



Australian Government

Department of Infrastructure, Regional Development and Cities



Department of Infrastructure, Regional Development & Cities

Christmas Island Stormwater Remediation Works Clearing Permit Support Document

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1. Introduction

1.1 Project location and scope

This document has been produced to support the clearing permit for the proposed stormwater and drainage works to be undertaken at the Drumsite on Christmas Island. This report contains information sourced during desktop studies and provides some context to the field survey outcomes. The areas surveyed during the site visit are shown on Figure 1, Appendix A. Studies have been used to determine the significance of the clearing based on the Ten Clearing Principles.

1.2 Purpose of this report

The purpose of this report is to identify the major environmental issues in relation to construction of the drainage infrastructure and the upgrade of existing infrastructure and to undertake an assessment of the proposed works against the Ten Clearing Principles. This desktop and field work information and assessment may be used for the purposes of developing a clearing permit application for the proposed works.

1.3 Limitations and assumptions

This report: has been prepared by GHD for Department of Infrastructure, Regional Development & Cities and may only be used and relied on by Department of Infrastructure, Regional Development & Cities for the purpose agreed between GHD and the Department of Infrastructure, Regional Development & Cities as set out in section 1.2 of this report.

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The outcomes of surveys of forest areas may be limited due to weather conditions and seasons, in terms of the likelihood of observing certain species. Some species are commonly seen at most times of the year, whereas others may be relatively cryptic and require extended periods of search times to potentially be seen.

2. Description of the Project

2.1 Project Description

The Commonwealth Department of Infrastructure, Regional Development and Cities proposes to upgrade the stormwater and drainage infrastructure at the Drumsite on Christmas Island. This work is a response to the increasing flooding and landslip events that are causing damage to town site infrastructure in areas like the Christmas Island High School, Flying Fish Cove, Port and Kampong, as well as damage to vegetation surrounding these areas. Following consultation it was determined that some high priority works would be undertaken as a matter of urgency. The project will include:

- Supply and installation of drainage pipework including embankments, trenches and backfilling
- Installation of drainage structures including but not limited to manholes, gully pits and culverts
- Installation of a number of bunds, open drains and basins
- Connection of drainage works to existing drainage and where required, replacement of the existing structures
- Clearing of Natural Heritage land, native and non-native vegetation (approx. 2.01 ha in total) to allow for the installation of two drainage basins and some roadside drainage pipes.

2.2 Project Footprint

The project is located within the Drumsite area on Christmas Island, which is part of the residential area. Flying Fish Cove and the Port are located to the North and North West of the project site, which extends over approximately 1.5 km, with pockets of works to be undertaken. The school site covers the area adjacent to the Christmas Island High School and Murray Road. The Silver City site covers the Drumsite industrial park and includes the George Fam Incline (Incline). The footprint includes existing residential and industrial land use zones as well as areas with remnant vegetation.

The clearing of native vegetation makes up a small part of this overall project footprint, as outlined in this document, and is shown in, Appendix A.

From here on in this document, the term 'project' refers to the areas of vegetation required to be cleared and not the entire project footprint.

3. Methodology

3.1 Desktop assessment

A desktop assessment of the project and the potential constraints of the proposed works was undertaken by reviewing relevant reports, GIS spatial files and publically available, government managed databases. The information sources utilised in this assessment are presented in Table 1.

Table 1 Information sources

Aspect	Information Source
Matters of National Environmental Significance (MNES)	EPBC Act Protected Matters Search Tool (DEE 2019)
Contaminated sites	DWER Contaminated Sites Database (DWER 2019)
Climate	Bureau of Meteorology Climate Data Online (BoM 2019)
Geology and soils	Geotechnical Hazard Assessment of Caves on Christmas Island (Coffey Partners International PTY Ltd 1998) Geology (DEE 2019a)
Hydrology	Department of the Environment and Energy (DEE 2019a) Christmas Island Remediation Works - Site Inspection and Concept Development (GHD 2019) Christmas Island (Indian Ocean) Geophysical Survey for Groundwater (Pettifer and Polak 1979)
Environmentally Sensitive Areas	DWER Clearing Permit System (DWER 2019a)
Land use and reserves	Shire of Christmas Island Local Planning Scheme No. 2 (DPLH 2019)

3.1.1 Vegetation types

A consolidated vegetation mapping exercise of the entire island was undertaken between 2011 and 2014. This was undertaken by GeoSicence Australia, in collaboration with Christmas Island Phosphates and the Commonwealth Department of Environment (including Christmas Island National Parks). This vegetation mapping is a combination of a geospatial exercise, incorporation of existing vegetation mapping and knowledge of stakeholders. Ground-truthing of the vegetation was not undertaken across the island as part of this data collection.

Vegetation at the school site (both at the proposed basin and along Murray Road) has been mapped as predominantly 'Regrowth' with some minor areas of 'Mixed weed and pioneer species'. Vegetation within the proposed basin area at Silver City area is mapped to predominantly contain '*Leucaena leucocephala* dominant' with some areas of 'Regrowth'. The proposed clearing area along the incline is mapped as 'Mixed weed and pioneer species' and some small areas of 'Regrowth'. *Leucaena leucocephala* is an introduced shrub species.

3.2 Field survey

The vegetation and fauna of the survey areas was observed and recorded over a two-day period on February 20th and 21st 2019. Rainfall within the month previous to the site visit was very limited, and only scattered, light showers were recorded in parts of the Island during the survey period.

The areas were surveyed on foot, by a highly experienced ecologist, [REDACTED], who has previously undertaken a number of surveys on the Island, and an assistant. The school site was re-visited at and beyond dusk on one day, to observe or hear bird or bat species, and potentially, geckos. After a period of quiet observation (approximately 20 minutes), previously recorded bird calls on the Christmas Island Bird app (Director of National Parks 2019) were used to attempt to encourage responses from likely species in the area.

The time after dusk was used to check trees and tree trunks for the Christmas Island Gecko using head torches.

Limitations

The outcomes of surveys of forest areas may be limited due to weather conditions and seasons, in terms of the likelihood of observing certain species. Some species are commonly seen at most times of the year, whereas others may be relatively cryptic and require extended periods of search times to potentially be seen.

4. Assessment of environmental aspects and impacts

4.1 Physical environment

4.1.1 Climate

Christmas Island is located in the tropics, approximately 550 km South East of the capital of Indonesia, Jakarta. The island is located towards the southern edge of the equatorial region and experiences a tropical monsoonal climate with limited variations in temperature throughout the year. The closest meteorological recording station is located at Christmas Island (No. 200790) approximately 2.7 km South East of the project footprint. Temperatures are considered stable and climatic data from this station indicates the mean maximum temperature ranges from 28 °C in January to 26.3 °C in July. The mean minimum temperature ranges from 22.7 °C in February to 22.5 °C in July. The mean annual rainfall is 2,199 mm with fairly consistent rainfall year round (BoM 2019).

4.1.2 Geology, landforms and soils

The area of Christmas Island is characterised by steep slopes and geologically significant subterranean cave systems. The island's coastline consists mainly of steep cliff faces ranging up to 20 m high (DEE 2019a).

