B7

AIRPORT AND SURROUNDS

TERRESTRIAL FLORA

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APPENDICES (REFER SEPARATE APPENDICES DISK)

7.1 INTRODUCTION

The terrestrial vegetation communities and flora species within and adjacent to the Sunshine Coast Airport Expansion Project (the Project) area are described in this chapter, specifically with respect to:

- The policy context and legislative framework of the project in relation to terrestrial flora
- The abundance and distribution of terrestrial flora within the Project area and the adjacent study area
- Ecological and conservation values of each vegetation community, at local, State and Commonwealth scales
- Ecological and conservation values of significant flora species
- Processes known or likely to control the distribution and abundance of flora.

This chapter also includes identification and assessment of potential impacts to terrestrial flora and reviews mitigation measures inherent in the design and provides additional mitigation measures specific to impacts on terrestrial flora features.

This chapter has been prepared in accordance with the Terms of Reference (TOR) for the Environmental Impact Statement (EIS).

7.2 METHODOLOGY AND ASSUMPTIONS

7.2.1 Nomenclature and terminology

The focus on the presentation of baseline results and assessment of impacts is within the Project area, which is defined as the development footprint and is shown in **Figure 7.2a**.

For additional local context and consideration of areas where potential direct and indirect impacts could occur, reference is made to adjacent environmentally significant areas, such as Mt Coolum National Park and the Marcoola Beach dunes. The total study area for this chapter extends from the Marcoola Beach dunes to the east and west to the south Maroochy River. The northern and southern edges have been defined by the extents of both sections of Mt Coolum National Park (**Figure 7.2a**).

Within this report, the conservation status of a species is described as 'Endangered', 'Vulnerable', 'Near Threatened' and 'Least Concern', in line with the provisions of the *Native Conservation Act 1992* (Qld) and/or the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

Vegetation type descriptions used are based on the structural types described by Specht (1970). Plant names follow the *Census of Queensland Flora* (Bostock, P.D. & Holland, A.E. (eds) 2010).

7.2.2 Information and data collection

The information and data collected in this study consists of desktop sourced information and maps, as well as detailed field surveys of the study area.

7.2.2.1 Desktop studies

The desktop study involved review of Geographic Information Systems (GIS) maps and datasets as well as reports and literature relevant to flora values in the study area. This included the following sources:

- Regional Ecosystem (RE) and remnant vegetation mapping version 8 (Department of Natural Resources and Mines (DNRM) 2013)
- High value regrowth vegetation mapping version 2.1 (DNRM 2013)
- Wetland Management Area mapping and classification (Department of Environment and Heritage Protection (DEHP) 2011)
- Directory of Important Wetlands mapping (Australian Department of Environment and Heritage 2005)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool for the study area (accessed 27 August 2012)
- CORVEG and HERBRECS data for the study area (Queensland Herbarium 2012)
- DERM Wildlife Online database search (accessed 29th August 2012)
- Atlas of Living Australia (accessed 28th August 2012)
- Aerial photography for several years between 1958 and September 2011 (DNRM 2011)
- Other reports and literature, which are cited throughout this chapter.

7.2.2.2 Field surveys

The majority of the field surveys were undertaken in July and August 2012, as well as supplementary spring surveys undertaken in October 2012. The surveys were undertaken to enable:

- Description and mapping of vegetation communities
- Description of the floristic composition, health and structure of vegetation communities
- Detection, mapping and population estimates of threatened flora species, including species with seasonal flowering attributes
- Identification of existing threatening processes, such as pest plant infestations, land management practices and hydrological interactions.

The field survey program was designed to collect information on the terrestrial vegetation communities and flora species and to allow mapping, assessment and analysis in accordance with the requirements of the TOR Part B Section 5.2.2 and Part C Section 2.3.

Figure 7.2a: Study area and Project area

Project area

Study area

Client
Sunshine Coast Airport

Job Title
Sunshine Coast Airport Expansion Project

Map Title
Project Area and context

Meters

0 400 800 1,200

Issue	Date	By	Chkd	Appd
D1	31/01/2014	SXJ	LOM	LOM

ARUP

Level 4, 108 Wickham Street
Fortitude Valley, QLD 4006
Tel +61 (7)3023 6000 Fax +61 (7)3023 6023
www.arup.com

Scale at A4
1:25,000

Map Status
Final

Coordinate System
GDA 1994 MGA Zone 56

7.2.2.3 Main survey

Field surveys were undertaken between 30 July and 3 August 2012, between 8 and 10 October 2012, and on 15 January 2013 for areas directly impacted by, and immediately surrounding, the Project area. As part of this, four types of survey were undertaken within the Project area. This included:

- Fifty-six quaternary surveys (Neldner 2012)
- Seven secondary surveys (Neldner 2012)
- Random meander traversing to establish the location and extent of the two known *Allocasuarina emuina* (Mount Emu She-oak) populations in the study area (see discussion below)
- Fifty-seven systematic density count quadrats undertaken to estimate the population of Mount Emu She-oak (**Figure 7.2b**).

The study area was traversed by foot to access all survey locations. During the traverse, general notes on the floristic composition, health and condition of the vegetation communities were also taken. Where desktop research revealed there had been previous sightings of threatened or near threatened plant species in the study area these locations were also traversed and thoroughly searched.

- The aim of the systematic quadrats was to sample the population of Mount Emu She-oak to obtain an estimate of total population within the study area. The locations of these quadrats are shown in **Figure 7.2b**. There are two known populations within the study area (Environmental Protection Agency 2007; Lamont 2010). Mount Emu She-oak Population Area 1 (AEP1) is west of Runway (RWY) 12/30 whilst Mount Emu She-oak Population Area 2 (AEP2) is approximately 1 km north. Population extents were determined through a review of literature as well as through survey itself to delineate the edges of the Mount Emu She-oak populations. As only 1 specimen of Mount Emu She-oak was found in AEP2 after it was traversed, no quadrats were undertaken in this area; thus, the 57 quadrats to estimate the population of Mount Emu She-oak were undertaken entirely within AEP1.
- It was observed that different population densities of Mount Emu She-oak occurred in different vegetation types and samples within AEP1 were split into vegetation types to allow comparison (**Figure 7.2b**). Vegetation communities sampled included:
- 21 quadrats in open to closed heath within the southern section of Lot 857CG4403 and the western section of Lot 699 SP214349
- 11 quadrats in closed heath within the northern section Lot 857CG4403
- 15 quadrats in low open forest to open forest on Lot 101CP883235 and the northern section Lot 857CG4403.

Quadrats of 10 m x 10 m were equally spaced with the use of a 50 m x 50 m grid overlayed on aerial photography of the Project area.

One quadrat was positioned within the centre of each grid square, except where areas could not be accessed due to dense ground cover or the existence other physical barriers such as drainage lines. In each quadrat, two ecologists counted the number of individual Mount Emu She-oak plants present. To allow efficient and effective field identification and detectability, surveys were undertaken during the time the species is known to be in flower.

Analysis was then carried out to estimate the population density of Mount Emu She-oak in each of the vegetation types and this was then used to estimate the population within AEP1. An analysis of variance (ANOVA) was also undertaken to confirm whether or not the mean population density was significantly different between vegetation types.

7.2.2.4 Supplementary spring surveys

Spring surveys were undertaken on 8 to 10 and 23 October 2012. These were undertaken in order to meet the requirements of the TOR survey guidelines (refer TOR Part B Section 5.2.2 and Part C Section 2.3), as seasonal surveys are required to adequately account for vegetation growth patterns, life-cycles and detectability. Specifically, this survey is required to meet the TOR and relevant survey guidelines for *Phaius australis* (Lesser Swamp Orchid) and *Prasophyllum wallum* (Swamp Leek) as this corresponds with the flowering period for these species. Section 5.2 of the TOR notes that ecological surveys following a wet season may be required to detect the full range of species and ecosystem conditions. The intention for seasonal surveys in the Project area is to increase the chance of detection and identification for significant flora species during flowering periods. As these species flower during the spring months (September-November) the seasonal surveys were focused during this time of the year and not following the wet season (i.e. post-February). Due to the habitat requirements of these species, surveys were targeted in areas of paperbark forest/ wetland and closed/wet heathland.

7.2.2.5 Vegetation mapping

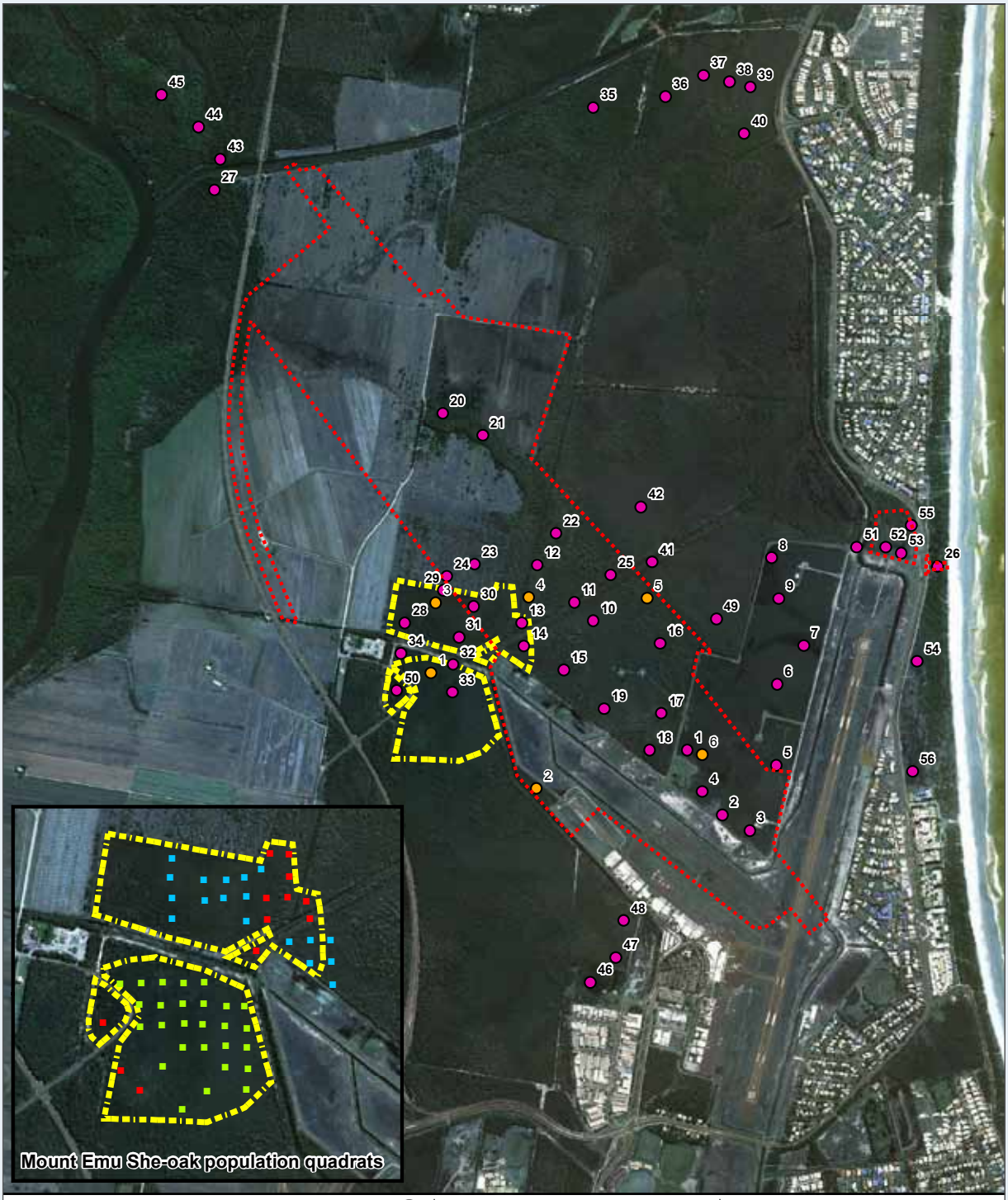
Analysis of high resolution aerial photography, Queensland Government mapping, the secondary and quaternary survey data and the general notes undertaken throughout the study area were used to define and map vegetation communities within the study area. This was undertaken using GIS software to produce a thematic map displaying the different vegetation communities across the study area.

Using a combination of quaternary and secondary surveys, the vegetation communities within the study area were mapped at a scale of 1:5,000 (63 samples within approximately 185 ha).

7.2.2.6 Assumptions and technical limitations

The Wildlife Online database, HERBRECS data and EPBC Act Protected Matters Search Tool (PMST) have been used to aid in the identification of flora in the study area.

Figure 7.2b: Field survey locations



A limitation of the Wildlife Online and HERBRECS databases is that the search results show plant species that have been directly observed or collected. It does not show all plant species that exist within the search area. The databases are not based on predictive distribution modelling or habitat suitability of an area. For this reason, there is potential that significant species could exist within an area but have not been included within the databases.

The PMST utilises predictive modelling of the distribution of threatened species based on historical observations, and each species habitat requirements and known ranges. The tool does not rely on recent observation and may be subject to an amount of error due to the specific on-ground features at a site. The species within the results of the PMST may not actually exist within the search area.

Due to limitations associated with all field sampling there is potential for threatened species to exist within the study area that have not been identified within past or current surveys or other information used as part of this study. There is also potential that threatened flora species may establish between time of writing and construction commencement.

7.3 POLICY CONTEXT AND LEGISLATIVE FRAMEWORK

7.3.1 *Environment Protection and Biodiversity Conservation Act 1999* (Cth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the regulation of the environmental impacts of development at a Commonwealth level. The act regulates any proposed action that has, will have or is likely to have a significant impact on any matter of national environmental significance.

The project was referred to the Australian Government Department of Environment (DoE) on 31 January 2011. The Commonwealth Government subsequently designated the project a controlled action to be assessed via an EIS due to the potential impact of the project on wetlands of international importance (see Chapter C4, Marine Ecology), listed threatened species and communities, and listed migratory species (see Chapter B8, Terrestrial Fauna).

Of these matters, only threatened flora species and ecological communities are relevant to this chapter. The impact to wetlands of international significance refers to the dredging of Moreton Bay, which will not affect terrestrial flora values. In addition, the impact upon migratory species refers to fauna species only and is also outside the scope of this chapter.

7.3.2 *Nature Conservation Act 1992*

The *Nature Conservation Act 1992* (NC Act) provides for the identification, protection and management of Queensland's threatened flora and fauna, as well as regulating the use and disturbance of all wildlife. The management and regulations within the NC Act are administered by DEHP.

The NC Act defines 'protected plant' as a plant that is prescribed as, threatened (extinct, endangered or vulnerable), near threatened or least concern (i.e. common) plants. This definition covers all Australian native plants in Queensland.

A clearing permit will be required where the project will result in the removal of protected plants (endangered, vulnerable, near threatened or least concern flora species) within a high risk area.

The NC Act and the NC Regulation were amended as current legislation on 31 March 2014. The main changes to this legislation included changes on the triggers for requiring a clearing permit for protected plants. The amendments also repealed the *Nature Conservation (Protected Plants) Conservation Plan 2000*.

The amendments to the NC Act provide for a clearer understanding of when a clearing permit for protected plants is required. The amendments removed any reference to land tenure. Triggers for permits are based on the risk of encountering endangered, vulnerable or near-threatened (EVNT) plants during clearing activities. Only clearing vegetation within high risk areas can trigger the need for a clearing permit for protected plants under the NC Act.

This risk is captured through the Flora Survey Trigger Map, which maps all known observations of EVNT plants in Queensland and applies a 1 km buffer around these points. When clearing vegetation within the high risk area on the trigger map, a flora survey is required within the clearing impact area to identify if there are any actual EVNT species within the clearing impact area. If EVNT species are identified within the clearing area a flora survey report must be provided to the Department of Environment and Heritage Protection (DEHP) and a clearing permit is required. If not EVNT species are present, DEHP must be notified of the flora survey.

If clearing is proposed outside of the high risk area, and if there are known observations of EVNT plants and clearing will be carried out within 100 m of these plants there is still a legislative responsibility under the NC Act to apply for a clearing permit. In all other cases clearing outside of the high risk area is exempt from requiring a clearing permit under the NC Act.

The Project area is mapped within the high risk area and the project will result in impact to EVNT plants (Mount Emu She-oak) and vegetation within 100m of EVNT plants. A clearing permit under the NC Act will be required for this clearing.

7.3.3 *Vegetation Management Act 1999* (Qld)

The *Vegetation Management Act 1999* (VM Act) regulates the clearing of native vegetation in Queensland. The VM Act was introduced to halt broad-scale clearing in Queensland. The objectives of the VM Act are to:

- Preserve remnant Regional Ecosystems (RE) that are endangered, of concern or least concern
- Preserve vegetation in areas of high nature conservation value
- Preserve areas vulnerable to land degradation
- Ensure clearing does not cause land degradation
- Maintain or increase biodiversity

- Maintain ecological processes and encourage ecologically sustainable land use
- Regulate vegetation clearing.

The vegetation management framework within the VM Act is supported by Regional Ecosystem (RE) mapping, which maps areas of regulated vegetation subject to assessment and approval under an Operational Works application to clear native vegetation. Regulated vegetation includes remnant RE, regrowth RE on leasehold land for agriculture or grazing and State land, vegetation subject to an offset or declaration, and regrowth watercourse vegetation in Great Barrier Reef Catchments. The regulated vegetation map shows that remnant vegetation present within the Project area. All mapped regrowth vegetation within the project area is on freehold land and is not regulated by the VMAct.

Under the VM Act, clearing or regulated vegetation is only permitted if it is for a 'relevant purpose'. Pursuant of Section 22A(2)(a) of the VM Act, a project declared to be a significant project under the SDPWO Act is considered to be a relevant purpose.

Permits to clear vegetation are required unless exemptions apply under the *Sustainable Planning Regulation 2009 (Qld)* (SP Regulation). Under Schedule 24, Part 1(8) of the SP Regulation clearing vegetation for an airport related purpose, on airport premises, is exempt from requiring a permit to clear native vegetation.

7.3.4 *Land Protection (Pest and Stock Route Management) Act 2002*

The *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) provides a framework and powers for improved management of weeds, pest animals and the stock route network.

Under the LP Act, landholders have responsibilities for the management of declared plants. There are three classes of declared plants. Class 1 declared plants are plants that have the potential to become very serious pests in Queensland. The LP Act requires all landholders to keep their land free of Class 1 declared plants.

Class 2 declared plants are plants that have already spread over a substantial area of Queensland and their occurrence has resulted in serious impacts. Landholders must implement reasonable measures to keep their land free of Class 2 declared plants.

Class 3 plants are those that are commonly established in parts of Queensland and control by landowners is not warranted unless the plant is impacting, or has the potential to impact, on nearby environmentally significant areas (e.g. National Parks).

Both Class 3 and Class 2 declared pest plants are known to occur within the study area. The species and location are discussed in Section 7.4.7.

7.3.5 *Environmental Offsets Act 2014*

The *Environmental Offsets Act 2014* (Offsets Act) was passed with amendments on 22 May 2014. The commencement date for the Offsets Act has not been specified, but it is understood that the Offsets Act is expected to commence mid-2014. It is proposed to be supported by the Environmental Offsets Regulation 2014, the Queensland Environmental Offsets Policy and the Financial Settlement Offset Calculation Methodology, which are all currently the subject of public consultation.

The Offsets Act will introduce a new framework for environmental offsets in Queensland. Under the new framework provided by the Offsets Act, the existing five issue-specific offset policies are replaced by a single State policy governing the assessment of environmental offsets.

The Offsets Act will bind all persons including the State, but is expressed not to affect or limit the functions and powers of the Coordinator-General under the *State Development and Public Works Organisation Act 1971* (SDPWO Act).

Section 15 of the *Environmental Offsets Act 2014* removes the ability for the State and local government to impose an offset condition in relation to a prescribed activity, if a Commonwealth decision has already been made in relation to the same, or substantially the same activity, prescribed environmental matter and area of impact. It also removes the ability of a local government to impose an offset condition for a prescribed activity, if a State decision has already been made in relation to the same, or substantially the same activity, prescribed environmental matter and area of impact.

7.3.6 EPBC Act Environmental Offsets Policy

This offsets policy must be addressed when proposing offsets to compensate for residual adverse impacts on matters of national environmental significance. The policy outlines when offsets are required, the minimum acceptable offset to achieve a conservation outcome, appropriate delivery mechanisms (direct or indirect) and require long-term protection.

Under the EPBC Act Environmental Offsets Policy, it first must be demonstrated that impacts to matters of national environmental significance are avoided and mitigated as far as is practicable. Any residual significant impacts after all avoidance and mitigation measures have been applied, can be compensated with an offset. The offset must be a direct, land based requirement, providing for a long term and permanent net gain for the feature that is impacted. The policy requires over 90 per cent of the residual impact to be delivered in this way. Additional indirect measures, such as contribution to research, may be proposed to make up the gap if required.

To assist in determining the quantum of impact that an offset proposal covers, the Australian Government has compiled an Offset Assessment Guide, which is a tool that includes an impact and offset calculator. This tool takes into account the quantum of impact, the proposed offset, the timeframe over which the offset is delivered and a level of confidence score. A detailed offset proposal must refer to the Offset Assessment Guide, and provide detail on how the offset can adequately compensate and improve the feature that is impacted.

