

Part 4: Terrestrial environmental impact assessment

12. Terrestrial vegetation

12.1 KEY STATUTORY REQUIREMENTS, POLICY AND GUIDANCE

12.1.1 Objectives

The EPA objective for terrestrial vegetation is:

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

The EPBC Act objective that relates to terrestrial vegetation is:

To provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance.

12.1.2 Legislation

Commonwealth

The conservation of vegetation and flora is covered primarily by the EPBC Act through the controlling provision for listed threatened species and ecological communities.

Australia is a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). An official list of endangered species is administered through the EPBC Act. The current list differs from the various state lists, although some listed species are common. Actions with the potential to significantly impact on these species or on matters of national environmental significance require assessment and approval by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities.

State

The conservation of vegetation and flora is covered primarily by the following legislation:

- *Wildlife Conservation Act 1950*, and
- *Environmental Protection Act 1986* (EP Act).

In Western Australia, all flora native to the State is protected under the Wildlife Conservation Act and threatened flora must be “declared” and listed in the Wildlife Conservation (Rare Flora) Notice 2008. Schedule 1 in this notice is relevant to this Proposal.

The Department of Environment and Conservation (DEC) maintains a list of Threatened and Priority Ecological Communities (TECs and PECs, respectively). TECs are communities that fit into one of the following categories: “presumed totally destroyed”, “critically endangered”, “endangered” or “vulnerable”. Those communities that do not meet survey criteria or that are not adequately defined are added to the PEC lists as Priorities 1, 2 or 3.

There are also four categories of “Priority” flora which cover poorly known species. Based on the number of known sites and the degree of threat to those populations, these categories are arranged to give an indication of the priority for undertaking further surveys (i.e., Priority 1 Flora generally have less than 5 known populations, which are under threat, whilst Priority 4 Flora have been adequately surveyed and although rare, are not threatened).

Part IV of the EP Act requires the environmental impact assessment of proposals with the potential for significant impact on the environment, and provides for the Minister for Environment to authorise implementation of proposals.

Part V of this legislation prohibits unauthorised environmental harm and pollution, provides for the regulation of prescribed premises and prohibits the unauthorised clearing of native vegetation.

Management of declared weeds is under the Agriculture and Related Resources Protection Act 1986.

The *Biosecurity and Agricultural Management Act 2007* has been promulgated to establish a modern biosecurity regulatory system to prevent serious animal and plant pests and diseases from entering the state, and to minimise the spread and impact of any that are already present within the state.

12.1.3 Policy and guidance

National strategies

The state and federal governments have endorsed the National Strategy for the Conservation of Australia's Biological Diversity (DEST, 1996) and the National Strategy for Ecologically Sustainable Development (Ecologically Sustainable Development Steering Committee, 1992). The strategies address the conservation of Australia's biological diversity by defining several guiding principles.

EPA Position Statement No. 2

EPA Position Statement No. 2 (EPA, 2000) provides an overview of the EPA's position on the clearing of native vegetation in Western Australia. Principles and related objectives and actions have been adopted from the above national strategies in the development of this position statement.

In assessing a proposal, the EPA will take into account the following elements when considering impacts on vegetation:

- comparison of proposal scenarios, or options, to evaluate protection of biodiversity at the species and ecosystems levels, and demonstration that all reasonable steps have been taken to avoid disturbing native vegetation;
- no known species of plant or animal is caused to become extinct as a consequence of the proposal and the risks to threatened species are considered to be acceptable;
- no association or community of indigenous plants or animals ceases to exist as a result of the proposal;
- there is a comprehensive, adequate and secure representation of scarce or endangered habitats within the proposal area and/or in areas biologically comparable to the proposal area protected in secure reserves;
- there would be an expectation that a proposal would demonstrate that the vegetation removal would not compromise any vegetation type by taking it below the 'threshold level' of 30% of the pre-clearing extent of the vegetation type;
- where a proposal would result in a reduction below the 30% level, it would be expected that alternative mechanisms be put forward to address the protection of biodiversity;
- if the proposal is large (in the order of 10 – 100 ha or more, depending on where in the State) the proposal area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity are secure and protected; and
- the on-site and off-site impacts of the proposal are identified and the proponent demonstrates that these impacts can be managed.

EPA Position Statement No. 3

EPA Position Statement No. 3 (EPA, 2002a) discusses the principles the EPA would apply when assessing proposals that may have an effect on biodiversity values in Western Australia. The outcomes sought by this Position Statement are intended to:

- promote and encourage all proponents and their consultants to focus their attention on the significance of biodiversity and, therefore, the need to develop and implement best practice in terrestrial biological surveys; and
- enable greater certainty for proponents in the environmental impact assessment process by defining the principles the EPA will use when assessing proposals that may impact on biodiversity values.

EPA Guidance Statement No. 51

EPA Guidance Statement No. 51 (EPA, 2004c) provides guidance on standards and protocols for terrestrial flora and vegetation surveys, particularly those undertaken for the environmental impact assessment of proposals.

12.2 DESCRIPTION

12.2.1 Introduction

The Proposal will involve development at Anketell Point of land based infrastructure such as stockpile areas, transfer conveyors, approximately 14 km of rail (including loop) terminating approximately 3km south of Anketell Point, a desalination plant, power generation plant and associated power line corridor, workshops, administration buildings, re-fuelling and ancillary infrastructure, bulk fuel storage, quarries, and access roads and service corridors. This will require clearing of native vegetation with a footprint of approximately 770 ha within the identified Proposal envelope. This section of the PER/draft PER assesses the potential impacts of this proposed clearing, and proposes a range of management measures to avoid, minimise and mitigate the impacts identified.

12.2.2 Studies

The technical information provided in the section of the PER/draft PER is based on the following report, which is included in Appendix 1:

- Supporting Study 12.1: Flora and Vegetation Assessment
AECOM. 2010. Level 2 Flora and Vegetation Assessment of Proposed Anketell Point and Dixon Island proposed Port Development areas. July. Report prepared by AECOM Australia Pty Ltd for API Management Pty Ltd, Como, Western Australia.

This section also includes relevant information from other studies cited herein.

Information on the studies completed, and a summary of key outcomes, is presented in Table 12.1. All flora and vegetation surveys listed below were designed and implemented to meet the requirements of EPA Guidance Statement No. 51 (EPA, 2004c). The field surveys provide an appropriate assessment of the flora and vegetation values of the Proposal area for the requirements of this PER/draft PER. The outcomes of the surveys have been concluded cognisant of survey uncertainties. Limitations of the field surveys are detailed in Supporting Study 12.1.

Information on the studies completed, and a summary of key outcomes, is presented in Table 12.1.

Table 12.1 Summary of terrestrial vegetation investigations and key outcomes

Investigation Proposed within ESD	Investigations Completed	Key Outcomes Relevant to Terrestrial Vegetation	PER Section
<p>A Level 2 floristic assessment of the Proposal area including:</p> <ul style="list-style-type: none"> Accurate definition of the condition of habitats at Anketell Point and the surrounding area; Identification of the vascular flora species present; Determination of the presence or absence of declared Rare Flora, TECs, Priority species or PECs; Definition and mapping of vegetation communities; and Definition and mapping of vegetation and habitat condition. <p>Hydrological investigations.</p>	<p>Level 2 flora and vegetation assessments in accordance with EPA Guidance Statement No. 51 (EPA, 2004c) have been completed across the Proposal area, the eastern portion of Dixon Island and the central portion of the proposed quarry site. Additional Level 1 surveys have been conducted for the western two-thirds of Dixon Island, the proposed accommodation area, the outer buffer of the proposed quarry site and the proposed power corridor. All areas which were surveyed to Level 1 detail in 2009 were re-visited, and groundtruthed to Level 2 detail in May 2010.</p>	<p>The surveys recorded 207 species from 97 genera and 41 families of which 204 species being native and 3 introduced (Supporting Study 12.1). The most frequently recorded species were from the:</p> <ul style="list-style-type: none"> Poaceae (grasses – 38 species) Papilionaceae (pea family – 28 species) Malvaceae (hibiscus family – 17 species). <p>This representation of taxa is typical for the Pilbara region.</p>	<p>Sections 2.4.3 and 12.3.2.</p> <p>Supporting Study 12.1.</p>

12.3 IMPACT ASSESSMENT

12.3.1 Environmental aspects and potential impacts

The following impacts on terrestrial flora and vegetation may occur:

- direct loss of native vegetation and flora, including areas of Priority Ecological Communities, and Priority Flora species, during terrestrial clearing;
- introduction of weed species;
- smothering of vegetation by dust during terrestrial clearing and operations;
- accidental fire during construction and operations; and
- changes in surface drainage resulting in degradation of native vegetation.

12.3.2 Assessment of potential impacts

Land System Units

The proposed footprint traverses six of the eight Land System units for the Pilbara, namely Rocklea, Ruth, Littoral, Cheerrawarra, Uardoo and Boolgeeda, with the Ruth, Littoral and Cheerawarra shown to represent the greatest area proposed to be impacted (Table 12.2).

Table 12.2 Proportion of Land System Unit areas within Proposal footprint

Land System Unit	Extent in Bioregion (ha)	Loss from Proposal (ha)	Loss at Regional Scale (%)
Boolgeeda	961,635	6.1	less than 0.001%
Cheerawarra	49,211	238.9	0.49%
Littoral	210,733	224.5	0.11%
Rocklea	2,881,200	17.4	less than 0.001%
Ruth	169,300	258.5	0.15%
Uaroo	987,066	3.7	less than 0.001%
Total for Land Systems		749.1	
Dixon Island (not yet mapped for Land System Units)		17.4	

All of the Land System Units represented in the survey area (Supporting Study 12.1) are well represented in the local and regional area, with the exception of the Cheerawarra Unit. The vegetation units within the survey area supported by the Cheerawarra Land System are described in Table 12.3.

To determine whether these vegetation communities are of regional significance (i.e. limited to one Land System Unit), an assessment of their representation in the region was completed (Supporting Study 12.1). This assessment identified that all of the vegetation communities supported by the Cheerrawarra Land System Unit within the Proposal area are likely be more widespread than initial results indicate (Table 12.3), and it is unlikely that these vegetation communities are regionally significant.

Table 12.3 Evaluation of potential regional significance of vegetation communities recorded within the Cheerawarra land system within the Proposal Area

Vegetation Community Code	Corresponding Land System Unit Site Type	Conclusion
Hf	Alluvial Plain Tussock Grassland (and occasionally grassy shrublands) (Site Type Group I); Site Type equivalent: Alluvial Plain Roebourne Plains grass grassland (ARPG). ARPG is a fairly common site type that occurs on level slopes and alluvial plains with gilgai microrelief. ARPG is the most extensive or commonly represented site type on the Horseflat, Pullagarah, Hooley and Paraburdoo land system and occurs as a minor component on 22 other land systems.	Hf potentially occurs in other land system units. Unlikely to be regionally significant.
DCAT1	Drainage Shrubland and Woodlands (Site Type Group K); Site Type equivalent: Drainage spinifex grassland with Eucalypt overstorey (DESG). DESG is fairly common and occurs on drainage tracts and narrow floors. DESG is represented in conservation reserves and occurs as a minor component on 12 other land systems.	DCAT1 is potentially not restricted to the Cheerawarra land system as it occurs elsewhere and within other land systems. Unlikely to be regionally significant.
Thg	Hill Hummock Grassland (Site Type Group A); Site Type equivalent: Hill spinifex grassland (HSPG). HSPG is dominant on 14 land systems, is a major component on three land systems and is a minor site type on a further 27 land systems.	Thg is unlikely to be restricted to the Cheerawarra land system. Unlikely to be regionally significant.
Thg(c)	Sandplain and Dune Grassland (Site Type Group G): Site Type equivalent: Either Sandplain Soft Spinifex Grassland (SSSG) or Coastal Dune soft spinifex Grassland (CDSG). SSSG is common and fairly widespread on sandplains and dunes. SSSG is the most extensive site type on the Cheerawarra, Dune, Lime, Nita and Onslow land systems, is common on another four, and is a minor component of 14 others.	Thg is unlikely to be restricted to the Cheerawarra land system. Unlikely to be regionally significant.
AThg1 MAT MATE	No exact or closely matched Site Types found. Survey data compiled for the Proposal and the adjacent API mine and rail proposal indicate that these vegetation communities are all abundant throughout the area and occur on land systems other than the Cheerawarra land system.	These communities are not restricted to the Cheerawarra land system. Unlikely to be regionally significant.
Lit	Sandplain and Dune Grassland (Site Type Group G): No exact match for community Lit was found, however, it is similar to Site Type Coastal Dune Buffel Grass Grassland (CDBG). CDBG is the most extensive Site Type on the Eighty Mile Land System and is a minor Site Type on the Anna and Dune Land System.	Lit is unlikely to be restricted to the Cheerawarra land system. Unlikely to be regionally significant.