The surface geomorphology is karstic, derived from the weathering of limestone bedrock. The majority of the island is dominated by a karst topography which includes the cavernous type topography and pinnacle fields. The rainforest that dominates the middle of the island does not generate significant runoff and is considered to be highly permeable when undisturbed (Coffey 1998).

The soils are phosphate rich, weakly structured, commonly fine grained with occasional rock fragments, in many areas forming only a thin surface layer above the underlying base rock. Areas such as the Incline are very susceptible to high levels of erosion due to the deeper soil profiles with limited root structure.

From observations on site, the area for the proposed Silver City basin shows evidence of historical erosion from previous disturbance and subsequent rainfall events.

4.1.3 Contaminated sites

A search of the DWER Contaminated Sites Database revealed there are no known or registered contaminated sites intersecting the project area or within at least 5 km of the site (DWER 2019).

A visual inspection of the project site by an environmental scientist did not identify any visual evidence of contamination.

4.1.4 Potential impacts

- Geology – The clearing of vegetation will typically expose the soil to the elements, increasing the potential for further erosion and movement of soils. At the Silver City site, the ground is covered with weed species that have naturally degraded the soil condition. The flooding events have caused further extensive damage to the vegetation in this area and therefore while clearing can temporarily impact the condition of the soil, the outcome of the

works will see an improvement to surrounding soil conditions as weeds are removed and flooding events are significantly reduced.

- Contaminated sites – No contaminated sites have been identified through visual inspection and a search of the DWER database. If any sites that were suspected to be contaminated are uncovered during construction, actions will be undertaken to manage the potential impacts in accordance with a site environmental management plan.

4.2 Land use

4.2.1 Land vesting

The majority of the project area occurs on Crown land, controlled by the Australian Government. Some other areas along road reserve and private lots will be impacted by the proposed works, including Lot 3022 which is currently being leased by Phosphate Resources for mining activities. The closest sensitive receptor, residential property, is located approximately 150 m to the North East of the project footprint.

4.2.2 Land use

The Shire of Christmas Island local planning scheme has mapped the current land use of the wider project area. The Silver City site falls on Crown Reserve land, part of which will be cleared for the installation of a new drainage basin. The school site also falls predominantly on Crown Reserve which lies adjacent to the CI school. This area is classified as Public Purpose land. The area of clearing that will be required adjacent to Murray Road falls on Crown Reserve land (DPLH 2019).

4.2.3 Conservation reserves and areas

No DBCA conservation reserves or areas occur within, or adjacent to, the project footprint.

4.2.4 Environmentally sensitive areas

A search of the DWER Environmentally Sensitive Areas database was undertaken using the Clearing Permit System Map (DWER 2019a). The search identified the Natural Heritage of the island to meet the criteria of DWER's declared environmentally sensitive areas.

The Silver City area occurs within a Commonwealth listed Natural Heritage area (site 105187). The ecological significance of the place is due to its high level of endemism and its unique assemblage of terrestrial and marine species and natural environments (DEE 2019b). The Natural Heritage area covers a significant proportion of the island and its surrounding waters.

4.2.5 Potential impacts

- Land Use – There will be some impacts to land use in the area, however they are considered to be positive impact. In the southern section previous extensive flooding events have caused significant damage to the school and surrounding area, including vegetation downslope. The upgraded drainage infrastructure will reduce the impacts of major rainfall events to both infrastructure and natural areas. In the northern section, the land experiences significant erosion due to the flooding. The improved infrastructure will help control the water flows, reducing risk of further erosion.
- Surrounding conservation reserves and ESAs – The project will involve approximately 1.07 ha of clearing within the Natural Heritage area at the Silver City site for the installation of a larger drainage basin and associated infrastructure. The overall impact on the Natural Heritage area is considered to be insignificant given the minimal clearing requirement (approximately 0.007% of total Natural Heritage area on CI). Additionally, the vegetation

within this area is dominated by introduced shrubs, as outlined in the vegetation and flora results in section 4.4.

4.3 Hydrology

4.3.1 Groundwater and hydrogeology

Underground water accumulates at the interface of limestone and the underlying volcanic rock strata (DEE 2019a). Here it will flow down fractures in the volcanic rock or flow along the interface as in the case of the flow system from Grant's Well (Pettifer & Polak, 1979).

4.3.2 Surface water and drainage

The island's steeply sloping topography is a major factor in influencing the surface runoff. Despite Christmas Island's high volume of rainfall, the island has very limited permanent surface water. The majority of the rainfall will flow underground to join the karst drainage system, in which the water accumulates underground in the caves and sinkholes in the limestone (DEE 2019a). Rainforest soils are reported to be highly permeable when undisturbed however when development occurs, the infiltrative capacity is reduced. The limited root matrix of the native forest vegetation hinders the ability of the soil to maintain integrity against concentrated flows and in areas of deeper soil profiles, erosion can happen rapidly (GHD 2019). This is evident in areas such as the Silver City Incline.

4.3.3 Wetlands

There are no Ramsar wetlands that intersect the project. Two Ramsar sites are located on Christmas Island, the Dales (site 61) and Hosnies Spring (site 40). These wetlands are located approximately 12.5 km west and 5.3 km southeast of the project respectively.

4.3.4 Potential impacts

- Surface water – As a result of the project works, there are expected to be some localised changes to surface water flows. Namely, works will see an improvement in stormwater and drainage infrastructure which will assist in minimising the risk of future land slip events. The design of this infrastructure has used the principles of following the existing drainage pathways, and is simply formalising this arrangement. Given this, significant negative impacts to the groundwater and surface water flows are not expected.
- Wetlands – Given the distance between the Ramsar sites and the Project, no impacts on these wetlands are anticipated to occur as a result of the proposed clearing.

4.4 Vegetation and flora

4.4.1 Vegetation types and condition

School site – drainage basin area

The area of vegetation (0.45 ha) to be cleared adjacent to the existing basin at the Christmas Island High School is in good condition, with a range of tree species present. The area has been partially disturbed in the past, particularly on the school and basin edge, as well as where it abuts a major power line to the west.

Location and soils

The vegetation is on an upper/middle terrace of the Island, in relatively shallow soils over some areas of outcropping limestone boulders and sheets.

Vegetation type

The vegetation is marginal rainforest (AGPS, 1993) and consists of a range of forest tree species up to 30 m high, over lower level trees and palms, with a very limited understorey. At the outer edges of the forest, adjacent to the school, a number of weed shrub and herb species are present, in a dense layer at the base of the trees.



Photo 1 School site vegetation – southern section of the proposed basin looking north



Photo 2 School site vegetation – northern section of the proposed basin looking north



Photo 3 School site groundcover – middle of the proposed basin

Plant species identified during the survey are shown in Table 2.

