December survey and the mainland habitat featured less activity compared to the offshore islands. To validate the low utilisation rates and low-quality turtle nesting of the hawksbill turtle on the mainland beach, the proponent has committed to a pre-construction survey to be completed in October.

Direct disturbance of 50 m wide of a low-quality turtle nesting mainland beach will occur within the terrestrial development envelope for the construction and operation of a jetty/conveyor and small boat launch facility. No vegetation or modification to habitat on or within close proximity to offshore islands is proposed.

The EPA has assessed there to be an unlikely significant residual impact from the clearing (disturbance) of low-quality turtle nesting habitat as there is recorded suitable and viable marine turtle nest habitat offshore (particularly Long and Sholl Islands) 15 km of the entrance to Mardie creek.

Entrapment in seawater intakes will be minimised by through setting the intake speed rate to 0.15 m/s, will be only be abstracted at Mean Sea Level, and enclosing the intakes with four-sided mesh.

The EPA considers that the proposal is unlikely to significantly impact marine turtle habitat and is not expected to affect the ecological integrity of the species habitat within the terrestrial and marine development envelope and is likely to be consistent with EPA objective. This is subject to the outcomes of a pre-construction survey to confirm the low utilisation of Hawksbill turtle on the mainland beach area and to confirm the low-quality habitat status.

Vessel strike

The likelihood of a vessel strike during dredging, piling, operations, and construction from proposed vessel movements is considered a low risk. The proponent has predicted that there will be slow speed (of the transshipment barge and relatively low vessel movements (2–4 barge movements per day). In a managed environment, environmental risk of vessel strike is considered to be low with the implementation of the DMP required under the EPA's recommended conditions.

With the incorporation of management measures the EPA has assessed that there is unlikely to be a residual risk to marine turtles from the proposal.

The EPA considers that impacts associated with vessel strike as a result of the proposal are likely to meet the EPA's objective for the factor of Marine Fauna, subject to the implementation of the proponent's proposed vessel speed limits of <12 knots, monitoring and mitigation measures.

Marine noise emissions

A Marine Noise Assessment indicated that marine fauna could be impacted by noise from dredging and piling activities (Talis 2019).

The EPA has assessed there to be a potential significant residual risk of marine noise to marine fauna and if not managed will likely be inconsistent with its objective. The residual impact is likely to be able to be counter-balanced with an outcome-based management approach. The implementation of the DMP and UWNMP required under the EPA's recommended conditions, which includes soft start procedures for both observation and exclusion zones, will reduce the potential impact risk and therefore not expected to affect the ecological integrity of marine species within and adjacent to the marine and dredge channel development envelope.

Artificial light spill

There is a potential risk that light from the proposal will be visible to hatchlings on the

offshore islands located between 10 to 15 km away (i.e. Angle, Middle, Long, Round, Sholl, and Mardi Islands) as there is a direct line of sight to the proposal across the ocean (Preston Consulting 2021).

The proponent has informed that hatchlings departing from nesting beaches on the offshore islands will typically be carried on prevailing tides and currents into deeper offshore waters and not inshore to the mainland where the jetty is located. Pendoley Environmental (2020) advised that due to the higher sand temperature within the mainland beach area the low success rate of turtle nests, this area is not considered to be significant rookery area (Preston Consulting 2020). Due to the very low density of nesting by Flatback and Hawksbill turtles along this stretch of mainland coast, the risk of exposure to light on the mainland is considered to be low (Preston Consulting 2021).

The proponent has assessed that the impact of artificial light emissions from the vessels (dredge, support vessels) based on the potential light spill and glow reaching significant turtle habitats and/or nesting beaches and rookeries is expected to be negligible (Preston Consulting 2020).

In addition, the proponent has identified marine turtles may be attracted to light spill on the water beneath the trestle jetty. Due to potential impacts to Marine Turtles, the proponent has committed to:

- Development and implementation of an Illumination Plan which will include design, construction, mitigation and management measures as per EPA (2010) and DotEE¹⁰ (2020) guidelines.
- Completion of a turtle nesting monitoring program (offshore Island and mainland beach) when construction commences and for 3 years when the proposal is operational. The outcomes of this program may amend the proposed management measures to ensure that potential significant impact of light spill on nesting and hatching viability on the recorded beaches on Long Island and Sholl Island can be reduced.

The EPA is unable to assess the residual risk of artificial light spill due to the absence of detailed monitoring information. The EPA expects the results obtained from the monitoring program (and associated mitigation and management strategies to reduce the impacts of light spill within the Illumination Plan) will enable the level of risk to be determined to ensure that the ecological integrity of the turtle roosting areas and hatchling survival rates are not compromised by artificial light spill.

The EPA has considered whether there are mitigation measures available to avoid where practicable, or otherwise minimise the impact of light spill. Consistent with the principle of intergenerational equity, the EPA has also considered whether there are mitigation measures available to ensure that the ecological integrity of suitable and viable marine turtle nesting habitat can be maintained for future generations.

Green sawfish

Green sawfish are expected to be present in the creeks and rivers of the Mardie

¹⁰ Now known as Department of Agriculture, Water and the Environment (DAWE)

coastline. It is further noted that sawfish were most likely to be found at the mouths of tidal creeks and were highly unlikely to be found within the upstream reaches of tidal creeks (Preston Consulting 2021).

Occurrence and habitat disturbance

The proposal includes minor works disturbance within two of the 15 tidal creeks in the LAUs. Acoustic studies have indicated that Sawfish do not travel more than 700 m upstream from the mouth of the river but are likely to utilise mangal and nearshore habitats. The proposal includes minor disturbance more than 700 m upstream, therefore it is unlikely that any sawfish will be present at the seawater intake or small boat launching facility due to their location (Preston Consulting 2020 and 2021).

The EPA has assessed there to be an unlikely significant residual risk to the green sawfish from the proposed habitat to be removed due to the remaining potential habitat available within the other 13 tidal creeks within the LAU and that there is a low risk that the species would be present within the disturbance area. A total of 17 ha of mangrove habitat will be cleared.

The EPA considers that the proposal is unlikely to have a material impact on the habitat associated with the green sawfish or to be inconsistent with the EPA's objective to protect marine fauna.

Vessel strike

The likelihood of a vessel strike during dredging and construction from proposed vessel movements is considered a low risk. The proponent has predicted that there will be slow speed of the transshipment barge and relatively low vessel movements (2–4 barge movements per day). In a managed environment, environmental risk of vessel strike is considered to be low with the implementation of the DMP required under the EPA's recommended conditions.

With the incorporation of management measures the EPA has assessed that there is unlikely to be a residual risk to marine fauna from the proposal.

The EPA considers that impacts associated with vessel strike as a result of the proposal are likely to meet the EPA's objective for the factor of Marine fauna, subject to the implementation of the proponent's proposed monitoring and mitigation measures.

Marine noise emissions

A Marine Noise Assessment indicated that the species could be impacted by noise from dredging and piling activities (Talis 2019).

The EPA has assessed there to be a potential significant residual risk of marine noise to marine fauna and if not managed and will likely be inconsistent with its objective. The residual impact is likely to be able to be counter-balanced with an outcome-based management approach. The implementation of the DMP and UWNMP (which includes soft start procedures for both observation and exclusion zones) will reduce the potential impact risk and therefore not expected to affect the ecological integrity of marine species within and adjacent to the marine and dredge

channel development envelope. The EPA has recommended conditions requiring these plans to be implemented.

Dugong

Dugongs (*Dugong dugon*) have been observed in the waters around Mardie during the surveys (from desktop review) during the incidental aerial surveys in 2017 and have high potential to occur in the region. The development envelope is unlikely to represent important habitat for dugongs.

Short-nosed seahorse

The short-nosed seahorse (*Hippocampus kuda*) is typically found in reef flats or shallow waters along the outer reef edge in water depths to 10 m. While the mapped subtidal BCH types within the marine area is suitable habitat for the short-nosed seahorse it is unlikely to occur in proximity to the dredge channel and marine development envelopes. The nearest suitable habitat is located more than 5 km away from the dredge channel and marine development envelope (Preston Consulting 2020). The development envelope is unlikely to represent important habitat for this species.

Summary

The EPA recommends the following environmental conditions in Appendix A to minimise impacts on MNES:

- condition 1 – Authorisation of extent of proposal
- condition 4 – Marine Environmental Quality
- condition 5 – Flora and Vegetation, with particular regard to *Minuria tridens*
- condition 6 – Benthic Communities and Habitat (intertidal)
- condition 7 - Benthic Communities and Habitat (Dredge Management Plan)
- condition 8 – Terrestrial fauna, with particular regard to migratory shorebirds
- condition 9 – Illumination and light spill
- condition 10 – Marine fauna.

The EPA considers that there will be a significant residual impact from clearing of intertidal BCH, vegetation, and fauna habitat within the terrestrial development envelope. The EPA has recommended offsets in conditions 13 and 14 (see section 4) to account for the significant residual impact to conservation significant vegetation communities and fauna habitat due to implementation of the proposal.

The EPA's view is that the impacts from the proposal on the above-listed MNES are therefore not expected to result in an unacceptable or unsustainable impact on the:

- conservation status of Listed Threatened Species and Communities and Listed Migratory Species.

6 Conclusion and recommendations

The EPA has taken the following into account in its assessment of the proposal:

- environmental values likely to be significantly affected by the proposal
- residual impacts to those environmental values, separately and holistically (this has included considering cumulative impacts of the proposal)
- EPA's confidence in the proponent's proposed mitigation measures
- likely residual impacts which can be minimised with the imposition of conditions
- the impacts can be managed consistent with the EPA's objectives for the key environmental factors
- whether other statutory decision-making processes can mitigate the potential impacts of the proposal on the environment
- the EP Act principles.

It is the EPA's view that reasonable conditions could be imposed on the proposal to be consistent with the EPA's objectives for environmental factors.

Given the above, the EPA recommends that the proposal may be implemented subject to the conditions recommended in Appendix A.

7 Other advice

The EPA notes that there is a requirement for:

- Traffic impact assessment as part of the City of Karratha development application and building application process under the *Planning and Development Act 2005*.
- Ongoing monitoring of marine pests is undertaken at all WA Ports through the State-Wide Array Surveillance Program (SWASP). The port (jetty and associated activities) will fall under the jurisdiction of PPA and the port will be required to participate in the SWASP.
- Port activities fall under the jurisdiction of PPA, the proponent will implement marine pest management measures during construction and operation to reduce the risk of the introduction of marine pests (Preston Consulting, 2021). This is to be undertaken in consultation with PPA and DPRID.
- Oil Spill and Response Plan is to be developed and implemented in consultation with the PPA and is to be included within the mining proposal submitted to DMIRS.
- Recreational fishing from structures i.e. jetty within the development envelopment is not supported and should be managed through PPA in consultation with the proponent.
- The EPA notes that the following aspects of the proposal can be regulated through Part V of the EP Act:
 - licensing of emissions and discharges (including noise, dust, light spill) from prescribed premises
 - regulation of spills including brine, chemicals and hydrocarbons
 - runoff from onshore dredge disposal
 - operation and management of the landfill and sewage disposal associated with the proposal
 - spillages of product of hydrocarbons to the marine environment during bulk loading processes
- The EPA notes that the following aspects of the proposal can be regulated through the *Mining Act 1978*:
 - Mesquite and other weed management
 - fire risk management
 - terrestrial fauna management
 - feral animal control
 - fauna vehicle strike
 - entrapment of fauna in ponds
 - exclusion areas (no uncontrolled access to migratory shore bird habitat) outside terrestrial and marine development envelope
 - integrity and stability of associated infrastructure including evaporation pond, including lateral seepage and pond wall breaches

- erosion and scouring as a result of drainage and surface water diversion structures
- ongoing re-assessment of dredge spoil and sediments for acid sulphate soils risk
- decommissioning of infrastructure and rehabilitation of terrestrial areas following closure of the project.
- Associated approvals such as section 18 under the AH Act and associated Heritage Management Plans for the proposal (i.e. disturbance to Peter's creek) will be sought by the proponent.
- Bushfire requirements will be addressed through the provisions within the *Planning and Development Act 2005*, *Bushfire Act 1954* and the Western Australian Planning Commission (2015) State Planning Policy 3.8 Planning in Bushfire Prone Areas and Guidelines for Planning in Bushfire Prone Areas. The relevant approvals are regulated via City of Karratha (Local Government Authority) and Department of Fires and Emergency Services.

Future referrals

In assessing the Mardie Project, the EPA has had consideration for the cumulative impacts to intertidal benthic habitat and communities in the region.