Threatened and Priority Ecological Communities

A search of the EPBC Act database list of threatened species and ecological communities did not identify any listed flora or vegetation at the Proposal area.

A search of the DEC Threatened (TEC) and Priority Ecological Communities (PEC) database did not identify any known TECs within the Proposal area. The search did identify three PECs in close proximity to the Proposal area: Roebourne Plains Gilgai Grassland (Priority 1) and Stony Chenopod Association of the Roebourne Plain Area (Priority 1) (herein called Roebourne Chenopod Association); and Horseflat Land System of the Roebourne Plains (Priority 3).

The distribution of above listed PECs, as well as species composition, soil types and position in the landscape were used to determine if described vegetation communities within the Proposal area were associated with these PECs of interest.

Through flora and vegetation surveys, follow up ground truthing and liaison with DEC it has been confirmed that none of the described vegetation communities are associated with the Priority 1 PECs in the region. The Horseflat (Hf) vegetation community, described and mapped within the Proposal area, is equivalent to the Horseflat Land System of the Roebourne Plain PEC (Priority 3). The DEC description used to characterise this PEC (namely, species composition and site characteristics such as soil type and position in the landscape) are comparable to the data for the Hf vegetation community described and mapped during flora and vegetation surveys.

The methods used to conduct this comparison are commensurate with the expectations of DEC for determination of TEC/PEC status.

The Hf vegetation community covers approximately 8 ha (or 1%) of proposed disturbance footprint. Overall, this vegetation community is also unlikely to be of regional significance as it is extensively represented in four land systems (see Table 12.3).

The species composition from quadrat data for the Horseflat community from this area indicates the presence of *Eragrostis xerophila*, one of the PEC indicator species. This quadrat also exhibited a high proportion of *Cenchrus ciliaris*, an environmental weed of the Pilbara Region. The presence of *Cenchrus ciliaris* highlights the degraded nature of the community and correlates to the “Good – Degraded” range of vegetation condition recordings given during surveys. Due to the relatively degraded nature of the community, impacts to this community are unlikely to be significant or change the current status of this Priority 3 PEC.

Conservation Significant Flora

No EPBC Act database listed threatened flora were recorded within the Proposal footprint and none of the recorded vegetation communities are equivalent to ecological communities of Commonwealth significance.

No Declared Rare Flora or Priority Flora were been recorded within the Proposal footprint. No known individuals or populations of conservation significant flora will be affected by the Proposal.

Four Priority Flora species were identified from DEC Threatened and Priority Flora database searches as potentially present in the Proposal area: one Priority 1 species, *Helichrysum oligochaetum*, and three Priority 3 species, *Acacia glaucocaesia*, *Eragrostis lanicaulis* and *Terminalia supranitifolia*. Whilst not recorded in over two years of surveys to date, areas that are determined to potentially support populations of these flora (see Table 3.10 in Section 3; Supporting Study 12.1) have been and will continue to be targeted during future vegetation and flora surveys.

Direct clearing

The terrestrial footprint of the Proposal is approximately 770 ha.

Fifteen of the 20 vegetation communities mapped and described within the survey envelope (which is shown in Figure 3.20) will be affected by clearing. The extent of each of the vegetation communities within the survey area and the extent of potential disturbance to each community by the Proposal is provided in Table 12.4. A very small area of the Proposal (5.7ha surveyed, of which 2.3 ha will be disturbed) is represented by vegetation communities based on desktop extrapolation and have not been considered during impact assessments. These communities require follow-up surveys to be assigned a vegetation community code and description. Mapped vegetation communities “Cleared”, “Bare”, “Beach” and “Tidal Mud Flats” have also not been included in this assessment as they are not considered vegetation assemblages. Refer to Section 13 for the impact assessment of these areas as habitat types. Mangroves and their impact assessment are described in Section 8.

It is unlikely that disturbance to these vegetation communities will result in a significant impact or change in their current status (Supporting Study 12.1).

Table 12.4 Vegetation communities within the survey envelope and those potentially disturbed by the Proposal

Group	Vegetation community code	Description	Total Survey Area (AECOM, 2009) (Ha)	Total Survey Area to be disturbed (ha) (proportion to be disturbed %)
Grasslands	Hf	Horseflats of <i>Eragrostis</i> spp., <i>Eriachne</i> spp. and <i>Dichanthium</i> spp. on stony red clayey loam.	11.5	8.4 (73%)
	Thg	Mid Dense to Closed Hummock Grasslands of <i>Triodia</i> spp. on hillslopes, ridgetops and stony plains.	1494.8	329.1 (22%)

Group	Vegetation community code	Description	Total Survey Area (AECOM, 2009) (Ha)	Total Survey Area to be disturbed (ha) (proportion to be disturbed %)
	Thg(c)	Mid Dense to Closed Hummock Grasslands of <i>Triodia pungens</i> over an Open Tussock Grassland of <i>Cenchrus ciliaris</i> and <i>Eragrostis</i> aff. <i>eriopoda</i> . (WAS site 963) on pale orange sandy clay.	32.5	28.3 (87%)
Shrublands	AxT	Tall Shrubland to Open Shrubland of <i>Acacia xiphophylla</i> over Hummock Grassland dominated by <i>Triodia wiseana</i> (fine form) and <i>Triodia angusta</i> on red rocky clay loam.	14.2	4.7 (33%)
	ATg	Shrubland of <i>Acacia inaequilatera</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> with occasional <i>Acacia coriacea</i> subsp. <i>coriacea</i> , <i>Acacia coriacea</i> subsp. <i>pendens</i> and <i>Acacia bivenosa</i> over Open Shrubland of <i>Corchorus</i> aff. <i>parviflorus</i> , <i>Corchorus</i> aff. <i>walcottii</i> (K. J. Atkins 570), <i>Stemodia grossa</i> and <i>Sida</i> aff. <i>echinocarpa</i> (MET 15, 350) over a Hummock Grassland of <i>Triodia epactia</i> (Form A) over a Very Open Tussock Grassland of <i>Cenchrus ciliaris</i> on orange sandy clay drainage lines.	22.3	1.4 (7%)
	CHT	Shrubland of <i>Acacia stellaticeps</i> , <i>Acacia coriacea</i> subsp. <i>coriacea</i> and <i>Crotalaria cunninghamii</i> over a Very Open Herbland of <i>Ptilotus astrolasius</i> var. <i>astrolasius</i> over a Hummock Grassland of <i>Triodia epactia</i> (Form B) and <i>Cymbopogon ambiguus</i> on sands.	94.0	0.0 (0%)
	CST	Scattered <i>Spinifex longifolius</i> over <i>Aerva javanica</i> on pale brown sands on shoreline.	4.6	0.0 (0%)
	GT	Tall Shrubland of <i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i> over a Tussock Grassland of <i>Cenchrus ciliaris</i> with scattered <i>Triodia wiseana</i> (fine form) on rocky mid to upper slope sand.	26.0	0.0 (0%)
	Lit	Tall Open Scrub to Tall Shrubland of <i>Acacia coriacea</i> subsp. <i>coriacea</i> and <i>Acacia sabulosa</i> with scattered <i>Santalum lanceolatum</i> and <i>Senna artemisioides</i> subsp. <i>oligophylla</i> x <i>helmsii</i> over a Tussock Grassland of <i>Cenchrus ciliaris</i> on shorelines.	266.7	15.2 (6%)
	MAC	Tall Open Scrub to Open Heath dominated by <i>Acacia sabulosa</i> and <i>Acacia bivenosa</i> with occasional <i>Acacia pyrifolia</i> subsp. <i>pyrifolia</i> over a Closed Tussock Grassland of <i>Cenchrus ciliaris</i> on sandy clay slopes.	35.4	1.2 (4%)
	MATE	Tall Shrubland of <i>Acacia xiphophylla</i> , <i>Acacia bivenosa</i> and <i>Acacia synchronicia</i> over a Mid Dense Hummock Grassland of <i>Triodia wiseana</i> (fine form), <i>Eriachne</i> spp. and <i>Aristida</i> spp. on red sandy loam.	63.9	63.9 (100%)

Group	Vegetation community code	Description	Total Survey Area (AECOM, 2009) (Ha)	Total Survey Area to be disturbed (ha) (proportion to be disturbed %)
	AThg1	Tall Shrubland to Open Shrubland dominated by <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia bivenosa</i> , <i>Acacia ancistrocarpa</i> and <i>Acacia synchronicia</i> over a Mid Dense Hummock Grassland dominated by <i>Triodia wiseana</i> (fine form) on rocky sandy flats, hill slopes and ridgetops.	258.6	76.6 (30%)
	AThg2	Open Shrubland to Low Open Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> with scattered <i>Corchorus</i> aff. <i>parviflorus</i> over a Mid Dense Hummock Grassland of <i>Triodia wiseana</i> (fine form) on rocky hill slopes.	112.7	24.3 (22%)
	MAT	Mixed Shrubland of <i>Acacia</i> spp. mainly dominated by <i>Acacia ancistrocarpa</i> , <i>Acacia bivenosa</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> over a Mid Dense Hummock Grassland of <i>Triodia wiseana</i> (fine form), <i>Triodia angusta</i> , <i>Triodia</i> aff. <i>epactia</i> , <i>Triodia epactia</i> (Form A) on orange-brown sandy soil with rocky nodules.	375.9	76.8 (20%)
Samphire	Sam1	Low Shrubland dominated by <i>Tecticornia halocnemoides</i> subsp. <i>tenuis</i> with scattered <i>Trianthema turgidifolia</i> and <i>Tecticornia pruinosa</i> on brown clayey loam.	24.5	2.4 (10%)
	Sam2	Low Open Heath dominated by <i>Hemichroa diandra</i> , <i>Tecticornia halocnemoides</i> subsp. <i>tenuis</i> and <i>Tecticornia indica</i> subsp. <i>bidens</i> with scattered <i>Avicennia marina</i> subsp. <i>marina</i> on edges of tidal mudflats.	14.2	0.0 (0%)
Drainage Lines, Creeklines and Minor Flow Lines	Amg	Tall Shrubland of <i>Acacia inaequilatera</i> with occasional <i>Corymbia hamersleyana</i> over a grassland dominated by <i>Triodia wiseana</i> , <i>Triodia epactia</i> and <i>Chrysopogon fallax</i> in association with drainage lines.	36.9	0.0 (0%)
	DCAT1	Woodland of <i>Corymbia hamersleyana</i> over a Tall Shrubland mainly dominated by <i>Acacia bivenosa</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Acacia ancistrocarpa</i> with occasional <i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i> over a Mid Dense Hummock Grassland of <i>Triodia wiseana</i> (fine form) and <i>Triodia angusta</i> on red rocky soils in association with drainage lines.	70.4	12.3 (17%)
	DCAT2	Low Open Woodland of <i>Corymbia hamersleyana</i> over a Tall Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia bivenosa</i> and <i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i> over a Mid Dense Hummock Grassland of <i>Triodia wiseana</i> (fine form) over a Tussock Grassland dominated by <i>Chrysopogon fallax</i> and <i>Cenchrus ciliaris</i> in minor drainage lines.	16.4	1.0 (6%)
	Excluded*	Bare and/or Cleared, Tidal Mud Flats and Beach.	506.3	116.7 (23%)

*Excluded refers to the total of areas excluded from the impact assessment, consisting of area extrapolated to a low level of certainty and areas mapped as Cleared, Bare, Beach and Tidal Mud Flats (Supporting Study 12.1).