Table 2 Plant species observed at school site

Species	Height/layer	Introduced	Notes
<i>Aleurites moluccana</i>	Tree	Yes	On edge of forest
<i>Barringtonia racemosa</i>	Tree	No	
<i>Dysoxylum gaudichaudianum</i>	Tree	No	
<i>Ficus microcarpa</i> subsp. <i>microcarpa</i>	Tree	No	Common
<i>Gyrocarpus americanus</i>	Tree	No	
<i>Inocarpus fagifer</i>	Tree	No	
<i>Ochrosia ackeringae</i>	Tree	No	
<i>Pisonia grandis</i>	Tree	No	
<i>Pisonia umbellifera</i>	Tree	No	
<i>Muntingia calabura</i>	Tree	Yes	
<i>Terminalia catappa</i>	Tree	No	Not common
<i>Arenga listeri</i>	Palm	No	Common
<i>Celastrus paniculatus</i>	Shrub	No	
<i>Claoxylon indicum</i>	Small tree	No	
<i>Clauseana excavata</i>	Small tree	Yes	
<i>Colubrina pedunculata</i>	Small tree/shrub	No	
<i>Cordia curassavica</i>	Small shrub	Yes	Very common in disturbed areas
<i>Guettarda speciosa</i>	Shrub	No	Occasional
<i>Leea angulata</i>	Shrub	No	
<i>Leucaena leucocephala</i>	Shrub	Yes	Not common, mostly on edges
<i>Ligustrum glomeratum</i>	Shrub	No	Common
<i>Maclura cochinchinensis</i>	Shrub/vine	No	
<i>Stachytarpheta jamaicensis</i>	Small shrub	Yes	
<i>Turnera ulmifolia</i>	Small shrub	No	
<i>Cissus repens</i>	Twiner	No	

Species	Height/layer	Introduced	Notes
<i>Microsorium punctatum</i>	Fern	No	Common epiphytic fern
<i>Pyrrhosia lanceolata</i>	Fern	No	Common epiphytic fern

School site – Murray Road area

The area of vegetation to be cleared at this site is 0.11 ha. This section of clearing is located across the road from the school on Murray Road and the vegetation is predominantly introduced species.

Location and soils

The survey area included a narrow strip (5 m) of vegetation adjacent to the east side of Murray Road. The vegetation is on an upper/middle terrace of the Island, in sandy soils.

Vegetation type

Only a few semi-mature trees of the marginal rainforest vegetation type are present in the survey area, with much of the vegetation being mown weeds or introduced shrubs (the latter in a strip 2-3 m wide). Included were a non-native palm and an introduced, unidentifiable small tree/shrub from the Fabaceae family.



Photo 4 Vegetation along Murray Road looking east

Plant species identified during the survey are shown in Table 3.

Table 3 Plant species observed at Murray Road

Species	Height/layer	Introduced	Notes
<i>Barringtonia racemosa</i>	Medium tree	No	Behind the impacted vegetation
<i>Celtis timorensis</i>	Small tree	No	Common
<i>Claoxylon indicum</i>	Small tree	No	
<i>Clauseana excavata</i>	Small tree	Yes	
<i>Cocus nucifera</i>	Medium tree	Yes	
<i>Colubrina pedunculata</i>	Small tree/shrub	No	
<i>Delonix regia</i>	Medium tree	Yes	Poinciana tree
<i>Ficus microcarpa</i> subsp. <i>microcarpa</i>	Medium tree	No	On outer edge of strip
<i>Gyrocarpos americanus</i>	Medium tree	No	10-15m high, immature clump
<i>Macaranga tanarius</i>	Medium tree	No	Common in patches
<i>Cordia curassavica</i>	Small shrub	Yes	Very common in disturbed areas
<i>Euphorbia</i> sp.	Herb	?yes	Common
<i>Grewia acuminata</i>	Climber	No	
<i>Ipomoea</i> sp.	Twiner	Yes	
<i>Leucaena leucocephala</i>	Tall shrub	Yes	Common
<i>Maclura cochinchinensis</i>	Shrub/vine	No	
<i>Pyrrosia lanceolata</i>	Fern	No	Common epiphytic fern
<i>Ricinis communis</i>	Tall shrub	Yes	
<i>Stachytarpheta jamaicensis</i>	Shrub	Yes	

Silver City area (including Incline)**Locations and Soils**

The survey area covers a previously disturbed basin area and deep drainage line between Silver City and the phosphate conveyor corridor. The area includes approximately 1.45 ha of vegetation to be cleared. The vegetation is on an upper/middle terrace of the Island. Much of the area has been previously excavated for drainage and/or soil borrow, which has exposed outcropping limestone and boulders.

Vegetation Type

What remains of the native vegetation consists of scattered trees and shrubs of marginal rainforest. The majority of the plants are introduced shrubs and small trees in disturbed soils, dominated by the introduced species, *Leucaena leucocephala*.



Photo 5 Silver City vegetation looking east



Photo 6 Silver City vegetation looking north



Photo 7 Silver City vegetation looking north

Plant species identified during the survey are shown in Table 4.

Table 4 Plant species observed at Silver City

Species	Height/layer	Introduced	Notes
<i>Aleurites moluccana</i>	Tree to 10 m	Yes	On conveyor edge
<i>Delonix regia</i>	Tree	Yes	Poinciana tree
<i>Dysoxylum gaudichaudianum</i>	Tree	No	On conveyor incline edge and in basin edge
<i>Ficus microcarpa</i> subsp. <i>microcarpa</i>	Tree	No	On conveyor incline edge and in basin area
<i>Gyrocarpus americanus</i>	Tree	No	
<i>Macaranga tanarius</i>	Tree	No	On conveyor incline edge only
<i>Melia azedarach</i>	Tree	No	
<i>Ochrosia ackeringae</i>	Tree	No	
<i>Abutilon listeri</i>	Tall shrub	No	Scattered
<i>Arenga listeri</i>	Palm	No	Scattered
<i>Claoxylon indicum</i>	Small tree	No	
<i>Clauseana excavata</i>	Small tree	Yes	
<i>Carica papaya</i>	Small tree	Yes	Scattered
<i>Euphorbia</i> sp.	Small shrub	?yes	Common
<i>Leea angulata</i>	Shrub	No	
<i>Leucaena leucocephala</i>	Shrub	Yes	Dominant plant in basin and disturbed areas of banks/incline
<i>Ligustrum glomeratum</i>	Shrub	No	
<i>Maclura cochinchinensis</i>	Shrub/vine	No	Common
<i>Microsorium punctatum</i>	Fern	No	Occasional epiphytic fern
<i>Murraya koenigii</i>	Tall shrub	Yes	

4.4.2 Conservation significant flora

Three flora species listed as significant under the EPBC Act (1999) were identified during the EPBC Protected Matters Search as potentially occurring in the area.

These are:

- *Asplenium listeria* (a spleenwort), Critically Endangered
- *Pneumatopteris truncata* (a fern), Critically Endangered
- *Tectaria devexa* var. *minor* (a fern), Endangered.

No conservation significant flora were recorded during the field surveys, or are considered likely to occur on any of the survey sites.

4.4.3 Potential impacts

Some impacts are expected as a result of the works, due to the requirement for clearing of native and non-native vegetation.