All offsets must also demonstrate how the offset area will be protected in perpetuity, such as changes in land tenure, application of conservation agreements or transfer into a State reserve system. A direct, land based offset will also require a maintenance and monitoring plan for a suitable length of time to ensure the offset is delivered and is self-sustaining.

Any offset that proposes the translocation of a threatened species must also consider the EPBC Act Policy Statement - Translocation of Listed Threatened Species. Translocation for flora species or vegetation communities can include a variety of methods, including seed collection, propagation and revegetation or movement of whole plants or vegetation communities (Vallee et al 2004). The policy statement provides a formal position that must be adopted by both the proponent when proposing a translocation and assessed by DoE officers when making a decision or recommendation regarding a translocation proposal.

For a translocation proposal to mitigate or offset an impact there must be clear evidence that the approach will be successful, risk of failure must be considered as well as any other impacts or risks as a result of the translocation.

7.4 EXISTING CONDITIONS

This section describes the vegetation communities of the Project area and outlines the value at a local, regional, state and national level. The significance of the vegetation communities for supporting rare flora species is presented, with a description of the vegetation assemblages that are likely or known to support these species. Where applicable, reference is made to previous studies and scientific literature that describes the ecology of the vegetation communities and flora species of the Project area.

7.4.1 Landscape context

The Project area is within the coastal zone of South East Queensland (SEQ), which is one of the most biologically diverse areas in Australia, but also one of the fastest developing zones for urban and peri-urban development. Throughout this region, existing pressures on flora have originated mainly from extensive land clearing in the region, with 65 per cent of the native vegetation being cleared or modified since European settlement (National Wildlife Corridors Plan Advisory Group 2012). As part of this, over 90 per cent of coastal heath has been cleared, with the remaining areas outside of national parks highly threatened from development (Leiper et al 2008).

The dominant factors influencing flora within the SEQ coastal zone are geography, geology and soils. The Project area sits predominantly on a large Pleistocene coastal plain of sand and mud. To the south-west of the Project area, there is also an area of Holocene tidal flats associated with the Maroochy River.

Within and adjacent to the Project area vegetation clearing has occurred since European settlement to facilitate agriculture and urban development. Aerial photographs obtained for the period between 1958 and 2011 show the expansion of sugar cane cropping to the west of the Project area, whilst urban development has established to the south and east of the Project area. Over time these land use changes have replaced areas of melaleuca wetland, mixed open forest, heathland and marine clay pan woodlands (DERM 2006). Large areas of contiguous remnant vegetation still exist along the Maroochy River as well as north and south of the airport (see **Figure 7.4a**).

A large part of this vegetation has been conserved within the Mount Coolum National Park (**Figure 7.4b**). The Mount Coolum section of the National Park was gazetted in 1990, with the two sections at Marcoola to the north and south of the Project area added at a later date. The park provides for the conservation of cultural, recreational, educational and economic values associated with the plants and plant communities that are present. The park protects 50 per cent of vascular plant species recorded for the Sunshine Coast area and represents approximately 40 per cent of the fern species found globally (EPA, no date; Queensland Department of Environment 1998). The park provides for the conservation of for several threatened flora species, including *Allocasuarina thalassoscopia* (Mt Coolum She Oak), Mount Emu She-oak and *Bertya sharpeana* (Mt Coolum Bertya), amongst others (EPA, no date). Flora in the Marcoola sections includes paperbark open forest to woodland, *Banksia aemula* (Wallum Banksia) woodland and open heathland (DERM 2011).

The Marcoola sections of the National Park also form part of Coolum Creek and Lower Maroochy River Wetlands, which are listed as nationally important wetlands. The wetlands are made up of several mapped areas (as shown as on **Figure 7.4b**), and includes low coastal marshes, swamps, estuary and sub-coastal tributaries approximately 32km in length and more than 15 km inland in the Eudlo Creek system (Department of Sustainability, Environment, Water, Population and Communities (SEWPAC 2010)).

The wetlands are significant for their high value to wildlife and ecosystems, the provision of habitat for threatened flora as well as the very high cultural significance for education and recreational purposes (SEWPC 2010).

In the south and west of the study area, Maroochy River Conservation Park and Maroochy Wetlands Conservation Park also part of the Lower Maroochy River Wetlands. Maroochy River Conservation Park is approximately covers 174 ha and includes areas of paper-bark tea tree swamp and tall open forest comprised of *Corymbia intermedia* (Pink Bloodwood) and *Lophostemon confertus* (Brush Box). A mixture of dry heath and rainforest species are found throughout the understorey of both forest types (Queensland Parks and Wildlife Service 1999).

Maroochy Wetlands Conservation Park covers 66 ha and comprises mainly saltpan vegetation, including grassland and herbland on marine clay plains (DERM 2011).

Figure 7.4a: Regional Ecosystems within the study area

Coolum Creek Conservation Park (342 ha) also exists in the north-east of the study area. Similar to Maroochy Wetlands Conservation Park, the park comprises mainly saltpan vegetation.

Areas of native remnant vegetation in the Project area are directly connected with both the northern and southern sections of the Marcoola precincts of Mount Coolum National Park. Ecological connectivity to Coolum Creek Conservation Park as well as Maroochy Wetlands Conservation Park in the west is currently severed by the Sunshine Motorway and vast tracts of cropping land.

In the south, the Maroochy River Conservation Park is also severed from intact vegetation communities in the Project area by airport infrastructure and urban development. Due to the different dispersal methods of plants within the study area, the degree of severance across the study area will vary. Some plants that have wide dispersal methods (e.g. via birds, bats or insects that fly long distances) are able to disperse seeds over wide areas and across land barriers, whilst others do not cross large distances during a single dispersal event and will be generally limited by the waterways, channels and urban development across the study area.

7.4.2 Regional Ecosystems

7.4.2.1 Mapped Regional Ecosystems

Within the Project area, approximately 27 per cent of the total area is mapped as containing remnant Regional Ecosystems (RE). A further 2 per cent is mapped as containing regrowth RE. The remaining 71 per cent is mapped as being non-vegetated (**Figure 7.4c**).

The dominant remnant REs within the Project area are:

- 12.2.7 – *Melaleuca quinquenervia* (Broad-leaved Paperbark) open forest and palustrine wetland covering 15 per cent of the Project area
- 12.2.12 – Closed or wet heath covering 11.7 per cent of the Project area.

Other REs mapped within the Project area occur across areas less than 1 per cent of the total area, and include sedgeland and *Casaurina glauca* (Coastal She-oak) woodland (**Table 7.4a**).

There is a higher proportion of remnant vegetation within the study area and surrounding landscape (**Figure 7.4d**). This higher proportion of remnant vegetation is due to the protection provided by the National Park areas and the riparian zones of the rivers and waterways.

Due to the physical conditions within the study area, there is a clumped distribution of mapped vegetation communities (**Figure 7.4e**). The RE mapping shows that the sand plains directly north and south of the airport are dominated by *Melaleuca quinquenervia* (Broad-leaved Paperbark) open forest and areas of closed heath. There is also a large sedgeland area dominated by *Baumea spp., Juncus spp.* and *Lepironia articulata* (Grey Sedge) mapped to the north of RWY 18/36.

The marine clay plains and estuaries along the Maroochy River are mapped as being dominated by mangrove shrubland to low closed forest with large patches of Coastal She-oak open forest (12.1.1) on the margins of the saltpan areas. The mapping also shows that Broad-leaved Paperbark open forest on coastal alluvium fringes these areas.

7.4.2.2 Survey results

Both the secondary and quaternary surveys (see **Figure 7.2b**) were undertaken to verify the RE mapping in the area within the Project area, the adjacent sections of Mt Coolum National Park and estuarine areas to the north-west of the Project area across the Sunshine Motorway. The results of the RE verification are contained in **Table 7.4b**. Within the 'RE mapping correct' column of **Table 7.4b**, a tick and cross together means the mapping was only partially correct.

Table 7.4a: Summary of mapped Regional Ecosystems within the Project area

Regional Ecosystem	Regional Ecosystem	Regional Ecosystem	Regional Ecosystem
12.1.1	1.15	0.6%	*Casuarina glauca* open forest on margins of marine clay plains
12.2.12	23.78	11.7%	Closed or wet heath
12.2.14	0.21	0.1%	Foredune complex
12.2.15	0.25	0.1%	Closed sedgeland in coastal swamps
12.2.7	30.62	15.0%	Broad-leaved Paperbark open forest and palustrine wetland
Regrowth	3.17	2%	Least Concern RE
Non-remnant	144.80	70.5%	Cleared, airport and cane lands

Figure 7.4b: Protected areas

Figure 7.4c: Proportion of mapped Regional Ecosystems within the Project area

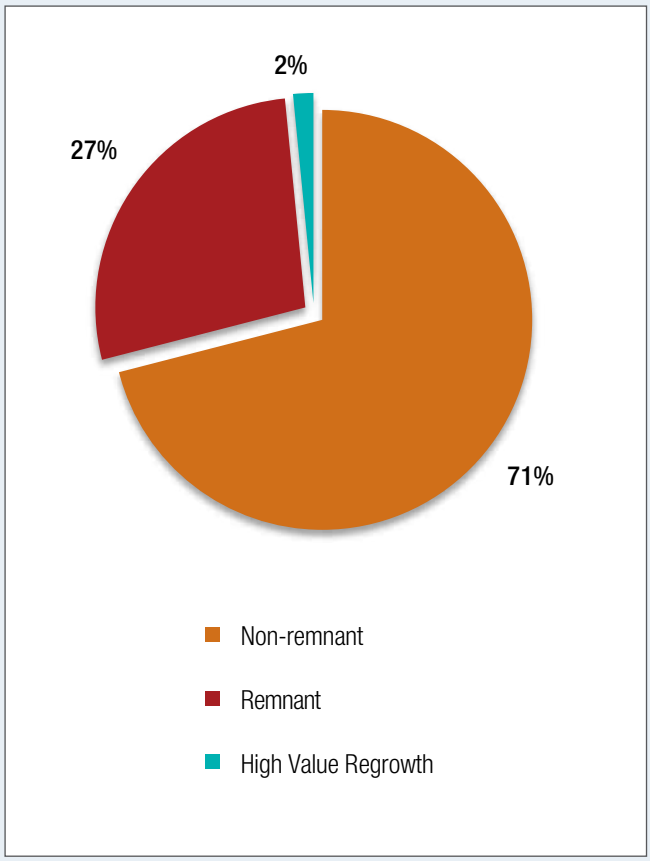
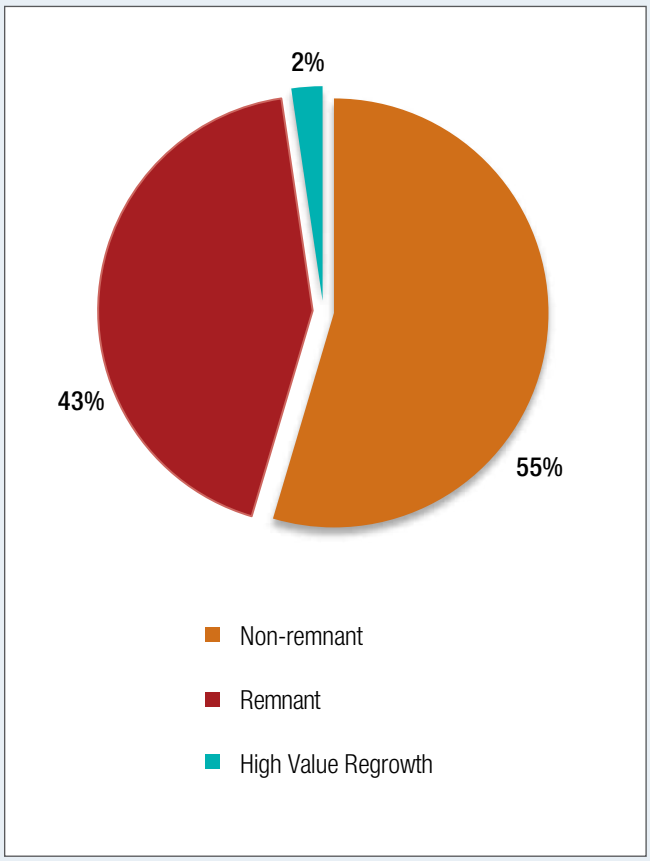


Figure 7.4d: Proportion of mapped Regional Ecosystems within the wider study area



7.4.2.3 Factors influencing vegetation distribution

During the fieldwork for this project, it was observed that the areas of melaleuca forest (RE 12.2.7) have expanded into areas mapped by the State Government as closed heath (RE 12.2.12). This is mainly evident around the constructed drainage lines and on the edges of the large heath plains in the northern and southern sections of Mt Coolum National Park. The expansion of melaleuca and eucalypt trees around drainage lines is likely a result of the earthworks to create embankments for the drainage lines and lowering of the groundwater table adjacent to the drainage lines. Along the edges of the heath plains the encroachment of melaleuca forest is likely due to reduced fire frequency compared to pre-development fire regimes as Broad-leaved Paperbark establishment is hindered by frequent fire events.

A study by Bartareau and Skull (1994, in Watson 2001) found that frequent burning reduced seedling establishment of a close relative of Broad-leaved Paperbark (*Melaleuca viridiflora*). A burning frequency of 10 to 20 years was recommended to allow saplings to establish to a size that can survive fire events.

A more regular fire interval is recommended for heathland as many characteristics of this community (including reproductive effort, plant density, vegetative cover, plant height and vertical density) peak at four to seven years after fire and then plateau or decline (McFarland 1998).

Once the community reaches a successional peak there is an opportunity for Broad-leaved Paperbark to establish.

Evidence of reduced fire frequency was also observed in the area of heathland (RE 12.2.12) surrounding secondary survey point 3. This area was dominated by a thick stand of *Hakea actites* (Wallum Hakea), which is likely to be excluding the abundance of other heath species. McFarland (1998) also found that lack of fire, even within 5 – 10 years, can cause this species to become dominant.

Another difference between the RE mapping and observed ground conditions is in the patch of unmapped RE directly north of the RWY 12/30. This area has been managed by the airport as low heath under the airport's Wallum Heath Management Plan (Hammermeister, Smith & Henderson, no date).

Although there is a mapped patch of regrowth RE, and some remnant RE further to the north, the site surveys for this project found that the unmapped areas within the Wallum Heath Management Area could floristically be considered regrowth wet heath and sedgeland. The vegetation here often had a low shrub layer of common heath species, including *Baeckea frutescens* (Weeping Baeckea), *Sprengelia sprengeliodes* (Sprengelia), *Dillwynia floribunda* (Showy Parrot Pea) and occasional emergent Broad-leaved Paperbark saplings. *Xanthorrhoea fulva* (Swamp Grasstree), *Leptocarpus tenax* (Slender Twine-rush), *Schoenus brevifolius* (Spikey

Figure 7.4e: Regional Ecosystem vegetation community mapping

Table 7.4b: RE verification

Survey Label	No.	Mapped RE	RE mapping correct	Description of observed vegetation community
Secondary	1	12.2.12	✔	Observed to be closed heathland on sandy soils, with occasional *Melaleuca quinquenervia* as a scattered canopy tree.
	2	12.2.12/ 12.2.7	✔ ✘	Transect undertaken across the boundary of two REs. Closest descriptions is RE 12.2.7. It was observed to be closed forest and had a canopy of *M. quinquenervia*. It is likely that the entire patch of RE 12.2.12 is RE 12.2.7.
	3	12.2.12	✔	RE Observed to be closed heathland on sandy soils. Very dense thicket dominated by Hakea actites.
	4	12.2.7	✔	Open forest where *M. quinquenervia* was the dominant canopy species.
	5	12.2.7	✘	Sedgeland. This area forms part of the Sunshine Coast Airport's heathland rehabilitation area and could be classified as sedgeland (RE 12.2.15) with surrounding wet heath (RE 12.2.12).
	6	Non-RE	✘	Open heathland on sandy plain. This area forms part of the Sunshine Coast Airport's heathland rehabilitation area and could be classified as regrowth RE 12.2.12.
Quaternary	1 2 3 4	Non-RE	✘	Open heathland on sandy plain. This area forms part of the Sunshine Coast Airport's heathland rehabilitation area and could be classified as regrowth RE 12.2.12.
	5	12.2.7	✘	This small patch of RE is more akin to RE 12.2.12b. It was vegetated swamp co-dominated by *Blechnum indicum*, and *Schoenus brevifolius*.
	6	12.2.12	✔	Dwarf open heath. RE 12.2.12 is the closest description.
	7	12.2.15	✔	*Baumea teretifolia* dominated swampland.
	8	12.2.15	✔	*Baumea articulata* dominated swampland.
	9	12.2.12	✔	Soil saturated with pooling water at site point and contains elements of sedgeland and open heath.
	10	12.2.12	✔	Historical aerial photography shows a transition from RE12.2.12 to RE 12.2.7. Low woodland, with *M. quinquenervia* low trees. 12.2.12 is still a suitable description however.
	11	12.2.12	✘	Historical aerial photography shows a transition from RE 12.2.12 to open forest more akin to RE 12.2.7. RE 12.2.7 is more suitable as a description due to the dominant tree layer of *M. quinquenervia* and heath and sedge understorey.
	12	12.2.7	✔	Remnant open forest dominated by *M. quinquenervia.*

Survey Label	No.	Mapped RE	RE mapping correct	Description of observed vegetation community
Quaternary	13	12.2.12	✘	Historical aerial photography shows a transition from RE 12.2.12 to open forest more akin to RE 12.2.7. RE 12.2.7 is more suitable as a description due to the dominant tree layer of *Melaleuca quinquenervia* and heath and sedge understorey.
	14	12.2.12	✘	Historical aerial photography shows a transition from RE 12.2.12 to open forest more akin to RE 12.2.7. RE 12.2.7 is more suitable as a description due to the dominant tree layer of *M. quinquenervia*.
	15	12.2.12	✘	Historical aerial photography shows a transition from RE 12.2.12 to open forest more akin to RE 12.2.7. RE 12.2.7 is more suitable as a description due to the dominant tree layer of *M. quinquenervia*.
	16	12.2.7	✔	Remnant open forest of *M. quinquenervia* with very dense ground layer of sedge species.
	17	12.2.7	✔	Remnant open forest of *M. quinquenervia* with ground layer of heath species.
	18	12.2.12	✔	Site at edge of two vegetation communities with low open forest dominated by *Melaleuca sieberi* to south, extending to airport fence. Open heath at site point, extending north to *M. quinquenervia* open forest.
	19	12.2.12	✔	Historical aerial photography shows a transition from RE 12.2.12 to RE 12.2.7. low open forest, with low layer of *M. quinquenervia*. RE 12.2.12 is still a suitable description however.
	20	12.1.1	✘	RE 12.2.7. Closed forest of *M. quinquenervia* up to 25 m tall. *Blechnum indicum* dominant ground layer.
	21	12.2.7	✔	Closed forest of *M. quinquenervia* up to 25 m tall. *B. indicum* dominant ground layer.
	22	12.2.7	✔	Open forest with *M. quinquenervia* dominant. Well defined tree subcanopy layer, with *Alphitonia excelsa, Acacia leiocalyx and Elaeocarpus retitculatus.*
	23	Non-RE	✔	Regrowth dominated by Slash Pine, with some *M. quinquenervia saplings.*
	24	Non-RE	✔	Similar vegetation composition as site 23, with *M. quinquenervia* more dominant. *Acacia sp* also well developed within shrub layer.
	25	12.2.7	✔	Open forest with M. quinquenervia dominant. Well-developed sub-canopy of *E. reticulatus* up to 10-12 m.
	26	12.2.14	✔	Low open forest with *Macaranga tanarius, A. leiocalyx, Casuarina equisitifolia* and *Banksia integrifolia subsp. integrifolia* co-dominant.
	27	12.1.1	✔	*Casuarina glauca* open forest.
	28 29	12.2.12	✘	Historical aerial photography shows a transition from RE 12.2.12 to RE 12.2.7. Closed forest, with *M. quinquenervia* dominating the tree layer. Thick understorey of *Hakea actites*. RE 12.2.7 is a more suitable description.