The EPA advises that all future salt proposals on the West Pilbara Coast (defined as the area from the bottom of the Exmouth gulf to Karratha) which have the potential to impact tidal samphire mudflats habitat, algal mat and mangrove habitat will need to assess potential regional and cumulative impacts to these habitats.

This consideration must include assessment of the cumulative impacts with existing, approved and proposed proposals, in the context of the known extent of habitats in the Pilbara. Assessment must include both direct impacts, and consideration of changes to the ecological process such as surface water, groundwater, and tidal inundation which support intertidal habitats.

All future proposals must include in their assessment consideration of Mangrove Management Areas defined in *EPA Guidance Statement No. 1 – Protection of tropical arid zone mangroves along the Pilbara coastline* (EPA, 2001) and demonstration that the objectives of this guidance will be met. The EPA does not consider that this proposal represents a precedent that would indicate that any development within regionally significant mangroves, or impacts to hydrological processes that support these mangroves would be acceptable for future proposals.

Sea level rise is a key consideration in the assessment of impacts to intertidal benthic habitat and communities. Future salt proposals must include assessment of the proposal's potential to adversely impact the capacity for intertidal benthic communities to adapt to predicted sea level rise scenarios.

Appendix A: Recommended conditions

Section 44(2) of EP Act specifies that the EPA's report must set out (if it recommends that implementation be allowed) the conditions and procedures, if any, to which implementation should be subject. This appendix contains the EPA's recommended conditions and procedures.

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED **(*Environmental Protection Act 1986*)**

MARDIE PROJECT

Proposal: The proposal is to construct and operate a solar salt production plant and export facility including seawater intake, evaporation and crystalliser ponds, processing plant, trestle jetty and supporting infrastructure to produce salt and sulphate of potash, located 80 kilometres south-west of Karratha, in the Pilbara region of Western Australia.

Proponent: Mardie Minerals Pty Ltd
Australian Company Number: 152 574 457

Proponent Address: Level 2, 1 Altona Street WEST PERTH WA 6872

Assessment Number: 2167

Report of the Environmental Protection Authority: 1704

Pursuant to section 45 of the *Environmental Protection Act 1986*, it has been agreed that the proposal described in part A of the proponent's referral document dated 17 April 2018, as amended by the section 43A notice issued by the EPA on 26 May 2020, may be implemented and that the implementation of the proposal is subject to the following implementation conditions and procedures:

1 Proposal Implementation

1-1 When implementing the proposal, the proponent shall ensure the proposal does not exceed the following extents:

Proposal element	Location	Limitation or maximum extent
Physical elements		
Clearing of vegetation in good to excellent condition	Figure 1	No more than 2,319 ha within the 15,667 ha terrestrial development envelope.

Direct and indirect impacts to Horseflat PEC	Figure 1	No more than 145 ha direct impacts and 20 ha indirect impacts within the 15,667 ha terrestrial development envelope.
Clearing of landward samphire	Figure 1	No more than 854 ha within the 15,667 ha terrestrial development envelope, subject to the requirements of condition 5-1(4).
Clearing of coastal samphire	Figure 1	No more than 296 ha within the 15,667 ha terrestrial development envelope.
Direct disturbance of algal mat	Figure 1	No more than 880 ha within the 15,667 ha terrestrial development envelope.
Direct disturbance of mangrove habitat outside of the RRDMMA	Figure 1	No more than 13 ha within the 15,667 ha terrestrial development envelope.
Direct disturbance of mangrove habitat inside the RRDMMA	Figure 1	No more than 4 ha of clearing within the RRDMMA , subject to the requirements of condition 2.
Dredging	Figure 1	No more than 800,000 m ³ , disturbing no more than 55 ha within the 304 ha dredge development envelope.
Drainage corridors to maintain surface water flows	Figure 1	Minimum of two drainage corridors of a minimum 200 m wide, aligned with existing natural drainage lines.
Clearing of foraging habitat for the Pilbara leaf-nosed bat	Figure 1	No more than 2,562 ha within the 15,667 ha terrestrial development envelope.
Clearing of foraging habitat for the northern coastal free-tailed bat	Figure 1	No more than 1,132 ha within the 15,667 ha terrestrial development envelope.
Clearing of habitat for the Pilbara olive python, including riparian and freshwater pool habitats	Figure 1	No more than 6 ha within the 15,667 ha terrestrial development envelope.
Clearing of foraging habitat for the northern quoll	Figure 1	No more than 64.5 ha within the 15,667 ha terrestrial development envelope.
Operational elements		
Discharge of bitterns, including desalinisation plant bitterns	Figure 2	Up to 3.6 GL/a with a specific gravity no more than 1.25 via diffuser into the designated Low Ecological Protection Area shown in Figure 2.

Seawater intake	Figure 2	Seawater intake not exceeding 0.15 m/s through intake pipes fitted with four-side screens.
Groundwater	N/A	No dewatering of groundwater for any reason except to meet the requirements of condition 3-6.
Timing elements		
Mine life	N/A	Up to 63 years from issue of this statement

2 Robe River Delta Mangrove Management Area

2-1 The proponent shall ensure that the implementation of the proposal achieves the following outcome in the **RRDMMA** as shown in Figure 3:

- (1) no development that would have an **adverse impact** on the ecological function of the **RRDMMA** or the maintenance of ecological processes which sustain mangrove habitats within the **RRDMMA**.

2-2 Prior to any ground disturbance within the **RRDMMA**, the proponent shall submit a revised design for disturbance within the **RRDMMA** to the CEO which meets the outcome of condition 2-1(1). The revised design shall include the following:

- (1) evaluation of how the mangrove habitat in the **RRDMMA** will be affected by the direct and **indirect impacts** associated with the revised design of the proposal (including consideration of mangrove habitats, dependent habitats, ecological function and ecological processes which sustain the mangrove habitat, and worst case scenarios);
- (2) evaluation of the significance of the effects determined in accordance with condition 2-2(1);
- (3) consideration of the following in conditions 2-2(1) and 2-2(2):
 - (a) quantification of the cumulative impacts of the proposal within the **RRDMMA**, including **direct** and **indirect impacts**, and impacts to mangrove capacity to adapt to sea-level rise;
 - (b) modelling of changes to surface water flows as a result of the proposal, including impacts to drainage lines or hydrological features that may support mangroves; and
 - (c) any seepage recovery infrastructure that could be required within the area under condition 3-9;

- (4) demonstration that the implementation of the proposal will not have an **adverse impact** on the ecological function of the **RRDMMA** and the maintenance of ecological processes which sustain the mangrove habitats;
 - (5) demonstration that the proposal includes best practise design, management, monitoring and contingency measures to achieve the outcome of condition 2-1(1);
 - (6) maps of the **RRDMMA** which may be directly or indirectly affected by the proposal showing in detail:
 - (a) the location of mangroves;
 - (b) all drainage lines and other hydrological and ecological features that may support mangrove habitat; and
 - (c) areas which may be directly or indirectly affected by the proposal, including reasonable buffer area to account for extent of **indirect impacts**;
 - (7) a peer review of the design, and evaluation required by conditions 2-1(1) and 2-2(2) carried out by an independent person or independent persons with relevant expertise determined by the CEO, that provides an analysis of whether the revised design would meet the outcome of condition 2-1(1).
- 2-3 The proponent shall avoid all **direct** and **indirect impacts** within the **RRDMMA**, unless the CEO has confirmed by notice in writing that the information provided under condition 2-2 demonstrates that the proposed disturbance is consistent with the outcome of condition 2-1(1).
- 2-4 Within ninety (90) days of the conclusion of construction in the **RRDMMA**, the proponent shall provide to the CEO mapping and arial imagery to demonstrate that loss of mangroves in the **RRDMMA** due to construction for the proposal was not greater than four (4) ha.

3 Inland Waters

- 3-1 The proponent shall ensure that the following outcomes are achieved:
- (1) no **adverse impact** to water levels or water quality in Mardie pool as a result of changes to groundwater regimes or groundwater quality;
 - (2) no **adverse impact** to water levels or water quality in Mardie pool as a result of surface water flows associated with the proposal;

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- (3) no changes to the extent of surface water flooding extent during a one (1)-year **ARI** or changes to tidal inundation as a result of the construction of the intertidal causeway that are greater than predicted in *Mardie Project – Environmental Review Document* (June 2020);
 - (4) no changes to the health, extent of diversity of more than five (5) ha of intertidal benthic communities and habitat, including mangrove, samphire and algal mat as a result of changes to groundwater regimes or groundwater quality associated with the proposal;
 - (5) decreased freshwater inundation attributable to the project of no more than fifty-two (52) ha of coastal samphire;
 - (6) decreased freshwater inundation attributable to the project of no more than thirteen (13) ha mangroves outside the **RRDMMA**; and
 - (7) decreased freshwater inundation attributable to the project of no more than 130 ha mangroves within the **RRDMMA**, subject to the requirements of condition 2-3.
- 3-2 Prior to ground disturbing activities associated with the intertidal causeway, the proponent shall submit and have approved by the CEO the final design of the intertidal causeway, including modelling to demonstrate that the impacts associated with the causeway do not exceed that predicted in *Mardie Project – Environmental Review Document* (June 2020).
- 3-3 The proponent shall prepare and submit to the CEO a Groundwater Monitoring and Management Plan.
- (1) The proponent shall submit with the Groundwater Monitoring and Management Plan, a peer review of the plan carried out by an independent person or independent persons with relevant expertise determined by the CEO, that provides an analysis of the suitability of the plan to meet the outcomes of conditions 3-1(1) and 3-1(4).
 - (2) The proponent shall not commence transfer of seawater, brine or waste product into any evaporation or crystalliser ponds associated with the proposal until the CEO confirmed by notice in writing that the Groundwater Monitoring and Management Plan meets the requirements of condition 3-4.
- 3-4 The Groundwater Monitoring and Management Plan required by condition 3-3 shall:
- (1) when implemented, substantiate and ensure that the outcome of conditions 3-1(1) and 3-1(4) will be met;

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- (2) provide the details, including timing, of hydrogeological investigations to be carried out that will:
 - (a) provide a detailed understanding of the hydrological regime in the project area;
 - (b) inform the final design of monitoring that will meet the requirement of condition 3-4(1); and
 - (c) inform the final design of management and mitigation actions that will be implemented to meet the outcomes of conditions 3-1(1) and 3-1(4);
 - (3) detail the timing of monitoring bore installation and collection of baseline data, providing justification to demonstrate that data will represent baseline where it is collected after the commencement of operations;
 - (4) detail the methodology of seepage recovery actions that will be implemented where seepage from evaporation ponds to groundwater is detected;
 - (5) specify early warning trigger criteria that will trigger the implementation of management and/or contingency actions to prevent non-compliance with conditions 3-1(1) and 3-1(4).
 - (6) specify threshold criteria to demonstrate compliance with condition 3-1(3).
 - (7) specify the methodology of a monitoring program to determine if trigger criteria and threshold criteria have been met and meet the requirement of condition 3-4(1).
 - (8) specify management and/or contingency actions to be implemented if the trigger criteria required by condition 3-4(5) and/or the threshold criteria required by condition 3-4(6) have not been met; and
 - (9) provide the format and timing for the reporting of monitoring results against trigger criteria and threshold criteria to demonstrate that the outcomes in conditions 3-1(1) and 3-1(4) have been met over the reporting period in the Compliance Assessment Report required by condition 18-6.
- 3-5 The exceedance of a threshold criteria, regardless of whether management actions or threshold contingency actions have been or are being implemented, constitutes non-compliance with these conditions.

- 3-6 The proponent shall implement the most recent version of the Groundwater Monitoring and Management Plan which the CEO has confirmed by notice in writing, addresses the outcomes of conditions 3-1(1) and 3-1(4).
- 3-7 In the event that monitoring or investigations at any time indicate an exceedance of threshold criteria specified in the Groundwater Monitoring and Management Plan confirmed under condition 3-6, the proponent shall:
- (1) report the exceedance in writing to the CEO within seven (7) days of the exceedance being identified;
 - (2) implement the contingency actions required by the Groundwater Monitoring and Management Plan within seven (7) days of the exceedances being reported and continue implementation of those actions until the CEO has confirmed by notice in writing that it has been demonstrated that the threshold criteria are being met and implementation of the threshold contingency actions are no longer required;
 - (3) investigate to determine the cause of the threshold criteria being exceeded;
 - (4) investigate to provide information for the CEO to determine potential environmental harm or alteration of the environment that occurred due to threshold criteria being exceeded;
 - (5) provide a report to the CEO within twenty-one (21) days of the threshold criteria exceedance being reported. The report shall include:
 - (a) details of contingency actions implemented;
 - (b) the effectiveness of the contingency actions implemented against the threshold criteria;
 - (c) the findings of the investigations required by conditions 3-7(3) and 3-7(4);
 - (d) measures to prevent the threshold criteria being exceeded in the future;
 - (e) measures to prevent, control or abate impacts which may have occurred; and
 - (f) justification of the threshold criteria remaining, or being adjusted based on better understanding, demonstrating that the outcome in conditions 3-1(1) and 3-1(4) will be met.