Groundwater-dependent ecosystems

Groundwater-dependent ecosystems support plant species that require groundwater for survival. Key indicators of groundwater-dependent ecosystems are phreatophytic species, which are linked to permanent water sources (Busch *et al.* 1992; HGM 1999). The main phreatophytic species in the Proposal area is *Corymbia hamersleyana* and the inferred groundwater-dependent ecosystems in the Proposal area contain vegetation communities associated with this species: DCAT1 and DCAT2.

Due to a lack of physiological and/or morphological adaptations to drought, phreatophytic vegetation often exhibit low tolerance to water stress for extended periods of time (Smith *et al.* 1998; Graham 2001). Phreatophytes respond to significant and rapid groundwater drawdown by a decline in health and eventual death (HGM 1999; BHP 1997).

The Proposal area is considered to support approximately 13 ha of phreatophytic vegetation (Supporting Study 12.1).

Surface water dependent vegetation (in particular Mulga)

The Proposal may alter local surface hydrology, which in turn may impact on surface water dependent vegetation. Impacts arising from alteration to local surface flows include inundation of upstream areas and water starvation to downstream areas, as well as scouring or erosion and siltation of drainage channels.

Where defined drainage from the steeper slopes enter the lower slope areas, channels typically exhibit a reduced discharge capacity and in many instances become less defined and braided or may even completely disperse over flat areas. In these areas runoff tends to spread over a wider front and vegetation communities (such as grove and intergrove mulga communities) have developed a reliance on seepage water provided by the overland flow, known as “sheetflow”.

Linear infrastructure such as railways and roads can affect sheetflow if inadequately managed. This infrastructure can interrupt to the existing surface water flow patterns and reduce or redirect sheetflow.

Mulga communities represent a total area of 215 ha (or approximately 6%) of the total surveyed area (Supporting Study 12.1). Mulga communities located down gradient from proposed infrastructure, which have the potential to be negatively impacted as a result of impeded sheetflow, is estimated to be approximately 34 ha.

Introduction of weed species

Vehicle and machinery movement has the potential to introduce or spread weeds. The environmental weed; buffel grass and kapok are among the suite of weeds growing in the Proposal area. Appropriate weed control procedures will be implemented to control the introduction and spread of these weeds.

Smothering by dust

Dust may affect plants by blocking stomata and reducing photosynthetic ability (URS, 2009). Dust deposition can be expected on vegetation immediately adjacent to active operational areas, such as the main roads, stockpiles and ship-loading areas (which are approximately 1km off Dixon Island). Dust suppression procedures in these areas will apply.

Accidental fire

Uncontrolled or unintentional fires may result from such activities as welding, track grinding and deficient management of fuel storage and handling. Management procedures including hot work permits will be applied to minimise to risk of fire.

12.4 MITIGATION

12.4.1 Approach

Impacts on vegetation and flora will be minimised by appropriate project design in the first instance and by avoiding areas of higher ecological or conservation value where practicable. Rehabilitation works will be completed where warranted to lessen, over time, the impact on vegetation and flora.

To ensure that terrestrial vegetation is protected as much as practicable API's Project Environmental Management Plan will include management measures for terrestrial flora and vegetation, weed control, surface water management, and acid sulphate soils management (if warranted).

The intended mitigation of impacts on vegetation and flora, determined with regard to the EPA (2006) recommended mitigation hierarchy is outlined as follows.

12.4.2 Performance management

Environmental targets and performance indicators have been developed based on the management objectives for terrestrial vegetation in the Proposal area (Table 12.5).

Table 12.5 Terrestrial vegetation management objectives, targets and performance indicators

Management Objective	Target	Performance Indicators
Minimise the area of cleared land required for construction and operation activities.	No unutilised cleared land. Clearing may only be authorised in accord with documented plans.	Land clearing statistics.
Ensure no vegetation is disturbed outside of approved clearing boundaries.	No clearing or disturbance outside of predefined boundaries or beyond extent (ha) approved.	Ground Disturbance Authorisations and Inspection Reports, Clearing Reconciliation Reports.
Protect all identified significant plant species or communities, consistent with the provisions of the <i>Wildlife Conservation Act 1950</i> .	Avoid direct impacts on located Priority Flora species.	Clearing Reconciliation Reports.
Control the distribution and abundance of introduced plant species (weeds).	No introduction of new species of weeds in the Proposal area.	Mapped or recorded occurrence of new weed species.
	No spread of existing weed species within the Proposal area or beyond from Proposal activities.	Mapped or recorded extent of existing weed species.
Minimise impacts to vegetation due to altered surface water flows.	Prevent changes to sheetflow in areas identified as containing vegetation dependent on such flow.	Demonstration of considered and adequate drainage design.
Prevent uncontrolled or unintentional fires.	No uncontrolled or unintentional fires in Proposal area.	Annual Reporting.

12.4.3 Key management actions

Key management actions will be implemented to assist the achievement of the terrestrial vegetation objective (Table 12.6).

Table 12.6 Terrestrial vegetation key management actions

Action	Accountability	Timing
Include the following information in employee and contractor inductions : <ul style="list-style-type: none"> • protection of significant flora and vegetation; • restriction of activities to within approved clearing boundaries; • identification and reporting of weeds; • hot work permit requirements and fire safety; and • hygiene procedures to minimise the introduction and spread of weeds. 	Port Manager Project Manager	At induction and throughout all stages.
Make available maps of the approved clearing envelope(s) to all persons involved in port planning and relevant personnel involved in initial ground-disturbance authorisation.	Port Manager Project Manager	All stages.

Action	Accountability	Timing
Define clearing boundaries with ground markings (e.g., flagging) or as GPS coordinates in the earthmoving equipment prior to commencement of ground-disturbing activities.	Port Manager Project Manager	Prior to commencement of ground-disturbing activities.
Prevent unauthorised access to any habitat of conservation significance	Port Manager Project Manager	All stages.
Install culverts of appropriate capacity under road and rail infrastructure at creek crossings.	Construction and Design Manager	All stages.
Install “environmental culverts” based on hydrological and engineering design where roads or the railway crosses areas of sheetflow.	Construction and Design Manager	All stages.
Include vegetation and flora protection specifications in all construction related contracts and subcontracts.	Port Manager Project Manager	All stages.
Implement weed management measures for mobilisation and demobilisation of plant and equipment. Key measures, as detailed in the weed management environmental operating procedure include (but are not limited to): <ul style="list-style-type: none"> • provide facilities for cleaning equipment; • complete and submit a weed hygiene certificate; • material containing weed seeds must be disposed of on advice of Environmental personnel; • identify, record, monitor and notify all contractors of weed risk areas; and • conduct weed control in accordance with the priority determined for each species. 	Construction Manager	All stages.
Undertake rehabilitation of decommissioned construction areas.	Port Manager Project Manager	Throughout construction and on commissioning.
Implement dust suppression measures within the port area during construction and operation.	Port Manager Project Manager	All stages.
Prepare and implement management and monitoring procedures for fire control.	API Environment Manager	Baseline conditions and indicators monitored prior to ground disturbance.
Conduct targeted surveys (undertaken by a suitably qualified consultant) for the four Priority Flora species that may occur in the area: <ul style="list-style-type: none"> • <i>Acacia glaucocaesia</i>; • <i>Eragrostis lanicaulis</i>; • <i>Helichrysum oligochaetum</i>, and • <i>Terminalia supranitifolia</i>. 	API Environment Manager	Prior to commencement of ground disturbing activities.
Prepare and implement appropriate chemical handling and storage procedures.	Construction Manager Port Manager	Construction phase. Operational phase.
Ensure track-grinding maintenance is conducted in accordance with appropriate fire risk management and response plans.	Port Manager Project Manager	Operations.

12.5 PREDICTED OUTCOME

The greatest risk to terrestrial vegetation and flora posed by the Proposal is direct disturbance within the design footprint. The Proposal footprint, on current information, does not impact on species of conservation significance. Vegetation community Hf which is considered to be equivalent to the Priority 3 Horseflat Land System of the Roebourne Plain PEC, falls within the Proposal footprint.

Areas disturbed during construction that are not required for the operational phase will be rehabilitated. After mitigation and management measures, the Proposal will result in the following outcomes for terrestrial vegetation:

- direct disturbance of up to approximately 770 ha;
- no threatened or protected species or vegetation communities under the Wildlife Conservation Act and no Priority Flora species will be affected by the Proposal (subject to the results of targeted surveys to be undertaken prior to any disturbance);
- no Threatened Ecological Communities will be affected by the Proposal;
- one PEC has been identified in the Proposed footprint area; Priority 3 Horseflat Land System of the Roebourne Plain; and
- impacts to surface water-dependent vegetation are unlikely as sheetflow will be maintained along linear infrastructure corridors.

The EPBC Act objective to “provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance” can be met as no EPBC Act listed flora or vegetation were recorded at the Proposal area.

The EPA objective to “maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge” can effectively be met by the Proposal.

13. Terrestrial fauna

13.1 KEY STATUTORY REQUIREMENTS, POLICY AND GUIDANCE

13.1.1 Objectives

The EPA objective for terrestrial fauna is:

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.

The EPBC Act objective that relates to terrestrial fauna is:

To provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance.

13.1.2 Legislation

Commonwealth

Fauna species of national conservation significance are listed under the EPBC Act and have been classified as “critically endangered”, “endangered”, “vulnerable” or “conservation dependent” (classifications broadly consistent with International Union for Conservation of Nature categories).

Migratory wader species are also protected under the EPBC Act. The national List of Migratory Species consists of those species listed under the following international conventions:

- Japan-Australia Migratory Bird Agreement (JAMBA);
- China-Australia Migratory Bird Agreement (CAMBA);
- Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA); and
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

All listed Threatened Migratory species protected under the EPBC Act are considered in Section 20.

State

The protection and conservation of native fauna in Western Australia is covered by the following state legislation:

- *Wildlife Conservation Act 1950*, and
- *Conservation and Land Management Act 1984*.

In Western Australia, rare or endangered species are protected by the Wildlife Conservation (Specially Protected Fauna) Notice 2008 (2), under the Wildlife Conservation Act. Schedules 1 and 4 in this notice are relevant to this Proposal.

The DEC (Nature Conservation Division) Priority fauna list also nominates species of potential conservation significance in categories from Priority 1 to 5. The potential impacts of a proposal on Priority-listed species should be managed such that the status of the species does not decline so as to qualify as “threatened” using IUCN criteria.

13.1.3 Policy and guidance

EPA Position Statement No. 3

EPA Position Statement No. 3 (EPA, 2002a) discusses the principles the EPA would apply when assessing proposals that may affect biodiversity values in Western Australia. The position statement intends to provide the following outcomes:

- promote and encourage all proponents and their consultants to focus attention on the significance of biodiversity and, therefore, the need to develop and implement best practice in terrestrial biological surveys; and
- enable greater certainty for proponents in the environmental impact assessment process by defining the principles the EPA will use when assessing proposals that may have an effect on biodiversity values.

EPA Guidance Statement No. 20

EPA Guidance Statement No. 20 (EPA, 2009b) provides guidance on standards, sampling methods and protocols for the sampling of short-range endemic fauna undertaken for the environmental impact assessment of proposals.

EPA Guidance Statement No. 56

EPA Guidance Statement No. 56 (EPA, 2004d) provides guidance on standards, sampling methods and protocols for terrestrial fauna surveys, particularly those undertaken for the environmental impact assessment of proposals.