Survey Label	No.	Mapped RE	RE mapping correct	Description of observed vegetation community
Quaternary	30	12.2.12	✔	RE observed to be closed heathland on sandy soils. Very dense thicket dominated by *H. actites*.
	31	12.2.12	✔	RE observed to be closed heathland on sandy soils. Very dense thicket dominated by *H. actites*. Occasional emergent *M. quinquenervia*.
	32	12.2.12	✘	Historical aerial photography shows a transition from RE 12.2.12 to RE 12.2.7. Closed forest, with *M. quinquenervia* dominating the tree layer. Heath understorey. RE 12.2.7 is a more suitable description.
	33	12.2.12	✔	Observed to be open heathland on sandy soils, with occasional *M. quinquenervia* as a scattered canopy tree.
	34	12.2.12	✘	Historical aerial photography shows a transition from RE 12.2.12 to RE 12.2.7. Closed forest, with *M. quinquenervia* dominating the tree layer. Heath understorey. RE12.2.7 is a more suitable description.
	35 36	12.2.12	✔	Observed to be low closed forest with a thick stem density of *Melaleuca sieberi* dominating. *Banksia aemula* and *Lophostemon confertus* were subdominant. An understorey of heath shrub and sedge species was also present.
	37	12.2.12	✔	Observed to be open heathland on sandy soils, with occasional emerging *Melaleuca quinquenervia*.
	38	12.2.9	✔	Observed to be low open forest dominated by *B. aemula*. *M. sieberi* was observed to be emerging within the shrub layer. An understorey of heath shrub and sedge species was also present.
	39	12.2.12	✔	Observed to be open heathland on sandy soils, with occasional emerging *M. quinquenervia*. Dead shrubs common (probably *Persoonia virgata*).
	40	12.2.9	✔	Observed to be low closed forest with *B. aemula* and *Lophostemon confertus* codominant. *M. sieberi* was subdominant. An understorey of heath shrub and sedge species was also present.
	41	12.2.7	✔	Open forest domianated by *M. quinquenervia*. Heath shrub and sedge species present.
	42`	12.2.12	✔	Observed to be open heathland on sandy soils, with occasional emerging *M. quinquenervia*. Dead shrubs common (probably *Persoonia virgata*).
	43	12.1.1	✔	*C. glauca* open forest, with a subdominant tree layer of *Melaleuca quinquenervia*.
	44	12.1.3	✔	Mangrove open to closed forest dominated by *Bruguiera gymnorrhiza* and *Acrostichum speciosum*. *Avicennia marina* subdominant.
	45	12.1.2	✔	Saltpan vegetation. Codominated by *Sporobolus virginicus* and *Phragmites australis*.

Survey Label	No.	Mapped RE	RE mapping correct	Description of observed vegetation community
Quaternary	46	Non RE	✘	This area could be considered regrowth 12.2.7. Very dominate ground layer of *Baloskion pallens*. Young, emerging *M. quiquenervia*.
	47	12.2.12	✔	Low open heath dominated by *Xanthorrhoea fulva*.
	48	12.2.12	✔	*M. quinquenervia* forest with heath understorey.
	49	12.2.12	✔	Observed to be open heathland on sandy soils, with occasional emerging *M. quinquenervia*. Dead shrubs common (probably *Persoonia virgata*).
	50	12.2.12	✔	RE observed to be closed heathland on sandy soils. Very dense thicket dominated by *H. actites*.
	51	Non RE	✘	This area could constitute regrowth 12.2.15 as it was observed to be riparian sedgement with mature shrubs such as *B. robur*, *Persoonia virgatata*, and *H. actites*. *Schoenus brevifolius* dominated the ground layer whilst *M. quinquenervia* dominated the treelayer.
	52	12.2.12	✔	Relatively accurate, though very few shrub elements due to weediness. Could also be considered 12.2.15.
	53	12.2.12	✔	Relatively accurate, though very few shrub elements due to weediness. Could also be considered 12.2.15.
	54	Non RE	✘	Regrowth 12.2.15
	55	Non RE	✔	This area was predominantly the roadside vegetation. It was comprised of *Imperata cylindrical*, *B. robur*, *Banksia spinulosa var. collina*, *M. quinquenervia* and weeds such as *Megathyrsusmaximus var. maximus* and *Baccharis halimifolia*
	56	Non RE	✘	Regrowth 12.2.15. Sedge species dominated the ground layer whilst *M. quinquenervia* was also present.

Sedge), *Baumea teretifolia* (Pointed Twigrush), *Gahnia sieberiana* (Red-fruited Saw-sedge) and *Blechnum indicum* (Bungwall) are also common within the ground layer in wetter areas.

There is also a large patch of remnant RE that is mapped to the north of quaternary site 19. This area is regularly slashed for safety reasons, as it functions as a helicopter training area. The cleared area can be seen north of RWY 12/30 in aerial photography and does not meet the floristic requirements of a remnant vegetation community.

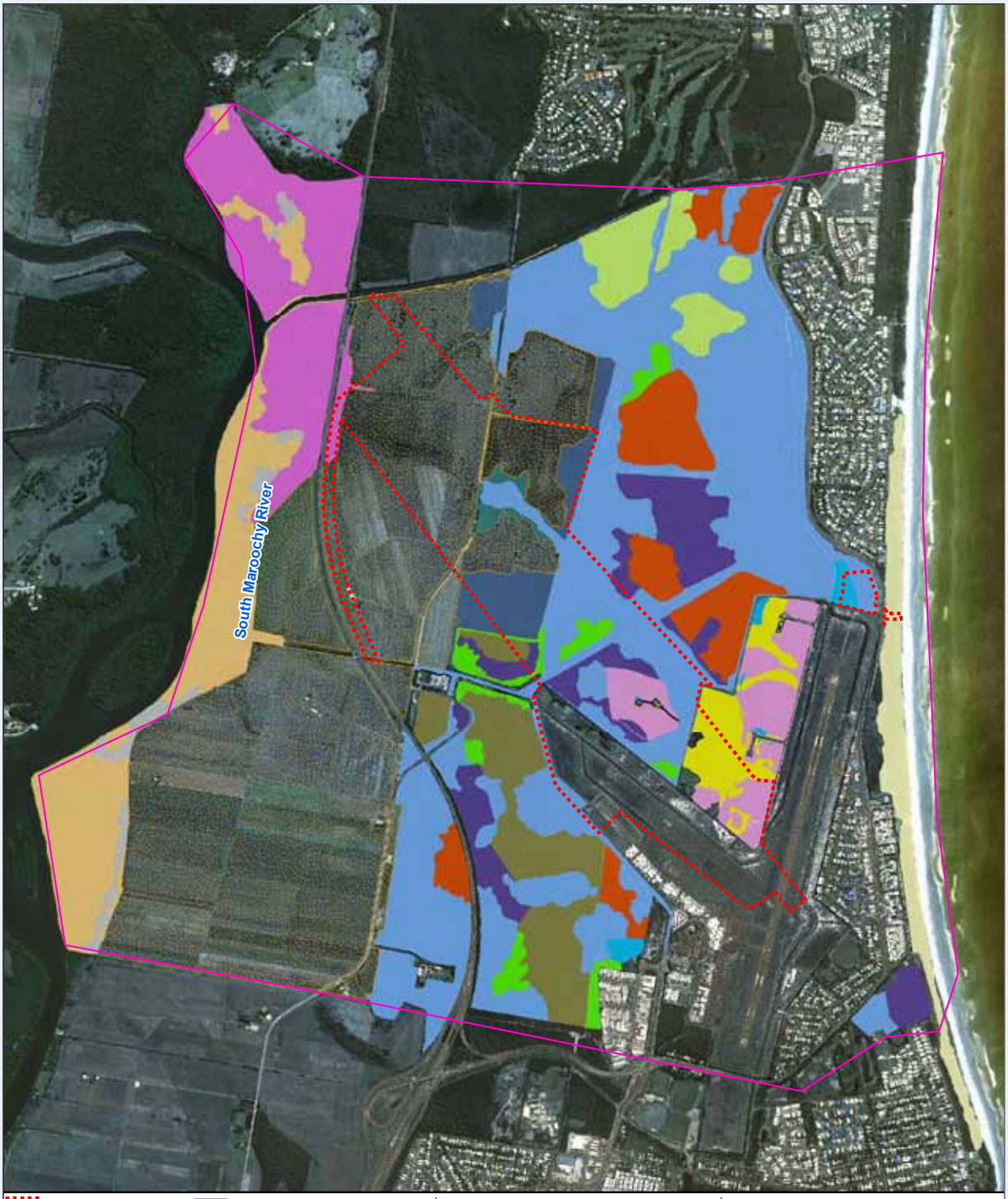
There are also several other inconsistencies between the RE mapping and the observed vegetation communities on the ground. For this reason, vegetation community mapping has been prepared across the study area at a scale of 1:5,000.

7.4.3 Vegetation community mapping

Based on aerial photography and site investigations, 17 communities have been described within the study area. Details of the location, floristic composition and structure of these communities are provided below in **Figure 7.4f** and **Table 7.4c**.

North and south of the airport is dominated by melaleuca woodland, melaleuca swamp, and various heath complexes. To the west is a large area of disused agricultural land, extending to the edge of the South Maroochy River. Here, vegetation is typically of estuarine clay pans and mangrove shrubland, with fringing Coastal She-oak open forest. To the east of the study area there are foredune complexes whilst a large area of melaleuca wetland exists directly to the north of RWY 18/36.

Figure 7.4f: Surveyed vegetation communities



The distribution of vegetation communities within the study area relates to an interaction of ecological processes including climate, disturbance history (fire, clearing, agriculture etc.), soil conditions, topography and slope aspect, hydrology and species characteristics such as competitiveness, reproductive capacity and reproductive technique. It is predicted that paperbark forest is replacing and encroaching on heath areas, with this process most likely due to changed fire regimes. Other factors that may have influenced vegetation community distribution within the study area include:

- Clearing for urban and agricultural expansion, the extent of which can be seen in **Figure 7.4f**
- Vegetation regrowing on abandoned agricultural land
- The introduction of weed species from forestry, agriculture and urban gardens
- Edaphic factors, as heath distribution in Australia is mainly determined by soils and geology rather than climate (Barry, 2005). The availability of sandy soils with limited soil nutrients and poor drainage has allowed heathland and paperbark wetlands to occur. Heath is also commonly associated with shallow water tables (particularly after rain), which perch (or semi-perch) on a hardpan layer such as coffee rock (Griffith et al. 2003; Bryan 1973; Department of Environment and Heritage Protection 2013)
- The presence of the Maroochy River estuary, influencing soil salinity due to tidal mixing with fresh river water, and surrounding marine clay plains
- Changes in groundwater levels due to surrounding development (e.g. drawdown around constructed drainage lines) and the associated changes in drainage
- SCA has also rehabilitated an area of heathland within the airport grounds in the Wallum Heath Management Area, resulting in an area of regrowth heathland to the west of RWY18/36.

7.4.4 State significant flora species

The Wildlife Online and HERBRECS database show the following endangered, vulnerable or near-threatened species listed under the NC Act as being recorded within the study area:

- Mount Emu She-oak – endangered
- *Allocasuarina thalassoscopica* (Mount Coolum She-oak) – endangered
- *Bertya sharpeana* (Mt Coolum Bertya) – near threatened
- *Acacia baueri subsp. baueri* (Tiny Wattle) – vulnerable
- *Eucalyptus conglomerata* (Swamp Stringybark) – endangered
- *Durringtonia paludosa* (Durringtonia) – near threatened
- *Schoenus scabripes* – near threatened
- *Phaius australis* (Lesser Swamp-orchid) – endangered.

The only species with a known population within the Project area is Mount Emu She-oak, which is discussed in detail in **Section 7.4.6.**

There is suitable habitat for the significant flora species listed above throughout the Project area, however no individuals or populations were recorded during the field surveys.

7.4.5 Matters of national environmental significance

7.4.5.1 Threatened ecological communities

The EPBC Act Protected Matters Search Tool (PMST) results also show that the critically endangered Lowland Rainforest of Subtropical Australia Threatened Ecological Community (TEC) may occur within the study area.

A review of the RE mapping and the results of the field survey indicate that this TEC is not present within the Project area, or within the wider study area. No other TECs were been identified from desktop studies or from the field surveys.

7.4.5.2 Threatened flora species

The PMST identified 19 EPBC Act listed threatened plant species that may exist within or adjacent to the Project area. However, as the tool utilises predictive modelling and does not rely on recent observations it may be subject to an amount of error due to the specific on-ground features at a site. **Table 7.4d** assesses the likelihood of each of these species being present in the Project area and **Figure 7.4g** maps habitat suitability for EPBC Act threatened flora. This mapping has been prepared in accordance with the requirements of Part C, Section 2.3 of the TOR.

The Wildlife Online database and Queensland Herbarium HERBRECS data show four EPBC Act listed threatened flora species have been previously recorded within the study area. These are Mount Emu She-oak, *Allocasuarina thalassoscopica* (Mount Coolum She-oak), *Phaius australis* (Lesser Swamp-orchid) and *Eucalyptus conglomerata* (Swamp Stringybark).

During the targeted and systematic field surveys carried out across the Project area, only a single threatened species – Mount Emu She-oak – was directly observed. Further detail on the Mount Emu She-oak population within the Project area is provided in **Section 7.4.6**.

There are currently no known populations of other EPBC Act listed threatened flora species within the Project area, however the presence of suitable habitat means that plants may establish or may be present at very low numbers to avoid detection. All other flora species identified in database and desktop searches are not considered likely to be able to establish within the Project area due to an absence of required habitat characteristics.

Table 7.4c: Site-based vegetation communities in the study area

Floristic community type	Description
 Agricultural land	These areas have historically been used for cropping since the early 1960s. Currently used for growing sugar cane, they are largely devoid of native vegetation, with the exception of scattered *Acacia spp*. and eucalypt regrowth along road edges.
 Casuarina open forest	Casuarina open forest, typically RE 12.1.1. This is dominated by *Casuarina glauca*, with *Melaleuca quinquenervia* sub-dominant and occasional *Myoporum acuminatum*. Other flora species observed included a shrub layer of *Alpinia arundelliana, Acacia maidenii* and *Livistona decora*. *Hibbertia scandens* was occasional whilst the ground layer consisted mostly of *C. glauca* leaf litter and *Phragmites australis*.
 Mangrove forest	This area encompasses open forest, closed forest and low closed forest and is typically RE 12.1.3. This ecosystem is dominated by *Avicennia marina* and *Bruguiera gymnorrhiza*, whilst *Acrostichum speciosum* and *C. glauca* is also common in parts.
 Marine couch/saltpan	This ecosystem consists of open patches of *Sporobolus virginicus* and *P. australis*, and is typically described as saltpan vegetation RE 12.1.2. Only small patches of this ecosystem exist across the study area and these are associated with the estuary areas of the Maroochy River.

Floristic community type	Description
 Foredune complex	Foredune complex, typically RE 12.2.14. This vegetation community was observed to contain *Macaranga tanarius, Pandanus tectorius, Acacia leiocalyx, Casuarina equisitifolia, Banksia integrifolia subsp. integrifolia, Schinus terebinthifolius, Alphitonia excelsa, Alectryon coriaceus* and *Melaleuca quinquenervia* within the canopy layer. In the sub-canopy were the vines were *Passiflora sp*. and *H. scandens*, whilst the ground layer consisted of *Imperata cylindrica, Bidens pilosa, Spinifex sericeus, Dianella congesta, Carpobrotus glaucescens* and several common exotic pasture grasses.
 Eucalypt regrowth	There is a small section of regrowth eucalypt forest, with several large eucalypt trees that have been retained along the edges of Finland Rd. The understorey in this area is dominated by exotic species, including *Lantana camara* and *Pinus elliotti* saplings.
 Melaleuca/slash pine regrowth	Melaleuca / slash pine regrowth, with clumped distributions of *M. quinquenervia* and *Pinus elliotii*, both at various stages of growth. There was also the occasional *A. leiocalyx* and *A. cincinnata*. The ground layer was open and predominantly bare, though *Fimbristylis polytrichoides, Lindsaea incisa, Lycopodiella cernua, Imperata cylindrica* and *Andropogon virginicus* were common in parts.
 Closed heath	Closed heath, typically RE 12.2.12. This vegetation community was dominated by *Hakea actites*, which formed a thick shrub layer between 1 and 2m high. Other common species in the shrub layer include *Melaleuca nodosa, Leptospermum liversidgei, Banksia robur, Allocasuarina emuina, Persoonia virgata* and *Leucopogon pimeleoides* as an emergent. The ground layer commonly consisted of *Xanthorrhoea fulva, Sporodanthus interruptus, Leptocarpus tenax* and *Empodisma minus*.

Table 7.4c: Site-based vegetation communities in the study area

Floristic community type	Description
 Melaleuca Low open forest	Melaleuca low open forest, which represents the expanding areas of RE 12.2.7 into neighbouring areas of RE12.2.12. This area is in the later stages of forest advancement and may now be considered RE 12.2.7. The low canopy was dominated by *M. quinquenervia* which was emerging over open heath.
 Melaleuca open forest	Melaleuca open forest, typically RE 12.2.7. *M. quinquenervia* was the dominant canopy species, with occasional Eucalyptus robusta. A well-defined sub-canopy tree layer of *A. excelsa, A. leiocalyx* and *E. reticulatus* was also observed. Within the shrub layer was *A. maidenii, Melastoma malabathricum subsp. malabathricum, Leucopogon pimeleoides, Persoonia virgata, Pultenea paleacea* and *B. robur*. The ground layer often included *Baloskion tetraphyllum, Blechnum indicum, Sporodanthus interuptus, Empodisma minus* and *Gahnia sieberiana*. *Hibbertia scandens* was also common as a vine.
 Melaleuca wetland	Melaleuca wetland, typically RE 12.2.7. *M. quinquenervia* was observed to dominate the tree layer, with the occasional *L. suaveolens* and *Melicope elleryana*. The shrub layer included *Lindsaea incisa*, and the vine *Parsonsia straminea*. The ground layer was commonly saturated with water and was dominated by *Blechnum indicum*, with occasional *Leersia hexandra*.
 Open heath	Open heath, typically RE 12.2.12. This vegetation community was observed to be dominated by *H. actites* followed by *B. robur*, with a scattered low canopy of *M. quinquenervia*. Other shrubs commonly observed include *A. emuina*, *L. liversidgei*, *Melaleuca thymifolia*, *Dillwynia glaberrima*, *Lomandra confertifolia* and *Persoonia virgata*. The ground layer was dense with *X. fulva, S. interruptus* and *L. tenax.*

Floristic community type	Description
 Open heath with melaleuca thickening	Open heath with Melaleuca thickening, which represents the expanding areas of RE 12.2.7 into neighbouring areas of RE 12.2.12 (as discussed in Section 2.2.2). This area maintains the characteristics of heath, though a more-dominant tree layer of *M. quinquenervia* is starting to emerge.
 Regrowth open heath	Regrowth open heath, typically RE 12.2.12. In this vegetation community, heath vegetation was less than 0.5m tall, and could also be considered dwarf open heath in some areas. There was the occasional clump of *M. quinquenervia* saplings in some locations, though the shrub layer was ecologically dominant. This was composed of *Boronia falcifolia*, *B. robur*, *Banksia aemula*, *Sprengelia sprengeliodes, Philotheca queenslandica, Ricinocarpus pinifolius, M. nodosa, Strangea linearis, Dillwynia floribunda, Phyllota phylicoides, B. frutescens* and *L. liversidge*i. The ground layer was thick and comprised of *X. fulva, S. interuptus, L. tenax, E. minus* and *G. sieberiana*.
 Regrowth wet heath	Regrowth wet heath, typically RE 12.2.12. In this vegetation community, the soil was observed to be saturated, with pooled water up to 100mm high. This community differed to regrowth open heath as it was dominated by heath species more adapted to saturated conditions. Flora observed included *B. indicum* (dominant), *Baloskion tetraphyllum, G. sieberiana, Lepironia articulata* and *Schoenus brevifolius*. The occasional *Pultenea paleacea* was also observed whilst *M. quinquenervia* and *Acacia sp*. saplings were present on the outer edges.

Floristic community type	Description
 Sedgeland	Sedgeland, typically RE 12.2.15. This community exists at drainage and low level depressions with pooling water. It has some aspects of regrowth wet heath flora, though sedges are more dominant. Species observed include *B. teretifolia* and *B. indicum* (which are often dominant), *X. fulva, L. articulata* and *G. sieberiana*. The occasional *Persicaria subsessilis* was also observed.
 *Banksia aemula/ Melaleuca sieberi* low closed forest	This ecosystem is dominated by a low (>10m) canopy layer of *M. sieberi* and *B. aemula*. The presence of *B. aemula* as a codominate canopy species indicates that this ecosystems could be described as RE 12.2.9. *Lophostemon confertus* was also occasionally present as a canopy species. The shrub layer consists of common heathland shrubs such as *Leucopogon leptospermoides, Ricinocarpus pinifolius, Austromyrtus dulcis* and *Leucopogon juniperus*, whilst *S. interuptus* (dominant), *B. tetraphyllum* and *X. fulva* is also present as a ground layer.

7.4.6 Mount Emu She-oak

Surveys identified one population of Mount Emu She-oak at Population 1 (AEP1) within the Project area, as well as a smaller population at Population 2 (AEP2) to the north of the Project area, on the western edge of Mount Coolum National Park. No other threatened species were observed during the surveys.

Mount Emu She-oak is currently known from 11 populations on the Sunshine Coast. Two of these populations occur within the study area.

Population Area 1

Mount Emu She-oak population 1 (AEP1) is known as the Finland Road population within the National Recovery Plan for the Mt Emu She-oak *Allocasuarina emuina* ('the Recovery Plan') (Environmental Protection Agency 2007). The population area includes SCC-owned freehold land, State land and the South Marcoola Section of the Mount Coolum National Park. The Recovery Plan states that individuals are scattered over the entire area (Environmental Protection Agency 2007).

Figure 7.4h shows the locations of the Mount Emu She-oak surveys designed to estimate the population in AEP1. The results of the population estimates are shown in **Table 7.4e**. Based on this study, it is estimated AEP1 contains 12,152 Mount Emu She-oak plants over an area of 23.8 ha.