- 3-8 The proponent:

- (1) may review and submit proposed amendments to the Groundwater Monitoring and Management Plan;
- (2) shall review and submit proposed amendments to the Groundwater Monitoring and Management Plan as and when directed by the CEO; and
- (3) shall review and submit proposed amendments to the Groundwater Monitoring and Management Plan every five (5) years.

3-9 The proponent shall continue to implement the Groundwater Monitoring and Management Plan or any subsequent revisions as confirmed by the CEO in condition 3-3, until the CEO has confirmed by notice in writing that the proponent has demonstrated that the environmental outcomes detailed in conditions 3-1(1) and 3-1(4) have been met.

4 Marine Environmental Quality (operations)

4-1 Within five (5) years of the end of the mine life, the proponent shall ensure that all infrastructure associated with the proposal including the trestle jetty, bitterns diffuser, boat launching facilities and loading facilities that:

- (1) is not located on a mining tenement administered under the *Mining Act 1978*; and
- (2) has not been agreed by notice in writing from the CEO to be retained through transfer of responsibility to a responsible authority or operator,

is safely decommissioned and removed from the development envelopes for disposal.

4-2 The proponent shall manage all aspects of the proposal, including bitterns discharge, to meet the following outcome:

- (1) the levels of ecological protection to be achieved inside of the:
 - (a) Low Ecological Protection Area shown in Figure 2 and described in the spatial data in schedule 1;
 - (b) Moderate Ecological Protection Area shown in Figure 2 and described in the spatial data in schedule 1;
 - (c) High Ecological Protection Area shown in Figure 2 and described in the spatial data in schedule 1; and
 - (d) Maximum Ecological Protection Area shown in Figure 2 and described in the spatial data in schedule 1,

are consistent with the method for deriving Environmental Quality Guidelines (EQG) and Environmental Quality Standards (EQS) for the

corresponding level of ecological protection described in Appendix 1, Table 1 of the EPA's *Technical Guidance for protecting the quality of Western Australia's marine environment*.

- 4-3 To ensure that the outcome of condition 4-2 is met, the proponent shall implement the Marine Environmental Quality Monitoring and Management Plan (R190108 Rev4A, 24 June 2021). This plan shall:
- (1) specify early warning trigger criteria (Environmental Quality Guidelines - EQG) that will trigger the implementation of management and/or contingency actions to prevent non-compliance with condition 4-2;
 - (2) specify threshold criteria (Environmental Quality Standards - EQS) to demonstrate compliance with condition 4-2;
 - (3) specify monitoring program to determine if trigger criteria (Environmental Quality Guidelines - EQG) and threshold criteria (Environmental Quality Standards - EQS) have been met;
 - (4) specify management and/or contingency actions to be implemented if the trigger criteria (Environmental Quality Guidelines - EQG) required by condition 4-3(1) and/or the threshold criteria (Environmental Quality Standards - EQS) required by condition 4-3(2) have not been met; and
 - (5) provide the format and timing for the reporting of monitoring results against trigger criteria (Environmental Quality Guidelines - EQG) and threshold criteria (Environmental Quality Standards - EQS) to demonstrate that the outcomes in condition 4-2 have been met over the reporting period in the Compliance Assessment Report required by condition 18-6.
- 4-4 The exceedance of a threshold criteria (Environmental Quality Standards - EQS), regardless of whether management actions or threshold contingency actions have been or are being implemented, constitutes non-compliance with these conditions, if the exceedance is attributable to the proposal.
- 4-5 The proponent shall implement the Marine Environmental Quality Monitoring and Management Plan (R190108 Rev4A, 24 June 2021) or the most recent version of the Marine Environmental Quality Monitoring and Management Plan (R190108 Rev4A, 24 June 2021) which the CEO has confirmed by notice in writing, addresses the requirements of condition 4-2.
- 4-6 In the event that monitoring or investigations at any time indicate an exceedance of threshold criteria (Environmental Quality Standards - EQS) specified in the Marine Environmental Quality Monitoring and Management Plan (R190108 Rev4A, 24 June 2021) confirmed under condition 4-5, the proponent shall:

- (1) report the exceedance in writing to the CEO within seven (7) days of the exceedance being identified;
- (2) implement the contingency actions required by the Marine Environmental Quality Monitoring and Management Plan (R190108 Rev4A, 24 June 2021) within seven (7) days of the exceedances being reported and continue implementation of those actions until the CEO has confirmed by notice in writing that it has been demonstrated that the threshold criteria (Environmental Quality Standards - EQS) are being met and implementation of the threshold contingency actions are no longer required;
- (3) investigate to determine the cause of the threshold criteria (Environmental Quality Standards - EQS) being exceeded;
- (4) investigate to provide information for the CEO to determine potential environmental harm or alteration of the environment that occurred due to threshold criteria (Environmental Quality Standards - EQS) being exceeded;
- (5) provide a report to the CEO within twenty-one (21) days of the exceedance being reported. The report shall include:
 - (a) details of contingency actions implemented;
 - (b) the effectiveness of the contingency actions implemented against the threshold criteria (Environmental Quality Standards - EQS);
 - (c) the findings of the investigations required by conditions 4-6(3) and 4-6(4);
 - (d) measures to prevent the threshold criteria (Environmental Quality Standards - EQS) being exceeded in the future;
 - (e) measures to prevent, control or abate impacts which may have occurred; and
 - (f) justification of the threshold criteria (Environmental Quality Standards - EQS) remaining, or being adjusted based on better understanding, demonstrating that the outcomes in condition 4-2 will be met.

4-7 The proponent:

- (1) may review and submit proposed amendments to the Marine Environmental Quality Monitoring and Management Plan (R190108 Rev4A, 24 June 2021);

- (2) shall review and submit proposed amendments to the Marine Environmental Quality Monitoring and Management Plan (R190108 Rev4A, 24 June 2021) as and when directed by the CEO;
 - (3) shall review and submit proposed amendments to the Marine Environmental Quality Monitoring and Management Plan (R190108 Rev4A, 24 June 2021) every five (5) years.
- 4-8 The proponent shall continue to implement the Marine Environmental Quality Monitoring and Management Plan (R190108 Rev4A, 24 June 2021) or any subsequent revisions as confirmed by the CEO in condition 4-5, until the CEO has confirmed by notice in writing that the proponent has demonstrated that the environmental outcomes detailed in condition 4-2 has been met.

5 Flora and Vegetation

- 5-1 The proponent shall ensure that the following outcomes are achieved:
- (1) no more than 165 ha cumulative impacts to the Horseflat **PEC** as a result of the proposal, including **direct impacts** to no more than 145 ha
 - (2) no **direct** or **indirect impacts** to the known locations of *Minuria tridens* identified in *Phoenix – Detailed Flora and vegetation survey for the Mardie project* (June 2020);
 - (3) no **direct impacts** or **indirect impacts** to any known locations of the sterile, potentially rare or novel *Tecticornia* Taxa, identified within *Phoenix – Detailed Flora and vegetation survey for the Mardie project* (June 2020), unless the CEO has confirmed by notice in writing that further investigations have demonstrated that the specimens represent adequately widespread species such that disturbance of the known specimens would not be inconsistent with EPA's objective for Flora and Vegetation;
 - (4) no disturbance associated with the proposal to more than 30% of the currently mapped extent (256 ha) of the 'landward' *Tecticornia* vegetation described in *Mardie Project – Response to Submissions* (March 2021), until the CEO has confirmed by notice in writing that:
 - (a) supplementary *Tecticornia* surveys outside the development envelopes have been undertaken;
 - (b) the methodology of the supplementary surveys is in accordance with (EPA Guidance), or represents adequate effort to meet the outcome of condition 5-1 (3);

- (c) the supplementary surveys have mapped additional vegetation consistent with the description of the landward samphire in *Mardie Project – Response to Submissions* (March 2021); and
- (d) the additional *Tecticornia* vegetation mapped in the supplementary surveys is sufficiently widespread in the region that clearing of up to 854 ha of this vegetation would not be inconsistent with the EPA's objectives for Flora and Vegetation.

5-2 The proponent shall conduct targeted pre-clearance surveys of all areas of vegetation mapped as AcAjTE, Tspp or TtSvTc in *Phoenix – Detailed Flora and vegetation survey for the Mardie project* (June 2020).

5-3 The proponent shall not clear in any area of AcAjTE, Tspp or TtSvTc vegetation as mapped in *Phoenix – Detailed Flora and vegetation survey for the Mardie project* (June 2020), until the CEO has confirmed by notice in writing that:

- (1) the pre-clearance survey of that area was conducted in accordance with EPA *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016);
- (2) the proponent has demonstrated avoidance and minimisation of **direct** and **indirect impacts** to any significant flora identified during pre-clearance surveys required by condition 5-2 as far as practicable, including:
 - (a) revision of the development envelope to avoid any significant individual where possible; and
 - (b) where individuals of *Minuria tridens* are identified during pre-clearance surveys and cannot be avoided, development of a research strategy to inform the potential for re-establishment of a population of *Minuria tridens* in the region.

6 Benthic Communities and Habitat Monitoring and Management Plan

6-1 The proponent shall ensure the implementation of the proposal achieves the following outcomes:

- (1) **direct impacts** to coastal samphire (as defined in the *Mardie Project – Response to Submissions* March 2021) of no more than 7.2% of the extent within the study area identified in Figure 3;
- (2) direct and project attributable indirect disturbance to algal mat of no more than 25% of the extent within the study area identified in Figure 3;
- (3) project attributable **direct** and **indirect impacts** of no more than 8% of the extent of algal mat on the **west Pilbara coast**; and

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- (4) no long-term (greater than five (5) years) project attributable net detectable loss of algal mat outside the proposal footprint.
- 6-2 The proponent shall ensure the proposal is constructed and operated to meet the following objectives:
- (1) changes to the health, diversity, and extent of benthic communities and habitat as a result of changes to surface water, groundwater quality groundwater regimes, and marine environmental quality associated with the proposal are detected as early as possible;
 - (2) loss of benthic communities and habitat as a result of the proposal, including loss of health, abundance or diversity as a result of project attributable **indirect impacts**, are accurately recorded and reported to meet the requirements of condition 14-1(4); and
 - (3) project attributable **adverse impacts** to benthic communities and habitat are addressed using best-practice available management mitigation and contingency measures.
- 6-3 Prior to the construction of any pond walls, intertidal causeway, or other structure that could potentially impact on intertidal benthic communities and habitat, including mangrove habitat, algal mat and samphire habitat, unless otherwise approved by the CEO in writing, the proponent shall prepare and submit to the CEO a Benthic Communities and Habitat Monitoring and Management Plan.
- 6-4 The Benthic Communities and Habitat Monitoring and Management Plan shall:
- (1) when implemented, substantiate and ensure that the outcomes of conditions 2-1 and 6-1 will be met, and the objectives of condition 6-2 will be achieved;
 - (2) substantiate whether the outcomes of conditions 3-1(4) and 4-1 are being met.
 - (3) take account of all available data to determine whether the outcome of condition 6-1(3) will be met;
 - (4) include the details of mitigation actions to be implemented if the outcomes of condition 6-1 are not being met;
 - (5) include the methodology of a monitoring program for mangroves in the **RRDMMA** shown in Figure 1, to ensure no **indirect impacts** occur within this area as a result of the proposal subject to the requirements of condition 2-3, and to demonstrate that the outcome of condition 2-1 is met;