13.2 DESCRIPTION

13.2.1 Introduction

The Proposal will involve the development of infrastructure at the Anketell area with a terrestrial footprint of approximately 770 ha within the identified Proposal envelope. This section of the PER assesses the potential direct and indirect impacts of the Proposal on terrestrial fauna in the Proposal area. This includes examination of potential impacts on the habitats considered of higher value which comprise mangroves and associated intertidal mudflats, and coastal and secondary dunes (as described in Section 3.4 of the PER). This section also proposes a range of management measures to avoid, minimise and mitigate the impacts identified.

13.2.2 Studies

The technical information provided in the section of the PER/draft PER is based on the following reports, which are included in Appendix 1:

- Supporting Study 13.1: Terrestrial Vertebrate Fauna Survey
Phoenix. 2010. Terrestrial Vertebrate Fauna Survey for Anketell Point Rail Alignment and Port Projects. July. Final report prepared by Phoenix Environmental Sciences Pty Ltd for API Management Pty Ltd, Como, Western Australia including addendum letter dated 28th September 2010.
- Supporting Study 13.2: Migratory Wader Assessment
AECOM. 2010. Migratory Wader Assessment Report. November. Report prepared by AECOM Australia Pty Ltd for API Management Pty Ltd, Como, Western Australia.
- Supporting Study 13.3: Short-range Endemic Invertebrate Fauna Survey
Phoenix. 2010. Short-range Endemic Invertebrate Baseline Survey Report. Anketell Point Rail Alignment and Port Projects. July. Final report prepared by Phoenix Environmental Sciences Pty Ltd. for API Management Pty Ltd, Como, Western Australia.
- Supporting Study 13.4: Subterranean Fauna
Phoenix. 2010. Subterranean Fauna Desktop Review. Anketell Point Port Project. February. Report prepared by Phoenix Environmental Sciences Pty Ltd for API Management Pty Ltd, Como, Western Australia.

This section also includes relevant information from other studies cited herein.

Information on the studies completed, and a summary of key outcomes, is presented in Table 13.1. All terrestrial fauna surveys listed below were designed and implemented to meet the requirements of the relevant EPA Guidance Statement. The field surveys provide an appropriate assessment of the fauna values of the Proposal area for the requirements of this PER/draft PER. The outcomes of the surveys have been concluded cognisant of survey uncertainties. Limitations of the field surveys are detailed in the relevant Supporting Studies.

Table 13.1 Summary of terrestrial fauna investigations and key outcomes

Investigation Proposed within ESD	Investigations Completed	Key Outcomes Relevant to Terrestrial Fauna	PER Section
<ul style="list-style-type: none"> Prepare inventory of the vertebrate fauna recorded in the Proposal area. Prepare a list of species that may potentially occur in the Proposal area. Survey of vertebrate fauna species within Proposal area (focus on rare, threatened, vulnerable or geographically restricted species). Desktop assessment of likely presence of subterranean fauna (invertebrates) within the Proposal area. If the desktop assessment identifies significant potential for subterranean fauna to be impacted by the Proposal, then a targeted sampling program will be implemented to assist in impact assessment. Sampling program to determine presence or absence of short-range endemics. 	<p>Completed inventory of vertebrate fauna.</p> <p>Prepared list of species that may occur within the Proposal area.</p> <p>Completed Level 2 vertebrate fauna investigations.</p> <p>Completed migratory wader's assessment.</p> <p>Completed desktop assessment for subterranean fauna.</p> <p>Completed sampling program for short-range endemic taxa.</p>	<p>A total of 193 vertebrate species, including avifauna, mammals, amphibians and reptiles, were recorded during terrestrial vertebrate surveys of the Proposal area. The suite of vertebrate species present was typical of the coastal portions of the Pilbara bioregion. No terrestrial fauna species listed as Schedule 1 or Schedule 4 under the Wildlife Conservation Act or as Threatened fauna under the EPBC Act were recorded from the Proposal area during the terrestrial fauna survey.</p> <p>Five vertebrate species of lower-tier conservation significance were recorded from the Proposal area: little northern freetail bat (P1), <i>Lerista neviniae</i> (P1), eastern curlew (P4), Australian bustard (P4), western pebble-mound mouse. Four additional priority species may occur within the Proposal area.</p> <p>The subterranean fauna desktop assessment concluded that stygofauna may be present in the superficial freshwater aquifers of the Proposal area but these species are unlikely to be geographically restricted and there is a low risk that any significant stygal biodiversity values would be affected by the Proposal. It is unlikely that troglofauna are present within the Proposal area due to lack of suitable habitat.</p> <p>Four potential short-range endemic species were recorded from the Proposal area.</p>	<p>Sections 2 and 13,</p> <p>Supporting Studies 13.1, 13.2, 13.3 and 13.4 in Appendix 1,</p> <p>Western Wildlife (2008; 2009a, b, c).</p>
<ul style="list-style-type: none"> Assess the relationships between vertebrate fauna and the vegetation communities of the Proposal site in order to clearly identify any habitats of significance. Mapping of potential habitat for protected or listed species to minimise disturbance or fragmentation during detailed design phase. Assessment of likely impacts on terrestrial fauna (including short-range endemic and protected species). 	<p>Completed assessment of significant fauna habitats.</p> <p>Completed mapping of fauna habitats. Explicitly mapped <i>Lerista neviniae</i> and little northern freetail bat habitat to avoid/minimise disturbance during design phase.</p> <p>Conducted assessment of likely impacts to terrestrial fauna.</p>	<p>Fauna habitats of significance in the Proposal area are:</p> <ul style="list-style-type: none"> Mangroves for mangrove bat communities; Intertidal mudflats and beaches for migratory waders; Coastal dunes for <i>Lerista neviniae</i> and short-range endemic taxa; and Rockpiles and drainage basins for short-range endemic taxa. 	<p>Section 13.3.2.</p>

Investigation Proposed within ESD	Investigations Completed	Key Outcomes Relevant to Terrestrial Fauna	PER Section
<ul style="list-style-type: none"> Desktop assessment of light pollution impacts on avifauna. 	Investigations have been undertaken as part of the Migratory Wader assessment.	<p>If not managed, light spill on migratory wader habitat has the potential to result in loss of habitat, introduced pests and behavioural change.</p> <p>Mitigation measures will ensure that the risk of these impacts is low.</p>	Section 13.3.2, Supporting Study 13.2.
<ul style="list-style-type: none"> Modelling of noise and vibration emission during port construction and operation. 	Modelling conducted.		Section 13.3.2, Supporting Study 18.1.
<ul style="list-style-type: none"> Assessment of potential for causeway and bridge structure between Dixon Island and mainland to result in an unacceptable introduction of fauna species to this island. 	Assessment completed.		Section 13.3.2.
Additional Investigations to those Proposed in ESD			
Supplementary investigations underway for potential short-range endemic taxa identified in the sampling program.	Sampling completed, awaiting identification and verification from Western Australian Museum.		Preliminary results mentioned in Section 3.4.

13.3 IMPACT ASSESSMENT

13.3.1 Environmental aspects and potential impacts

The following environmental aspects of the Proposal may potentially affect fauna:

- Vegetation clearing for the Proposal will result in the loss of fauna habitat and may result in animal mortality.
- Construction and operations activities may result in indirect fauna habitat modification through introduction of weeds, altered fire regime and changes to local surface hydrology.
- Light spill may alter fauna behaviour affecting their roosting sites and feeding patterns. Light also has the potential to affect breeding patterns as many species are dependent on seasonal light changes to trigger breeding responses.
- Noise emissions may affect the breeding of migratory waders, as the low frequency mating calls of the birds can be affected by the noise emissions of machinery.
- Sealing of surfaces and reduction in groundwater recharge (and reduction in surface nutrient inputs) and other localised changes to hydrology may affect subterranean fauna.
- Increase in off-road vehicle traffic and pedestrian movement on coastal dune and beach habitats may affect the stability of the fragile dune vegetation systems and may alter fauna behaviour, particularly nesting coastal birds and turtles. The restricted skink *Lerista neviniae* is confined to the coastal dune systems and increased human activity within this habitat may impact the species.
- Physical barriers or chemical or hydrocarbon spills, during construction and operation may impact fauna habitats and behaviour (i.e. movement) and harm fauna.
- Causeway construction will increase existing connectivity between the mainland and Dixon Island. This may further facilitate the movement of non-endemic fauna to Dixon Island. Non-endemic fauna have been recorded on Dixon Island.

13.3.2 Assessment of potential impacts

The field surveys provide an appropriate assessment of the fauna and habitat values of the study area for the requirements of this PER/draft PER. Any limitations applied to the field surveys and the impact assessments are detailed in Supporting Studies 13.1, 13.2, 13.3 and 13.4, and should be considered during this assessment.

Discussions on potential impacts on Migratory birds and other terrestrial species listed under the EPBC Act relevant to this Proposal, are described in Section 20 of this PER/draft PER.

Impacts on fauna habitat

Direct habitat loss

Vegetation clearing is the first step in ground disturbance and, for the purposes of evaluating impacts to fauna, has been defined as incorporating all subsequent ground-disturbing activities, such as topsoil removal and material excavation. In addition to habitat loss, vegetation clearing will result in the removal of soil strata, fauna mortality and/or displacement and habitat fragmentation. Vegetation clearing is therefore the primary and most significant impact on terrestrial fauna associated with the Proposal.

The Proposal will result in the clearing of approximately 770 ha of habitat. A breakdown of habitat loss on the basis of Land System Units on the mainland (see Section 3.4.3 and Figure 3.19) is provided in Table 13.2. Land System Units on Dixon Island have not yet been mapped,

Table 13.2 Habitat loss, based on land system units at the Proposal area

Land System Unit	Extent in Bioregion (ha)	Loss from Proposal (ha)	Loss at Regional Scale (%)
Boolgeeda	961,635	6.1	less than 0.001%
Cheerawarra	49,211	238.9	0.49%
Littoral	210,733	224.5	0.11%
Rocklea	2,881,200	17.4	less than 0.001%
Ruth	169,300	258.5	0.15%
Uaroo	987,066	3.7	less than 0.001%
Total for Land Systems		749.1	
Dixon Island (not yet mapped for Land System Units)		17.4	

The proportion of loss of Boolgeeda, Rocklea and Uaroo land system habitats is negligible at regional scales. This is a function of both their large extent in the Pilbara Bioregion and the relatively small areas of clearing required for the Proposal. The largest impact on a land system type in regional terms is for the habitats of the Cheerawarra land system (sandy coastal plains and saline clay plains supporting soft and hard spinifex grasslands and minor tussock grasslands). The clearing associated with the Proposal is less than 0.5% the total extent of this land system within the region (see Table 13.2).

Habitat loss has also been considered at a local scale using habitat mapping based on the vegetation and flora mapping of the Proposal area (Supporting Study 12.1).

The habitat types most affected at a local scale are: *Acacia xiphophylla* shrubland over *Triodia wiseana* hummock grassland on stony plains; and *Triodia wiseana* hummock and *Eragrostis* tussock grassland on coastal plains. Both these habitat types are relatively widespread in the Pilbara Bioregion. These habitat types occur in all the Land System Units listed in Table 13.2, and are well represented in the region and will not be significantly affected by the proposed clearing.

At the level of broad fauna habitat type, as defined in the vertebrate fauna survey (see Section 3.4.4) and broadly based on vegetation community mapping (see Figure 3.20), eight fauna habitat types occur within the study area, all of which will be disturbed to some extent by the Proposal (Table 13.3). All of the habitats occur more broadly within the immediate vicinity of the Proposal area. The fauna habitat type that will be most affected at a local scale is mudflat and samphire, which is the only habitat type to record a proportional loss at a local scale greater than 20%. The proportional loss of beach and mangrove habitat from the Proposal is minor, with less than 5% of local surveyed area impacted. The proportion of loss of drainage line habitat will be approximately 6% of the local surveyed area. With no major drainage line habitat occurring within the Proposal area, the proposed disturbance is restricted to very minor drainage lines.