The Finland population would constitute a significant population, having:

- The greatest number of individuals out of the other populations described by Lamont (2010) and the Recovery Plan
- Representing 47 per cent of the known population (based on 2003 population estimates within the Recovery Plan), or 29 per cent of the known population based on Lamont's (2010) survey in 2006.

This is due to the AEP1's large area compared to the other populations. It is not due to an extraordinarily high density of plants. The mean density of plants across all 11 populations was 994 plants/ha, with a standard deviation of 525.6 plants/ha (Lamont 2010).

Lamont (2010) estimated 12,429 individuals of Mount Emu She-oak existed in the Finland Road population in 2006, having sampled an area of 11.2 ha south of the drainage channel, excluding the area of Wallum Hakea dominated habitat north of the drainage channel.

Table 7.4d: Threatened species presence likelihoods

Species	EPBC Act*	NC Act*	Habitat and Distribution	Likelihood of presence in the Project area
Acacia attenuata	V	V	High rainfall areas of SEQ; confined to coastal lowland sand plains. This species occurs on flat coastal lowland plains, at altitudes of lower than 30 m above sea level. This species is through to have a close association with the ecotone between wet heathland and open eucalypt forest communities (SEWPC 2012a).	Possible
Acacia baueri subsp. bauera Tiny Wattle	Not listed	V	Grows in wet sandy heath on the coast and adjacent plateaus (Kodela, no date).	Possible The HERBRECS data shows that this species was collected from the airport ground in 2003 within the wet heath community. Wildlife Online reports four sightings and three specimens within the study area whilst the Atlas of Living Australia also reports that three individuals have been observed in the study area.
Allocasuarina defungens Dwarf Heath Casuarina	E	Not listed	Found around the Northern and Hunter–Central Rivers (NSW) in coastal areas of wet to dry heathland (TSSC 2008a).	Unlikely – not within or close proximity to known distribution (although RE 12.2.12 represents suitable habitat within the study footprint).
Allocasuarina emuina Emu Mountain She-oak	E	E	Restricted geographic range between Beerburrum and Noosa on Queensland's Sunshine Coast. Heathland environments (SEWPC 2012b).	Known Wildlife Online data, HERBRECS data, the Atlas of Living Australia, various studies (Lamont 2010, and others documented in the Recovery Plan [Environmental Protection Agency 2007]) and the present site investigations revealed that this species is common within areas within the Project area.
Allocasuarina thalassoscopica	E	E	Allocasuarina thalassoscopica is known from only one locality at Mt Coolum, 3 km south of Coolum Beach on the Sunshine Coast, Queensland. The plant is restricted to the heathland community on the slopes of the summit (TSSC 2008b)	Unlikely Know populations occur on the montane heath communities on the summit of Mount Coolum. No suitable habitat within the Project area.
Arthraxon hispidus Hairy-joint Grass	V	V	Found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps. In SEQ, Hairy-joint Grass has also been recorded growing around freshwater springs on coastal foreshore dunes, in shaded small gullies, on creek banks, and on sandy alluvium in creek beds in open forests, and also with bog mosses in mound springs (TSSC 2008c)	Unlikely The Atlas of Living Australia reports that this species has been observed in the study area, There is a low likelihood that the species could exist in the Project area due to the habitat types present.

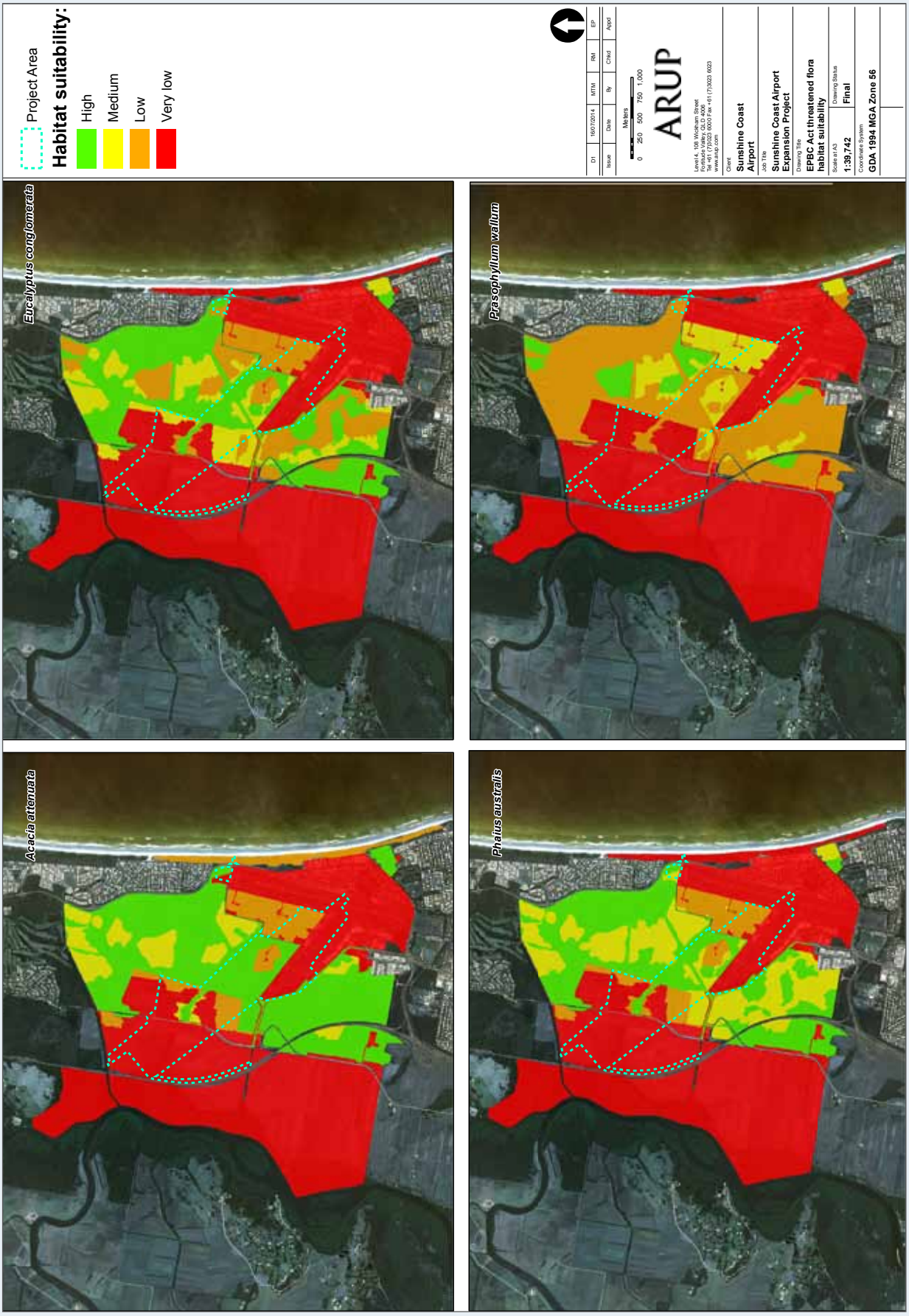
Species	EPBC Act*	NC Act*	Habitat and Distribution	Likelihood of presence in the Project area
Baloghia marmorata Marbled Balogia, Jointed Baloghia	V	V	Marbled Balogia has a geographically disjunct distribution confined to the Lismore district, in north-east NSW, and the Tamborine Mountains and Springbrook, in SEQ. Marbled Balogia is found in subtropical rainforest/ notophyll vine forest and wet sclerophyll forest (brush box woodland) with rainforest understorey between 150 and 550 m above sea level (TSSC 2008d).	Unlikely due to geographical range.
Bertya sharpeana Mt Coolum bertya	Not Listed	NT	Found on the steep cliffs of Mt Coolum. Inhabits montane heath (Leiper et al 2008).	Unlikely Know populations occur on the montane heath communities on the summit of Mount Coolum. No suitable habitat within the Project area.
Bosistoa selwynii Heart-leaved Bosistoa *Bosistoa transversa* Three-leaved Bosistoa	V	Not listed	Three-leaved Bosistoa is known from the Richmond River, NSW, to Mt Larcom near Gladstone, Queensland Bosistoas grow in wet sclerophyll forest, dry sclerophyll forest and rainforest up to 300 m in altitude (TSSC 2008e). These species had been separated out as separate species, but the distinction between the taxa cannot be maintained (Richards, no date).	Unlikely No suitable habitat within the Project area
Bulbophyllum globuliforme Miniature Moss-orchid	V	NT	Miniature Moss-orchid occurs in the McPherson Range of north-east NSW and SEQ; in the Maleny and Noosa areas of the Wide Bay district of Queensland and in the Calliope Range inland from Gladstone, Queensland. The species grows only on Hoop Pines (*Araucaria cunninghamii*), colonising the upper branches of mature trees in upland rainforest (TSSC 2008f)	Unlikely
Cryptocarya foetida Stinking Cryptocarya, Stinking Laurel	V	V	Stinking Cryptocarya is known from Iluka, NSW, to Fraser Island and east of Gympie, southern Queensland. Stinking Cryptocarya grows in littoral rainforest, usually on sandy soils, with mature trees also growing on basalt soils (TSSC 2008g).	Unlikely No suitable habitat within the Project area.
Durringtonia paludosa Durringtonia	Not listed	NT	Grows in closed sedgeland communities in coastal swamps and wet heath (James, no date; Leiper et al 2008).	Possible Suitable habitat within the sedgeland and wet heath areas.

Species	EPBC Act*	NC Act*	Habitat and Distribution	Likelihood of presence in the Project area
Eucalyptus conglomerata Swamp Stringybark	E	E	Swamp Stringybark is known from 10 locations and 22 populations between Kin Kin and Beerwah in southern Queensland. The species typically grows on the margin between open forest and heathland, on deep sandy acidic soils (TSSC 2008h).	Possible This species is known from Wildlife Online, HERBRECS data and the Atlas of Living Australia. The HERBRECS data reports that two individuals were observed 1 km north of Marcoola (outside of Project area) in 1990. The reported locations of these trees are lie within an area of residential development (Seaside Boulevard) built in the mid 1990's, and are therefore unlikely to still be present.
Leptospermum oreophilum	V	Not listed	Found on rocky slopes of the Glass House Mountains and Mt Coolum. Inhabits montane heath (Leiper et al 2008).	Unlikely This species was identified as part of the Wildlife Online search results. Due to its known distribution, it's likely this was recorded on Mt Coolum. It is unlikely to be within the Project area.
Macadamia ternifolia Small-fruited Queensland Nut, Gympie Nut	V	V	Small-fruited Queensland Nut is endemic to Queensland. Historically, this species occurred from near Gympie to Brisbane, however, the species is now restricted to an area between Mt Pinbarren south to Mary Cairncross Park, near Maleny. Small-fruited Queensland Nut has a specialised habitat requirement, and the species generally occurs in fertile, basalt-derived soils on steep southern slopes (TSSC, 2008i)	Unlikely. No suitable habitat within the Project area
Phaius australis Lesser Swamp-orchid	E	E	The Lesser Swamp-orchid is endemic to Australia and occurs in southern Queensland and northern NSW. The Lesser Swamp-orchid is commonly associated with coastal wet heath/sedgeland wetlands, swampy grassland or swampy forest and often where Broad-leaved Paperbark or Swamp Mahogany are found (SEWPC 2012c).	Possible Suitable habitat within wetter areas of the Broad-leaved Paperbark forest and sedgeland with a shaded canopy overstorey.
Phebalium distans Mt Berryman Phebalium	CE	E	The Mt. Berryman Phebalium is known from ten populations in SEQ, where it is endemic. Five of these are in close proximity to one another at Mt Berryman (Lockyer Valley Regional Council). Four are at Mt Jones Plateau, near Kingaroy (South Burnett Regional Council), and the tenth at Mt Walla, near Coalstoun Lakes (North Burnett Regional Council). It is always found in semi-evergreen vine thicket on red volcanic soils or communities adjacent to this vegetation type (TSSC 2008j).	Unlikely Outside of known population range and no suitable habitat present within the Project area.

Species	EPBC Act*	NC Act*	Habitat and Distribution	Likelihood of presence in the Project area
Plectranthus torrenticola	E	E	*Plectranthus torrenticola* is known from eight locations in the Sunshine Coast hinterland of SEQ, from the Blackall Range (south of Nambour) to Kin Kin (between Gympie and Noosa. The plant grows in open heathland on rock outcrops, or in dappled shade under eucalypt open forest close to margins of rainforest and often along creek lines, at altitudes of 250–450 m (SEWPC 2012d).	Unlikely No suitable habitat within the Project area.
Prasophyllum wallum	V	V	*Prasophyllum wallum* occurs in SEQ, in wallum communities and adjacent stabilised dunes and coastal Melaleuca swamp wetlands. The plant is reserved in Coolum Environmental Park (TSSC 2008k).	Possible Suitable habitat within closed and/or wet heathland habitats.
Schoenus scabripes	Not listed	NT	Grows in wet heath in sandy soils (Wilson 2005).	Possible The Wildlife Online and Atlas of Living Australian search results show that this plant has been recorded within the study area. The HERBRECS data shows that the species was recorded within the airport grounds in 2003. Suitable habitat within sedgeland and wet heath areas.
Streblus pendulinus Siah's Backbone, Sia's Backbone, Isaac Wood	E	Not listed	On the Australian mainland, Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest (SEWPC 2012e).	Unlikely No suitable habitat present within the Project area.
Taeniophyllum muelleri Minute Orchid, Ribbon-root Orchid	V	Not listed	Grows on outer branches and branchlets of rainforest trees; coast and coastal ranges, from sea level to 250 m alt (Weston, no date).	Unlikely No suitable habitat within the Project area.
Triunia robusta	E	E	*Triunia robusta* is restricted to a small area on Queensland's Sunshine Coast, between Pomona and Woombye, mainly in the Maroochy River catchment area covering a range of approximately 40 km. The physical characteristics and vegetation type across known sites of *Triunia robusta* vary substantially. The main habitat is notophyll vine forest, or mixed tall open forest developing a rainforest understorey in the absence of fire (TSSC 2008l).	Unlikely The Atlas of Living Australia show that this species has been recorded in the study area; however, the accuracy of the coordinate point is 26 km, and therefore this observation may not have been in the study area. It may exist within the small rainforest patches in study area and is unlikely to exist in Project area.

**EPBC Act: Represents the species listing under the EPBC Act. CE = Critically Endangered; E = Endangered; V = Vulnerable;*
±NC Act: Represents the species listing under the NC Act. E = Endangered; V = Vulnerable; and NT = Near Threatened.
^Likelihood of occurrence: Unlikely: no recent observations and/or no suitable habitat present; Possible: recent observations and/or suitable habitat present; Known: directly observed on the site

Figure 7.4g: Habitat suitability for EPBC Act listed flora not detected in the Project area



The surveys undertaken as part of the present study found that there was a difference in the density of Mount Emu She-oak depending on the vegetation community (**Figure 7.4h** and **7.4i** and **Table 7.4e**). The species had a higher density in the heath area south of the drainage channel. Here density was found to be 915 plants/ha, with the estimated number of plants in this area being 9,420.

The closed heath area to the north of the drain was dominated by a thick layer of Wallum Hakea that partially restricts the establishment and persistence of other flora. For this reason, Mount Emu She-oak density was found to be 322 plants/ha, with a total estimate of 2,083 plants. This is significantly lower than the southern area of AEP1. The northern area has the potential to support similar densities as the southern habitat areas if appropriate fire management is implemented. This is because the northern area appears to be in a later stage in succession, where Wallum Hakea has out-competed Mount Emu She-oak in the absence of an appropriate fire regime.

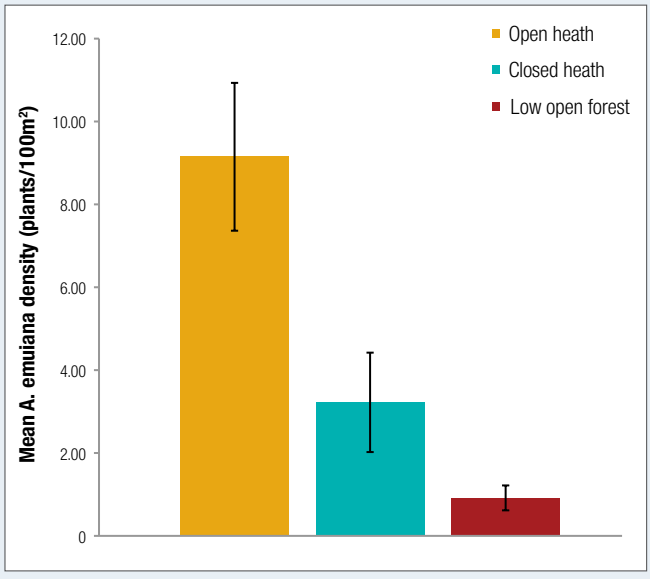
In areas of Broad-leaved Paperbark low open forest to open forest, Mount Emu She-oak density was found to be 92 plants /ha. In this vegetation community, it is estimated that 649 plants occur.

Population Area 2

Mount Emu She-oak population 2 (AEP2) is known from the Recovery Plan (Environmental Protection Agency 2007) as well as Lamont (2010) and is approximately 1 km north of AEP1. The Recovery predicted that 30 individuals were present in this population in 2003 whilst Lamont (2010) estimated 59 individuals based on surveys in 2006.

A traverse of the area during the current survey detected the presence of Mount Emu She-oak plants, however a systematic population survey was not carried out as AEP2 will not be impacted by the project.

Figure 7.4i: Mean Mount Emu She-oak density in the three different habitat types: Open heath, closed heath and low open forest. Bars represent the standard error



Both the Recovery Plan (Environmental Protection Agency 2007) and Lamont (2010, pp.45) notes that the population was beginning to senesce and become moribund. Lamont (2010) also notes that this was the only population found under coastal woodland, whilst the last fire appears to have occurred in1994 (Queensland Parks and Wildlife Service 2012). The development and thickening of the overstorey is likely to have resulted in shading of the species and thus limited growth. In addition, Lamont suggests (2010, pp. 51) that pollen flow may also be restricted by dense and/or emergent vegetation. During Lamont's (2010) study, he also showed that AEP2 had a low germination viability compared to the other populations.

The ecology of Mount Emu She-oak within the study area

A detailed description of the biology and ecology of Mount Emu She-oak can be found within the Recovery Plan for the species (Environmental Protection Agency 2007); however, relevant information has been included here to give an understanding of how ecological processes within the study area have influenced its abundance and distribution.

Mount Emu She-oak is restricted to heathland areas between Beerburrum and Noosa in Queensland's Sunshine Coast. The two populations are located in a flat coastal area as between the elevations of 2 and 4 m above sea level. Olsen (2002, in Environmental Protection Agency 2007) has indicated that the species prefers wetter heath soils, distinguishing it from its close relative *Allocasuarina thalassoscopica*, which occurs predominantly on dry heath soils. Mount Emu She-oak exists on nutrient poor light to medium clays or sandy loams with weak acidic reaction (Environmental Protection Agency 2007).

The current distribution of Mount Emu She-oak at AEP1 and 2 is restricted by conditions provided by cleared habitat and melaleuca forest, the depth of coffee rock and the varying fire history in the two population areas. There does appear to be suitable heath habitat south of AEP1within the southern section of Marcoola sections of the Mount Coolum National Park, though the population is not known to inhabit this area. Even if the species once existed in this area, the direction of the prevailing winds may be limiting the rate of recolonisation. This is because the wind-dispersed seeds have short dispersal distances, with much of the seed germinating within one metre of the adult plant. Thus, whilst northwest winds are common in the autumn months, prevailing south and south-east winds (Lamont 2010) could be reducing the rate of southerly colonisation/recolonisation.

The species has a close relationship with fire. During fire, the above ground parts of Mount Emu She-oak can be irreparably damaged; though seeds are often retained in the cones until they open after fire, allowing the species to successfully regenerate. Surviving adult plants are also able to flower in the growing season following fire whilst there is also evidence suggesting the species can resprout from viable lignotubers when the above ground parts of the plant are destroyed (Environmental Protection Agency 2007).

Figure 7.4h: Mount Emu She-oak population at Finland Road (AEP1)

Table 7.4e: Mount Emu She-oak population estimate by habitat type

Habitat type	Habitat area (ha)	Area sampled (ha)	Plants counted *no.*	Density (plants/ha)	Habitat N
Open heath (south)	10.30	0.27	247	915	9,420
Closed heath (north)	6.47	0.18	58	322	2,083
Broad-leaved paperbark low open forest/Open forest with heath	7.08	0.13	12	92	649
TOTAL	23.84	0.58	317	-	12,152

There is a strong negative correlation between germination rates and time since fire, and a strong positive relationship between germination rates and the number of fires experienced by a population over the last 20 years. Fire regime is a greater determinant of germination than population size, cone volume, and regularity of pollination, seeding production or seed size. This shows the importance of fire for the persistence of the species (Lamont 2010).

Despite the species' adaptation to fire, there are a few factors that can influence reproduction success post fire (Halford 1993, in Environmental Protection Agency 2007), including:

- Fire frequency: it is suggested that the plant requires two growing seasons before reproduction commences and another six months before the seeds can mature
- Fire intensity: A low intensity fire may not sufficiently stimulate the opening of cones
- Fire seasonality: Seasonal rainfall levels, soil and ambient temperatures and levels of sunlight post fire could also affect seedling recruitment after fire.