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- (6) specify early warning trigger criteria that will trigger the implementation of management and/or contingency actions to prevent non-compliance with the outcomes of conditions 2-1 and 6-1 or non-achievement of the objectives in condition 3-1 (4) and 6-2;
 - (7) specify threshold criteria to demonstrate compliance with conditions 2-1 3-1 (4) and 6-1 and that the objectives in condition 6-2 are being achieved;
 - (8) specify the details of a monitoring program to determine if trigger criteria required by condition 6-4(6) and threshold criteria required by condition 6-4(7) have been met;
 - (9) specify management and/or contingency actions to be implemented if the trigger criteria required by condition 6-4(6) and/or the threshold criteria required by condition 6-4(7) have not been met; and
 - (10) provide the format and timing for the reporting of monitoring results against trigger criteria and threshold criteria to demonstrate that the outcomes in condition 6-1 have been met and the objectives in condition 6-2 have been achieved over the reporting period in the Compliance Assessment Report required by condition 18-6.
- 6-5 The proponent must not commence operations until the CEO has confirmed in writing that the Benthic Communities and Habitat Monitoring and Management Plan submitted under condition 6-3 addresses the requirements of condition 6-4, the outcomes of conditions 2-1, 3-1(4), and 6-1, and the objectives of condition 6-2.
- 6-6 The exceedance of a threshold criteria (regardless of whether management actions or threshold contingency actions have been or are being implemented), and/or comply with the requirements of the Benthic Communities and Habitat Monitoring and Management Plan represents non-compliance with these conditions.
- 6-7 The proponent shall implement the most recent version of the Benthic Communities and Habitat Monitoring and Management Plan which the CEO has confirmed by notice in writing, addresses the requirements of conditions 2-1, 3-1(4), 6-1 and 6-2.
- 6-8 In the event that monitoring or investigations at any time indicate an exceedance of threshold criteria specified in the Benthic Communities and Habitat Monitoring and Management Plan confirmed under condition 6-5, the proponent shall:
- (1) report the exceedance in writing to the CEO within seven (7) days of the exceedance being identified;
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- (2) implement the contingency actions required by the Benthic Communities and Habitat Monitoring and Management Plan within seven (7) days of the exceedances being reported and continue implementation of those actions until the CEO has confirmed by notice in writing that it has been demonstrated that the threshold criteria are being met and implementation of the threshold contingency actions are no longer required;
 - (3) investigate to determine the cause of the threshold criteria being exceeded;
 - (4) investigate to provide information for the CEO to determine potential environmental harm or alteration of the environment that occurred due to threshold criteria being exceeded;
 - (5) provide a report to the CEO within twenty-one (21) days of the exceedance being reported. The report shall include:
 - (a) details of contingency actions implemented;
 - (b) the effectiveness of the contingency actions implemented against the threshold criteria;
 - (c) the findings of the investigations required by conditions 6-8(3) and 6-8(4);
 - (d) measures to prevent the threshold criteria being exceeded in the future;
 - (e) measures to prevent, control or abate impacts which may have occurred; and
 - (f) justification of the threshold criteria remaining, or being adjusted based on better understanding, demonstrating that the objectives in condition 6-1 will be met.

6-9 The proponent:

- (1) may review and submit proposed amendments to the Benthic Communities and Habitat Monitoring and Management Plan;
- (2) shall review and submit proposed amendments to the Benthic Communities and Habitat Monitoring and Management Plan as and when directed by the CEO; and
- (3) shall review and submit proposed amendments to the Benthic Communities and Habitat Monitoring and Management Plan every five (5) years.

- 6-10 The proponent shall continue to implement the Benthic Communities and Habitat Monitoring and Management Plan or any subsequent revisions as confirmed by the CEO in condition 6-5, until the CEO has confirmed by notice in writing that the proponent has demonstrated that the environmental outcomes detailed in conditions 2-1 and 6-1 and the objectives in condition 6-2 have been met.

7 Benthic Communities and Habitat and Marine Environmental Quality

Dredge Management Plan

- 7-1 The proponent shall ensure implementation of the proposal achieves the following environmental protection outcomes:
- (1) no irreversible loss of, or serious damage to, benthic communities and habitats outside of the authorised Zone of High Impact as spatially defined in Figure 4; and
 - (2) no negative change from the baseline state of benthic communities outside of the authorised Zone of High Impact and authorised Zone of Moderate Impact as spatially defined in Figure 4.
- 7-2 The proponent shall implement the Dredge Management Plan (R190043 Rev2B, 24 June 2021) or any subsequent versions of the Plan which the CEO has confirmed by notice in writing addresses the requirements of condition 7-3, for all dredging activities, including maintenance dredging activities during operations.
- 7-3 The Dredge Management Plan shall:
- (1) when implemented, substantiate that the outcomes of condition 7-1 are being met;
 - (2) specify early warning trigger criteria that will trigger the implementation of management and/or contingency actions to prevent non-compliance with condition 7-1;
 - (3) specify threshold criteria to demonstrate compliance with condition 7-1;
 - (4) specify monitoring program to determine if trigger criteria and threshold criteria have been met;
 - (5) specify management and/or contingency actions to be implemented if the trigger criteria required by condition 7-3(2) and/or the threshold criteria required by condition 7-3(3) have not been met; and
 - (6) provide the format and timing for the reporting of monitoring results against trigger criteria and threshold criteria to demonstrate that the

outcomes in condition 7-1 have been met over the reporting period in the Compliance Assessment Report required by condition 18-6

- 7-4 The exceedance of a threshold criteria (regardless of whether management actions or threshold contingency actions have been or are being implemented), represents non-compliance with these conditions, if the exceedance is project-attributable.
- 7-5 In the event that monitoring or investigations at any time indicate an exceedance of early warning trigger criteria or threshold criteria specified in the Dredge Management Plan (R190043 Rev2B, 24 June 2021) confirmed under condition 7-2, the proponent shall:
- (1) report the exceedance in writing to the CEO within seven (7) days of the exceedance being identified;
 - (2) implement the contingency actions required by the Dredge Management Plan (R190043 Rev2B, 24 June 2021) within seven (7) days of the exceedances being reported and continue implementation of those actions until the CEO has confirmed by notice in writing that it has been demonstrated that the trigger criteria and/or threshold criteria are being met and implementation of the trigger criteria and/or threshold contingency actions are no longer required;
 - (3) investigate to determine the cause of the early warning trigger criteria or threshold criteria being exceeded;
 - (4) investigate to provide information for the CEO to determine potential environmental harm or alteration of the environment that occurred due to threshold criteria being exceeded;
 - (5) provide a report to the CEO within twenty-one (21) days of the exceedance being reported. The report shall include:
 - (a) details of contingency actions implemented;
 - (b) the effectiveness of the contingency actions implemented against the early warning trigger criteria or threshold criteria;
 - (c) the findings of the investigations required by conditions 7-5(3) and 7-5(4);
 - (d) measures to prevent the early warning trigger criteria or threshold criteria being exceeded in the future;
 - (e) measures to prevent, control or abate impacts which may have occurred; and

- (f) justification of the early warning trigger criteria or threshold criteria remaining, or being adjusted based on better understanding, demonstrating that the outcomes in condition 7-1 will be met.

7-6 The proponent:

- (1) may review and submit proposed amendments to the Dredge Management Plan (R190043 Rev2B, 24 June 2021);
- (2) shall review and submit proposed amendments to the Dredge Management Plan (R190043 Rev2B, 24 June 2021) as and when directed by the CEO; and
- (3) shall review and submit proposed amendments to the Dredge Management Plan (R190043 Rev2B, 24 June 2021) every five (5) years.

7-7 The proponent shall continue to implement the Dredge Management Plan (R190043 Rev2B, 24 June 2021) or any subsequent revisions as confirmed by the CEO in condition 7-2, until the CEO has confirmed by notice in writing that the proponent has demonstrated that the environmental outcomes in condition 7-1 have been met.

Marine Pest Procedures

7-8 The proponent shall ensure the implementation of the proposal achieves the following outcome:

- (1) No introduction of marine pests into the state or within the state as a result of the proposal.

7-9 To achieve the environmental outcome in 7-8 (1), prior to construction the proponent shall develop and submit to the CEO procedures for managing all vessels and immersible equipment prior to mobilisation and during the proposal to the requirements of the CEO, on advice of the Department of Primary Industries and Regional Development.

7-10 The proponent shall not commence any marine construction or dredging activities until the CEO has confirmed by notice in writing that the marine pest management procedures required by condition 7-9 have been prepared to the CEO's satisfaction on advice from DPIRD.

7-11 The proponent shall implement the procedures required by condition 7-9 during the construction of the proposal.

8 Terrestrial Fauna

8-1 The proponent shall undertake the proposal to meet the following outcomes:

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- (1) no reduction in the richness and abundance of migratory shorebirds and other shorebirds in the proposal area attributable to the proposal; and
 - (2) no **direct impacts** to the habitats of known short range endemic invertebrates unless demonstrate that the taxon occurs outside the impact areas.
- 8-2 Prior to ground disturbing activities, unless otherwise agreed in writing by the CEO, the proponent shall prepare and submit to the CEO a Long-term migratory shorebird monitoring program, which shall:
- (1) be conducted at the ponds and in proximity to the trestle jetty (impact areas) and in representative habitats in control areas, as per the requirements of the *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*;
 - (2) continue for a minimum of five (5) years to capture construction and post construction phases of the project;
 - (3) include a commitment and timing for the results of each completed survey to be submitted to the ‘Shorebirds 2020’ initiative, DAWE and DBCA;
 - (4) include trigger and threshold criteria and management actions to be implemented if change in the richness and abundance of migratory shorebirds and other birds are identified;
 - (5) ensure the annual monitoring program will continue until the CEO has confirmed by notice in writing that the outcomes of condition 8-1 have been met.
- 8-3 Unless otherwise agreed by the CEO, the proponent shall not commence any construction of evaporation ponds, crystalliser ponds, intertidal causeway or trestle jetty until the CEO has confirmed by notice in writing that the Long-term migratory shorebird monitoring program meets the requirements of condition 8-2.
- 8-4 The proponent:
- (1) may review and submit proposed amendments to the Long-term migratory shorebird monitoring program
 - (2) shall review and submit proposed amendments to the Long-term migratory shorebird monitoring program as and when directed by the CEO; and

- (3) shall review and submit proposed amendments to the Long-term migratory shorebird monitoring program every five (5) years.
- 8-5 The proponent shall implement the Long-term migratory shorebird monitoring program or any subsequent revisions that the CEO has confirmed by notice in writing meets the outcome of condition 8-1 (1) and the requirements of condition 8-2, until the CEO has confirmed by notice in writing that the proponent has demonstrated that the environmental outcomes of condition 8-1 (1) have been met.
- 8-6 In order to meet the outcomes of conditions 8-1(2), the proponent shall complete pre-clearance survey for short-range endemic fauna within areas designated as having moderate or high prospectivity for short range endemic invertebrates in the *Mardie Project – Response to Submissions* (March 2021).
- 8-7 The proponent shall avoid clearing any areas designated as having moderate or high prospectivity for short range endemic invertebrates in the *Mardie Project – Response to Submissions* (March 2021), until the CEO has confirmed by notice in writing that:
- (1) the pre-clearance survey required by 8-6 has been undertaken in accordance with the *EPA Technical Guidance Sampling of short range endemic invertebrate fauna*; and
 - (2) the proponent has demonstrated avoidance and minimisation of impacts to any confirmed short range endemic habitat such that the outcome of condition 8-1(2) has been met including:
 - (a) avoidance of taking construction material from any mudflat islands confirmed to be habitat for short range endemic species.

9 Illumination and Light Spill

- 9-1 Prior to ground disturbing activities, unless otherwise agreed in writing by the CEO, the proponent shall develop and submit to the CEO an Illumination Plan for marine and terrestrial fauna, which shall:
- (1) incorporate the design and mitigation measures within the EPA 2010 *Environmental Assessment Guideline No. 5 – Environmental Assessment Guideline for Protecting Marine Turtles from Light Impacts* or subsequent updates; and
 - (2) incorporate the design and mitigation measures within the DotEE (2020) *Light Pollution Guidelines: National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds*, Commonwealth of Australia.

- 9-2 Unless otherwise agreed by the CEO, the proponent shall not operate or install any lighting equipment associated with the construction or operation of the proposal until the CEO has confirmed by notice in writing that the Illumination Plan meets the requirements of condition 9-1.
- 9-3 The proponent shall implement the most recent version of the Illumination Plan which the CEO has confirmed by notice in writing, addresses the requirements of condition 9-1.
- 9-4 The proponent:
- (1) may review and submit proposed amendments to the Illumination Plan;
 - (2) shall review and submit proposed amendments to the Illumination Plan as and when directed by the CEO; and
 - (3) shall review and submit proposed amendments to the Illumination Plan every five (5) years.
- 9-4 The proponent shall continue to implement the Illumination Plan or any subsequent revisions as confirmed by the CEO in condition 9-3, until the CEO has confirmed by notice in writing that the implementation of the Plan may cease.