Table 13.3 Habitat loss associated with the Proposal based on broad fauna habitat types

Fauna Habitat Type	Dixon Island			Mainland			Total		
	Disturbed Area (ha)	Total Area (ha)	Proportional Loss (%)	Disturbed Area (ha)	Total Area (ha)	Proportional Loss (%)	Disturbed Area (ha)	Total Area (ha)	Proportional Loss (%)
Beach	1.1	13.2	8.4%	0.4	20.9	1.8%	1.5	34.1	4.4%
Coastal Dunes	1.3	47.5	2.8%	14.5	203.7	7.1%	15.8	251.1	6.3%
Hill Slope	12.5	207.0	6.0%	163.9	1452.7	11.3%	176.4	1659.7	10.6%
Mangroves*	0.33	61.0	0.5%	0.09	2036	0.004%	0.4	2097	0.02%
Mudflats and samphire	0.0	32.4	0.0%	114.6	417.9	27.4%	114.6	450.3	25.5%
Plains	2.3	152.1	1.5%	440.4	3408.4	12.9%	442.7	3560.6	12.4%
Drainage Line				13.5	231.1	5.8%	13.5	231.1	5.8%
Rocky Outcrops				0.1	0.9	5.6%	0.1	0.9	5.6%
TOTAL	17.6	513.2	3.4%	747.5	7771.7	9.6%	765.0	8284.8	9.2%

*proportional loss is based on survey areas from Section 8

Other potential impacts

The construction and operation of the port infrastructure and associated railway may also indirectly impact fauna and habitat. Potential impacts are discussed below.

Altered fire regime. The Proposal may lead to an increase in fire frequency. In particular, track grinding and maintenance activities during operation pose the greatest risk, however there is also some risk of fires being started during construction of the port and railway. The fauna habitats with vegetation that carries fire readily, namely the spinifex and hummock grassland habitats, are at most risk. Vegetation in these habitats is adapted to fire and capable of recovery; though increased fire frequency or intensity can lead to habitat simplification and degradation. A number of management initiatives will be employed as part of the Proposal to minimise the risk of increases in fire frequency.

Changes to surface hydrology. The railway has the potential to alter surface hydrology in the minor drainage systems that cross its alignment. This may cause modification and degradation of drainage line habitat. Surface hydrology changes will be minimised through appropriate culvert design.

Introduction or spread of weeds. The spread or introduction of weeds is a risk associated with the construction of the port and railway infrastructure. Changes to the floristic and structural nature of vegetation can reduce the habitat value. The replacement of *Triodia* hummock grasslands by buffel grass, which has occurred across large areas of the Pilbara, is an example of such a shift. This risk will be minimised by the development and implementation of topsoil management and weed control procedures prior to and during construction, with follow-up monitoring and control as necessary (see Section 12.4).

Spread of non-endemic fauna (feral animals). There is some potential for the Proposal to facilitate increased spread of non-endemic fauna, through vegetation clearing, habitat disturbance and the construction of roads/tracks. Causeway construction will increase existing connectivity between the mainland and Dixon Island, which may further facilitate the movement of non-endemic fauna between these areas. Non-endemic fauna have been recorded on Dixon Island. Feral fauna management measures will be implemented to minimise this risk.

Impact to birds and bats from physical barriers. The physical structures such as the causeway and other infrastructure may impact flight patterns of avifauna and bats within the Proposal area. Barbed wire will not be used in the Proposal area.

Leaks or spills. There is a risk of hydrocarbon and chemical leaks or spills from transport and storage of fuel, failure of plant and equipment and storage and disposal of waste could result in smothering of fauna habitat, acute toxicity to habitat or fauna, and/or chronic toxicity to habitat or fauna. These risks will be minimised through the implementation of hydrocarbon and chemical storage, management and contingency procedures.

Off-road vehicle traffic and pedestrian movement on dune habitat. An increase in pedestrian and off-road vehicular traffic may lead to habitat degradation, fauna mortality, fauna displacement and disruption to feeding or breeding activity. At most risk, are the beaches, mangroves and coastal dune systems (these are fragile, easily destabilised) which provide habitat for a number of conservation significant fauna. Access to these habitats by the workforce (contractors and employees) for the Proposal will be controlled through the implementation of management measures, including inductions, access restrictions/procedures and signage.

Light spill. Artificial lighting from the Proposal during construction and operation may cause disturbance to some terrestrial fauna. Potential impacts are the alteration of foraging activity to bats, and changes in fauna assemblage in any areas affected by light spill. Lighting may also increase the availability of prey for adaptable bats and birds by attracting insects. Light management measures will be implemented to minimise the impact of light spill on fauna.

Noise and vibration. The major sources of noise and vibration from the Proposal are earthworks and blasting during construction, and the operation of ore handling equipment during operation. Potential impacts to fauna are short-term behavioural changes and displacement.

Dust. The Proposal will lead to dust generation during construction and operation of the facilities from vegetation clearing and topsoil removal, earthworks, excavation and the storage and transfer of iron ore. This may have minor physiological effects on fauna and dust deposition on vegetation may impact fauna habitat. Dust suppression measures will be implemented within the port area during construction and operation.

Impacts on fauna of conservation significance

Five vertebrate species of conservation significance were recorded from the Proposal area (see Section 3.4.4), comprising two Priority 1 species and three Priority 4 species (Table 13.2). Four other conservation significant fauna species are likely to occur in the area are also discussed in Table 13.2. The primary impact on most of these species is the direct removal of habitat arising from vegetation clearing for construction of the Proposal and, for some, associated mortality and/or displacement of individuals.

For the Priority fauna species recorded, the direct loss of habitat will be minimal compared to the local extent of similar habitats (see Table 13.4).

One subterranean fauna species, Blind gudgeon, is listed on the EPBC database as potentially occurring within the Proposal area. Migratory bird species listed under the EPBC Act are discussed in Section 20.

Table 13.4 Summary of potential impacts on the conservation species recorded or likely to occur within the Proposal area

Species	Status	Habitat Loss (ha)	Loss at Local Scale ^a (%)	Comments
Northern quoll (<i>Dasyurus hallucatus</i>)	Schedule 1, Endangered	176.5ha	10.6%	Habitat generalist but most likely to occur on the rocky tors and associated inland hill slopes within the Proposal area. There is a large extent of suitable habitat elsewhere in the locality. Discussed further in Section 20 of the PER/draft PER.
Peregrine falcon (<i>Falco peregrinus</i>)	Schedule 4	NA	NA	General area likely to be utilised for hunting. No potential breeding habitat exists within the Proposal area. Cliffs on the north side of Dixon Island outside of the Proposal disturbance envelope may provide breeding habitat.

Species	Status	Habitat Loss (ha)	Loss at Local Scale ^a (%)	Comments
*Little northern freetail bat (<i>Mormopterus loriae cobourgiana</i>)	Priority 1	0.4	0.02**	Direct loss of roosting and principal foraging habitat (i.e. mangroves) is negligible on a local scale. Potential behavioural changes from light spill but extent of impact not known as no species-specific studies exist.
* <i>Lerista neviniae</i>	Priority 1	8.1	2.9 ^b	Direct loss of coastal dune habitat is minor and represents approximately 2.9% of the API surveyed habitat extent for <i>Lerista neviniae</i> . This proportional loss is further reduced to approximately 1.5% once the additional coastal dune habitat mapped at Cape Lambert is also considered. This estimate allows for 19.2 ha of the habitat to be removed for the Rio Tinto Cape Lambert Port B proposal (Table 13.5). There is a risk of habitat degradation and destruction of nests from increased activity in the coastal dunes.
*Eastern curlew (<i>Numenius madagascariensis</i>)	Priority 4	115.1	4.5**	Direct loss of habitat is minor on a local scale. There is a large extent of suitable habitat elsewhere in the locality, including mangrove creeks and tidal flats in addition to beach habitat.
*Australian bustard (<i>Ardeotis australis</i>)	Priority 4	619	11.9	Direct loss of habitat is minor on a local scale. While it represents approximately 12% of the mapped extent of suitable habitat, additional extensive habitat (open stony or sandy plains and lower hillslopes) exists elsewhere in the locality.
*Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Priority 4	619	11.9	Similar to the Australian Bustard, direct loss of habitat is minor on a local scale and additional suitable habitat exists elsewhere within the locality. It is unclear if this species is extant within the Proposal area as it was only recorded by way of three inactive mounds.
Bush stone-curlew (<i>Burhinus grallarius</i>)	Priority 4	442	12.4	Direct loss of habitat is minor on a local scale and likely to be an overestimate of loss of ideal habitat for the species.
Short-tailed mouse (<i>Leggadina lakedownensis</i>)	Priority 4	0	0	No suitable habitat occurring within the Proposal area will be directly disturbed.
Blind gudgeon (<i>Milyeringa veritas</i>)	Vulnerable	0	0	No suitable habitat exists within the Proposal area.

* recorded within the Proposal area

** proportional loss is based on the mangrove survey areas from Section 8

Notes:

a – based on extent of fauna habitat mapped during the vertebrate fauna survey (see Supporting Study 13.1).

b – Proportion of total estimated *Lerista neviniae* habitat that will be directly disturbed by the Proposal (see below).

Lerista neviniae. This fossorial skink has a highly restricted distribution (see Section 3.4.4). The extent of potential *Lerista neviniae* habitat in the immediate area of Anketell Point was mapped in Supporting Study 13.1 (see Figure 3.22). Analysis of the vegetation clearing required for the Proposal indicates a total predicted clearing of 8.1 ha of *Lerista neviniae* habitat across both the mainland and Dixon Island portions of the Proposal (see Figure 3.22). API specifically treated the extent of this habitat as a design constraint, and this relatively small loss of habitat is due primarily to the perpendicular crossing by the proposed infrastructure corridor between Anketell Point and the jetty access causeway, rather than by the siting of stockpiles or other facilities (see Section 3.4.4).

There is approximately 280 ha of the *Lerista neviniae* habitat within the surveyed Proposal area, including approximately 38ha on Dixon Island, and an additional approximate 218 ha recorded during other surveys at the Rio Tinto Cape Lambert Port B proposal (Biota, 2008b). The 8.1 ha (0.7 ha of which is disturbance to habitat on Dixon Island) disturbance attributable to the current API Proposal represents 2.9% of the habitat at the surveyed Proposal area and 1.6% once the additional coastal dune habitat mapped at Cape Lambert is considered (Table 13.5). The cumulative impact from the API and Rio Tinto Cape Lambert Port B proposals is approximately 5.5% of known habitat.

The proposed infrastructure corridor will fragment *Lerista neviniae* habitat on the mainland and Dixon Island, which may isolate populations (see Figure 3.22). There is a risk that this may isolate sub-populations. It is relevant to note that the current distribution of *Lerista neviniae* in the locality occurs as a series of naturally isolated habitats and individuals are thought to have a range of no more than 300 m. API will incorporate culverts within the design of the infrastructure corridor to allow these populations to maintain some level of connectivity.

Lerista neviniae habitat may also be affected by off-road vehicle traffic and pedestrian movement on dune habitat. The Proponent will implement environmental management procedures to manage these impacts such that the adjacent habitat areas are not affected during construction and operations.

Table 13.5 Habitat loss associated with *Lerista neviniae*

Lerista neviniae Habitat	Proportional loss from API survey area (280 ha)	Proportional loss from API and Cape Lambert survey areas (known habitat extent) (498 ha)
API proposal footprint (8.1 ha, 0.7 ha of which is on Dixon Island).	2.9% (0.3% of which is on Dixon Island).	1.6% (0.2% of which is on Dixon Island).
Rio Tinto Cape Lambert Port B proposal footprint (19.2 ha).		3.9%
Cumulative API and Rio Tinto Cape Lambert proposal footprint (27.3 ha).		5.5%

Little northern freetail bat (*Mormopterus loriae cobourgiana*). This mangrove specialist may show behavioural changes due to an increase in light levels leading to increased insect activity and concentrations, with resultant changes in bat foraging activity. The extent of this is difficult to quantify but may lead to localised concentrations of bat activities in areas adjacent to the Proposal where increased light levels lead to increased insect density. Studies suggest members of this genus exist in harmony with nearby human activities (Scanlon and Petit, 2008).