- Clearing of Natural Heritage area – The impact is considered to be insignificant due to the extent of the clearing area in regards to the greater heritage value of the area. The vegetation that falls within the Natural Heritage area is considered to be degraded and scattered rainforest. The area is also overgrown with weeds so the overall impact of clearing this vegetation is negligible.
- Conservation significant flora – No anticipated impacts due to lack of presence of such flora within or in close proximity to the project.
- Clearing of native vegetation – Some small areas of native and non-native vegetation will be required to be cleared for the works. The total clearing area for the project is 2.01 ha which mainly consists of weedy and introduced species, with some small pockets of good native vegetation. Impacts to the wider natural values are considered to be insignificant.

4.5 Fauna

4.5.1 Fauna habitat

Schools site – drainage basin

The rainforest habitat of this site is in good condition, although surrounded on two sides by disturbance and/or a major road. The range of plant species, as well as limestone soils for crustaceans, would provide habitat for a number of the Island's fauna species. A small number of dead canopy trees may provide roost sites, but no evidence of roosting of colonies was observed.

Schools site – Murray Road

The fauna habitat includes immature forest edge, as well as mowed grasses and herbs. No potential roost trees are present.

Silver City drainage basin

The Silver City drainage site contains limited fauna habitat, with a very limited number of large rainforest trees and a highly disturbed surface. No crabs were observed and there were limited burrows. Two large dead trees may provide occasional roosting.

4.5.2 Fauna diversity

A small number of resident fauna species were recorded during the day and evening site visits. These were as follows:

Table 5 Fauna recorded

Species	Common name/Status	Density/location
Crustaceans		
Gecarcoidea natalis	Red Crab	Very common at school site; not seen at other sites
Birgus latro	Robber Crab	Common at school site; not seen at other sites
Discoplax hirtipes	Blue Crab	Occasional at school site; not seen at other sites
Avifauna		
Turdus poliocephalus erythropleurus	Island Thrush (Vulnerable)	Commonly observed, especially in disturbed areas and grass; all sites
Zosterops natalis	Christmas Island White-eye	Commonly observed at school site
Ducula whartoni	Christmas Island Imperial Pigeon	Heard at all sites
Ninox natalis	Christmas Island Hawk Owl	Heard calling in the distance at school site
?Passer montanus	?Tree Sparrow	Silver City area only

4.5.3 Conservation significant fauna

Desktop assessment

A range of fauna listed under the EPBC Act (1999) are present on the Island. A Likelihood of Occurrence assessment of the potential presence of those species on, or using the habitat of the project site has been undertaken (Appendix B).

The Likelihood of Occurrence (Appendix B) assessment identified the following:

- 3 species were considered Likely to Occur
- 7 species were considered Possible to Occur
- 16 species were considered Unlikely to Occur
- 12 species were considered Highly Unlikely to Occur

Two species considered Highly Unlikely to occur have been listed as Extinct under the IUCN Red List, and in Government of Australia (2010).

Given the distance between the proposed works area and the ocean, listed marine species which are restricted to the ocean (whales, sharks, dolphins and fish) were considered not to be impacted by project works.

Field survey

Two species listed as Vulnerable under the EPBC Act were observed. Notes on these species are extracted from the Christmas and Cocos Keeling Island Birding Guide (2019).

Island Thrush

An endemic subspecies on Christmas Island, listed as vulnerable. There are numerous subspecies in Southeast Asia and the Pacific, but this is the only remaining subspecies in

Australia. Common on Christmas Island throughout the forest and settled in areas. Feeds on the ground; often tame and curious.

Christmas Island Hawk Owl

Endemic to Christmas Island, and listed as vulnerable. There are approximately 500 pairs known. These hold territories in both plateau and terrace forest. They are sometimes seen at streetlights in Settlement and Drumsite chasing insects and are also known to be found at Territory Day Park and the Golf Course.

4.5.4 Potential impacts

The project will result in the direct loss of native vegetation and associated fauna habitat due to the clearing requirements. The main potential impacts expected on fauna include:

- Habitat loss – the clearing of vegetation could potentially contribute to habitat loss for some fauna species. The overall clearing area for the project is 2.01 ha which is unlikely to have any significant impact on habitat overall. The project clearing areas are also not expected to cause any fragmentation of habitats due to their extent and locations. In relation to impacts on crab species, particularly those which migrate from the National Park and surrounding areas to the ocean, these are considered to be minimal. This will be achieved by limiting construction works to those times outside of crab migration, as advised by Christmas Island National Parks.

No areas which are considered significant for EPBC listed species for nesting or roosting will be impacted.

- Secondary impacts from noise, dust and vibration during construction - this could potentially scare some fauna species away temporarily but is unlikely to have a permanent impact on fauna.

5. Assessment of vegetation clearing

Table 6 Assessment against the ten clearing principles

Principle	Assessment	Outcome	References
(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	<p>A desktop search of the EPBC Protected Matters Search identified the potential presence of 37 conservation significant fauna within a 5 km radius of the project. This total does not include those species that are exclusively marine as the project area is located a distance from the marine environment. The search identified 23 species listed as Threatened, 7 Migratory birds and 4 Migratory terrestrial species. A likelihood of occurrence assessment has been undertaken and showed that 3 species are likely to occur, 7 species may possibly occur and 28 species are unlikely or highly unlikely to occur.</p> <p>Three significant flora species are listed under the EPBC Act and have been recorded in the area. No EPBC listed flora was observed in the field surveys.</p> <p>A consolidated vegetation mapping exercise was undertaken for the proposed clearing areas to determine vegetation type and condition. The mapping indicates that two main vegetation associations are present within the project area:</p> <ul style="list-style-type: none"> • Weed dominated vegetation and pioneer regrowth (majority of the Silver City site), • Regrowth (majority of the school site) <p>The clearing area at Silver City is dominated by <i>Leaucanea leucocephala</i>, an introduced species which accounts for approximately 0.65 ha of the clearing area while Regrowth accounts for approximately 0.39 ha of the site. Around the edges of the project, there are some areas identified as mixed</p>	The proposed clearing is unlikely to be At Variance to this principle.	EPBC Act Protected Matters Report

Principle	Assessment	Outcome	References
	<p>weed and pioneer species. At the school site, almost the entire proposed clearing area has been identified as Regrowth, accounting for approximately 0.44 ha of the total proposed 0.45 ha. Some native rainforest species are present, but, due to the size of clearing area, it is not expected that the project will have any detrimental effect on the wider biodiversity of the Island vegetation.</p> <p>The project intersects a Commonwealth listed Natural Heritage area at the Silver City site which has been listed broadly due to its biogeographically significant status and notable endemic species. The proposed clearing area at Silver City, despite falling in this Natural Heritage area, has been determined by desktop and field survey to be of degraded condition. What remains of the native vegetation consists of scattered trees and shrubs of marginal rainforest. The majority of the plants are introduced shrubs and small trees in disturbed soils, dominated by the introduced species, <i>Leucaena leucocephala</i>. Therefore, the biodiversity within the planned clearing areas is lacking and is not anticipated to be impacted by the project works.</p>		
<p>(b) Native vegetation should not be cleared if it comprises the whole of part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.</p>	<p>The EPBC Protected Matters Search identified species that have been recorded within 5 km of the project area. The likelihood of occurrence assessment based on these results concluded that:</p> <ul style="list-style-type: none"> • 3 species are likely to occur • 7 species may possibly occur • 28 species are considered unlikely or highly unlikely to occur. <p>Christmas Island Thrush (Endangered)</p> <p>An endemic subspecies on Christmas Island, listed as vulnerable. There are numerous subspecies in Southeast Asia and the Pacific, but this is the only remaining subspecies in Australia. Common on Christmas Island throughout</p>	<p>The proposed clearing is unlikely to be At Variance to this principle.</p>	<p>EPBC Act Protected Matters Report</p>