10 Marine Fauna

- 10-1 The proponent shall implement the proposal to meet the following environmental outcomes:
- (1) clearing in the fauna habitat type identified as low-quality turtle nesting habitat (sandy beach habitat) in the *Mardie project – Environmental Review Document* (June 2020) is limited to a width of 50 metres, parallel to the high water mark;
 - (2) no **adverse impact** to marine turtle behaviour on offshore islands as a result of project attributable light spill;
 - (3) no entrainment or entrapment of marine turtles and fauna within sea water intake pipes (primary, desalination, and diffuser intake), which will be fitted using a four (4) side screen with no larger than 5 millimetres mesh width. Sea water intake on these pipes must not exceed 0.15 metres per second.
- 10-2 In order to demonstrate that **direct impacts** to significant marine turtle habitat will be minimised as far as practicable, the proponent shall conduct a pre-construction marine turtle survey within habitat identified as sandy beach habitat in the *Mardie project – Environmental Review Document* (June 2020).

- 10-3 The proponent shall avoid any construction activity within habitat identified as sandy beach habitat in the *Mardie project – Environmental Review Document* (June 2020), until the CEO has confirmed by notice in writing that:
- (1) the surveys required by condition 10-2 have been conducted in accordance with best practice, by a qualified fauna (marine turtle) specialist and completed during the entire breeding and hatchling season of marine turtles;
 - (2) outcomes of the surveys required by condition 10-2 have been provided to DAWE, DBCA, DWER; and
 - (3) where significant turtle nesting habitat has been identified by surveys required by condition 10-2, mitigation measures to reduce potential impacts to the beach area as far as practicable have been identified and the proponent has committed to implementing the identified mitigation measures.
- 10-4 Prior to the commencement of operations the proponent shall submit to the CEO a Marine Turtle Monitoring Program. This plan shall:
- (1) when implemented, substantiate that the outcome required by condition 10-1(2) is being met;
 - (2) when implemented, determine whether artificial light spill emissions are influencing nesting and mis-orientation or disorientation of turtles on the offshore islands (including but not limited to Long and Sholl Islands), and any areas determined to be significant turtle nesting habitat by surveys required by condition 10-3;
 - (3) specify the details of the methodology of monitoring of the nesting turtle population in the proposal area, including nesting adults and hatchlings, during the species-specific reproductive period, which is to include (but not be limited to):
 - (a) identification of the species of turtles nesting on the beaches;
 - (b) identification of the abundance and the distribution of adult tracks on the nesting beaches;
 - (c) collection of data on the health of the nesting habitat;
 - (d) collection of data on hatchling orientation; and
 - (e) measurements on the intensity and extent of light sources visible from nesting beaches.

- (4) include a commitment to annually compare cumulative results against the baseline assessment (Pendoley Environmental 2019, Mardie Salt Project Marine Turtle Monitoring Program 2018/2019. Rev 0, Report No. RP-59001);
 - (5) include measures to reduce light spill to offshore islands to be implemented in the event that **adverse impacts** from the proposal are detected, including a decrease in percentage range and usage of nesting sites (from the baseline study (*Pendoley Environmental 2019, Mardie Salt Project Marine Turtle Monitoring Program 2018/2019. Rev 0, Report No. RP-59001*); and
 - (6) provide criteria for when the Illumination Plan required by condition 9-1 will be revised in response to outcomes of the monitoring required by condition 10-6.
- 10-5 Unless otherwise agreed by the CEO, the proponent shall not commence operations until the CEO has confirmed in writing that the Marine Turtle Monitoring Program addresses the requirements of condition 10-4.
- 10-6 The proponent shall continue to implement the Marine Turtle Monitoring Program until the CEO has confirmed by notice in writing, on advice from DBCA and DWER, that the outcome of condition 10-1(2) has been, and will continue to be met.
- 10-7 In order to demonstrate that impacts to marine fauna from marine noise associated with the proposal are minimised as far as practicable, the proponent shall implement the *Underwater Noise Management procedure (MAR-0000-EV-PRO-BCI-000-0007, 22 June 2021)*.

11 Social Surroundings

- 11-1 The proponent must implement the proposal to meet the following objectives:
- (1) avoid, where possible, and minimise direct and project attributable **indirect impacts** to:
 - (a) social, cultural, heritage, and archaeological values within and surrounding the development envelope;
 - (b) visual and amenity impacts to social and cultural places and activities; and
 - (c) access to traditional lands.
- 11-2 Prior to ground disturbing activities, the proponent shall develop and submit to the CEO a Heritage Management Plan in accordance with requirements described within the *Horizon Heritage Management 2018. Work Program*

Clearance for the Yaburara and Marthudunera People and BCI Minerals Limited for the proposed Mardie Salt Project, south of Cape Preston.

- 11-3 The Heritage Management Plan required by condition 11-2 shall include (but not be limited to):
- (1) a framework for consultation with Traditional Owners (Yaburara and Mardudhunera People and Kuruma Mardudhunera People) and other relevant stakeholders during the life of the proposal;
 - (2) a commitment that, in the instance of any previously unrecorded heritage places being identified within the development envelope, the proponent shall avoid the area and must contact the Yaburara and Mardudhunera People and the Kuruma Mardudhunera People and DPLH within ten (10) days of discovery, prior to implementing mitigation actions required;
 - (3) a commitment to ensure that staff and contracting personnel are made fully aware of their obligations under the *Aboriginal Heritage Act 1972*;
 - (4) risk-based management actions that will be implemented to demonstrate compliance with the objectives specified in condition 11-1;
 - (5) measurable management target(s) to determine the effectiveness of the risk-based management actions;
 - (6) monitoring to measure the effectiveness of management actions against management targets;
 - (7) mitigation actions to be implemented in the event that monitoring demonstrates that management targets will not be met;
 - (8) a process for revision of management actions and changes to proposal activities, in the event that the management targets are not achieved. The process must include an investigation to determine the cause of the management target(s) not being met; and
 - (9) the format and timing to demonstrate that condition 11-1 has been met for the reporting period in the Compliance Assessment Report required by condition 18-6.
- 11-4 Unless otherwise agreed by the CEO, the proponent must not commence ground-disturbing activities until the CEO has confirmed in writing that the Heritage Management Plan submitted under condition 11-2 addresses the requirements of condition 11-3.
- 11-5 The proponent shall implement the most recent version of the Heritage Management Plan which the CEO has confirmed by notice in writing, addresses the requirements of condition 11-3.

11-6 In the event that monitoring or investigations at any time indicate an exceedance of management targets specified in the Heritage Management Plan confirmed under condition 11-5 the proponent shall:

- (1) report the exceedance in writing to the CEO within seven (7) days of the exceedance being identified;
- (2) implement the contingency actions required by the Heritage Management Plan within seven (7) days of the exceedances being reported and continue implementation of those actions until the CEO has confirmed by notice in writing that it has been demonstrated that the management targets are being met and implementation of the mitigation actions are no longer required;
- (3) investigate to determine the cause of the management targets being exceeded;
- (4) provide a report to the CEO within twenty-one (21) days of the exceedance being reported. The report shall include:
 - (a) details of notification of stakeholders and planned ongoing consultation with stakeholders;
 - (b) details of mitigation actions implemented;
 - (c) the effectiveness of the mitigation actions implemented against the management targets;
 - (d) the findings of the investigations required by conditions 11-6(3);
 - (e) measures to prevent the management targets being exceeded in the future;
 - (f) measures to prevent, control or abate impacts which may have occurred; and
 - (g) justification of the management targets remaining, or being adjusted based on better understanding, demonstrating that the outcomes in condition 11-1 will be met.

11-7 The proponent:

- (1) may review and submit proposed amendments to the Heritage Management Plan;
- (2) shall review and submit proposed amendments to the Heritage Management Plan as and when directed by the CEO; and

- (3) shall review and submit proposed amendments to the Heritage Management Plan every five (5) years.

11-8 The proponent shall continue to implement the Heritage Management Plan or any subsequent revisions as confirmed by the CEO in condition 11-5, until the CEO has confirmed by notice in writing that the proponent has demonstrated that the environmental outcomes and objectives detailed in condition 11-1 have been met.

12 Monitoring and Adaptive Management Program

12-1 The proponent must implement a monitoring and adaptive management plan to meet the outcomes and objectives of conditions 3-1(2), 3-1 (3), 3-1(5), 3-1(6), 3-1(7), 4-1, 5-1(1), 5-1(2), 5-1(3), 5-1(4), 7-8, 10-1 (1), 10-1(3), 10-3(3) and 11-1(1) which includes:

- (1) threshold criteria to determine compliance with all condition limits and outcomes;
- (2) trigger criteria that provide an early warning that any condition limits are not likely to be met;
- (3) monitoring parameters, sites, control/reference sites, methodology, timing and frequencies which will be used to measure threshold and trigger criteria. Include methodology for:
 - (a) baseline data;
 - (b) data collection and analysis methods;
 - (c) adaptive management methodology;
 - (d) contingency; and
 - (e) reporting;
- (4) details of monitoring of *Minuria tridens* individuals and populations identified in *Phoenix – Detailed Flora and vegetation survey for the Mardie project (June 2020)* and any found during the pre-clearance surveys required by condition 5-2 must be undertaken yearly for the life of the project to assess **indirect impacts** of changes to groundwater and surface hydrology; and
- (5) details of reporting requirements in the event that any changes to individuals and populations of *Minuria tridens* are detected, including requirements to provide mitigation measures to protect this species.

- 12-2 The proponent shall submit the monitoring and adaptive management plan to the CEO within one year of the issue of this statement.
- 12-3 The proponent may revise the monitoring and adaptive management plan.
- 12-4 The proponent shall revise the monitoring and adaptive management plan as and when the CEO requires.
- 12-5 The proponent shall implement the version of the plan submitted in accordance with 12-2, or the most recent version of the plan which the CEO has confirmed by notice in writing meets the requirements of 12-1.

13 Terrestrial Offsets

- 13-1 The proponent shall contribute funds to the Pilbara Environmental Offsets Fund calculated pursuant to condition 13-2, to achieve the objective of counterbalancing the significant residual impacts of **direct impacts** and **indirect impacts** to:
 - (1) 'Good' to 'Excellent' condition native vegetation, including foraging and dispersal habitat for the pilbara olive python, northern quoll, pilbara leaf-nosed bat, and EPBC Act listed migratory/marine bird habitat;
 - (2) Priority 3 **PEC** - Horseflat Land System of the Roebourne Plains; and
 - (3) critical habitat for the Pilbara olive python (riparian and freshwater pool habitat).
- 13-2 The proponent's contribution to the Pilbara Environmental Offsets Fund shall be paid biennially, with the amount to be contributed calculated based on the clearing undertaken in each year of the biennial reporting period in accordance with the highest applicable rate specified in condition 13-3. The first biennial reporting period shall commence from ground disturbing activities of the environmental value(s) identified in condition 13-3.
- 13-3 Calculated on the 2019–2020 financial year, the contribution rates are:
 - (1) \$826 AUD (excluding GST) per hectare of 'Good' to 'Excellent' condition native vegetation, including foraging and dispersal habitat for the Pilbara olive python, northern quoll, pilbara leaf-nosed bat and EPBC Act listed Migratory/marine bird habitat cleared or indirectly impacted for the proposal within the Roebourne IBRA subregion;
 - (2) \$1,653 AUD (excluding GST) per hectare of Priority 3 **PEC** - Horseflat Land System of the Roebourne Plains cleared or indirectly impacted for the proposal within the Roebourne IBRA subregion; and

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- (3) \$1,653 AUD (excluding GST) per hectare of riparian vegetation, which is also critical habitat for the Pilbara Olive Python, cleared or indirectly impacted for the proposal within the Roebourne IBRA subregion.
- 13-4 From the commencement of the 2019-2020 financial year, the rates in condition 13-3 will be adjusted annually each subsequent financial year in accordance with the percentage change in the CPI applicable to that financial year.
- 13-5 Where offsets are required for an area of land under condition 14 that is also subject to offsets under condition 13-3, the higher amount shall apply.
- 13-6 To achieve the objective in condition 13-1, the proponent shall prepare and submit a Mardie Project Impact Reconciliation Procedure to the CEO prior to ground disturbing activities. This procedure shall:
- (1) spatially define the environmental value(s) identified in condition 13-1;
 - (2) spatially define the areas where offsets required by condition 13-1 are to be exempt;
 - (3) include a methodology to calculate the amount of clearing undertaken during each year of the biennial reporting period for each of the environmental values identified in condition 13-3;
 - (4) state that clearing calculation for the first biennial reporting period will commence from ground disturbing activities in accordance with condition 13-2 and end on the second 30 June following the commencement of ground disturbing activities;
 - (5) state that clearing calculations for each subsequent biennial reporting period will commence on 1 July of the required reporting period, unless otherwise agreed by the CEO;
 - (6) indicate the timing and content of the Impact Reconciliation Reports; and
 - (7) be prepared in accordance with *Instructions on how to prepare Environmental Protection Act 1986 Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports* (or any subsequent revisions).
- 13-7 The proponent:
- (1) may review and revise the Impact Reconciliation Procedure; or
 - (2) shall review and revise the Impact Reconciliation Procedure as and when directed by the CEO by a notice in writing.