Impacts on short-range endemics

The Proposal area contains some habitat suitable for harbouring short-range endemic invertebrates most notably isolated coastal dunes, rock piles and drainage basins at the feet of minor hills. The coastal dune and rock pile habitats have largely been avoided by the Proposal footprint. The rail alignment does intersect two drainage basins and will result in the removal of some of this habitat.

Three possible and one likely short-range endemic species were recorded during short-range endemic surveys (Supporting Study 13.3). There is limited information regarding the four potential short-range endemic taxa, with single records for two of the species and records of the other two species from only two and three sites. Taxonomic identifications of specimens collected in an additional targeted survey in May 2010 are pending. All four target groups (trap door spiders, scorpions, pseudoscorpions and land snails) were recorded in the latter survey in locations outside the Proposal footprint.

Records of two of the potential short-range endemic species (*Eucyrtops* sp. and *Lychas* 'near *harveyi*') occur within the Proposal footprint (Table 13.6 and Figure 3.23). The other two species (*Synsphyronus* sp. 1 and *Quistrachia* sp.) were recorded from locations outside the Proposal footprint and while some potential habitat for these species will be disturbed, the risk of impacts to these species from the Proposal is low. The single *Eucyrtops* sp. record occurs within the railway footprint in coastal clay-loam drainage basin habitat and the species is considered likely to at least inhabit other similar mesic drainage basins in elsewhere in the locality. The two *Lychas* 'near *harveyi*' records occur within the railway footprint, from quite different habitats: drainage basin and stony plain. The stony plain record suggests this species may not be confined to typical short-range endemic habitats and therefore the risk of impact on the species from the Proposal is low.

Table 13.6 Summary of potential impacts on short-range endemic taxa within the Proposal area

Species and Group	Potential Habitat Loss	Direct Disturbance Where Species Recorded	Comments
<i>Eucyrtops</i> sp. (trapdoor spider)	Yes	Yes	Railway intersects drainage basin habitat where single record was made. Other drainage basin habitat occurs in elsewhere in the locality. Considered likely to (at least) occur in adjacent drainage basins.
<i>Lychas</i> 'near <i>harveyi</i> ' (scorpion)	Yes,	Yes	Railway intersects coastal drainage basin and stony plain habitats where records were made. Other drainage basin and stony plain habitat occurs in elsewhere in the locality.
<i>Synsphyronus</i> sp. 1 (pseudoscorpion)	Yes	No	Very small area of coastal dune habitat on Dixon Island will be directly disturbed. Species may be confined to Dixon Island.
<i>Quistrachia</i> sp. (land snail)	Yes	No	Railway intersects some rocky hillslope habitat. Closest record of species is approximately 5 km from rail footprint.

Impacts on subterranean fauna

Assuming that stygofauna occur in the Proposal area, the risk that any significant impacts would arise as a result of the Proposal appears to be low. The Proposal does not entail any substantial production borefields, dewatering or pit excavation. The only potential impacts on stygofauna that remain are:

- sealing of surfaces and reduction in groundwater recharge (and reduction in surface nutrient inputs); and
- localised changes to hydrology.

The desktop assessment completed for the Proposal (Supporting Study 13.4) suggested a low risk of any stygofauna species being restricted in distribution to the area of the Proposal where standard operating procedures such as adequate spill reporting, containment and cleanup will be employed. Considering this and the relatively low level of threatening processes presented by the Proposal, there appears to be a low risk that any significant stygal biodiversity values would be affected.

There is little evidence that a troglobitic community would be likely to occur where the bulk of the Proposal infrastructure will be constructed. The coastal portions of the area are dominated by quarternary silty sands and the silts and muds of the mangrove flats, which do not provide suitable habitat for troglofauna. The marine derived quarternary sands that dominate the rest of the geological stratigraphy are considered unlikely to harbour troglofauna. Some areas of basic volcanic rock protruding from the surface with the capacity for potential troglofauna habitat (air filled cavities and voids) are within the Proposal area.

Impact mechanisms would be similar to those identified above for stygofauna in the event that troglofauna do occur within the Proposal footprint. While some localised loss of individuals might occur due to these processes, the widely connected nature of the lithology in this coastal plain setting suggests a low risk of any changes to conservation status of any troglobitic species.

Blind gudgeon (Milyeringa veritas)

This species is known to occur on the Cape Range Peninsula in the arid north-west of WA (Humphreys & Feinberg 1995) and at Barrow Island to the north-east of the Cape Range Peninsula, off the WA coastline (Humphreys 1999).

The geology of the Anketell Point Proposal area is not conducive to occurrence of the fish as it requires a karstic habitat with relatively open subterranean spaces (due to ranging up to 4.5 cm in length). Anketell Point consists of tidal mudflats, and low sand dunes overlying basalt (Phoenix 2010). While the sand dunes may contain a small perched freshwater aquifer, the karstic habitat the fish require does not occur within the dunes (S. Halse 2010, pers. comm.).

If the species does occur on the Pilbara Coastal Plain outside of the Cape Range Peninsula or Barrow Island, it is likely to be restricted to a narrow band of habitat near the coast in the lower Robe and Fortescue River basins where typical prey species such as *Stygocaris* sp. and *Haptolana yarraloola* have been recorded. Anketell Point appears to be unsuitable for the blind gudgeon, based on the underlying geology. This is supported by the observation that no stygofauna with affinities to the fish or similar habitat have been recorded within 20 km of Anketell Point (Bennelongia Environmental Consulting, 2010).

Introduction of fauna to Dixon Island

At present, Dixon Island is connected to the mainland at low tide. Access is provided across sand and mudflats located within the central section of Bouguer Passage. Fauna surveys have identified that species represented on the mainland are mostly represented on Dixon Island. With respect to feral animals, turtle surveys have identified predation at turtle nests on Dixon Island, primarily by foxes (Supporting Study 9.2).

Introduced animals can have significant effects on native fauna. Three introduced predatory species were recorded during surveys (dog, cat and red fox) (Supporting Study 13.1).

There is little evidence to suggest that construction of the causeway and bridge structure will lead to the modification of fauna assemblages on Dixon Island. Nevertheless, API is committed to controlling feral animals in proximity to the Proposal (including areas on Dixon Island) with the objective of limiting predation on species of conservation significance (including turtles, migratory birds and *Lerista neviniae*).

13.4 MITIGATION

13.4.1 Approach

Impact mitigation and management of terrestrial fauna in general and, more specifically, on conservation significant fauna and short-range endemic species is based on the site-specific data available from the studies completed for this Proposal. Management actions will include avoidance where practicable, through infrastructure positioning and final design. The Coastal Habitat Management Plan (included as a draft in Appendix 3 of the PER/draft PER) will be implemented to ensure, among other things, impacts to *Lerista neviniae* habitat are minimised. API's approach has been developed in accordance with the EPA's recommended mitigation hierarchy (EPA, 2006).

13.4.2 Performance management

The success of mitigation and management measures will be measured by assessing key performance indicators against specific targets for each management objective (Table 13.7).

Table 13.7 Terrestrial fauna management objectives, targets and performance indicators

Management objectives	Targets	Performance indicators
Protect habitat outside of approved Proposal footprint during the life of the Proposal.	No terrestrial fauna habitat outside the approved disturbance footprint will be adversely affected.	Ground-disturbance permit process and post-implementation auditing.
Minimise impacts on terrestrial fauna of conservation significance.	Minimum practicable loss of habitat and of individuals of fauna of conservation significance.	Adherence to clearing limits for <i>Lerista neviniae</i> and <i>Mormopterus loriae cobourgiana</i> habitat.
Ensure that all personnel are aware of fauna of conservation significance and related management protocols.	Inductions for all personnel contain information about terrestrial fauna; selected personnel receive relevant terrestrial fauna encounter and handling training within 12 months of commencement.	Training records.

13.4.3 Key management actions

Key management actions will be implemented to facilitate the achievement of fauna objectives (Table 13.8).

Table 13.8 Fauna key management actions

Action	Accountability	Timing
Where there is flexibility with placement of Proposal infrastructure, avoid siting it in any habitat of high conservation significance.	Design Manager	Design stage
Define clearing boundaries with ground markings (e.g., flagging) or as GPS coordinates in the earthmoving equipment prior to commencement of ground-disturbing activities.	Port Manager Project Manager	All stages
Prevent unauthorised access to habitat of conservation significance.	Port Manager Project Manager	All stages
Maintain natural drainage flows wherever practicable and prevent ponding of water.	Port Manager Project Manager	All stages
Implement dust suppression measures during construction and operation.	Port Manager Project Manager	All stages
Rehabilitate decommissioned construction areas to re-establish habitat.	Port Manager Project Manager	Throughout construction and on commissioning.
Include relevant fauna protection specifications in construction related contracts and subcontracts.	Port Manager Project Manager	All stages
All members of the workforce are to be inducted regarding terrestrial fauna identification and encounter (including physical interaction with fauna, littering, feeding, approaching and unexpected fauna encounters).	Port Manager Project Manager	All stages – at induction
Undertake a feral predator control programme. Control measures to be implemented will include (but not be limited to) the following actions: <ul style="list-style-type: none"> develop an animal sighting register that will record feral animal locations; putrescibles waste will be managed in a manner so that it cannot act as a food source for animals; and regular feral animal control as warranted will be arranged through Environmental personnel. 	Port Manager Project Manager	All stages
Utilise culverts to allow for movement of <i>Lerista neviniae</i> .	Port Manager Project Manager	Design stage
Apply speed limits to mining equipment and light vehicles.	Port Manager Project Manager	All stages
Ensure track-grinding maintenance is conducted in accordance with appropriate fire risk management and response plans.	Port Manager Project Manager	Operations

13.5 PREDICTED OUTCOMES

After mitigation and management measures have been applied, the Proposal will result in the following outcomes in relation to terrestrial fauna:

- Approximately 770 ha of terrestrial fauna habitat will be removed in the development of the Proposal.
- The habitat types likely to be most affected at a local scale are *Acacia xiphophylla* shrubland over *Triodia wiseana* hummock grassland on stony plains (Rocky outcrop habitat type) and *Triodia wiseana* hummock and *Eragrostis* tussock grassland on coastal plains (Coastal plains habitat type), which are both represent widespread vegetation communities (and habitat types) in the Pilbara Bioregion.
- The removal of habitat will result in changes to the localised abundance and distribution of terrestrial fauna.
- The Proposal will not conflict with the intent of the Wildlife Conservation Act, as the conservation status of no terrestrial vertebrate or invertebrate fauna species will be changed as a result of the Proposal.
- Regional terrestrial fauna habitat status and associated biodiversity values are unlikely to be affected by implementation of the Proposal.

The EPBC Act objective to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance can be met by the Proposal (also refer to Section 20).

The EPA objective to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge can effectively be met by the Proposal.

14. Soils

14.1 KEY STATUTORY REQUIREMENTS, POLICY AND GUIDANCE

14.1.1 Objective

The EPA objective for soil is:

To maintain the integrity, ecological functions and environmental values of the soil and landform.

14.1.2 State legislation

Part IV of the EP Act requires the environmental impact assessment of proposals with the potential for significant impact on the environment, and provides for the Minister for Environment to authorise implementation of the Proposal.

Part V of this legislation prohibits unauthorised environmental harm and pollution, provides for the regulation of prescribed premises and prohibits the unauthorised clearing of native vegetation.

The Contaminated Sites Act 2003 aims to protect human health, the environment and environmental values by providing for the identification, recording, management and remediation of contaminated sites in WA.

14.1.3 Policy and guidance

The Acid Sulfate Soils Guideline Series released by the DEC forms a comprehensive statutory and policy framework for the identification, assessment and management of acid sulphate soils in Western Australia. The guideline series includes the following publications:

- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DEC, 2009a); and
- Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DEC, 2009b).

The Proposed Framework for Managing Acid Sulfate Soils (DoE, 2004b) is also relevant.