Within AEP1, wildfires are reported as occurring in 1994 and 2002 for the southern area (Queensland Parks and Wildlife Service, 2012), whilst the Recovery Plan for the species notes that a fire occurred in 2001. The 2001 fire mentioned in the Recovery Plan may in fact be the same as the 2002 fire mentioned by the Queensland Parks and Wildlife Service (QPWS), given that the QPWS actively manages fire within the area. There is no recent evidence of fire within the area of Mount Emu She-oak habitat north of the drainage channel, as evidenced by the differing vegetation characteristics between the north and south areas. The northern area contains dense layer of tall Wallum Hakea whilst the southern area is more open and floristically diverse.

Field observations have suggested that Mount Emu She-oak may begin to senesce after approximately 10-15 years in the absence of fire (Olsen 2002 in Lamont 2010) whilst parent plants may succumb to fungal attack from *Phytophthora cinnamomii* (Lamont 2010). The viability of the seedbank of several species of *Allocasuarina* has been found to decrease over similar timeframes (Halford 1993a; Pannell & Myerscough 1993; McKiernan 1997 in Lamont 2010). The absence of fire in the northern area is likely due to the fact that this area is owned by SCC and fires managed by QPWS were restricted to lands south of the drainage channel (i.e. predominantly the National Park area).

The Recovery Plan notes that the AEP1 population exhibited germination after a fire in 2001 (pp. 9), potentially explaining why the population density of Mount Emu She-oak is much higher in the southern portion.

Across all known Mount Emu She-oak populations on the Sunshine Coast, Lamont (2010) found that the northern and southern population groups (separated by the Maroochy River) were genetically distinct. In the northern region, AEP1 and 2 were found to be genetically distinct from the other nine populations and displayed a high level of genetic similarity despite their current distance of over 1 km. Little exchange was detected with the populations that lie approximately 12 km to the north (Lamont, pp. 90). AEP1 and 2 were revealed to have a relatively low genetic diversity compared to the other populations.

7.4.7 Declared pest plants

The areas of remnant vegetation traversed within the Project area as part of the main survey were observed to be generally free of exotic plant species. Exotic plant species were observed to be common on the edges of areas of remnant RE, within the foredune area, and within areas of melaleuca/slash pine regrowth. Declared pest plants observed during the surveys include:

- *Asparagus aethiopicus* (Basket Asparagus Fern, a declared Class 2 pest plant)
- *Baccharis halimifolia* (Groundsel, a declared Class 2 pest plant)
- *Lantana camara* (Lantana, a declared Class 3 pest plant)

Groundsel was locally common and abundant within cleared areas of the former cane lands and Asparagus Fern occurred within regrowth areas of paperbark forest in the former cane lands. Lantana was observed at very low densities on the edges of remnant vegetation adjoining the former cane lands.

Under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) Class 2 declared pest plants are established in Queensland and an have adverse economic, environmental and social impacts. Landholders must take reasonable steps to keep these plants off their land and control or remove any infestations.

Class 3 declared pest plants are already established in Queensland and landholders are only required to control

these plants when they are adjacent to an environmentally significant area, such as a National Park. SCC has a legislative responsibility to control these pest plants on the SCA site. Impacts associated with weed spread during construction will be addressed in the Environmental Management Plan (EMP) for the project (see Chapter E3), however ongoing weed management will be required by SCA to contain any existing weed infestations outside of the construction footprint for the Project.

7.5 DESCRIPTION OF SIGNIFICANCE CRITERIA

The results of the impact assessment for this chapter are discussed in relation to three factors:

- the magnitude of impacts (significance / consequence) (**Table 7.5a**)
- the duration of impact (**Table 7.5b**)
- the likelihood of impact (**Table 7.5c**).
- These are considered together to determine the final level of impact, which is described in **Table 7.5d**.

7.6 IMPACT ASSESSMENT

In this section direct impacts are first described in the context of the project's known impacts to environmental values such as vegetation communities and significant flora species. Indirect impacts associated with edge effects, fragmentation hydrology and groundwater are also discussed.

7.6.1 Mitigation inherent in design

In the early stages of design development, the population of Mount Emu She-oak was identified as a significant constraint. The alignment of the Airport Drive extension, as the main access road, was designed to avoid the area of closed heath to the south of the drain. This area supports the highest density of Mt Emu She-oak plants in the Finland Road population area.

During the development of the final design for the Project, the total development footprint has been reduced to include only the new runway area, with the future new terminal building excluded from the project. The alignment of the runway has also shifted further to the south-east. These design amendments have minimised the amount of clearing in the remnant closed heathland around Finland Road.

Design of the runway strip and northern drainage has been modified in order to significantly reduce impacts to ground water quality and ground water levels. This includes sheet pile lining of the northern perimeter drain to prevent drawdown of groundwater to the north, as well as lining of the runway fill area to prevent seepage of saline water into the groundwater during construction.

7.6.2 Matters of National Environmental Significance

Within the Project area, the only matter protected under Commonwealth legislation is the Finland Road Mount Emu She-oak population. The project will result in a loss of approximately 4.4 ha of Mount Emu She-oak habitat. At the time of survey, this represented approximately 550 plants, or 5 per cent of the Finland Road population (**Table 7.6a** and **Figure 7.6a**). This estimate is likely to be variable and depends on the time the survey was undertaken and the seral stage (the stage of regeneration of ecosystem after disturbance such as fire or clearing). This is because Mount Emu She-oak populations have the potential to be much denser in heathland areas that have been subject to a suitable fire regime of a cool, winter burn every 5-10 years. This fire regime has been excluded from the northern areas of closed heath and the melaleuca open forest habitat types that support Mount Emu She-oak in the Project area.

Table 7.6b assesses the significance of the impact to Mount Emu She-oak based on the criteria for endangered species within the Significant Impact Guidelines (DOE, 2013).

Based on the results of the assessment against the EPBC Act significant impact criteria in **Table 7.6b**, it is assessed that the project is likely to have a significant impact upon Mount Emu She-oak. This is due to the direct removal of plants and supporting habitat that reduces the area of occupancy for the Finland Road population and the removal of habitat that will lead to a reduction in plants in the population. With the implementation of an environmental offset, it is likely that the project can reduce the impact and potentially, over time, provide a positive conservation outcome for the species. Proposed mitigation measures and offsets are discussed in **Section 7.7**.

Table 7.6c provides an assessment of the Project against recovery plans for Mt Emu-She Oak and Attenuata Wattle (as per the requirements of the TOR.

7.6.3 Impacts to State matters

7.6.3.1 Regional Ecosystems

A total of 55.7 ha of mapped remnant RE will be directly impacted due to the project. Of this:

- 49.9 ha of remnant RE will be cleared
- 5.8 ha of remnant RE will be subject to selective clearing, trimming and management, as its height generally exceeds 30cm. This area will be transitioned to dwarf heathland.

The mapped high value regrowth within the Project area is not considered to be regulated vegetation under the VM Act as it is on freehold land. Under the recent amendments to the VM Act, high value regrowth is only regulated on leasehold land for agriculture or grazing and State land.

Table 7.5a: Impact significance criteria

Impact Significance / Consequence	Description of magnitude
Very High	Local extinction of populations of significant flora species listed under the EPBC Act and NC Act. Greater than 10 per cent remnant Threatened Ecological Communities cleared within the Project area. Total collapse or replacement of adjacent remnant vegetation communities.
High	Reduction in numbers of significant flora species listed under the EPBC Act and NC Act to an extent that population size is reduced in the long term and/or recruitment rates are reduced. 5-10 per cent remnant Threatened Ecological Communities cleared within the Project area. Greater than 50 per cent remnant Regional Ecosystems cleared within the Project area. Measurable changes in the adjacent ecosystem components and/or floristic components outside the known environmental range of the existing ecosystem.
Moderate	Short term reduction in population size of a significant flora species listed under the EPBC Act and NC Act or temporary reduction in recruitment rates. 20-50 per cent remnant Regional Ecosystems cleared within the Project area. Less than 5 per cent remnant Threatened Ecological Communities cleared within the Project area. Measurable changes to adjacent ecosystem components, but functions and services (i.e. habitat provision, vegetation structure) are retained.
Minor	No direct impact on significant flora, but potential indirect, short-term impacts that will reduce the health of individual plants. 5-20 per cent remnant Regional Ecosystems cleared within the Project area. Important ecosystem components, functions and services shaping vegetation communities not affected, however some impact to specific plant species or communities.
Negligible	No impact to significant flora species. Less than 5 per cent remnant Regional Ecosystems cleared within the Project area. Potential changes to adjacent ecosystems, but within natural variation to maintain the existing vegetation community.

Table 7.5b: Duration of impact

Relative Duration of Environmental Effects	
Temporary	Days to months
Short Term	Up to 1 year
Medium Term	1 to 5 years
Long Term	From 5 to 50 years
Permanent / Irreversible	In excess of 50 years

Table 7.5c: Likelihood of impact

Likelihood of Impact
Highly unlikely
Unlikely
Possible
Likely
Almost certain

Table 7.5d: Risk matrix

	Significance				
Likelihood	**Negligible**	**Minor**	**Moderate**	**High**	**Very High**
Highly Unlikely/Rare	Negligible	Negligible	Low	Medium	High
Unlikely	Negligible	Low	Low	Medium	High
Possible	Negligible	Low	Medium	Medium	High
Likely	Negligible	Medium	Medium	High	Extreme
Almost Certain	Low	Medium	High	Extreme	Extreme

The clearing areas are shown in **Figure 7.6b**, and described further in **Table 7.6d**.

Most of the clearing of remnant RE is for an airport related purpose on airport premises and is therefore exempt from requiring a clearing permit pursuant to Schedule 24, Part 1, Section 8 of the SP Regulation. For the other areas where RE is not on airport premises (i.e. associated with dredge pipeline construction and laydown), a permit to clear RE is also not required as clearing will be carried out to construct community infrastructure (air transport infrastructure) listed in Schedule 2 of the SP Regulation. Under Schedule 24, Part 1, Section 16 of the SP Regulation, clearing for community infrastructure is exempt from requiring a clearing permit. Due to these exemptions, all clearing of RE is exempt from requiring a permit to clear vegetation under the SP Act and UM Act.

Despite this, SCA intends to compensate for the loss of RE vegetation by rehabiliation of a site at Palmview (see **Section 7.7.1.1**).

7.6.3.2 Protected areas

No protected areas will be directly impacted by the Project. There will be no vegetation clearing or trimming required within the National Park boundaries. There is the potential for minor, indirect impacts to vegetation communities in the Mount Coolum National Park due to:

- Increases in groundwater salinity and changes in groundwater levels caused by seepage from the runway strip fill material
- Edge effects and fragmentation due to the dissection of habitat connectivity associated with the project.

Vegetation communities within Mount Coolum National Park are strongly influenced by soil and groundwater conditions, with the distribution of heathland and open forest communities particularly affected by the presence of coffee rock and the depth to groundwater. Changes to groundwater quality and levels have the potential to alter the vegetation communities present within the National Park.

Natural rainfall regimes, including storm events and droughts, can also influence the distribution of these groundwater dependent communities.

The northern and southern sections of Mount Coolum National Park are currently connected by remnant paperbark wetland and heathland across the Project area. The clearing of vegetation within the Project area are likely to sever this connection, increasing the distance between the two sections by over 600 m.

There may also be indirect impacts associated with edge effects and fragmentation, including introduction and spread of exotic and declared pest plants.

7.6.3.3 State listed flora species

Only one species, Mount Emu She-oak, listed as endangered under the NC Act will be impacted by the project, although measures are proposed to reduce the significance of this impact (see **Section 7.7**).

7.6.4 Impacts to local matters

Construction of the project will result in the clearing and trimming of vegetation across the Project area, including:

- Clearing required for construction of the new runway strip and flyover area
- Clearing required for the dredge pipeline access area and pipeline construction compound. This clearing is required for construction only and will be rehabilitated upon completion of construction
- Trimming required for the relocation of the VHF Omnidirectional Range (VOR) navigation aid and Obstacle Limitation Surface (OLS). In these areas, vegetation will be transitioned to dwarf heathland so that the vegetation is less than 30 cm above ground level (AGL).

The extent of clearing for each vegetation community is shown in **Table 7.6e** and **Figure 7.6c**. As trimming will ultimately result in the transition of each of the vegetation communities to dwarf heathland, trimming areas are considered to represent a loss of the respective pre-existing vegetation communities.

Clearing will result in a loss of 90.0 ha of native vegetation communities (this excludes ex-agricultural areas and areas already cleared).

- 77.3 ha will be cleared and permanently replaced by airport infrastructure (e.g. sealed areas or managed grassland associated with the runway strip)
- 9.9 ha may require trimming to maintain a low, dwarf heath vegetation community in the areas required for the VOR
- Temporary clearing associated with the dredge pipeline construction compound and access area will impact 0.9 ha of sedgeland, 1.7 ha of melaleuca open forest and 0.2 ha of foredune complex. In these areas, the impacts of clearing will be rehabilitated in line with the EMP upon the completion of construction.

Table 7.6a: Mount Emu She-oak impacts for each habitat type

Habitat type	Total impacted (ha)	Mount Emu She-oak density (plants/ha)	No. impacted
Closed heath (north)	0.62	322	200
M. quin LOF/OF with heath	3.79	92	350
TOTAL	4.41	-	550
% IMPACTED	18%	-	5%

Figure 7.6a: Impacts to Mount Emu She-oak within the Project area

Table 7.6b: The significance of impact for Mount Emu She-oak under the EPBC Act

Criteria under the Significant Impact Guidelines (DOE, 2013)	Impact Assessment
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population, or	The project will result in a loss of approximately 4.4 ha of habitat that supports Mount Emu She-oak. This reduction in population area will lead to a direct loss of 550 plants out of a population of 12,152, or 5 per cent of the total population which is 23.8 ha in size. The reduction in area of supporting habitat is likely to reduce the capacity of the Project area to maintain the current population size. The project would result in a small long-term decrease in the size of the Finland Road population. A 5.7 ha section of the remaining population is located in the southern portion of the Mt Coolum National Park and is protected in perpetuity.
Reduce the area of occupancy of the species, or	The area of suitable habitat for Mount Emu She-oak has been reduced within the Project area. 4.4 ha of Mount Emu She-oak habitat or 5 per cent of the 23.8 ha Finland Road population.
Fragment an existing population into two or more populations, or	The project will not fragment the existing Finland Road population as the edge of the population is being affected.
Adversely affect habitat critical to the survival of a species, or	Mount Emu She-oak occurs in coastal heathland habitat on the Sunshine Coast and the species requires this vegetation community to persist. Each subpopulation is also considered important for conservation purposes. The majority (82 per cent) of the closed heath habitat within the Project area that supports Mount Emu She-oak has been retained. Despite the reduction in this habitat area, the species is likely to persist within the Project area.
Disrupt the breeding cycle of a population, or	The project is not likely to disrupt the breeding cycle of this species. Mount Emu She-oak relies on wind for pollination and dispersal and the project is unlikely to alter the dominant wind patterns and direction. Fire is also required to stimulate seed release and germination and the project is not likely to directly result in the removal of fire management from the population area.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or	The project will result in a loss of approximately 4.4 ha of Mount Emu She-oak habitat, which is 5 per cent of the 23.8 ha Finland Road population area. Therefore, the project is likely to decrease the availability of habitat to the extent that the Finland Road population may decline in numbers.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The project is not likely to result in the introduction of an invasive species that is harmful to Mount Emu She-oak. During the construction phase of the project, an EMP will be implemented that will include pest plant management procedures.
Introduce disease that may cause the species to decline, or	The project is not likely to introduce a disease that may cause the population of Mount Emu She-oak to decline. During the construction phase of the project, an EMP will be implemented that will include soil hygiene and management procedures to mitigate against the import of any soil pathogens.
Interfere with the recovery of the species.	The Recovery Plan for Mount Emu She-oak notes the importance of the protection and management of each known population. Each population should be considered the important unit for the conservation and recovery of the species. By avoiding the majority of the population and habitat area within the Project area, the Finland Road population will be retained. It is not likely that the project will interfere with the recovery of the species, or contradict the objectives of the Recovery Plan.

Figure 7.6b: Regional Ecosystems impacted

Table 7.6c: Assessment Against Mount Emu She-oak and Attenuate Wattle Recovery Plan Objectives

Recovery Plan	Objective	Action/response
Environmental Protection Agency 2007 (Mount Emu She-oak)	Protect, restore and maintain known populations and locate and/or establish new populations of Mount Emu She-oak.	The project will result in impacts to approximately 4 ha of Mount Emu She-oak habitat or 5% of the Finland Road population. The balance of this population and habitat area have been retained through modifications of the project design, including diversion of the main access road around areas of high quality habitat and minimising project elements. The area impacted consists of a lower density of Mount Emu She-oak plants. The offset proposed for the residual impact will be located adjacent to an existing population to the north of the Project Area and will consist of an addition to this population. The offset area will be managed to increase the density of plants to result in a net increase in the population over time. The offset area will also be protected in perpetuity through a conservation tenure mechanism.
	Address and review the key threats to Mount Emu She-oak.	Key threats to Mount Emu She-oak include alteration or loss of suitable habitat, altered fire regimes, increase stormwater runoff and establishment of exotic species. The Project will result in the loss of a small area of Mount Emu She-oak habitat that is proposed to be offset in accordance with the EPBC Act Environmental Offsets Policy. Declared pest plants and invasive exotic species will be managed during the construction phase of the project. Weed management plans will be prepared as part of the construction Environmental Management Plan. The Project will not result in any changes to the current fire management practices within the Mount Emu She-oak population area. There will be no significant changes to stormwater runoff into areas of retained Mount Emu She-oak habitat, as runoff from the Project will be predominantly captured in new drainage infrastructure.
	Develop research programs that assist with the recovery and conservation of Mount Emu She-oak.	The proposed Mount Emu She-oak offset will utilise the heath tile translocation methodology as part of the site preparation and revegetation works. This methodology has been successful for managing other threatened flora species. As part of the offset, a monitoring plan will be prepared that assesses the progress and performance of the revegetation works. This data will assist in improving the understanding of carrying out revegetation works to establish new populations of Mount Emu She-oak.
	Promote community awareness and education in relation to Mount Emu She-oak.	As part of the Mount Emu She-oak offset and revegetation works, opportunities to partner with research institutions and community groups can be explored.
Brownlie 2007 (Attenuate Wattle)	Determine the extent of the species distribution by confirming its presence or absence at pre-recorded sites and in areas of potential habitat.	There are no known populations of Attenuate Wattle within the project area. Targeted surveys were carried out for Attenuate Wattle within the Project Area and surrounds and no new populations were recorded.

Recovery Plan	Objective	Action/response
	To maintain or enhance known Attenuate Wattle populations by providing protection from further decline through the abatement or removal (where possible) of identified threats.	There are no known populations of Attenuate Wattle within the Project Area.
	To obtain long-term protection of Attenuate Wattle populations/ habitat.	The majority of the Project Area has been mapped as containing very low or low habitat value for Attenuate Wattle. Areas that have the habitat characteristics to support Attenuate Wattle plants or populations of plants have been surveyed as part of this Project and no new populations where identified. The compensatory habitat revegetation works proposed at Palmview will result in the creation of suitable habitat for Attenuate Wattle and this area will be protected with a conservation covenant.
	To increase public awareness of Attenuate Wattle and encourage community involvement in maintaining existing populations.	As there are no known populations of Attenuate Wattle within the Project Area, it is considered outside of the scope of this project to carry out education and community engagement programs.
	To increase knowledge of Attenuate Wattle biology and ecology through the development and implementation of population monitoring programs.	As there are no known populations of Attenuate Wattle within the Project Area, it is considered outside of the scope of this project to carry out population monitoring programs.

Table 7.6d: Mapped RE directly impacted by the Project

Type of RE	Status	Total impact (ha)	% impact in study area	% impact in Project area	Type of Impact
12.1.1	Of Concern	1.2	2.1%	100%	Clearing
12.2.7	Not of Concern	24.4	14.7%	98.6%	Clearing
		5.8			Transition to dwarf heathland
12.2.12	Not of Concern	23.8	10.8%	100%	Clearing
12.2.14	Not of Concern	0.2	0.7%	100%	Clearing
12.2.15	Not of Concern	0.3	0.7%	99.5%	Clearing
TOTAL REMNANT RE IMPACTED		55.7	8.9%	99.2%	

Table 7.6e: Site-based vegetation communities impacted within the Project area

Vegetation Community	Total Impacted area (ha)	Type of Impact	*Suitable Habitat for Threatened Species*
Casuarina open forest	1.4	Clearing	
Closed heath	0.6	Clearing	• *Acacia attenuata* • *Acacia baueri subsp. baueri* • *Allocasuarina emuina* • *Phaius australis* • *Prasophyllum wallum*
Eucalypt regrowth	3.3	Clearing	
	0.2	Transition to Dwarf Heathland	
Foredune complex	0.4	Clearing	
Mangroves	0.03	Clearing	
Melaleuca low open forest	3.7	Clearing	
Melaleuca open forest	32.7	Clearing	• *Acacia attenuata* • *Eucalyptus conglomerata* (predominantly margins between forest and heathland) • *Phaius australis* • *Prasophyllum wallum*
	5.5	Transition to Dwarf Heathland	
Melaleuca/slash pine regrowth	9.9	Clearing	
	3.9	Transition to Dwarf Heathland	
Open heath with Melaleuca thickening	6.3	Clearing	• *Acacia attenuata* • *Acacia baueri subsp. baueri* • *Allocasuarina emuina* • *Eucalyptus conglomerata (predominantly margins between forest and heathland)* • *Phaius australis* • *Prasophyllum wallum*
	0.3	Transition to Dwarf Heathland	
Regrowth open heath	13.2	Clearing	• *Acacia attenuata* • *Acacia baueri subsp. baueri* • *Allocasuarina emuina* • *Phaius australis* • *Prasophyllum wallum*
Regrowth wet heath	7.7	Clearing	• *Acacia attenuata* • *Acacia baueri subsp. baueri* • *Phaius australis*
Sedgeland	1.0	Clearing	• *Durringtonia paludosa* • *Phaius australis* • *Schoenus scabripes*

- Of the 90 ha of native vegetation that will be cleared, 55.7 ha is mapped as remnant RE (see **Section 7.6.3.1**).