- 13-8 The proponent shall submit an Impact Reconciliation Report in accordance with the Impact Reconciliation Procedure approved in condition 13-6
- 13-9 The Impact Reconciliation Report required pursuant to condition 13-8 shall provide the location and spatial extent of the clearing undertaken as a result of the proposal during each year of each biennial reporting period.
- 13-10 The proponent may apply in writing and seek the written approval of the CEO to reduce all or part of the contribution payable under condition 13-2 where:
- (1) a payment has been made to satisfy a condition of an approval under the *Environment Protection and Biodiversity Conservation Act 1999* in relation to the proposal; and
 - (2) the payment is made for the purpose of counterbalancing impacts of the proposal on matters of national environmental significance identified in condition 13-1.

14 Marine and Intertidal Research Offsets

- 14-1 Given the significant residual impacts and risks of the proposal to mangroves, algal mat, and coastal samphire, the proponent shall undertake the following offset measures for the purpose of guiding the strategic protection and management of the ecological values of these habitats on the **west Pilbara coast**, which include migratory bird habitat and ecological maintenance of marine fauna habitat, consistent with the financial, governance and accountability arrangements described in schedule 2:
- (1) contribution to a relevant scientific initiative, on the basis described in schedule 2 (Project A), which has the aim of mapping the original and current extent of Samphire and Algal mat on the **west Pilbara coast**;
 - (2) contribution to a relevant scientific initiative, on the basis described in schedule 2 (Project B), which has the aim of identifying and quantifying the potential effects of sea level rise on the values of mangroves, samphire, and algal mat on the **west Pilbara coast**, and identifying the significance of salt projects in preventing the adaptation of intertidal BCH to sea-level rise;
 - (3) contribution to a relevant scientific initiative, on the basis described in schedule 2 (Project C(i)), for the purposes of funding research with the aim of identifying the ecological roles, values and functions of intertidal benthic communities and habitat;
 - (4) maintenance of a contingency fund, on the basis described in schedule 2 (Project C (ii)) for the purposes of funding research with the aim of identifying the ecological roles, values and functions of intertidal benthic

communities and habitat, to be paid in the event that loss of intertidal benthic communities and habitat, or loss of health, percent cover or diversity of intertidal benthic habitat and communities is identified by the Benthic communities and habitat monitoring and management plans required by condition 6; and

- (5) contribution to a relevant scientific initiative, on the basis described in schedule 2 (Project C (iii)) for the purposes of funding research with the aim of identifying the ecological roles, values and functions of intertidal benthic habitat, to be paid in the event that disturbance to mangrove habitat in the **RRDMMA** occurs subject to the requirements of condition 2.
- 14-2 The proponent shall ensure that the real funding for Projects A, B and C will be maintained through indexation to the Perth consumer price index (CPI) with the first indexation occurring on XX Month Year.
- 14-3 The proponent shall select a third party to carry out the work required to meet the outcomes of condition 14-1 to the satisfaction of the CEO. In applying to the CEO for endorsement of the selected third parties, the proponent shall provide:
- (1) demonstration of the track record, experience, qualifications and competencies of the proposed third party to carry out the work and achieve the outcomes in the intertidal and marine environment.
- 14-4 Prior to the commencement of ground disturbance, unless otherwise agreed by the CEO, the proponent shall provide to the CEO documentation of an agreement between the proponent and the third parties endorsed by the CEO under condition 14-3. This agreement shall:
- (1) ensure that the funds described in schedule 2 are used to meet the objectives of condition 14-1
 - (2) provide the objectives, timing (deliver outcomes within three (3) years of issue of Ministerial Statement or as otherwise agreed with the CEO), milestones and methodology of the proposed research and management programs to meet the objectives in condition 14-1; and
 - (3) identify how outcomes of the proposed programs will be made available publicly.
- 14-5 The proponent shall include in each Compliance Assessment Report required by condition 18-1:
- (1) an outline of the success of implementation of Projects A, B and C, including progress against completion criteria; and

- (2) the details of payments made with consideration for the requirement of condition 14-2.

15 Environmental Performance Report

- 15-1 The proponent shall submit a ten yearly Environmental Performance Report to the CEO within three months of the expiry of the ten year period commencing from the date of substantial commencement of the proposal, or such other time as may be approved in writing by the CEO.
- 15-2 Each Environmental Performance Report shall report on proposal impacts on the following environmental values:
 - (a) state of algal mats;
 - (b) state of mangroves inside and outside the **RRDMMA**;
 - (c) state of groundwater;
 - (d) state of surface water;
 - (e) holistic assessment of proposal impacts against environmental values, including a comparison of the state of each environmental value at the beginning and end of the ten year period; and
 - (f) proposed adaptive management and continuous improvement strategies.
- 15-3 The Environmental Performance Report may be in whole or part prepared in conjunction with other proponents where there are cumulative impacts from their proposals.

16 Contact Details

- 16-1 The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within twenty-eight (28) days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.

17 Time Limit for Proposal Implementation

- 17-1 The proponent shall not commence implementation of the proposal after five (5) years from the date of this Statement, and any commencement, prior to this date, must be substantial.
- 17-2 By the date that is five (5) years from the date of this Statement, the proponent shall notify the CEO in writing of the date of substantial commencement of the proposal, together with reasons why that date has been selected.

18 Compliance Reporting

- 18-1 The proponent shall prepare, and maintain a Compliance Assessment Plan which is submitted to the CEO at least six (6) months prior to the first Compliance Assessment Report required by condition 18-6, or prior to implementation of the proposal, whichever is sooner.
- 18-2 The Compliance Assessment Plan shall indicate:
- (1) the frequency of compliance reporting;
 - (2) the approach and timing of compliance assessments;
 - (3) the retention of compliance assessments;
 - (4) the method of reporting of potential non-compliances and corrective actions taken;
 - (5) the table of contents of Compliance Assessment Reports; and
 - (6) public availability of Compliance Assessment Reports.
- 18-3 After receiving notice in writing from the CEO that the Compliance Assessment Plan satisfies the requirements of condition 18-2 the proponent shall assess compliance with conditions in accordance with the Compliance Assessment Plan required by condition 18-1.
- 18-4 The proponent shall retain reports of all compliance assessments described in the Compliance Assessment Plan required by condition 18-1 and shall make those reports available when requested by the CEO.
- 18-5 The proponent shall advise the CEO of any potential non-compliance within seven (7) days of that non-compliance being known.
- 18-6 The proponent shall submit to the CEO the first Compliance Assessment Report fifteen (15) months from the date of issue of this Statement addressing the twelve (12) month period from the date of issue of this Statement and then annually from the date of submission of the first Compliance Assessment Report, or as otherwise agreed in writing by the CEO.
- 18-7 The Compliance Assessment Report shall:
- (1) be endorsed by the proponent's Chief Executive Officer or a person delegated to sign on the Chief Executive Officer's behalf;
 - (2) include a statement as to whether the proponent has complied with the conditions;

- (3) identify all potential non-compliances and describe corrective and preventative actions taken;
- (4) be made publicly available in accordance with the approved Compliance Assessment Plan; and
- (5) indicate any proposed changes to the Compliance Assessment Plan required by condition 18-1.

19 Public Availability of Data

19-1 Subject to condition 19-2, within a reasonable time period approved by the CEO of the issue of this Statement and for the remainder of the life of the proposal, the proponent shall make publicly available, in a manner approved by the CEO, all validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products (e.g. maps)), management plans and reports relevant to the assessment of this proposal and implementation of this Statement.

19-2 If any data referred to in condition 19-1 contains particulars of:

- (1) a secret formula or process; or
- (2) confidential commercially sensitive information,

the proponent may submit a request for approval from the CEO to not make these data publicly available. In making such a request the proponent shall provide the CEO with an explanation and reasons why the data should not be made publicly available.

Table 1: Abbreviations and definitions

Acronym or abbreviation	Definition or term
CEO	The Chief Executive Officer of the Department of the Public Service of the State responsible for the administration of section 48 of the <i>Environmental Protection Act 1986</i> , or his delegate.
ha	Hectare
direct impact	Any impact resulting from physical disturbance of the environment, including digging, clearing, or otherwise breaking or changing the ground or other surfaces, or direct contact with the environment by emissions from the proposal.
indirect impact	Any impact to the environment as a result of changes to ecological processes.

adverse impact	Any negative change that could result in a loss of health, diversity or abundance of the receptor/s being impacted.
PEC	Priority Ecological Community
landward Samphire	Samphire described as landward in <i>Mardie Project: Response to Submissions (29 March 2021)</i>
coastal Samphire	Samphire described as coastal in <i>Mardie Project: Response to Submissions (29 March 2021)</i>
RRDMMA	The Robe River Delta Mangrove Management Area as shown in Figure 3.
ARI	Annual Recurrence Interval
DAWE	The Commonwealth Department of Water and the Environment, or any of its successors responsible for the administration of the <i>Environmental Protection and Biodiversity Conservation 1999</i> .
DBCA	The Western Australian Department of Biodiversity, Conservation and Attractions, or any of its successors responsible for the administration of the <i>Biodiversity Conservation Act 2016</i> .
DWER	The Western Australian Department of Water and Environmental Regulation, or any of its successors responsible for the administration of section 48 of the <i>Environmental Protection Act 1986</i> .
west Pilbara coast	The extent of the Pilbara coast from the bottom of the Exmouth Gulf to Karratha.