Principle	Assessment	Outcome	References
	<p>the forest and settled in areas. Feeds on the ground; often tame and curious.</p> <p>This species was observed within the study area during the field surveys, as well as throughout other locations on the island. In discussions with Christmas Island National Parks, it was confirmed the thrush is found across most of the island (pers. coms. Alasdair Grigg, 21 February 2019).</p> <p>Christmas Island Hawk-Owl (Vulnerable)</p> <p>Endemic to Christmas Island, and listed as vulnerable. There are approximately 500 pairs known. These hold territories in both plateau and terrace forest. They are sometimes seen at streetlights in Settlement and Drumsite chasing insects and are also known to be found at Territory Day Park and the Golf Course.</p> <p>This species was heard within proximity of the school site during the evening fauna survey. No potential nesting hollows were sighted within the project area.</p> <p>Christmas Island Emerald Dove (Endangered)</p> <p>The Emerald Dove generally occurs within the forest including areas of secondary regrowth, however are known to forage within the settled areas.</p> <p>This species was not observed during the site surveys.</p>		
(c) Native vegetation should not be cleared of it includes, or is necessary for the continued existence of, rare flora.	No EPBC or BC Act listed flora were recorded in the survey or are considered likely to occur.	The proposed action is Not at Variance to this principle.	EPBC Act Protected Matters Report

Principle	Assessment	Outcome	References
(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	There are no EPBC Act listed Threatened Ecological Communities identified in or in the vicinity of the project area.	The proposed action is Not at Variance to this principle.	EPBC Act Protected Matters Report
(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	The Silver City site consists mainly of scattered shrubs and trees of marginal rainforest. This is made up of some native species however is dominated by the introduced species, <i>Leucaena leucocephala</i> . The central section (Murray Road) of clearing consists mainly of non-native palms and other introduced species with significant amounts of weed. The school site includes a section of good quality rainforest vegetation but includes areas with weed shrub and herb species in a dense layer at the base of the trees. The majority of the vegetation that will be cleared for the project is regrowth and has been previously cleared or disturbed.	The proposed clearing is unlikely to be At Variance to this principle.	
(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	The current stormwater and drainage infrastructure on the island is considered to not be functioning to the needs of the island. There are no official watercourses outside manmade drainage lines and during these significant rainfall events, the drainage lines do not have the capacity to contain all the water flow. There are no wetlands in the vicinity of the project. The project will significantly improve the functionality of current system as well as providing new infrastructure to prevent further damage from large rainfall events. This will also improve outcomes for the people and vegetation located downstream of the water flows.	The proposed action is Not at Variance to this principle	DEE 2019a GHD 2019 Pettifer & Polak 1979

Principle	Assessment	Outcome	References
(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The project is considered necessary to improve the stormwater and drainage infrastructure on the island due to a number of landslip events and increasing erosion. This is a result of flooding events which have caused significant damage to down-gradient infrastructure. The most significant areas currently affected are located in between the Drumsite and Flying Fish Cove and specifically along the Kampong residential area. The flooding events and consequent high levels of erosion are causing major damage to vegetation in the area. The construction is anticipated to significantly reduce the number of flooding events and associated erosion and therefore will have a positive impact for land degradation.	The proposed action is Not at Variance to this principle.	GHD 2019
(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The Silver City site is located with a Commonwealth listed Natural Heritage area of which 1.07 ha of vegetation will be required to be cleared. The more severe flooding events are currently causing significant erosion which is in turn damaging the existing vegetation in the area. By improving the drainage lines, the natural heritage of the surrounding area to the project will be preserved, hence increasing the overall value of the Natural Heritage area. The clearing area at the Silver City site is also dominated by various weed species and scattered vegetation. The clearing of this type of vegetation is not expected to have a significant impact and will not be detracting from the heritage of the area as the clearing areas are fairly small (2.01 ha in total).	The proposed clearing is unlikely to be At Variance to this principle.	EPBC Act Protected Matters Search Tool
(i) Native vegetation should not be cleared if the clearing is likely to cause deterioration in the quality of surface or underground water.	Christmas Island has very little permanent surface water despite its high rainfall as discussed in Section 4.3.2. The steep topography is a major factor in the surface runoff that typically joins the karst drainage system underground, accumulating in the caves and sinkholes in the limestone. The project works are expected to significantly reduce the extent of surface water experienced in floods and as these flood events will typically pick up contaminants that would usually not be found in the surface water. The	The proposed action is Not at Variance to this principle.	DEE 2019a GHD 2019 Pettifer & Polak 1979

Principle	Assessment	Outcome	References
	existing surface water flows will not be interrupted or degraded by the vegetation clearing.		
(j) Native vegetation should not be cleared if the clearing is likely to cause, or exacerbate, the incidence or intensity of flooding.	The current stormwater and drainage infrastructure on Christmas Island is insufficient to deal with the rainfall of the area. The island currently experiences significant flooding events from uncaptured runoff that has caused landslips and contributed to high levels of erosion. The flooding is causing damage to town site infrastructure at the Drumsite and surrounds. A number of changes are proposed as part of this project to manage the water flows and reduce the risks associated with flooding.	The proposed action is Not at Variance to this principle.	GHD 2019