The remaining 34.3 ha is considered to be regrowth native vegetation with minor local significance due to the relatively degraded and disturbed nature of these communities.

These areas are not mapped as remnant RE, nor are they considered remnant communities from a floristic perspective. There are no flora species of State or national significance in these areas, and they habitat type is unlikely to support any significant flora species. They also contain areas of weed infestations.

For these reasons, the impact associated with the removal of 34.3 ha of non-remnant native vegetation is considered to be minor.

7.6.5 Indirect impacts

7.6.5.1 Fragmentation and edge effects

Clearing of remnant vegetation within the Project area would reduce the current levels of ecological connectivity between the northern and southern sections of Mount Coolum National Park. Plant reproduction and seed dispersal can be affected by habitat fragmentation, including patch isolation and size. Many plants rely on birds and mammals for pollination and seed dispersal, and a reduction in landscape connectivity can impact on these mutualisms (Harris et al 2004).

Over the long term, a reduction in ecological connectivity can result in reductions in flora dispersal and changes to gene flow between the northern and southern sections of the Mount Coolum National Park. Impacts on genetic diversity will vary however, as species respond differently to the effects of fragmentation (Aguilar et al. 2008; Young et al 1996). For instance, Lamont (2010) has shown that populations of the wind-pollinated Mount Emu She-oak appear to be unaffected by fragmentation (patch size or isolation), due to the species' clonal nature.

The clearing within the Project area may also increase edge effects for patches of vegetation that will fringe the development footprint. In these areas, edge effects may include weed infestation and microclimate change (Saunders 1991), with the potential impact extending approximately 5 to 15 m in from the edge. Edge effects often lead to local changes to abundance and diversity of flora in the effected edge area. As weeds respond well to disturbance, weed species are often more abundant on edges of vegetation patches.

Impacts associated with edge effects are generally most severe at the time of clearing and during construction. They can be reversed by applying mitigation measures. Without mitigation, the resultant edge effects, patch size and isolation caused by the project are likely to cause minor, indirect impact to flora species and vegetation communities within and adjacent to the Project area. These impacts can be mitigated by completing landscaping and revegetation works with dense plantings at the edges of retained vegetation.

Ongoing weed management at remnant edges can also reduce edge effects and reduce impacts associated with weed incursion.

Consideration for a vegetated corridor linking the north and south sections of Mount Coolum National Park to mitigate against the reduction in ecological connectivity has been considered in a corridor proposed along the boundary of the Project area with the Sunshine Motorway from Finland Road across the northern end of the runway to then running east along Marcoola Drain to the northern end of Mount Coolum National Park (see Chapter B8 – Terrestrial Fauna).

7.6.5.2 Groundwater quality and levels

The vegetation communities present within and adjacent to the Project area can all be considered groundwater dependent ecosystems. The closed heath and sedgeland vegetation communities are particularly dependent on a shallow groundwater aquifer, especially the perched aquifer above the coffee rock. The health and distribution of vegetation communities within and adjacent to the Project area have the potential to be influenced by groundwater quality (particularly salinity) and changes to levels as a result of the runway construction.

Groundwater levels across the site (ranging from 0.2 m to 3.4 m BGL) are similar and generally reflect one shallow groundwater system.

Coffee rock is typically present at depths between approximately 0.5 m to 5 m Below Ground Level (BGL) across the Project area. It is anticipated to be of relatively low permeability compared with the overlying and underlying alluvial sands and clays. The coffee rock encountered indicates variability in depth to ground level, thickness and degree of cementation. Our experience also indicates that the coffee rock typically contains voids and weaknesses across relatively small distances.

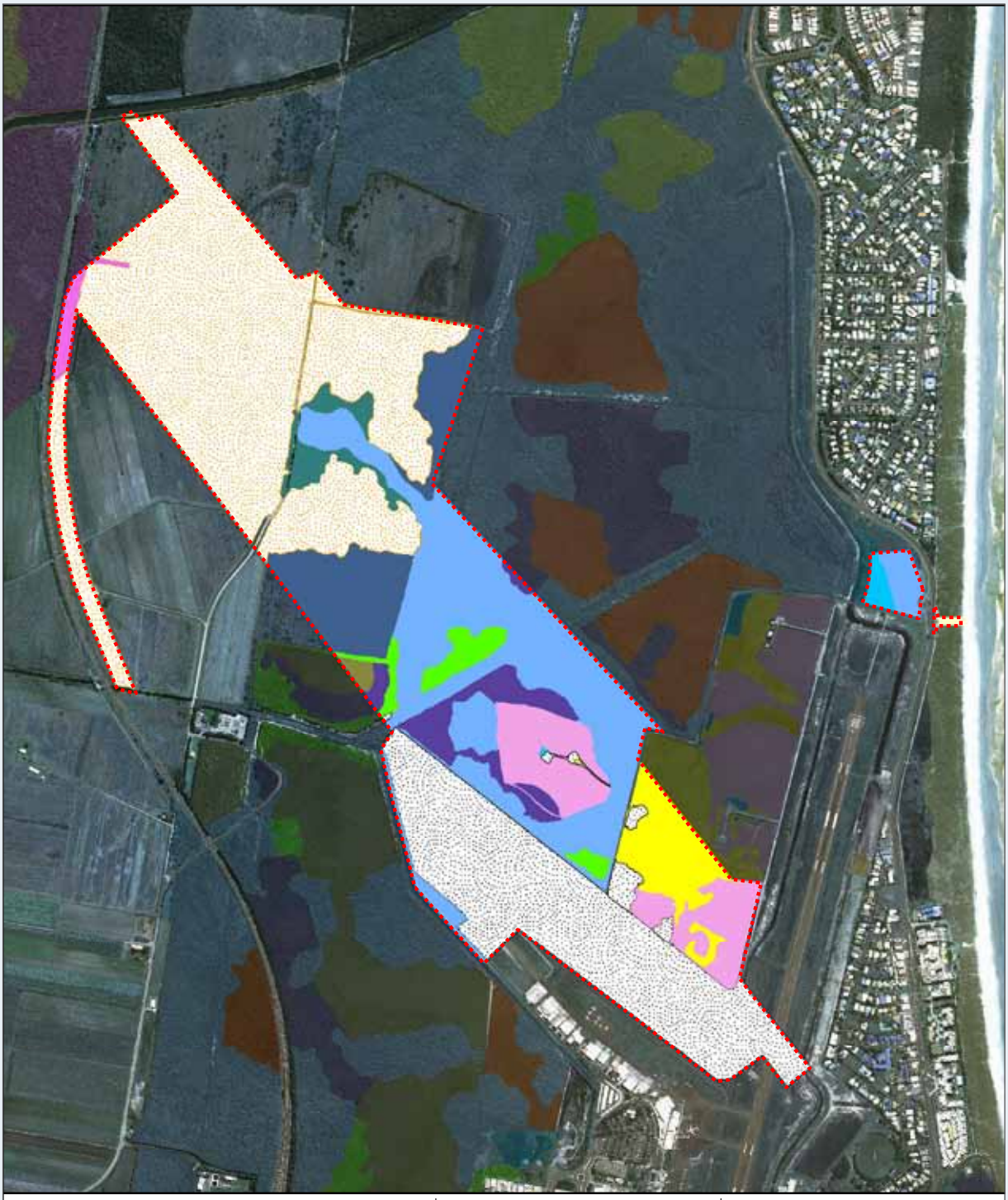
Because coffee rock has low permeability, it plays an important role in the existing hydrogeological processes, which, within coastal plain aquifers, can be a significant factor in the relationship between fresh and saline groundwater.

The low permeability of the coffee rock layer suggests it could act as a barrier to groundwater flow. However, it is likely to be hydraulically connected at the catchment scale to the shallow aquifer, and it would therefore act as a semi-confining layer.

Groundwater above the coffee rock is likely to be semi-perched. Groundwater may flow from the shallow perched water table above the coffee rock to the aquifer below. This flow is expected to occur preferentially through weaknesses and voids in the coffee rock. Groundwater may also migrate upwards through the coffee rock where hydrogeologic conditions permit.

Monitoring indicates that groundwater is generally fresher than brackish in both the perched and sub-surface aquifer with more saline groundwater conditions found in monitoring wells closer to the Maroochy River. This suggests that there

Figure 7.6c: Vegetation communities proposed to be cleared or trimmed



is connectivity with the groundwater and the Maroochy River, which is tidal and salinity in the sub-surface aquifer is diluted by rainfall.

Rainfall infiltration into the sub-surface aquifer occurs through drainage lines and slight downward leakage through the coffee rock. Annually net recharge makes up a small percentage (1-5 per cent) of precipitation infiltrating the subsurface (gross recharge). During dry weather groundwater may move upwards through the coffee rock via capillary action and plant uptake resulting in evaporation and evapotranspiration.

The current surface water drains in the Project area generally follow the flat topography with extremely low gradients (i.e. <0.1 per cent) resulting in relatively stagnant channel flows and therefore insignificant discharge rates of groundwater.

Groundwater quality in the sub-surface aquifer is moderately acidic with an average pH of 4.63. Water in surface drains is slightly more acidic as a result of the influence of the acidic soils.

Average groundwater salinity in the sub-surface aquifer is approximately 450mg/l. Surface water salinity varies across all monitoring locations.

A three-dimensional numerical model was prepared for the project to assess and quantify potential impacts associated with the construction of the new runway. The model was established to estimate groundwater levels and salinity concentrations before, during and after delivery of sand to site for construction of the runway. As the site is characterised by relatively flat topography and groundwater gradients, a three dimensional flow model with depth-averaged material parameters was adopted to provide an appropriate representation of groundwater flow conditions.

Assumptions adopted in the modelling include:

- The reclamation will be undertaken as described in the construction methodology in Chapter A5, Project Construction
- The perimeter bund will be approx. 1 m to 2.5 m above surface level and the polishing pond embankment will be approx. 3.75 m AHD
- The maximum filling level was assumed at 3.3 m AHD
- The polishing pond will be unlined, as it is underlain by a thick layer of naturally occurring clay material, which acts as a barrier to tailwater infiltration
- The bunds and fill area are lined by a very high quality high-density polyethylene (HDPE) liner with an assumed ≤ 3 punctures/ha
- Although the underlying soils across the site are stratified, most notably by a low permeability coffee rock layer, site investigations indicate the movement of groundwater across these strata and therefore weighted horizontal and vertical hydraulic conductivities were adopted for the coffee rock layer
- Weighted vertical and horizontal hydraulic conductivities were assigned to area with soft clay, similar to that for the coffee rock (so low permeability)
- A base layer of sand extending to -15 m AHD was assumed beneath the coffee rock layer
- A value of 1 per cent has been adopted for net recharge. Subsequent field investigations have indicated that net recharge could be closer to 5 per cent. Model results for salinity impacts may therefore be considered conservative.

The conceptual hydrogeological model of tailwater infiltration from hydraulically delivered sand is shown in **Figure 7.6d**. The solid red arrows indicate tailwater movement, and the dashed arrows indicate potential pathways into the surrounding environment, the faded arrows indicate less tailwater infiltration further from the reclamation area. Although not shown in **Figure 7.6d**, the potentiometric surface (which is an imaginary surface that defines the level to which water in a confined aquifer would rise were it completely pierced with wells) for the hydraulic head in the semi-confined unit is below the perched water table level in the upper most stratigraphic unit.

The proposed northern perimeter drain will intercept and drain away saline tailwater infiltration in the upper layers of the aquifer between the reclamation area and the drain. However, tailwater infiltration is also expected to occur in the lower levels of the aquifer. While the coffee rock layer is likely to act as a partial barrier to tailwater infiltration into the lower aquifer, investigations indicate that the coffee rock is discontinuous, allowing some interaction between the upper and lower layers of the aquifer. Consequently, the lower permeability layer of coffee rock cannot be relied upon to contain tailwater infiltration in the upper layers of the aquifer where it would be intercepted by the northern perimeter drain.

Given the sensitivity of the neighbouring Mount Coolum National Park to potential groundwater impacts, mitigation of groundwater level and salinity impacts was considered necessary for the project. Consequently, the design includes a high quality liner within the base of the reclamation area to minimise infiltration of seawater into the underlying groundwater. **Figure 7.6e** shows the conceptual hydrogeological model of tailwater infiltration with a liner, indicating an expected reduced infiltration rate and therefore lower salinity concentration in groundwater.

The predicted seepage was used to predict the potential groundwater elevation and salinity impacts from the reclamation activities. The model results are illustrated in **Figure 7.6f** and **Figure 7.6g**. **Figure 7.6f** shows the contours of the predicted 0.1 m increase in groundwater head at the end of filling and 1 year after filling is complete.

A head increase of 0.1 m was selected as the impact indicator, as changes less than 0.1 m would be indiscernible from natural variation.

The modelling indicates that the 0.1 m increase in groundwater head is not expected to extend beyond

approximately 250 m from the reclamation area, or approximately 80 m into the northern section of the national park.

Figure 7.6g shows the contours of 1,000 mg/L salinity concentration in the groundwater. The modelling indicates the 1,000 mg/L contour is unlikely to cross the SCA property boundary within 100 years from the completion of filling. Modelling over a 300-year period indicates the following:

- Salinity concentrations 50 m from the northern perimeter drain (approx. the national park boundary) are predicted to peak at 1,000 mg/L approx. 200 years after filling is complete
- Salinity concentrations 150 m from the northern perimeter drain are not predicted to exceed 500 mg/L over 300 years.

The south-western side of the site is predicted to have groundwater impacts of negligible significance due to the sub-regional groundwater flow from the fill area to the east and south-east towards the coast and due to the interception of flow from the fill to the southwest by a perimeter drain along the south-western edge of the fill area.

7.6.5.3 Implications for vegetation communities

For the purpose of assessing impacts to vegetation communities, very high salinity is considered to be between 3,680 and 5,520 mg/L, whilst severe salinity is considered to be between 5,520 and 9,200 mg/L (House et al. 1998).

When plants are exposed to saline soils, their ability to extract water from the soil is reduced. This causes water stress, nutrient imbalances, salt toxicity and reduced rates of growth (House et al. 1998). Very high to severe salinity usually appears as salt scalded bare ground and halophytes are the only plant species that can tolerate these extremes in salt concentrations (House et al, 1998).

Generally, 3,500 mg/L is regarded as the maximum for safe watering of plants (DAFF 2005), however the flora species that exist in the Project area have different salt tolerances. Tolerance thresholds for some flora species known to exist in the area are given in **Table 7.6f**.

With a high quality liner in place, a maximum salinity of just 500 mg/L is reached after about 300 years at a 150 m distance from the northern perimeter drain, which extends 100 m in the regional aquifer below Mount Coolum National Park.

Salinity below 500 mg/L represents a low level of salinity with respect to impacts on plant physiology (House et al. 1998), and is consistent with ambient groundwater salinity levels within the Project area. North of the northern perimeter drain, vegetation communities consist of Melaleuca open forest, open heath, and open heath with emergent Broad-leaved Paperbark (see **Figure 7.4f**). Installation of a high quality liner is predicted to effectively mitigate against elevated salinity in groundwater and result in negligible changes to flora species composition within affected areas of vegetation (including the National Park) over the long term (50 to 300 years).

The increase of 0.1 m of groundwater head in the submerged aquifer is considered to have negligible impacts to the flora species and vegetation communities in the adjacent northern section of Mount Coolum National Park. The water levels in the perched aquifer are considered to be the main influence on vegetation communities in the area. The interaction and movement of water between the perched and regional aquifer will depend on the recharge rates and the permeability of the coffee rock in specific areas. The increase in groundwater head may result in smaller localised areas that have a slightly shallower groundwater level in the perched aquifer.

Northern perimeter drain

The potential drawdown effect from the northern perimeter drain was modelled to assess variation in water levels in the adjacent hydrological/hydrogeological systems. The northern perimeter drain extends from the new runway's junction with RWY 18/36 to Marcoola drain, near the Sunshine Motorway. The drain will have a base width of 10 m and be approx. 1.5 m deep. Hydraulic conductivity of the surrounding soils was estimated at 2.7 m/day and the rainfall recharge to the system was estimated at 0.00004 m/day.

The drawdown assessment was undertaken for dry and wet weather conditions. For the dry weather condition, the northern perimeter drain was assumed to be dry, with the only inflow from groundwater. The modelled wet weather condition was a 2 y ARI rainfall event, which is representative of a local rainfall event, and groundwater inflow.

The dry weather scenario is the worst-case for groundwater drawdown. Modelling indicates that a 0.1 m drawdown for dry weather conditions extends between 200 m and 300 m from northern perimeter drain. As the modelled drawdown from the drain extends into the National Park, a low-permeability cut-off wall is proposed on the northern side of the drain to intercept groundwater flows and prevent draw down; the installation of the cut-off wall is shown diagrammatically in **Figure 7.6h**.

As indicated in **Figure 7.6h**, drawdown of the groundwater table is expected to occur only between the drain and cut-off wall; this distance will be minimised, taking into account the stability of the drain. It is proposed to install a plastic (HDPE) sheet pile wall, which will significantly reduce the potential for flow into the northern perimeter drain and address potential drawdown impacts in the national park.

It is expected that such a sheet pile barrier is likely to reduce drawdown to the extent well below natural random or climatic driven fluctuations of the current water table.

The overall effective permeability of the sheet pile barrier would have to be well below the permeability of the sand and the sheet piles would have to be founded into coffee rock or to be installed at greater depth if coffee rock is absent. Due to the installation of the cut off wall there is not expected to be any reduction in groundwater levels in the adjacent northern section of Mount Coolum National Park.

Figure 7.6d: Hydrogeological conceptualisation of tailwater infiltration with no mitigation.