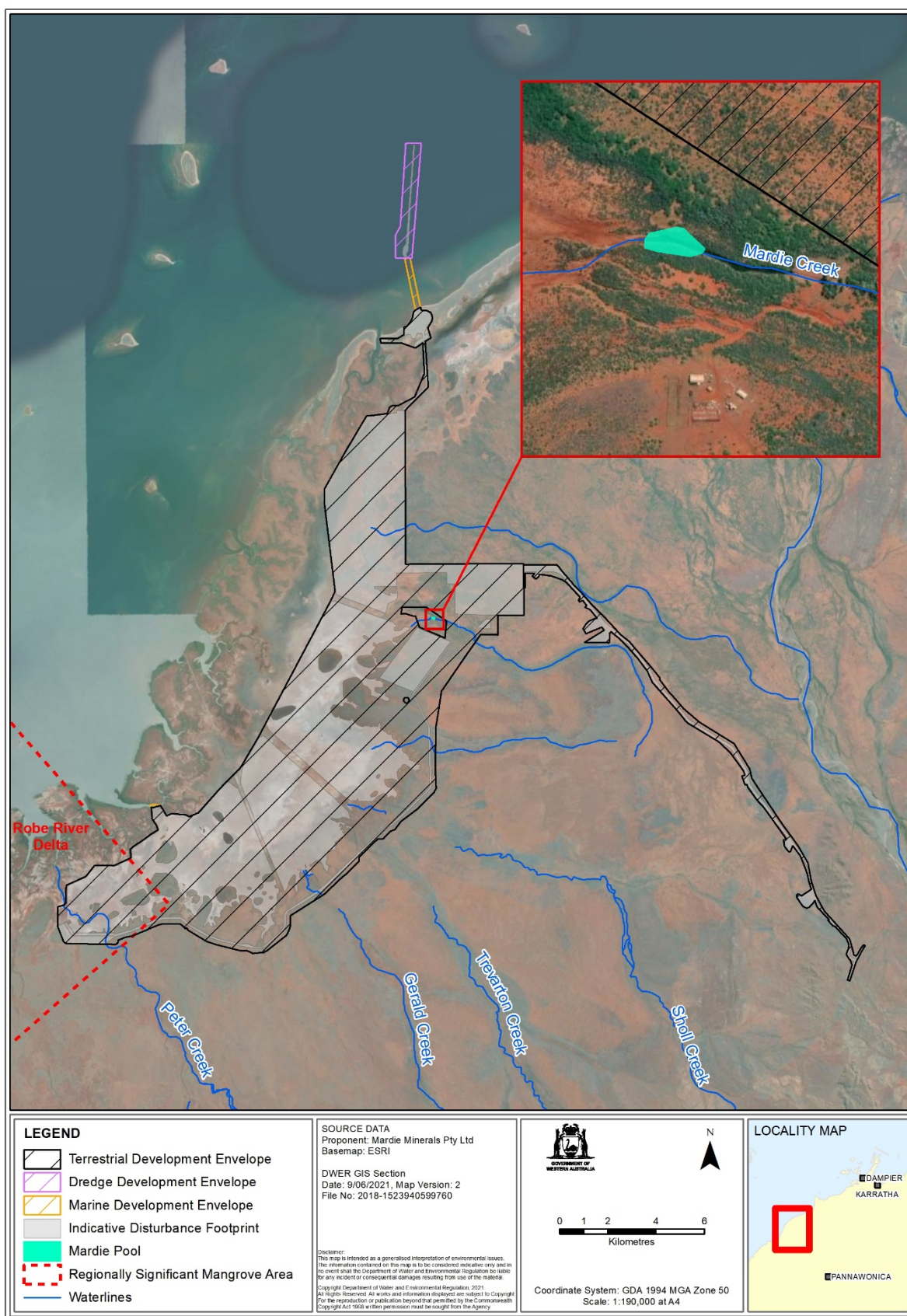


Figure 1: Proposal location and development envelopes

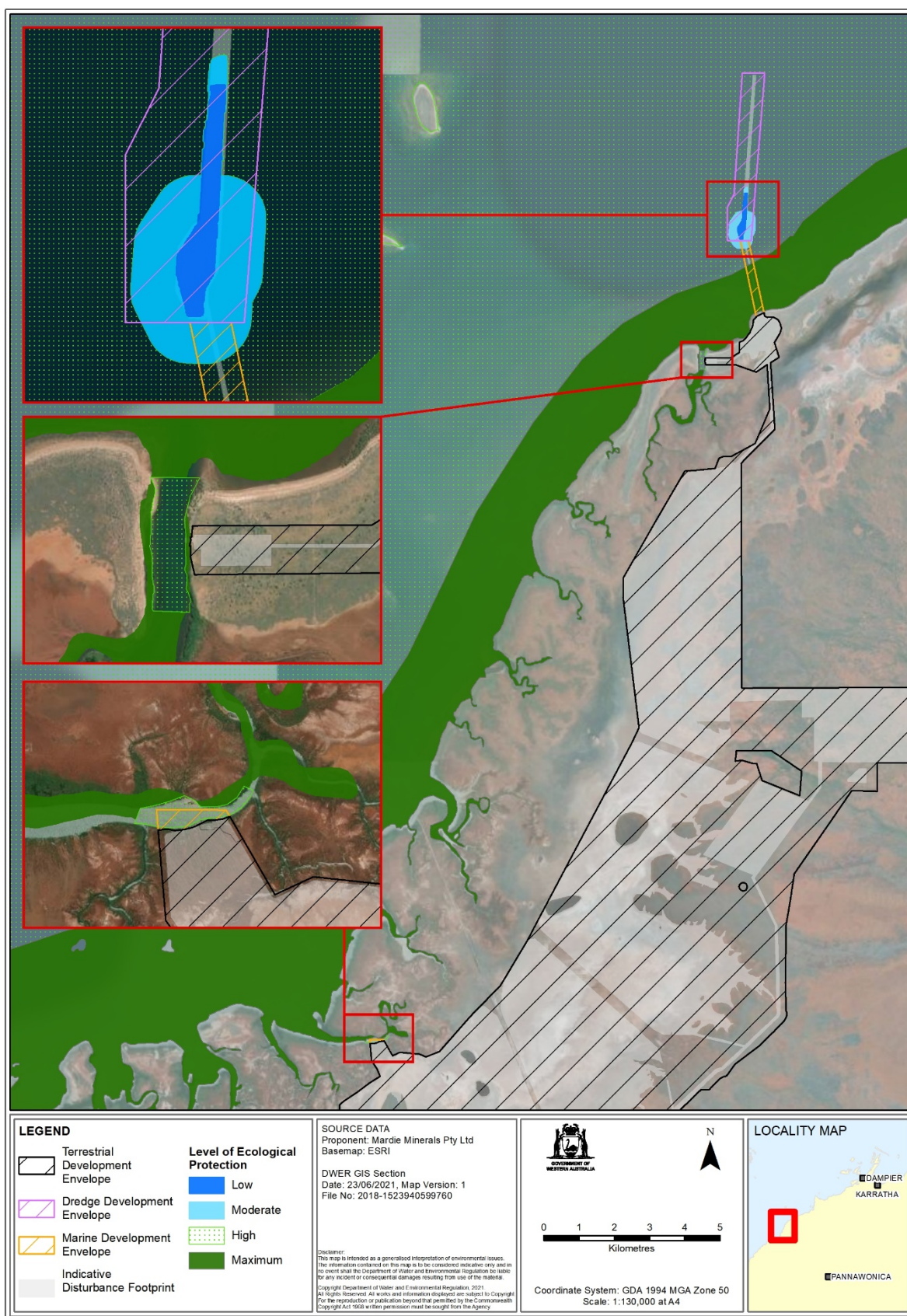


Figure 2: Marine levels of environmental protection

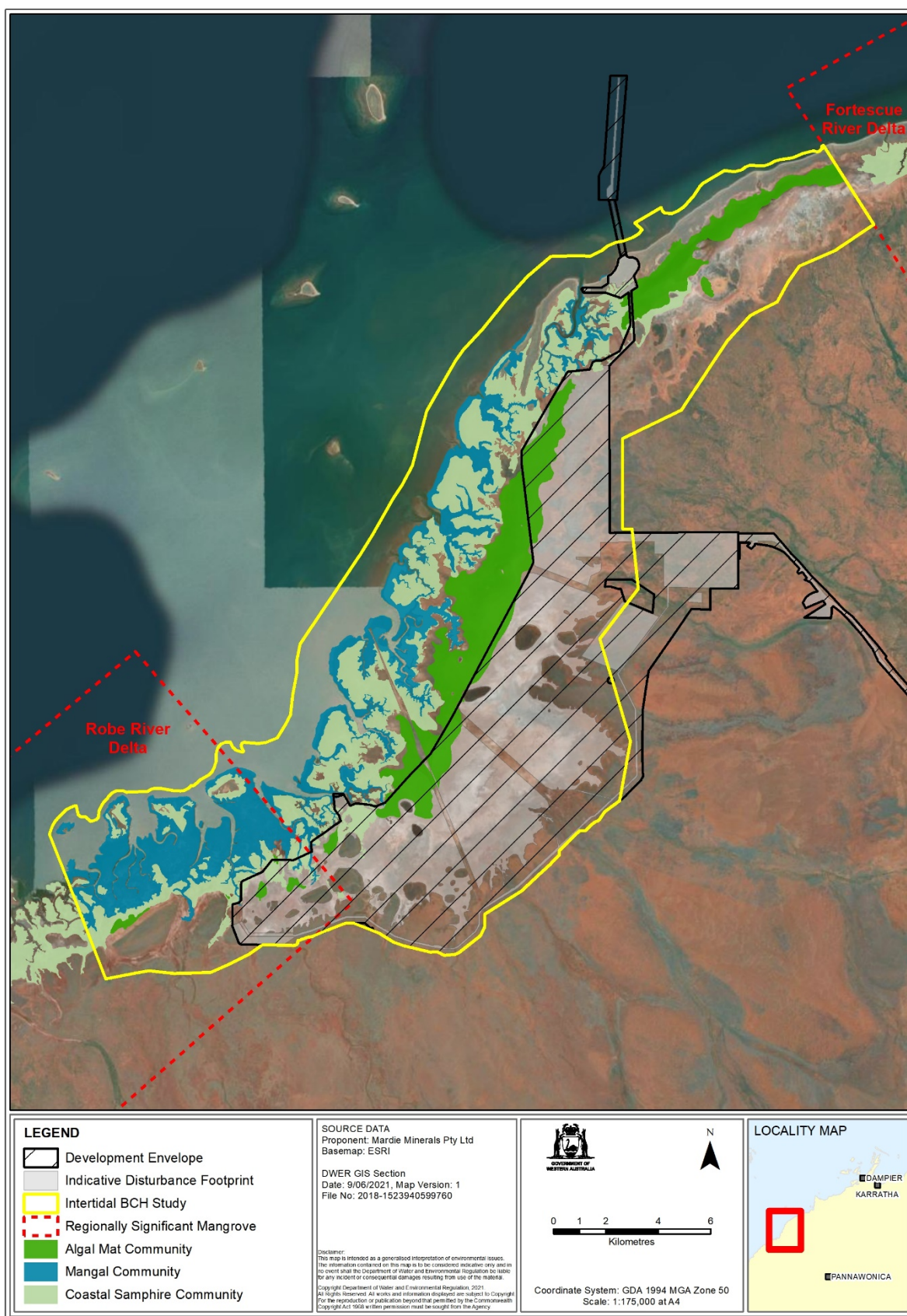


Figure 3: Intertidal benthic communities and habitat study area

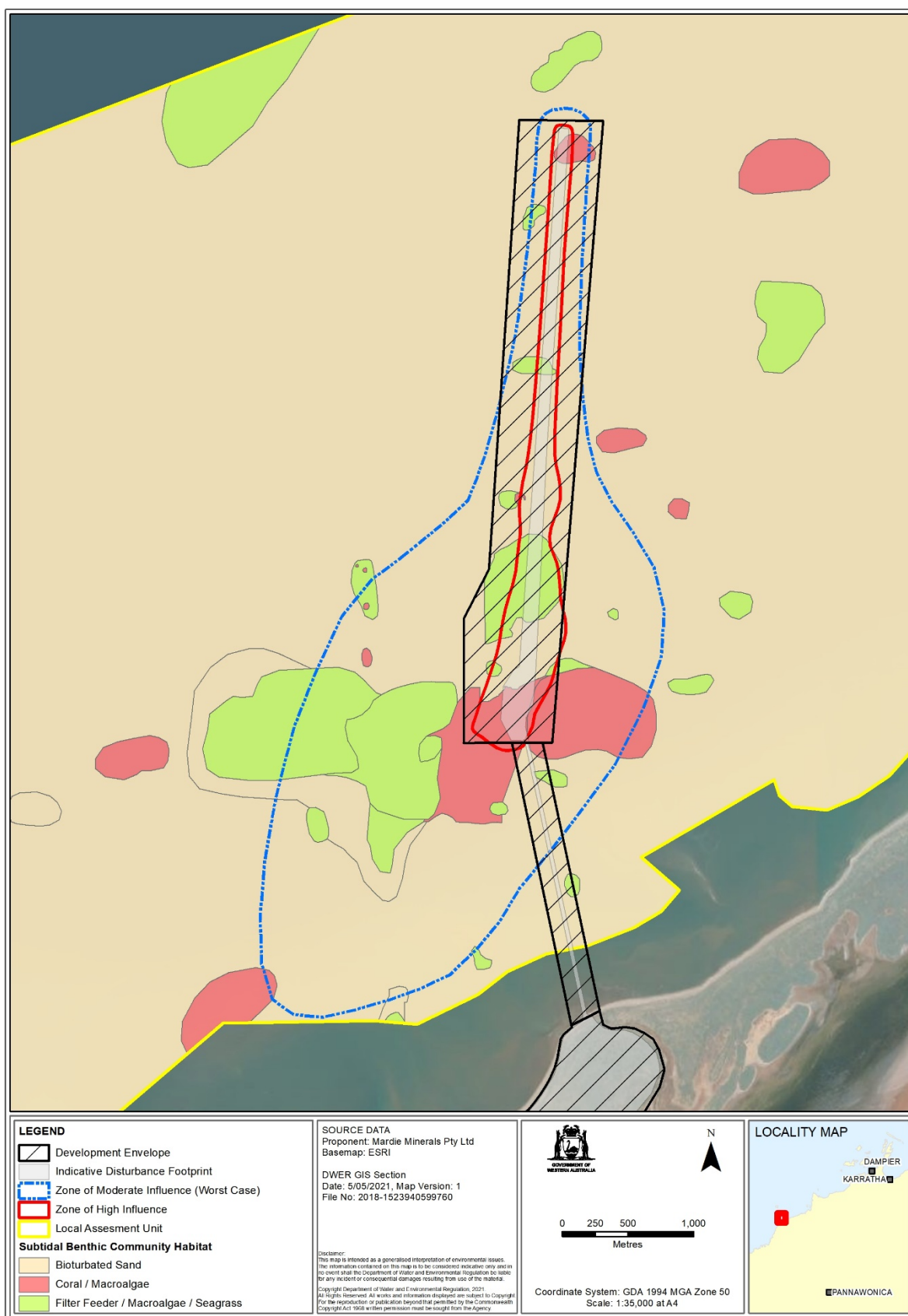


Figure 4: Zone of High Influence and Zone of Moderate Influence for dredging operations