14.2 DESCRIPTION

14.2.1 Introduction

Development of the Proposal will require the construction of ore transport, handling and storage infrastructure, including car dumpers, transfer conveyors, stockpiles and ore stackers and reclaimers. Other proposed infrastructure includes railway access, road links, power generation and a desalination plant. Construction of these facilities will involve vegetation clearing, ground disturbance and some excavation.

There is a risk of ground contamination during construction and operation due to spillages and accidental discharges. There is also potential during construction for the disturbance of acid sulphate soils.

14.2.2 Studies

Table 14.1 briefly outlines the key outcomes of the relevant surveys, investigations and modelling reports.

Table 14.1 Key outcomes of studies relevant to soils

Investigations proposed within ESD	Investigations completed	Key Outcomes relevant to Soils	PER section
Baseline soil investigation (including acid sulphate soils).	Preliminary acid sulphate soil field investigation.	There is a risk that some of the soils within the tidal flats area of Anketell Point are potential acid sulphate soils. A more detailed acid sulphate soil investigation is warranted.	Sections 2.4.1 and 14.3.2, WorleyParsons (2009b).
Investigations additional to those proposed within ESD			
Oil spill modelling and risk assessment.	Forty-nine risk scenarios were developed.	Classification of likelihood of each scenario and identification of relevant management controls.	Section 14.3.2

14.3 IMPACT ASSESSMENT

14.3.1 Environmental aspects and potential impacts

Potential impacts to soils resulting from the Proposal are:

- disturbance of acid sulphate soils during terrestrial clearing which if unmanaged, could result in surface water and soil contamination;
- hydrocarbon spills during construction or operation, resulting in soil contamination; and
- contamination of soils from foam suppressants used during fire fighting (actual or exercises).

14.3.2 Assessment of potential impacts

Disturbance of acid sulphate soils

Construction of the Proposal will result in disturbance to small areas of intertidal land that have been identified, on preliminary sampling (WorleyParsons, 2009b), as potential acid sulphate soils (see Section 3.4.1). This disturbance may be associated with construction of the rail car dumpers, and minor trenching for services. If acid sulphate soils are present and are disturbed during construction, there is a potential for release of acidity, resulting in surface water and soil contamination. More detailed investigations will be completed, and management plans developed as appropriate, following the acceptance of final port design.

Hydrocarbon spills and fire fighting foam

There is potential for diesel, hydraulic fluid and lubricant spills during construction and operations phases from the operation and presence of the diesel fuel pipeline, storage of diesel, refuelling, and operation of land-based machinery. In addition, foams used in fighting electrical or oil fires can cause potential impacts.

Hydrocarbon spills and fire fighting foam discharge (in the event of a fire or during training exercises) to the terrestrial environment have the potential to contaminate soils and surface waters, with a consequential impact on natural drainage lines and local flora and fauna. Terrestrial hydrocarbon spills are predominantly associated with diesel pipeline inventories, diesel storage and refuelling. Fire fighting foam is predominantly associated with electrical or oil fires, and so will be contained to areas near fuel storage and power, or to purpose built fire fighting practice areas. As activities such as refuelling and diesel storage and will be undertaken in purpose-built containment areas and will be controlled via instrumentation and manual intervention, the likelihood of spills directly to the terrestrial environment is considered low (Table 14.2).

Construction Phase

Fuel storage facilities are likely to be installed on Dixon Island and at Anketell Point, providing diesel for heavy equipment, marine vessels and other machinery. Such facilities will be contained and bunded, and strict refuelling and fuel handling procedures will be enforced. Heavy earth moving machinery will be working on Dixon Island and at Anketell Point and there is potential for hydraulic fluid and lubricating oil leaks from hoses and storage tanks, and diesel spills from fuel tank and hose ruptures (Table 14.2).

Operations phase

Operational diesel offloading from fuel tankers will be infrequent, occurring around six times per year, with diesel offloaded in batches of up to 20 ML and piped to a storage tank fuel farm at Anketell Point at a rate of up to 1 ML per hour. Loss of containment from events such as pipeline rupture or leakage from dropped objects, materials failure (e.g. corrosion, erosion), piping component failure (e.g. flanges, gaskets, valves), and emergency systems failure may result in a release of diesel to the terrestrial environment along the Dixon Island and Anketell Point pipeline corridors and at the fuel farm (Table 14.2). The rested pipeline inventory (i.e. non-operating inventory) also poses a risk as the pipeline remains charged with diesel at all times. Physical impacts from collisions to the pipeline (i.e. from vehicles or heavy machinery) or dropped objects (e.g. from cranes) could cause a rupture of the charged pipeline.

Table 14.2 Potential hydrocarbon spills to terrestrial environment

Location/ Phase	Equipment (Activity)	Event (Cause)	Preliminary Management Controls	Event Likelihood ¹⁹
Operations	Fuel pipeline (rested inventory).	Diesel spill to terrestrial environment (Spill from pipeline rupture).	<ul style="list-style-type: none"> • Piping systems design, integrity inspections and maintenance • Flow, pressure and tank level instrumentation, alarms and monitoring • Dropped object protection • Collision prevention systems • Isolation / shutoff valves • Communications systems • Operations procedures • Routine operator inspections 	Unlikely
	Fuel pipeline (operating flow).	Diesel spill to terrestrial environment (Spill from pipeline rupture during fuel pumping operation).	<ul style="list-style-type: none"> • Piping systems design, integrity inspections and maintenance • Flow, pressure and tank level instrumentation, alarms and monitoring • Emergency shutdown functionality • Isolation / shutoff valves • Manned operation and visual monitoring • Communications systems • Operations procedures • Offloading procedures • Routine operator inspections • Relatively short duration of operation • Low frequency of use 	Rare
Operations	General vehicle and machinery operations (operation of mechanical equipment).	Diesel, lubricant spill to terrestrial environment from fuel tank/reservoir weeps and seeps, mechanical failure.	<ul style="list-style-type: none"> • Operating procedures • Communications systems • Mechanical/tank integrity inspections and maintenance • Spill kits 	Unlikely
		Hydraulic oil spills (resulting from ruptured pressure hoses).	<ul style="list-style-type: none"> • Mechanical/tank integrity inspections and maintenance • Spill kits 	Possible

¹⁹ Refer to Appendix 2 of the PER (ESD) for the risk assessment methodology, including classification of the likelihood of risk events.

Location/ Phase	Equipment (Activity)	Event (Cause)	Preliminary Management Controls	Event Likelihood ¹⁹
	General vehicle and machinery operations (refuelling equipment).	Diesel spill to terrestrial environment during refuelling.	<ul style="list-style-type: none"> • Refueling procedures • Refueling compound design - containment and bunding • Communications systems • Pipe/refueling fittings inspections and maintenance • Manned operation and visual monitoring • Emergency shutdown functionality • Flow instrumentation • Central refueling location • Mobile fuel trucks equipped with drip trays • Spill kits 	Unlikely
Construction	Temporary fuel hose (diesel transfer hoses).	Diesel spill to terrestrial environment (fuel hose rupture).	<ul style="list-style-type: none"> • Flow, pressure and tank level instrumentation, alarms and monitoring • Hose/fittings design, inspections and maintenance • Manned operation and visual monitoring • Communications systems • Isolation / shutoff valves • Relatively short duration of operation • Low frequency of use 	Unlikely
	Temporary fuel hose (diesel storage).	Diesel spill to terrestrial environment (tank rupture).	<ul style="list-style-type: none"> • Bunded facility • Tank design • Tank integrity inspections • Routine operator inspections 	Unlikely
	General vehicle and machinery operations (operation of mechanical equipment).	Diesel, lubricant spill to terrestrial environment from fuel tank / reservoir weeps and seeps, mechanical failure.	<ul style="list-style-type: none"> • Operating procedures • Communications systems • Mechanical/tank integrity inspections and maintenance • Spill kits 	Unlikely
		Hydraulic oil spills (resulting from ruptured pressure hoses).	<ul style="list-style-type: none"> • Mechanical/tank integrity inspections and maintenance • Spill kits 	Possible
Construction	General construction activity (temporary fuel storage).	Diesel spill to terrestrial environment from fuel tank rupture.	<ul style="list-style-type: none"> • Bunded facility • Tank design • Tank integrity inspections • Routine operator inspections • Spill kits • Construction EMP 	Unlikely
	General construction activity (refuelling equipment).	Diesel spill to terrestrial environment during refuelling.	<ul style="list-style-type: none"> • Refueling procedures • Refueling compound design - containment and bunding • Communications Systems 	Possible

Location/ Phase	Equipment (Activity)	Event (Cause)	Preliminary Management Controls	Event Likelihood ¹⁹
			<ul style="list-style-type: none"> • Pipe/refueling fittings inspections and maintenance • Manned operation and visual monitoring • Emergency shutdown functionality • Flow instrumentation • Central refueling location • Spill kits 	
Operations Fuel Farm (capacity 36 ML).	Diesel fuel loading operation.	Loss of containment from piping systems at fuel farm during a loading operation.	<ul style="list-style-type: none"> • Piping systems design, integrity inspections and maintenance • Flow, pressure and tank level instrumentation, alarms and monitoring • Emergency shutdown functionality • Isolation/shutoff valves • Manned operation and visual monitoring • Communications systems • Operations procedures • Routine operator inspections • Relatively short duration of operation • Low frequency of use 	Rare
	Diesel fuel storage.	Tank rupture - loss of containment of diesel to terrestrial environment.	<ul style="list-style-type: none"> • Bunded facility • Tank design • Tank integrity inspections • Routine operator inspections 	Rare

14.4 MITIGATION

14.4.1 Approach

API's approach to mitigation has been developed in accordance with EPA's recommended mitigation hierarchy (EPA, 2006).

Acid sulphate soils

When the detailed Proposal design is finalised and the precise area and location of disturbance of soils is defined, further investigations into the extent of acid sulphate soils in the Proposal footprint will be undertaken as required in accordance with the DEC guidelines. If warranted, based on the outcomes of these investigations, procedures will be prepared to manage the potential risks resulting from disturbance of acid sulphate soils as a result of construction activities within any such areas, in accordance with the comprehensive statutory and policy framework for the identification, assessment and management of acid sulphate soils in Western Australia outlined in the guidelines listed in 14.1.3.

In summary, if there is potential to disturb acid sulphate soils (ASS) as part of this Proposal (i.e. excavation for the construction of the car dumper and minor trenching works for services), a field investigation is required which involves soil sampling, laboratory analysis, reporting of the results and formulation of management strategies as part of an Acid Sulphate Soils Management Plan (ASSMP), if acid sulphate soils (potential and/or actual) are found during field investigations. The ASSMP must address potential environmental impacts, the earthwork and dewatering strategies to minimise and manage these impacts, and a monitoring program to ensure that management measures are effective.

The objective of an ASSMP is to outline a strategy to effectively manage the determined extent and severity of ASS on the project site, in relation to the proposed scope of works. The ASSMP would provide for ongoing management and monitoring of the effects of disturbance of ASS through the entire construction or operation period of the Proposal and describe the construction schedules and environmental management procedures. This includes:

- evidence of practical, achievable and auditable plans for the management of the Proposal to ensure that environmental impacts are minimised which requires an integrated plan for comprehensive monitoring and control of construction and operational impacts;
- a framework to confirm compliance with approval conditions stipulated by regulatory authorities; and
- evidence that the project management will be conducted in an environmentally acceptable manner.

The ASSMP is submitted to the Western Australian Department of Conservation and Environment for review and approval, prior to the construction of relevant components of the Proposal.

Hydrocarbon spills

Construction Phase

Temporary diesel storage tanks will be contained within bunded facilities and designed and maintained in accordance with Australian Standards. Central refuelling locations will be developed on Dixon Island and at Anketell Point for the construction phase to avoid 'scattered' refuelling areas. Spill clean-up kits will be available at the refuelling locations, and any mobile refuelling trucks will be equipped with fuel trays and spill kits. A listing of preliminary management controls for various spill hazards in the construction phase is provided in Table 14.3.