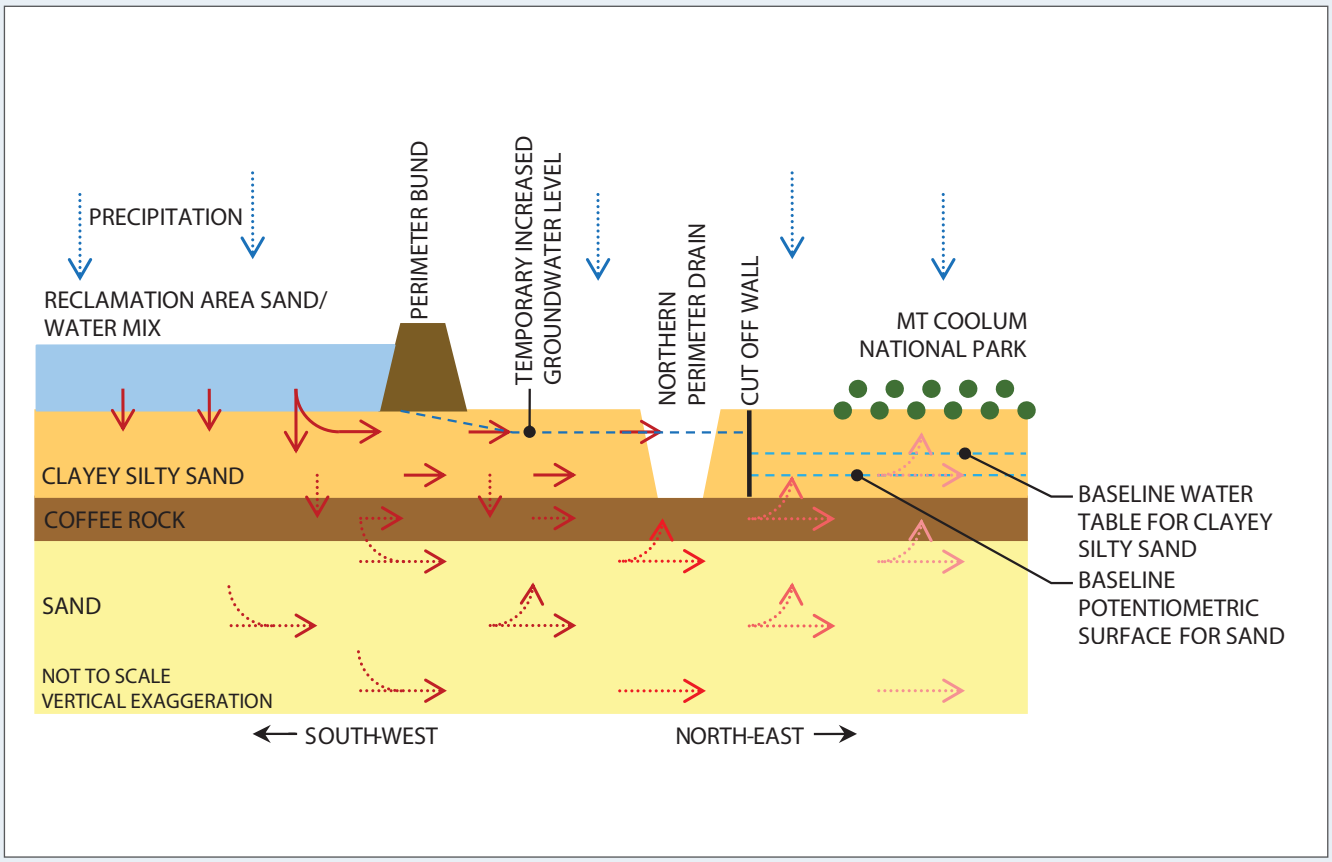


Figure 7.6e: Hydrogeological conceptualisation of tailwater infiltration with a high quality liner indicating reduced infiltration

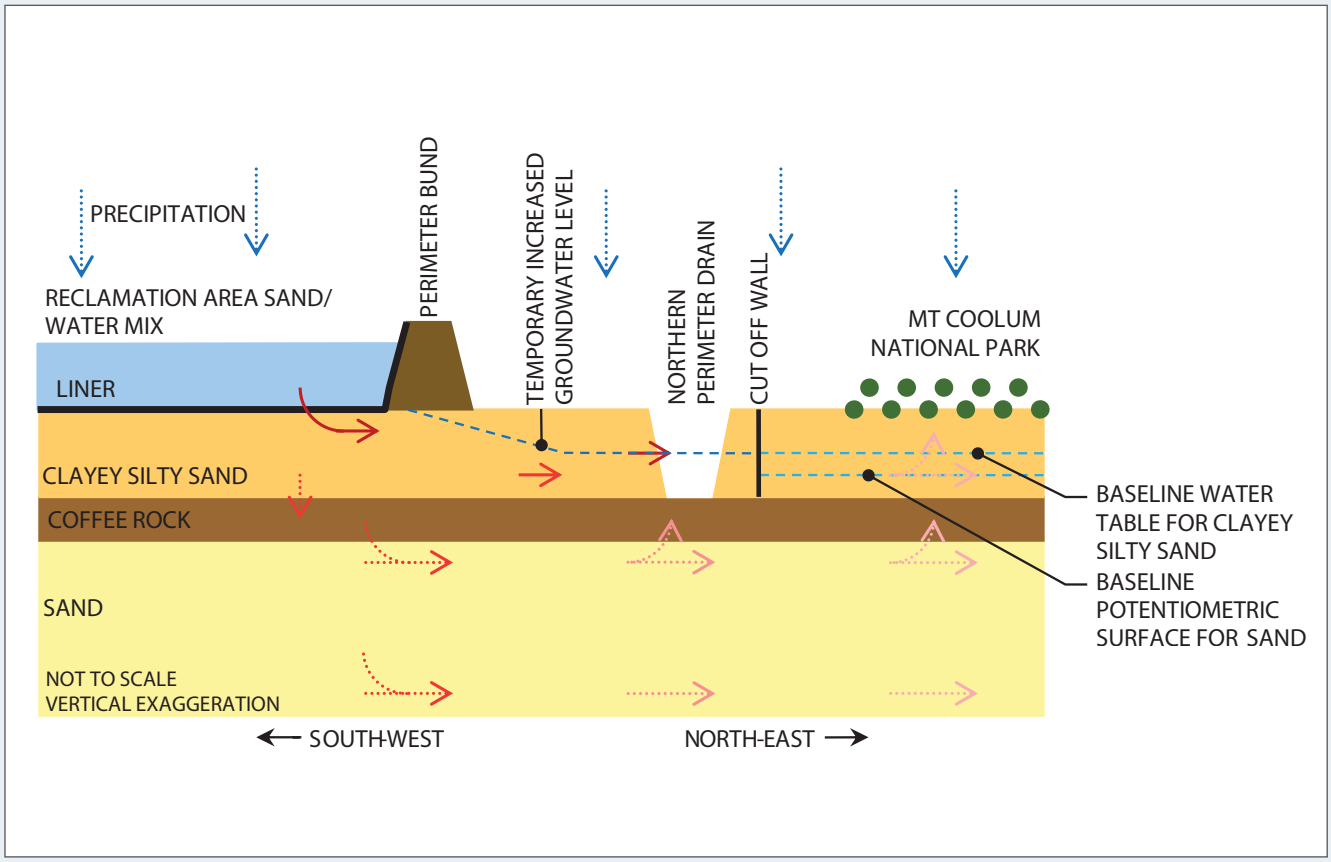


Figure 7.6f: Contours for predicted 0.1 m increase in groundwater head during and after reclamation

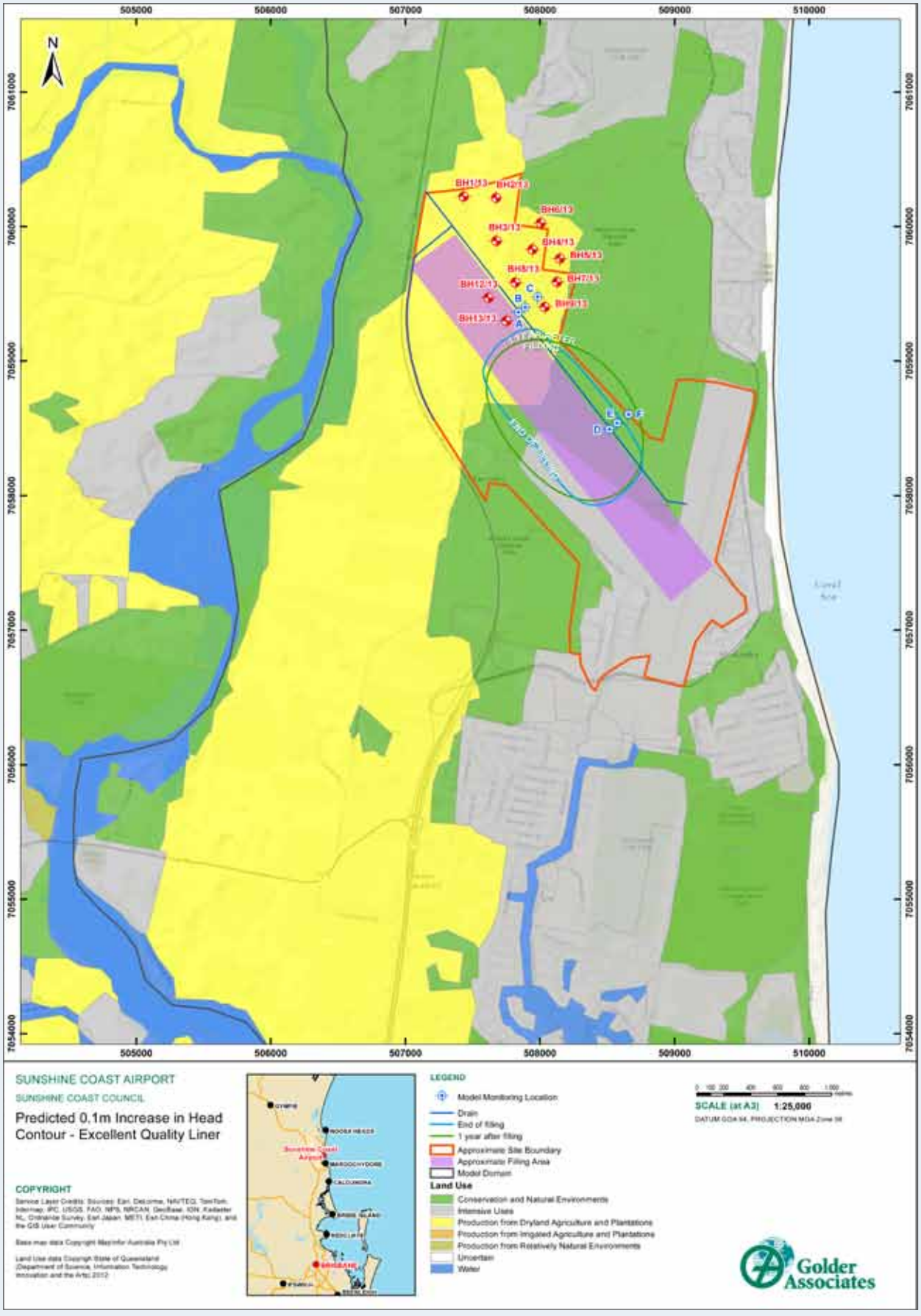


Figure 7.6g: Contours for predicted 1,000 mg/L salinity concentration in groundwater during and after reclamation

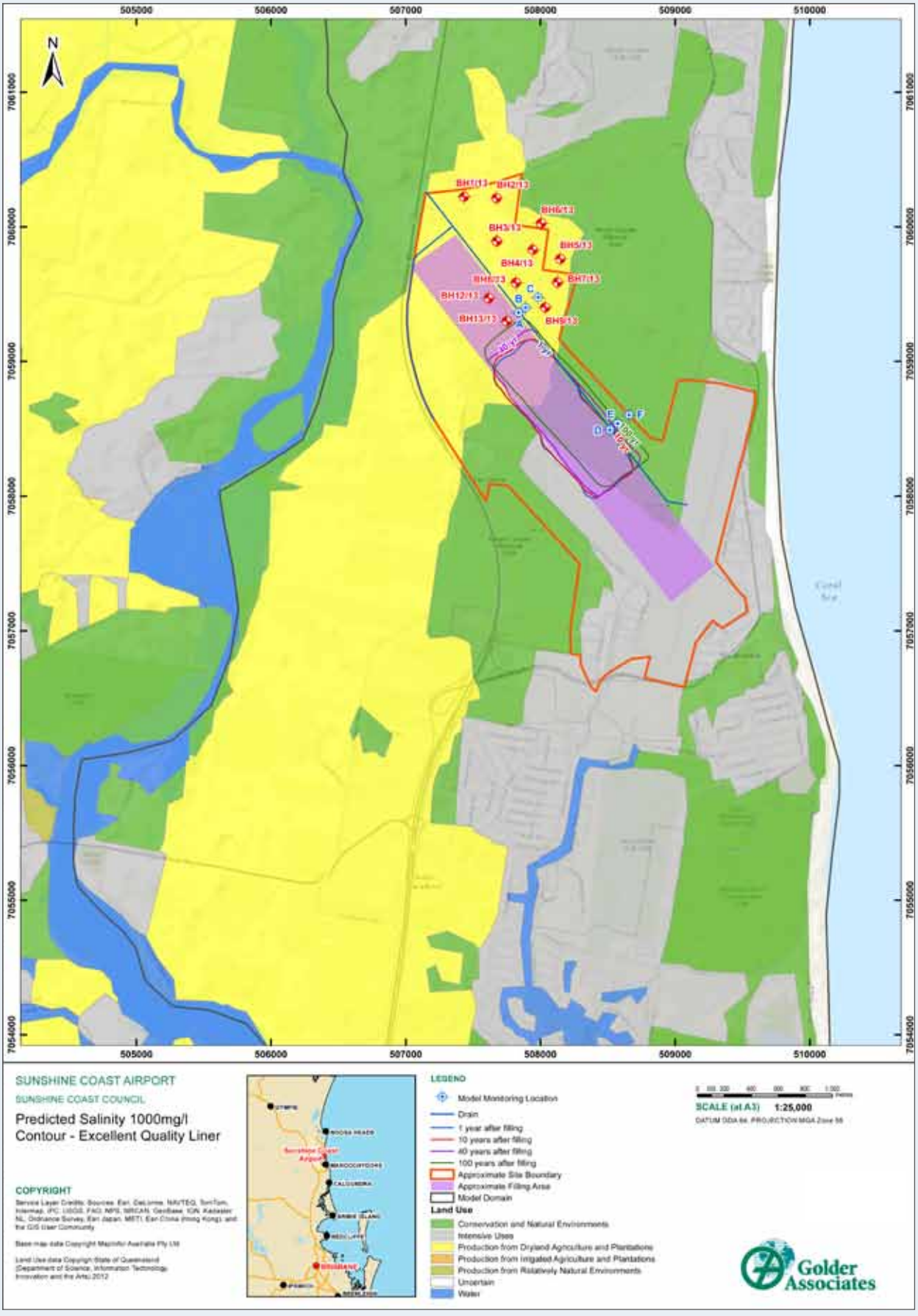
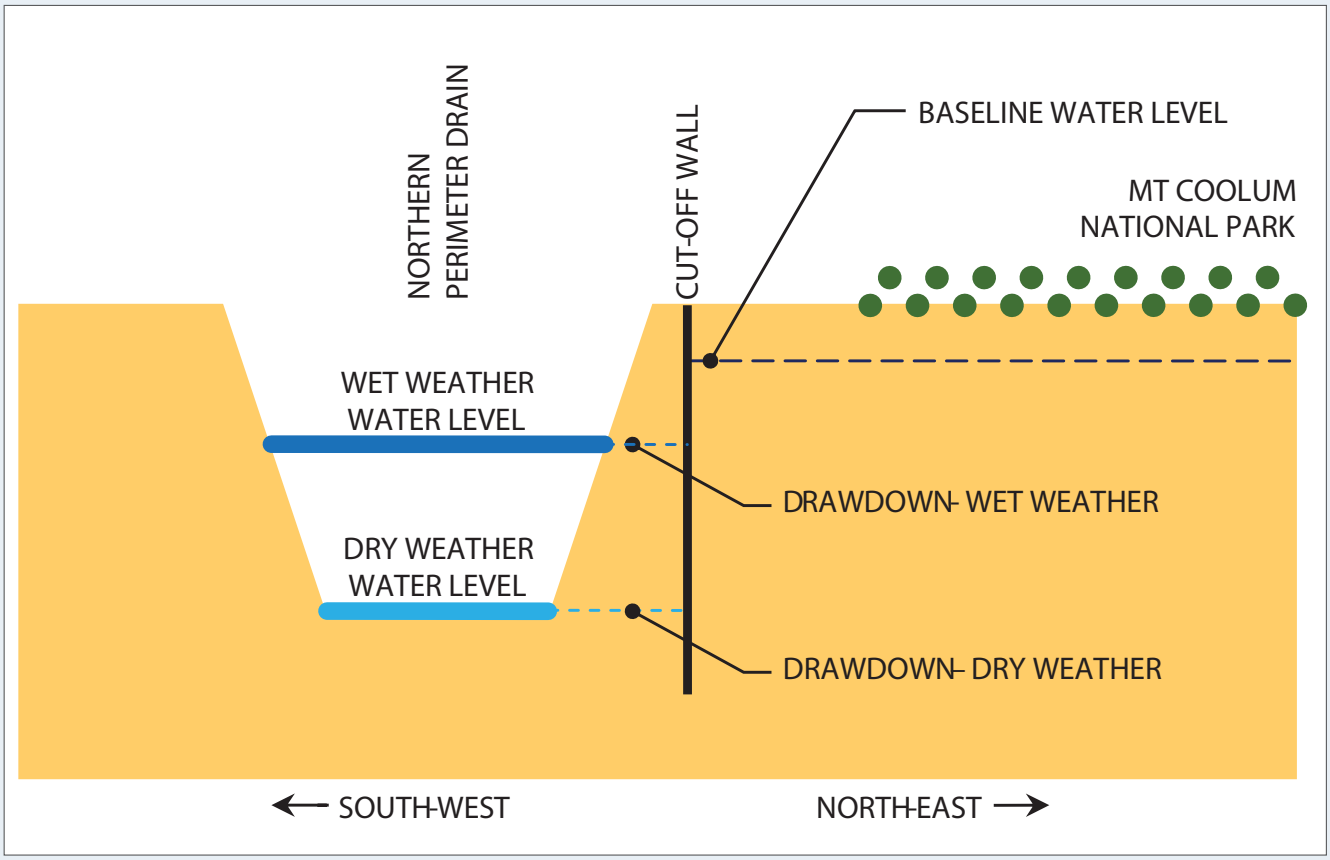


Table 7.6f: Tolerance thresholds for a sample of species known to exist in the Project area

Species	Tolerance Thresholds
Melaleuca quinquenervia (Broad-leaved Paperbark)	Marcar et al. (2002) suggests this species can tolerate soils with salinity up to 7,400 mg/L.
Melaleuca bracteata (Black Tea-tree)	Marcar et al. (2002) suggests this species can tolerate soils with salinity up to 3,700 mg/L. Dunn (1994) has suggested this species can tolerate very high soil salinity.*
Melaleuca nodosa (Prickly-leaved paperbark)	House et al. (1998) recorded a 60 to 80 per cent survival rate in soils with very high to severe salinity.*
Eucalyptus tereticornis (Forest Red Gum)	Macar et al. (2002) suggests his species can tolerate soils with salinity up to 3,700 mg/L. Dunn (1994) has suggested this species can tolerate very high soil salinity.* House et al. (1998) recorded survival rates of 80-100 per cent in soils with very high salinity and survival rates of 60-80 per cent in soils with severe salinity.*
Eucalyptus robusta (Swamp Mahogany)	Macar et al. (2002) suggests his species can tolerate soils with salinity up to 3,700 mg/L. House et al. (1998) recorded 60-80 per cent survival rates in soils with very high to severe salinity.* Dunn (1994) has suggested this species can tolerate high to very high soil salinity.*

** High soil salinity is generally considered to be between 1840 and 3680 mg/L; very high salinity is generally considered to be between 3,680 and 5,520 mg/L; severe salinity is general considered to be between 5,520 and 9,200 mg/L (House et al. 1998).*

Figure 7.6h: Hydrogeological conceptualisation of northern perimeter drain and cut-off wall



7.6.5.4 Flooding

Section 5.5 of Chapter B5, Flooding, outlines the predicted flooding impacts for the project. Overall, the impacts of flooding will be temporary and of a local scale. Duration of flooding will also not be significantly affected. Flooding caused by the project is expected to result in negligible changes to vegetation and flora values across the study area.

7.6.5.5 Weed introduction and spread

During construction, machinery brought to the site has the potential to carry weed reproductive material. Weed management procedures will minimise the potential of new weeds being introduced to the site or weed reproductive material leaving the site. During construction, a negligible impact can be expected if standard and appropriate mitigation measures are undertaken as per the EMP.

During operations, the additional edge effects are likely to create larger areas of habitat suitable for colonisation of weed species. These are likely to be species locally common in cleared areas. The impact upon vegetation communities is expected to be negligible however as site surveys have identified that weed species are suppressed in areas of vegetation outside of where edge effects occur.

7.6.5.6 Changed fire regimes

Fire management requirements for surrounding off-airport areas of vegetation will not be restricted by the project. Similar to current arrangements, any fire management can be coordinated with the operation of the airport. The project will not directly cause changes to current fire management practices or fire regimes within and adjacent to the Project area.

7.7 MITIGATION MEASURES

During the design development phase of the project, consideration was made for the protection of significant terrestrial flora features within the Project area. These have included minimising the project footprint, amending the alignment of the Airport Drive extension and shifting the runway alignment to the south-east. In addition to these mitigation measures inherent in the design, further measures are proposed to reduce the risk associated with impacts to terrestrial flora (**Table 7.7a**).

Where residual impacts exist following application of the design and additional mitigation measures offsets will be considered, in accordance with relevant environmental offset policies.

For this project there are some residual impacts to Mount Emu She-oak and an offset will be required to compensate for this impact.

7.7.1 Additional recommendations

As part of the impact assessment for terrestrial flora, a number of recommendations have been made for further mitigation of impacts to terrestrial flora features within the project area. These mitigation measures include provision of compensatory habitat through revegetation works, a land-based offset for Mount Emu She-oak and construction and operational considerations in the construction EMP.

7.7.1.1 Revegetation works

Revegetation works to compensate for the removal of 55.7 ha of remnant melaleuca forest, heathland and sedgeland vegetation communities are proposed to be carried out on a suitable receiving site. Under Queensland legislation clearing of remnant RE for the Project is exempt from further approvals and the relevant offset policies. Despite these exemptions and in line with Section 5.2.1 of the TOR mitigation of impacts through rehabilitation and restoration has been considered.

To provide a long-term 'no net loss' of impacted remnant vegetation communities, it is proposed to carry out compensatory revegetation and restoration works to plant new areas or restore degraded sites with a similar vegetation group as the impacted communities. Due to the impacts to Broad-leaved Paperbark forest and closed heath vegetation communities, a site is required that has a strong potential to support these communities.

SCA and SCC have identified a potential site for receiving these revegetation works at Palmview. The Lower Mooloolah River Environmental (LMRE) Reserve is owned in freehold by SCC and is located to the east of Claymore Road, Palmview and covers Lots 37 C3147, 1 RP27759 & 2 RP27760 (**Figure 7.7a**). This site has been reviewed by an ecologist as part of this assessment, to determine it's potential suitability for establishing vegetation communities impacted as a result of the Project.