Schedule 1

All co-ordinates are in metres, listed in Map Grid of Australia Zone 51 (MGA Zone 51) datum of Geocentric Datum of Australia 1994 (GDA94)

Spatial data depicting the figures in this schedule are held by the Department of Water and Environmental Regulation as follows:

- Development envelopes and Indicative Footprint (Figure 1) – DWERDT468947
- Marine Levels of Environmental Protection (Figure 2) – DWERDT468963
- Intertidal BCH study area (Figure 3) – DWERDT468968
- Dredging areas on influence (ZoMI and ZoHI) (Figure 4) – DWERDT468959

Schedule 2: Proponent residual Impacts and Risk Management Measures – Mardie Project (Condition 14)

Project	Value and Timeframe	Responsibility to implement	Cost
Project A Mapping of the original and current extent of Samphire and Algal mat on the west Pilbara Coast .	\$1500,000 prior to the commencement of construction	Proponent	\$1500,000
Project B Identify and quantify the potential effects of sea level rise on mangroves, samphire and algal mat on the west Pilbara Coast	\$500,000 prior to the commencement of construction.	Proponent	\$500,000
Project C (i) Identify the ecological roles, values and functions of algal mat on the west Pilbara coast	\$500,000 prior to the commencement of construction	Proponent	\$500,000
Project C (ii) Identify the ecological roles, values and functions of intertidal benthic communities and habitat on the west Pilbara coast	\$2102 per hectare of mangroves within the RRDMMMA, that the CEO has approved to be disturbed, prior to the commencement of disturbance within the RRDMMMA	Proponent	
Project C (iii) Identify the ecological roles, values and functions of intertidal benthic communities and habitat on the west Pilbara coast	\$2102 per hectare of algal mat, coastal samphire or mangroves that monitoring indicates has been lost due to project-attributable indirect impacts, or subject to loss of health, percent cover or diversity of intertidal within 3 months of the loss being identified.	Proponent	

Appendix B: Decision-making authorities

Section 45(1) requires the Minister for Environment to consult with decision-making authorities (DMAs), and if possible, agree on whether or not the proposal may be implemented, and if so, to what conditions and procedures, if any, that implementation should be subject.

The following decision-making authorities have been identified:

Decision-Making Authority	Legislation (and approval)
1. Minister for Aboriginal Affairs	<i>Aboriginal Heritage Act 1972</i> (section 18 permit)
2. Minister for Environment	<i>Biodiversity Conservation Act 2016</i> (taking of flora and fauna)
3. Minister for Mines and Petroleum	<i>Mining Act 1978</i> (grant of mining lease)
4. Minister for Water	<i>Rights in Water and Irrigation Act 1914</i> (water abstraction licence / permit to interfere with bed and banks)
5. Chief Dangerous Goods Officer, Department of Mines, Industry Regulation and Safety	<i>Dangerous Goods Safety Act 2004</i> (storage and handling of dangerous goods)
6. Chief Executive Officer, Department of Water and Environmental Regulation	<i>Environmental Protection Act 1986</i> (works approval and licence)
7. Chief Executive Officer, Pilbara Ports Authority	<i>Port Authorities Act 1999</i>
8. Commissioner, Main Roads WA	<i>Main Roads Act 1930</i>
9. Executive Director, Resource and Environmental Compliance Division, Department of Mines, Industry Regulation and Safety	<i>Mining Act 1978</i> (mining proposal)
10. State Mining Engineer, Department of Mines, Industry Regulation and Safety	<i>Mines Safety and Inspection Act 1994</i> (mine safety and approval to commence mining)

Appendix C: Consideration of Environmental Protection Act principles

EP Act Principle	Consideration
<p>1. The precautionary principle</p> <p><i>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</i></p> <p><i>In application of this precautionary principle, decisions should be guided by –</i></p> <ul style="list-style-type: none"> <i>a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</i> <i>b) an assessment of the risk-weighted consequences of various options.</i> 	<p>The EPA has considered the precautionary principle in its assessment and has had particular regard to this principle in its assessment of impacts to Intertidal Benthic Communities and Habitat (BCH). The assessment of these impacts is provided in this report.</p> <p>The EPA notes that there is some uncertainty regarding the values of algal mat and scientific knowledge regarding the role of algal mat in ecosystem maintenance. In the light of this, the EPA has determined to assess impacts to algal mat on the basis that they have a high value in ecosystem maintenance.</p> <p>The EPA has recommended conditions to ensure that measures are undertaken to minimise impacts to intertidal BCH, and to ensure that significant residual impacts associated with the proposal are offset in a manner that will result in improved management of intertidal BCH in the region.</p> <p>With regard to changes to groundwater regimes and quality from saline seepage associated with the proposal, the EPA has considered whether there are mitigation measures available to avoid or otherwise minimise impacts to groundwater. The EPA considers that the proposed mitigation of seepage recovery would be effective in preventing impacts to groundwater regimes and groundwater quality. The EPA has recommended a condition to ensure that mitigation is implemented.</p> <p>From its assessment of this proposal the EPA has concluded that the proposal subject to conditions can be implemented with no threat of serious or irreversible harm.</p>
<p>2. The principle of intergenerational equity</p> <p><i>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced</i></p>	<p>The EPA notes that the proposal may increase the impacts of climate change by preventing the inland migration of intertidal BCH. The EPA has recommended an offset to counterbalance this significant residual impact, that will result in improved management of intertidal BCH, to assist in preserving this habitat and its values for future generations.</p> <p>Consistent with the principle of intergenerational equity, the EPA has also considered whether there are mitigation measures available to ensure that the ecological integrity of suitable and viable marine turtle nesting habitat can be maintained for future generations. The EPA</p>

EP Act Principle	Consideration
<i>for the benefit of future generations.</i>	expects the mitigation and management strategies available to reduce the impacts of light spill that will be included within the recommended Illumination Plan will enable the impacts of lighting to be managed to ensure that the ecological integrity of the turtle roosting areas and hatchling survival rates are not compromised by artificial light spill.
<p>3. The principle of the conservation of biological diversity and ecological integrity</p> <p><i>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</i></p>	<p>The EPA notes that there is potential for the proposal to result in impacts to the diversity of Samphire, given the inherent difficulty in surveying and identifying <i>Tecticornia</i> species in the field.</p> <p>The EPA has concluded that the risk of any species of <i>Tecticornia</i> occurring exclusively within the development envelope is low and has proposed conditions to ensure that no rare or threatened species are impacted by the proposal.</p> <p>The EPA has considered the Principle of ecological integrity in relation to impacts to mangrove habitat in the RRDMMMA. The EPA has noted that the proposal has the potential to impact ecological processes that maintain mangroves in this area. The EPA has determined that the proposal could be implemented subject to minor changes to maintain ecological processes in this area. The EPA has recommended a condition to ensure that the final design of the proposal maintains ecological processes in the RRDMMMA.</p>

Appendix D: Evaluation of other environmental factors

Environmental factor	Description of the proposal's likely impacts on the environmental factor	Government agency and public comments	Evaluation of why the factor is not a key environmental factor
Air			
Greenhouse Gas Emissions	<p>The proposal is estimated to produce on average:</p> <ul style="list-style-type: none"> • Scope 1: 45,760 tCO₂-e over the first 2 years from vegetation clearing • Scope 2: 53,292 tCO₂-e per year from natural gas and diesel consumption. <p>Greenhouse gas emissions associated with the proposal will contribute to an increase in gas levels within the atmosphere which will lead to excess warming of the Earth's atmosphere.</p>	There were no agency or public comments on greenhouse gas emissions.	<p>The proponent ESD (Preston Consulting 2018) was finalised prior to the implementation of the EPA (2020a) <i>Environmental Factor Guideline – Greenhouse Gas Emissions</i> in April 2020. While the proponents ERD (submitted in June 2020) also did not address GHG emission, the proponent has provided GHG emissions associated with diesel and natural gas consumption to the EPA during the assessment of the proposal.</p> <p>Having regard to:</p> <ul style="list-style-type: none"> • the significance considerations in the <i>Statement of Environmental Principles, Factors and Objectives</i> (EPA 2020) • the scope 1 emissions do not exceed 100,000 tpa CO₂-e per annum • <i>Environmental Factor Guideline – Greenhouse Gas Emissions</i> (EPA 2020) • the passive nature of the proposal (evaporative solar project that utilises seawater to produce raw salts) <p>the EPA considers it is unlikely the proposal would have a significant impact on greenhouse gas emissions and that the impacts to this factor are manageable.</p> <p>Accordingly, the EPA did not consider greenhouse gas emissions to be a key environmental factor at the conclusion of its assessment.</p>

Appendix E: Relevant policy, guidance and procedures

The EPA had particular regard to the policies, guidelines and procedures listed below in the assessment of the proposal.

- *Environmental Factor Guideline – Benthic Communities and Habitats* (EPA 2016)
- *Environmental Factor Guideline – Flora and Vegetation* (EPA 2016)
- *Environmental Factor Guideline – Greenhouse Gas Emissions* (EPA 2020)
- *Environmental Factor Guideline – Inland Waters* (EPA 2018)
- *Environmental Factor Guideline – Marine Environmental Quality* (EPA 2016)
- *Environmental Factor Guideline – Marine Fauna* (EPA 2016)
- *Environmental Factor Guideline – Social Surroundings* (EPA 2016)
- *Environmental Factor Guideline – Terrestrial Fauna* (EPA 2016)
- *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual* (EPA 2020)
- *Statement of Environmental Principles, Factors and Objectives* (EPA 2020)
- *Technical Guidance – Flora and vegetation surveys for environmental impact assessment* (EPA 2016)
- *Technical Guidance – Protecting the quality of Western Australia’s marine environment* (EPA 2016)
- *Technical Guidance – Protection of benthic communities and habitats* (EPA 2016)
- *Technical Guidance – Sampling of short-range endemic invertebrate fauna* (EPA 2016)
- *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020)
- *WA Environmental Offsets Policy* (Government of Western Australia 2011)
- *WA Environmental Offsets Guidelines* (Government of Western Australia 2014).

Commonwealth (Department of Agriculture, Water and the Environment) policies and guidance relevant to the EPA’s assessment of this proposal:

- *Commonwealth EPBC Act Environmental Offsets Policy* (Commonwealth of Australia 2012a)
- *Wildlife Conservation Plan for Migratory Shorebirds* (Commonwealth of Australia 2015)
- *Matters of National Environmental Significance. Significant Impact Guidelines 1.1. Environmental Protection and Biodiversity Conservation Act 1999* (DoE 2013)
- *EPBC Act Policy Statement 3.21 - Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoE 2015)
- *National Recovery Plan for Olearia macdonnellensis, Minuria tridens (Minnie Daisy) and Actinotus schwarzii (Desert Flannel Flower)* (Nano, C. and Pavey, C. 2008).

Appendix F: List of submitters

7-day comment on referral

Public submission 1
Public submission 2
Public submission 3
Wildflower Society of Western Australia

Submitters on the Environmental Review Document

Government agencies

Department of Agriculture, Water and the Environment (Commonwealth) (DAWE)
Department of Biodiversity, Conservation and Attractions (DBCA)
Department of Primary Industries and Regional Development (DPIRD)
Department of Water and Environmental Regulation (DWER)

Organisations and public

Pilbara Ports Authority (PPA)
Santos
Public submission 1
Public submission 2

Appendix G: Assessment timeline

Date	Progress stages	Time (weeks)
13 June 2018	EPA decided to assess – level of assessment set	
28 November 2018	EPA approved Environmental Scoping Document	24
18 June 2020	EPA accepted Environmental Review Document	81
29 June 2020	Environmental Review Document released for public review	2
7 September 2020	Public review period for Environmental Review Document closed	10
31 March 2021	EPA accepted proponent's Response to Submissions	36
20 May 2021	EPA considered assessment	7
30 June 2021	EPA provided report to the Minister for Environment	6
7 July 2021	EPA report published	3 days
21 July 2021	Close of appeals period	2

Timelines for an assessment may vary according to the complexity of the proposal and are usually agreed with the proponent soon after the EPA decides to assess the proposal and records the level of assessment.

In this case, the EPA did not meet its timeline objective to complete its assessment and provide a report to the Minister.

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