Accounting for the preliminary control measures proposed for the construction phase, the likelihood of spills to the terrestrial environment from the hazards identified are generally considered 'unlikely' (Table 14.2), with the exception of spills occurring during day to day refuelling of equipment and unpredictable ruptures of hydraulic hoses which are considered 'possible'.

Operations phase

Diesel storage facilities for up to 36 ML are proposed from which diesel will be distributed to rail facilities, rail cars (for transport to the mine), and diesel users within the port area. There remains a risk for small spills and leaks during daily operation of diesel distribution and storage equipment at the port, although the risk is minimised by compliance with Australian and International Standards and design controls typical of an industrial port facility, which include:

- Bunding designed for 100% of total storage plus capacity for a 100 year rain event; and
- Fuel dispensing points located over catchment pads which are connected to a drains network routed to an oily water separation system.

The operation of heavy machinery, vehicles and hydraulic equipment around the port area and infrastructure corridor may also lead to small spills of hydraulic fluids and lubricating oils to the terrestrial environment. The incidence of such spills are generally considered of minor significance relative to the hazards associated with potential diesel spills, due to the low volumes involved.

Accounting for the preliminary control measures proposed for the operations phase, the likelihood of spills to the terrestrial environment from the hazards identified are generally considered 'unlikely' or 'rare' (Table 14.2). The provision of bunded facilities (described above) with secondary containment for refuelling and diesel storage represents the primary mitigation for spills impacting the terrestrial environment. Table 14.2 details the management controls relevant to fuel offloading operations and the rested pipeline diesel inventories. Dropped object protection and collision prevention systems (where required) represent key measures for preventing physical impacts that have the potential to result in pipeline rupture. Although loss of containment from the diesel pipeline (operational flow or rested inventory) represents the highest potential spill volume, the preliminary management controls and industry precedents indicate that spills from the rested pipeline inventory would be 'unlikely' and spills from the diesel pipeline during refuelling operations would be 'rare'.

14.4.2 Performance management

The success of mitigation and management measures will be measured by assessing key performance indicators against specific targets for each management objective (Table 14.3).

Table 14.3 Soil quality management objectives, targets and performance indicators

Management Objectives	Targets	Performance Indicators
Minimise disturbance to potential acid sulphate soil.	Avoid known potential acid sulphate soil where practicable.	Soil testing.
Manage disturbed acid sulphate soils to avoid adverse impacts on all aspects of the surrounding environment.	No contamination of surface water or soils with acidity or heavy metals.	Soil testing.
Prevent impacts to terrestrial environment due to hydrocarbon spill.	No ground contamination by hydrocarbons.	Spill register Implementation of remediation procedures. Monitoring results.

14.4.3 Key management actions

Management actions will be implemented to facilitate the achievement of soil objectives (Table 14.4). Soil management measures are also incorporated into the management other relevant factors such as vegetation and flora.

Table 14.4 Key management actions to protect soils

Action	Accountability	Timing
Complete detailed survey of footprint area to determine acid leachate potential.	API Environment Manager	Prior to Construction.
Prepare and implement acid sulphate soils management procedures (as warranted) in accordance with the DEC guidelines.	API Environment Manager	Prior to Construction.
Implement appropriate hydrocarbon transport, storage and handling procedures.	Construction and Operation Managers	Construction phase. Operational phase.

14.5 PREDICTED OUTCOME

Further investigations into the extent of acid sulphate soils at the site will be undertaken as required in accordance with the DEC guideline series. If required based on the outcomes of these investigations, acid sulphate soils management procedures will be prepared in accordance with the management principles presented in DoE (2004b) and DEC (2009b) to manage the potential risks resulting from disturbance of acid sulphate soils. Implementation of these management and monitoring measures will ensure the EPA objective for soils will be met by the Proposal.

The risks of hydrocarbon spills, or contamination by fire fighting foam, are low, given the use of appropriate management and mitigation measures. The EPA's objective for soil will be met by the Proposal.

15. Greenhouse gas emissions

15.1 KEY STATUTORY REQUIREMENTS, POLICY AND GUIDANCE

15.1.1 Objectives

The EPA objective for greenhouse gas emissions is:

To minimise emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions.

To achieve the EPA objective for greenhouse gas emissions, the EPA's environmental assessment objectives are (EPA, 2002b):

- To ensure that potential greenhouse gas emissions emitted from proposed projects are adequately addressed in the planning/design and operation of projects and that;
- best practice is applied to maximise energy efficiency and minimise emissions;
- comprehensive analysis is undertaken to identify and implement appropriate offsets; and
- proponents undertake an ongoing program to monitor and report emissions and periodically assess opportunities to further reduce greenhouse gas emissions over time.

15.1.2 Legislation

The *National Greenhouse and Energy Reporting Act 2007* (Cwlth) establishes a single, national system for reporting greenhouse gas emissions, abatement actions, and energy consumption and production by corporations. It requires the reporting of energy production, energy consumption, and Scope 1 and 2 greenhouse gas emissions (discussed further in Section 15.2.1).

The *Energy Efficiency Opportunities Act 2006* (Cwlth) requires organisations that consume more than 0.5 petajoules (PJ) of energy per annum to have effective energy management systems in place that identify, evaluate and consider implementing energy-saving opportunities that have reasonable payback.

The *Carbon Rights Act 2003* (WA) provides for the registration of a “carbon right” and accompanying “carbon covenant” on land titles, in so doing improving certainty for carbon trading.

15.1.3 Policy and guidance

Western Australia Greenhouse Strategy

The Greenhouse Strategy (WAGT, 2004) sets out the Western Australian Government's position on climate change.

EPA Guidance Statement No. 12

EPA Guidance Statement No. 12, Guidance Statement for Reducing Greenhouse Gas Emissions (EPA, 2002b), sets out objectives regarding the minimisation of greenhouse gas emissions from new or expanding operations.

15.2 DESCRIPTION

15.2.1 Introduction

The greenhouse effect refers to the retention of heat radiated from the Earth's surface by atmospheric (primarily carbon-based) gases. The main anthropogenic greenhouse gas is carbon dioxide (CO₂), which has increased in concentration in the atmosphere by about 31% over the last 200 years (EPA, 2002b). There is considerable evidence that an increasing atmospheric greenhouse gas concentration is leading to global warming, sea level rise and climate change.

In the context of reporting and impact assessment, greenhouse gas emissions are categorised as either direct or indirect emissions and defined as either Scope 1, 2 or 3 emissions as follows:

- Scope 1 emissions are direct greenhouse gas emissions from sources that are owned or controlled by a company. For example, emissions from combustion in boilers, furnaces and vehicles and emissions from chemical production in process equipment. Scope 1 emissions include fugitive emissions on site.
- Scope 2 emissions are indirect greenhouse gas emissions from the generation of electricity, steam and heating or cooling purchased or otherwise brought into the organisational boundary of the company and consumed by the company. Scope 2 emissions physically occur at the facility where electricity or steam is generated.
- Scope 3 emissions are all other indirect greenhouse gas emissions that are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Examples include the extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

15.2.2 Studies

Greenhouse gas emissions for the WPIOP (mine, rail and port infrastructure) were estimated by Energetics (2009a) using projected diesel consumption from the project prefeasibility study. This was augmented by generic mining energy consumption and emission factors based on similar sized iron ore operations in Western Australia. The estimated greenhouse gas emission total includes only Scope 1 and Scope 2 emissions to be consistent with the National Greenhouse and Energy Reporting Act and Energy Efficiency Opportunities Act programmes.

Table 15.1 briefly outlines the key outcomes of the relevant surveys, investigations and modelling reports.

Table 15.1 Key outcomes of studies relevant to greenhouse gas emissions

Investigation	Investigations Completed	Key Outcomes Relevant to Greenhouse Gas Emissions	PER Section
Proposed within ESD			
Estimation of greenhouse gas emissions during construction and operation.	A Carbon Strategy has been developed, identifying opportunities, risks and initial steps.	Estimated greenhouse gas emissions for port capacity of 115Mtpa iron ore is 200 ktpa CO ₂ -e ²⁰ emissions (0.04% and 0.25% of Australia and W.A net emissions 2008, respectively).	Energetics (2009a), (Section 15.3.2).
Additional Investigations to those Proposed in ESD			
Energy efficient design investigations.	Energy Efficiency Design Workshop Record.	Opportunities to minimise carbon footprint through design, construction and operational phases of the Proposal identified.	Energetics (2009b).

15.3 IMPACT ASSESSMENT

15.3.1 Environmental aspects and potential impacts

The vast majority of greenhouse gas emissions will be generated by natural gas combustion for power generation and diesel fuel combustion during construction and port operations.

²⁰ CO₂ equivalent (CO₂-e) is the universal unit of measurement used to indicate the global warming potential of each of the six greenhouse gases (CO₂, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride), generally over a timeframe of 100 years. Carbon dioxide has a CO₂-e of 1; methane has a CO₂-e of 21 (i.e., it is 21 times more warming than carbon dioxide).

15.3.2 Assessment of potential impacts

Estimated greenhouse gas emissions have been derived from preliminary investigations undertaken by Energetics (2009a). Assuming full utilisation of a 40MW open cycle gas turbine power plant and 5000 kL of diesel consumption per annum in the handling and export of 115 Mtpa of iron ore, greenhouse gas emissions are estimated to be in the order of 200 ktpa of CO₂-e. This is approximately 0.04% of the estimated net greenhouse gas emissions for Australia in 2008 (553 Mt of CO₂-e, Department of Climate Change and Energy Efficiency 2009) and 0.25% of the estimated net greenhouse gas emissions for Western Australia (79.5 Mt of CO₂-e, Department of Climate Change and Energy Efficiency 2010).

15.4 MITIGATION

15.4.1 Approach

API will ensure continuous-improvement energy management principles are incorporated into business management systems and are auditable against the six elements in the Energy Efficiency Opportunities Act:

1. Scheme Commencement
2. National Emission Reduction Targets
3. CPRS Permit Price Cap
4. Emissions Data to Determine CPRS Liability
5. Scheme Coverage: Emissions and Facilities
6. Treatment of Purchased Electricity (and other supply chain impacts).

15.4.2 Performance management

The success of mitigation and management measures will be measured by assessing key performance indicators against specific targets for each management objective (Table 15.2).

Table 15.2 Greenhouse gas management objectives, targets and performance indicators

Management Objectives	Targets	Performance Indicators
Minimise CO ₂ emissions during construction.	Adoption of appropriate and clean technologies.	Monitor actual emission rates.
Meet and continually strive to lower CO ₂ emissions targets during operation.	API CO ₂ emissions targets (to be determined following detailed design phase).	Monitor actual emission rates.

15.4.3 Key management actions

Key management actions will be implemented to facilitate the achievement of greenhouse gas management objectives (Table 15.3).

Table 15.3 Greenhouse gas key management actions

Action	Accountability	Timing
Prevent unnecessary clearing of vegetation.	Construction Manager	During construction
Conduct annual energy audits of operations.	Environmental Manager	During operations
Report greenhouse gas emissions in accordance with the National Greenhouse and Energy Reporting System.	Operations Manager	During operations
Participate in Commonwealth Carbon Pollution Reduction Scheme as required.	Operations Manager	During operations
Monitor greenhouse gas efficiencies (emissions per tonne of product) during the operational phase.	Operations Manager	During operations

Action	Accountability	Timing
Benchmark greenhouse emission targets for each major stage and component of the Proposal against best practice.	Operations Manager	During operations
Monitor actual emission rates once the Proposal is in the operational phase, and set realistic and achievable CO ₂ emission targets.	Operations Manager	During operations

15.5 PREDICTED OUTCOME

Implementation of energy conservation measures during design and operations will minimise greenhouse gas emissions and ensure compliance with the National Greenhouse and Energy Reporting Act and the Energy Efficiency Opportunities Act. The Proposal will be managed so as to ensure the EPA objective to minimise emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions is met.