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Appendix A - Figures

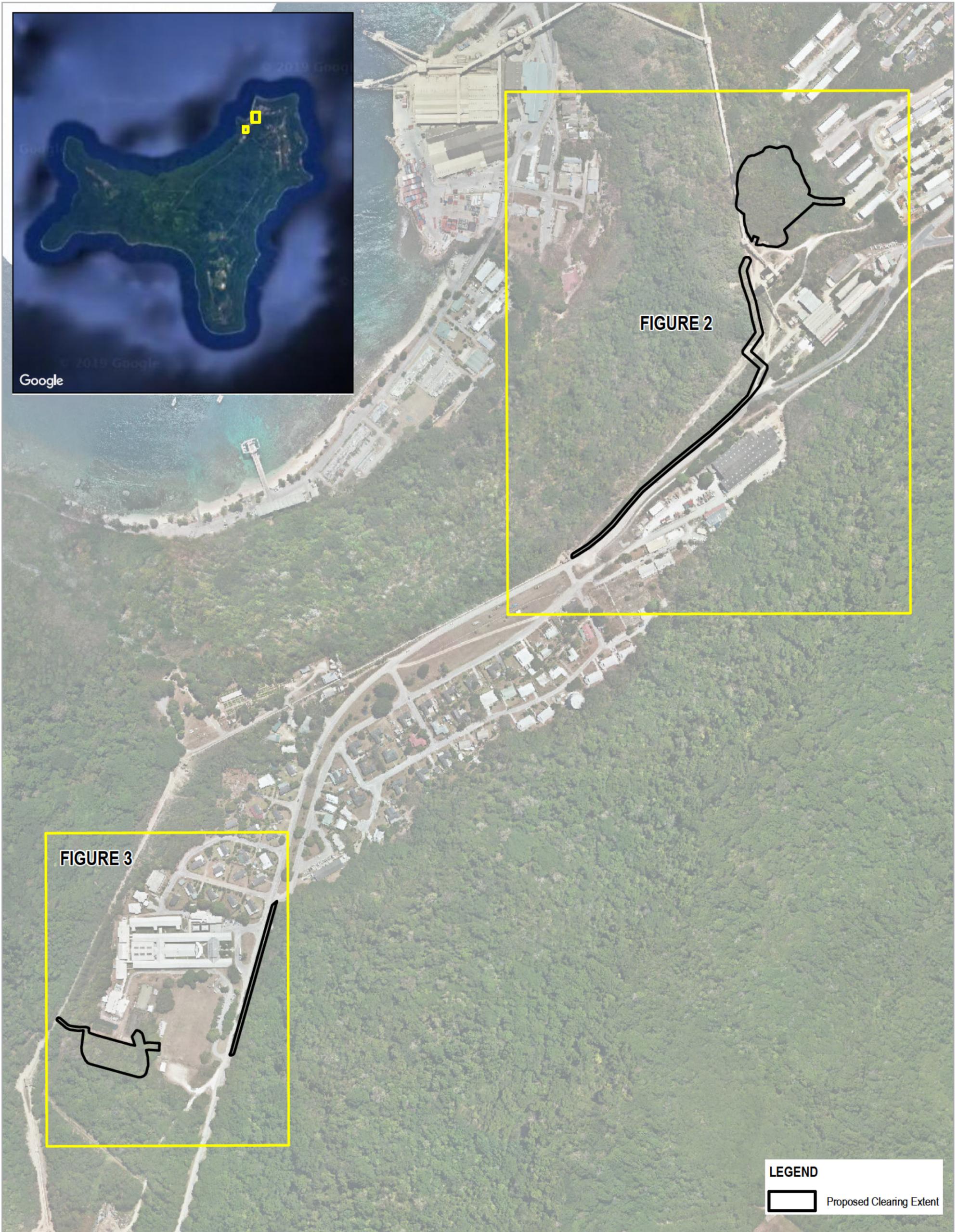
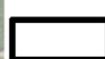


FIGURE 3

FIGURE 2

LEGEND

 Proposed Clearing Extent

Paper Size ISO A3

0 50 100 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: CIG94



Department of Infrastructure,
Regional Development and Cities
Christmas Island
Stormwater Remediation Project

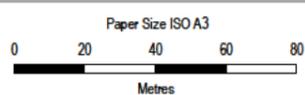
Project No. 61-35637
Revision No. 0
Date 10 Apr 2019

Overview

FIGURE 1

LEGEND

- Proposed Drainage Pits and Pipes
- Proposed Clearing Extent



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: CIG94



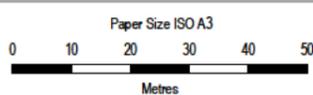
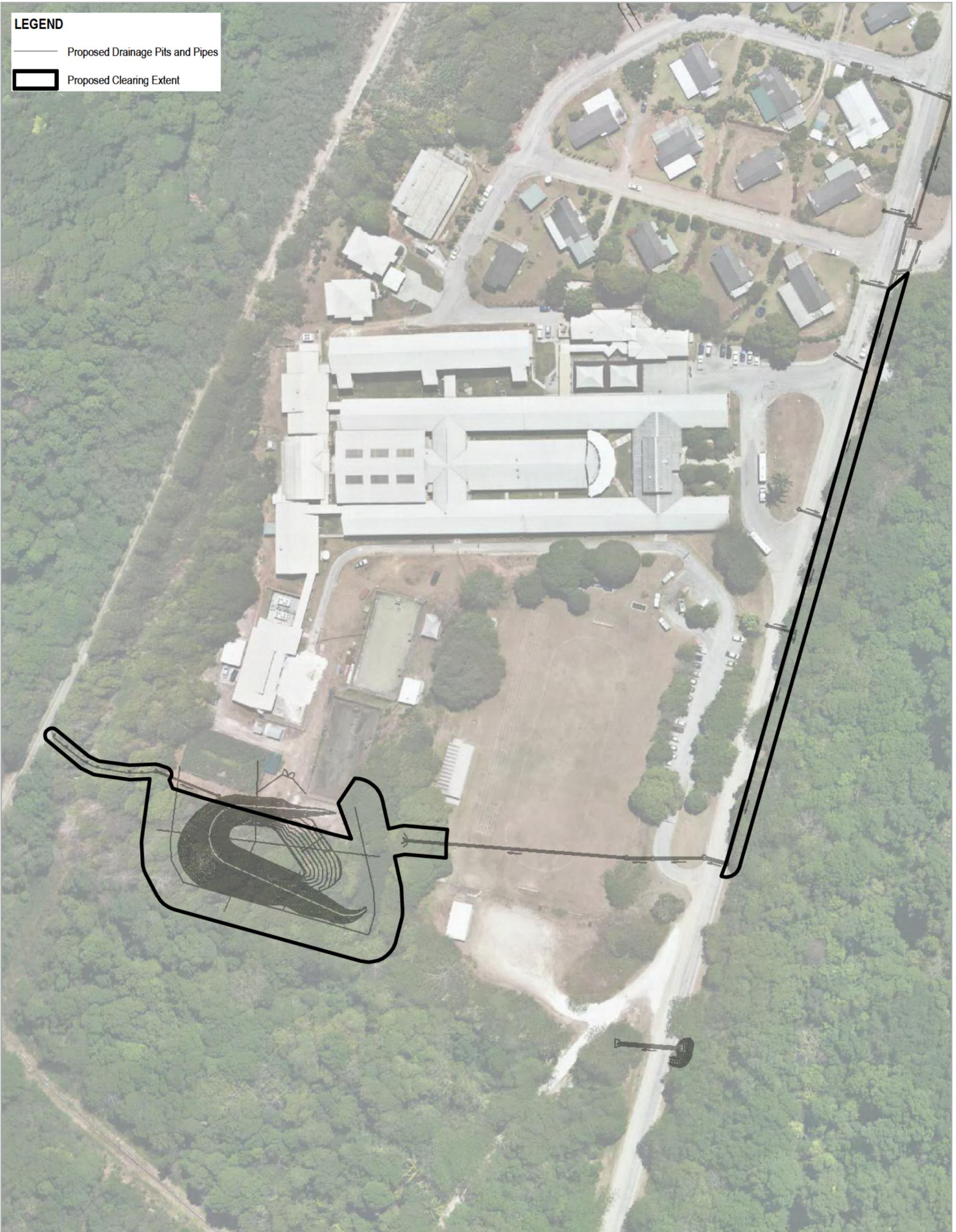
Department of Infrastructure,
Regional Development and Cities
Christmas Island
Stormwater Remediation Project
Proposed Clearing Area