The initial investigations indicate that sections of the LMRE Reserve at Palmview are highly suitable for establishing Broad-leaved Paperbark open forest/wetland and sedgeland vegetation communities, with some areas of marginal suitability for establishing closed heathland. Based on current floristics, pre-clearing RE mapping and historical aerial photographs, the entire site has an excellent potential for establishing Broad-leaved Paperbark and eucalypt open forest, with areas of sedgeland.

The pre-clearing RE mapping of the Palmview site is RE 12.3.5, which is classified as Broad Vegetation Group 22a - Open forests and woodlands dominated by *Melaleuca quinquenervia* (swamp paperbark) in seasonally inundated lowland coastal areas and swamps.

There is strong evidence of Broad-leaved Paperbark and eucalypt open forest present within areas of advanced regrowth vegetation and younger paperbark regrowth occurring across areas of pasture. Areas recommended for focusing restoration works in the short term are in the north-eastern corner of the property that is bordered by the national park and the Mooloolah River. This area has a good coverage of Broad-leaved Paperbark regrowth and would require less intensive, assisted regeneration works to improve the structure and condition of native vegetation cover. Assisted regeneration works would include grazing

Table 7.7a: Summary of design stage and additional mitigation measures for terrestrial flora

Impact	Design considerations	Additional proposed measures
Direct impacts		
Clearing of 550 Mount Emu She-oak plants	Alignment of Airport Drive to avoid high quality habitat for Mount Emu She-oak. A new terminal building has been removed from the project	Protection of retained population with appropriate vegetation protection procedures during construction. Implementation of appropriate fire regime and management within the balance of the population area retained. Implementation of an offset involving translocation of impacted heath vegetation community containing Mount Emu She-oak plants.
Clearing of native vegetation, including remnant RE	The design has been rationalised based on the upgrade needs and only includes the new runway	Compensatory habitat and revegetation works with paperbark forest and closed heath at freehold land owned by SCC at Palmview. Locate all temporary construction areas within existing cleared locations. Revegetate areas cleared for construction purposes Vegetation protection measures to be incorporated into the construction EMP.
Indirect impacts		
Groundwater quality and levels	Installation of liner. Sheet pile wall along northern perimeter drain	Groundwater monitoring to be carried out pre, during and post construction.
Spread or establishment of declared pest plants	Location of declared pest plants have been marked with GPS during field surveys	Weed hygiene measures to be included in the construction EMP.
Reduced connectivity between north and south Mt Coolum National Park		Proposed rehabilitated corridor as described in Chapter B8 – Terrestrial Fauna.

exclusion and management, weed and exotic grass removal and implementation of an appropriate fire regime. This area is also directly connected to the Mooloolah River National Park and the riparian corridor of the Mooloolah River, providing mitigation of current edge effects on these sensitive areas.

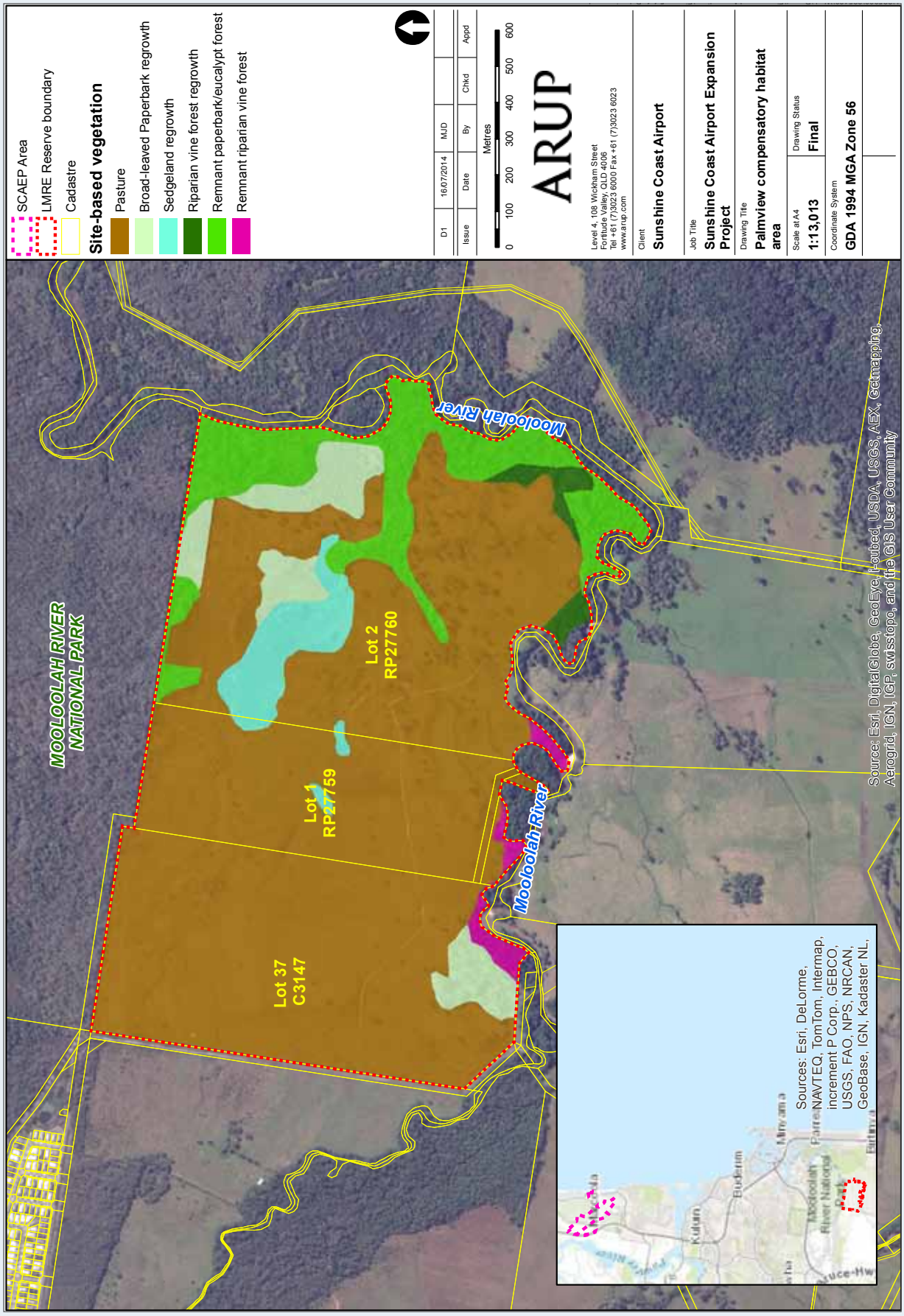
There may be suitable areas to establish closed heathland vegetation community along the northern property boundary; however this would require more intensive revegetation works to create a new vegetation community. This would require a more 'traditional' revegetation program, with site preparation and installation of plants or direct seeding required. There is little evidence of closed heath elements present within the site, and historical mapping does not show any areas of lower height vegetation within the site.

The final revegetation strategy for the Palmview site will be subject to a detailed site-wide rehabilitation plan that outlines the methodology for planning and delivering the required works to achieve a remnant vegetation community. There is likely to be a mix of revegetation, assisted regeneration and habitat installation methods used to manage the current degraded vegetation communities to achieve a remnant community.

Revegetation works in these areas will assist in compensating for the direct loss of the remnant vegetation communities that will be directly impacted by the project. The area of revegetation works will be, at a minimum, the same as the 55.6 ha impact and consist of paperbark wetland, sedgeland and closed heath vegetation communities. This will assist in maintaining no net loss of remnant vegetation within the bioregion as a result of the project. Prior to the implementation of the revegetation works a detailed revegetation plan specifying revegetation and ongoing management strategies will be prepared. Appropriate conservation tenure mechanisms will also be put in place to ensure the long term protection and management of these sites.

The timeframes for achieving a self-sustaining, remnant native vegetation community at the Palmview site will be variable, depending on the rehabilitation methodology implemented. As part of the detailed rehabilitation plan for the Palmview site, ongoing management and monitoring strategies will be developed to ensure that the vegetation communities on the site are on a successional trajectory towards a remnant condition.

Figure 7.7a: Palmview compensatory habitat site



7.7.1.2 Mount Emu She-oak offset

Transplanting of Mount Emu She-oak into an alternative habitat area will be undertaken to offset the residual impact associated with the 5 per cent reduction in the Finland Road population. The proposed offset will involve transplanting the entire 4.41 ha of impacted closed heath and low melaleuca forest to a suitable location to the north.

The proposed offset has been assessed against the EPBC Act Environmental Offsets Assessment Guide and can meet the requirements of the applicable EPBC Act environmental offsets policy. The proposal is also considered to be in accordance with the *EPBC Act Policy Statement – Translocation of listed threatened species*.

There is a previous local example of successful heath translocation at the University of the Sunshine Coast and preliminary investigations have been carried out at the Project area to assess the soil conditions for the proposed translocation receiving site.

There is also limited scope to suitably offset the impact through increasing the protection of existing populations or other indirect management recommendations made in the *National Recovery Plan for the Mount Emu She-oak* (EPA 2007).

Most other 11 known populations identified in the current Recovery Plan for Mount Emu She-oak occur in the Queensland conservation estate, with the exception of the Peregian Springs population and a small population of 100 plants (1.8 ha) at Coolum Ridges (although at this site, the area containing Mt Emu she-oak and adjacent buffer zones have been protected through the inclusion into open space as part of a development approval). Since the drafting of the Recovery Plan these two sites outside of the conservation estate, now have a level of protection. There are no known opportunities to protect/manage any 'at risk' populations.

Prior to translocation of the impacted area it is recommended that a cool, winter burn is carried out to reduce the biomass of Wallum Hakea and canopy trees in this area. The vegetation communities within the impact area are adapted to fire, and a burn will assist in maintaining the heathland community, as well as reducing the above ground biomass to facilitate heath tile translocation.

An excavator with a tray-shaped bucket is proposed to remove heath tiles for translocation into alternative areas (see **Figure 7.7b**).

The heath tiles contain topsoil and the existing seed bank, and are placed in a suitably prepared area. Successful heath tile translocation has been undertaken at the University of the Sunshine Coast (USC), with tiles sourced from remnant heath at Bundilla for the Brightwater Development (UDIA, no date; LAMR Pty Ltd 2012). At the heath tile translocation site at the USC a healthy, functioning heath ecosystem has established, providing supporting habitat for several threatened flora species.

Land to the north of the proposed runway has been identified as the offset receiving site for the heath tile translocation of the impacted Mount Emu She-oak population (**Figure 7.7c**). Ground investigations thus far suggest that this area has a sandy topsoil and a shallow (>1.5 m) indurated sand layer suitable for the establishment of Mount Emu She-oak. The existence of AEP2 and heathland to the east also provides evidence that the area is likely to provide suitable habitat for heathland translocation.

The total quantum of impact on Mt Emu She-oak is 550 plants.

A time horizon of 10 years is considered sufficient for the translocated heath area to establish and evidence of Mt Emu She-oak recruitment to occur at the offset site.

Over this time, based on the existing plant density of 322 plants/ha, it is likely that 1,420 plants will be present in the translocated area. Using the EPBC Act offset assessment guide, this proposal has been calculated to provide for over 100 per cent of the offset requirements.

A 50 per cent confidence score has been applied to this assessment, as there is evidence that heath translocation can be successful within the bioregion and initial ground investigations have identified characteristics that can support the vegetation community.

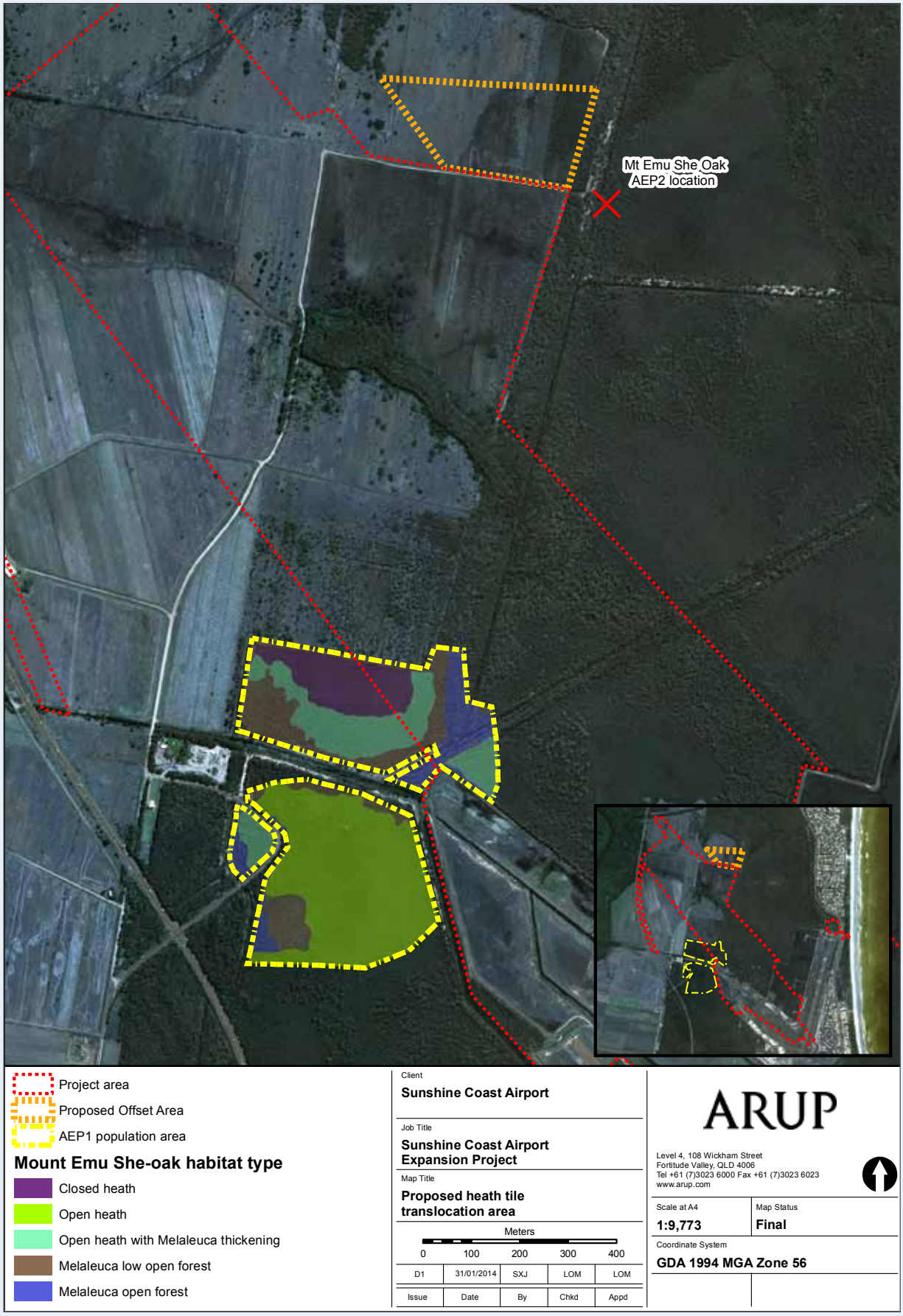
It is proposed that seed is collected from the impacted Mount Emu She-oak plants, and stored as a contingency for offset works. The collected seed would be appropriately stored in a seed bank, or measures taken to propagate new plants in a nursery for replanting works.

An offset does not need to be greater in area to account for the temporal lag and risk. The quantum of impact for the Mount Emu She-oak population is calculated from an area of lower quality habitat. Through ongoing management of the translocation area, including weed and fire management, it is anticipated that a higher density of plants can be achieved within the 10 year time frame.

A detailed Offset Management Plan will be prepared as part of subsequent stages of the project which will outline all on-ground works required, management and monitoring regimes and details of how the land tenure of the offset area will be secured. The intent is that the site be protected in perpetuity through a mechanism such as a Native Refuge declaration, conservation covenant or gazettal into the National Park.

Figure 7.7b: Heath tile translocation process (from UDIA, no date)

Figure 7.7c: Proposed area for transplant or planting



7.7.1.3 Summary of impact and mitigation measures

The impacts on terrestrial vegetation and flora communities are summarised in **Table 7.7a**. Mitigation measures inherent in the development of the project design as well as mitigation measures to be implemented during the construction and operation of the project are also described.

7.8 CONCLUSION

This chapter has described existing flora and vegetation characteristics within the study area with the aim of identifying potential impacts with the proposed Sunshine Coast Airport Expansion Project.

The project is expected to result in a direct impact to remnant Regional Ecosystems, with 55.6 ha of least concern remnant vegetation being lost to the Project. Whilst SCA is exempt under the Vegetation Management Act for this clearing, compensatory revegetation works is proposed on other SCC owned land on the Sunshine Coast at Palmview. Through this mitigation, no net loss of the impacted RE within the bioregion will be the outcome. Following the application of this mitigation measure the project is expected to have a minor risk to State listed, remnant vegetation.

In addition, the Project results in the loss of approximately 4 ha of the EPBC Act listed Mount Emu She-oak habitat, which is estimated to currently support approximately 550 Mount Emu She-oak plants, from a population of 12,152. Through the design of the project, the majority of the Mount Emu She-oak population has been retained. The moderate residual risk to the species is proposed to be compensated by the provision of an offset, which will translocate the impacted plants to land owned by SCA to the north of the runway in an area of suitable habitat within the Study Area.

Indirect impacts associated with the reduction in landscape connectivity and functionality between the northern and southern section of Mt Coolum National Park is proposed to be mitigated by the creation of a corridor on airport land inside the Sunshine Motorway corridor. This is addressed in more detail in Chapter B8 – Terrestrial Fauna.

Fragmentation and edge effects are also likely to occur as a result of the Project due to clearing activities. A weed management plan will be prepared as part of the EMP for the construction works and will be implemented during construction and operation to reduce the risk of weed colonisation in disturbed areas.

The Project has the potential to increase salinity in groundwater, up to 1,000mg/L, due to seepage of seawater from the dredge material into existing groundwater. This impact has been modelled to be restricted to 150m beyond the runway platform and occur over a period of 50-300 years. In addition a potential 0.1m increase in groundwater head in the regional aquifer within 80m of the northern section of Mt Coolum National Park is also predicted. Two key mitigation measures have been included in the modelling: the installation of a high quality liner under the area of runway to be filled during construction to reduce seepage of seawater into the groundwater; and a cut off wall installed at or below the level of the coffee rock along the edge of the northern perimeter drain to prevent drawdown of groundwater from the perched aquifer.

Mitigation measures included in the design are considered appropriate to reduce any indirect impacts associated with changes vegetation communities in groundwater quality and quantity in the adjacent National Park.

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Table 7.7a: Impact assessment summary table

Primary Impacting process	Mitigation inherent in the design	Significance of impact	Likelihood of impact	Risk	Additional mitigation measures	Significance of impact	Likelihood of impact	Residual risk
Clearing remnant native vegetation	The new runway has been located on former cane land where possible. The project footprint has been minimised to include only a new runway. Airport Drive extension has been located outside areas of remnant vegetation.	High	Almost certain	Extreme	Carry out revegetation works and habitat restoration at Palmview to compensate for the loss of remnant vegetation. Construction compounds, storage areas and stockpiles are to be located in existing cleared areas. Carry out revegetation works in areas cleared for temporary construction purposes.	Minor	Almost certain	Medium
Reduction in the area and population size of Mount Emu She-oak	Additional infrastructure associated with the terminal has been removed from the project. Airport Drive extension has been designed to avoid the area of high quality *Mount Emu She-oak* habitat, where the highest plant densities occur.	High	Almost certain	Extreme	Impacts offset through translocation of heath vegetation community with Mount Emu She-oak Collection of seed from the impacted Mount Emu She-oak plants for storage and ultimate propagation for use in replanting works.	Moderate	Possible	Medium
Clearing of good quality habitat for threatened species listed under the NC Act and EPBC Act that have not been detected within the Project area.	Surveys carried out in accordance with the TOR did not identify any other populations of threatened flora. Airport Drive extension has been located outside areas of remnant vegetation.	Minor	Possible	Low	Pre-clearing surveys and mitigation when additional threatened or near threatened plants are identified. If any threatened or near-threatened plants are found they will be translocated or offset.	Negligible	Possible	Negligible

Primary Impacting process	Mitigation inherent in the design	Significance of impact	Likelihood of impact	Risk	Additional mitigation measures	Significance of impact	Likelihood of impact	Residual risk
Reduced landscape connectivity between Mt Coolum National Park	Project footprint has been reduced to include only the new runway footprint.	Moderate	Likely	Medium	Carry out revegetation works and habitat restoration across the balance area of cane land to the north and south of the runway alignment. Revegetated corridor along the edge of the Sunshine Motorway linking the northern and southern section of Mount Coolum National Park (see Chapter B8 – Terrestrial Fauna)	Minor	Possible	Low
Weed establishment and spread	Not applicable	Moderate	Likely	Medium	Weed hygiene procedures to be included in the construction EMP. Weed Management to be carried out on-airport during operations.	Minor	Possible	Low
Increased salinity of adjacent aquifers	Use of a high quality liner underneath the fill area.	Negligible	Possible	Negligible	Not applicable	Negligible	Possible	Negligible
Increase in groundwater head by 0.1 m	Use of a high quality liner underneath the fill area.	Negligible	Possible	Negligible	Not applicable	Negligible	Possible	Negligible