Project No. 61-35637
Revision No. 0
Date 12 Apr 2019

FIGURE 2

LEGEND

-  Proposed Drainage Pits and Pipes
-  Proposed Clearing Extent



Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 48



Department of Infrastructure,
 Regional Development and Cities
 Christmas Island
 Stormwater Remediation Project
Proposed Clearing Area

Project No. 61-35637
 Revision No. 0
 Date 10 Apr 2019

FIGURE 3

Appendix B – Fauna likelihood of occurrence assessment

Fauna likelihood of occurrence

Species	EPBC Status	Likelihood of Occurrence
Listed Threatened Species		
Birds		
Christmas Island Goshawk <i>Accipiter hiogaster natalis</i>	Endangered	Possible - The CI Goshawk generally favours the forest and forest fringes, however are known to forage in most habitats. The species nest sites are often near cleared land, possibly as they provide better visibility and access to food (Hill 2004a). Most records show the species within the National Park.
Red Knot <i>Calidris canutus</i>	Endangered Migratory Marine	Unlikely – The Red Knot mainly inhabits mud and sandflats and sandy, sheltered beaches. They are occasionally seen on terrestrial saline wetlands near the coast but rarely freshwater swamps (Higgins & Davies 1996).
Curlew Sandpiper <i>Calidris ferruginea</i>	Critically Endangered Migratory Marine	Unlikely – Curlew Sandpipers mainly occur on mudflats in sheltered coastal areas and around non-tidal swamps near the coast. They are also sometimes found inland around lakes, dams, waterholes and bore drains with edges of mud or sand. They occur in fresh and brackish water and occasionally around floodwaters (Higgins & Davies 1996).
Christmas Island Emerald Dove <i>Chalcophaps indica natalis</i>	Endangered	Likely – The Emerald Dove generally occurs within the forest including areas of secondary regrowth, however are known to forage within the settled areas (Carter 2000b; Craig 1996).
Christmas Island Frigatebird <i>Fregata andrewsi</i>	Endangered Migratory Marine	Unlikely – CI is the only place in the world this species is known to breed and nest in the forest canopy. It is known to forage in the water surrounding the island (Hill & Dunn 2004).
Christmas Island Hawk-Owl <i>Ninox natalis</i>	Vulnerable	Likely – The Hawk-Owl mainly inhabits dense rainforest on both plateau and coastal terraces (Higgins 1999). On the plateau, it is found in tall closed evergreen forest with irregular canopy and emergent trees. On coastal terraces this species inhabits deciduous forests and highly disturbed (formerly cleared) areas with secondary growth of native and introduced trees as well as low herb lands with dense growths of ferns (Gibson-Hill 1947; Hill 1996a; Hill & Lill 1998a). Found in areas around Settlement and Drumsite.
Abbott's Booby <i>Papasa abbotti</i>	Endangered Marine	Possible – A marine species that needs to come ashore to breed. The Abbott's Booby nests in tall rainforest trees which are associated with uneven terrain created by gullies, hill-sides or cliffs. Most nest trees are located in uneven canopy containing emergent trees and sites are densest along the crests of gullies and west facing slopes (Nelson & Powell 1986). This species nests along the road near the project site.
Christmas Island White-tailed Tropicbird	Endangered Marine	Possible – Primarily nests in the forested areas of the island, although nests have been found in various habitats. They utilise trees in closed

<i>Phaethon lepturus fulvus</i>		canopy rainforest, bare sandy ground and rugged rocky terrain for nest sites. The species forages in warm waters around the island and is not expected to be found in the construction area.
Christmas Island Thrush <i>Turdus poliocephalus erythropleurus</i>	Endangered	Likely/recorded – The Island Thrush is found throughout the island in areas including tall closed evergreen rainforest, open semi-deciduous rainforest and secondary regrowth, and forages in settled areas (Commonwealth of Australia 2002). It is least common in disturbed habitats and in suboptimal endemic vegetation (James & Retallick 2007).
Mammals		
Christmas Island Shrew <i>Crocodyria trichura</i>	Critically Endangered (Extinct in the IUCN list)	Unlikely – The preferred habitat of the CI Shrew is unknown however they have been found in tall plateau rainforest in deep soils and terrace rainforest with shallow soils (Schulz 2004). It has been noted that the species likely uses holes in rocks and the roots of trees as sheltering habitat (Andrews 1900). Now considered extinct under international listings.
Christmas Island Pipistrelle <i>Pipistrellus murrayi</i>	Critically Endangered (Extinct in the IUCN list)	Highly Unlikely – This species has previously been recorded in a range of habitats including plateau and terrace rainforest, secondary rainforest regrowth, mine regeneration and formerly around the settlement area (Tidemann 1985). It has not been seen or heard since 2009 despite being easy to see and hear. It is now considered extinct under international listings.
Christmas Island Flying-fox <i>Pteropus natalis</i>	Critically Endangered	Unlikely – Known to roost only in two main camps on the island in large communal groups.
Reptiles		
Loggerhead Turtle <i>Caretta caretta</i>	Endangered Migratory Marine	Highly Unlikely – Loggerhead Turtles nest on open, sandy beaches and live at or near the surface of the ocean and move with the ocean currents (Spotila 2004). They choose a variety of tidal and sub-tidal habitat as feeding areas and do not rely on a listed threatened ecological community (Limpus 2008a). CI is mostly surrounded by steep cliff faces with few beaches which restricts easy access to island.
Green Turtle <i>Chelonia mydas</i>	Vulnerable Migratory Marine	Highly Unlikely – Once Green Turtles reach 30-40 cm curved carapace length, they settle in shallow foraging habitats such as tropical tidal and sub-tidal reef habitat or inshore seagrass beds (Musick & Limpus 1997). CI is mostly surrounded by steep cliff faces with few beaches which restricts easy access to island.
Christmas Island Blue-tailed Skink <i>Cryptoblepharus egeriae</i>	Critically Endangered	Possible – Has previously been found all over CI in tall primary rainforest, deciduous thickets, coastal thickets and settlement areas. The forage in low vegetation, on exposed rocks and in the tree canopy (Cogger et al. 1983). In 2010 only one population was known to remain on the Island (Commonwealth of Australia 2010).
Christmas Island Giant Gecko	Endangered	Possible - This species is found in primary rainforests, secondary growth and scrubby regeneration. There is continuing decline in the

<i>Cryptodactylus sadleiri</i>		extent of species habitat due to mining (IUCN 2018).
Leatherback Turtle <i>Dermochelys coriacea</i>	Endangered Migratory Marine	Highly Unlikely – This species is highly pelagic, venturing close to shore mainly during the nesting season (Sarti Martinez 2000). They require sandy beaches to nest, with coarser sand suggestively more conducive to successful hatching than finer sand (Limpus et al. 1984b). CI is mostly surrounded by steep cliff faces with few beaches, which restricts easy access to island.
Forest Skink <i>Emoia nativitatis</i>	Critically Endangered	Highly Unlikely – Listed as extinct in 2017 on IUCN Red List (IUCN 2018).
Hawksbill Turtle <i>Eretmochelys imbricata</i>	Vulnerable Migratory Marine	Highly Unlikely – The first 5-10 years are spent drifting in ocean currents and will settle and forage in tropical tidal and sub-tidal reef habitat once they reach 30-40 cm curved carapace length (Carr 1987a). They have been found within seagrass habitats of coastal waters and the deeper habitats of trawl fisheries (Poiner & Harris 1996). CI is mostly surrounded by steep cliff faces with few beaches, which restricts easy access to island.
Olive Ridley Turtle <i>Lepidochelys olivacea</i>	Endangered Migratory Marine	Highly Unlikely - Small juveniles to adults reside in coastal zones and females lay eggs on sandy beaches (Musick & Limpus 1997). A substantial part of the population forage over shallow benthic and pelagic habitats and have not been frequently recorded in coral reef habitat or shallow inshore seagrass flat (Limpus 2008). CI is mostly surrounded by steep cliff faces with few beaches, which restricts easy access to island.
Christmas Island Gecko (Lister's Gecko) <i>Lepidochelys listeri</i>	Critically Endangered	Unlikely – Most abundant in primary rainforest on the plateau but also occurs in disturbed plateau habitat including secondary forest growth. They do not utilise areas revegetated after mining activities (Cogger et al. 1983). Not recorded since a single record at Egeria Point in 2009 (Commonwealth of Australia 2010)
Flatback Turtle <i>Natator depressus</i>	Vulnerable Migratory Marine	Highly Unlikely – Post-hatchling and juvenile Flatback Turtles do not have the wide dispersal phase in the oceanic environment (Walker & Parmenter 1990). Adults inhabit soft bottom habitat and nest on sandy beaches in the tropics and subtropics (Limpus 1995a). Species not dependent on a threatened ecological habitat. CI is mostly surrounded by steep cliff faces with few beaches, which restricts easy access to island.
Christmas Island Blind Snake <i>Ramphotyphlops exocoeti</i>	Vulnerable	Unlikely – The CI Blind Snake is a fossorial snake that occurs in tall closed forest on deeper soils on the island's central plateau where it occupies the sub-surface and litter layer of the forest floor (Cogger 2006).
Listed Migratory Species		
Migratory Marine Birds		
Common Noddy <i>Anous stolidus</i>	Marine	Unlikely – During the breeding season the Common Noddy usually occurs on or near islands, on rocky islets, cliffs, cays of coral or sand, nesting in bushes and other low vegetation. When not in the nest, the species will forage in

		surrounding waters, generally remaining close to the nest (Higgins & Davies 1996). They have also been recorded nesting in the forks of tall trees, in holes in dead timber and on tree stumps.
Lesser Frigatebird <i>Fregata ariel</i>	Marine	Unlikely – Typically breed in mangroves, bushes and occasionally on bare ground on small tropical and sub-tropical islands (IUCN 2018).
Great Frigatebird <i>Fregata minor</i>	Marine	Possible – As above, they typically breed in mangroves, bushes and occasionally on bare ground on small tropical and sub-tropical islands (IUCN 2018). Species have been known to nest in the upper terraces (Drumsite) (Island Explorer 2008).
White-tailed Tropicbird <i>Phaethon lepturus</i>	Marine	Unlikely – The White-tailed Tropicbird can be found over pelagic waters and the coast of tropical and subtropical seas. The species is loosely colonial, nesting in rocky crevices or sheltered scrape on the ground (IUCN 2018).
Red-tailed Tropicbird <i>Phaethon rubricauda</i>	Marine	Unlikely – This species mainly breeds on remote islands on inaccessible cliffs (IUCN 2018).
Brown Booby <i>Sula leucogaster</i>	Marine	Unlikely – The Brown Booby occurs in both marine and terrestrial habitat including tropical waters of major oceans, often staying close to breeding islands. The species nests on rugged rocky terrain, beaches, coral rubble and guano flats and readily roost on artificial structures (Marchant & Higgins 1990).
Red-footed Booby <i>Sula sula</i>	Marine	Unlikely – The species readily flies over land near shore but does not cross wide areas of land. They forage in deep water and near islands, outside reefs but rarely close to continental land masses. Nests may be placed in any vegetation dense enough to accommodate a colony (Marchant & Higgins 1990).
Migratory Terrestrial Species		
Red-rumped Swallow <i>Cecropis daurica</i>	Marine	Possible – This species is generally found in open hilly country and mountains, sea cliffs and cultivated areas/ human habitations. Also found in inland wetlands, forest and shrub land (IUCN 2018). Species known in northern area of island near project site. Works have potential to affect the species.
Barn Swallow <i>Hirundo rustica</i>	Marine	Unlikely – In the Asia-Pacific region the species is known mainly from large freshwater swamps utilising dead trees for perches and nearby grassland for foraging (Coates 1990a).
Grey Wagtail <i>Motacilla cinerea</i>	Marine	Unlikely – The Grey Wagtail is found in lowland watercourses, fast-flowing water with exposed rock and often in forested areas. These are the areas they prefer to breed in. Also found in inland wetlands (IUCN 2018).
Yellow Wagtail <i>Motacilla flava</i>	Marine	Unlikely – This species occupies a range of damp habitats with low vegetation. It is also found in large forest clearings (IUCN 2018).
Migratory Wetlands Species		

Common Sandpiper <i>Actitis hypoleucos</i>	Marine	Highly Unlikely – Generally the species forages in shallow water and on bare soft mud at the edges of wetlands. The Common Sandpiper has been recorded in a wide range of coastal wetlands and inland wetlands with varying levels of salinity, mostly found around muddy margins or rocky shores (Geering et al. 2007; Higgins & Davies 1996).
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	Marine	Highly Unlikely – The Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. They also forage in these areas. They have been recorded roosting on sandy beaches, stony shores or on rocks in water (Higgins & Davies 1996)
Pectoral Sandpiper <i>Calidris melanotos</i>	Marine	Highly Unlikely – The Pectoral Sandpiper prefers shallow fresh to saline wetlands. They are usually found in coastal or near coastal habitat but occasionally found further inland. They forage in shallow water or soft mud at the edge of wetlands (Higgins & Davies 1996).
Listed Marine Species		
Birds		
Great Egret <i>Ardea alba</i>	Marine	Highly Unlikely – The Great Egret has been found in a wide range of wetland habitats including inland, freshwater and vegetated. The species frequents shallow water and generally retreat to more permanent wetlands or coastal areas when other wetlands are dry (Kushlan & Hancock 2005; Marchant & Higgins 1990).